Appendix B, Noise Measurements and Complaints

Charlotte Douglas International Airport

DRAFT – August 2024

PREPARED FOR
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Appendix B Noise Measurements and Complaints

B.1 Noise Measurement Program

A temporary noise measurement program was conducted from October 4, 2022 to October 10, 2022. The temporary noise measurement program was conducted in accordance with 14 Code of Federal Regulations (CFR) Part 150 guidelines as provided in Section A150.5. Noise meters were located at different public locations to measure noise from aircraft operations. Noise measurements were taken using two methods, short-term measuring (up to one-hour per site) and long-term measuring (five days per site). Each site was selected relative to flight patterns, proximity to other measuring sites, areas of past noise concern, and lack of ambient (background) noise sources. The following sections describe the methodologies, locations, and results of the short-term and long-term noise measurement efforts.

B.1.1 Equipment Type

State of the art equipment used in this program included the Larson Davis LxT and 831 sound level meters. These are Class I Precision Sound Level Meters (as defined by American National Standards Institute (ANSI) and International Electrotechnical Commission (IEC)). The equipment was calibrated in compliance with manufacturer's procedures. Microphones and recording equipment were of the highest quality and capable of recording and calculating the various noise metrics. The equipment settings included the "A" frequency, weighting, filter characteristics, and the "slow response" characteristics. The instrumentation that was used for collecting short-term and long-term measurements as listed in **Table B-1, *Acoustical Measurement Instrumentation***.

Table B-1 Acoustical Measurement Instrumentation

Method	Equipment Type		
	Sound Level Meter	Microphone	Pre-amp
Long-Term	Larson Davis 831C	377B02	PRM831
Short-Term	Larson Davis LxT1	377B02	PRMLxT

Source: Landrum & Brown, 2023.

B.1.2 Noise Measurement Site Selection

Noise measurements were taken at eight long-term sites and 20 short-term sites. The long-term and short-term noise measurement sites were chosen based on their proximity to the Airport, the flow of aircraft operations during the measurement program, and areas of past noise concerns. General sites were selected on the basis of ambient noise level (or more specifically, the absence of loud ambient noise such as vehicular traffic), locations of flight tracks derived from radar data, locations of noise complaints received by the Airport, and the locations of concentrations of residential land uses that experience high numbers of aircraft overflights. Specific locations were suggested by Airport staff, as well as through application of consultant experience. Attempts were also made to select sites where noise measurements were taken during previous noise studies. Specific selection criteria included the following:

- Emphasis on areas of numerous aircraft noise events according to earlier evaluations;
- Representative sampling of all major types of operations and aircraft operating at CLT;

- Screening of each site for local (ambient) noise sources or unusual terrain characteristics, which could affect measurements; and
- Location where there are concentrations of residential development.

For the seven long-term noise measurement sites, additional emphasis was placed upon the location of flight corridors for operations arriving and departing each runway end. While there are numerous locations available for measuring, the selected sites fulfil the above criteria and provide a representative sampling of the varying aircraft noise conditions in the vicinity of the Airport. **Exhibit B-1, *Noise Measurement Sites*** illustrates the locations of both the short-term and long-term noise measurement sites. **Table B-2, *Short-Term Noise Measurement Sites*** lists the 20 short-term sites and **Table B-3, *Long-Term Noise Measurement Sites*** lists the eight (8) long-term sites.

Table B-2 Short-Term Noise Measurement Sites

Site ID	Site Description
S1	Winget Park
S2	River Cabin Lane
S3	Berewick Commons Parkway near Loch Lomond Drive
S4	Griers Fork Drive & Brown Grier Road
S5	Gerald Drive at Sullivan Trace Drive
S6	Farmhurst Drive - Treetops Apartments
S7	Thornfield Road cul-de-sac - west end
S8	Central Steele Creek Church - 9401 S Tryon St
S9	Harvest Center Church - 5415 Airport Drive
S10	Peachtree Road and Emmanuel Drive - Church Parking
S11	Prairiegrouse Court
S12	Coulwood Drive & Fielding Road
S13	Community west of Sam Wilson Rd on Farrhill Rd
S14	Verde Creek Road west of San Gabriel Avenue
S15	Chappell Baptist Church – 110 Bradford Drive
S16	Eagles Landing Drive
S17	Still Pond Court
S18	Cabe Lane
S19	St Johns Chapel Baptist Church - 8833 Moores Chapel Road
S20	Margo Drive & Taimi Drive

