APPENDIX F

NOISE

This appendix contains the following:

- Noise Technical Report
- Notification Letter

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Noise Technical Report

Raleigh-Durham International Airport

September 14, 2022

PREPARED FOR

Raleigh-Durham Airport Authority

PRESENTED BY

Landrum & Brown, Incorporated

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1 Introduction

The purpose of this Noise Technical Report is to provide supporting documentation for the Environmental Assessment (EA) being prepared for the Proposed Runway 5L/23R Replacement Project at the Raleigh-Durham International Airport (RDU or Airport). This document describes the overall approach, methods, and results of the noise assessment.

1.1 Description of the Proposed Action

All elements of the Proposed Action are described in detail in the EA. The Proposed Action includes relocating Runway 5L/23R west of existing Runway 5L/23R and, after construction is complete, converting the existing Runway 5L/23R to a taxiway. The project also includes use of fill material from Airport borrow sites, use of water from Brier Creek Reservoir, construction of drainage improvements, relocation of a portion of Lumley Road, utility relocations, demolition of four buildings, relocation of aircraft navigational aids, acquisition of property, and removal and/or mitigation of obstacles in accordance with Federal Aviation Administration (FAA) safety standards.

1.2 Characteristics of Sound

Sound is created by a source that induces vibrations in the air. The vibration produces alternating bands of relatively dense and sparse particles of air, spreading outward from the source like ripples on a pond. Sound waves dissipate with increasing distance from the source. Sound waves can also be reflected, diffracted, refracted, or scattered. When the source stops vibrating, the sound waves disappear almost instantly and the sound ceases.

Sound conveys information to listeners. It can be instructional, alarming, pleasant, relaxing, or annoying. Identical sounds can be characterized by different people or even by the same person at different times, as desirable or unwanted. Unwanted sound is commonly referred to as “noise.”

Sound can be defined in terms of three components:

- Level (amplitude)
- Pitch (frequency)
- Duration (time pattern)

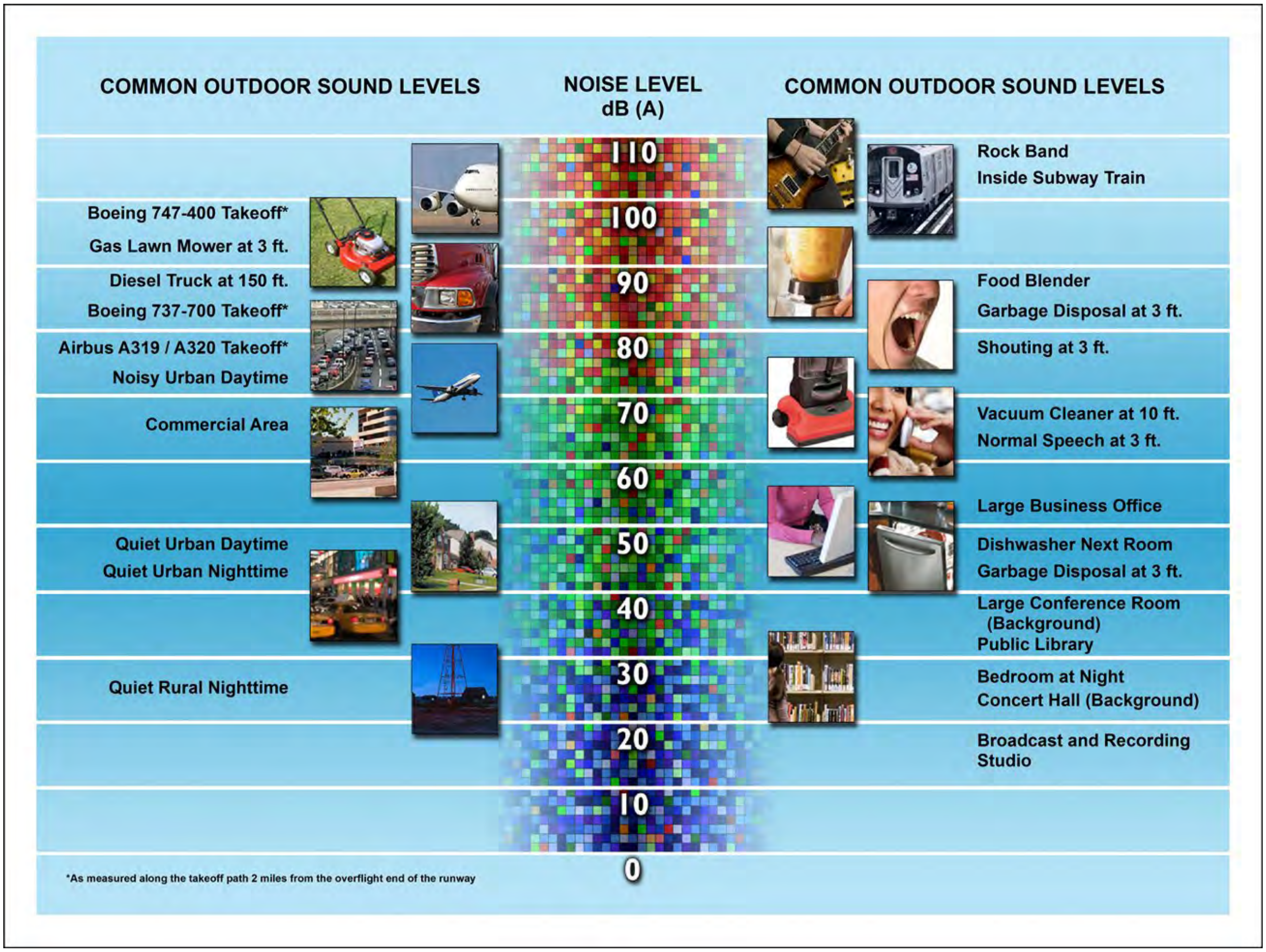
1.2.1 Sound Level

The level or amplitude of sound is measured by the difference between atmospheric pressure (without the sound) and the total pressure (with the sound). Amplitude of sound is like the relative height of the ripples caused by the stone thrown into the water. Although physicists typically measure pressure using the linear Pascal scale, sound is measured using the logarithmic decibel (dB) scale. This is because the range of sound pressures detectable by the human ear can vary from one (1) to 100 trillion units. A logarithmic scale allows for discussion and analysis of noise using more manageable numbers. The range of audible sound ranges from approximately one (1) to 140 dB, although everyday sounds rarely rise above about 120 dB. The human ear is extremely sensitive to sound pressure fluctuations. A sound of 140 dB, which is sharply painful to humans, contains 100 trillion times more sound pressure than the least audible sound. **Exhibit 1-1** shows a comparison of common sources of indoor and outdoor sounds measured on the dB scale.

By definition, a 10 dB increase in sound is equal to a tenfold (10^1) increase in the mean square sound pressure of the reference sound. A 20 dB increase is a 100 fold (10^2) increase in the mean square sound pressure of the reference sound. A 30 dB increase is a 1,000-fold (10^3) increase in mean square sound pressure.

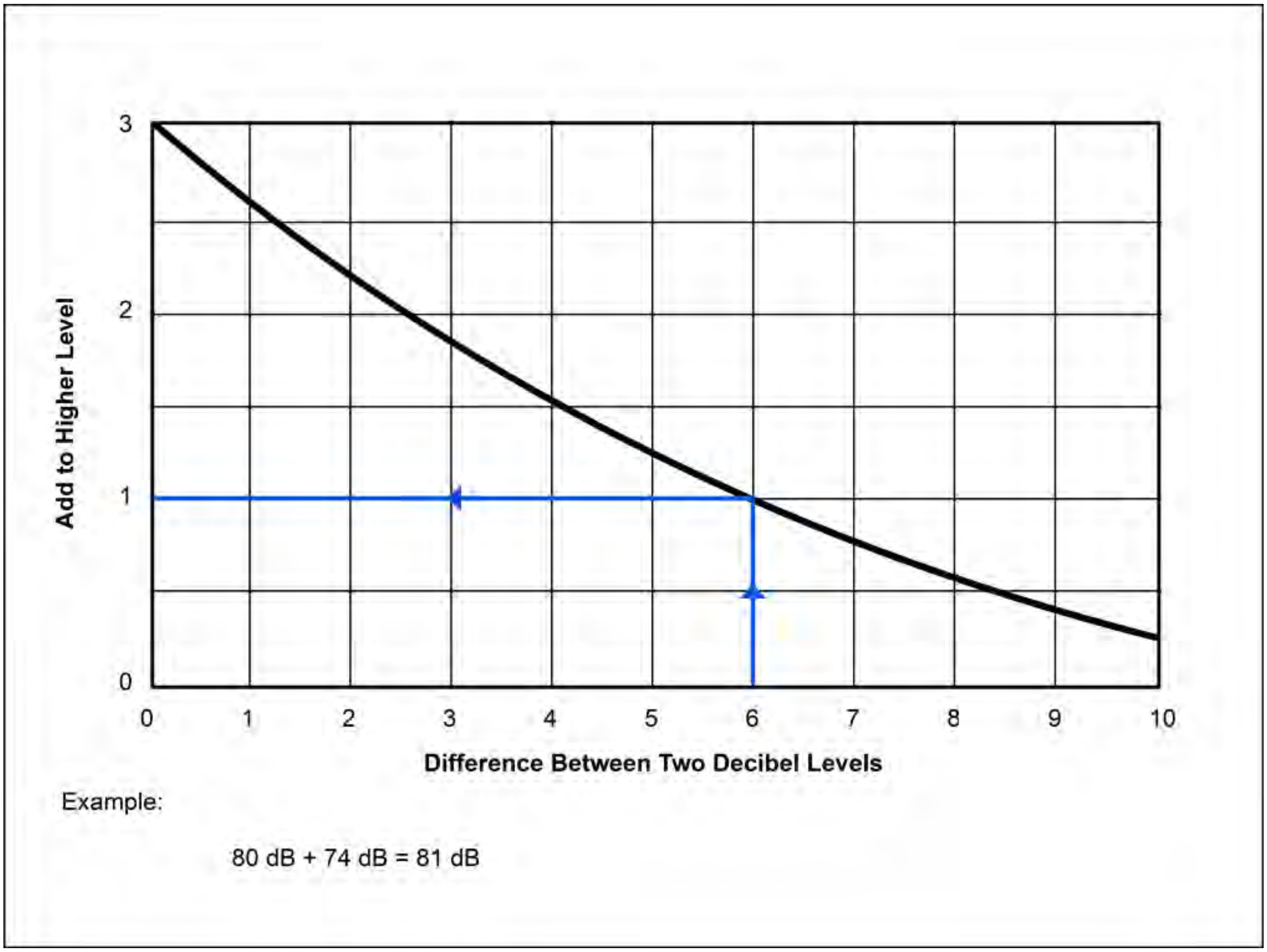
A logarithmic scale requires different mathematics than used with linear scales. The sound pressures of two separate sounds, expressed in dB, are not arithmetically additive. For example, if a sound of 80 dB is added to another sound of 74 dB, the total is a one (1) dB increase in the louder sound (81 dB), not the arithmetic sum of 154 dB (See **Exhibit 1-2**). If two equally loud noise events occur simultaneously, the sound pressure level from the combined events is three (3) dB higher than the level produced by either event alone.

EXHIBIT 1-1, COMPARISON OF SOUND



Source: Landrum and Brown.

EXHIBIT 1-2, EXAMPLE ADDITION OF TWO DECIBEL LEVELS

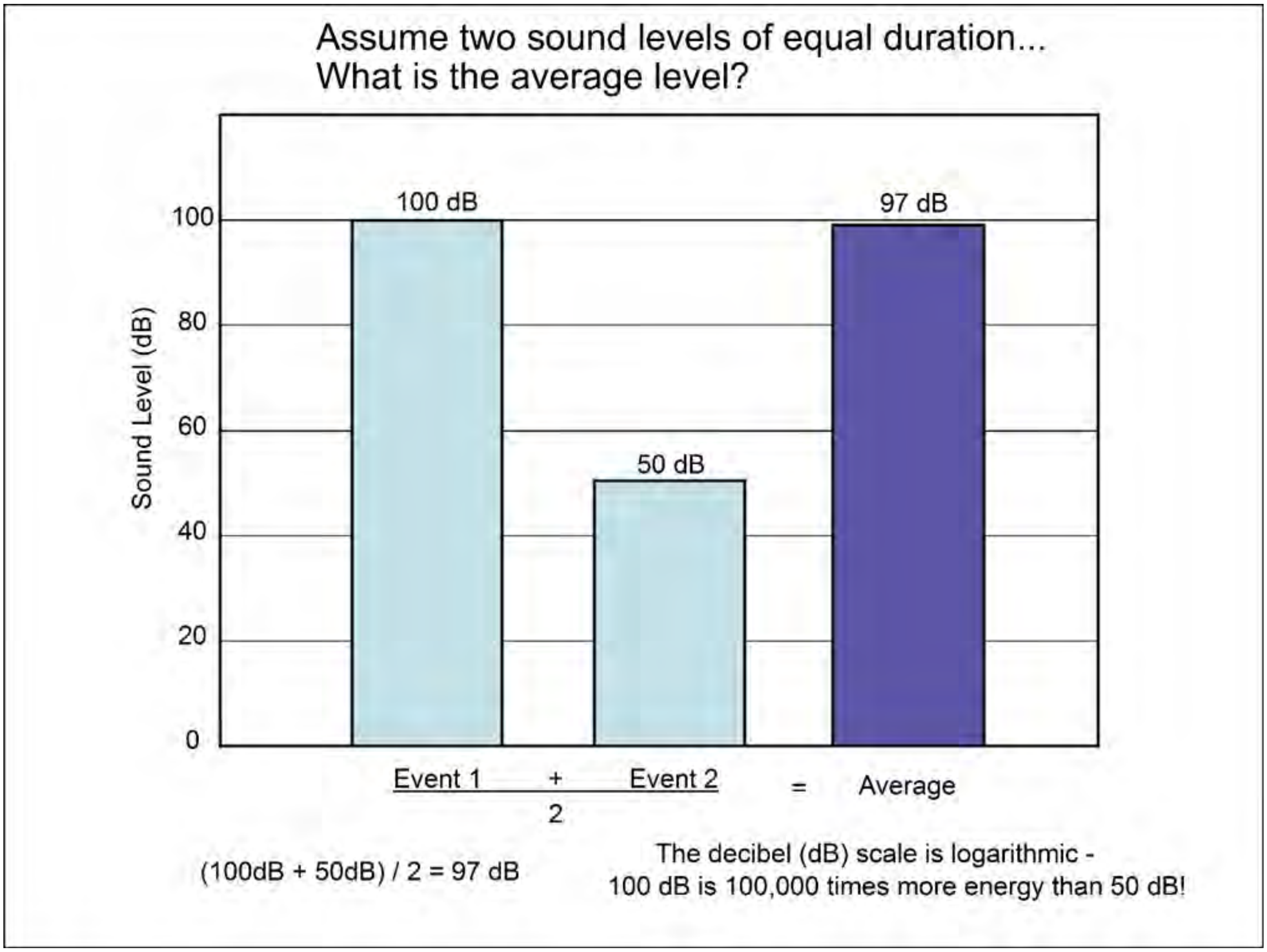


Source: Information on Levels of Environmental Noise. USEPA. March 1974.

Logarithmic averaging also yields results that are quite different from simple arithmetic averaging. Consider the example shown in **Exhibit 1-3**. Two sound levels of equal duration are averaged. One has a maximum sound level (Lmax) of 100 dB, the other 50 dB. Using conventional arithmetic, the average would be 75 dB. The true result, using logarithmic math, is 97 dB. This is because 100 dB has far more energy than 50 dB (100,000 times as much!) and is overwhelmingly dominant in computing the average of the two sounds.

Human perceptions of changes in sound pressure are less sensitive than a sound level meter. People typically perceive a tenfold increase in sound pressure, a 10 dB increase, as a doubling of loudness. Conversely, a 10 dB decrease in sound pressure is normally perceived as half as loud. In community settings, most people perceive a three (3) dB increase in sound pressure (a doubling of the sound pressure or energy) as just noticeable. In laboratory settings, people with good hearing are able to detect changes in sounds of as little as one (1) dB.

EXHIBIT 1-3, EXAMPLE OF SOUND LEVEL AVERAGING



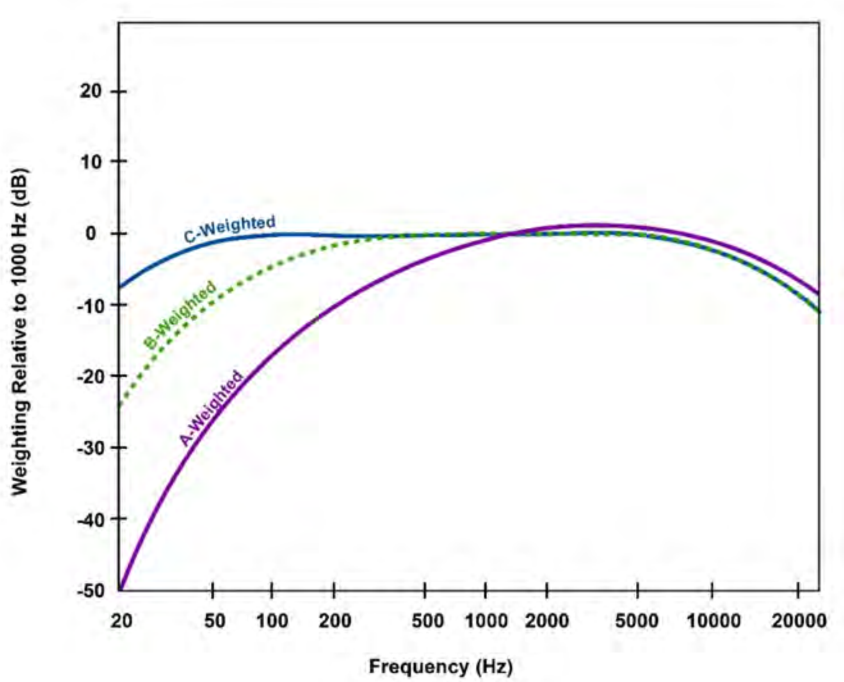
Source: Landrum & Brown, 2022

1.2.2 Sound Frequency

The pitch (or frequency) of sound can vary greatly from a low-pitched rumble to a shrill whistle. If we consider the analogy of ripples in a pond, high frequency sounds are vibrations with tightly spaced ripples, while low rumbles are vibrations with widely spaced ripples. The rate at which a source vibrates determines the frequency. The rate of vibration is measured in units called "Hertz" – the number of cycles, or waves, per second. One's ability to hear a sound depends greatly on the frequency composition. Humans hear sounds best at frequencies between 1,000 and 6,000 Hertz. Sound at frequencies above 10,000 Hertz (high-pitched hissing) and below 100 Hertz (low rumble) are much more difficult to hear.

When attempting to measure sound in a way that approximates what our ears hear, we must give more weight to sounds at the frequencies we hear well and less weight to sounds at frequencies we do not hear well. Acousticians have developed several weighting scales for measuring sound. The A-weighted scale was developed to correlate with the judgments people make about the loudness of sounds. The A-weighted decibel scale (dBA) is used in studies where audible sound is the focus of inquiry. **Exhibit 1-4** shows the A, B, and C sound weighting scale. The U.S. Environmental Protection Agency (USEPA) has recommended the use of the A-weighted decibel scale in studies of environmental noise.[1] Its use is required by the Federal Aviation Administration (FAA) in airport noise studies.[2] For the purposes of this analysis, dBA was used as the noise metric and dB and dBA are used interchangeably.

EXHIBIT 1-4, SOUND FREQUENCY WEIGHTING CURVES



Source: Federal Highway Administration

1.2.3 Duration of Sounds

The duration of sounds – their patterns of loudness and pitch over time – can vary greatly. Sounds can be classified as continuous like a waterfall, impulsive like a firecracker, or intermittent like aircraft overflights. Intermittent sounds are produced for relatively short periods, with the instantaneous sound level during the event roughly appearing as a bell-shaped curve. An aircraft event is characterized by the period during which it rises above the background sound level, reaches its peak, and then recedes below the background level.

1.2.4 Perceived Noise Level

Perceived noisiness is another method of rating sound that was originally developed for the assessment of aircraft noise. Perceived noisiness is the subjective measure of the degree to which noise is unwanted or causes annoyance to an individual. To determine perceived noise level, 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 inherently subjective and thus subject to

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1 Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety. U.S. Environmental Protection Agency, Office of Noise Abatement and Control. 1974, P. A-10.

2 "Airport Noise Compatibility Planning." 14 CFR Part 150, Sec. A150.3.

greater variability. For example, two separate events of equal noise energy may be perceived differently if one sound is more annoying to the listener than the other.

1.2.5 Propagation of Noise

Outdoor sound levels decrease as a function of distance from the source, and as a result of wave divergence, atmospheric absorption, and ground attenuation. If sound is radiated from a source in a homogeneous and undisturbed manner, the sound travels as spherical waves. As the sound wave travels away from the source, the sound energy is distributed over a greater area, dispersing the sound energy of the wave. Spherical spreading of the sound wave reduces the noise level at a rate of six (6) dB per doubling of the distance.

Atmospheric absorption also influences the levels that are received by the observer. The greater the distance traveled, the greater the influence of the atmosphere and the resultant fluctuations. Atmospheric absorption becomes important at distances of greater than 1,000 feet. The degree of absorption is a function of the frequency of the sound as well as the humidity and temperature of the air. The higher frequencies are more readily absorbed than the lower frequencies. Over large distances, the lower frequencies become the dominant sound as the higher frequencies are attenuated.

Turbulence and gradients of wind, as well as temperature and humidity also play a significant role in determining the degree of attenuation. Certain conditions, such as inversions, can also result in higher noise levels than would result from spherical spreading because of channeling or focusing the sound waves.

The effect of ground attenuation on noise propagation is a function of the height of the source and/or receiver and the characteristics of the terrain. The closer the source of noise is to the ground, the greater the ground absorption. Terrain consisting of soft surfaces such as vegetation provide for more ground absorption than hard surfaces. Ground attenuation is important for the study of noise from airfield operations.

1.3 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. These factors include not only physical (acoustic) characteristics of the sound but also secondary (non-acoustic) factors, such as sociological and external factors.

Sound rating scales are developed to account for the factors that affect human response to sound. Nearly all of these factors are relevant in describing how sounds are perceived in the community. Many of the non-acoustic parameters play a prominent role in affecting individual response to noise. Background sound (ambient noise) is also important in describing sound in rural settings. Some non-acoustic factors that may influence an individual's response to aircraft noise include:

- Predictability of when the sound/noise will occur;
- How the noise affects certain activities;
- Fear of an aircraft crashing;
- Belief that aircraft noise could be prevented or reduced by aircraft designers, pilots, or authorities related to airlines or airports; and
- Sensitivity to noise in general.

Thus, it is important to recognize that non-acoustic factors such as those described above, as well as acoustic factors, contribute to human response to noise.

1.4 Standard Noise Descriptors

Given the multiple dimensions of sound, a variety of descriptors, or metrics, have been developed for describing sound and noise. Some of the most commonly used metrics are discussed in this section. They include:

- Maximum Level (Lmax)
- Time Above Level (TA)
- Sound Exposure Level (SEL)
- Equivalent Sound Level (Leq)
- Day-Night Average Sound Level (DNL)

1.4.1 Maximum Level (Lmax)

Lmax is simply the highest sound level recorded during an event or over a given period of time. It provides a simple and understandable way to describe a sound event and compare it with other events. In addition to describing the peak sound level, Lmax can be reported on an appropriate weighted decibel scale (A-weighted, for example) so that it can disclose information about the frequency range of the sound event in addition to the loudness.

Lmax, however, fails to provide any information about the duration of the sound event. This can be a critical shortcoming when comparing different sounds. Even if they have identical Lmax values, sounds of greater duration contain more sound energy than sounds of shorter duration. Research has demonstrated that for many kinds of sound effects, the total sound energy, not just the peak sound level, is a critical consideration.

1.4.2 Time Above Level (TA)

The “time above,” or TA, metric indicates the amount of time that sound at a particular location exceeds a given sound level threshold. TA is often expressed in terms of the total time per day that the threshold is exceeded. The TA metric explicitly provides information about the duration of sound events, although it conveys no information about the peak levels during the period of observation.

1.4.3 Number of Events Above Level (NA)

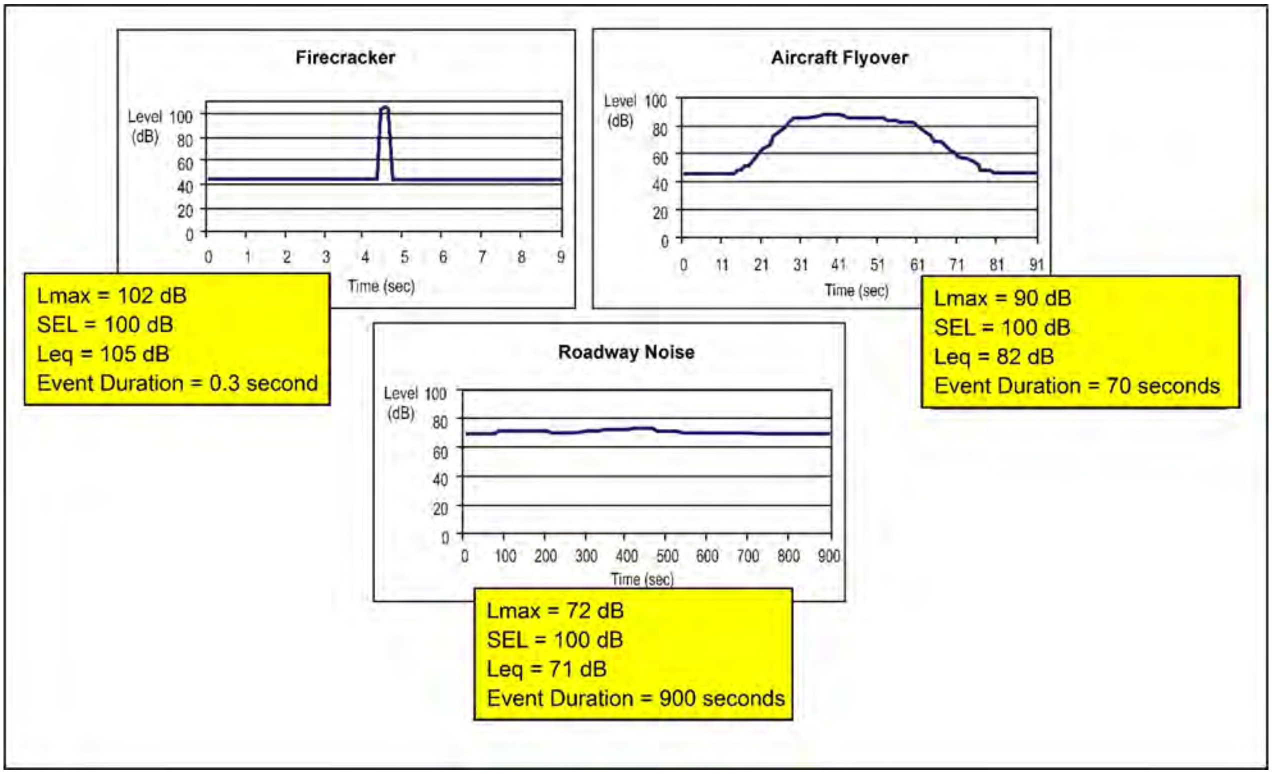
Similar to TA, the Number of Events Above (NA) metric indicates the total number of aircraft events at particular location that exceed a given sound level threshold in dB. The NA metric explicitly provides information about the number of sound events, although it conveys no information about the duration of the event(s).

1.4.4 Sound Exposure Level (SEL)

The sound exposure level, or SEL metric, provides a way of describing the total sound energy of a single event. In computing the SEL value, all sound energy occurring during the event, within 10 dB of the peak level (Lmax), is mathematically integrated over one second. Very little information is lost by discarding the sound below the 10 dB cut-off, since the highest sound levels completely dominate the integration calculation. Consequently, the SEL is always greater than the Lmax for events with a duration greater than one second. SELs for aircraft overflights typically range from five to 10 dB higher than the Lmax for the event.

Exhibit 1-5 shows graphs of instantaneous sound levels for three different events: an aircraft flyover, steady roadway noise, and a firecracker.

EXHIBIT 1-5, MEASUREMENT OF DIFFERENT TYPES OF SOUND



Source: Landrum & Brown, 2022

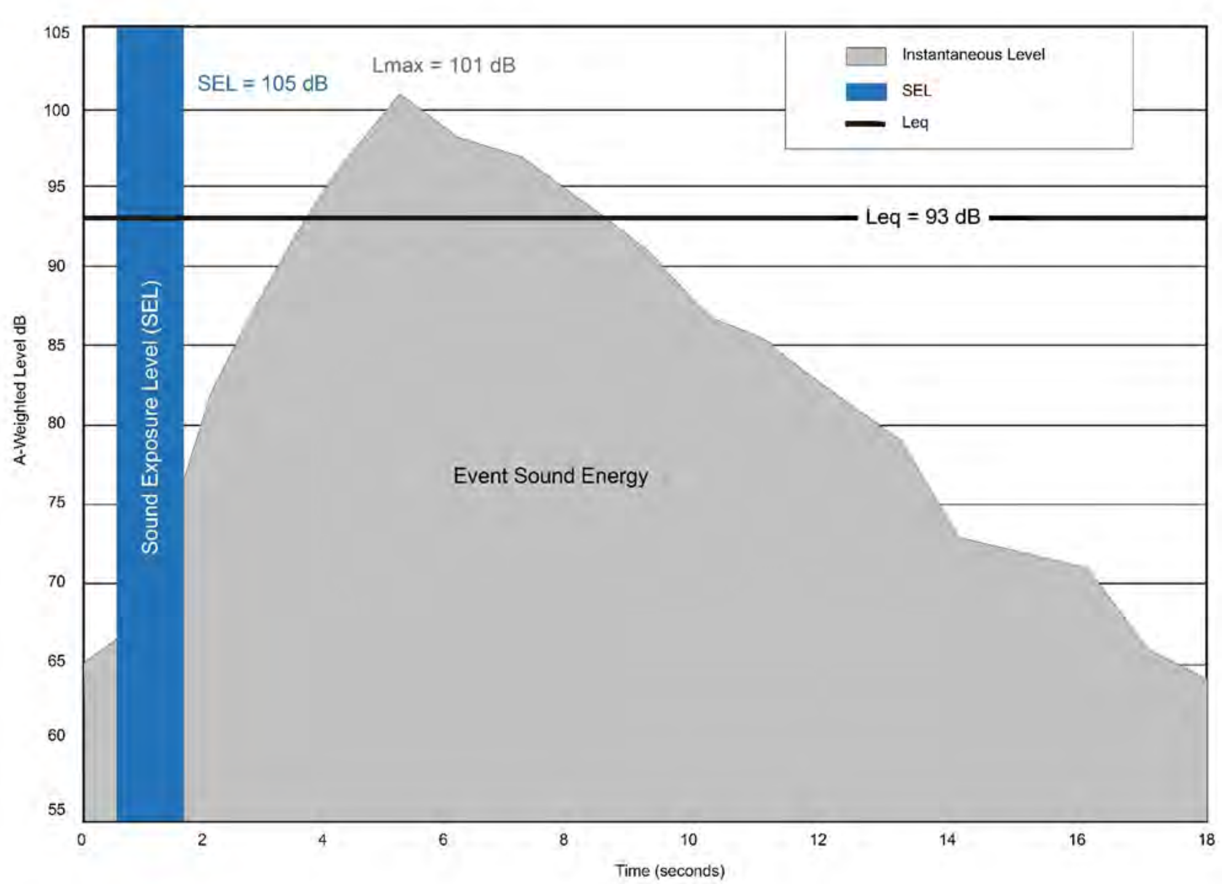
The Lmax and the duration of each event differ greatly. The pop of the firecracker is quite loud, 102 dB but lasts less than a second. The aircraft flyover has a considerably lower Lmax at 90 dB, but the event lasts for over a minute. The Lmax from the roadway noise is even quieter at only 72 dB, but it lasts for 15 minutes. By considering the loudness and the duration of these very different events simultaneously, the SEL metric reveals that the total sound energy of all three is identical. This can be a critical finding for studies where total noise dosage is the focus of study. As it happens, research has shown conclusively that noise dosage is crucial in understanding the effects of noise on animals and humans.

1.4.5 Equivalent Sound Level (Leq)

The equivalent sound level (Leq) metric may be used to define cumulative noise dosage, or noise exposure, over a period of time. In computing Leq, the total noise energy over a given period of time, during which numerous events may have occurred, is logarithmically averaged over the time period. The Leq represents the steady sound level that is equivalent to the varying sound levels actually occurring during the period of observation. For example, an 8-hour Leq of 67 dB indicates that the amount of sound energy in all the peaks and valleys that occurred in the 8-hour period is equivalent to the energy in a continuous sound level of 67 dB. Leq is typically computed for measurement periods of 1 hour, 8 hours, or 24 hours, although any time period can be specified.

Exhibit 1-6 shows the relationship of Leq to Lmax and SEL. In this example, a single aircraft event lasting 18 seconds is represented. The instantaneous noise levels for the event range from 64 to an Lmax of 101 dBA. The area under the curve represents the sound energy accumulated during the entire event. The compression of this energy into a single second results in an SEL of 105 dBA. The Leq average of the sound energy for each second during the event would be 93 dB. If this event were the only event to occur during an hour, the aircraft sound energy for the other 3,582 seconds would be considered to be zero. When converted to an hourly Leq, the level would be nearly 70 dB of Leq. This again indicates the dominance of loud events in noise summation and averaging computations.

EXHIBIT 1-6, RELATIONSHIP AMONG SOUND METRICS



Source: Landrum & Brown, 2022

Leq is a critical noise metric for many kinds of analysis where total noise dosage, or noise exposure, is under investigation. As already noted, noise dosage is important in understanding the effects of noise on both animals and people. Indeed, research has led to the formulation of the "equal energy rule." This rule states that it is the total acoustical energy to which people are exposed that explains the effects the noise will have on them. That is, a very loud noise with a short duration will have the same effect as a lesser noise with a longer duration if they have the same total sound energy.

1.4.6 Day-Night Average Sound Level (DNL)

The Day-Night Average Sound Level (DNL) metric is really a variation of the 24-hour Leq metric. Like Leq, the DNL metric describes the total noise exposure during a given period. Unlike Leq, however, DNL, by definition, can only be applied to a 24-hour period. In computing DNL, an extra weighting of 10 dB is assigned to any sound levels occurring between the hours of 10:00 p.m. and 7:00 a.m. This is intended to account for the greater annoyance that nighttime noise is presumed to cause for most people. Recalling the logarithmic nature of the dB scale, this extra weight treats one nighttime noise event as equivalent to 10 daytime events of the same magnitude.

As with Leq, DNL values are strongly influenced by the loud events. For example, 30 seconds of sound of 100 dB, followed by 23 hours, 59 minutes, and 30 seconds of silence would compute to a DNL value of 65 dB. If the 30 seconds occurred at night, it would yield a DNL of 75 dB.

This example can be roughly equated to an airport noise environment. Recall that an SEL is the mathematical compression of a noise event into one second. Thus, 30 SELs of 100 dB during a 24-hour period would equal 65 DNL, or 75 DNL if they occurred at night.

