Lake Elmo Airport (21D)
Mobile Sound Study Report

November 2021

Community Relations Office

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1.0 Introduction

The Metropolitan Airports Commission (MAC) completed the 2021 21D Mobile Sound Study in support of the Lake Elmo Airport Advisory Council (LEAAC) 2021-2022 Work Plan. The study occurred over a seven-day period (August 4-10, 2021) and involved two industry standard methods for assessing aircraft sound: field-measured data and modeled data. Field measured sound data, conducted by MAC Community Relations staff, used sound analyzers and best practices to measure and collect data at three field locations on airport property.

Sound level modeling for 21D flight activity was performed using the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT) modeling software.

The results of this study are intended to enhance communication about sounds associated with Lake Elmo Airport (21D) aircraft activity.

The sections below describe the 21D runway use, aircraft operations, weather, field-measured data collection process and analysis, AEDT modeling data and analysis, a comparison of measured data and modeled data, and a summary of aircraft noise complaints received during the study period.

2.0 Operations

21D is a general aviation, public use airport owned and operated by the MAC. The airport is a reliever airport for Minneapolis-St. Paul International Airport (MSP) and accommodates flight training, recreational flying, and some business aviation in single-engine and twin-engine propeller-driven airplanes, and occasional helicopters.

The airport is open for aircraft operations 24 hours per day. There are two runways available for use at 21D: Runway 14/32 and Runway 4/22. Helicopters may land and depart from areas other than a runway.

Flight training at 21D generates multiple operations during a single flight as pilots practice their takeoffs and landings (called touch and go operations) for proficiency. It is normal and expected that the airport will be busier in the spring and summer when increased flight training and recreational flying become more prevalent compared to other seasons. The 21D Mobile Sound Study was scheduled to capture as much aircraft activity data as possible.

The MAC Noise and Operations Monitoring System (MACNOMS) collects flight tracking data and reports operations data. Until recently, MACNOMS counted an operation only when a flight began or ended at the airport. This means that a single training flight that practiced numerous takeoffs and landings would only be counted for its initial takeoff and its final landing. Beginning on July 1, 2021, the MACNOMS methodology for counting operations was updated to reflect total aircraft departures and arrivals more accurately at MAC airports. The updated methodology was used for this study's operations counts.

During the study period, MACNOMS data show 864 total operations at 21D with 435 arrivals and 429 departures. Table 2.1 shows the number of operations on each 21D runway per day. The highest levels of 21D runway use occurred on Runway 22 with 167 arrivals and 167 departures.

Table 2.1: 21D Aircraft Activity per Runway each Day during the Study Period								
Runway	4-Aug	5-Aug	6-Aug	7-Aug	8-Aug	9-Aug	10-Aug	**Runway Total**
21D Arrivals								
4	-	-	5	1	-	24	-	30
14	2	17	8	2	43	50	17	139
22	88	13	1	-	9	1	55	167
32	1	-	69	-	3	13	12	98
blank	-	-	-	-	-	1	-	1
21D Departures								
4	-	-	4	1	-	22	-	27
14	4	15	10	-	38	47	17	131
22	84	15	2	-	13	1	52	167
32	-	-	69	-	-	16	16	101
blank	-	-	-	-	-	3	-	3
Daily Total	**179**	**60**	**168**	**4**	**106**	**178**	**169**	**864**

Runway 14/32 was used for 54 percent of the activity during the study period and Runway 4/22 was used 45 percent. Figure 2.1 shows the 21D flight tracks for daytime operations.

There were five arrivals and four departures that operated between the hours of 10:00 P.M. and 7:00 A.M. during the study period. Three takeoffs and three landings, most likely performed for pilot nighttime currency certification, on August 10, 2021 between 10:19 P.M. and 10:41 P.M. In addition, there was a landing on August 8, 2021 at 12:29 A.M., one landing at 10:51 P.M. on August 9, 2021, and one departure at 6:02 A.M. on August 10, 2021. There were 41 total nighttime operations during the third quarter of 2021. Figure 2.2 depicts 21D nighttime activity during the study period. Weather during the study week was desirable for flying with typical mid-summer wind and temperature patterns, and very little precipitation occurred. Weather conditions (e.g., temperature, precipitation, wind, etc.) affect airport activity, runway use decisions and aircraft performance. In addition to operational factors, weather conditions can also affect the way sound is transmitted and observed. For these reasons, weather data are documented during the study period. A summary of daily weather conditions is provided in the Appendix.