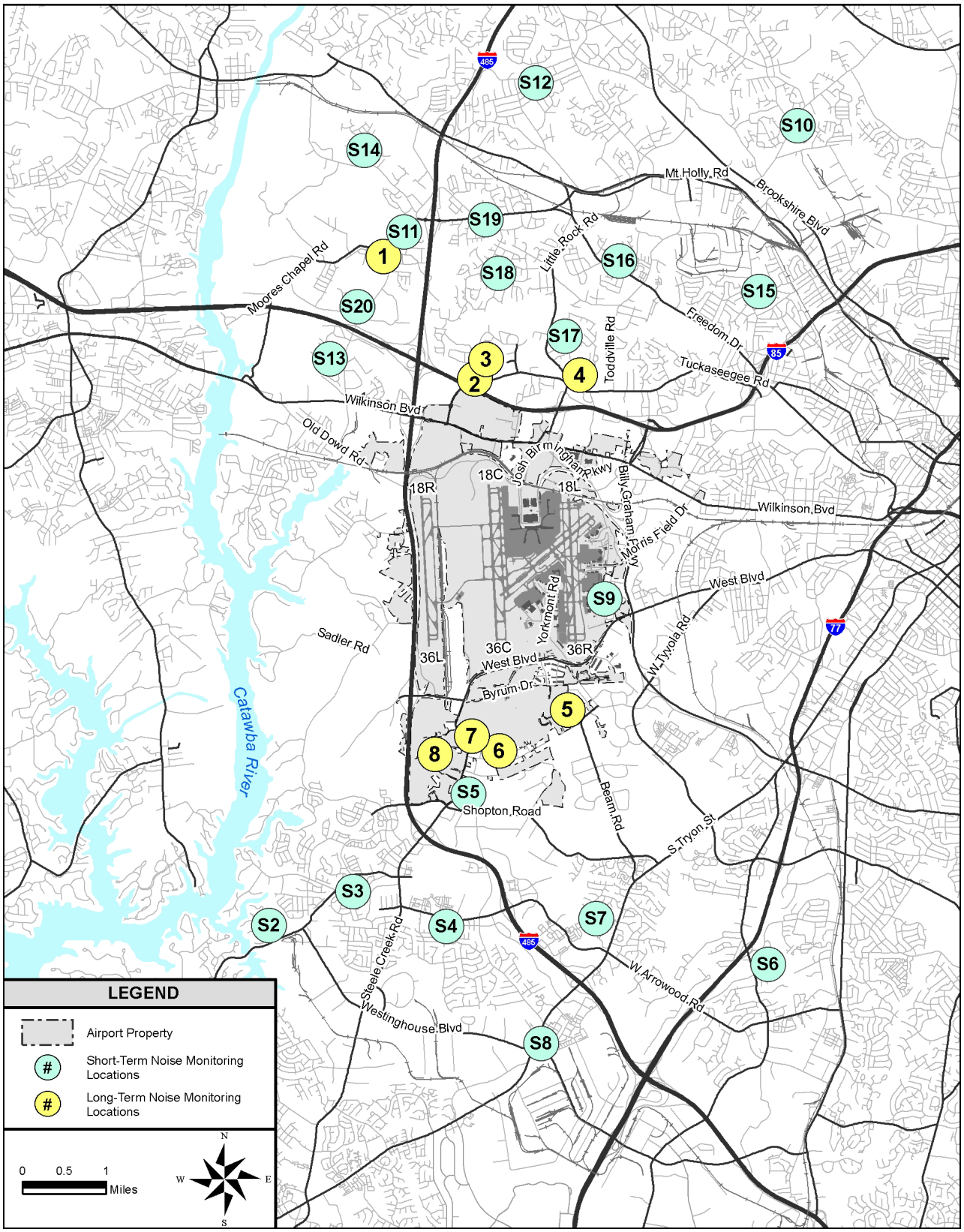
Source: Landrum & Brown, 2024

Table B-3 Long-Term Noise Measurement Sites

Site ID	Site Description
1	Moore's Chapel United Methodist Church, 10601 Moores Chapel Road, Charlotte, NC 28214
2	Every Nation Baptist Church, 7700 Tuckaseegee Road, Charlotte, NC 28214
3	West Mecklenburg High School, 7400 Tuckaseegee Road, Charlotte, NC 28214
4	Mulberry Baptist Church,6450 Tuckaseegee Road, Charlotte, NC 28214
5	Airport-Owned Property off Belle-Oaks Drive
6	Airport-Owned Property on McAlpine Drive
7	Steele Creek Presbyterian Church, 7407 Steele Creek Road, Charlotte, NC 28217
8	Airport Property, 9410 Markswood Road, Charlotte, NC 28278

Source: Landrum & Brown, 2024

Exhibit B-1 Noise Measurement Sites



Source: Landrum & Brown, 2024

B.1.3 Weather Information

The temporary noise measuring was conducted for approximately one (1) hour at some sites and five (5) days at other sites. The weather during the measuring period ranged from sunny and clear skies to rainy/overcast conditions. Both north and south air traffic flow occurred during the measurement dates.

B.2 Noise Measurement Methodology

B.2.1 Short-Term Measurement Procedures

Aircraft noise levels were recorded using the equipment indicated in Table B-1 for each of the 20 short-term sites. Radar data was obtained from the Airport flight tracking system to correspond to the times of measurement. The noise-measurement program was designed to provide a sampling of single events throughout the study area. It was not designed to record cumulative noise levels. The measurement equipment was field calibrated at each location at the beginning of each measurement session. The monitors were attended while active to ensure that only aircraft noise events were recorded, or to note instances where a non-aircraft noise event was recorded simultaneously with an aircraft noise event. The measuring procedure called for the operator to enable the noise monitor when an aircraft noise event first became audible and continue measuring that event until the noise level receded back to ambient levels, usually lasting a duration of 30-90 seconds. After the event, the operator recorded the average noise level (Leq), the sound exposure level (SEL), the event duration, and the maximum sound level (Lmax). Other event information, such as aircraft type and operational characteristics, was also annotated, as available. Ambient noise levels, without aircraft noise or intermittent community noise, were recorded at each site. Short-term measurements were suspended during periods of heavy rain.