This situation could actually occur in places around a real airport. If the area experienced 30 overflights during the day, each of which produced an SEL of 100 dB, it would be exposed to 65 DNL. Recalling the relationship of SEL to the peak noise level (Lmax) of an aircraft overflight, the Lmax recorded for each of those overflights (the peak level a person would actually hear) would typically range from 90 to 95 dB.

1.5 Health Effects of Noise

A considerable amount of research has been conducted to identify, measure, and quantify the potential effects of aviation noise on health. The various methods by which noise can be measured (e.g. single dose, long-term average, number of events above a certain level, etc.), and difficulties in separating other lifestyle factors from the analysis, increases the complexity of determining the health effects of noise, and has caused considerable variability in the results of past studies. The health effects of noise are often divided into the following topics: cardiovascular effects, hearing loss, sleep disturbance, and speech/communication interference.

1.5.1 Cardiovascular Effects

Several studies have suggested that increased hypertension or other cardiovascular effects, such as increased blood pressure, and change in pulse rate, may be associated with long-term exposure to high levels of environmental noise. When conducting cross-sectional studies of environmental noise exposure, it is difficult to control for other important variables. Subsequent reviews of past research have pointed out that such studies "…are notoriously difficult to interpret. They often report conflicting results, generally do not identify a cause and effect relationship, and often do not report a dose-response relationship between the cause and effect."[3] In 2018, the World Health Organization (WHO) published its Environmental Noise Guidelines report (WHO report) with reference to recent research related to aircraft noise and human response.[4] The WHO report references two ecological studies that provide information on the relationship between aircraft noise and incidence of ischemic heart disease

[3] Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.

[4] World Health Organization, Regional Office for Europe, Environmental Noise Guidelines for the European Region, 2018.

(IHD); however, this "…evidence was rated low quality." Additionally, the WHO report referenced one cohort study and several cross-sectional studies of the relationship between aircraft noise and hypertension. The WHO report noted "…inconsistency across studies" and the "…evidence was rated low quality." Therefore, it is difficult to draw any conclusions about the relationship between aircraft noise exposure and cardiovascular effects.

1.5.2 Hearing Loss

The potential for noise-induced hearing loss is commonly associated with occupational noise exposure from working in a noisy work environment or recreational noise such as listening to loud music. Recent studies have concluded that "because environmental noise does not approximate occupational noise levels or recreational noise exposures…it does not have an effect on hearing threshold levels." Furthermore, "aviation noise does not pose a risk factor for child or adolescent hearing loss, but perhaps other noise sources (personal music devices, concerts, motorcycles, or night clubs) are a main risk factor."[5] This conclusion is supported by the 2018 WHO Environmental Noise Guidelines which notes that "(n)o studies were found, and therefore no evidence was available on the association between aircraft noise and hearing impairment and tinnitus."[6] Because aviation noise levels near airports do not approach levels of occupational or recreational noise exposures associated with hearing loss, hearing impairment is likely not caused by aircraft noise for populations living near an airport.

1.5.3 Sleep Disturbance

Sleep disturbance is a common complaint from people who live in the vicinity of an airport. A large amount of research has been published on the topic of sleep disturbance caused by environmental noise. This research has produced variable results due to differing definitions of sleep disturbance, different ways for measuring sleep disturbance (behavioral awakenings or sleep interruption), and different settings in which to measure it (laboratory setting or field setting).

In 1992, the Federal Interagency Committee on Noise (FICON) recommended an interim dose-response curve to predict the percent of the exposed population expected to be awakened (percent awakening) as a function of the exposure to single event noise levels expressed in terms of the SEL. This interim curve was based on statistical adjustment of previous analysis and included data from both laboratory and field studies. In 1997, Federal Interagency Committee on Aviation Noise (FICAN) recommended a revised sleep disturbance relationship based on data and analysis from three field studies.

Exhibit 1-7 shows the results of the 1992 and 1997 analyses. The top graph shows a comparison of the 1992 FICON and 1997 FICAN curves. The 1997 FICAN curve represents the upper limit of the observed field data and should be interpreted as predicting the "maximum percent of the exposed population expected to be behaviorally awakened", or the "maximum percent awakened" for a given residential population.

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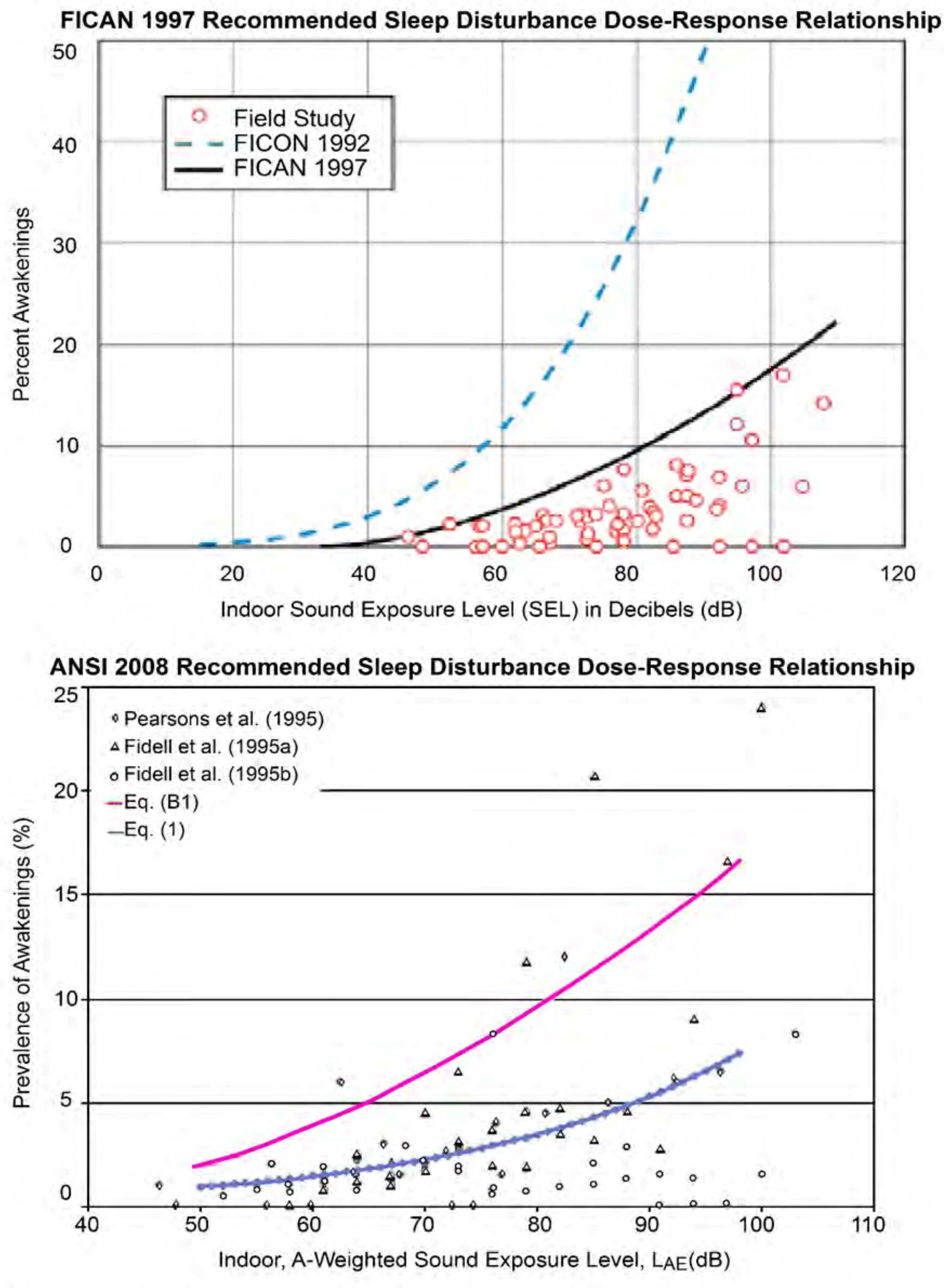
5 Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.

6 World Health Organization, Regional Office for Europe, Environmental Noise Guidelines for the European Region, 2018.

EXHIBIT 1-7, SLEEP DISTURBANCE DOSE-RESPONSE CURVES



Sources: Federal Interagency Committee on Aviation Noise (FICAN), June 1997; American National Standards Institute, 2008.

In 2008, FICAN recommended the use of a revised method to predict sleep disturbance in terms of percent awakenings based on data published by the American National Standards Institute (ANSI).[7] In contrast to the earlier FICAN recommendation, the 2008 ANSI standard indicates that the probability of awakening is lower for a single noise event in cases where the population is exposed to the given noise source for a long period of time (more than one year) compared to the probability of awakening for sound that is new to an area. In Exhibit 1-7, the lower graph shows these two relationships, with Equation 1 (blue dotted line) representing percent awakenings from long-term noise and Equation B1 (pink dashed line) representing percent awakenings from a new noise source based on the 1997 FICAN results. As shown in this exhibit, at an indoor SEL of 100 dB, the probability of awakenings would be expected to exceed 15 percent for a new noise source; yet for long-term noise sources, the probability of awakening is expected to be less than 10 percent.

The numerous studies and reports that have been developed on the subject of sleep disturbance related to environmental noise over the past several decades have produced varied results. A review of past studies conducted by the Airport Cooperative Research Program suggests that in-home sleep disturbance studies clearly demonstrate that it requires more noise to cause awakenings than was previously theorized based on laboratory sleep disturbance studies.[8] The 2018 WHO Environmental Noise Guidelines references six studies that attempted to measure sleep disturbance at noise levels between 40 dB and 65 dB. Over 11% of the population was characterized as highly sleep-disturbed at nighttime levels of 40 dB. These studies were based on self-reporting and the "…evidence was rated moderate quality…" for an association between aircraft noise and probability of awakenings.[9]

Due to the variability of study methodologies, particularly studies outside of a laboratory, and other influencing factors, it is difficult to determine the noise level at which a high percentage of the population would be expected to be awakened by aircraft noise. No definitive conclusions have been drawn on the percent of a population that is estimated to be awakened by a certain level of aircraft noise and recent studies have cautioned about the over interpretation of the data.[10]

1.5.4 Communication Interference

Communication interference can impact activities such as personal conversations, classroom learning, and listening to radio and television. Most studies have focused on communication interference due to continual noise sources. In 1974, the USEPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, which is one of the few studies to focus on intermittent noise. The study concluded that for voice communication, an indoor Leq of 45 dB allows normal conversation at distances up to 2 meters with 95 percent sentence intelligibility. **Exhibit 1-8** shows the required distance between talker and listener based on the type of speech communication (normal voice, loud voice, etc.) and the environmental noise level from the 1974 USEPA report.

Noise can also impact communication between student and teacher necessary for learning in a classroom setting. It is usually accepted that noise levels above a certain Leq may affect a child's learning experiences. Research has shown a "decline in reading when outdoor noise levels equal or

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7 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, 2008.

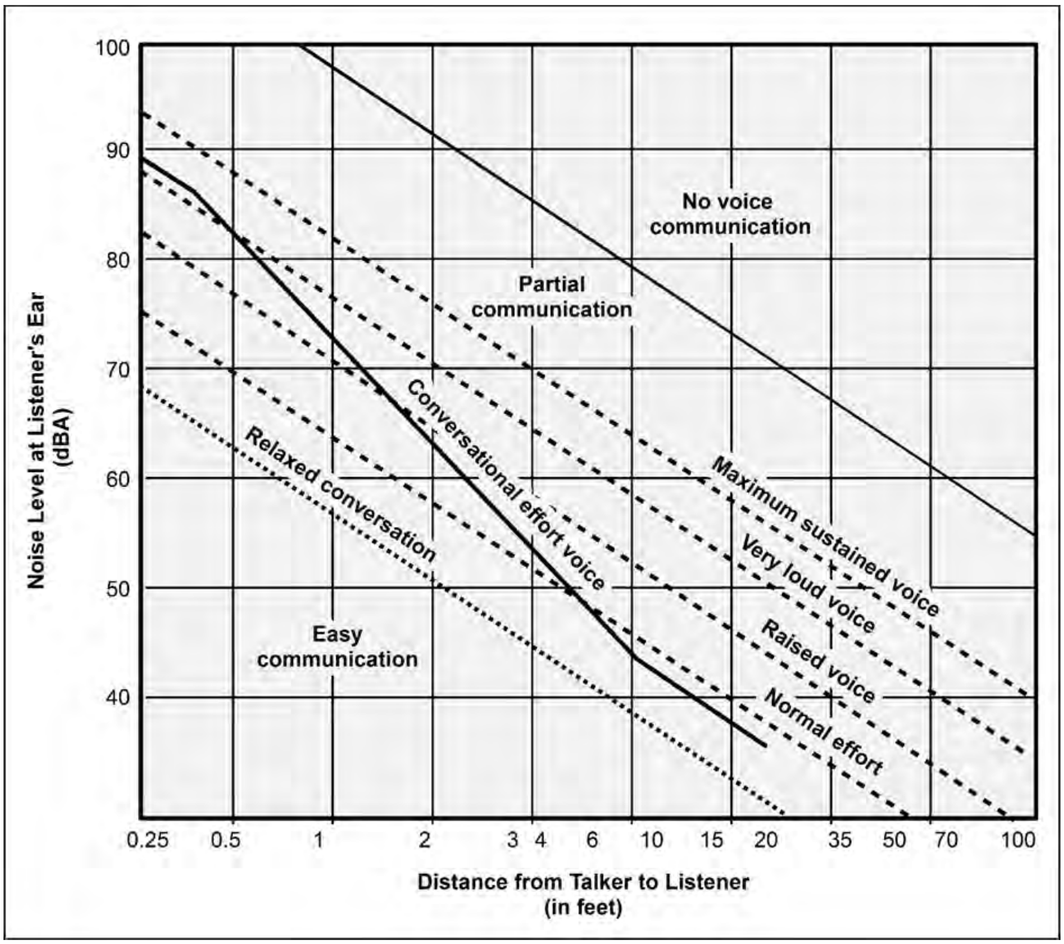
8 Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.

9 World Health Organization, Regional Office for Europe, Environmental Noise Guidelines for the European Region, 2018.

10 Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.

exceed Leq of 65 dBA."[11] Furthermore, a study conducted by FICAN in 2007 found: "(1) a substantial association between noise reduction and decreased failure (worst-score) rates for high-school students, and (2) significant association between noise reduction and increased average test scores for student/test subgroups. In general, the study found little dependence upon student group and upon test type."[12] A study of noise exposure and the effects on school test scores between 2000/01 and 2008/09 found "…statistically significant associations between airport noise and student mathematics and reading test scores, after taking demographic and school factors into account."[13] This study also found that schools that had been provided sound insulation had better test scores than schools that were not sound insulated. This study made no recommendation regarding the noise level at which impacts upon learning may occur.

EXHIBIT 1-8, NOISE EFFECTS ON DISTANCE NECESSARY FOR SPEECH COMMUNICATION



Source: FICON, 1992; from USEPA, 1974.

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11 Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.

12 Federal Interagency Committee on Aviation Noise (FICAN), Findings of the FICAN Pilot Study on the Relationship between Aircraft Noise Reduction and Changes in Standardized Test Scores, July 2007.

13 National Academies of Sciences, Engineering, and Medicine; Assessing Aircraft Noise Conditions Affecting Student Learning, Volume 1: Final Report; 2014.

2 Regulatory Setting

This section presents information regarding noise and land use criteria that may be useful in the evaluation of noise impacts.

2.1 Land Use Control Responsibilities

The Airport Authority has no role or authority over any airspace and therefore does not have control over the flight paths or altitudes that aircraft fly. The role of the Airport Authority is to administer and control the operations and facilities at RDU. The federal government has exclusive sovereignty over U.S. airspace. The FAA is responsible for managing the National Airspace System (NAS) including all aircraft flight paths and altitudes. Local governments including the City of Raleigh, the Town of Morrisville, Town of Cary, and Durham County are responsible for land-use zoning in order to minimize aircraft noise impacts on their residents. The Airport Authority actively maintains communication with surrounding communities regarding aircraft noise patterns in order to help these communities avoid incompatible land uses.

2.2 Noise Control Act

Congress passed the Noise Control Act (42 U.S.C. §4901 et seq.) in 1972, which established a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. The act set forth the foundation for conducting research and setting guidelines to restrict noise pollution.

2.3 Federal Aviation Noise Abatement Policy

On November 18, 1976, the U.S. Department of Transportation and FAA jointly issued the Federal Aviation Noise Abatement Policy. This policy recognized aircraft noise as a major constraint on the further development of the commercial aviation established key responsibilities for addressing aircraft noise. The policy stated that the Federal Government has the authority and responsibility to regulate noise at the source by designing and managing flight procedures to limit the impact of aircraft noise on local communities; and by providing funding to airports for noise abatement planning.

2.4 Aviation Safety and Noise Abatement Act of 1979

The Aviation Safety and Noise Abatement Act of 1979, which is codified as 49 U.S.C. 47501-47510, set forth the foundation for the airport noise compatibility planning program outlined in 14 Code of Federal Regulations (CFR) Part 150. The act established the requirements for conducting noise compatibility planning and provided assistance and funding for which airport operators could apply to undertake such planning.

2.5 Airport Noise and Capacity Act of 1990

The Airport Noise and Capacity Act (ANCA) of 1990 established two broad directives for the FAA: 1) to establish a method by which to review airport noise and access/use restrictions imposed by airport proprietors, and 2) to institute a program to phase out Stage 2 aircraft over 75,000 lbs. by December

31, 1999. In order to implement ANCA, the FAA amended 14 CFR Part 91 and issued 14 CFR Part 161 which sets forth noise levels that are permitted for aircraft of various weights.

2.6 Federal Requirements to Use DNL in Environmental Noise Studies

The DNL metric is the standard noise metric for use in FAA studies and decision-making purposes. The FAA uses the DNL metric for purposes of determining an individual's cumulative noise exposure, for land use compatibility under 14 CFR part 150, and for assessing the significance of predicted noise impacts under NEPA.

Part 150 established the DNL as the noise metric for determining the exposure of individuals to aircraft noise and identified residential land uses as being normally compatible with noise levels below 65 DNL. As shown in **Table 2-1**, all land uses within areas below 65 DNL are considered to be compatible with airport operations. Residential land uses are generally incompatible with noise levels above 65 DNL. In some areas, residential land use may be permitted in the 65 to 70 DNL range with appropriate sound insulation measures implemented. This is done at the discretion of local communities. Schools and other public use facilities located between 65 to 70 DNL are generally incompatible without sound insulation. Above 75 DNL, schools, hospitals, nursing homes, and churches are considered incompatible land uses. The information presented is meant to act as a guideline. According to 14 CFR Part 150, "Adjustments or modifications of the descriptions of the land-use categories may be desirable after consideration of specific local conditions." [14]

Ongoing research activities sponsored by the FAA and the broader research community are working to develop a greater understanding of other noise-related impact criteria. This research may expand the use of supplemental metrics, including new metrics designed to measure speech interference (N75), Percent Awakening, Learning (Leq(8)), and rattling from low frequency noise Lmax(c).

[14] 14 CFR Part 150, Part B Noise Exposure Map Development, Section A150.101 Noise contours and land usages, paragraph (c).

TABLE 2-1, LAND USE COMPATIBILITY GUIDELINES - 14 CFR PART 150

	YEARLY DAY-NIGHT AVERAGE SOUND Level (DNL) In Decibels					
Land Use	**Below 65**	**65-70**	**70-75**	**75-80**	**80-85**	**Over 85**
RESIDENTIAL						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
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
Land Use	**Below 65**	**65-70**	**70-75**	**75-80**	**80-85**	**Over 85**
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						

	YEARLY DAY-NIGHT AVERAGE SOUND Level (DNL) In Decibels					
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

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB 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 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 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 level is low.
(5) Land use compatible provided 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.

Notes: 1. The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.
2. SLUCM=Standard Land Use Coding Manual.
3. Y (Yes)=Land Use and related structures compatible without restrictions.
4. N (No)=Land Use and related structures are not compatible and should be prohibited.
5. NLR=Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
6. 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.

Source: 14 CFR Part 150, *Airport Noise Compatibility Planning*, Appendix A, Table 1.

3 Methodology

The overall approach to conducting this noise analysis follows FAA guidelines for preparing NEPA documents, which includes FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures (including the Desk Reference)* and FAA Order 5050.4B. In accordance with these orders and guidance documents, the overall approach and goal of the noise impact analysis is to meet the requirements of NEPA.

This noise assessment included an evaluation of the impacts of airport-related noise levels upon the surrounding area, presented in terms of the number and type of noise-sensitive land uses located within the noise contours for the Proposed Action and the No Action Alternative for the projected future conditions in 2028 and 2033. The year 2028 was selected because it represents the projected opening year of the proposed runway replacement. In addition, 2033 is used as a basis for analysis, because it represents a condition five years beyond the proposed runway replacement opening year. The number of annual operations at RDU for the future conditions in 2028 and 2033 were based off the FAA-approved aviation activity forecast.

A description of the existing conditions was also provided for background and context only. For the assessment of impacts, the Proposed Action was compared to the No Action Alternative of the same future year. Results are provided later in this technical report.

A significant noise impact would occur if the analysis shows that the Proposed Action would result in noise-sensitive areas to experience an increase in noise of DNL 1.5 dB or more, at or above 65 DNL noise exposure when compared to the No Action Alternative for the same timeframe. For example, an increase in noise exposure over a noise sensitive land use from 65 DNL to 66.5 DNL is considered a significant impact. Similarly, if a noise-sensitive area that receives less than 65 DNL under the No Action Alternative would receive noise exposure of 65 DNL as a result of the Proposed Action, then those areas are also considered significantly impacted.

3.1 Model Used in this Analysis

The analysis of noise exposure for this EA was prepared using the FAA's Aviation Environmental Design Tool (AEDT) Version 3d. [15] Inputs to the AEDT include runway definition, number of aircraft operations during the time period evaluated, the types of aircraft flown, the time of day when they are flown, how frequently each runway is used for arriving and departing aircraft, the routes of flight used when arriving to and departing from the runways, and departure profiles. The AEDT calculates noise exposure for the area around an airport and outputs contours of noise exposure using the DNL metric. For this noise analysis and to estimate potential noise impacts terrain data files were applied in AEDT without line-of-sight blockage.

15 Per FAA memorandum dated September 27, 2017, Guidance on determining which version of the Aviation Environmental Design Tool (AEDT) to use for FAA actions and studies, "The current version of AEDT is required for all noise, fuel burn and emissions modeling for FAA actions where the environmental analysis is initiated on or after the version release date. As noted in the Federal Register and FAA Order 1050.1F, the required model version is the one in effect at the time the "environmental analysis process is underway." AEDT version 3d was the version when this EA was initiated.

3.2 Determination of Noise Sensitive Facilities

Identifying and evaluating land uses within the airport environs is an important step in the noise assessment. This evaluation is necessary to identify residential and other noise-sensitive land uses around the Airport. Noise-sensitive land uses usually have human activity that may be subject to speech, hearing, or sleep interference. Noise-sensitive land uses include, but are not limited to, single- and multi-family residential use, schools, places of worship, hospitals or other medical facilities, nursing homes, day care centers, or public libraries. The methodology for making this identification comprised of examining land use classifications and zoning patterns, surveying and mapping, developing a geographic information system (GIS) land use database, and applying 14 Code of Federal Regulations (CFR) Part 150 guidelines for land use compatibility.

For this assessment, land use data was obtained from Wake and Durham Counties. These maps were used as the basis for the land use graphics included in the noise assessment. Existing land uses such as residential areas, open land, commercial, and manufacturing areas were also verified through aerial photographs and field checks.

Other noise-sensitive facilities include schools, places of worship (churches, mosques, synagogues, etc.), libraries, hospitals, assisted living facilities, and other noise-sensitive facilities. The locations of these facilities were determined from the data obtained from Wake and Durham Counties. Aerial photographs and field checks were also conducted to verify the location of some of the noise-sensitive facilities.

A GIS database was developed to identify the noise sensitive facilities including residential units located in the noise contours. This GIS database consists of a set of points representing each residential unit or other noise sensitive facility. Associated with each point is the number of units contained in the structure, if applicable, and the type of unit (single-family, multi-family or mobile home, school, church, etc.). The points are located directly on the building or structure. If the noise contour touched any part of the noise sensitive facility structure, then it was considered within the contour. If the property (parcel) was in the contour but the actual structure was out of the contour, then it was considered not within the contour.

In order to determine the potential population within the contours, the average persons per household for Wake County (2.61 persons per household) was assigned to each housing point. This average persons per household data was obtained from the U.S. Census Bureau.

3.3 Aircraft Noise Impacts During Construction

A preliminary construction phasing plan was developed by the Airport Authority with the intent to minimize impacts to airport operations during construction. Due to the preliminary phasing plan to construct the Proposed Action, there is little potential for change in noise from how the Airport operates today. Any potential Runway 5L/23R closures would be planned to avoid impacts to current operations similar to how RDU operates now when there is a need to replace individual runway slabs for maintenance. While not expected, if there is a specific need for an extended Runway 5L/23R closure and any increase to operations on Runway 5R/23L, the goal will be a closure measured in days, not weeks. Therefore, this would not result in a long-term condition, is not expected to cause a notable change to the noise environment, and no noise contours were modeled for the construction years. The Airport Authority will be responsible to submit a formal Construction Safety and Phasing Plan to the

FAA to maintain aviation and airfield safety during construction pursuant to FAA AC 150/5370 2G, *Operational Safety on Airports During Construction*.

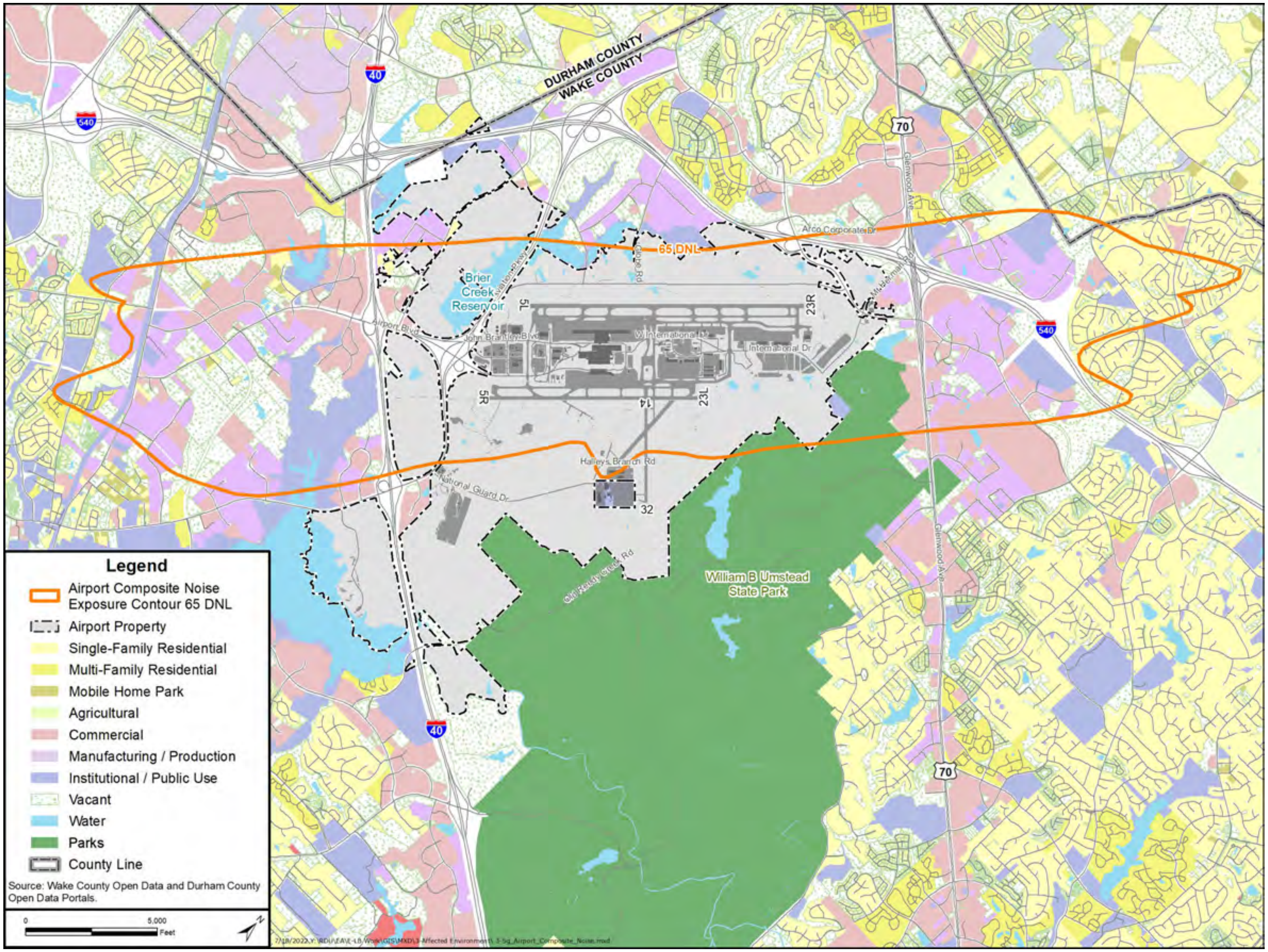
4 Existing Conditions

In order to better understand and describe the current noise conditions at RDU, several scenarios are provided. These scenarios include the Airport Authority's current land use planning noise contours (referred to as the composite contour), noise contours that depict a PreCOVID condition, and noise contours that depict a condition during the height of the COVID pandemic. The existing conditions are provided for background and context only.

4.1 Existing Land Use Planning Noise Contours

In the early 1990's, the Airport Authority developed a set of noise contours to depict the noise environment around RDU. The Airport Authority combined these contours into a set of composite noise contours that depict noise levels at 55 DNL, 60 DNL, 65 DNL, and 70 DNL contours. The composite noise contours are still used by the Airport Authority to assist local governments including the City of Raleigh, the Town of Morrisville, Town of Cary, and Durham County to apply land use restrictions in areas near RDU to ensure that future land use and development within a geographic area is compatible with airport activities. The composite noise contours currently used by the Airport Authority are provided on their website at https://www.rdu.com/airport-authority/aircraft-noise-at-rdu/. The 65 DNL Noise Exposure Contour of the composite noise contours is presented on **Exhibit 4-1**. The 65 DNL Noise Exposure Contour extends well beyond Airport property.

EXHIBIT 4-1, 65 DNL EXISTING NOISE EXPOSURE CONTOUR FOR LAND USE PLANNING



Source: Airport Authority, Durham County GIS, Wake County GIS, 2021.

4.2 Existing Conditions (2019) PreCOVID

4.2.1 Runway Definition

RDU has two parallel runways (5L/23R and 5R/23L) spaced approximately 3,500 feet apart. Runway 5L/23R is the longest runway on the airfield at 10,000 feet in length and is 150 feet wide. Runway 5R/23L is 7,500 feet long and 150 feet wide. A crosswind runway, (Runway 14/32) is located to the southeast of the main airfield and is 3,570 feet long and 100 feet wide. Runway 14/32 is used primarily by the North Carolina National Guard and light general aviation aircraft. **Table 4-1** provides information on the current runways and lengths at RDU.

TABLE 4-1, RUNWAYS – EXISTING CONDITIONS (2019) PRECOVID

RUNWAY	LENGTH (FEET)
5L/23R	10,000
5R/23L	7,500
14/32	3,570

Source: Airport Authority, 2021.

4.2.2 Number of Operations and Fleet Mix

In 2019, prior to the global health pandemic, there were 223,249 annual operations at RDU. It should be noted that all annual operations in this document reflect calendar year operations. When divided by 365, the result is 611.64 average-annual day operations. Specific aircraft types and times of operation were developed from RDU Airport Flight Tracking System data for 2019. **Table 4-2** provides a summary of the average annual day operations by aircraft category and time of day that was used for the Existing Conditions (2019) PreCOVID. **Table 4-3** shows the average daily number of arrivals and departures by time of day and individual aircraft type.

TABLE 4-2, SUMMARY OF AVERAGE-ANNUAL DAY OPERATIONS – EXISTING CONDITIONS (2019) PRECOVID

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL	PERCENT OF TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME		
Heavy Jets	3.8	2.2	4.1	1.8	11.9	2%
Large Commercial Jets	159.2	36.2	167.8	27.6	390.8	64%
Regional / General Aviation Jets	35.8	3.7	35.4	4.2	79.1	13%
General Aviation Props	48.3	2.9	47.8	3.5	102.5	17%
Civil Helicopters	7.1	2.5	4.3	5.3	19.2	3%
Military Jets	0.4	0.1	0.5	0.0	1.0	<1%
Military Props	1.8	0.1	1.8	0.1	3.8	1%
Military Helicopters	1.2	0.4	0.7	0.9	3.3	<1%
Total	257.6	48.2	262.4	43.5	611.6	100%

Notes: Total may not equal due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.

Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, RDU Flight Tracking System data, Landrum & Brown analysis, 2021.