Figure 2.1: 21D Daytime (7:00 A.M to 10:00 P.M.) Operations During Study Period

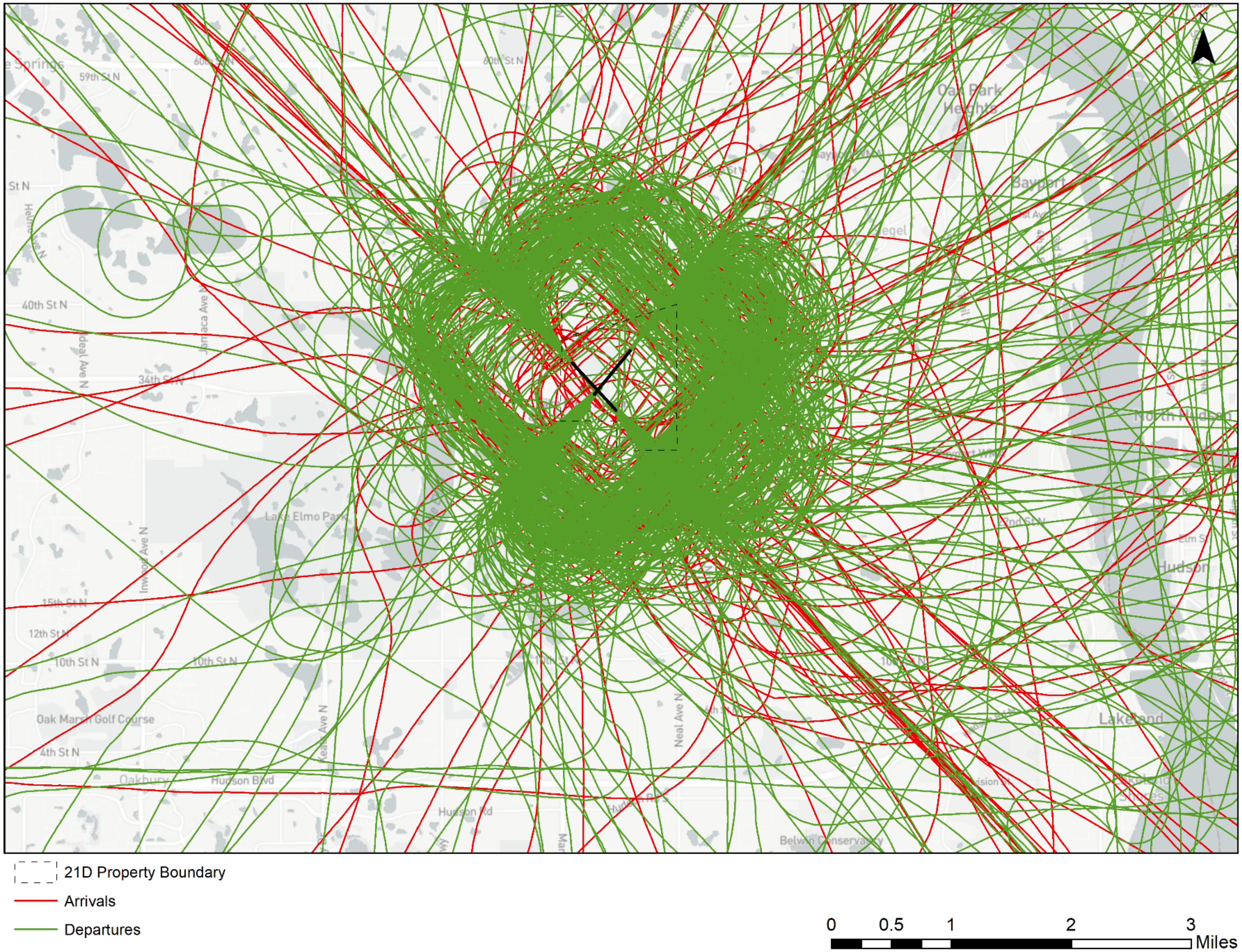
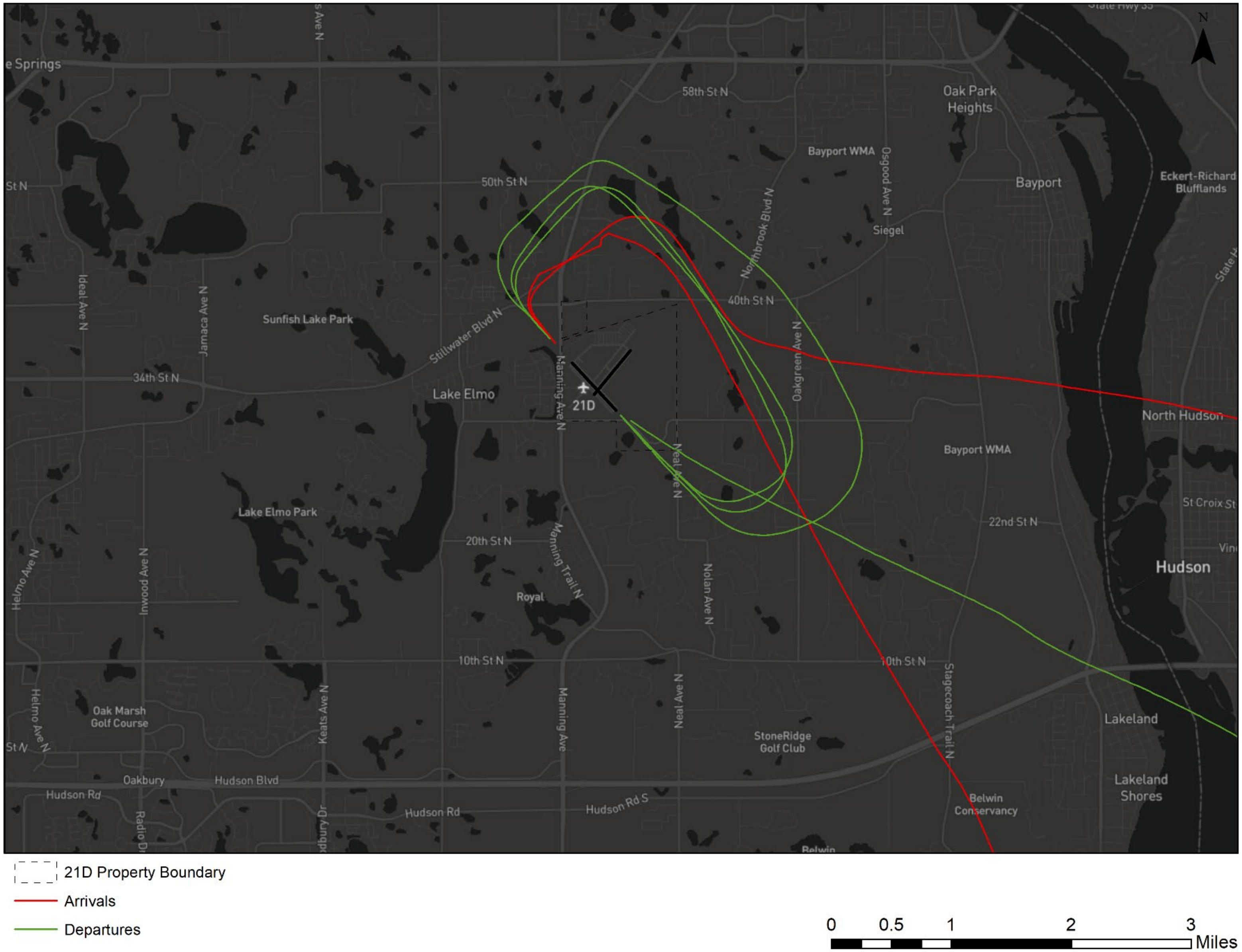


Figure 2.2: 21D Nighttime (10:00 PM to 7:00 AM) Operations During Study Period



3.0 Field-Measured Sound Data

Field measurement sites are positioned consistent with MAC Mobile Sound Monitoring Guidelines. These guidelines are provided in the Appendix.

The dates of this study period are August 4-10, 2021. Figure 3.1 shows a map of the field measurement equipment locations, and Figure 3.2 shows a picture of each field measurement site. Equipment specifications and are provided in the Appendix.

Figure 3.1: Field Measurement Equipment Locations

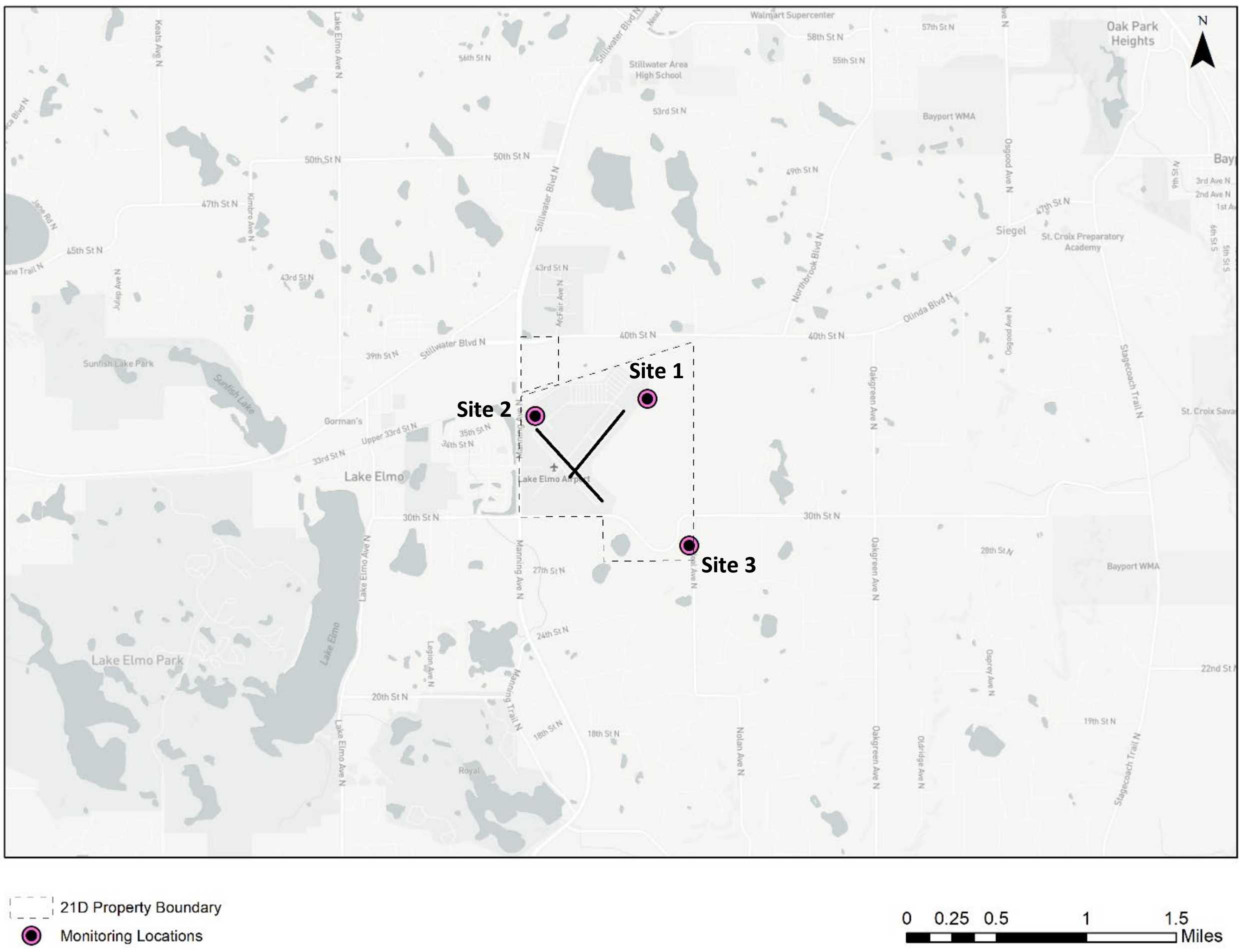


Figure 3.2: Field-Measurement Site Photos

Site 1

Site 2

Site 3

3.2 Field Measurement Analysis and Parameters

One sound analyzer collected data at each of the field-measurement sites. Each site operated continuously, measuring sound levels utilizing a slow response with A-weighting (dBA), as federally-prescribed by standards for collecting aircraft sounds in the FAA's 14 CFR Part 150. Sound events are identified and documented when the sound level exceeds 65 dBA for four seconds or longer. The parameters used by the sound monitoring instrumentation measure both community and aircraft sounds. Any sound event not correlated with 21D aircraft activity is considered a community event. The equipment and tolerances are set to be sensitive so that aircraft do not have to fly directly over the measurement site to be recorded.