The short-term noise measurement program provided for the collection of a large number of single-event measurements at a variety of locations throughout the community at distances ranging from several hundred feet to several miles between the aircraft and the measuring site. This information, when correlated with the radar data and operating schedules, allowed for a comparison to the determination of applicable noise curves and performance characteristics within the AEDT database for the most significant aircraft and operators. Section 6.4 discusses the analysis of short-term noise measurement data and comparison to AEDT aircraft profiles based on the initial results of the noise measurement data correlation and further investigation of average aircraft weights upon departure.

B.2.2 Long-Term Measurement Procedures

For the long-term measurement program, equipment was placed at eight (8) sites and ran continuously for approximately seven days. The equipment was set up on October 4, 2022 and taken down on October 10, 2022. This provided for 120 consecutive hours of measurements starting at 12:00 am on October 5, 2022 and ending at 11:59 pm on October 9, 2022. Measurement staff coordinated with property owners and caretakers to gain access to these properties; which included churches and undeveloped land in the vicinity of CLT.

The measuring equipment was field calibrated at each location at the beginning of each measurement session. Staff periodically checked the equipment to ensure proper operation. The

calibration was checked at the end of the measurement session to confirm the equipment remained in calibration throughout the measurement period.

The sound level meters were programmed to record one-second Leq in addition to “event” Leq, SEL, Lmax, and duration. The sound level meters were programmed to classify an “event” as a period of time in which the noise level rose above 65 dB for a duration of at least five seconds. Noise event data was then correlated to radar data to determine if the noise was likely caused by an aircraft overflight that occurred over the site at the time of the noise event.