TABLE 4-3, AVERAGE-ANNUAL DAY OPERATIONS BY AIRCRAFT TYPE – EXISTING CONDITIONS (2019) PRECOVID

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Heavy Jets					
Airbus A300F4-600 Series	0.6	0.3	0.6	0.3	1.7
Boeing 767-300 ER Freighter	1.8	1.1	2.0	0.9	5.8
Boeing MD-11 Freighter	0.3	0.2	0.3	0.2	1.0
Boeing 767-300 Series	0.4	0.2	0.4	0.2	1.2
Boeing 777-200-ER	0.7	0.4	0.8	0.3	2.2
Subtotal	*3.8*	*2.2*	*4.1*	*1.8*	*11.9*
Large Commercial Jet					
Airbus A319-100 Series	10.0	2.3	10.6	1.7	24.6
Airbus A320-200 Series	23.6	5.4	24.9	4.1	57.9
Airbus A320-NEO	0.2	0.0	0.2	0.0	0.5
Airbus A321-200 Series	4.2	1.0	4.4	0.7	10.3
Boeing 717-200 Series	7.9	1.8	8.3	1.4	19.4
Boeing 737-400 Series	0.4	0.1	0.4	0.1	0.9
Boeing 737-700 Series	21.7	4.9	22.9	3.8	53.2
Boeing 737-800 Series	19.5	4.4	20.5	3.4	47.8
Boeing 737-900 Series	0.5	0.1	0.5	0.1	1.2
Boeing 737-900-ER	3.7	0.8	3.9	0.6	9.0
Boeing MD-83	1.2	0.3	1.3	0.2	3.1
Boeing MD-88	3.1	0.7	3.3	0.5	7.7
Boeing MD-90	1.2	0.3	1.3	0.2	2.9
Bombardier CRJ-700	0.2	0.0	0.2	0.0	0.4
Bombardier CRJ-700-ER	12.5	2.8	13.1	2.2	30.6
Bombardier CRJ-900	12.2	2.8	12.9	2.1	30.0
Bombardier CRJ-900-ER	5.3	1.2	5.6	1	13.1
Embraer ERJ170	4.0	0.9	4.2	0.7	9.9
Embraer ERJ175	2.4	0.5	2.6	0.4	5.9

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Embraer ERJ175-LR	12.8	2.9	13.5	2.2	31.4
Embraer ERJ190-AR	12.6	2.9	13.3	2.2	31.0
Subtotal	*159.2*	*36.1*	*167.9*	*27.6*	*390.8*
Regional Jets / General Aviation Jets					
Bombardier Challenger 300	2.4	0.2	2.4	0.3	5.3
Bombardier Challenger 600	0.6	0.1	0.6	0.1	1.4
Bombardier CRJ-200	7.2	0.7	7.1	0.8	15.8
Bombardier CRJ-200-ER	1.0	0.1	1.0	0.1	2.2
Bombardier CRJ-200-LR	3.4	0.4	3.5	0.4	7.7
Bombardier Learjet 60	0.3	0.0	0.3	0.0	0.6
Cessna 525 CitationJet	2.7	0.3	2.6	0.3	6.0
Cessna 550 Citation II	0.7	0.1	0.7	0.1	1.5
Cessna 560 Citation Excel	2.2	0.2	2.2	0.3	4.9
Cessna 560 Citation V	2.4	0.2	2.3	0.3	5.2
Cessna 560 Citation XLS	1.0	0.1	1.0	0.1	2.2
Cessna 650 Citation III	0.9	0.1	0.9	0.1	2.0
Cessna 680 Citation Sovereign	1.5	0.2	1.5	0.2	3.4
CIRRUS SF-50 Vision	0.4	0.0	0.4	0.0	0.8
Dassault Falcon 2000	0.9	0.1	0.9	0.1	2.1
Embraer 505	1.7	0.2	1.7	0.2	3.8
Embraer ERJ135	4.0	0.4	4.0	0.5	8.9
Gulfstream G280	0.3	0.0	0.3	0.0	0.7
Gulfstream IV-SP	0.6	0.1	0.6	0.1	1.3
Raytheon Beechjet 400	0.9	0.1	0.8	0.1	1.9
Raytheon Hawker 800	0.7	0.1	0.6	0.1	1.5
Subtotal	*35.9*	*3.7*	*35.4*	*4.2*	*79.1*
General Aviation Propeller Aircraft					
ATR 42-300	1.5	0.1	1.4	0.1	3.1

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Cessna 172 Skyhawk	4.1	0.3	4.1	0.2	8.7
Cessna 182	1.1	0.1	1.2	0.1	2.5
Cessna 208 Caravan	2.7	0.1	2.7	0.2	5.7
Cirrus SR20	0.3	0	0.2	0	0.5
Cirrus SR22	4.5	0.3	4.6	0.3	9.7
Diamond DA40	5.6	0.4	5.5	0.3	11.8
Diamond DA42 Twin Star	0.8	0	0.7	0.1	1.6
Diamond DV-20 Katana (FAS)	3	0.2	2.9	0.2	6.3
EADS Socata TBM-700	0.7	0	0.7	0.1	1.5
Mooney M20-K	0.7	0	0.7	0.1	1.5
Pilatus PC-12	2.7	0.2	2.6	0.2	5.7
Piper PA-28 Cherokee Series	10.8	0.7	10.8	0.8	23.1
Piper PA-32 Cherokee Six	0.9	0.1	0.9	0.1	2
Piper PA-34 Seneca	0.1	0	0	0	0.1
Piper PA46-TP Meridian	0.5	0	0.6	0	1.1
Raytheon Beech 55 Baron	2.7	0.2	2.6	0.2	5.7
Raytheon Beech Bonanza 36	0.8	0	0.8	0.1	1.7
Raytheon Super King Air 200	1.8	0.1	1.8	0.1	3.8
Raytheon Super King Air 300	2.2	0.1	2.2	0.2	4.7
SOCATA TBM 850	0.8	0	0.8	0.1	1.7
Subtotal	*48.3*	*2.9*	*47.8*	*3.5*	*102.5*
Military Jets					
Boeing C-17A	0.1	0.0	0.1	0.0	0.3
Boeing F/A-18 Hornet	0.1	0.0	0.1	0.0	0.1
Cessna 560 Citation V	0.2	0.0	0.2	0.0	0.4
Gulfstream 5 / G-5SP Gulfstream G500	0.1	0.0	0.1	0.0	0.2
Subtotal	*0.4*	*0.1*	*0.5*	*0.0*	*1.0*
Military Props					

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Fairchild SA-226-T Merlin III	1.0	0.0	1.0	0.0	2.0
Lockheed C-130 Hercules	0.5	0.0	0.5	0.0	1.1
Raytheon Super King Air 200	0.3	0.0	0.3	0.0	0.6
Subtotal	*1.8*	*0.0*	*1.8*	*0.1*	*3.7*
Civil Helicopters					
Aerospatiale SA-350D Astar (AS-350)	3.1	1.1	1.9	2.4	8.5
Bell 407 / Rolls-Royce 250-C47B	2.6	0.9	1.6	2.0	7.1
Eurocopter EC-130	1.3	0.5	0.8	1.0	3.6
Subtotal	*7.1*	*2.5*	*4.3*	*5.3*	*19.2*
Military Helicopters					
Eurocopter EC-155B1	0.5	0.2	0.3	0.3	1.3
Sikorsky SH-60 Sea Hawk	0.1	0	0.1	0.1	0.3
Sikorsky UH-60 Black Hawk	0.6	0.2	0.4	0.5	1.7
Subtotal	*1.2*	*0.4*	*0.8*	*0.9*	*3.3*
Total	257.6	48.3	262.2	43.5	611.6

Notes: Total may not equal due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, RDU Flight Tracking System data, Landrum & Brown analysis, 2021.

4.2.3 Runway End Utilization

Average-annual runway end utilization was derived from analysis of RDU Flight Tracking System data. Runway utilization is generally determined by wind speed and wind direction since aircraft tend to depart and arrive into the wind. Runway use percentages were derived for aircraft types and summarized by category. **Table 4-4** summarizes the percentage of use by each aircraft category on each of the runways at RDU during the daytime (7:00 a.m. – 9:59 p.m.) and nighttime (10:00 p.m. – 6:59 a.m.) periods. During this timeframe, approximately 37 percent of aircraft operated in the northeast flow and 63 percent operated in the southeast flow, although this number varies by type of aircraft.

TABLE 4-4, RUNWAY END UTILIZATION - EXISTING CONDITIONS (2019) PRECOVID

AIRCRAFT CATEGORY	RUNWAY END						TOTAL
	5L	23R	5R	23L	14	32	
Daytime Arrivals							
Heavy Commercial Jet	35.9%	62.2%	0.9%	1.0%	0.0%	0.0%	100.0%
Large Commercial Jet	33.4%	46.2%	8.8%	11.6%	0.0%	0.0%	100.0%
Regional Jet	5.6%	14.3%	34.0%	45.7%	0.0%	0.5%	100.0%
Propeller Aircraft	7.0%	13.0%	24.6%	35.3%	0.0%	20.2%	100.0%
Military Jet	35.9%	62.2%	0.9%	1.0%	0.0%	0.0%	100.0%
Military Prop	7.0%	13.0%	24.6%	35.3%	0.0%	20.2%	100.0%
Nighttime Arrivals							
Heavy Commercial Jet	34.7%	61.6%	1.8%	2.0%	0.0%	0.0%	100.0%
Large Commercial Jet	37.2%	46.6%	7.1%	9.1%	0.0%	0.0%	100.0%
Regional Jet	5.9%	14.2%	41.7%	38.1%	0.0%	0.2%	100.0%
Propeller Aircraft	4.9%	9.3%	38.1%	40.3%	0.0%	7.4%	100.0%
Military Jet	34.7%	61.6%	1.8%	2.0%	0.0%	0.0%	100.0%
Military Prop	4.9%	9.3%	38.1%	40.3%	0.0%	7.4%	100.0%
Daytime Departures							
Heavy Commercial Jet	33.1%	62.4%	2.3%	2.1%	0.0%	0.0%	100.0%
Large Commercial Jet	32.9%	45.4%	8.8%	12.9%	0.0%	0.0%	100.0%
Regional Jet	3.4%	6.1%	36.8%	53.7%	0.0%	0.0%	100.0%
Propeller Aircraft	5.0%	10.1%	35.4%	45.8%	2.5%	1.2%	100.0%
Military Jet	33.1%	62.4%	2.3%	2.1%	0.0%	0.0%	100.0%
Military Prop	5.0%	10.1%	35.4%	45.8%	2.5%	1.2%	100.0%
Nighttime Departures							
Heavy Commercial Jet	34.7%	64.4%	0.5%	0.4%	0.0%	0.0%	100.0%
Large Commercial Jet	31.9%	43.8%	10.9%	13.4%	0.0%	0.0%	100.0%
Regional Jet	1.7%	4.3%	25.2%	68.9%	0.0%	0.0%	100.0%
Propeller Aircraft	6.2%	9.2%	29.2%	51.7%	3.3%	0.5%	100.0%
Military Jet	34.7%	64.4%	0.5%	0.4%	0.0%	0.0%	100.0%

AIRCRAFT CATEGORY	RUNWAY END						TOTAL
	5L	23R	5R	23L	14	32	
Military Prop	6.2%	9.2%	29.2%	51.7%	3.3%	0.5%	100.0%

Notes: Daytime = 7:00 a.m. – 9:59 p.m., Nighttime = 10:00 p.m. – 6:59 a.m.
Total may not equal due to rounding.
Source: RDU Flight Tracking System data, Landrum & Brown analysis, 2020.

4.2.4 Flight Tracks

A flight track is the path over the ground as an aircraft flies to, or from the Airport. For this EA, radar data was evaluated to ensure that the flight tracks used in the modeling of aircraft noise are representative of where aircraft are flying to and from RDU. Flight track locations and percent distribution for the Existing Conditions (2019) PreCOVID were derived primarily from analysis of radar data from the flight tracking data. This data was analyzed to verify the location, density, and width of existing flight corridors. In order to model the flight corridors in AEDT, consolidated flight tracks were developed from this radar data. Exhibits provided in **Attachment 1** show the consolidated AEDT fixed-wing departure and arrival flight tracks for each runway compared to a sample of radar data. Exhibits are also provided for touch-and-go flight tracks typically conducted by small fixed-wing aircraft for training purposes, and civil and military helicopter flight tracks.

4.2.5 Aircraft Weight and Departure Stage Length

Aircraft weight upon departure is a factor in the dispersion of noise because it impacts the rate at which an aircraft is able to climb. Generally, heavier aircraft have a slower rate of climb and a wider dispersion of noise along the flight route. When specific aircraft weights are unknown, the AEDT uses the distance flown to the first stop as a surrogate for the weight, by assuming that the weight has a direct relationship with the fuel load necessary to reach the first destination. The AEDT groups trip lengths into nine stage categories and assigns standard aircraft weights to each stage category. These categories are provided in **Table 4-5**.

TABLE 4-5, STAGE LENGTH CATEGORIES – EXISTING CONDITIONS (2019) PRECOVID

STAGE CATEGORY	STAGE LENGTH
1	0-500 nautical miles
2	501-1000 nautical miles
3	1001-1500 nautical miles
4	1501-2500 nautical miles
5	2501-3500 nautical miles
6	3501-4500 nautical miles
7	4501-5500 nautical miles
8	5501-6500 nautical miles
9	6500+ nautical miles

Source: AEDT database, 2021.

Destinations from RDU in 2019 within a stage length of one (1) include Atlanta, Detroit, New York, Philadelphia, and Washington, DC. Destinations within a stage length of two (2) include Boston, Chicago, Dallas, Houston, Miami, Minneapolis, and Tampa. Destinations within a stage length of three (3) include Denver and San Antonio. Destinations within a stage length of four (4) include Las Vegas, Los Angeles, Phoenix, and Salt Lake City, San Francisco, and Seattle. Destinations within a stage length of five (5) include London and Paris. The stage lengths modeled for the Existing Conditions (2019) PreCOVID are based upon a review of radar data providing aircraft destinations for scheduled departures at RDU. **Table 4-6** indicates the proportion of the operations that were modeled within each applicable stage length category for the Existing Conditions (2019) PreCOVID.

TABLE 4-6, STAGE LENGTH DISTRIBUTION – EXISTING CONDITIONS (2019) PRECOVID

AIRCRAFT TYPE	DEPARTURE STAGE LENGTH					TOTAL
	1	2	3	4	5	
Heavy Jets	69%	22%	0%	0%	9%	100%
Large Commercial Jets	78%	17%	2%	3%	0%	100%
Regional / General Aviation Jets	99%	1%	0%	0%	0%	100%
General Aviation Props	100%	0%	0%	0%	0%	100%
Military Jets	100%	0%	0%	0%	0%	100%
Military Props	100%	0%	0%	0%	0%	100%
Helicopter	100%	0%	0%	0%	0%	100%
Total	85%	12%	1%	2%	0%	100%

Note: Numbers may not sum due to rounding.
Source: RDU Flight Tracking System data, Landrum & Brown analysis, 2021.

4.2.6 Existing Conditions (2019) PreCOVID Noise Exposure Contour

The 65 DNL Noise Exposure Contour for the Existing Conditions (2019) PreCOVID is presented on **Exhibit 4-2**. The area within each five-decibel noise exposure contour is shown in **Table 4-7**. The 65+ DNL of the Existing Conditions (2020) Noise Exposure Contour encompasses 3.57 square miles. The noise contour reflects the average-annual day runway use patterns at RDU. The noise exposure contour extends outward from the parallel runway ends. The noise exposure contour extends further out from Runway 5L/23R due to the greater usage of this runway compared to Runway 5R/23L. The 65 DNL noise exposure contour is barely visible surrounding Runway 14/32 due to the minimal number of operations that used this runway in 2019. An area of the 65 DNL noise contour surrounds the helicopter parking ramp at the North Carolina National Guard facility to the southwest of the end of Runway 32 due to noise from helicopter operations.

TABLE 4-7, NOISE CONTOUR AREA EXISTING CONDITIONS (2019) PRECOVID

CONTOUR RANGE	NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)
65-70 DNL	2.32
70-75 DNL	0.69
75+ DNL	0.55
Total 65+ DNL	**3.57**

Source: Landrum & Brown analysis, 2022.

4.2.7 Noise Compatible Land Use

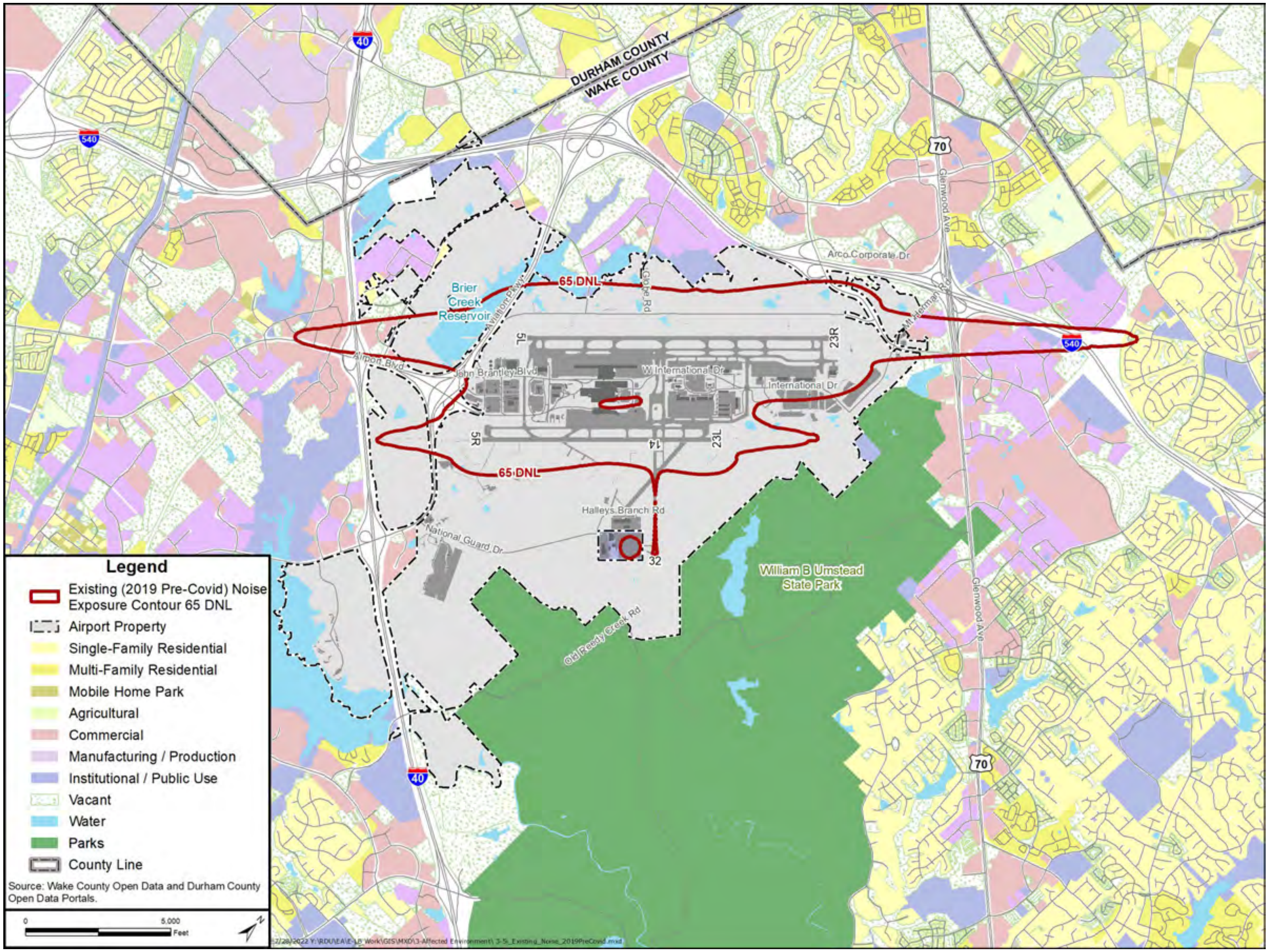
Summaries of the housing units and population affected by noise levels exceeding 65 DNL for the existing conditions (2019) PreCOVID noise exposure contours are provided in **Table 4-8**. There would be a total of 17 housing units with an estimated population of 45 people within the 65+ DNL. There are no public schools, churches/places of worship, nursing homes, hospitals, or libraries within any of the existing conditions (2019) PreCOVID contours.

TABLE 4-8, NON-COMPATIBLE LAND USE HOUSING AND POPULATION – EXISTING CONDITIONS (2019) PRECOVID

	65-70 DNL	70-75 DNL	75+ DNL	TOTAL
RESIDENTIAL				
Single-Family Units	17	0	0	17
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	0	0	0	0
Total	**17**	**0**	**0**	**17**
ESTIMATED POPULATION				
Single-Family Units	45	0	0	**45**
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	0	0	0	0
Total	**45**	**0**	**0**	**45**
NOISE-SENSITIVE FACILITIES				
Schools	0	0	0	0
Churches/Places of Worship	0	0	0	0
Day Care Facilities	0	0	0	0
Fire Stations	0	0	0	0
Total	**0**	**0**	**0**	**0**

Notes: Population numbers are estimates based on the United States Census average household size per number of housing units.
Source: Landrum & Brown analysis, 2022.

EXHIBIT 4-2, 65 DNL NOISE EXPOSURE CONTOUR - EXISTING CONDITIONS (2019) PRECOVID



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

4.3 Existing Conditions (2020) COVID

4.3.1 Runway Definition

There was no change to the airfield configuration (number of runways or their lengths) from 2019 to 2020. Therefore, the runway definitions described for 2019 are the same for 2020.

4.3.2 Number of Operations and Fleet Mix

During this time period, the number of aircraft operations at RDU decreased dramatically as compared to the number of aircraft operations in 2019. The decrease in operations were due to the impacts to aviation associated with the COVID-19 public health emergency. The number of annual operations at RDU for the Existing Conditions (2020) COVID was based on Air Traffic Control Tower (ATCT) counts for the period from June 2020 through May 2021.

In 2020, during the global health pandemic, 131,777 annual operations occurred. When divided by 365, the result is 361.0 average-annual day operations. Specific aircraft types and times of operation were developed from data from the RDU Airport Flight Tracking System for the same period. **Table 4-9** provides a summary of the average annual day operations by aircraft category and time of day that was used for the Existing Conditions (2020) COVID. **Table 4-10** shows the average daily number of arrivals and departures by time of day and individual aircraft type. Based on the data in the table, approximately nine (9) percent of the aircraft operations would occur during nighttime hours.

TABLE 4-9, SUMMARY OF AVERAGE-ANNUAL DAY OPERATIONS – EXISTING CONDITIONS (2020) COVID

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL	PERCENT OF TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME		
Heavy Jets	2.4	2.3	2.3	2.4	9.4	3%
Large Commercial Jets	71.1	11.2	74.7	7.6	164.6	46%
Regional/General Aviation Jets	16.8	1.2	16.8	1.1	35.9	10%
General Aviation Props	66.8	2.2	66.1	2.9	138.0	38%
Civil Helicopters	1.8	0	1.8	0	3.6	1%
Military Jets	0.6	0.1	0.6	0.1	1.4	<1%
Military Props	2.4	0.1	2.4	0.1	5.0	1%
Military Helicopters	1.4	0.2	1.3	0.2	3.1	1%
Total	163.3	17.3	166.0	14.4	361.0	100%

Notes: Total may not equal due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, RDU Flight Tracking System data, Landrum & Brown analysis, 2021.

TABLE 4-10, AVERAGE-ANNUAL DAY OPERATIONS BY AIRCRAFT TYPE – EXISTING CONDITIONS (2020) COVID

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Heavy Jets					
Airbus A300F4-600 Series	0.6	0.6	0.6	0.6	2.4
Boeing 767-300 ER Freighter	1.5	1.4	1.4	1.5	5.8
Boeing MD-11 Freighter	0.3	0.3	0.3	0.3	1.2
Subtotal	*2.4*	*2.3*	*2.3*	*2.4*	*9.4*
Large Commercial Jet					
Airbus A319-100 Series	8.5	1.4	9.0	0.9	19.8
Airbus A320-200 Series	5.8	0.9	6.1	0.6	13.4
Airbus A320-NEO	2.0	0.3	2.1	0.2	4.6
Airbus A321-200 Series	2.1	0.3	2.2	0.2	4.8
Boeing 717-200 Series	2.1	0.3	2.2	0.2	4.8
Boeing 737-700 Series	7.5	1.2	7.9	0.8	17.4
Boeing 737-800 Series	11.5	1.8	12.1	1.2	26.6
Boeing 737-900 Series	0.8	0.1	0.8	0.1	1.8
Boeing 737-900-ER	3.9	0.6	4.1	0.4	9.0
Bombardier CRJ-700	0.6	0.1	0.6	0.1	1.4
Bombardier CRJ-700-ER	0.8	0.1	0.8	0.1	1.8
Bombardier CRJ-900	7.2	1.1	7.5	0.8	16.6
Embraer ERJ170	3.9	0.6	4.1	0.4	9.0
Embraer ERJ175	2.4	0.4	2.5	0.3	5.6
Embraer ERJ175-LR	9.2	1.5	9.7	1.0	21.4
Embraer ERJ190-AR	2.8	0.5	3.0	0.3	6.6
Subtotal	*71.1*	*11.2*	*74.7*	*7.6*	*164.6*
Regional Jets / General Aviation Jets					
Bombardier Challenger 300	1.8	0.1	1.8	0.1	3.8
Bombardier Challenger 600	0.6	0	0.6	0	1.2
Bombardier Learjet 60	0.4	0	0.4	0	0.8

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Cessna 525 CitationJet	3	0.2	3	0.2	6.4
Cessna 550 Citation II	0.6	0	0.6	0	1.2
Cessna 560 Citation V	2.2	0.3	2.2	0.2	4.9
Cessna 560 Citation XLS	1.7	0.1	1.7	0.1	3.6
Cessna 650 Citation III	0.7	0	0.7	0.1	1.5
Cessna 680 Citation Sovereign	1.3	0.1	1.3	0.1	2.8
CIRRUS SF-50 Vision	0.6	0	0.6	0	1.2
Embraer 505	1.1	0.1	1.1	0.1	2.4
Gulfstream G280	0.4	0	0.4	0	0.8
Gulfstream IV-SP	0.4	0.1	0.4	0	0.9
Raytheon Beechjet 400	1.2	0.1	1.2	0.1	2.6
Raytheon Hawker 800	0.8	0.1	0.8	0.1	1.8
Subtotal	*16.8*	*1.2*	*16.8*	*1.1*	*35.9*
General Aviation Propeller Aircraft					
ATR 42-300	8.0	0.4	8.0	0.4	16.8
Cessna 172 Skyhawk	5.7	0.2	5.6	0.2	11.7
Cessna 182	0.5	0.0	0.5	0.0	1.0
Cessna 208 Caravan	2.4	0.1	2.4	0.1	5.0
Cirrus SR20	0.5	0.0	0.5	0.0	1.0
Cirrus SR22	3.4	0.1	3.3	0.2	7.0
Diamond DA40	16.1	0.5	15.9	0.7	33.2
Diamond DA42 Twin Star	1.1	0.0	1.0	0.1	2.2
EADS Socata TBM-700	0.4	0.0	0.4	0.0	0.8
Mooney M20-K	0.4	0.0	0.4	0.0	0.8
Pilatus PC-12	11.0	0.4	10.9	0.5	22.8
Piper PA-28 Cherokee Series	10.7	0.4	10.6	0.5	22.2
Piper PA-32 Cherokee Six	0.5	0.0	0.5	0.0	1.0
Piper PA-34 Seneca	0.7	0.0	0.7	0.0	1.4

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Piper PA46-TP Meridian	0.5	0.0	0.5	0.0	1.0
Raytheon Beech 55 Baron	0.9	0.0	0.9	0.0	1.8
Raytheon Beech Bonanza 36	1.3	0.0	1.3	0.1	2.7
Raytheon Super King Air 200	0.8	0.0	0.8	0.0	1.6
Raytheon Super King Air 300	1.4	0.1	1.4	0.1	3.0
SOCATA TBM 850	0.5	0.0	0.5	0.0	1.0
Subtotal	*66.8*	*2.2*	*66.1*	*2.9*	*138.0*
Military Jets					
Boeing C-17A	0.2	0.0	0.2	0.0	0.4
Boeing F/A-18 Hornet	0.1	0.0	0.1	0.0	0.2
Cessna 560 Citation V-M	0.2	0.1	0.2	0.1	0.6
Gulfstream 5 / G-5SP Gulfstream G500	0.1	0.0	0.1	0.0	0.2
Subtotal	*0.6*	*0.1*	*0.6*	*0.1*	*1.4*
Military Props					
Fairchild SA-226-T Merlin III	1.3	0.1	1.3	0.1	2.8
Lockheed C-130 Hercules	0.7	0.0	0.7	0.0	1.4
Raytheon Super King Air 200-M	0.4	0.0	0.4	0.0	0.8
Subtotal	*2.4*	*0.1*	*2.4*	*0.1*	*5.0*
Civil Helicopters					
Aerospatiale SA-350D Astar (AS-350)	0.9	0.0	0.9	0.0	1.8
Bell 407 / Rolls-Royce 250-C47B	0.6	0.0	0.6	0.0	1.2
Eurocopter EC-130	0.3	0.0	0.3	0.0	0.6
Subtotal	1.8	0.0	1.8	0.0	3.6
Military Helicopters					
Eurocopter EC-155B1	0.5	0.1	0.5	0.1	1.2
Sikorsky SH-60 Sea Hawk	0.1	0.0	0.1	0.0	0.2
Sikorsky UH-60 Black Hawk	0.8	0.1	0.7	0.1	1.7
Subtotal	*1.4*	*0.2*	*1.3*	*0.2*	*3.1*

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Total	163.3	17.3	166	14.4	361.0

Notes: Total may not equal due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, RDU Flight Tracking System data, Landrum & Brown analysis, 2021.

4.3.3 Runway End Utilization

Average-annual runway end utilization was derived from analysis of RDU Flight Tracking System data from June 2020 through May 2021. Runway use percentages were derived for aircraft types and summarized by category. **Table 4-11** summarizes the percentage of use by each aircraft category on each of the runways at RDU during the daytime (7:00 a.m. – 9:59 p.m.) and nighttime (10:00 p.m. – 6:59 a.m.) periods. During this timeframe, 41 percent of aircraft operated in northeast flow and 59 percent operated in southwest flow.

TABLE 4-11, RUNWAY END UTILIZATION - EXISTING CONDITIONS (2020) COVID

AIRCRAFT CATEGORY	RUNWAY END						TOTAL
	5L	23R	5R	23L	14	32	
Daytime Arrivals							
Heavy Commercial Jet	35.9%	62.2%	0.9%	1.0%	0.0%	0.0%	100.0%
Large Commercial Jet	33.4%	46.2%	8.8%	11.6%	0.0%	0.0%	100.0%
Regional Jet	5.6%	14.3%	34.0%	45.7%	0.0%	0.5%	100.0%
Propeller Aircraft	6.3%	13.3%	27.3%	34.8%	0.0%	18.2%	100.0%
Military Jet	35.9%	62.2%	0.9%	1.0%	0.0%	0.0%	100.0%
Military Prop	7.0%	13.0%	24.6%	35.3%	0.0%	20.2%	100.0%
Nighttime Arrivals							
Heavy Commercial Jet	34.7%	61.6%	1.8%	2.0%	0.0%	0.0%	100.0%
Large Commercial Jet	37.2%	46.5%	7.1%	9.1%	0.0%	0.0%	100.0%
Regional Jet	5.9%	14.2%	41.7%	38.1%	0.0%	0.2%	100.0%
Propeller Aircraft	4.9%	9.3%	38.1%	40.3%	0.0%	7.4%	100.0%
Military Jet	34.7%	61.6%	1.8%	2.0%	0.0%	0.0%	100.0%
Military Prop	4.9%	9.3%	38.1%	40.3%	0.0%	7.4%	100.0%
Daytime Departures							
Heavy Commercial Jet	33.1%	62.4%	2.3%	2.1%	0.0%	0.0%	100.0%

AIRCRAFT CATEGORY	RUNWAY END						TOTAL
	5L	23R	5R	23L	14	32	
Large Commercial Jet	32.9%	45.4%	8.8%	12.9%	0.0%	0.0%	100.0%
Regional Jet	3.4%	6.1%	36.8%	53.7%	0.0%	0.0%	100.0%
Propeller Aircraft	4.5%	10.7%	37.2%	44.3%	2.3%	1.0%	100.0%
Military Jet	33.1%	62.4%	2.3%	2.1%	0.0%	0.0%	100.0%
Military Prop	5.0%	10.1%	35.4%	45.8%	2.5%	1.2%	100.0%
Nighttime Departures							
Heavy Commercial Jet	34.7%	64.4%	0.5%	0.4%	0.0%	0.0%	100.0%
Large Commercial Jet	31.9%	43.8%	10.9%	13.4%	0.0%	0.0%	100.0%
Regional Jet	1.7%	4.3%	25.2%	68.9%	0.0%	0.0%	100.0%
Propeller Aircraft	6.2%	9.2%	29.2%	51.7%	3.3%	0.5%	100.0%
Military Jet	34.7%	64.4%	0.5%	0.4%	0.0%	0.0%	100.0%
Military Prop	6.2%	9.2%	29.2%	51.7%	3.3%	0.5%	100.0%

Notes: Daytime = 7:00 a.m. – 9:59 p.m., Nighttime = 10:00 p.m. – 6:59 a.m.
Total may not equal due to rounding.
Source: RDU Flight Tracking System data, Landrum & Brown analysis, 2020.

4.3.4 Flight Tracks

The flight tracks for the Existing Conditions (2020) COVID were assumed to be the same as those identified for Existing Conditions (2019) PreCOVID.

4.3.5 Aircraft Weight and Departure Stage Length

Due to the pandemic, two (2) transoceanic flights from RDU to western Europe (American Airlines daily service to London Heathrow Airport and Delta Air Lines daily service to Charles de Gaulle Airport in Paris) were temporarily halted. Both transoceanic flights are scheduled to return to the Airport in the future as international flights recover from the impacts associated with the COVID-19 public health emergency. **Table 4-12** indicates the proportion of the operations that were modeled within each applicable stage length category for the Existing Conditions (2020) COVID.

TABLE 4-12, STAGE LENGTH DISTRIBUTION – EXISTING CONDITIONS (2020) COVID

AIRCRAFT TYPE	DEPARTURE STAGE LENGTH				TOTAL
	1	2	3	4	
Heavy Jets	59%	41%	0%	0%	100%
Large Commercial Jets	52%	37%	5%	5%	100%
Regional / General Aviation Jets	99%	0%	0%	0%	100%
General Aviation Props	100%	0%	0%	0%	100%
Military Jets	100%	0%	0%	0%	100%
Military Props	100%	0%	0%	0%	100%
Helicopter	100%	0%	0%	0%	100%
Total	77%	18%	2%	2%	100%

Note: Numbers may not sum due to rounding.
Source: RDU Flight Tracking System data, Landrum & Brown analysis, 2021.

4.3.6 Existing Conditions (2020) COVID Noise Exposure Contour

The 65 DNL Noise Exposure Contour for the Existing Conditions (2020) COVID is presented on **Exhibit 4-3**. The area within each five-decibel noise exposure contour is shown in **Table 4-13**. The 65+ DNL of the Existing Conditions (2020) Noise Exposure Contour encompasses 1.77 square miles. The noise contour reflects the average-annual day runway use patterns at RDU. The noise exposure contour extends outward from the parallel runway ends. The noise exposure contour extends further out from Runway 5L/23R due to the greater usage of this runway compared to Runway 5R/23L. The 65 DNL noise exposure contour is not visible surrounding Runway 14/32 due to the minimal number of operations that used this runway in the existing conditions. An area of the 65 DNL noise contour surrounds the helicopter parking ramp at the North Carolina National Guard facility to the southwest of the end of Runway 32 due to noise from helicopter operations.