In this study, sound events from aircraft and community sound sources were detected. Sound events were correlated with 21D flight track data, collected by MACNOMS, using temporal and spatial parameters (time and distance). All uncorrelated sound events are referred to in this report as community events.

3.3 Field Measurement Results

There were 211 aircraft sound events and 26 community sound events measured at the three sites during the seven-day study period. This section summarizes information for both aircraft and community sound sources described in terms of single sound event metrics (LA_{max}, SEL, Event Duration) and summary-based metrics (DNL, ADNL, CDNL and LA_{90}).

Single Sound Event Metrics

Table 3.1 shows the daily number of single aircraft sound events aircraft sounds that exceeded 65 dBA for four seconds. The largest number of aircraft sound events captured during the study period on a daily basis occurred on Friday, August 6 with 80 events. The smallest number of aircraft sound events measured during the study period occurred on Saturday, August 7 with 1 event.

Table 3.1 also shows a total number of sound events captured for each site. Site 1 measured 42 aircraft sound events. Site 2 measured the most aircraft sound events during the study period with 108 events. Site 3 measured the second-highest number of aircraft sound events during the study period with 61 events. Both Site 2 and 3 measured activity associated with aircraft using Runway 14/32, the most-heavily used runway during the study period. More detail about runway use was provided in Section 2.0.

Table 3.1: Number of Measured 21D Aircraft Sound Events per Day

	Wed. August 4	Thur. August 5	Fri. August 6	Sat. August 7	Sun. August 8	Mon. August 9	Tue. August 10	Site Total
Site 1	5	2	5	1	1	24	4	42
Site 2	3	2	67	-	1	18	17	108
Site 3	6	6	8	-	18	11	12	61
Daily Total	**14**	**10**	**80**	**1**	**20**	**53**	**33**	**211**

Figure 3.3 shows the number of aircraft sound events that were measured each hour during the study period. The highest number of aircraft sounds were captured during the 3:00 P.M., 12:00 P.M. and 10:00 A.M. hours with 31, 25, and 20 measured aircraft sound events, respectively. Site 2 measured the highest

number of aircraft sound events during a one-hour period with 18 events. There were 4 aircraft sound events measured during the nighttime hours of 10:00 P.M. – 7:00 A.M., at Site 3.

Figure 3.3: Number of 21D Aircraft Sound Events Above 65 dBA per Hour by Site

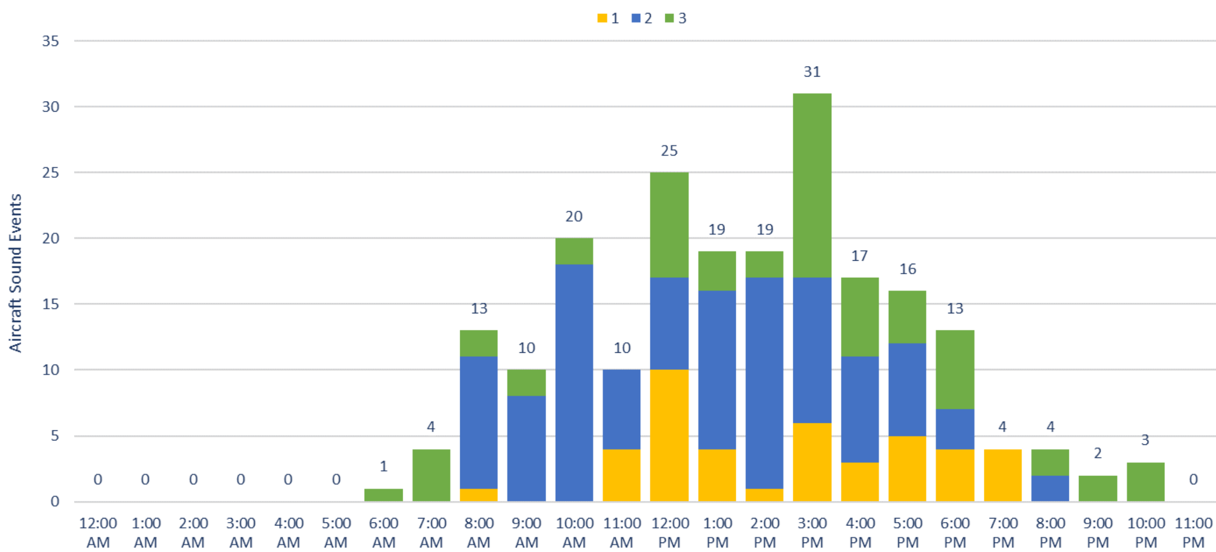


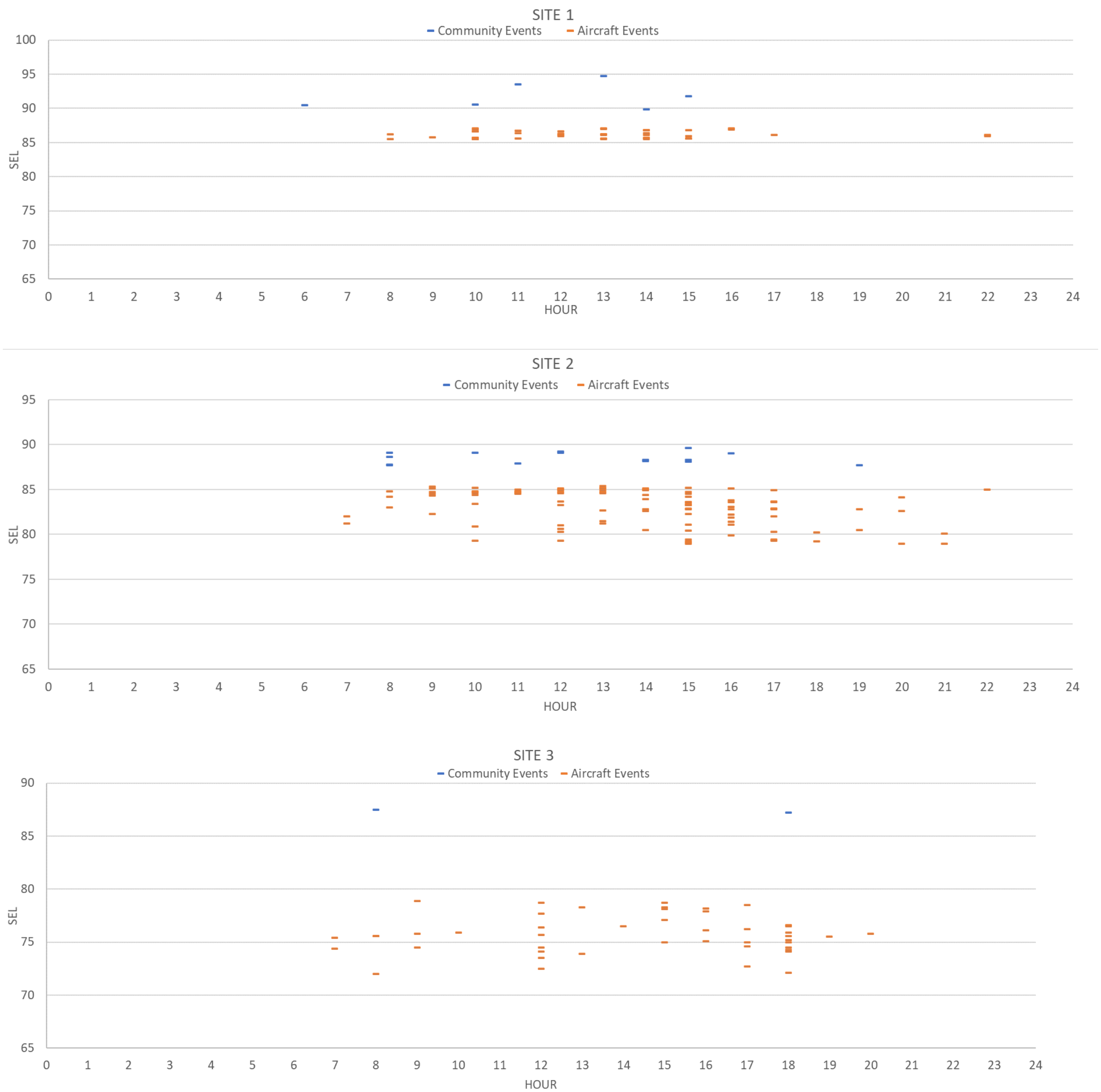
Table 3.2, below, shows the number of measured aircraft arrival and departure sound events with a maximum measured level (LA_{max}) at or above 65 dBA, 80 dBA, 90 dBA, and 100 dBA at each site. A total of 211 aircraft sound events were measured at or above 65 dBA. Of those, 46 events were at or above 80 dBA and none were at or above 90 dBA. The loudest sound event was captured at Site 1 and had an LA_{max} of 89.8 dB generated by a Cessna Skyhawk departing on 21D Runway 4. The highest number of arrival sound events was 43, measured at Site 2. The highest number of departure sound events was 65 measured at Site 2.