B.3 Noise Measurement Results

B.3.1 Short-Term Measurement Results

The noise measurement program collected a wide range of noise exposure levels from aircraft activity in the airport environs. The measured noise levels from departing aircraft tended to produce peak decibel levels several decibels higher than those of arriving aircraft. This difference is caused by two characteristics of the separate operations. First, exposure to noise above the background levels from arriving aircraft is typically shorter than from departing aircraft. Second, the power settings used during approach are lower than those necessary to climb during the take-off, resulting in noise levels for arrivals of several decibels less than measured at similar locations during departure. **Table B-4, *Short-Term Noise Measurement Results*** provides a summary of the short-term noise measurement results.

Table B-4 Short-Term Noise Measurement Results

Site ID	Site Description	Date of Measurement	Time of Measurement	Ambient Noise Level	Type of Event	Number of Events	Loudest Event (Lmax)	Loudest Aircraft	SEL Range
S1	Winget Park	10/6/2022	3:42 pm to 4:18 pm	39.4 - 43.2	Departures	11	72.0	B737	61.0 - 81.3
S2	River Cabin Lane	10/6/2022	5:45 pm to 6:32 pm	47.1 - 55.1	Departures	19	67.1	A319	60.7 - 78.3
S3	Berewick Commons Parkway near Loch Lomond Drive	10/6/2022	4:46 pm to 5:24 pm	43.9 - 56.9	Departures	27	72.4	A320	62.1 - 80.8
S4	Griers Fork Drive & Brown Grier Road	10/10/2022	1:59 pm to 2:51 pm	46.1 - 49.6	Arrivals	15	77.2	A321	77.7 - 86.1
S5	Gerald Drive at Sullivan Trace Drive	10/6/2022	9:21 am to 10:08 am	47.9 - 52.6	Arrivals	34	69.8	A319	69.4 - 78.6
S6	Treetops Apartments	10/6/2022	2:37 pm to 3:12 pm	45.0 - 54.3	Departures	15	75.7	B737	64.3 - 84.5
S7	Thornfield Road west end cul-de-sac	10/11/2022	8:33 am to 9:18 am	47.4 - 51.7	Arrivals	5	76.0	B737	67.8 - 85.8
S8	Central Steele Creek Church	10/5/2022	9:06 am to 9:49 am	55.3 - 59.6	Arrivals	30	76.0	CRJ900	67.4 - 83.7
S9	Harvest Center Church	10/6/2022	10:46 am to 11:46 am	42.9 - 56.9	Departures	30	69.0	A321	64.2 - 79.3
S10	Peachtree Road & Emmanuel Drive	10/10/2022	12:40 pm to 13:27 pm	42.6 - 49.7	Departures	13	77.4	A321	70.6 - 86.3
S11	Prairiegrouse Lane	10/4/2022	10:12 pm to 11:12 pm	54.1 - 57.6	Departures	11	69.2	A306	57.8 - 64.1
S12	Coulwood Drive & Fielding Road	10/11/2022	10:29 am to 10:55 am	42.8 - 45.5	Departures	7	69.8	CRJ900	70.6 - 80.3
S13	Community west of Sam Wilson Road on Farrhill Road	10/5/2022	5:55 pm to 6:37 pm	44.9 - 46.9	Departures	16	63.8	CRJ900	61.1 - 75.6
S14	Verde Creek Road west of San Gabriel Avenue	10/5/2022	11:12 am to 11:53 am	51.1 - 55.4	Departures	25	72.4	B738	48.9 - 82.8
S15	Chappell Baptist Church	10/5/2022	3:36 pm to 4:49 pm	45.8 - 48.3	Departures	13	62.4	A320	60.3 - 79.5
S16	Eagles Landing Drive	10/4/2022	9:05 am to 10:05 am	50.6 - 53.4	Departures	3	67.1	B757	74.3 - 78.4
S17	Still Pond Court	10/5/2022 10/6/2022	7:09 pm to 8:03 pm 1:19 pm to 1:51 pm	47.0 - 51.6 51.9 - 60.8	Departures Arrivals	23 11	75.3 82.1	B737 B737	61.1 - 86.0 67.4 - 89.5
S18	Cabe Lane	10/5/2022	2:35 pm to 3:33 pm	49.1 - 51.3	Departures	22	64.1	A321	55.0 - 76.0
S19	St Johns Chapel Baptist Church	10/10/2022	4:23 pm to 5:24 pm	46.7 - 49.8	Departures	55	86.1	B777	61.8 - 93.6
S20	Taimi Drive	10/5/2022	4:51 pm to 5:32 pm	47.3 - 48.0	Departures	25	77.2	A321	66.6 - 86.2