TABLE 4-13, NOISE CONTOUR AREA EXISTING CONDITIONS (2020) COVID

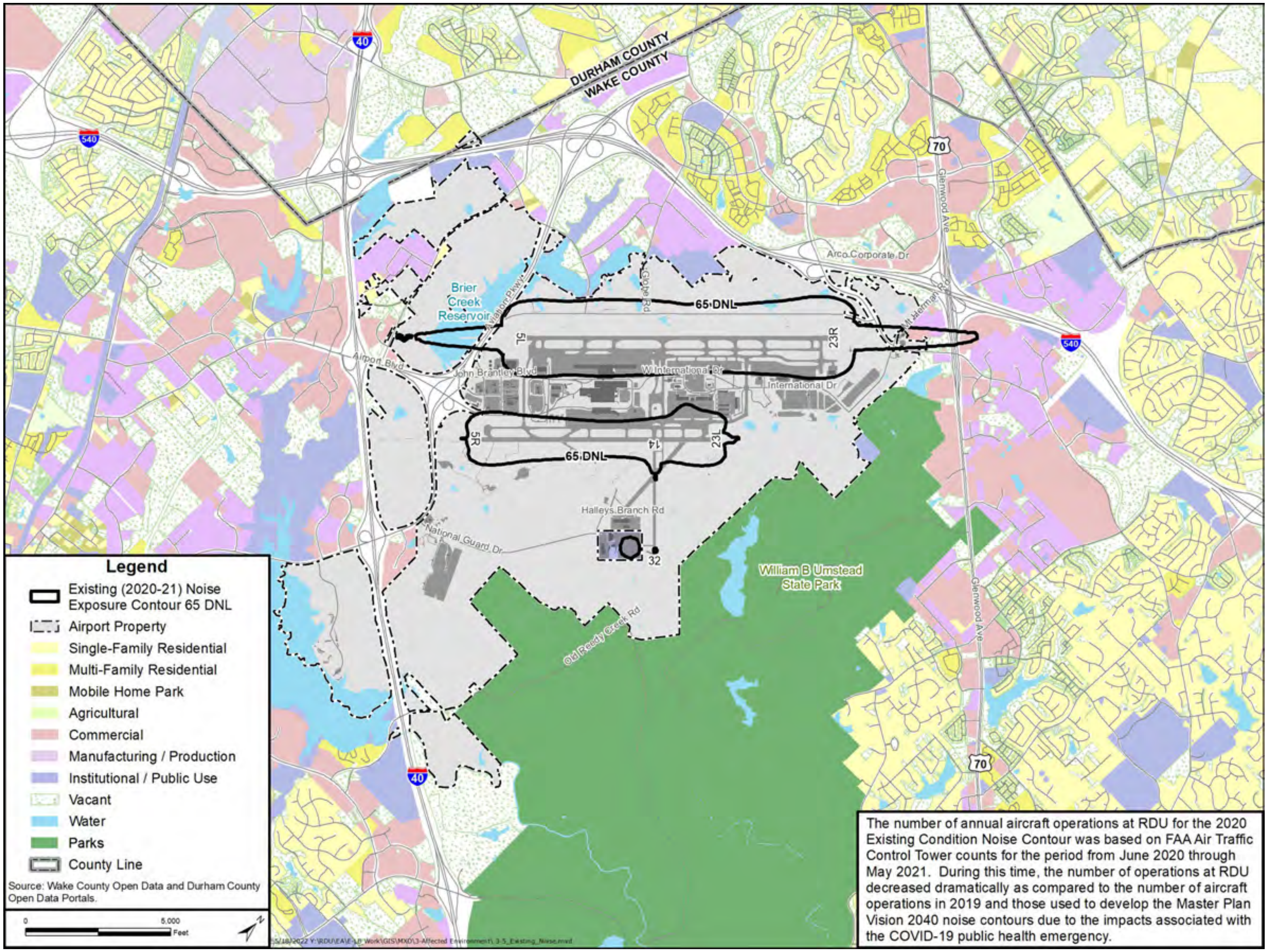
CONTOUR RANGE	NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)
65-70 DNL	0.98
70-75 DNL	0.41
75+ DNL	0.38
Total 65+ DNL	**1.77**

Source: Landrum & Brown analysis, 2021.

4.3.7 Noise Compatible Land Use

There are no public schools, churches/places of worship, nursing homes, hospitals, or libraries within any of the Existing Conditions (2020) COVID noise contours. In addition, there no single family, multifamily, or manufactured housing (mobile homes) within any of the contours.

EXHIBIT 4-3, 65 DNL NOISE EXPOSURE CONTOUR - EXISTING CONDITIONS (2020) COVID



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2021

5 Future (2028) No Action Alternative

5.1 Runway Definition

There would be no change to the airfield configuration (number of runways or their lengths) from the existing conditions to the Future (2028) No Action Alternative. Therefore, the runway definition for the Future (2028) No Action Alternative is expected to remain the same as the existing conditions.

5.2 Number of Operations and Fleet Mix

Based on the aircraft activity forecast[16], there would be an increase in aircraft operations from the existing conditions to the Future (2028) No Action Alternative. There is a total of 257,610 annual aircraft operations forecast for 2028 at RDU. When divided by 365, the result is 705.8 average-annual day operations. **Table 5-1** provides a summary of the average annual day operations by aircraft category and time of day that was used to model the Future (2028) No Action Alternative. **Table 5-2** shows the average daily number of arrivals and departures by time of day and individual aircraft type.

TABLE 5-1, SUMMARY OF AVERAGE-ANNUAL DAY OPERATIONS – FUTURE (2028) NO ACTION ALTERNATIVE

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL	PERCENT OF TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME		
Heavy Jets	4.9	3.0	5.6	2.3	15.8	2.2%
Large Commercial Jets	192.7	45.4	203.5	34.6	476.2	67.5%
Regional / General Aviation Jets	41.7	4.3	42.9	3.1	92.0	13.0%
General Aviation Props	52.6	1.7	50.4	3.8	108.5	15.4%
Civil Helicopters	2.6	0.0	2.6	0.0	5.2	0.7%
Military Jets	0.5	0.1	0.5	0.1	1.2	0.2%
Military Props	2.1	0.1	2.1	0.0	4.3	0.6%
Military Helicopters	1.2	0.1	1.2	0.1	2.6	0.4%
Total	298.3	54.7	308.8	44.1	705.8	100.0%

Notes: Total may not equal due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: Landrum & Brown analysis, 2022.

16 Raleigh-Durham International Airport. Aviation Activity Forecast, September 2021.

TABLE 5-2, AVERAGE-ANNUAL DAY OPERATIONS BY AIRCRAFT TYPE – FUTURE (2028) NO ACTION ALTERNATIVE

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Heavy Jets					
Airbus A300F4-600 Series	0.4	0.4	0.5	0.3	1.6
Airbus A330-900N Series (Neo)	0.9	0.0	0.9	0.0	1.8
Boeing 767-300 ER Freighter	2.3	2.3	2.9	1.8	9.3
Boeing 777 Freighter	0.3	0.3	0.3	0.2	1.1
Boeing 787-9 Dreamliner	1.0	0.0	1.0	0.0	2.0
Subtotal	*4.9*	*3.0*	*5.6*	*2.3*	*15.8*
Large Commercial Jets					
Airbus A319-100 Series	25.2	5.9	26.6	4.5	62.2
Airbus A320-200 Series	14.2	3.4	15.1	2.6	35.3
Airbus A320-NEO	6.0	1.4	6.4	1.1	14.9
Airbus A321-200 Series	4.6	1.1	4.8	0.8	11.3
Boeing 737-7	12.6	3	13.3	2.3	31.2
Boeing 737-800 Series	31.1	7.3	32.9	5.5	76.8
Boeing 737-900-ER	9.2	2.2	9.7	1.6	22.7
Bombardier CRJ-700	3.2	0.7	3.3	0.6	7.8
Bombardier CRJ-700-ER	2.5	0.6	2.6	0.5	6.2
Bombardier CRJ-900	11.2	2.6	11.8	2	27.6
Bombardier CS100	19.8	4.7	20.9	3.6	49
Embraer ERJ170	15.2	3.6	16.1	2.7	37.6
Embraer ERJ175	30.5	7.2	32.2	5.5	75.4
Embraer ERJ175-LR	7.4	1.7	7.8	1.3	18.2
Subtotal	*192.7*	*45.4*	*203.5*	*34.6*	*476.2*
Regional / General Aviation Jets					
Bombardier Challenger 300	4.5	0.5	4.7	0.3	10.0
Bombardier Challenger 600	1.5	0.2	1.6	0.1	3.4
Bombardier Learjet 60	0.9	0.1	0.9	0.1	2.0

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Cessna 525 CitationJet	7.5	0.8	7.7	0.6	16.6
Cessna 550 Citation II	1.5	0.2	1.5	0.1	3.3
Cessna 560 Citation V	5.4	0.6	5.5	0.4	11.9
Cessna 560 Citation XLS	4.2	0.4	4.4	0.3	9.3
Cessna 650 Citation III	1.7	0.2	1.8	0.1	3.8
Cessna 680 Citation Sovereign	3.3	0.2	3.3	0.2	7.0
CIRRUS SF-50 Vision	1.4	0.1	1.4	0.1	3.0
Embraer 505	2.9	0.3	2.9	0.2	6.3
Gulfstream G280	0.9	0.1	1.0	0.1	2.1
Gulfstream IV-SP	1.0	0.1	1.1	0.1	2.3
Raytheon Beechjet 400	2.9	0.3	3.0	0.2	6.4
Raytheon Hawker 800	2.1	0.2	2.1	0.2	4.6
Subtotal	*41.7*	*4.3*	*42.9*	*3.1*	*92.0*
General Aviation Props					
ATR 42-300	4.1	0.2	3.8	0.3	8.4
Cessna 172 Skyhawk	4.8	0.1	4.6	0.4	9.9
Cessna 182	0.5	0.0	0.4	0.0	0.9
Cessna 208 Caravan	6.0	0.2	5.7	0.5	12.4
Cirrus SR20	0.4	0.0	0.4	0.0	0.8
Cirrus SR22	2.8	0.2	2.7	0.2	5.9
Diamond DA40	13.5	0.3	13.2	0.8	27.8
Diamond DA42 Twin Star	0.9	0.0	0.8	0.1	1.8
EADS Socata TBM-700	0.2	0.0	0.2	0.0	0.4
Mooney M20-K	0.4	0.0	0.3	0.0	0.7
Pilatus PC-12	5.6	0.3	5.2	0.5	11.6
Piper PA-28 Cherokee Series	8.9	0.3	8.6	0.7	18.5
Piper PA-32 Cherokee Six	0.4	0.0	0.4	0.0	0.8
Piper PA-34 Seneca	0.6	0.0	0.6	0.0	1.2

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Piper PA46-TP Meridian	0.3	0.0	0.3	0.0	0.6
Raytheon Beech 55 Baron	0.8	0.0	0.7	0.1	1.6
Raytheon Beech Bonanza 36	1.1	0.0	1.1	0.1	2.3
Raytheon Super King Air 200	0.4	0.0	0.4	0.0	0.8
Raytheon Super King Air 300	0.7	0.1	0.7	0.1	1.6
SOCATA TBM 850	0.2	0.0	0.3	0.0	0.5
Subtotal	*52.6*	*1.7*	*50.4*	*3.8*	*108.5*
Civil Helicopters					
Aerospatiale SA-350D Astar (AS-350)	1.1	0.0	1.1	0.0	2.2
Bell 407 / Rolls-Royce 250-C47B	1.0	0.0	1.0	0.0	2.0
Eurocopter EC-130	0.5	0.0	0.5	0.0	1.0
Subtotal	*2.6*	*0.0*	*2.6*	*0.0*	*5.2*
Military Jets					
Boeing C-17A	0.1	0.0	0.1	0.0	0.2
Boeing F/A-18 Hornet	0.1	0.0	0.1	0.0	0.2
Cessna 560 Citation V	0.2	0.1	0.2	0.1	0.6
Gulfstream 5 / G-5SP Gulfstream G500	0.1	0.0	0.1	0.0	0.2
Subtotal	*0.5*	*0.1*	*0.5*	*0.1*	*1.2*
Military Props					
Fairchild SA-226-T Merlin III	1.1	0.1	1.1	0.0	2.3
Lockheed C-130 Hercules	0.6	0.0	0.6	0.0	1.2
Raytheon Super King Air 200	0.4	0.0	0.4	0.0	0.8
Subtotal	*2.1*	*0.1*	*2.1*	*0.0*	*4.3*
Military Helicopters					
Eurocopter EC-155B1	0.5	0.0	0.5	0.0	1.0
Sikorsky SH-60 Sea Hawk	0.1	0.0	0.1	0.0	0.2
Sikorsky UH-60 Black Hawk	0.6	0.1	0.6	0.1	1.4

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Subtotal	*1.2*	*0.1*	*1.2*	*0.1*	*2.6*
Grand Total	**298.3**	**54.7**	**308.8**	**44.1**	**705.8**

Notes: Total may not sum due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: Landrum & Brown analysis, 2022.

5.3 Runway End Utilization

There would be no anticipated change to how the runways are operated from the existing conditions to the Future (2028) No Action Alternative. While runway end utilization may vary based on weather conditions, it is not possible to predict future weather conditions. Therefore, the runway end utilization for the Future (2028) No Action Alternative is expected to remain the same as the existing conditions.

5.4 Flight Tracks

There would be no change to the flight tracks from the existing conditions to the Future (2028) No Action Alternative. Therefore, the flight tracks for the Future (2028) No Action Alternative are expected to remain the same as those provided in Attachment 1.

5.5 Aircraft Weight and Departure Stage Length

Based on the aircraft activity forecast, transoceanic flights are scheduled to return to the Airport by 2028 as international flights recover from the impacts associated with the COVID-19 public health emergency. Therefore, there would be aircraft with a departure stage length of five. The proportion of the operations that were modeled for each stage length modeled for the Future (2028) No Action Alternative are provided in **Table 5-3**.

5.6 Future (2028) No Action Alternative Noise Exposure Contour

The Noise Exposure Contour for the Future (2028) No Action Alternative is presented on **Exhibit 5-1**. The 65+ DNL of the Future (2028) No Action Alternative Noise Exposure Contour encompasses 4.39 square miles. The noise exposure contour extends outward from the parallel runway ends. The noise exposure contour extends further out from Runway 5L/23R due to the greater usage of this runway compared to Runway 5R/23L. The 65 DNL Future (2028) No Action Alternative noise exposure contour is considerably larger than the Existing Conditions (2020) COVID noise contours due to the potential overall increase of aircraft operations, especially in light of recovery after COVID-19. The area within each five-decibel noise exposure contour is shown in **Table 5-4**.

TABLE 5-3, STAGE LENGTH DISTRIBUTION – FUTURE (2028) NO ACTION ALTERNATIVE

AIRCRAFT TYPE	DEPARTURE STAGE LENGTH					TOTAL
	1	2	3	4	5	
Heavy Jets	38%	49%	0%	0%	13%	100%
Large Commercial Jets	56%	32%	4%	8%	0%	100%
Regional / General Aviation Jets	100%	0%	0%	0%	0%	100%
General Aviation Props	100%	0%	0%	0%	0%	100%
Military Jets	100%	0%	0%	0%	0%	100%
Military Props	100%	0%	0%	0%	0%	100%
Helicopter	100%	0%	0%	0%	0%	100%
Total	69%	23%	2%	6%	0%	100%

Source: Landrum & Brown analysis, 2022.

TABLE 5-4, NOISE CONTOUR AREA – FUTURE (2028) NO ACTION ALTERNATIVE

CONTOUR RANGE	NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)
65-70 DNL	2.95
70-75 DNL	0.81
75+ DNL	0.63
Total 65+ DNL	**4.39**

Source: Landrum & Brown analysis, 2022.

5.7 Noise Compatible Land Use

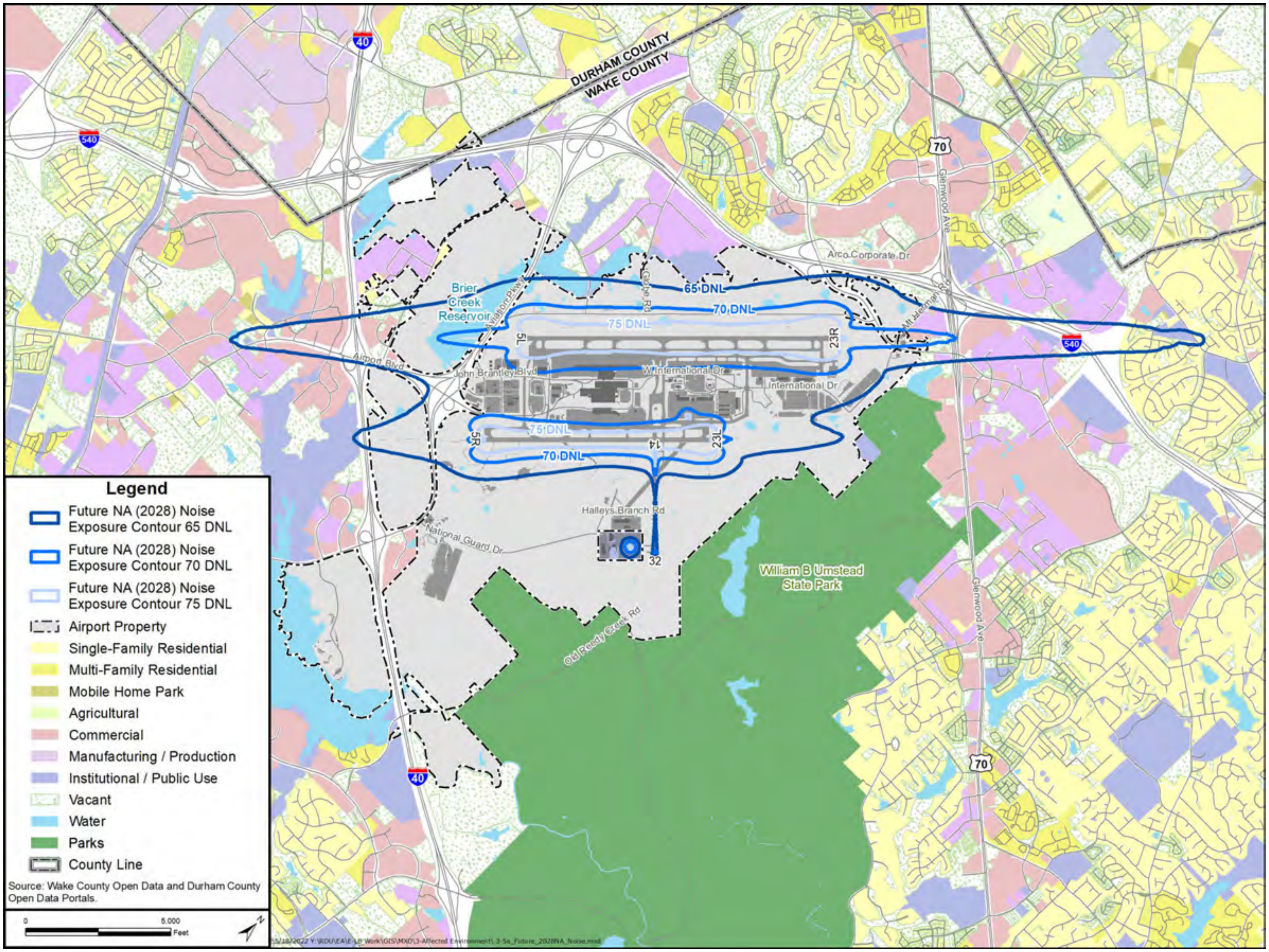
Summaries of the housing units and population affected by noise levels exceeding 65 DNL for the Future (2028) No Action Alternative noise exposure contours are provided in **Table 5-5**. There would be a total of 126 housing units with an estimated population of 329 people within the 65+ DNL. There are no public schools, churches/places of worship, nursing homes, hospitals, or libraries within any of the Future (2028) No Action Alternative contours.

TABLE 5-5, NON-COMPATIBLE LAND USE HOUSING AND POPULATION – FUTURE (2028) NO ACTION ALTERNATIVE

	65-70 DNL	70-75 DNL	75+ DNL	TOTAL
RESIDENTIAL				
Single-Family Units	126	0	0	126
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	0	0	0	0
Total	**126**	**0**	**0**	**126**
ESTIMATED POPULATION				
Single-Family Units	329	0	0	**329**
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	0	0	0	0
Total	**329**	**0**	**0**	**329**
NOISE-SENSITIVE FACILITIES				
Schools	0	0	0	0
Churches/Places of Worship	0	0	0	0
Day Care Facilities	0	0	0	0
Fire Stations	0	0	0	0
Total	**0**	**0**	**0**	**0**

Notes: Population numbers are estimates based on the United States Census average household size per number of housing units.
Source: Landrum & Brown analysis, 2022.

EXHIBIT 5-1, NOISE EXPOSURE CONTOUR - FUTURE (2028) NO ACTION ALTERNATIVE



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

6 Future (2028) Proposed Action

6.1 Runway Definition

As described in the EA, the Proposed Action would require a 10,639-foot-long physical runway pavement. **Table 6-1** provides the runway definitions modeled for the Future (2028) Proposed Action.

TABLE 6-1, RUNWAYS – FUTURE (2028) PROPOSED ACTION

RUNWAY	LENGTH (FEET)
5L/23R	10,639
5R/23L	7,500
14/32	3,570

Source: Airport Authority, 2022.

6.2 Number of Operations and Fleet Mix

There would be no change to the forecasted number of aircraft operations or fleet mix as a result of implementing the Proposed Action. Therefore, the number of aircraft operations and fleet mix for the Future (2028) No Action Alternative would remain the same for the Future (2028) Proposed Action. Based on the aircraft activity forecast, there is a total of 257,610 aircraft operations forecast for 2028 at RDU. When divided by 365, the result is 705.8 average-annual day operations.

6.3 Runway End Utilization

There would be no anticipated change to how the runways are operated from the Future (2028) No Action Alternative to the Future (2028) Proposed Action. Therefore, the runway end utilization for the Future (2028) Proposed Action is expected to remain the same as the Future (2028) No Action Alternative.

6.4 Flight Tracks

As a result of implementing the Proposed Action, the replacement Runway 5L/23R would be 537 feet northwest of the existing Runway 5L/23R. It is anticipated that the flight tracks for the replacement Runway 5L/23R would also be 537 feet northwest of the existing Runway 5L/23R. Flight track maps were not prepared for the Proposed Action because the 537-foot shift would be imperceptible at that scale. However, the flight tracks were shifted 537 feet northwest of the existing Runway 5L/23R within AEDT for modeling. The FAA and the Airport Authority are utilizing the existing arrival and departure procedures for the proposed runway to approximate the potential noise impacts evaluated in this EA. If different arrival and departure procedures are needed based on final design and updated obstructions, the FAA will reevaluate this EA to determine if any additional NEPA review is required. The testing, updating and reissuance of the arrival and departure procedure charts would occur after completion of the EA

6.5 Aircraft Weight and Departure Stage Length

No change to the number of aircraft operations or fleet mix would occur as a result of implementing the Proposed Action. The number of aircraft operations and fleet mix for the Future (2028) No Action Alternative would remain the same for the Future (2028) Proposed Action. The departure stage lengths for the Future (2028) Proposed Action are expected to remain the same as Future (2028) No Action Alternative. The AEDT model was used to determine aircraft weights for the specific airframe, destination, and runway length available.

6.6 Future (2028) Proposed Action Noise Exposure Contour

The Noise Exposure Contour for the Future (2028) Proposed Action is presented on **Exhibit 6-1**. The 65+ DNL of the Future (2028) Proposed Action Noise Exposure Contour encompasses 4.23 square miles. The noise exposure contour extends outward from the parallel runway ends. The area within each five-decibel noise exposure contour is shown in **Table 6-2**.

TABLE 6-2, NOISE CONTOUR AREA – FUTURE (2028) PROPOSED ACTION

CONTOUR RANGE	NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)
65-70 DNL	2.82
70-75 DNL	0.79
75+ DNL	0.62
Total 65+ DNL	**4.23**

Source: Landrum & Brown analysis, 2022.

6.7 Noise Compatible Land Use

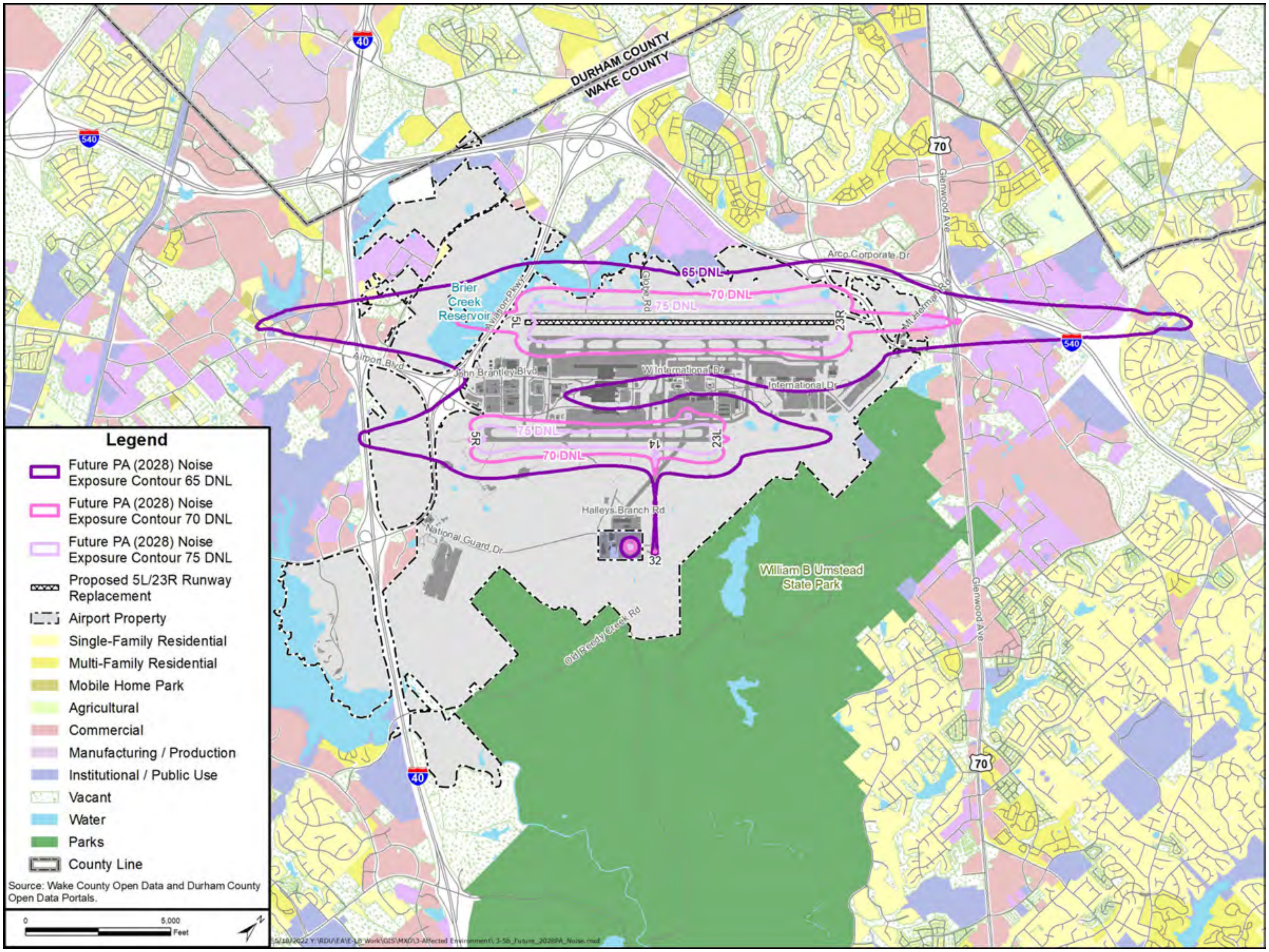
Summaries of the residential population and housing units affected by noise levels exceeding 65 DNL for the Future (2028) Proposed Action Noise Exposure Contours are provided in **Table 6-3**. There would be a total of 45 housing units with an estimated population of 118 people within the 65+ DNL. One (1) church (the Sorrell Grove Baptist Church) and one (1) fire station (Raleigh Fire Station #29) are located in the 65-70 DNL contour. The locations of the church and the fire station are depicted in Section 9 Exhibit 9-4 and 9-5. There are no public schools, nursing homes, hospitals, or libraries within any of the Future (2028) Proposed Action contours.

TABLE 6-3, NON-COMPATIBLE LAND USE HOUSING AND POPULATION – FUTURE (2028) PROPOSED ACTION

	65-70 DNL	70-75 DNL	75+ DNL	TOTAL
RESIDENTIAL				
Single-Family Units	44	0	0	44
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	1	0	0	1
Total	**45**	**0**	**0**	**45**
ESTIMATED POPULATION				
Single-Family Units	115	0	0	**115**
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	3	0	0	3
Total	**118**	**0**	**0**	**118**
NOISE-SENSITIVE FACILITIES				
Schools	0	0	0	0
Churches/Places of Worship	1	0	0	1
Day Care Facilities	0	0	0	0
Fire Stations	1	0	0	1
Total	**2**	**0**	**0**	**2**

Notes: Population numbers are estimates based on the United States Census average household size per number of housing units.
Source: Landrum & Brown analysis, 2022.

EXHIBIT 6-1, NOISE EXPOSURE CONTOUR - FUTURE (2028) PROPOSED ACTION



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

7 Future (2033) No Action Alternative

7.1 Runway Definition

There would be no change to the airfield configuration (number of runways or their lengths) from the Future (2028) No Action Alternative to the Future (2033) No Action Alternative. Therefore, the runway definition for the Future (2033) No Action Alternative is expected to remain the same as the Future (2028) No Action Alternative and the existing conditions.

7.2 Number of Operations and Fleet Mix

Based on the aircraft activity forecast, there would be an increase in operations from the Future (2028) No Action Alternative to the Future (2033) No Action Alternative. There is a total of 287,850 annual aircraft operations forecast for 2033 at RDU. When divided by 365, the result is 788.6 average-annual day operations. **Table 7-1** provides a summary of the average annual day operations by aircraft category and time of day that was used to model the Future (2033) No Action Alternative. **Table 7-2** shows the average daily number of arrivals and departures by time of day and individual aircraft type.

TABLE 7-1, SUMMARY OF AVERAGE-ANNUAL DAY OPERATIONS – FUTURE (2033) NO ACTION ALTERNATIVE

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL	PERCENT OF TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME		
Heavy Jets	5.6	4.1	7.7	2.1	19.5	2.5%
Large Commercial Jets	218.5	49.9	228.2	40.1	536.7	68.0%
Regional / General Aviation Jets	47.1	6.2	48.5	4.8	106.6	13.5%
General Aviation Props	54.3	1.6	52.2	3.7	111.8	14.2%
Civil Helicopters	2.9	0.0	2.9	0.0	5.8	0.7%
Military Jets	0.5	0.1	0.5	0.1	1.2	0.2%
Military Props	2.1	0.1	2.1	0.0	4.3	0.5%
Military Helicopters	1.2	0.1	1.2	0.1	2.6	0.4%
Total	332.2	62.1	343.3	51.0	788.6	100.0%

Notes: Total may not equal due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: Landrum & Brown analysis, 2022.

TABLE 7-2, AVERAGE-ANNUAL DAY OPERATIONS BY AIRCRAFT TYPE – FUTURE (2033) NO ACTION ALTERNATIVE

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Heavy Jets					
Airbus A300F4-600 Series	0.3	0.4	0.5	0.2	1.4
Airbus A330-900N Series (Neo)	0.9	0.0	0.9	0.0	1.7
Airbus A350-900 series	1.0	0.0	1.0	0.0	2.0
Boeing 767-300 ER Freighter	2.2	3.3	3.9	1.7	11.2
Boeing 777 Freighter	0.2	0.4	0.4	0.2	1.2
Boeing 787-9 Dreamliner	1.0	0.0	1.0	0.0	2.0
Subtotal	*5.6*	*4.1*	*7.7*	*2.1*	*19.5*
Large Commercial Jets					
Airbus A319-100 Series	28.8	6.6	30.1	5.3	70.8
Airbus A320-200 Series	17.1	3.9	17.9	3.1	42
Airbus A320-NEO	6.0	1.4	6.3	1.1	14.8
Airbus A321-200 Series	5.2	1.2	5.4	1.0	12.8
Boeing 737-7	14.3	3.3	14.9	2.6	35.1
Boeing 737-800 Series	35.5	8.1	37	6.5	87.1
Boeing 737-900-ER	10.4	2.4	10.8	1.9	25.5
Bombardier CRJ-700	2.5	0.6	2.7	0.5	6.3
Bombardier CRJ-700-ER	1.2	0.3	1.2	0.2	2.9
Bombardier CRJ-900	11.1	2.5	11.5	2.0	27.1
Bombardier CS100	22.7	5.2	23.8	4.2	55.9
Embraer ERJ170	19.7	4.5	20.5	3.6	48.3
Embraer ERJ175	36	8.1	37.8	6.6	88.5
Embraer ERJ175-LR	8.0	1.8	8.3	1.5	19.6
Subtotal	*218.5*	*49.9*	*228.2*	*40.1*	*536.7*
Regional / General Aviation Jets					
Bombardier Challenger 300	5.2	0.7	5.3	0.5	11.7
Bombardier Challenger 600	1.8	0.2	1.8	0.2	4.0

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Bombardier Learjet 60	1.0	0.1	1.0	0.1	2.2
Cessna 525 CitationJet	8.4	1.1	8.7	0.9	19.1
Cessna 550 Citation II	1.7	0.2	1.7	0.2	3.8
Cessna 560 Citation V	6.1	0.8	6.3	0.6	13.8
Cessna 560 Citation XLS	4.8	0.6	5.0	0.5	10.9
Cessna 650 Citation III	1.9	0.3	2.0	0.2	4.4
Cessna 680 Citation Sovereign	3.6	0.5	3.7	0.4	8.2
CIRRUS SF-50 Vision	1.6	0.2	1.6	0.2	3.6
Embraer 505	3.2	0.4	3.3	0.3	7.2
Gulfstream G280	1.0	0.2	1.1	0.1	2.4
Gulfstream IV-SP	1.2	0.2	1.2	0.1	2.7
Raytheon Beechjet 400	3.3	0.4	3.4	0.3	7.4
Raytheon Hawker 800	2.3	0.3	2.4	0.2	5.2
Subtotal	*47.1*	*6.2*	*48.5*	*4.8*	*106.6*
General Aviation Props					
ATR 42-300	4.5	0.1	4.3	0.4	9.3
Cessna 172 Skyhawk	4.7	0.1	4.6	0.3	9.7
Cessna 182	0.4	0.0	0.4	0.0	0.8
Cessna 208 Caravan	6.8	0.3	6.5	0.5	14.1
Cirrus SR20	0.4	0.0	0.4	0.0	0.8
Cirrus SR22	2.8	0.1	2.7	0.2	5.8
Diamond DA40	13.4	0.3	13	0.7	27.4
Diamond DA42 Twin Star	0.9	0.0	0.8	0.1	1.8
EADS Socata TBM-700	0.2	0.0	0.2	0.0	0.4
Mooney M20-K	0.4	0.0	0.3	0.0	0.7
Pilatus PC-12	6.2	0.2	5.9	0.6	12.9
Piper PA-28 Cherokee Series	8.9	0.3	8.6	0.6	18.4
Piper PA-32 Cherokee Six	0.4	0.0	0.4	0.0	0.8

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Piper PA-34 Seneca	0.6	0.0	0.6	0.0	1.2
Piper PA46-TP Meridian	0.3	0.0	0.3	0.0	0.6
Raytheon Beech 55 Baron	0.8	0.0	0.7	0.1	1.6
Raytheon Beech Bonanza 36	1.1	0.1	1.0	0.1	2.3
Raytheon Super King Air 200	0.4	0.0	0.4	0.0	0.8
Raytheon Super King Air 300	0.8	0.1	0.8	0.1	1.8
SOCATA TBM 850	0.3	0.0	0.3	0.0	0.6
Subtotal	54.3	1.6	52.2	3.7	111.8
Civil Helicopters					
Aerospatiale SA-350D Astar (AS-350)	1.3	0.0	1.3	0.0	2.6
Bell 407 / Rolls-Royce 250-C47B	1.1	0.0	1.1	0.0	2.2
Eurocopter EC-130	0.5	0.0	0.5	0.0	1.0
Subtotal	*2.9*	*0.0*	*2.9*	*0.0*	*5.8*
Military Jets					
Boeing C-17A	0.1	0.0	0.1	0.0	0.2
Boeing F/A-18 Hornet	0.1	0.0	0.1	0.0	0.2
Cessna 560 Citation V	0.2	0.1	0.2	0.1	0.6
Gulfstream 5 / G-5SP Gulfstream G500	0.1	0.0	0.1	0.0	0.2
Subtotal	*0.5*	*0.1*	*0.5*	*0.1*	*1.2*
Military Props					
Fairchild SA-226-T Merlin III	1.1	0.1	1.1	0.0	2.3
Lockheed C-130 Hercules	0.6	0.0	0.6	0.0	1.2
Raytheon Super King Air 200	0.4	0.0	0.4	0.0	0.8
Subtotal	*2.1*	*0.1*	*2.1*	*0.1*	*4.3*
Military Helicopters					
Eurocopter EC-155B1	0.5	0.0	0.5	0.0	1.0

AIRCRAFT TYPE	ARRIVALS		DEPARTURES		TOTAL
	DAYTIME	NIGHTTIME	DAYTIME	NIGHTTIME	
Sikorsky SH-60 Sea Hawk	0.1	0.0	0.1	0.0	0.2
Sikorsky UH-60 Black Hawk	0.6	0.1	0.6	0.1	1.4
Subtotal	*1.2*	*0.1*	*1.2*	*0.1*	*2.6*
Grand Total	**332.2**	**62.1**	**343.3**	**51**	**788.6**

Notes: Total may not equal due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: Landrum & Brown analysis, 2022.