Table 3.2: Number of Measured 21D Aircraft Sound Events by Level (LA_{max})				
Site	# of Events > 65dBA	# of Events > 80dBA	# of Events > 90dBA	# of Events > 100dBA
Aircraft Arrivals				
1	23	2	0	0
2	43	8	0	0
3	25	1	0	0
Arrival Total	**91**	**11**	**0**	**0**
Aircraft Departures				
1	19	3	0	0
2	65	29	0	0
3	36	3	0	0
Departure Total	**120**	**35**	**0**	**0**
Total Aircraft Events	**211**	**46**	**0**	**0**

Sound events cannot be directly compared without normalization due to level fluctuations throughout each sound event and variation in the duration of each sound event. Sound Exposure Level (SEL) is a metric that expresses a sound event as a one-second (1s) value, regardless of the actual event duration.

Figure 3.4 shows the measured hourly aircraft and community SEL events for each site.

Figure 3.4: Aircraft and Community Sound Events per Hour (SEL)



Site 2 measured the highest SEL community events, and the highest SEL aircraft events occurred at Site 2 and Site 1.

Table 3.3 shows the types of aircraft associated with highest LA_{max} and SEL at each site during the study period, ranked by LA_{max}.

The aircraft sound event with the longest duration was measured at 24 seconds and occurred at Site 2 by a Bell 206 (B206) helicopter on August 4, 2021 at 6:04 P.M. with a LA_{max} at 80.4 dB and a SEL of 87.2.

The loudest aircraft sound event during the study period occurred at Site 1 with a Cessna Skyhawk piston aircraft measuring a maximum level at 89.8 dBA on August 6, 2021 at 11:05 A.M. The SEL for this aircraft sound event measured at 93.5.

Table 3.3 Top-Ten Measured 21D Aircraft Sound Events per Site

Site 1							
Date and Time	LA_{max}	Duration	SEL	Aircraft Type	Flight ID	Rank LA_{max}	Rank SEL
8/6/2021 11:05	89.8	15	93.5	C72R	N758CE	1	1
8/9/2021 12:47	81.2	10	86.3	C208	N113RF	2	4
8/10/2021 17:53	81.1	8	84.9	P750	N750UP	3	8
8/9/2021 12:37	80.9	10	86.1	C208	N113RF	4	5
8/7/2021 19:35	80.5	15	87.7	PA28	N9461C	5	2
8/9/2021 12:48	79.5	13	86.6	PA28	N1679H	6	3
8/9/2021 13:05	78.4	13	84.7	PA28	N1679H	7	11
8/9/2021 12:56	78.4	12	85.1	PA28	N1679H	8	6
8/9/2021 11:38	78.4	15	85	C172	N70413	9	7
8/9/2021 11:48	78	12	84.8	C172	N70413	10	9

Site 2							
Date and Time	LA_{max}	Duration	SEL	Aircraft Type	Flight ID	Rank LA_{max}	Rank SEL
8/10/2021 13:12	89.1	17	94.7	PA32	N2899N	1	1
8/6/2021 15:03	87.6	12	91.8	BE35	N9875R	2	2
8/6/2021 10:01	86.9	12	90.6	C77R	N1972Q	3	3
8/6/2021 12:18	85.4	11	89.1	M20T	N231AE	4	9
8/6/2021 14:25	84.9	13	89.9	SR22	N747CT	5	4
8/6/2021 12:51	84.3	11	89.2	C310	N300BD	6	6
8/10/2021 14:17	84.2	10	88.2	P750	N750UP	7	14
8/6/2021 15:08	84.2	12	88.3	PT6A	N216PK	8	13
8/6/2021 14:39	84	11	88.3	P750	N750UP	9	12
8/6/2021 15:24	83.6	16	89.6	C172	N734RQ	10	5

Site 3							
Date and Time	LA_{max}	Duration	SEL	Aircraft Type	Flight ID	Rank LA_{max}	Rank SEL
8/5/2021 6:19	83.7	19	90.5	PA32	N2899N	1	1
8/5/2021 15:53	82.5	14	88.1	C177	N34623	2	2
8/5/2021 16:05	80.2	19	86.9	C177	N34623	3	4
8/9/2021 13:24	80.1	15	87.1	P750	N216PK	4	3
8/10/2021 22:37	78.4	16	85.9	PA32	N2899N	5	6
8/9/2021 10:36	78.4	15	85.5	SR22	N262BG	6	7
8/10/2021 22:29	78.3	17	86.1	PA32	N2899N	7	5
8/8/2021 16:10	77.1	14	85.1	PA32	N2899N	8	8
8/10/2021 22:20	77	15	85	PA32	N2899N	9	9
8/6/2021 14:45	76.8	9	82.8	P750	N750UP	10	14

Summary-Based Metrics

The Day-Night Average sound level (DNL) is an acoustic, summary-based metric that represents the total accumulation of all sound energy during a 24-hour day, including a 10 dB penalty applied to all sounds between 10:00 P.M. and 7:00 A.M. The FAA prescribes the use of DNL to establish a federal aviation threshold of significance of 65 dB DNL. DNL at or above 65 dB are considered incompatible for sensitive land uses such as residences and schools. The MAC distinguishes between aircraft and community-generated sounds using Aircraft DNL (ADNL) and Community DNL (CDNL) respectively.

Figure 3.5 shows the ADNL and CDNL accumulations during the study period for each site. The highest ADNL occurred at Site 2 with 55 dB DNL on August 6, which is below the federal threshold of significance. The CDNL at Site 2 on the same date was 62.1 dB DNL and the combined DNL was 62.9 dB DNL.

The highest combined DNL was 68.7 dB DNL, which occurred at Site 3 on August 7. The CDNL of 68.7 on this date contributed to this high level combined DNL. The ADNL on this date at this site was 0 dB DNL. More detail about the field-measured DNL can be found in the Appendix.