Source: Landrum & Brown, 2024

B.3.2 Long-Term Noise Measurement Results

Noise level readings were used to characterize the noise environment at each location and to distinguish the various noise levels associated with individual aircraft operations. The primary objective of the noise measurement program was to collect a sampling of noise and operational data for specific aircraft events and to measure ambient (background) noise levels. Secondarily, data from the long-term sites also included the average aircraft DNL for the 120-hour period; although, measured DNL levels for short periods of time can differ from average-annual levels due to differences in runway use and the other operational factors, as well as influences from non-aircraft noise sources. **Table B-5, *Long-Term Noise Measurement Results*** summarizes the results of the long-term noise measurement program.

Table B-5 Long-Term Noise Measurement Results

Site ID	Ambient Noise Level (L_{50})	DNL	Average Number of Aircraft Overflights Per Day	Loudest Event (Lmax)	Loudest Aircraft
1	51.9	62.2	346	92.6	B772
2	60.3	74.4	434	103.3	B772
3	53.3	60.6	497	94.2	B772
4	50.4	61.7	369	94.6	MD11
5	50.5	63.4	350	98.3	E145
6	46.3	66.7	410	96.6	A321
7	51.1	60.5	349	94.4	A321
8	54.7	62.4	429	90.3	B738

Source: Landrum & Brown, 2024

The noise measurement process was designed to capture the noise levels of a representative mix of aircraft operations at CLT. Some of the noise events collected at the measurement sites were produced by non-aircraft, e.g., cars, people, pets, wildlife, etc. However, at each site, the majority of noise events were produced by aircraft operations based on observations and aircraft radar data.

B.4 Noise Event Correlation

Measured noise events were matched to specific aircraft operations from radar data using the following two-step method:

1) Once the noise measurement data was downloaded, noise levels greater than 65 dB for a duration longer than five seconds were identified as individual noise events. Once an event fell below the 65 dB trigger level for more than two seconds, the event was considered to have ended
2) Using the flight data from the Airport's operations monitoring system, noise events that occurred while an aircraft flight path passed within one nautical mile (6,076 feet) along the ground from the measurement site were correlated and classified as aircraft noise events.

Although this method provided positive identification of aircraft operations and highly accurate correlation with measured noise events, some community noise (e.g. cars, lawnmowers, animals) and aircraft noise occurred simultaneously and correlated as aircraft noise events. Unfortunately, there is currently no technology to separate aircraft noise levels from simultaneous non-aircraft noise levels.

B.4.1 Ambient Noise Levels

The data collected at the long-term noise measurement sites included 50th percentile data (L_{50}), which is the noise level at which 50 percent of the measured levels are higher. The FAA typically recommends using the L_{50} level to determine ambient noise levels (i.e., the noise level that would occur in the absence of identifiable noise events such as continuous automobile traffic, wind, wildlife, etc.). Table 6-5 also shows the L_{50} level at each long-term measurement site. Ambient noise levels were reported for informational purposes and were not incorporated into the noise contour modelling because per Part 150 guidance, ambient noise is not an input requirement for the noise model and ambient noise levels can differ from location to location and between different times of day.

B.4.2 Comparison to AEDT Database

The primary purpose of the noise measurement program was to provide a sample of noise levels generated by individual aircraft events for comparison to the AEDT database. This effort was focused on the five most common aircraft that operate at CLT, and the two largest passenger aircraft that operate at CLT. The five most common aircraft provide for the greatest sample size, and the two largest passenger aircraft are the heaviest, thus having the greatest influence on the Airport's noise contours. For this analysis, data was obtained from the long-term noise measurement sites 1, 2, 4, 5, and 6.