7.3 Runway End Utilization

There would be no anticipated change to the how the runways are operated from the Future (2028) No Action Alternative to the Future (2033) No Action Alternative. Therefore, the runway end utilization for the Future (2033) No Action Alternative is expected to remain the same as the Future (2028) No Action Alternative and the existing conditions.

7.4 Flight Tracks

There would be no anticipated change to flight tracks from the Future (2028) No Action Alternative to the Future (2033) No Action Alternative. Therefore, the flight tracks for the Future (2033) No Action Alternative are expected to remain the same as those provided in Attachment 1.

7.5 Aircraft Weight and Departure Stage Length

The proportion of the operations that were modeled for each stage length modeled for the Future (2033) No Action Alternative are provided in **Table 7-3**.

7.6 Future (2033) No Action Alternative Noise Exposure Contour

The Noise Exposure Contour for the Future (2033) No Action Alternative is presented on **Exhibit 7-1**. The 65+ DNL of the Future (2033) No Action Alternative Noise Exposure Contour encompasses 4.97 square miles. The noise exposure contour extends outward from the parallel runway ends. The noise exposure contour extends further out from Runway 5L/23R due to the greater usage of this runway compared to Runway 5R/23L. The 65 DNL Future (2033) No Action Alternative noise exposure contour is larger than the Future (2028) No Action Alternative due the overall increase of aircraft operations. The area within each five-decibel noise exposure contour is shown in **Table 7-4**.

TABLE 7-3, STAGE LENGTH DISTRIBUTION – FUTURE (2033) NO ACTION ALTERNATIVE

AIRCRAFT TYPE	DEPARTURE STAGE LENGTH						TOTAL
	1	2	3	4	5	6	
Heavy Jets	41%	39%	0%	0%	10%	10%	100%
Large Commercial Jets	47%	40%	4%	9%	0%	0%	100%
Regional / General Aviation Jets	100%	0%	0%	0%	0%	0%	100%
General Aviation Props	100%	0%	0%	0%	0%	0%	100%
Military Jets	100%	0%	0%	0%	0%	0%	100%
Military Props	100%	0%	0%	0%	0%	0%	100%
Helicopter	100%	0%	0%	0%	0%	0%	100%
Total	63%	28%	3%	6%	0%	0%	100%

Source: Landrum & Brown analysis, 2022.

TABLE 7-4, NOISE CONTOUR AREA – FUTURE (2033) NO ACTION ALTERNATIVE

CONTOUR RANGE	NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)
65-70 DNL	3.36
70-75 DNL	0.92
75+ DNL	0.69
Total 65+ DNL	**4.97**

Source: Landrum & Brown analysis, 2022.

7.7 Noise Compatible Land Use

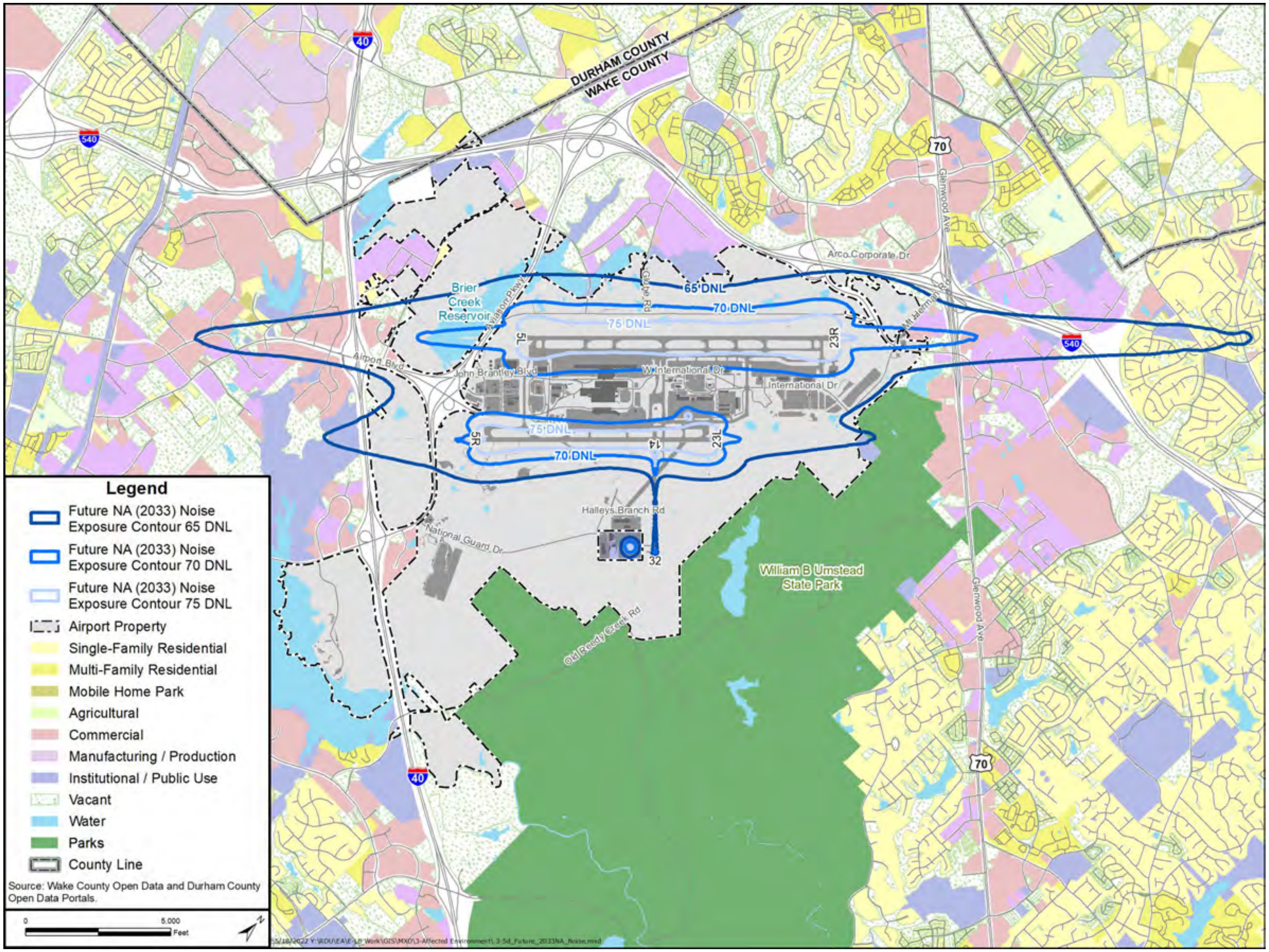
Summaries of the residential population and housing units affected by noise levels exceeding 65 DNL for the Future (2033) No Action Alternative Noise Exposure Contours are provided in **Table 7-5**. There would be a total of 248 housing units with an estimated population of 647 people within the 65+ DNL. One (1) noise sensitive facility (the Sorrell Grove Baptist Church) is located within the 65 DNL contour. The location of the church is depicted in Section 9 Exhibit 9-2. There are no public schools, nursing homes, hospitals, or libraries within any of the Future (2033) No Action Alternative contours.

TABLE 7-5, NON-COMPATIBLE LAND USE HOUSING AND POPULATION – FUTURE (2033) NO ACTION ALTERNATIVE

	65-70 DNL	70-75 DNL	75+ DNL	TOTAL
RESIDENTIAL				
Single-Family Units	248	0	0	248
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	0	0	0	0
Total	**248**	**0**	**0**	**248**
ESTIMATED POPULATION				
Single-Family Units	647	0	0	647
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	0	0	0	0
Total	**647**	**0**	**0**	**647**
NOISE-SENSITIVE FACILITIES				
Schools	0	0	0	0
Churches/Places of Worship	1	0	0	**1**
Day Care Facilities	0	0	0	0
Fire Stations	0	0	0	0
Total	**1**	**0**	**0**	**1**

Notes: Population numbers are estimates based on the United States Census average household size per number of housing units.
Source: Landrum & Brown analysis, 2022.

EXHIBIT 7-1, NOISE EXPOSURE CONTOUR - FUTURE (2033) NO ACTION ALTERNATIVE



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

8 Future (2033) Proposed Action

8.1 Runway Definition

As described in the EA, in order to provide the same takeoff distance and landing distance as the existing runway and meet FAA safety criteria, the Proposed Action would require a 10,639-foot-long physical runway pavement. The runway definitions for the Future (2033) Proposed Action are expected to remain the same as the Future (2028) Proposed Action.

8.2 Number of Operations and Fleet Mix

There would be no change to the number of aircraft operations or fleet mix as a result of implementing the Proposed Action. Therefore, the number of aircraft operations and fleet mix for the Future (2033) No Action Alternative would remain the same for the Future (2033) Proposed Action. Based on the aircraft activity forecast, there is a total of 287,850 annual aircraft operations forecast for 2033 at RDU. When divided by 365, the result is 788.6 average-annual day operations.

8.3 Runway End Utilization

There would be no anticipated change to how the runways are operated from the Future (2028) Proposed Action to the Future (2033) Proposed Action. Therefore, the runway end utilization for the Future (2033) Proposed Action is expected to remain the same as the Future (2028) Proposed Action.

8.4 Flight Tracks

As a result of implementing the Proposed Action, the replacement Runway 5L/23R would be 537 feet northwest of the existing Runway 5L/23R. It is anticipated that the flight tracks for the replacement Runway 5L/23R would also be 537 feet northwest of the existing Runway 5L/23R. Flight tracks for the Future (2033) Proposed Action are expected to remain the same as the Future (2028) Proposed Action. Flight track maps were not prepared for the Proposed Action because the 537-foot shift would be imperceptible at that scale. However, the flight tracks were shifted 537 feet northwest of the existing Runway 5L/23R within AEDT for modeling.

8.5 Aircraft Weight and Departure Stage Length

No change to the number of aircraft operations or fleet mix would occur as a result of implementing the Proposed Action. The departure stage lengths for the Future (2033) Proposed Action are expected to remain the same as Future (2033) No Action Alternative. Therefore, aircraft weight and departure stage lengths for the Future (2033) Proposed Action is expected to remain the same as the Future (2033) No Action Alternative. The AEDT model was used to determine aircraft weights for the specific airframe, destination, and runway length available.

8.6 Future (2033) Proposed Action Noise Exposure Contour

The Noise Exposure Contour for the Future (2033) Proposed Action is presented on **Exhibit 8-1**. The 65+ DNL of the Future (2033) Proposed Action Noise Exposure Contour encompasses five (5) square miles. The noise exposure contour extends outward from the parallel runway ends. The area within each five-decibel noise exposure contour is shown in **Table 8-1**.

TABLE 8-1, NOISE CONTOUR AREA – FUTURE (2033) PROPOSED ACTION

CONTOUR RANGE	NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)
65-70 DNL	3.39
70-75 DNL	0.91
75+ DNL	0.70
Total 65+ DNL	**5.00**

Source: Landrum & Brown analysis, 2022.

8.7 Noise Compatible Land Use

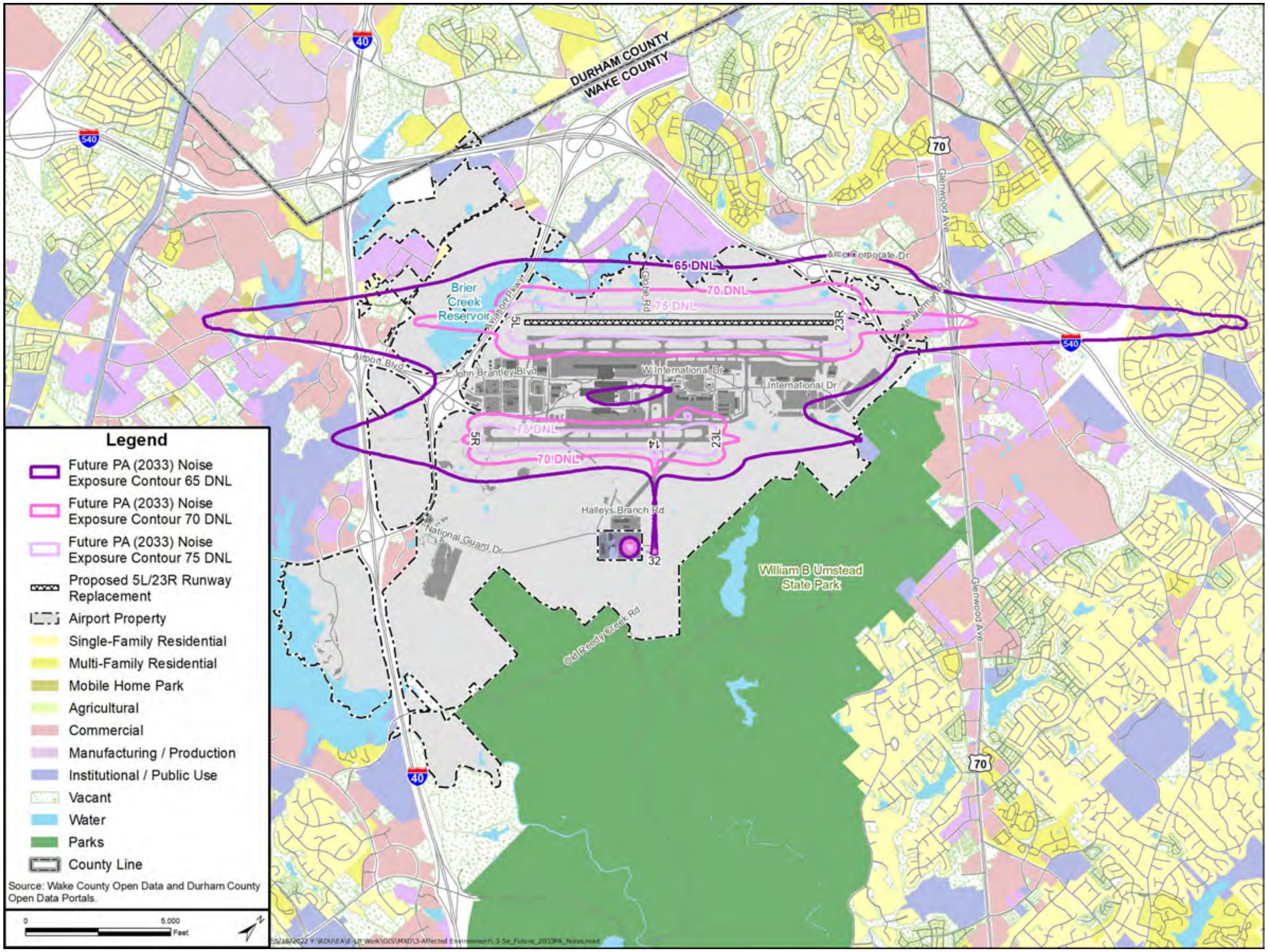
Summaries of the residential population and housing units affected by noise levels exceeding DNL 65 dB for the Future (2033) Proposed Action Noise Exposure Contours are provided in **Table 8-2**. There would be a total of 134 housing units with an estimated population of 351 people within the 65+ DNL. One (1) church (the Sorrell Grove Baptist Church) and one (1) fire station (Raleigh Fire Station #29) are located in the 65-70 DNL contour. The locations of the church and the fire station are depicted on Section 9 Exhibit 9-2. There are no public schools, nursing homes, hospitals, or libraries within any of the Future (2033) Proposed Action contours.

TABLE 8-2, NON-COMPATIBLE LAND USE HOUSING AND POPULATION – FUTURE (2033) PROPOSED ACTION

	65-70 DNL	70-75 DNL	75+ DNL	TOTAL
RESIDENTIAL				
Single-Family Units	133	0	0	133
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	1	0	0	1
Total	**134**	**0**	**0**	**134**
ESTIMATED POPULATION				
Single-Family Units	348	0	0	**348**
Duplex/Triplex Units	0	0	0	0
Mobile Home Units	3	0	0	3
Total	**351**	**0**	**0**	**351**
NOISE-SENSITIVE FACILITIES (NSF)				
Schools	0	0	0	0
Churches/Places of Worship	1	0	0	1
Day Care Facilities	0	0	0	0
Fire Stations	1	0	0	1
Total	**2**	**0**	**0**	**2**

Notes: Population numbers are estimates based on the United States Census average household size per number of housing units.
Source: Landrum & Brown analysis, 2022.

EXHIBIT 8-1, NOISE EXPOSURE CONTOUR - FUTURE (2033) PROPOSED ACTION



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

9 Comparison Summary

9.1 Comparison of the PreCOVID and COVID Noise Contour

Exhibit 9-1 reflects the comparison of the Existing Conditions (2019) PreCOVID 65+DNL Noise Exposure Contour and the Existing Conditions (2020) COVID 65+DNL Noise Exposure Contour. The comparison shows a dramatic decrease for the Existing Conditions (2020) COVID. **Table 9-1** summarizes the comparison of land areas within each contour. Again, the comparison shows a dramatic decrease for the Existing Conditions (2020) COVID.

TABLE 9-1, NOISE CONTOUR AREA COMPARISON (2019 VS. 2020)

CONTOUR RANGE	2019 PRECOVID NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)	2020 COVID NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)	DIFFERENCE
65-70 DNL	2.32	0.98	-1.34
70-75 DNL	0.69	0.41	-0.28
75+ DNL	0.55	0.38	-0.17
Total 65+ DNL	**3.57**	**1.77**	**-1.80**

Source: Landrum & Brown analysis, 2022.

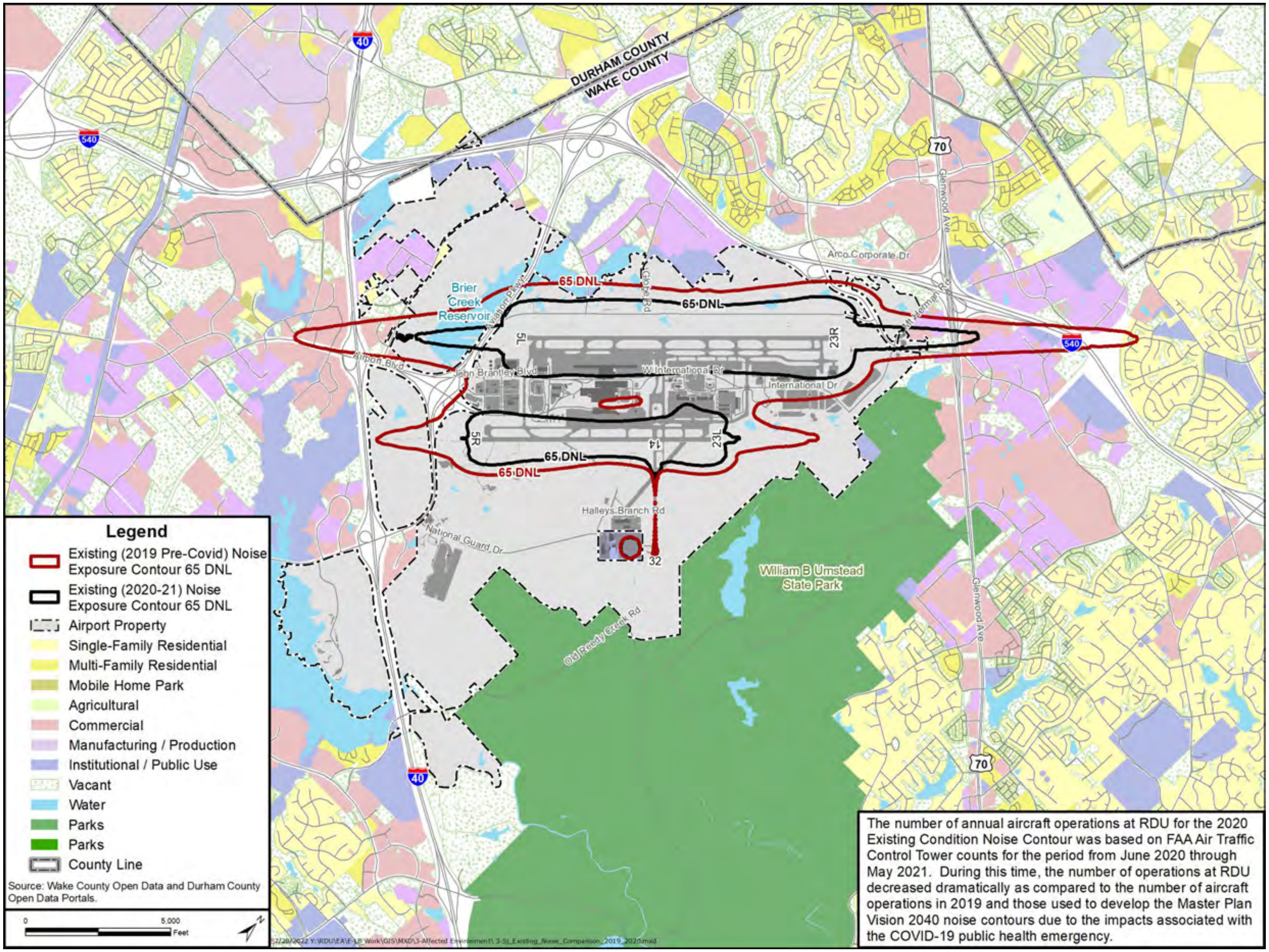
Table 9-2 summarizes the comparison of housing units, estimated population, and other noise sensitive facilities. Due to the decrease in the number of operations due to the impact attributed to COVID there were no public schools, churches/places of worship, nursing homes, hospitals, or libraries within any of the Existing Conditions (2020) COVID noise contours. In addition, there no single family, multifamily, or manufactured housing (mobile homes) within any of the contours.

TABLE 9-2, NOISE SENSITIVE FACILITIES COMPARISON (2019 VS. 2020)

CATEGORY	2019 PRECOVID	2020 COVID	DIFFERENCE
Total Housing Units	17	0	**-17**
Total Estimated Population	45	0	**-45**
Other Noise Sensitive Facilities	0	0	**0**

Source: Landrum & Brown analysis, 2022.

EXHIBIT 9-1, COMPARISON OF THE EXISTING (2019) PRECOVID AND THE EXISTING (2020) COVID NOISE CONTOUR



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

9.2 Comparison of the No Action Alternative and the Proposed Action

For the purpose of this analysis, noise exposure of noise sensitive facilities in the Proposed Action is compared to that of the No Action Alternative for that same timeframe. The significance determination for noise impacts is provided in Section 10.

Exhibit 9-2 reflects the comparison of the Future (2028) No Action Alternative Noise Exposure Contours and the Future (2028) Proposed Action Noise Exposure Contours. The comparison shows the shift westward of the contours compared to the No Action Alternative. This directly corresponds to the shift of the replacement runway 537 feet northwest of the existing runway. **Table 9-3** summarizes the comparison of land areas within each contour. In 2028, the Proposed Action would decrease the land areas within each contour as compared to the No Action Alternative. With the 2028 Proposed Action, shifting the replacement runway 537 feet northwest of the existing creates a larger gap in the contour between the two runways. This is because the noise from each runway has less influence on the other and almost become two independent contours. This effect also causes the tip of the Proposed Action contour to be shorter than the No Action Alternative even though it has a slightly longer pavement length. Therefore, the 2028 Proposed Action contour area is smaller than the No Action Alternative contour area.

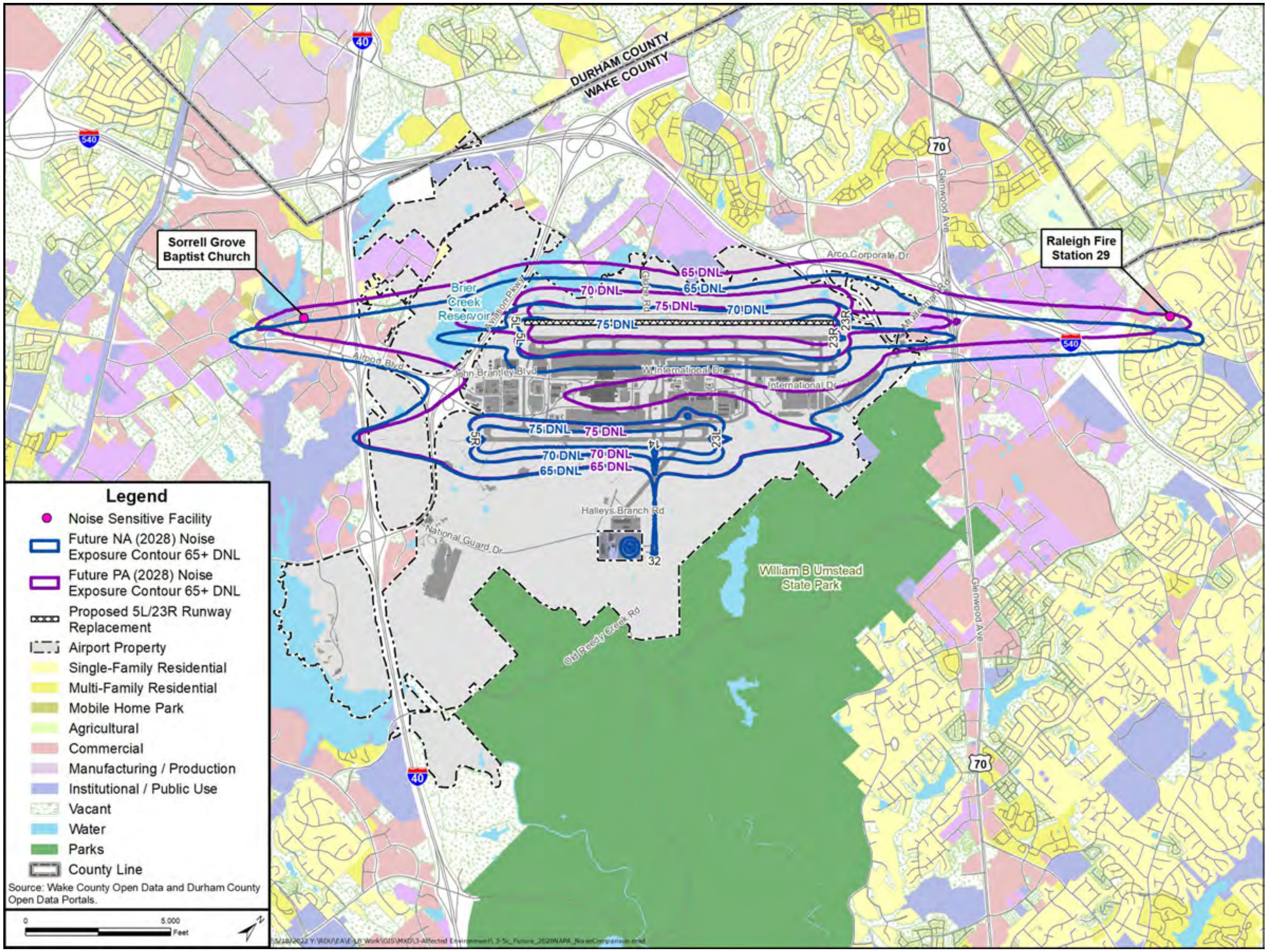
TABLE 9-3, NOISE CONTOUR AREA COMPARISION (2028)

CONTOUR RANGE	FUTURE (2028) NO ACTION ALTERNATIVE NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)	FUTURE (2028) PROPOSED ACTION NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)	DIFFERENCE
65-70 DNL	2.95	2.82	-0.13
70-75 DNL	0.81	0.79	-0.02
75+ DNL	0.63	0.62	-0.01
Total 65+ DNL	**4.39**	**4.23**	**-0.16**

Source: Landrum & Brown analysis, 2022.

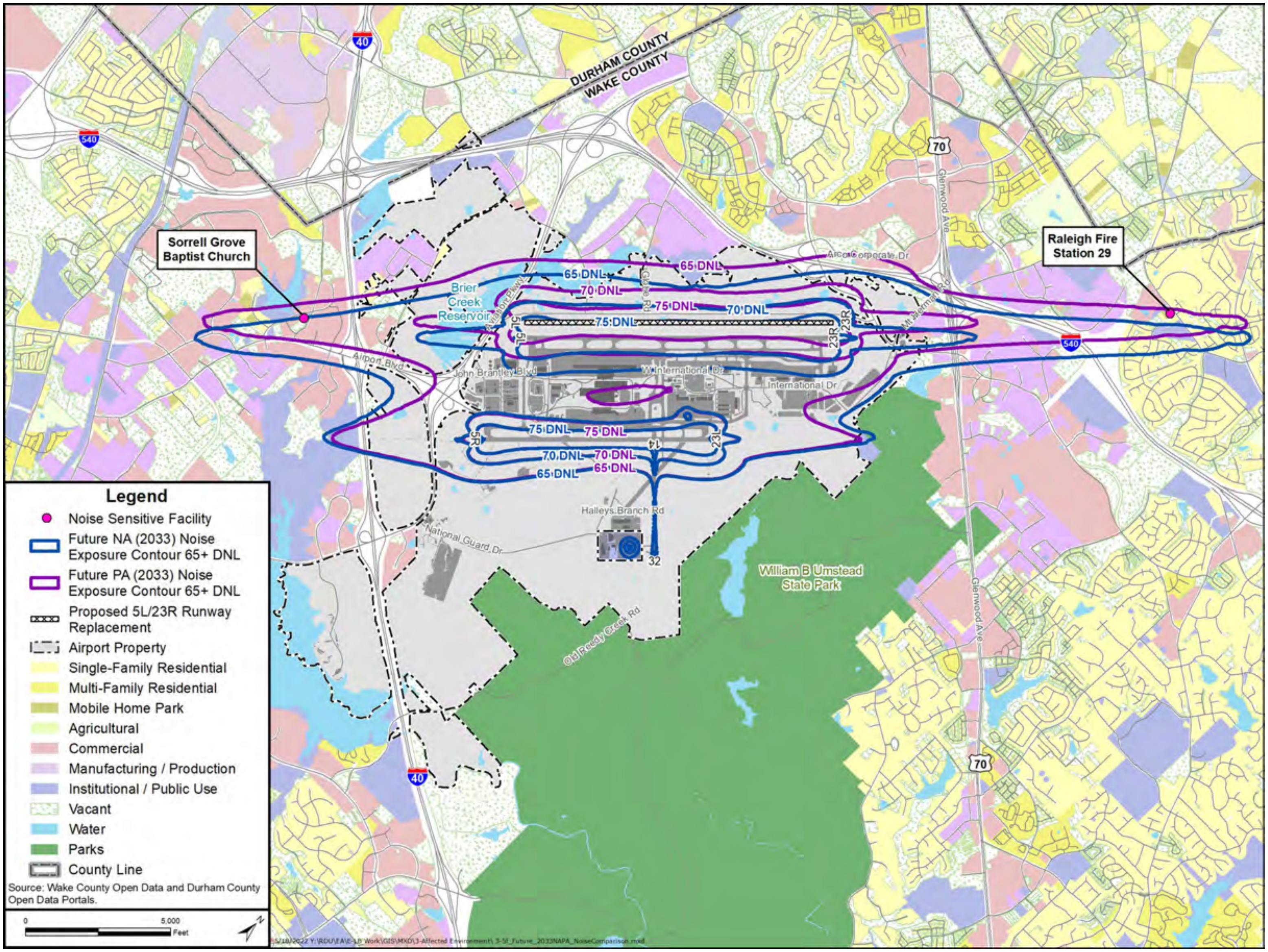
Exhibit 9-3 reflects the comparison of the Future (2033) No Action Alternative Noise Exposure Contours and the Future (2033) Proposed Action Noise Exposure Contours. Again, the comparison shows the shift westward of the contours compared to the No Action Alternative, which directly corresponds to the shift of the replacement runway 537 feet northwest of the existing runway. **Table 9-4** summarizes the comparison of land areas within each contour. In 2033, the Proposed Action would increase the land areas within each contour as compared to the No Action Alternative. In 2033 with the larger forecast increase in aircraft operations, the gap of the contour between the two runways becomes smaller as the contours blend back together and the tips of the contours are more similar. Therefore, the 2033 Proposed Action contour area is slightly larger than the No Action Alternative contour area.

EXHIBIT 9-2, COMPARISON OF THE FUTURE (2028) NO ACTION ALTERNATIVE AND THE FUTURE (2028) PROPOSED ACTION



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022.

EXHIBIT 9-3, COMPARISON OF THE FUTURE (2033) NO ACTION ALTERNATIVE AND THE FUTURE (2033) PROPOSED ACTION



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022.

TABLE 9-4, NOISE CONTOUR AREA COMPARISON (2033)

CONTOUR RANGE	FUTURE (2033) NO ACTION ALTERNATIVE NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)	FUTURE (2033) PROPOSED ACTION NOISE EXPOSURE CONTOUR AREA (IN SQUARE MILES)	DIFFERENCE
65-70 DNL	3.36	3.39	+0.03
70-75 DNL	0.92	0.91	-0.01
75+ DNL	0.69	0.70	+0.01
Total 65+ DNL	**4.97**	**5.00**	**+0.03**

Source: Landrum & Brown analysis, 2022.

Table 9-5 summarizes the comparison of housing units, estimated population, and other noise sensitive facilities for 2028. The Proposed Action would decrease the total number of housing units and population within the 65+ DNL as compared to the No Action Alternative. One (1) church (the Sorrell Grove Baptist Church) and one (1) fire station (Raleigh Fire Station #29) would be newly impacted due to the Proposed Action. The decrease in residences and population is attributed to the change in the shape and size of the Proposed Action noise exposure contour as compared to the No Action Alternative noise exposure contour.

TABLE 9-5, NOISE SENSITIVE FACILITIES COMPARISON (2028)

CATEGORY	FUTURE (2028) NO ACTION ALTERNATIVE	FUTURE (2028) PROPOSED ACTION	DIFFERENCE
Total Housing Units	126	45	**-81**
Total Estimated Population	329	118	**-211**
Other Noise Sensitive Facilities	0	2	**+2**

Source: Landrum & Brown analysis, 2022.

Table 9-6 summarizes the comparison of housing units, estimated population, and other noise sensitive facilities for 2033. The Proposed Action would decrease the total number of housing units and population within the 65+ DNL as compared to the No Action Alternative. In 2033, the Sorrell Grove Baptist Church is within the No Action Alternative and Proposed Action contours. However, one (1) fire station (Raleigh Fire Station #29) would be newly impacted due to the Proposed Action. The decrease in residences and population is attributed to the change in the shape and size of the Proposed Action noise exposure contour as compared to the No Action Alternative noise exposure contour.

TABLE 9-6, NOISE SENSITIVE FACILITIES COMPARISON (2033)

CATEGORY	FUTURE (2033) NO ACTION ALTERNATIVE	FUTURE (2033) PROPOSED ACTION	DIFFERENCE
Total Housing Units	248	134	**-114**
Total Estimated Population	647	351	**-296**
Other Noise Sensitive Facilities	1	2	**+1**

Source: Landrum & Brown analysis, 2022.