Figure 3.5: Aircraft and Community DNL Accumulations

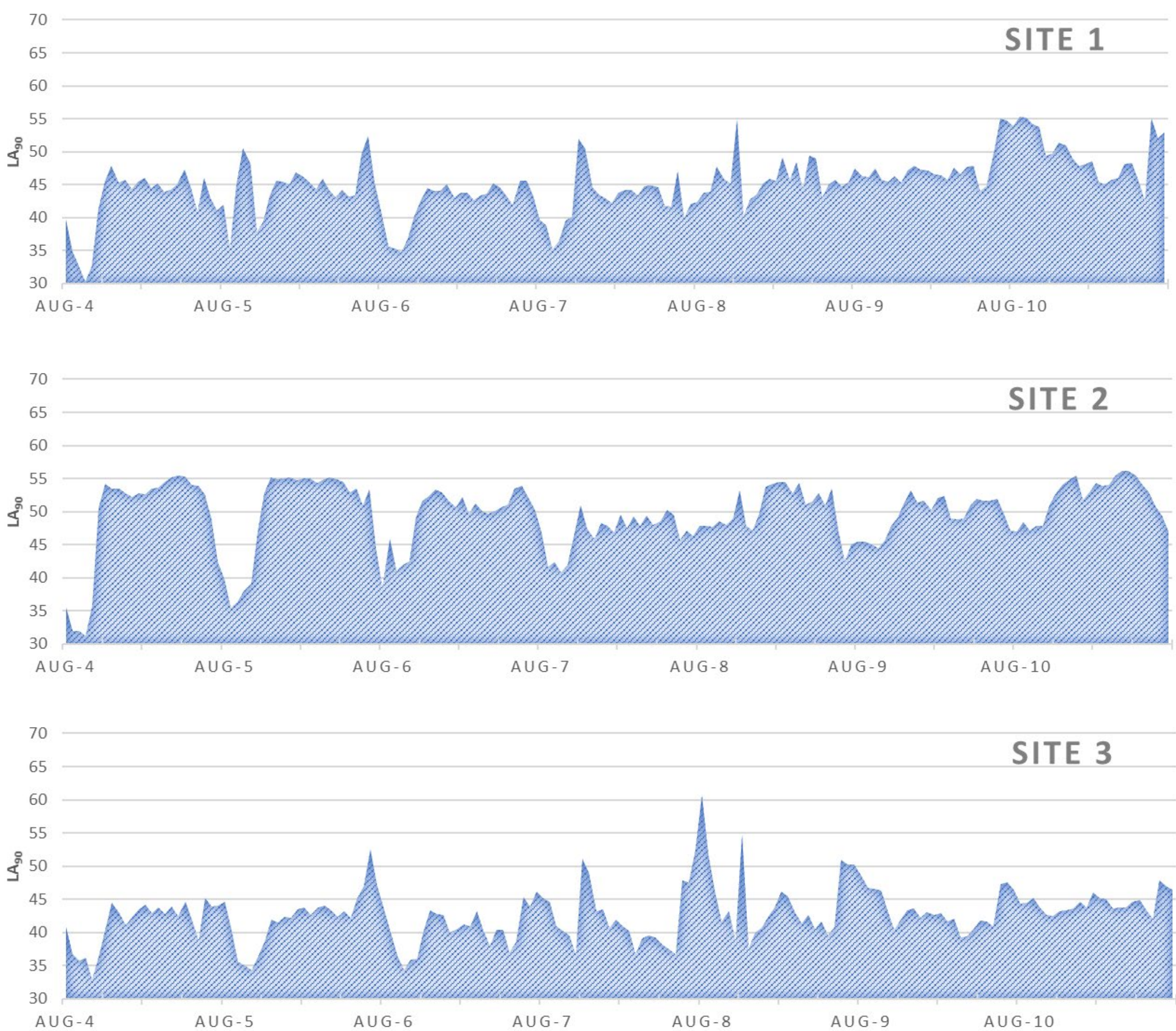
Ambient Sound Levels

Ambient sounds are continuous; emitted around us by sources in our community and environment. Some of these sounds are emitted by sources we cannot always see, such as wind, mechanical equipment, insects, freeways, etc. Many factors contribute to ambient sound levels (both intensity and frequency) and include both natural and human made sounds. Sound events can be transient and/or cyclical (day/night, morning/afternoon/evening/night, weeks, months, seasons, holidays, etc.). Ambient sound levels are important when observing and comparing sound sources to achieve objectivity.

A common method to estimate ambient sound level is to use a statistical metric called the LA_{90}, which is the A-Weighted sound level that is exceeded 90 percent of the time. Figure 3.6 shows the LA_{90} levels measured at each site during the study period.

The LA_{90} levels were highest in the vicinity of Site 3 on August 8 with 60.6 dB during the 12:00 A.M. hour most likely as a result of insect activity. As represented by valleys in the charts below, nighttime ambient sound levels are typically lower than daytime ambient sound levels.

Figure 3.6: Hourly Average Ambient Sound Levels



4.0 Sound Modeling

In addition to field monitoring, 21D aircraft activity from August 4-10, 2021 was modeled using the FAA's modeling tool, AEDT, Version 3d. The FAA notes in a recent report to Congress,

> "… while the DNL metric is FAA's decision-making metric, other supplementary metrics can be used to support further disclosure and aid in the public understanding of community noise effects."

With actual monitoring, as noted above, events are documented when the analyzer detects a sound level over 65 dBA for four seconds or longer. Due to the nature of environmental monitoring, MACNOMS must take measures to attempt to filter out community and other ambient sounds before assigning aircraft sound events to a specific operation. The AEDT model does not have community and ambient sounds to consider.

Conversely, AEDT must make assumptions about aircraft performance, flap configurations, engine settings, aircraft model types, weight, and weather. AEDT uses standard aircraft thrust settings, standard departure climb rates as well as standard arrival descent rates, which may not represent actual flight operating characteristics. Additionally, certificated sound data are available for many aircraft types in the model, however all aircraft operating at 21D are not represented. In those situations, modeling requires aircraft substitutions be used to represent missing aircraft types.

The goal of conducting field measurement studies and producing modeling results are similar and will often time produce the same sound metric calculations, differences between field measurements and sound modeling will sometimes show variances in the analysis results due to community sounds, measurement parameters, and necessary model assumptions.

The AEDT model can produce various sounds metrics. Two metric options available are the Number Above Noise Level and Time Above Noise Level. For this analysis, MAC staff evaluated the number of operations at or above 65 dB at specific grid points and their duration.

This modeled sound analysis depicts aircraft sound events from actual aircraft activity at 21D from August 4, 2021 through August 10, 2021 using model inputs such as runway use, aircraft fleet mix, aircraft performance and thrust settings, topography, and atmospheric conditions. Quantifying aircraft-specific sound characteristics in AEDT is accomplished using a comprehensive database developed by the FAA under 14 CFR Part 36. As part of the airworthiness certification process, aircraft manufacturers are required to subject aircraft to a battery of sound tests. Using federally-adopted and endorsed algorithms, this aircraft-specific sound information is used in the generation of model outputs. Justification for such an approach is rooted in national standardization of sound quantification at airports. Appendix A.3 includes the fleet mix and Appendix A.4 includes weather data utilized in the AEDT model for this analysis.

AEDT uses a grid pattern of individual noise measurement points, known as receptors, and calculates sound at each of these points. The grid pattern for this study included 22,500 unique points spaced 0.1 nautical miles apart arranged in a 15-mile by 15-mile square centered on the Lake Elmo Airport.

Additionally, AEDT uses standard weather inputs that are typically available for a study comprising a full year of data. For this study, standard weather inputs were changed to represent the average weather conditions for the study period. These inputs are available in Appendix A.4, Table A.1.

Figure 4.1 shows the modeled grid points by average number of events per day during the study period. Grid points with the highest number of events per day are all located within airport property.

Table 4.1 below provides the total number of sound events above 65 dBA modeled to occur at a field measurement location during the 21D study period. The table also provides the number of measured sounds events above 65 dBA correlated to aircraft during the study period for comparison.