A comparison of the average measured aircraft noise level and the average AEDT predicted aircraft noise level at four sites is shown in **Table B-6, *Aircraft Noise Single Event Data***. As shown, the difference in average measured and modelled noise level for arrivals and departures of these seven aircraft ranges between 0.0 and +/- 3.6 dB; and in most cases, the difference is at the lower end of this range. Analytical models (such as AEDT) often have a 95% confidence interval of ±3 dB to ±5 dB. Therefore, a difference of 3.9 dB between an estimate from measurements and one from an analytical model may not be significant.[1]

The comparison of measured and modelled noise levels, both single event and cumulative, are within an acceptable range of tolerance. The results of the temporary noise measurement program identified no significant inconsistencies between measured noise levels and AEDT predicted noise levels. Therefore, no adjustments to the existing aircraft noise profiles in the AEDT database are recommended for this study.

[1] Sec. 7.7.1, SAE ARP4721 – Part 1, Monitoring Aircraft Noise and Operations in the Vicinity of Airports: System Description, Acquisition and Operation, Issued 2006-08.

Table B-6 Aircraft Noise Single Event Data

Aircraft Type	AEDT ID	Operation Type	Measured Noise Level*	AEDT Modelled Noise Level	Difference
Airbus A300F4-600 Series	A300-622R	Arrival	91.69	95.52	3.8
		Departure	86.37	85.90	-0.5
Airbus A319-100 Series	A319-131	Arrival	85.43	88.26	2.8
		Departure	87.17	84.56	-2.6
Airbus A320-200 Series	A320-232	Arrival	85.62	88.53	2.9
		Departure	88.10	86.59	-1.5
Airbus A321-200 Series	A321-232	Arrival	86.07	87.44	1.4
		Departure	90.14	89.58	-0.6
Boeing 737-800 Series	737-800	Arrival	86.82	87.50	0.7
		Departure	90.01	90.07	0.1
Bombardier CRJ-700-ER / Bombardier CRJ-900-ER	CRJ9-ER	Arrival	84.59	85.89	1.3
		Departure	84.04	81.22	-2.8
Embraer ERJ175	EMB-175	Arrival	85.02	87.44	2.4
		Departure	87.68	85.40	-2.3

Note: The measured noise level represents the average SEL noise levels for each aircraft type at long-term noise measurement sites 1, 2, 4, 5, and 6.
Source: Landrum & Brown analysis, 2023

B.5 Noise Complaint History

Noise complaint records from January 1, 2020 to May 30, 2024 were gathered in a database format for analysis in this study. **Table B-7, *Summary of Noise Complaints*** provides a summary of the number of noise complaints received and **Table B-8, *Noise Complaints by Time of Day*** presents the noise complaints by time of day they were received. **Exhibit B-2, *Location of Noise Complaints***, illustrates the geographic locations of these noise complaints. Between January 1, 2020 through May 30, 2024, there were 3,16,279 total complaints from 994 individual households. Approximately 66 percent of all complaints during this timeframe came from four individual households.

Table B-7 Summary of Noise Complaints

Year	Number of Noise Complaints	Number of Individuals Submitting One or More Complaints
2020	55,036	230
2021	97,676	260
2022	97,703	181
2023	56,729	221
2024 (partial)	9,044	123
Total	316,279	**1,015**

Source: Charlotte Douglas International Airport, 2024.