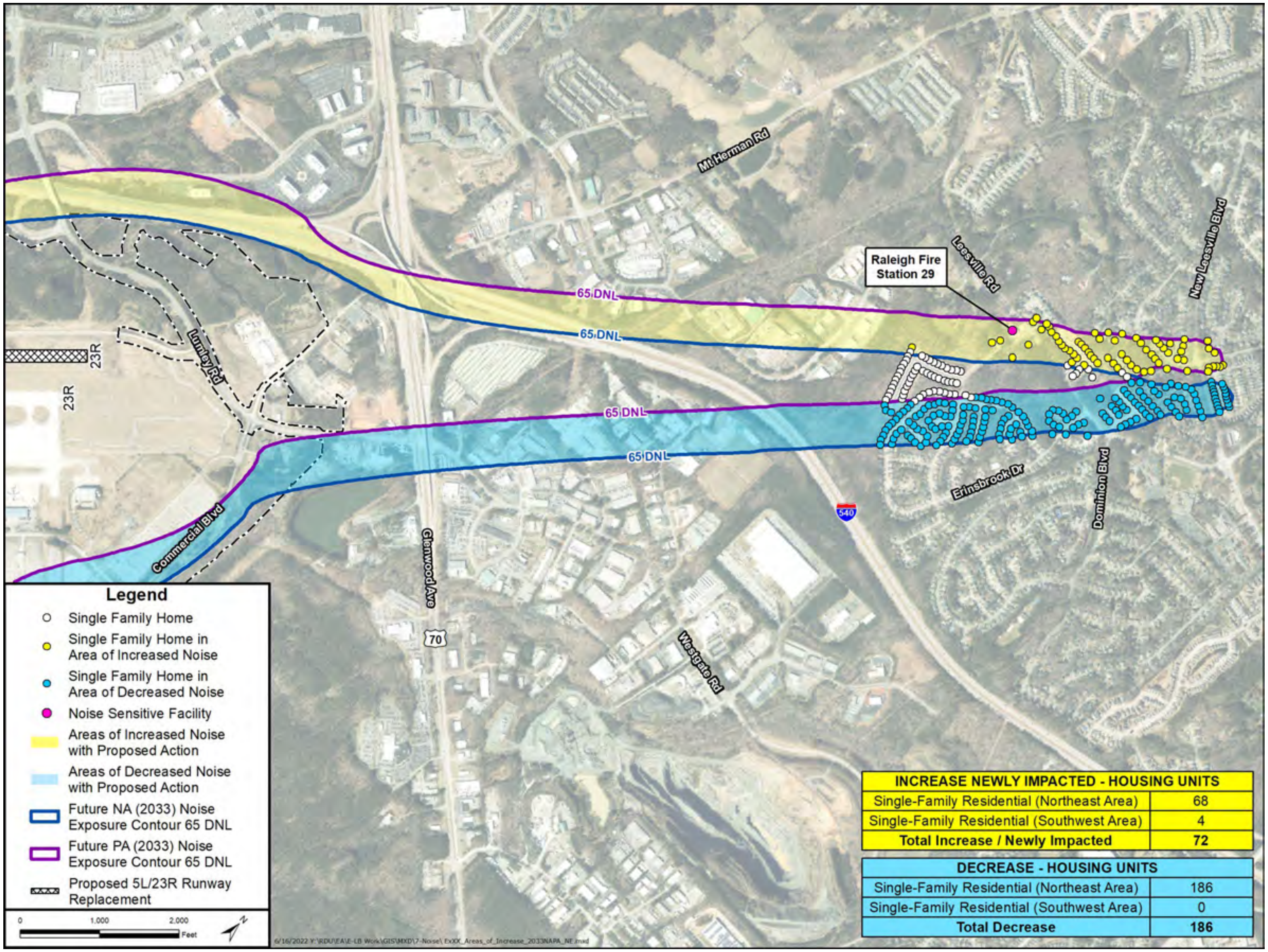
Based on the analysis, there would be 248 total housing units within the 65+ DNL for the No Action Alternative in 2033. There would be 134 total housing units within the 65+ DNL for the Proposed Action in 2033. Overall, the Proposed Action would result in 114 fewer housing units and 296 fewer estimated people and one additional noise-sensitive facility within the 65+ DNL as compared to the No Action Alternative.

With the shift in the noise contour westward, the Proposed Action would result in 72 housing units experiencing an increase in noise and 186 housing units experiencing a decrease in noise in the 65+ DNL noise exposure contour when compared to the 2033 No Action Alternative noise contour. An increase in noise is defined as newly being in the 65+ DNL noise contours, while a decrease in noise is defined as a residence that is no longer within the 65+DNL contours.

Exhibit 9-4 shows the change in housing units northeast of Runway End 23R that would experience an increase in noise at or above 65 DNL noise exposure in 2033. In the area northeast of Runway End 23R, the Proposed Action would result in 68 housing units (yellow dots) and 178 estimated people experiencing an increase in noise and 186 housing units (blue dots) and 486 estimated people experiencing a decrease in noise in the 65+ DNL noise exposure contour when compared to the 2033 No Action Alternative noise contour. The white dots represent housing units that are within both the Proposed Action and No Action Alternative noise contour and would experience similar noise whether the Project was constructed or not.

Exhibit 9-5 shows the change in housing units southwest of Runway End 5L that would experience an increase in noise at or above 65 DNL noise exposure in 2033. In the area southwest of Runway End 5L, the Proposed Action would result in four housing units (yellow dots) experiencing an increase in noise and no housing units experiencing a decrease in noise in the 65+ DNL noise exposure contour when compared to the 2033 No Action Alternative noise contour. The white dots represent housing units that are within both the Proposed Action and No Action Alternative noise contour.

EXHIBIT 9-4, CHANGE IN HOUSING COUNTS (2033) NORTHEAST AREA ZOOMED IN

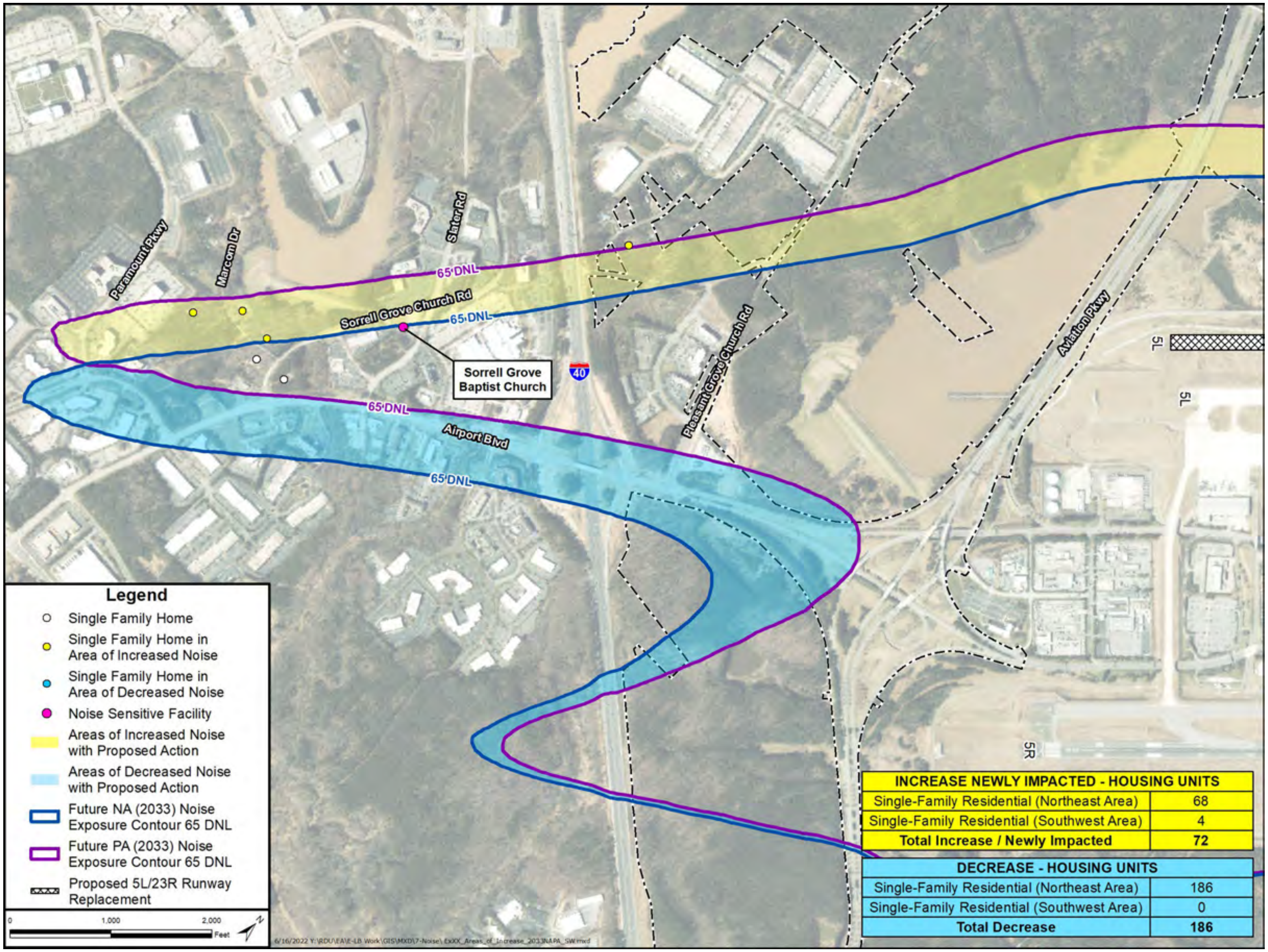


INCREASE NEWLY IMPACTED - HOUSING UNITS	
Single-Family Residential (Northeast Area)	68
Single-Family Residential (Southwest Area)	4
Total Increase / Newly Impacted	**72**

DECREASE - HOUSING UNITS	
Single-Family Residential (Northeast Area)	186
Single-Family Residential (Southwest Area)	0
Total Decrease	**186**

Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

EXHIBIT 9-5, CHANGE IN HOUSING COUNTS (2033) SOUTHWEST AREA ZOOMED IN



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022.

10 Significance Determination

A significant noise impact would occur if the analysis shows that the Proposed Action would result in noise-sensitive areas experiencing an increase in noise of DNL 1.5 dB or more, at or above 65 DNL noise exposure when compared to the No Action Alternative for the same timeframe.

As shown in **Exhibit 10-1**, the analysis concluded that the Future (2028) Proposed Action would result in noise-sensitive areas experiencing an increase in noise of DNL 1.5 dB or more, at or above 65 DNL noise exposure when compared to the No Action Alternative in 2028. Similarly, as shown in **Exhibit 10-2**, the analysis concluded that the Future (2033) Proposed Action would result in noise-sensitive areas experiencing an increase in noise of DNL 1.5 dB or more, at or above 65 DNL noise exposure when compared to the No Action Alternative in 2033. The year 2033 was used as the year for determination of significant impacts because the potential impacts would be greater in 2033 than those in 2028.

Exhibit 10-3 shows a close up of the housing units northeast of the Runway End 23R that would experience an increase in noise of DNL 1.5 dB or more at or above 65 DNL noise exposure in 2033. There are 35 housing units (91 estimated people) northeast of Runway End 23R that would experience the increase. **Exhibit 10-4** shows the causes of the shape of the 1.5 dB area. The shape of the area of DNL 1.5 dB increase within the 65 DNL of noise exposure contour is influenced by several factors caused by the relocated runway. To the northwest of the proposed Runway 05L/23R, sideline noise levels would increase due to engine noise from the start of the departure roll and the use of reverse thrust on arrivals. To the northeast and southwest of the proposed Runway 05L/23R, noise levels would increase due to the shift in aircraft approach path to the two runway ends. The triangular-shaped indentations in the DNL 1.5 dB increase area to the north of the Runway 23R approach end and west of the Runway 05L approach end show areas that would experience no change or minimal change in noise levels. These areas are affected by departures that turn west upon takeoff. These departure turns would occur with or without the Proposed Action. Under the Proposed Action and would be at similar altitudes as the No Action; therefore, there would be minimal change in noise levels along these departure paths as indicated by the shape of the area of DNL 1.5 dB increase within the 65 DNL.

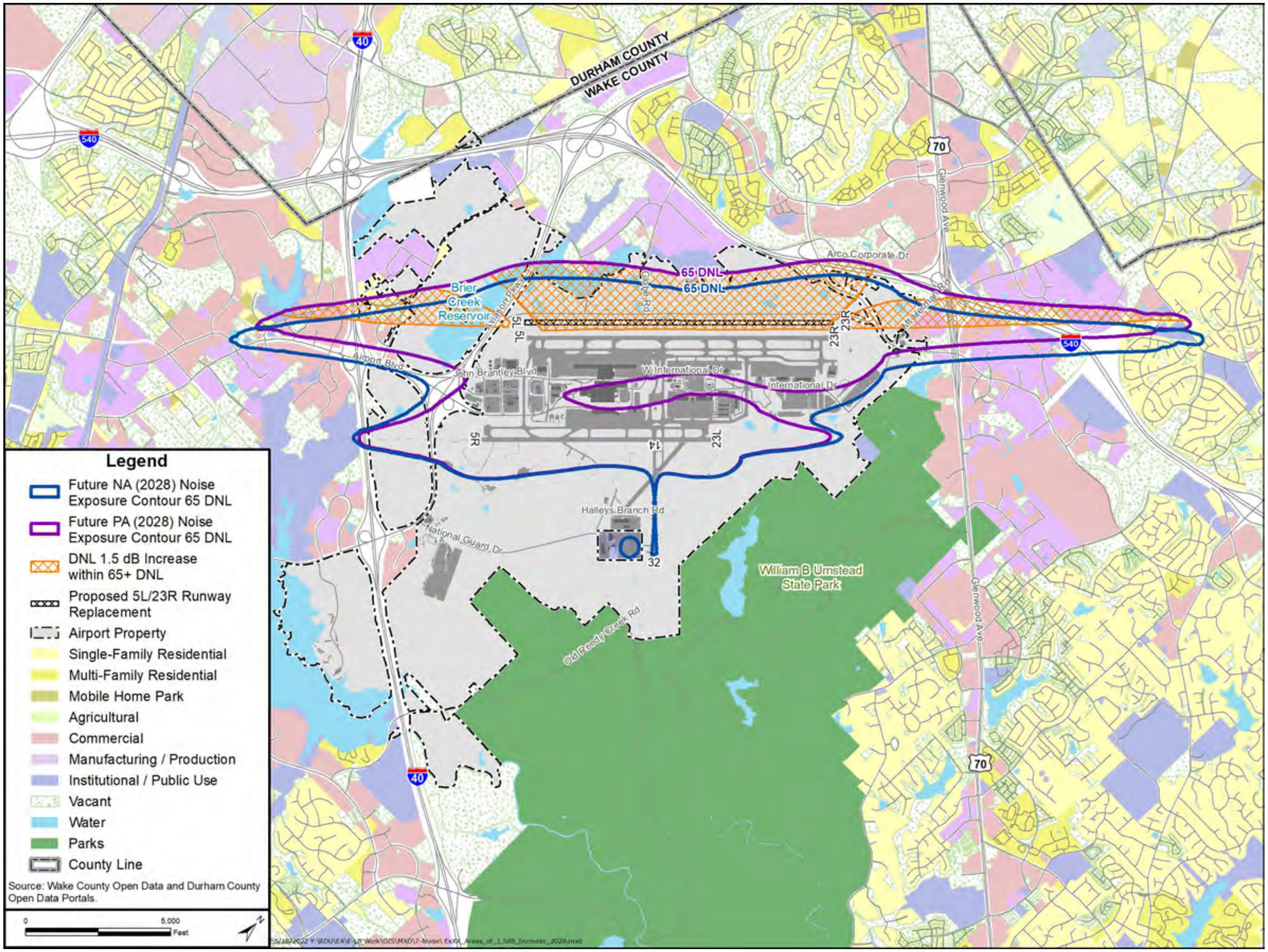
Exhibit 10-5 shows a close up of the housing units southwest of Runway End 5L that would experience an increase in noise of DNL 1.5 dB or more at or above 65 DNL noise exposure in 2033. There are two (2) housing units (six estimated people) southwest of Runway End 5L that would experience the increase. There would be 37 total housing units and 97 estimated people located within the DNL 1.5 dB increase area. **Exhibit 10-6** shows the causes of the shape of the 1.5 dB area. **Table 10-1** shows the total number of housing units and estimated population by housing type within the area of DNL 1.5 dB increase within the 65 DNL of the Future (2033) Proposed Action noise exposure contour. One (1) church (Sorrell Grove Baptist Church) and one (1) fire station (Raleigh Fire Station #29) would also be located within the DNL 1.5 dB increase area. No public schools, nursing homes, hospitals, or libraries would be located in the DNL 1.5 dB increase area.

TABLE 10-1, HOUSING AND POPULATION WITHIN THE AREA OF DNL 1.5 DB INCREASE WITHIN 65 DNL

HOUSING TYPE	HOUSING UNITS	ESTIMATED POPULATION
Single-Family Units	36	94
Duplex/Triplex Units	0	0
Mobile Home Units	1	3
Total	**37**	**97**

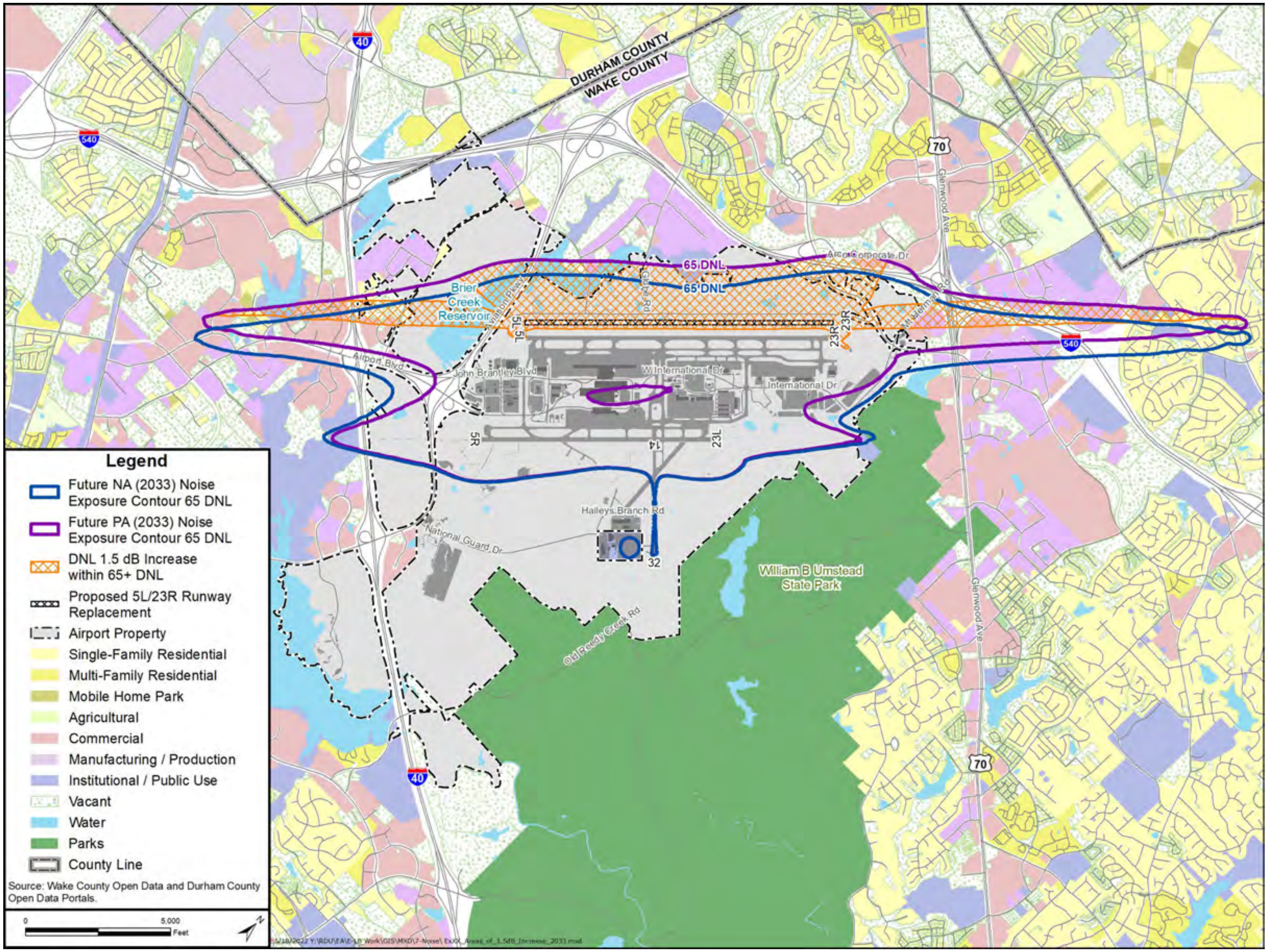
Source: Landrum & Brown analysis, 2022

EXHIBIT 10-1, 2028 AREAS OF 1.5DB INCREASE



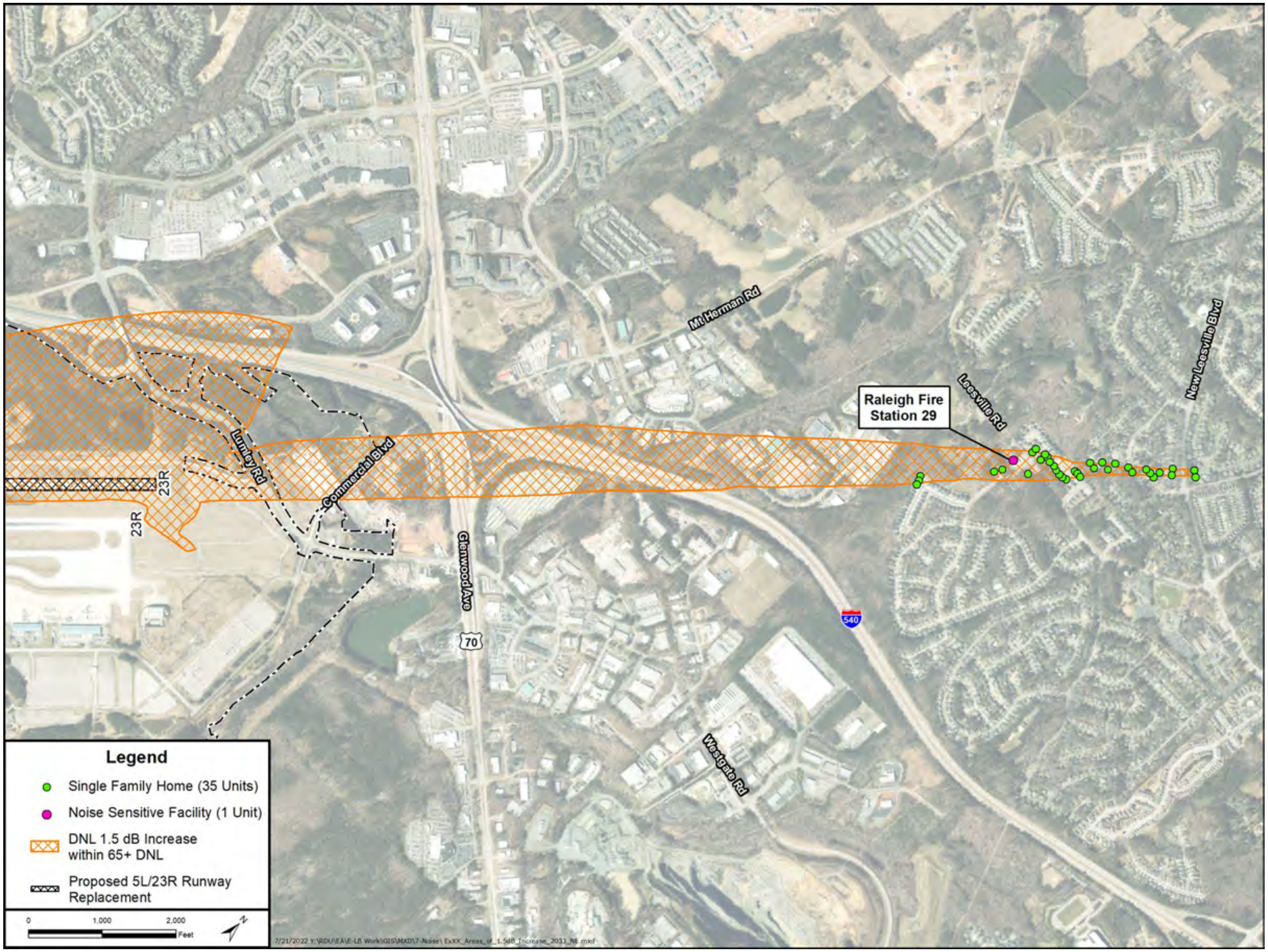
Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

EXHIBIT 10-2, 2033 AREAS OF 1.5DB INCREASE



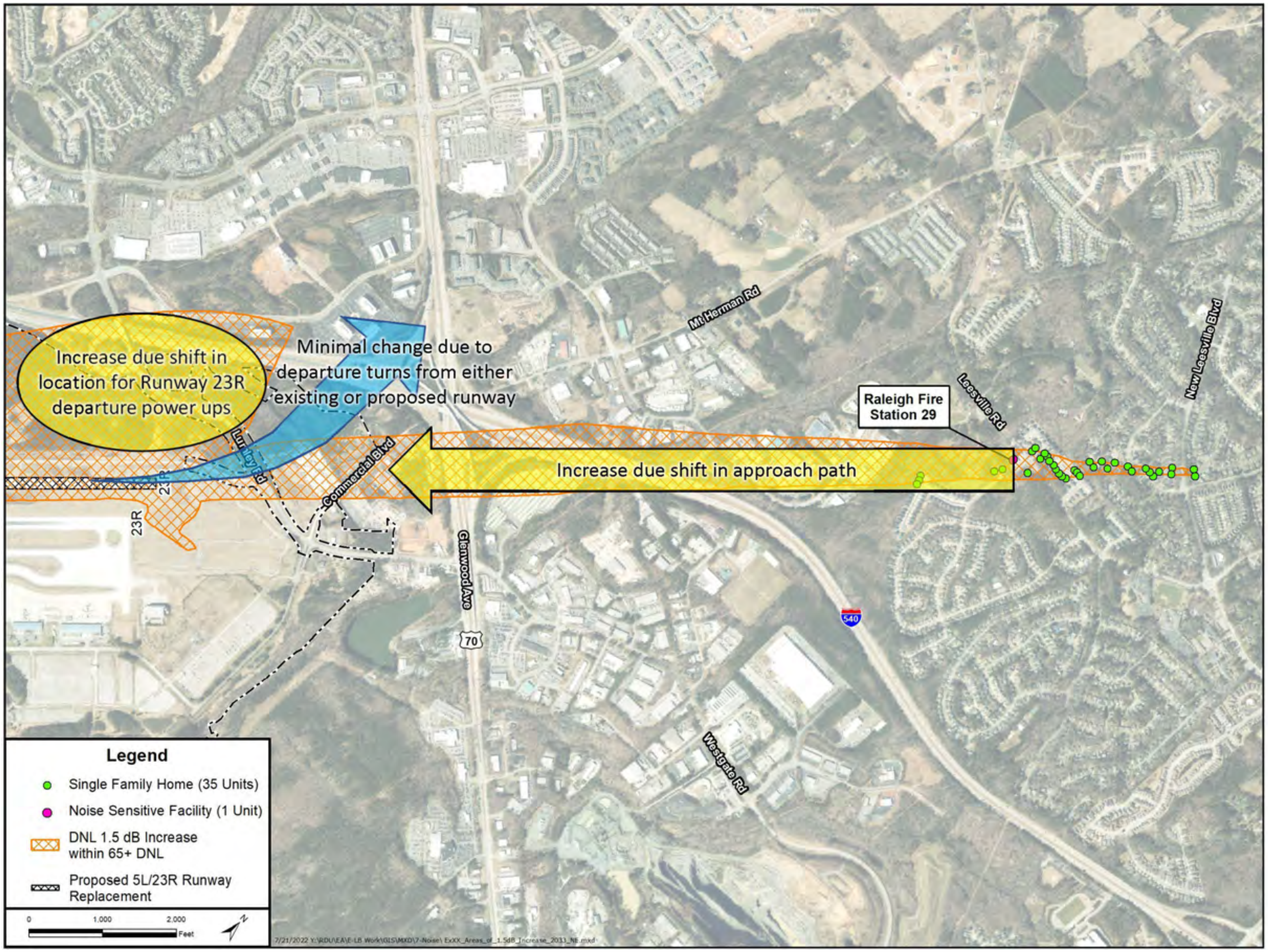
Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

EXHIBIT 10-3, AREAS OF 1.5 DB INCREASE - FUTURE (2033) PROPOSED ACTION NORTHEAST AREA ZOOMED IN



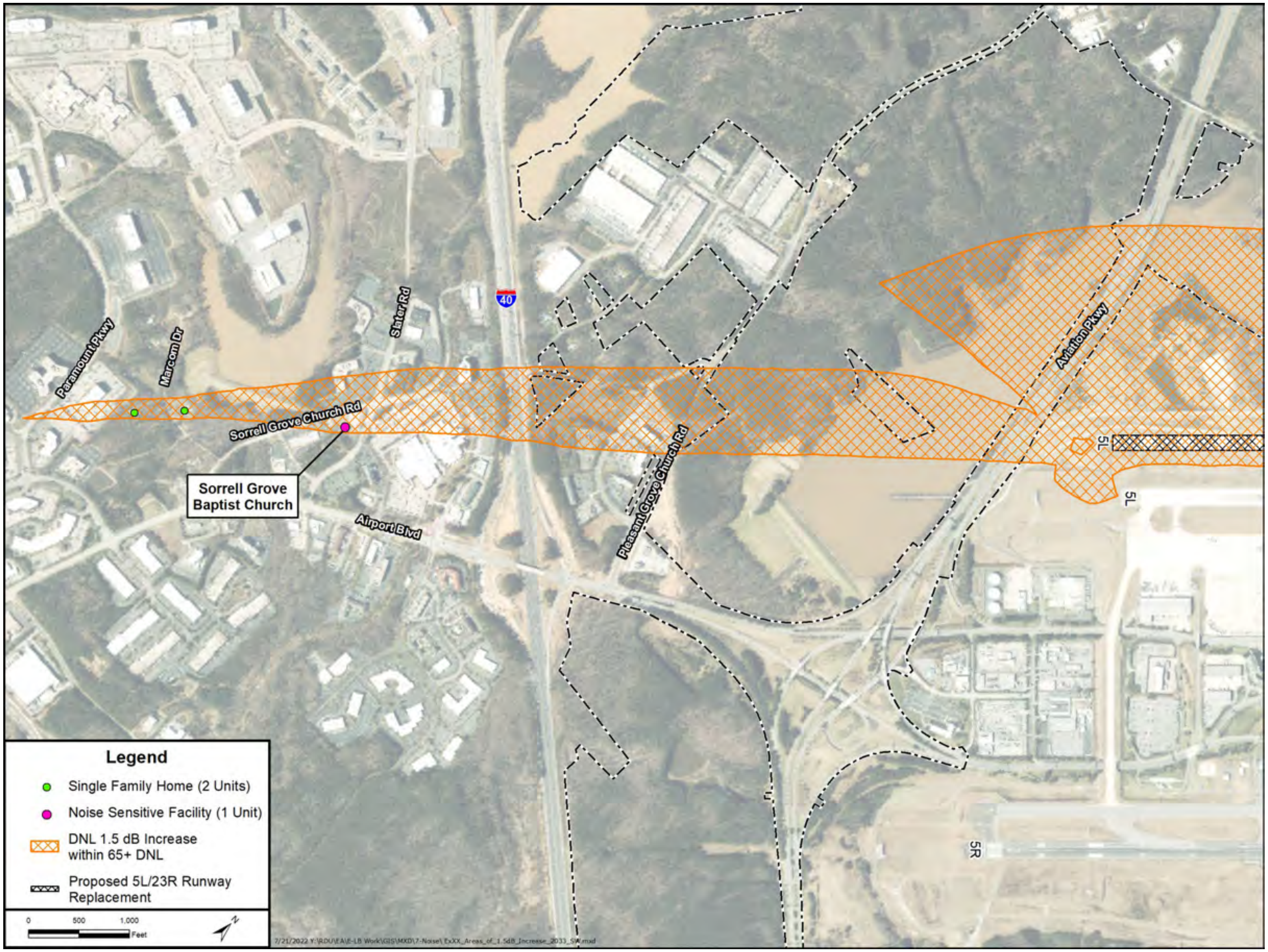
Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

EXHIBIT 10-4, AREAS OF 1.5 DB INCREASE - FUTURE (2033) PROPOSED ACTION NORTHEAST AREA ZOOMED IN



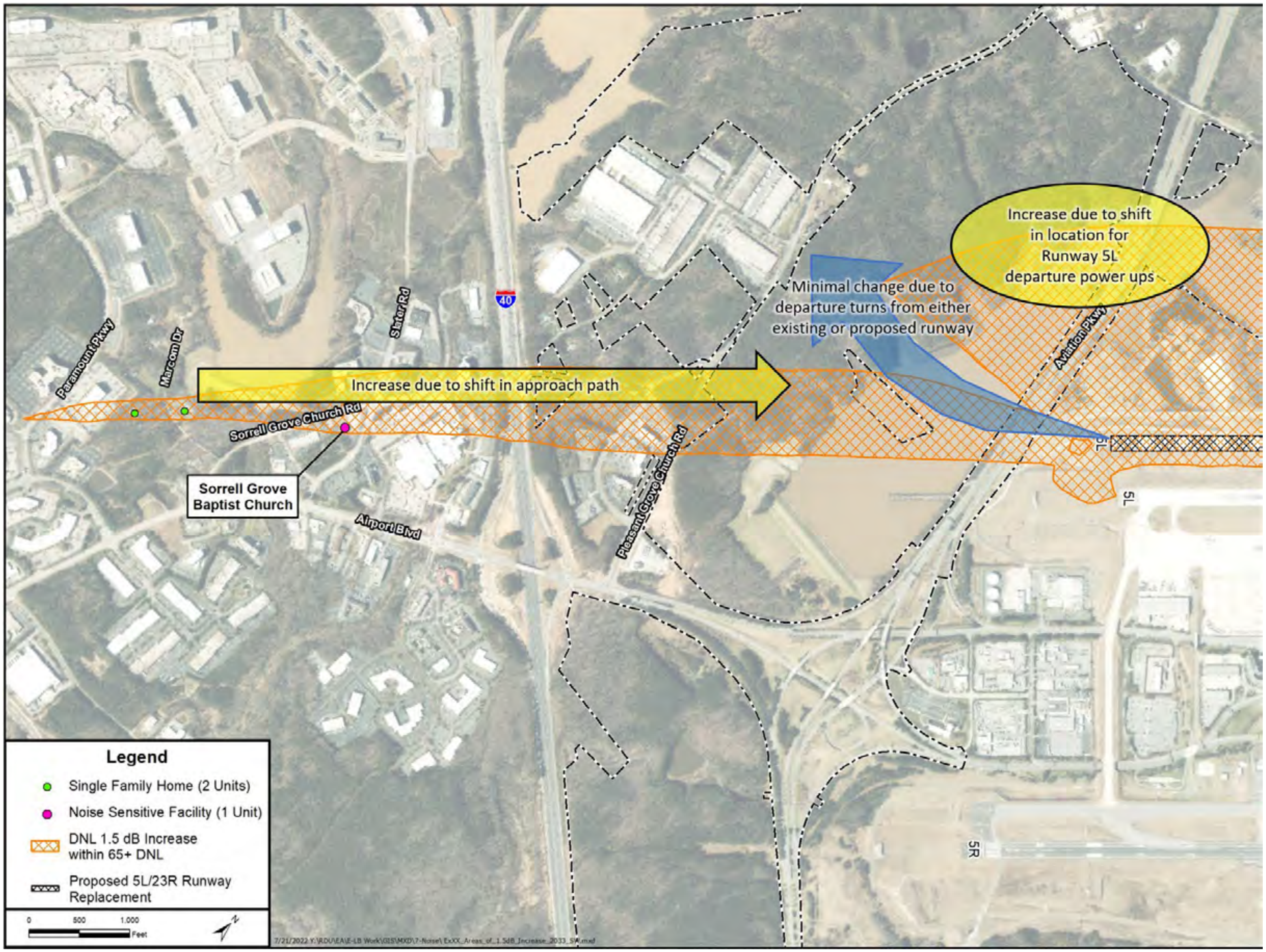
Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

EXHIBIT 10-5, AREAS OF 1.5 DB INCREASE - FUTURE (2033) PROPOSED ACTION SOUTHWEST AREA ZOOMED IN



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

EXHIBIT 10-6, AREAS OF 1.5 DB INCREASE - FUTURE (2033) PROPOSED ACTION SOUTHWEST AREA ZOOMED IN



Source: Airport Authority, Durham County GIS, Wake County GIS, and Landrum & Brown, 2022

10.1 Reportable Noise Change

The Proposed Action would require the FAA to test, update, and reissue the arrival and departure procedure charts for the replacement runway. For air traffic airspace and procedure actions where the study area is larger than the immediate vicinity of an airport, the noise analysis focuses on a change-in-exposure analysis. This analysis examines the change in noise levels as compared to population and demographic information. Per FAA Order 1050.1F, Section 11.3 Environmental Consequences, this analysis may be conducted using noise contours.