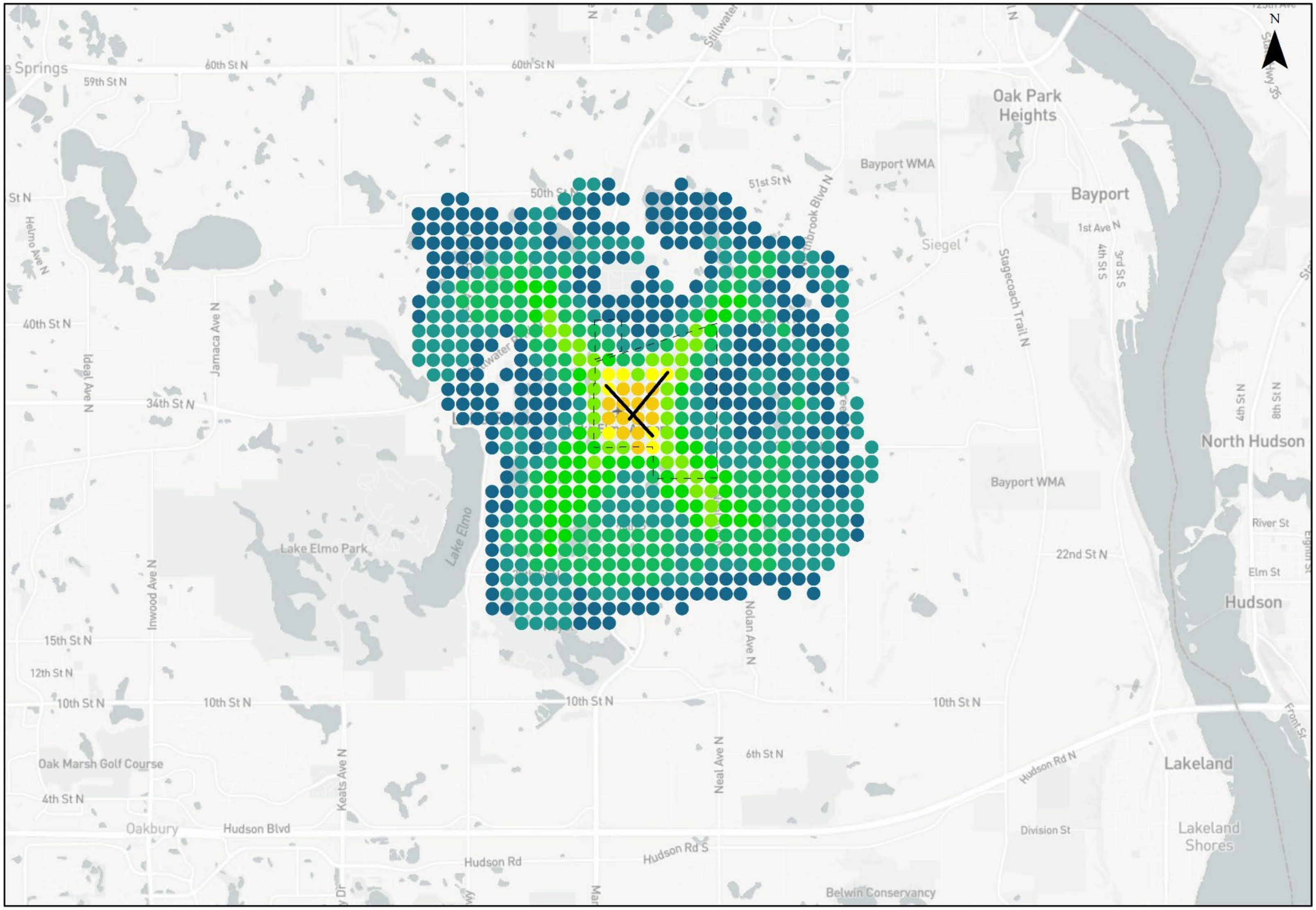
Table 4.1 Measured Vs Modeled Number Above Sound Levels			
Site	N^{65} Measured	N^{65} Modeled	Difference
1	42	218	176
2	108	307	199
3	61	150	89

Figure 4.2 shows the modeled grid points by average time spent above 65 dBA per day during the study period.

Table 4.2 below provides the total amount of time sound levels were above 65 dBA modeled to occur at a measurement location during the study period. The table also provides the total monitored time above 65 dBA correlated to aircraft during the study period for comparison.

Table 4.2 Measured Vs Modeled Time Above Sound Level			
Site	TA^{65} Measured (min)	TA^{65} Modeled (min)	Difference (min)
1	7.4	30.4	23.0
2	22.7	74.62	52.0
3	10.6	26.02	15.4

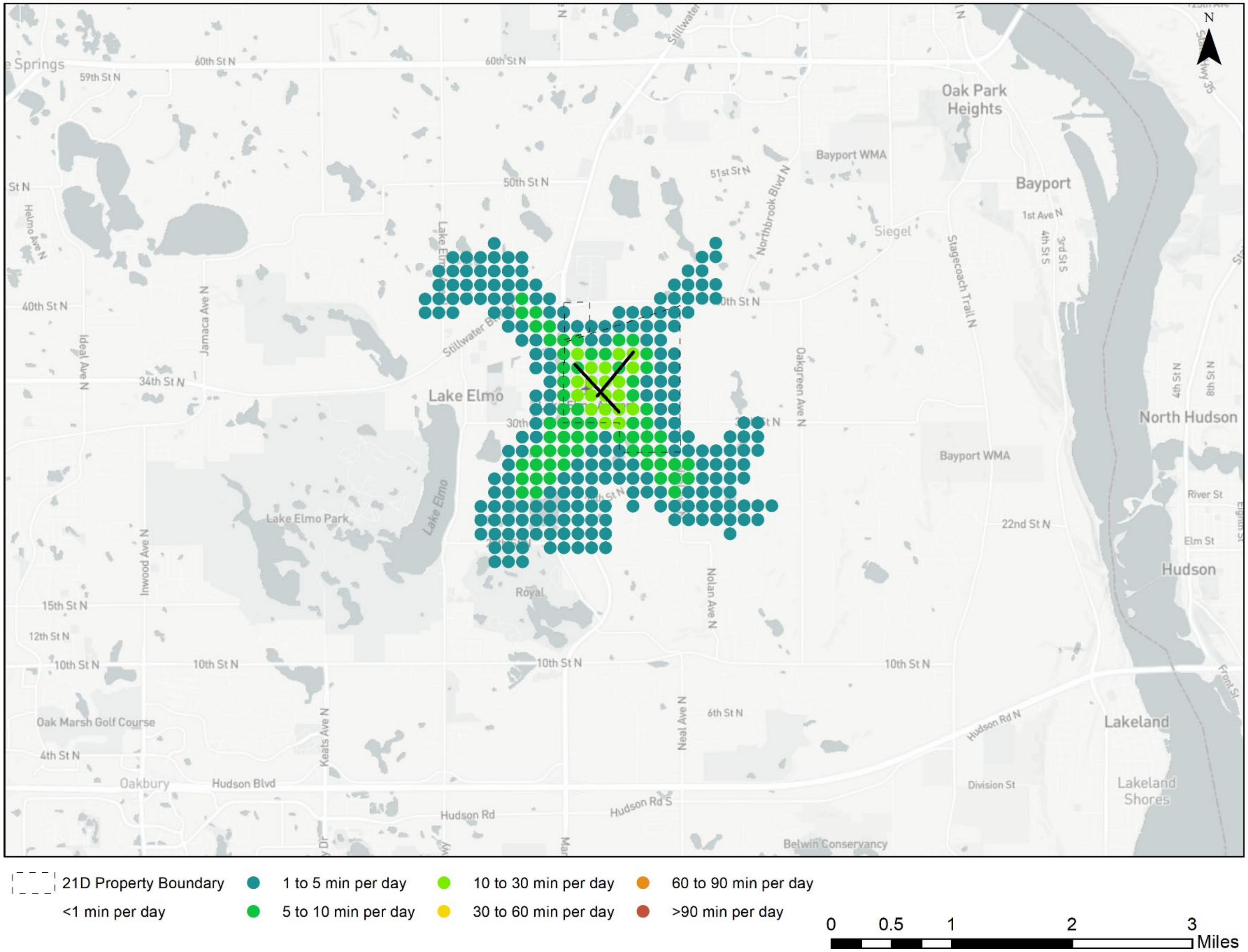
Figure 4.1: Number of Events Above 65 dB per Day



21D Property Boundary
<2 events per day
2 to 5 events per day
5 to 10 events per day
10 to 20 events per day
20 to 30 events per day
30 to 40 events per day
40 to 50 events per day
50 to 100 events per day

0 0.5 1 2 3 Miles

Figure 4.2: Time Above 65 dB (minutes per day)



5.0 Noise Complaints

During the study period, one complaint was received for the Lake Elmo Airport. This complaint was received during nighttime hours, between 10:00 P.M. and 7:00 A.M, at 11:45 P.M. on August 10, 2021. The aircraft operation at that time was a Piper Saratoga (PA32) piston aircraft that performed three closed traffic pattern circuits.