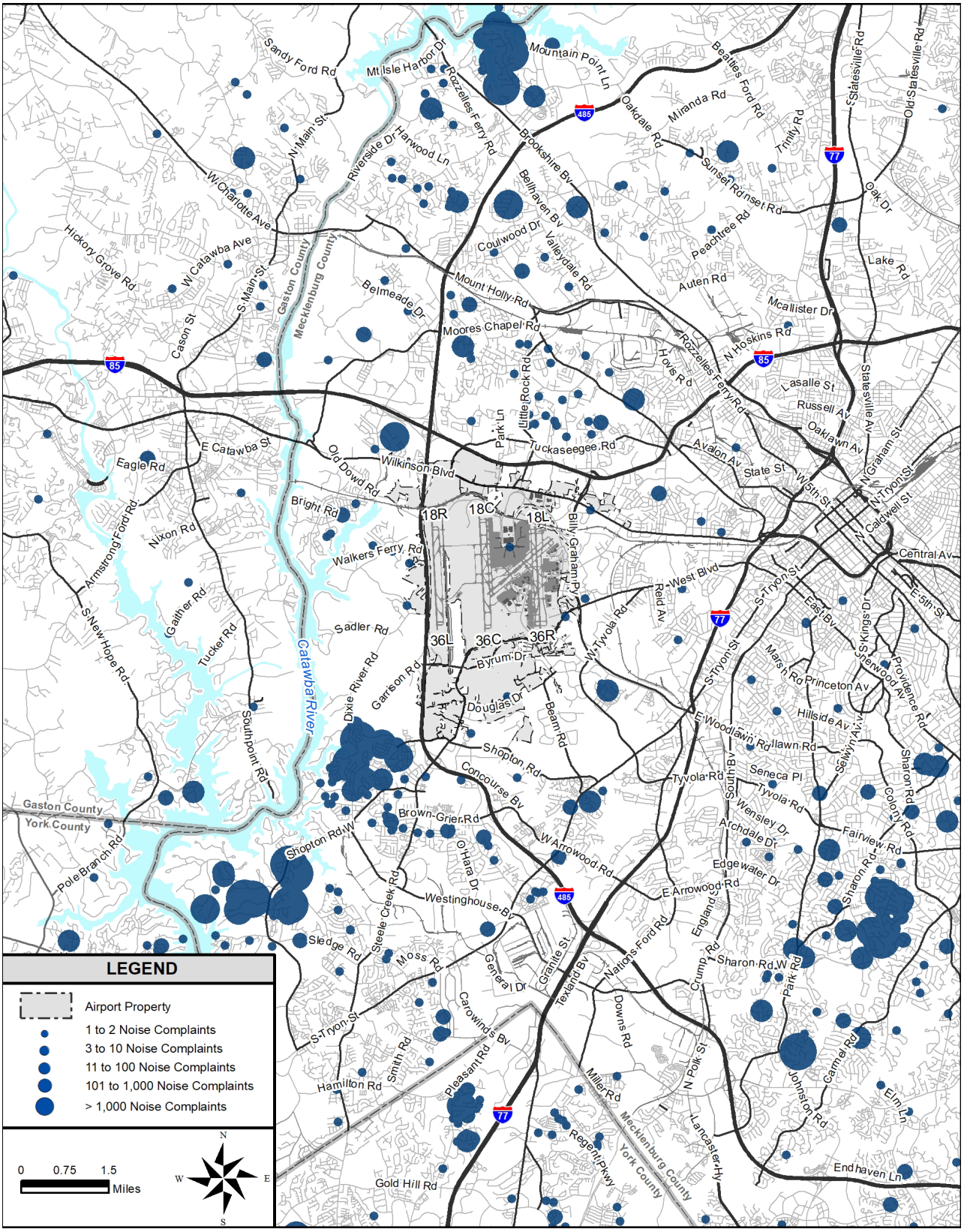
The majority of complaints were made regarding aircraft noise levels. Other reasons for complaints included complaints about aircraft altitude, frequency of overflights, disturbance of speech, disturbance of sleep, vibration, early morning or late night flights, and helicopter overflights. Staff from CLT reviews and responds to all complaints.

Table B-8 Noise Complaints by Time of Day

Time of Day	Percent of Complaints
0:00 - 1:00	0.4%
1:00 - 2:00	0.1%
2:00 - 3:00	0.0%
3:00 - 4:00	0.0%
4:00 - 5:00	0.1%
5:00 - 6:00	0.5%
6:00 - 7:00	1.1%
7:00 - 8:00	4.3%
8:00 - 9:00	3.5%
9:00 - 10:00	6.6%
10:00 - 11:00	4.6%
11:00 - 12:00	6.8%
12:00 - 13:00	3.8%
13:00 - 14:00	7.5%
14:00 - 15:00	4.5%
15:00 - 16:00	7.2%
16:00 - 17:00	6.3%
17:00 - 18:00	5.9%
18:00 - 19:00	7.4%
19:00 - 20:00	6.5%
20:00 - 21:00	8.5%
21:00 - 22:00	9.0%
22:00 - 23:00	3.1%
23:00 - 0:00	2.4%
Total	100.0%

Source: Charlotte Douglas International Airport, 2024; Landrum & Brown analysis, 2024.

Exhibit B-2 Noise Complaint Locations



Source: Landrum & Brown, 2024