Analysis was conducted to assess the potential noise impacts to housing units and the population located between the 60 and 65 DNL noise contours due to potential changes in airspace and air traffic procedures. The analysis was conducted using the recommendations of the FICON,[17] which the FAA has incorporated into FAA Order 1050.1F. The FICON was formed to review and make recommendations on Federal policies that govern the assessment of airport noise impacts. Under one of its policy recommendations, FICON concluded that it is prudent to provide for a systematic analysis of noise levels below 65 DNL in NEPA documents using the following screening procedures:

- Determine if a DNL 1.5 dB increase occurs at noise-sensitive sites within the 65 DNL or greater noise contour. If a DNL 1.5 dB increase does not occur, then it is likely that a DNL 3 dB increase would not be found within the 60 to 65 DNL noise contour, and no further screening would be necessary.
- If a DNL 1.5 dB increase does occur at noise-sensitive sites within the 65 DNL or greater noise contour, then determine the areas where a DNL 3 dB increase occurs within the 60 to 65 DNL noise contour.

According to the policy recommendations of the FICON, when areas of a DNL 3 dB increase in noise exposure within the 60 to 65 DNL noise contour and DNL 5 dB increase in the 45 to 60 DNL noise contour are identified in a NEPA analysis, the consideration of appropriate mitigation should include the potential for mitigating noise in these areas.[18] The FAA refers to noise changes meeting these criteria as “reportable.” Although they are not significant (see Exhibit 4-1 of Order 1050.1F), they may cause a proposed action to be highly controversial on environmental grounds. The same range of currently approved mitigation options that are potentially available at 65 DNL or greater should be considered, including eligibility for Federal funding. The FICON further acknowledges that there is no commitment by either the FAA or the Airport Authority for funding potential land use mitigation within a 60 to 65 DNL noise contour, because it is generally expected that Federal priority would be given to mitigating noise at higher levels.

Since the 2028 and 2033 Proposed Action noise exposure contours experienced a DNL 1.5 dB increase over noise sensitive facilities, an analysis was performed to determine if a DNL 3 dB increase over noise sensitive facilities occurred within the 60 to 65 DNL noise contour. The analysis determined no DNL 3 dB increase occurred in the 60 to 65 DNL of the Proposed Action in 2028 or 2033. Because

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[17] Federal Interagency Committee on Noise (FICON), August 1992, *Federal Agency Review of Selected Airport Noise Analysis Issues.*

[18] Per FAA Order 1050.1F, AEDT was used to identify where the 5 dB increase within the DNL 45 to 60 dB occurs. This was conducted to evaluate the potential noise impacts as a result of changes in airport arrivals and departures and determine whether there is the potential to increase noise levels over communities beneath the aircraft route.

there was no DNL 3 dB increase in the 60 to 65 DNL, an analysis of the DNL 5 dB increase in the 45 to 60 DNL noise contour was not necessary and was not conducted.

10.2 Construction Equipment Noise

Construction activities associated with the Proposed Action would result in temporary noise impacts to the residential areas surrounding the Detailed Study Area described in the EA. **Table 10-2** depicts an estimate of the typical maximum sound level energy at 50 feet from various types of construction equipment that is likely to be used during construction of the Proposed Action. The total sound energy would be a product of a machine's sound level, the number of such machines in service, and the average time they operate.

TABLE 10-2, CONSTRUCTION EQUIPMENT NOISE

CONSTRUCTION EQUIPMENT	TYPICAL MAXIMUM SOUND LEVEL (LMAX) IN DB(A) AT 50 FEET
Backhoe	78
Chain Saw	84
Concrete Mixer Truck	79
Dozer	82
Dump Truck	76
Excavator	81
Generator	81
Jackhammer	89
Paver	77
Pump	81
Pneumatic Tools	85
Rock Drill	81
Scraper	84

Source: Federal Highway Administration, Construction Noise Handbook, 9.0 Construction Equipment Noise Levels and Ranges. Online at http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm, Accessed August 2, 2018.

Construction noise from the Proposed Action would be temporary and anticipated to be limited to daytime hours. During construction, the nature of the construction noise and the overall noise level experienced by the surrounding area would depend on the specific construction activity being conducted. The closest residences to the construction site would be adjacent to the construction site. While Wake County, North Carolina does not establish residential noise limit at sites in areas where construction occurs during daytime hours (7:00 am to 11:00 pm), the County requires that that all equipment, manufacturers mufflers and noise reducing equipment are operated with all standard equipment, manufacturers mufflers and noise reducing equipment in use and in proper operating condition.[19] Contractors would be required to abide by this requirement. To further minimize construction noise to these residences, the Airport would leave 100 feet of vegetation in place as a buffer to attenuate noise. The FHWA typically considers 85 dBA as an appropriate residential noise limit during daytime and evening hours (7 am to 10 pm) for construction activities.[20] It is anticipated that construction noise is not likely to exceed the FHWA's residential noise limit for construction activities with consideration of the noise levels of construction equipment at 50 feet as shown in Table 10-2, the implementation of Wake County requirements related to construction equipment, and the 100-foot vegetation buffer. Furthermore, the closest residences to the construction site are also near commercial and industrial land uses as well as Airport property. As such, it is anticipated noise from construction equipment would likely not be discernible from other background noise sources, such as aircraft, roadway noise, and industrial and commercial land uses. Therefore, it can be asserted that noise from construction equipment would not result in a significant noise impact.

10.3 Mitigation, Avoidance, and Minimization Measures

Table 10-3 depicts the summary of the impacts based on the Future (2033) Proposed Action noise contour. There are 37 housing units (including one mobile home), one (1) church, and one (1) fire station in the significant increase area (1.5 dB or greater increase within the 65 DNL) of the Future (2033) Proposed Action noise contour. There are an additional 97 housing units (including one mobile home) that are also impacted within the Future (2033) Proposed Action noise contour (within the 65 DNL).

TABLE 10-3, SUMMARY OF PROPOSED ACTION IMPACTS (2033)

CATEGORY	SIGNIFICANT NOISE IMPACT (>1.5 DB INCREASE WITHIN 65 DNL)	OTHER NOISE IMPACTS (WITHIN 65 DNL)	TOTAL
Housing Units	37	97	**134**
Estimated Population	96	254	**348**
Other Noise Sensitive Facilities	2[(1) (2)]	0	**2**

Notes: (1) Sorrell Grove Baptist Church.
(2) Raleigh Fire Station #29
Source: Landrum & Brown analysis, 2022.

[19] https://codelibrary.amlegal.com/codes/wakecounty/latest/wake_nc/0-0-0-1518
[20] Adapted from Central Artery/Tunnel Noise Specification and Table 2 in Appendix A.

For the purposes of mitigating the significant noise impacts (1.5 dB or greater increase within the 65 DNL), the following actions would be required to be implemented:

- Offer to sound insulate 36 single-family housing units if they are eligible
- Offer to acquire 1 mobile home
- Offer to sound insulate the Raleigh Fire Station #29 and the Sorrell Grove Baptist Church

It should be noted that an avigation easement already is attached to some of the properties located within the 2033 Proposed Action 65 DNL noise contour and also within the area of a 1.5 dB increase within the 65 DNL noise contour. The terms of the avigation easement on these properties will need to be evaluated prior to implementation of the mitigation for the Proposed Action.[21]

10.3.1 Acquisition of Noncompatible Land

A single mobile home unit is located within the future DNL 65 and within the area of significant noise increase (1.5 dB or greater within the DNL 65). Since mobile homes cannot be effectively sound insulated due to the type of construction, the owner of the property home would be given an offer to acquire the property. Residents of the mobile home would be offered relocation assistance under the Uniform Relocation Assistance and Real Property Acquisition Act of 1970.

10.3.2 Sound Insulation of Noncompatible Structures

Sound insulation involves reducing aircraft noise levels inside noise-sensitive structures by decreasing the paths by which sound enters a building. Sound insulation methods typically include window and door replacement, caulking, weather-stripping, and installing central air ventilation so that the windows can be kept closed to maintain the noise reduction capability of the structure. Eligible structures include residences (single-family and multi-family), schools, churches/places of worship, and other noise-sensitive buildings located within the 65 DNL contour.

Sound insulation of a structure reduces the adverse impact of airport-related noise on building occupants or residents by reducing the interference of aircraft noise on activities such as sleeping, talking on the telephone, and watching television, but it does not alter noise impacts outside the home. Sound insulation improvements must provide a reduction of at least 5 dB and bring the average interior noise level below 45 dB (DNL) with the 45 dB standard being adopted by the FAA for interior noise.

Following FAA approval of the EA and of the proposed mitigation, the Airport Authority would undertake the sound insulation program. The Airport Authority would need to verify the final number and types of all housing units and other noise-sensitive structures, and their eligibility, prior to implementing the mitigation. This would be done after the FAA decision on the EA. The final number of units eligible to participate may increase due to block rounding or the rounding out of neighborhoods or streets. In addition, the Airport Authority needs to ensure that units are eligible to participate in the sound insulation program. The average interior noise levels of the units must be at 45 DNL or above, with windows closed, to be eligible. This eligibility is determined by acoustical testing of all, or a representative sample of, the potentially eligible units. The calculation of interior noise level must be

[21] According to existing RDUAA data, it is estimated that seven (7) of the 37 total single family housing units within the 1.5 dB or greater increase within the 65 DNL currently have an avigation easement on the property. The mobile home is not within the existing avigation easement area.

based on the average noise level of only the parts of school that are used for educational instruction, or the habitable areas of residences are used for living, sleeping, eating or cooking areas (single family and multi-family). Bathrooms, closets, halls, vestibules, foyers, stairways, unfinished basements storage or utility spaces are not considered to be habitable rooms, as are areas that are not allowed under local building codes.

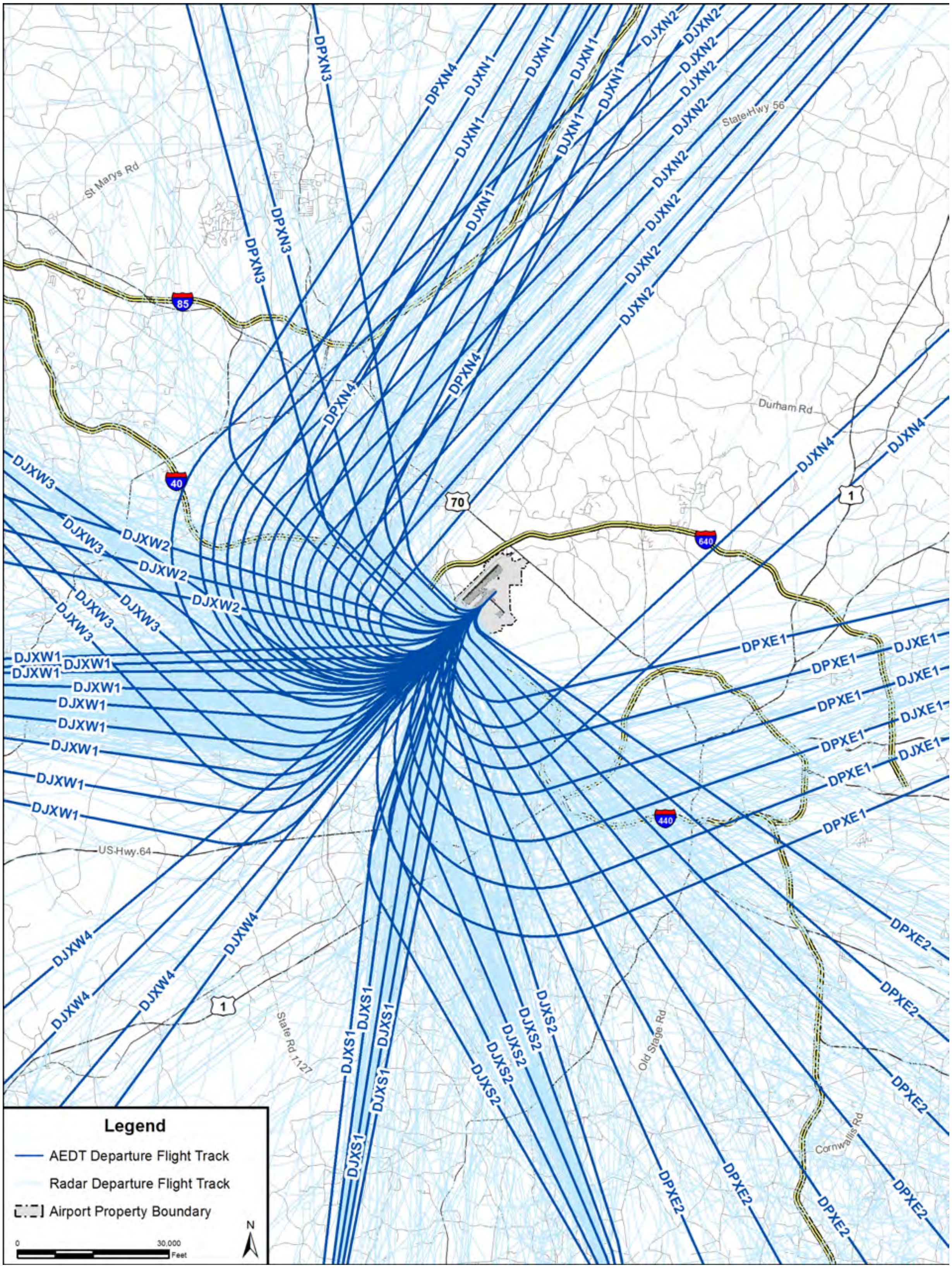
An easement or similar interest shall be reserved by the Airport Authority as a condition of participation in a sound insulation program. To ensure easement rights remain enforceable, a mortgage holder's interest in the property should be subordinated to the easement's rights. Subordination assures the easement rights will survive a foreclosure action and mortgagee or trustee sale of the fee interest.

10.3.3 Purchase of Avigation Easements

For property owners who decline participation in the sound insulation program, it would be appropriate for the Airport Authority to purchase an avigation easement. The avigation easement would provide the Airport Authority with a limited form of control on the property, while still maintaining neighborhood character and stability. Acquisition of easements do not reduce noise impacts or change noncompatible land use to compatible land use. However, it constitutes a suitable compatibility measure according to Federal guidelines.

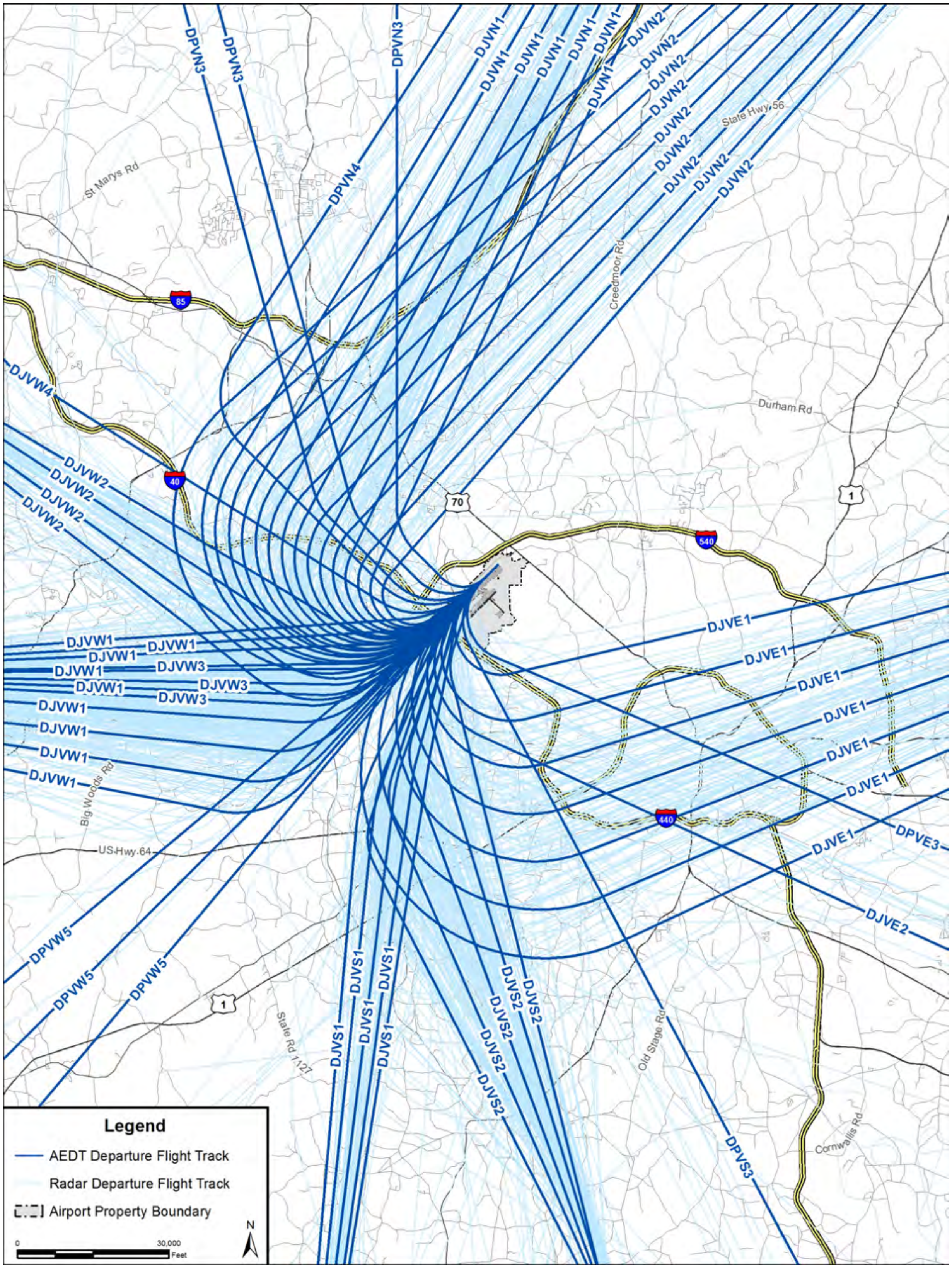
ATTACHMENT 1 FLIGHT TRACKS

EXHIBIT A-1, RUNWAY 23L DEPARTURE TRACKS



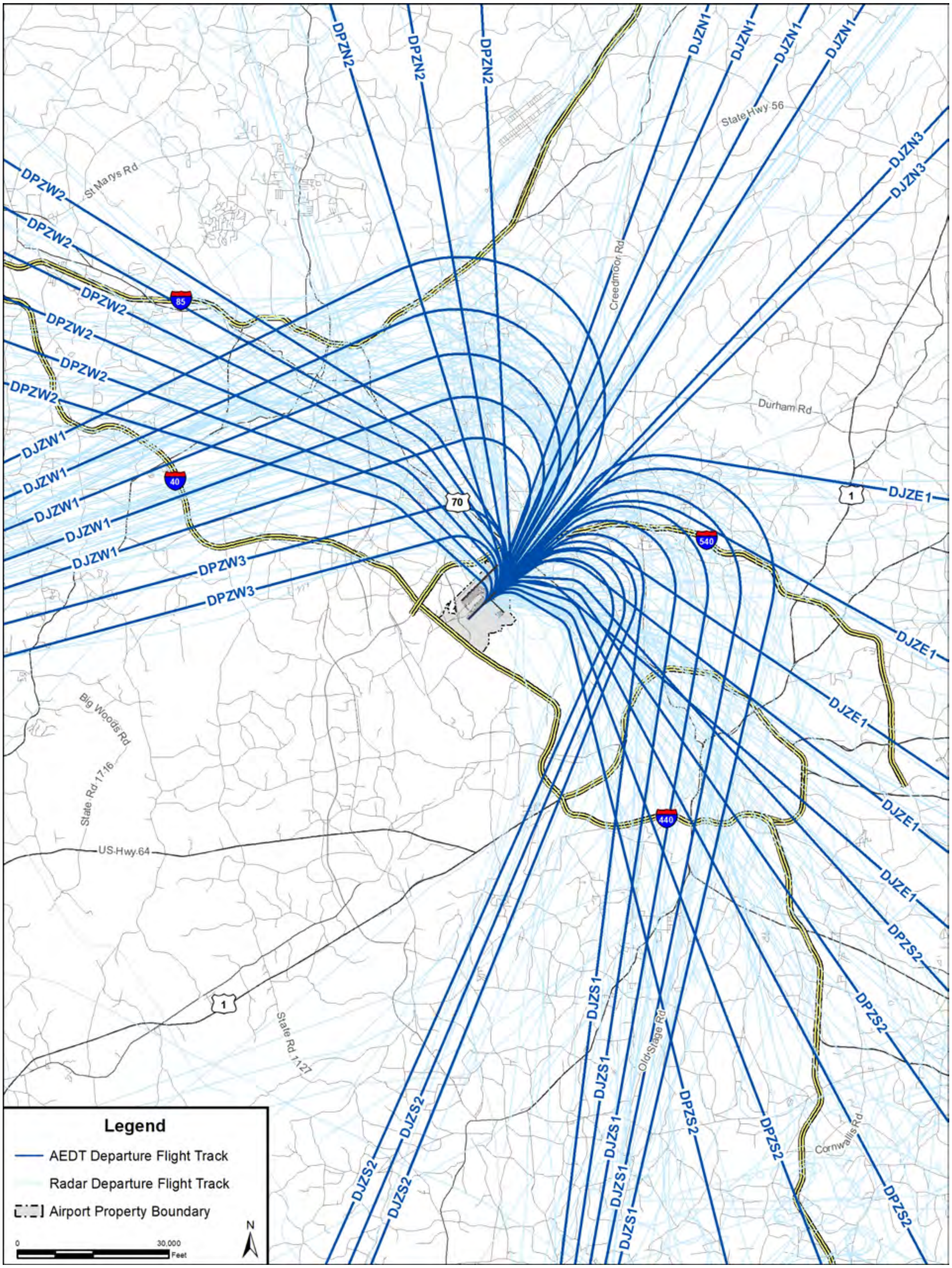
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-2, RUNWAY 23R DEPARTURE TRACKS



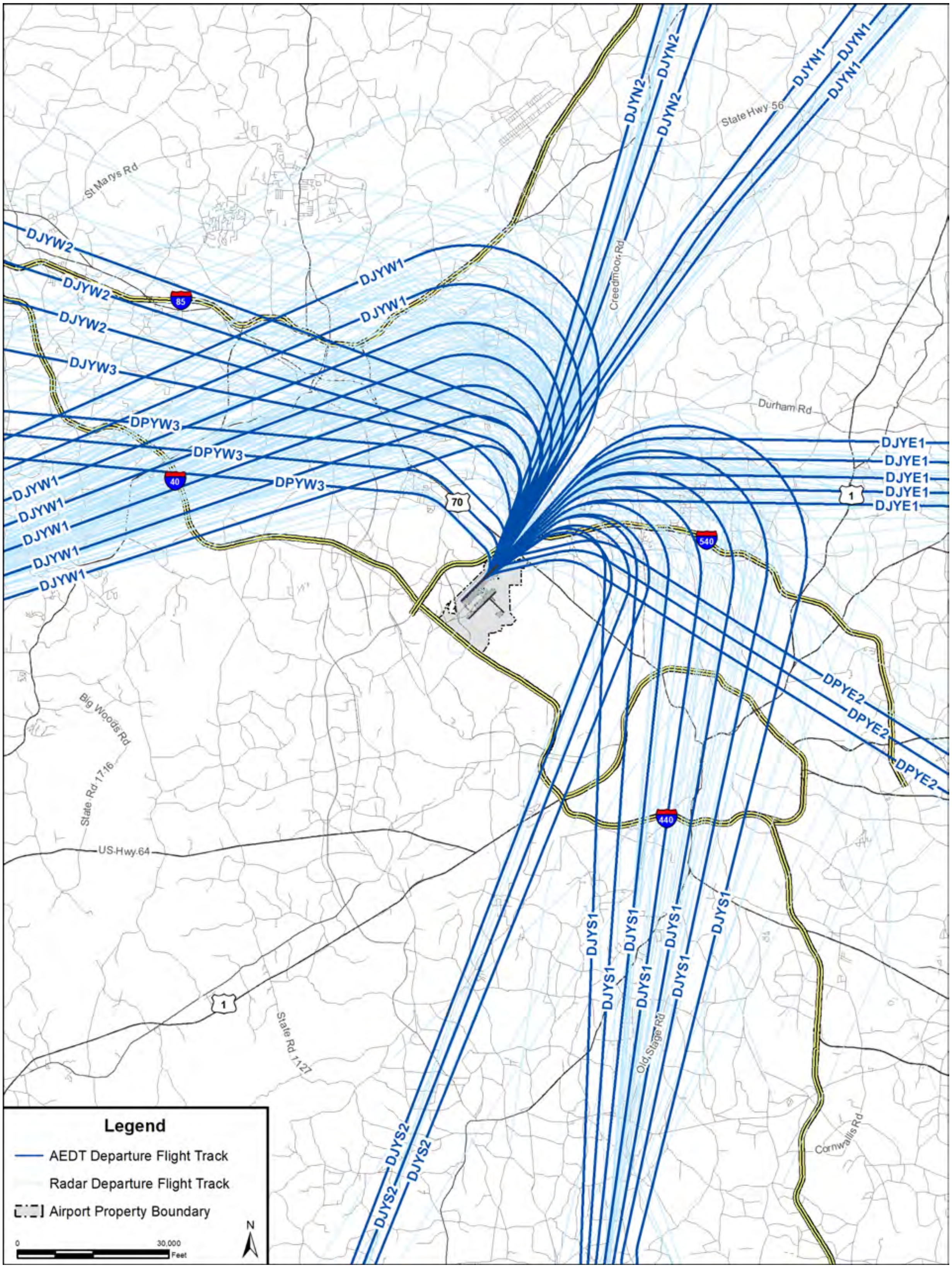
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-3, RUNWAY 5R DEPARTURE TRACKS



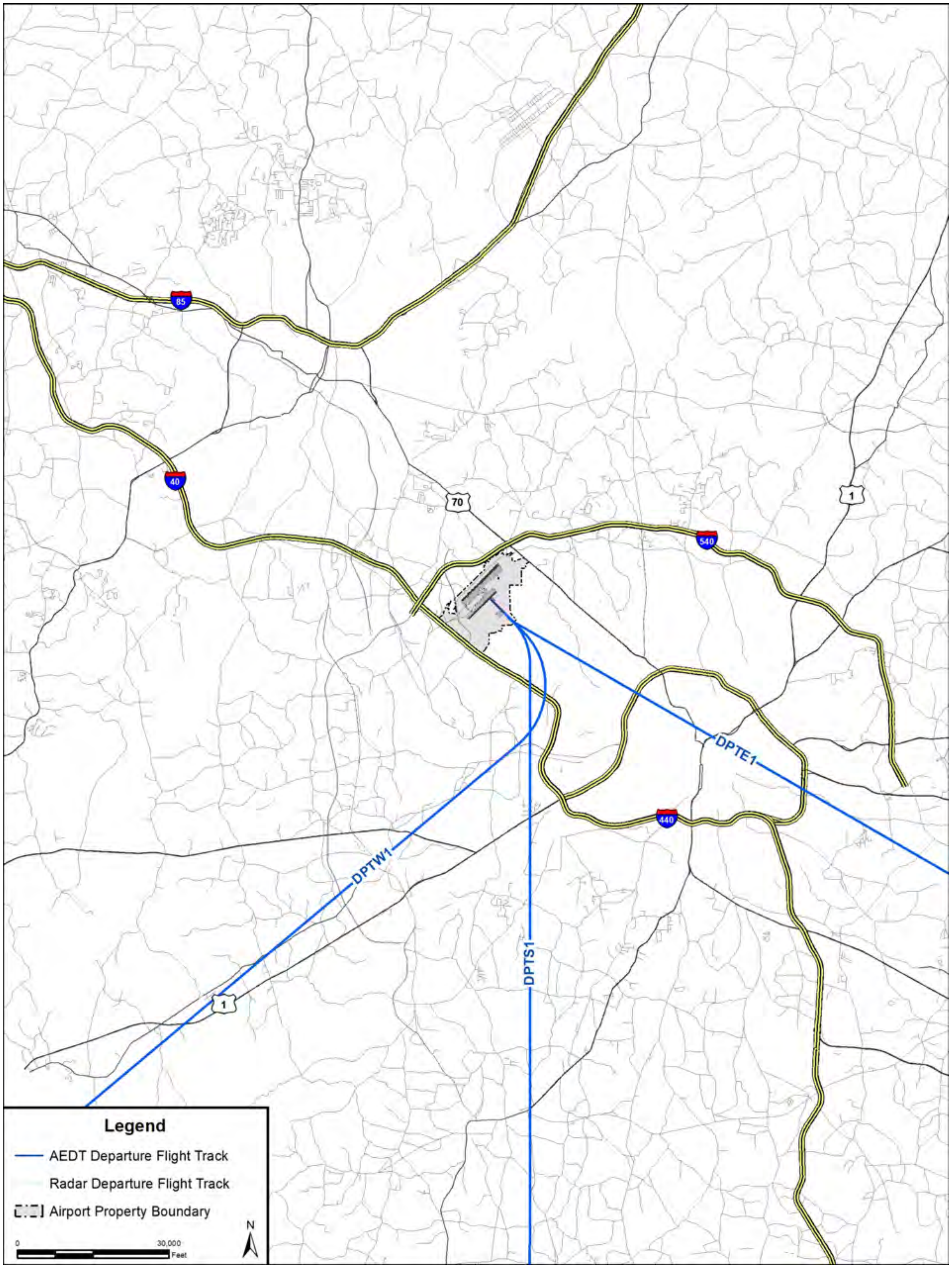
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-4, RUNWAY 5L DEPARTURE TRACKS



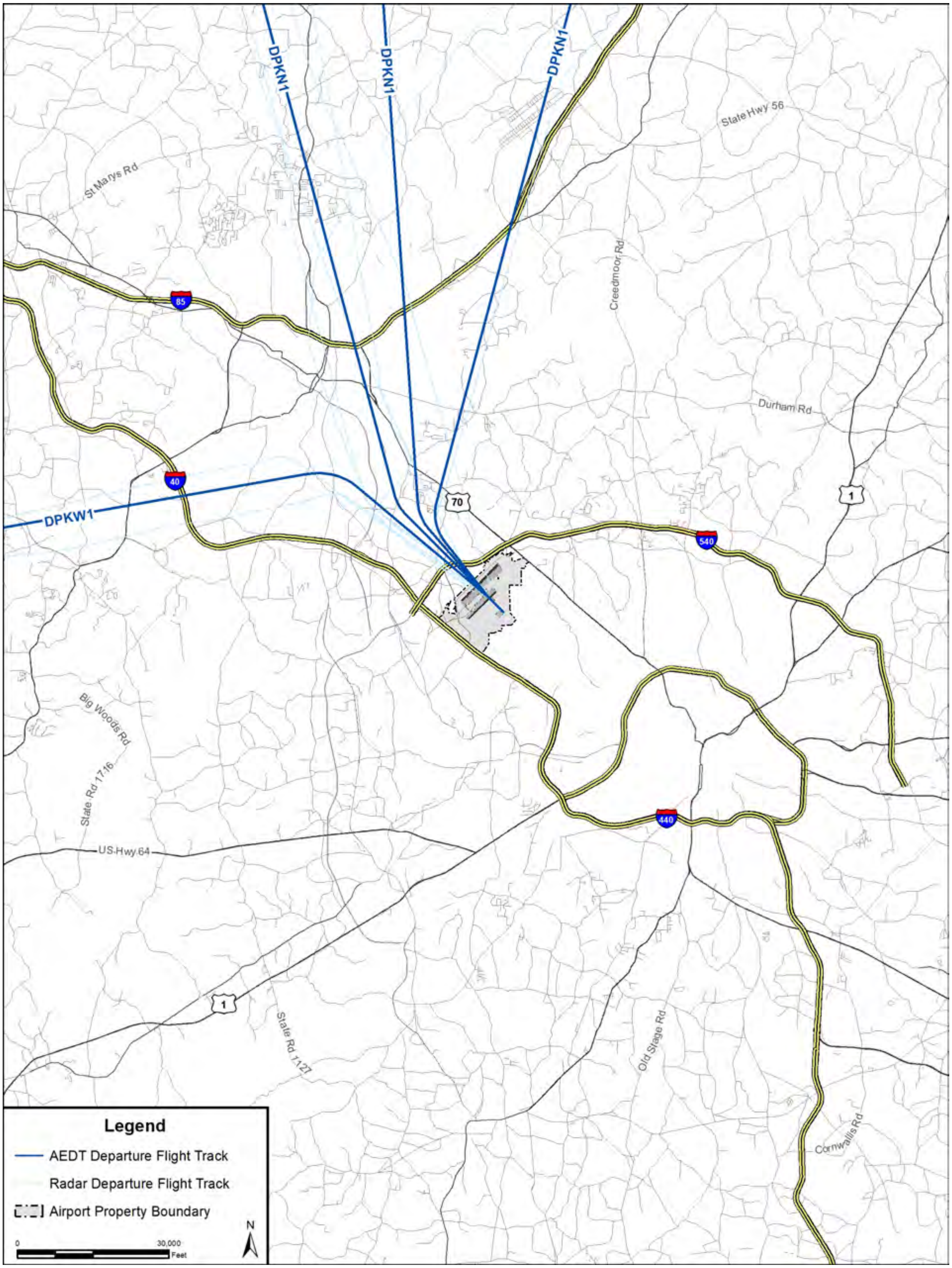
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-5, RUNWAY 14 DEPARTURE TRACKS