Figure 5.1 shows a complaint heat map representing the number of complaints within a grid square. Figure 5.2 shows complaints and the number of events above 65 dB.

Figure 5.1: 21D Study Period Complaint Heat Map

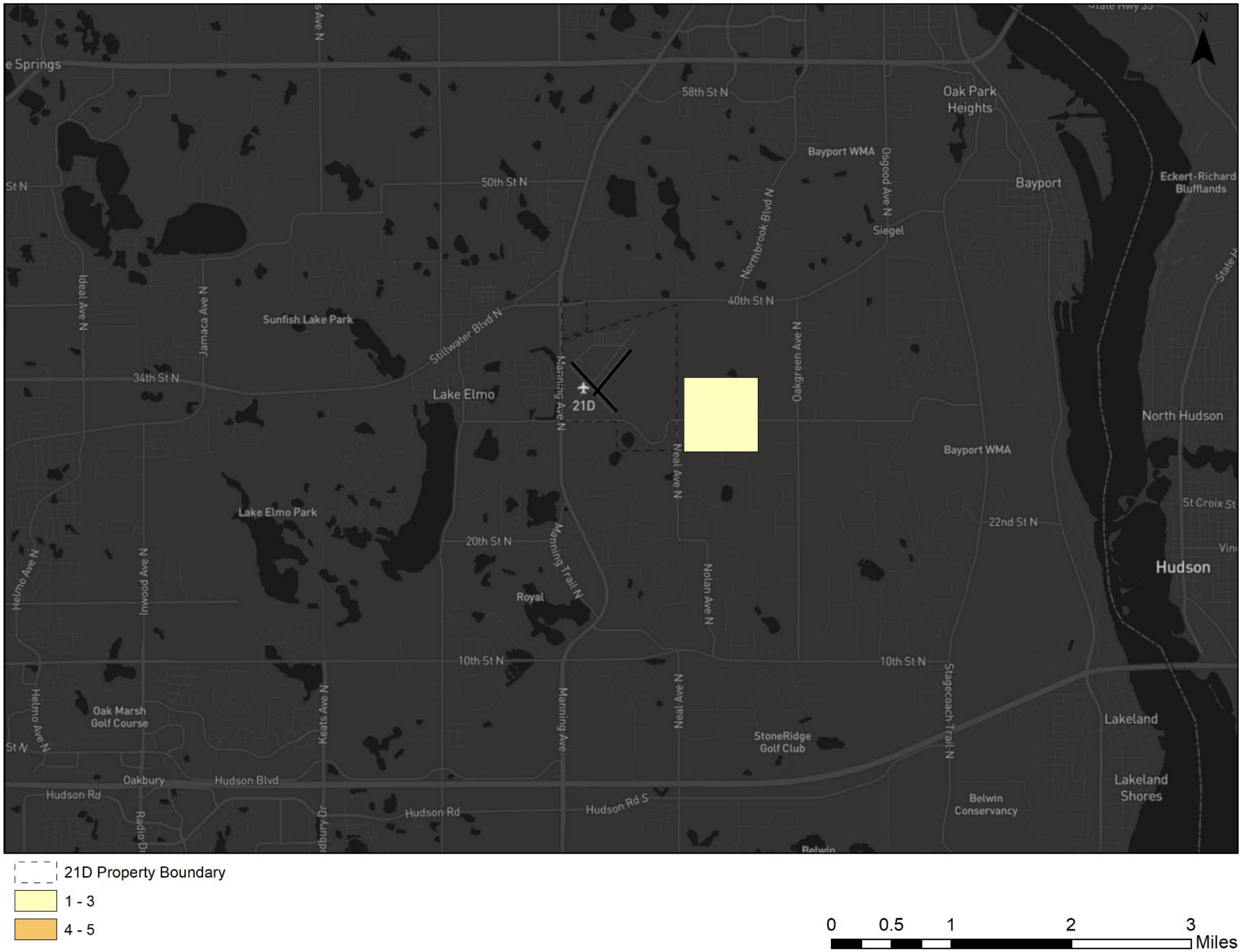
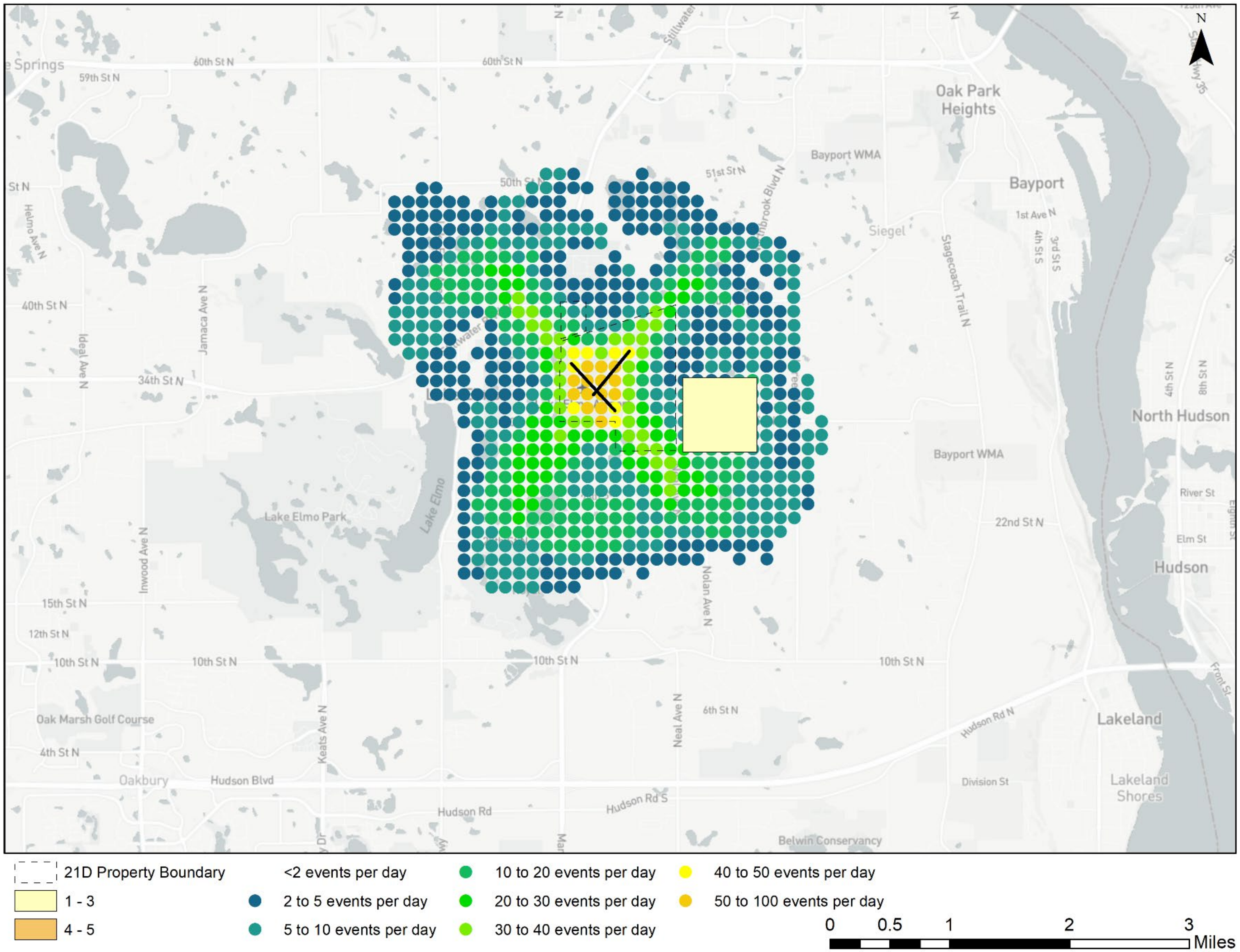


Figure 5.2: 21D Study Period Complaint Heat Map with Number of Events Above 65 dB



Appendix

A.1 MAC Mobile Sound Monitoring Request Guidelines

Mobile equipment sites are located to measure sounds near known aircraft flight paths:

- Located where flight operations are at altitudes, concentrations, and configurations creating aircraft sound levels above community sound levels.
- Away from known community sound sources (such as large arterial roads, train tracks, factories, transit centers, natural and other gathering spots) that may interfere with gathering aircraft sound data.
- Availability of power source(s).
- On MAC or public owned property (preferred).