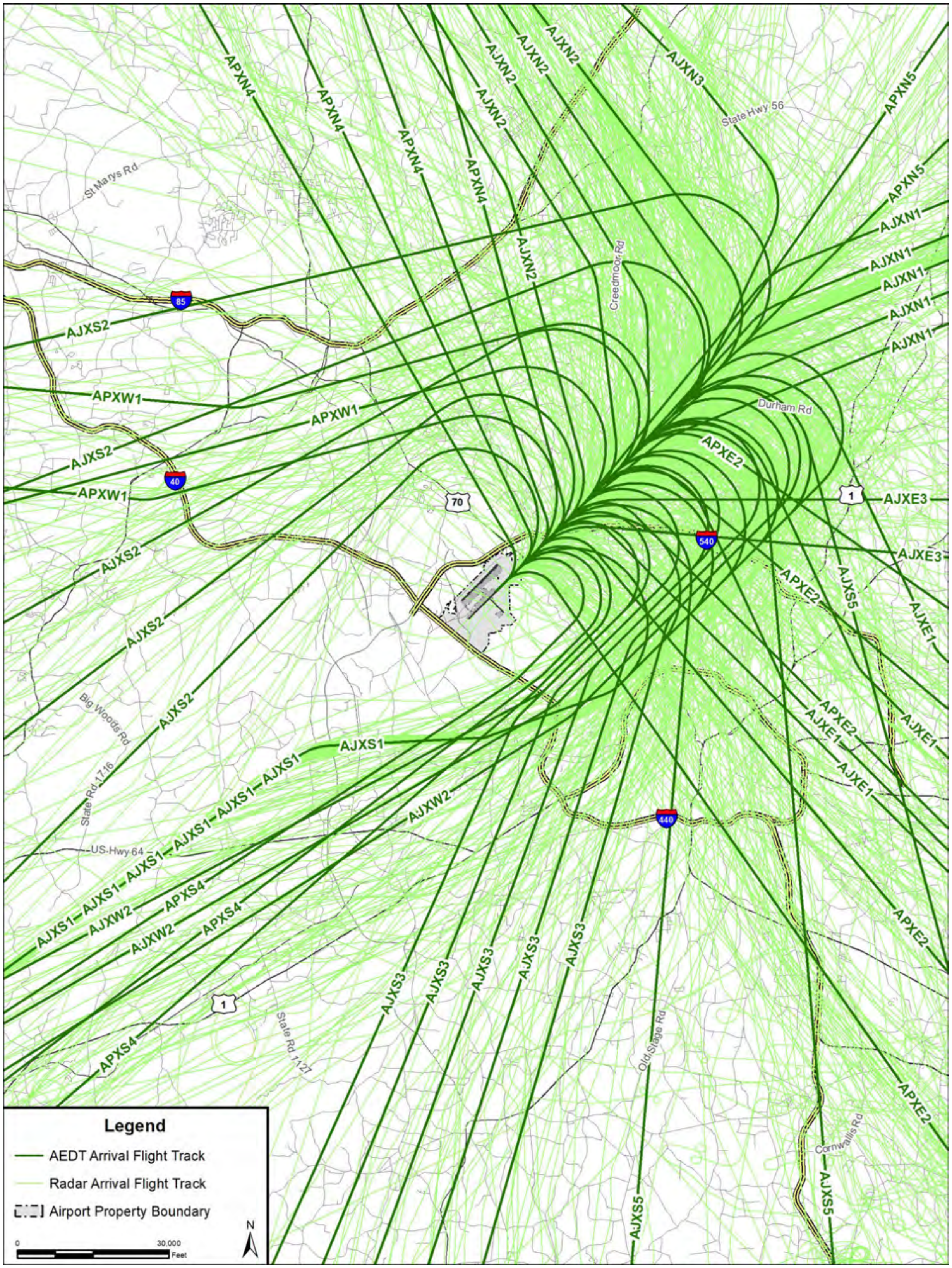
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-6, RUNWAY 32 DEPARTURE TRACKS



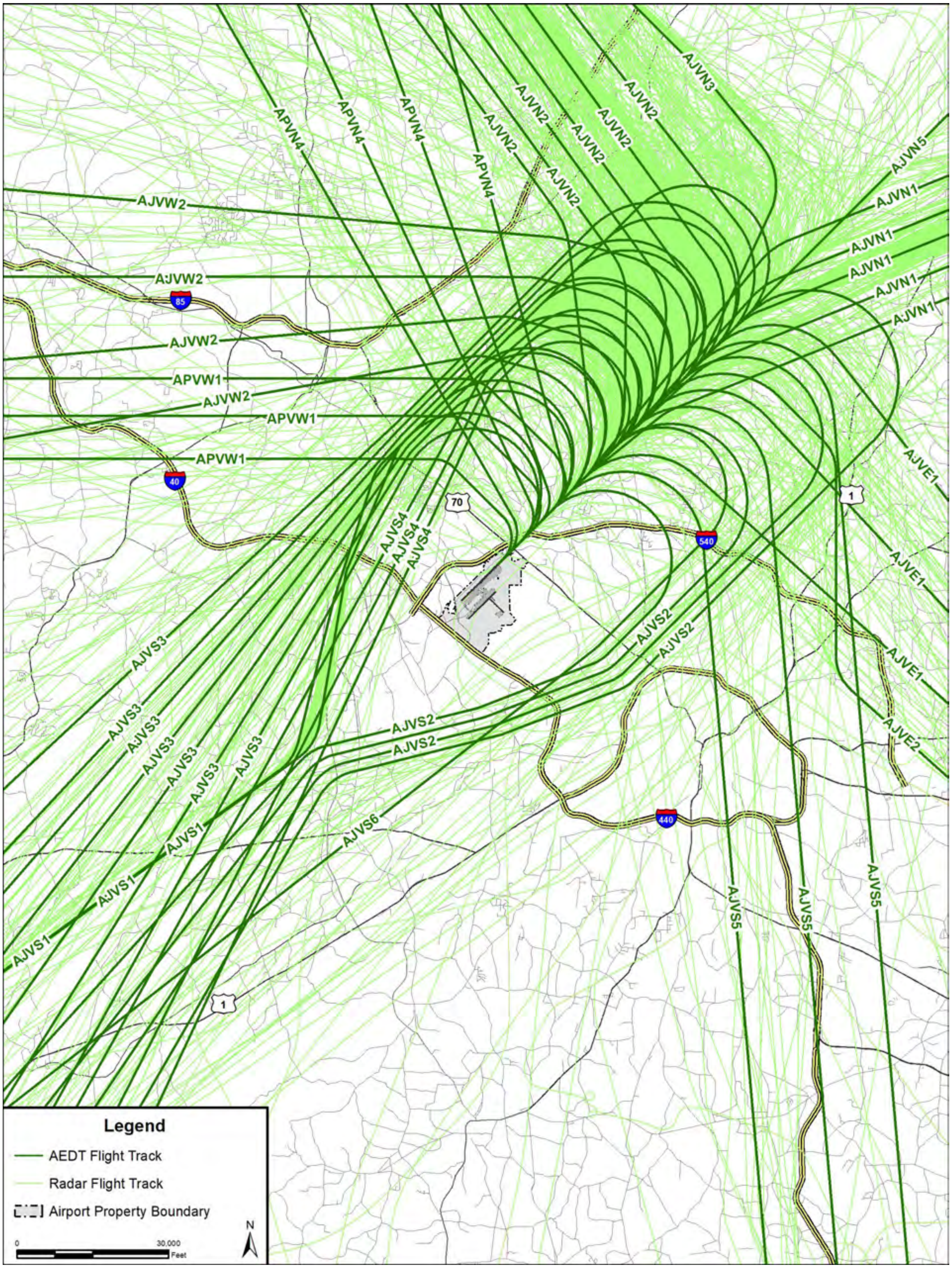
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-7, RUNWAY 23L ARRIVAL TRACKS



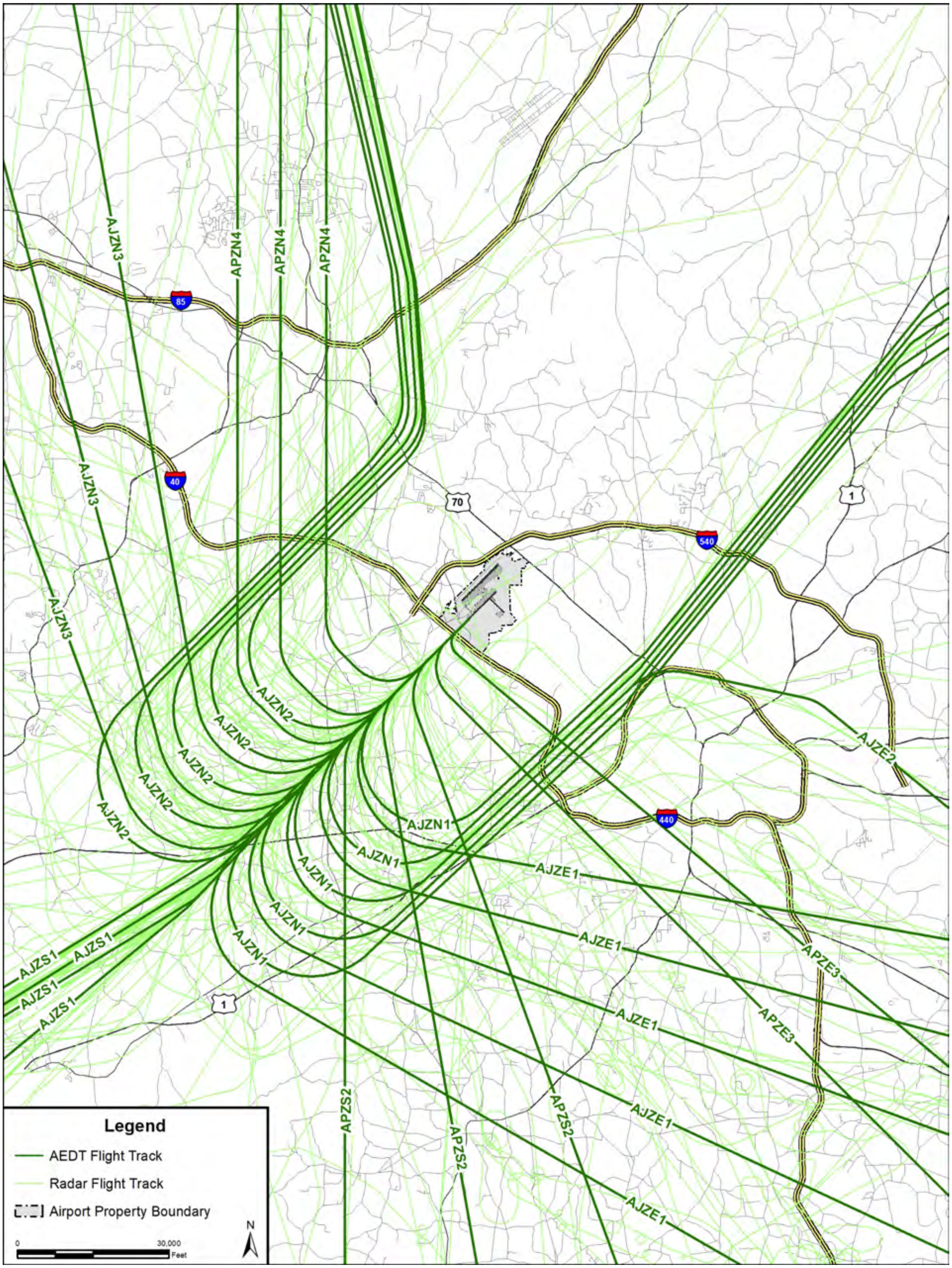
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-8, RUNWAY 23R ARRIVAL TRACKS



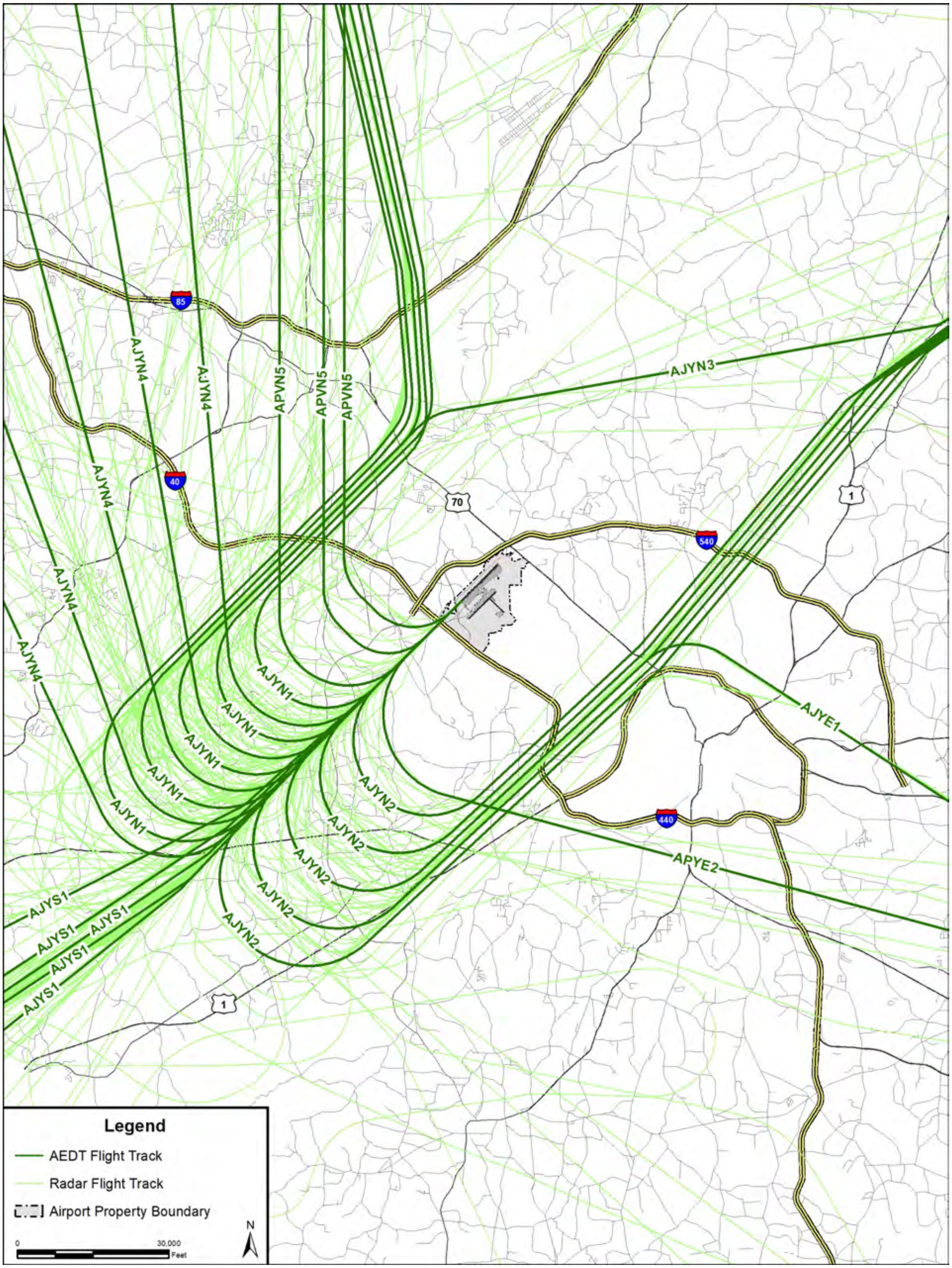
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-9, RUNWAY 5R ARRIVAL TRACKS



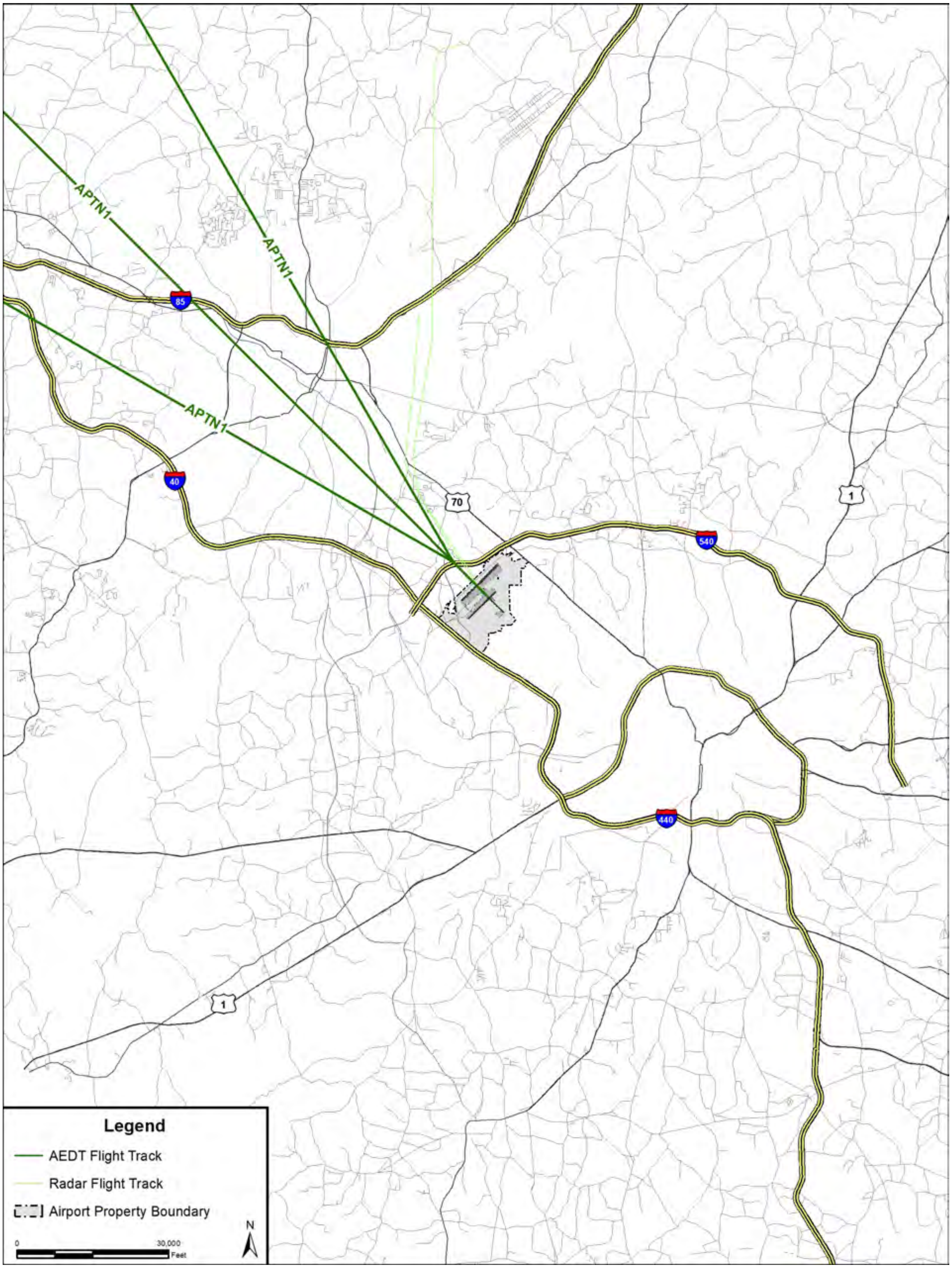
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-10, RUNWAY 5L ARRIVAL TRACKS



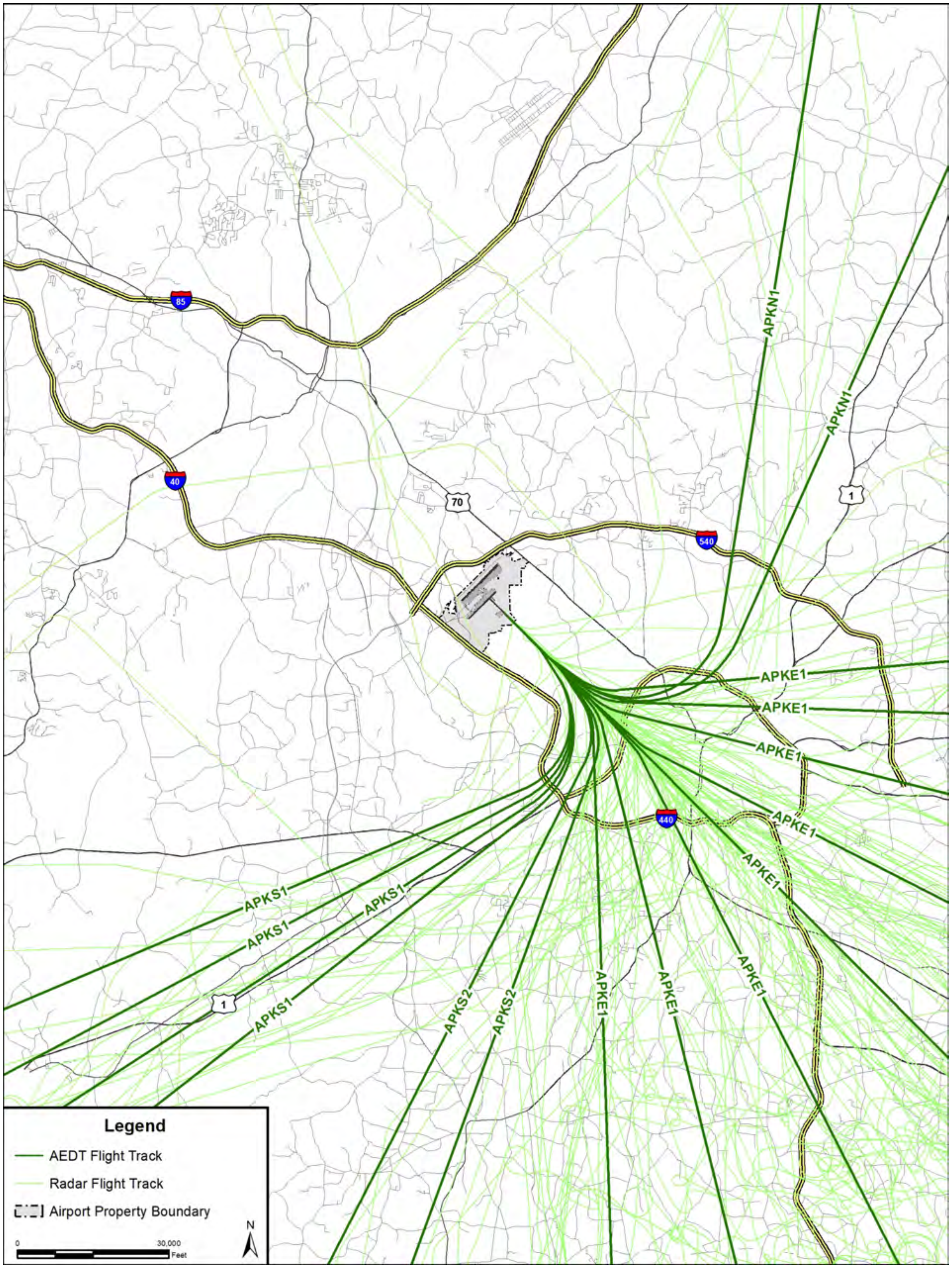
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-11, RUNWAY 14 ARRIVAL TRACKS



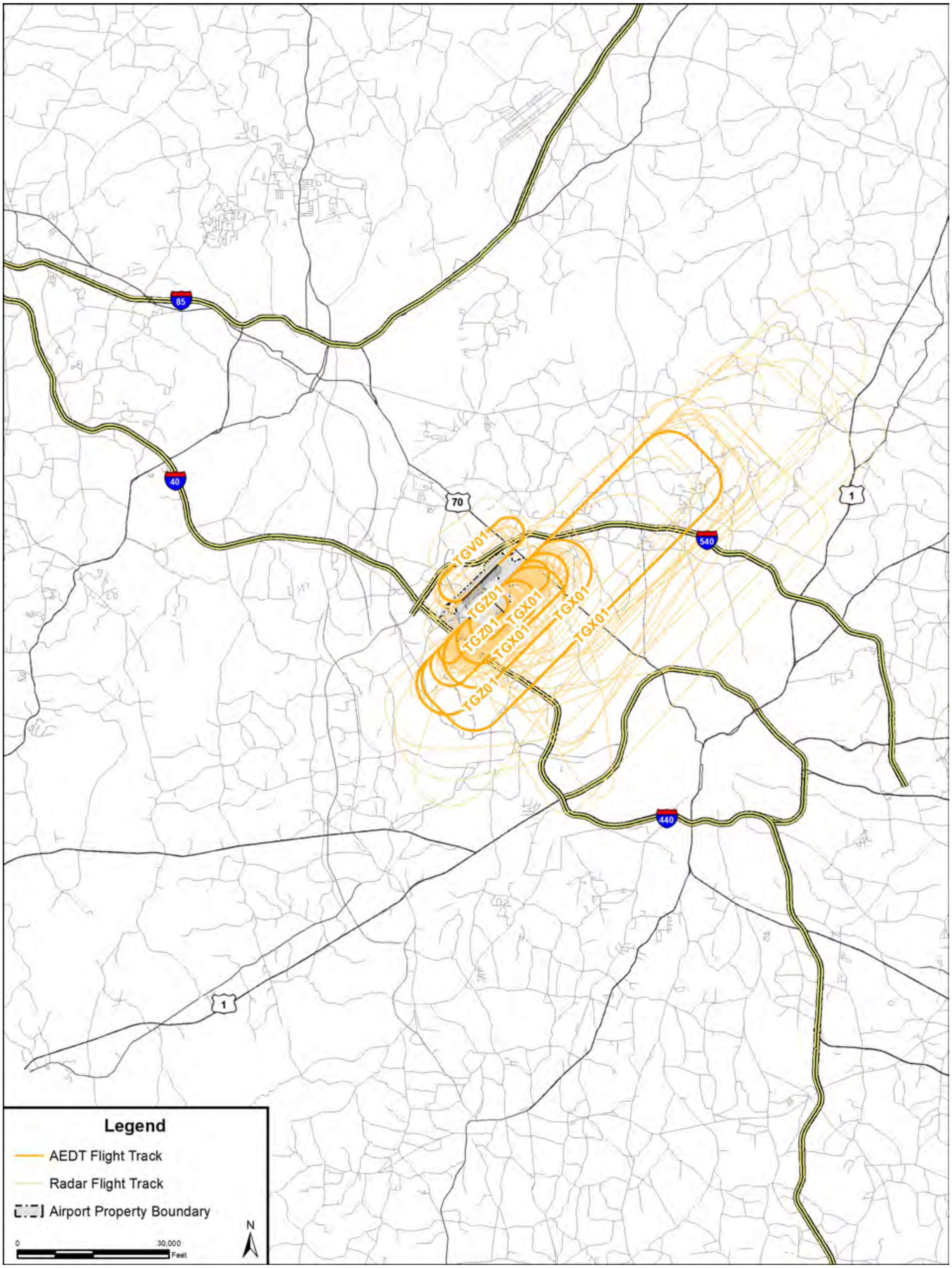
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-12, RUNWAY 32 ARRIVAL TRACKS



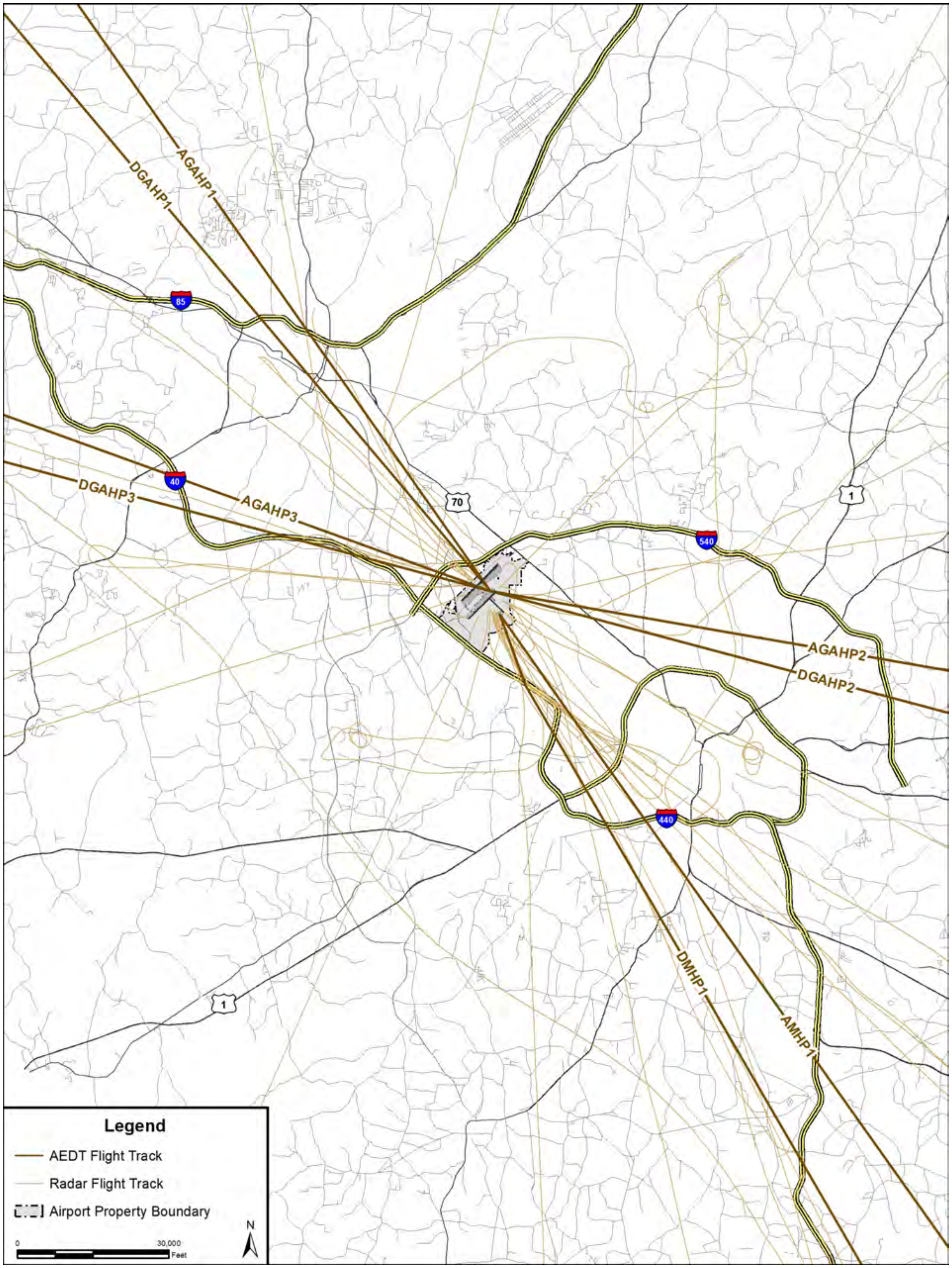
Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-13, TOUCH AND GO TRACKS



Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

EXHIBIT A-14, HELICOPTER TRACKS



Source: Airport Authority, Durham County GIS, Wake County GIS, and L&B, 2021

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T +1 513 530 5333
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landrum-brown.com

September 20, 2022

RE: Proposed Runway 5L/23R Replacement Project Environmental Assessment (EA) at the Raleigh-Durham International Airport Notification

This notification is to inform you that your residence has been identified as potentially being impacted from aircraft noise by a proposed runway replacement project at the Raleigh-Durham International Airport (RDU). The Raleigh-Durham Airport Authority (Airport Authority) and Federal Aviation Administration (FAA) are reaching out to ensure you are aware of the project and have an opportunity to participate in the public outreach efforts.

The Airport Authority and the FAA are currently preparing the required National Environmental Policy Act (NEPA) documentation for the proposed Runway 5L/23R Replacement Project at the RDU. Runway 5L/23R is nearing the end of its useful life and needs to be completely moved and reconstructed. The proposed Runway 5L/23R Replacement Project includes relocating Runway 5L/23R west of existing Runway 5L/23R and, after construction is complete, converting the existing Runway 5L/23R to a taxiway. The project also includes using fill material from airport borrow sites, using water from Brier Creek Reservoir, constructing drainage improvements, relocating a portion of Lumley Road and utilities, demolishing four buildings, relocating aircraft navigational aids, acquiring property, and removing and/or mitigating obstacles in accordance with FAA safety standards.

More information about the project is available at the following website: https://www.airportprojects.net/rdu-ea/ . You can sign up to be notified of upcoming events through this website. If you do not have computer access, you can call Landrum & Brown's RDU EA support number at (984) 275-3167 to leave a message and someone will get back with you to help.

Sincerely,

Chris Babb

Chris Babb
Landrum & Brown, Incorporated

Address	Street	Municipality	State	Zip Code
110	Marcom Drive	Morrisville	NC	27560-9521
113	Marcom Drive	Morrisville	NC	27560-9522
7231	Englehardt Drive	Raleigh	NC	27617-3300
7235	Englehardt Drive	Raleigh	NC	27617-3300
5108	Fairmead Circle	Raleigh	NC	27613-7857
5109	Fairmead Circle	Raleigh	NC	27613-7858
5112	Fairmead Circle	Raleigh	NC	27613-7857
5272	Fairmead Circle	Raleigh	NC	27613-7802
5276	Fairmead Circle	Raleigh	NC	27613-7802
5277	Fairmead Circle	Raleigh	NC	27613-7806
5281	Fairmead Circle	Raleigh	NC	27613-7806
5004	Jesmond Place	Raleigh	NC	27613-7854
12009	Leesville Road	Raleigh	NC	27613-8311
11984	McBride Drive	Raleigh	NC	27613-8338
11988	McBride Drive	Raleigh	NC	27613-8338
11991	McBride Drive	Raleigh	NC	27613-8338
11992	McBride Drive	Raleigh	NC	27613-8338
11995	McBride Drive	Raleigh	NC	27613-8338
11999	McBride Drive	Raleigh	NC	27613-8338
12003	McBride Drive	Raleigh	NC	27613-7559
12007	McBride Drive	Raleigh	NC	27613-7559
12011	McBride Drive	Raleigh	NC	27613-7559
12015	McBride Drive	Raleigh	NC	27613-7559
11908	Radner Way	Raleigh	NC	27613-5501
11912	Radner Way	Raleigh	NC	27613-5501
11916	Radner Way	Raleigh	NC	27613-5501
11917	Radner Way	Raleigh	NC	27613-5503
11925	Radner Way	Raleigh	NC	27613-5503
7257	Villoria Lane	Raleigh	NC	27617-2708
7301	Villoria Lane	Raleigh	NC	27617-7209
7305	Villoria Lane	Raleigh	NC	27617-7209
5200	Willow Cry Lane	Raleigh	NC	27613-5656
5205	Willow Cry Lane	Raleigh	NC	27613-5656
10004	Wynalda Way	Raleigh	NC	27613-7563
10007	Wynalda Way	Raleigh	NC	27613-7563
10011	Wynalda Way	Raleigh	NC	27613-7563
10012	Wynalda Way	Raleigh	NC	27613-7563
12117	Leesville Road	Raleigh	NC	27613
210	Sorrell Grove Church Road	Morrisville	NC	27560