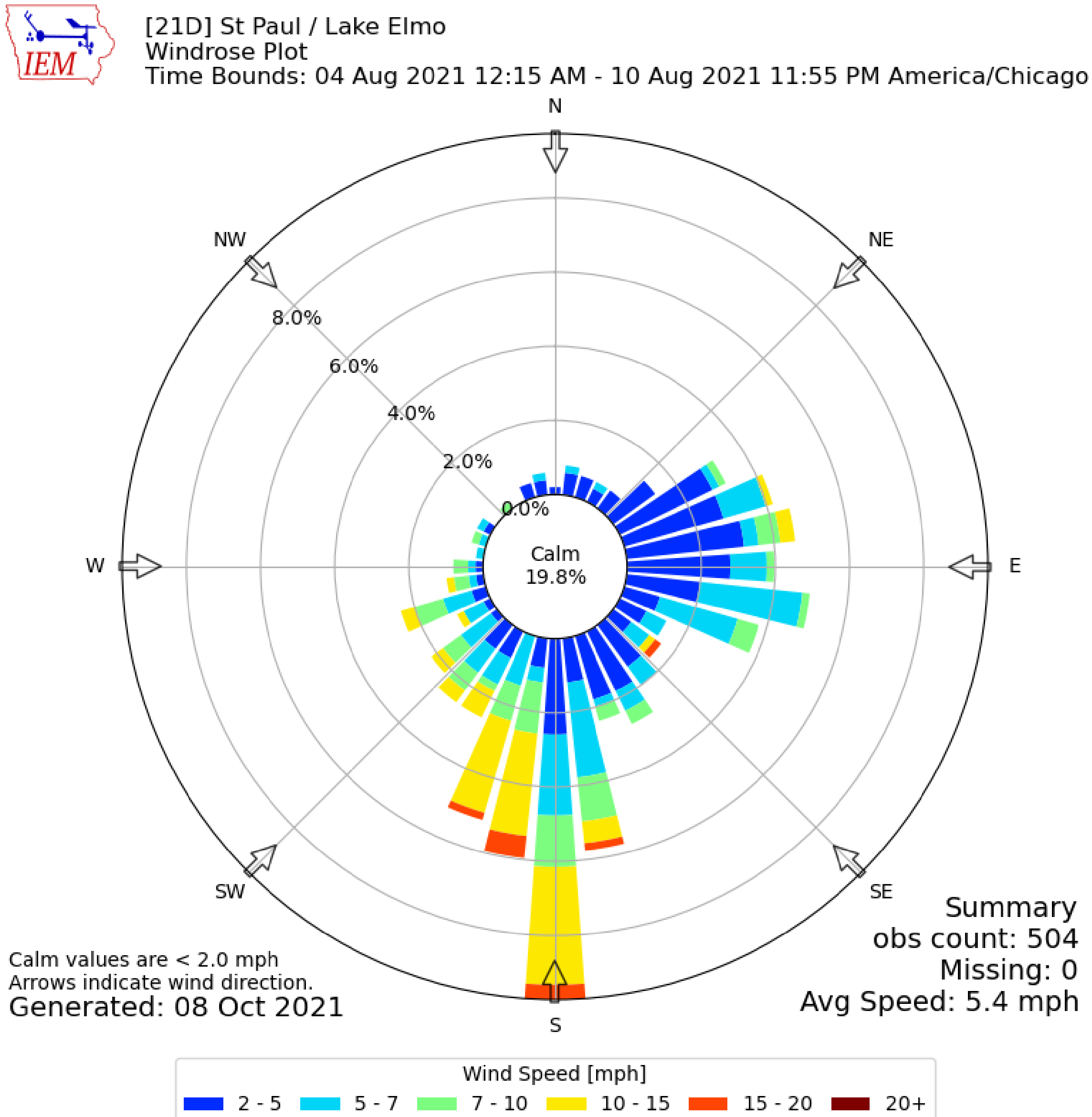
A.2 Field-Measured Sound Data: Aircraft and Community DNL

Site	Date	ADNL	CDNL	Combined DNL
1	4-Aug	37.0	52.1	52.2
1	5-Aug	28.7	56.9	56.9
1	6-Aug	44.9	55.0	55.4
1	7-Aug	38.3	65.2	65.2
1	8-Aug	28.9	58.8	58.8
1	9-Aug	48.0	57.0	57.5
1	10-Aug	37.9	59.7	59.7
2	4-Aug	38.3	65.6	65.6
2	5-Aug	34.7	68.3	68.3
2	6-Aug	55.0	62.1	62.9
2	7-Aug	0.0	64.1	64.1
2	8-Aug	30.0	62.1	62.1
2	9-Aug	48.8	61.5	61.7
2	10-Aug	50.3	63.9	64.1
3	4-Aug	34.2	51.4	51.5
3	5-Aug	51.7	57.9	58.8
3	6-Aug	39.5	50.8	51.1
3	7-Aug	0.0	68.7	68.7
3	8-Aug	43.9	61.0	61.1
3	9-Aug	41.9	53.9	54.2
3	10-Aug	51.3	53.1	55.3

A.3 Modeled Aircraft Distribution

Aircraft Type	Arrival	Departure	Touch and Go	Total Operations
Piston	**157.1**	**151.8**	**550.1**	**859.0**
Single Engine	**153.1**	**146.7**	**548.0**	**847.8**
American Champion Cibrata (FAS)	0.0	0.0	10.6	10.6
Beech 77 Skipper (FAS)	1.0	1.0	0.0	2.0
Beechcraft Bonanza 33 (FAS)	1.0	0.0	0.0	1.0
Beechcraft Bonanza 35 (FAS)	1.0	1.0	0.0	2.0
Bellanca 8 Scout Super Decathlon (FAS)	2.1	3.1	0.0	5.2
Cessna 140 (FAS)	1.0	1.0	0.0	2.0
Cessna 150 Series	5.2	3.1	16.9	25.2
Cessna 152 (FAS)	14.6	14.4	95.2	124.2
Cessna 170 (FAS)	1.0	0.0	0.0	1.0
Cessna 172 Skyhawk	36.6	34.9	201.0	272.5
Cessna 177 (FAS)	4.2	4.1	8.5	16.8
Cessna 180 (FAS)	1.0	1.0	0.0	2.0
Cessna 182	1.0	0.0	0.0	1.0
Cessna 206	0.0	1.0	0.0	1.0
Cirrus SR20	10.5	9.2	29.6	49.3
Cirrus SR22	3.1	4.1	0.0	7.2
Lancair (FAS)	2.1	1.0	0.0	3.1
Mooney M20-K	3.1	3.1	0.0	6.2
Pacific Aerospace P-750 XSTOL	4.2	4.1	0.0	8.3
Piper J-3 Cub (FAS)	12.5	12.3	23.3	48.1
Piper PA-18-150 (FAS)	3.1	3.1	2.1	8.3
Piper PA-28 Cherokee Series	32.4	32.9	146.0	211.3
Piper PA-32 Cherokee Six	5.2	5.1	14.8	25.1
Raytheon Beech Bonanza 36	2.1	2.1	0.0	4.2
Vans RV6 (FAS)	1.0	1.0	0.0	2.0
Vans RV-7	1.0	1.0	0.0	2.0
Vans RV9 (FAS)	3.1	3.1	0.0	6.2
Multi Engine	**4.0**	**5.1**	**2.1**	**11.2**
Cessna 310	1.0	1.0	0.0	2.0
Cessna 421	1.0	1.0	2.1	4.1
Piper PA-30 Twin Commanche	1.0	2.1	0.0	3.1
Piper PA-34 Seneca	1.0	1.0	0.0	2.0
Multi Engine	4.0	5.1	2.1	2.0
Turboprop	**1.0**	**1.0**	**0.0**	**2.0**
Single Engine	**1.0**	**1.0**	**0.0**	**2.0**
Cessna 208 Caravan	1.0	1.0	0.0	2.0
Helicopter	**1.0**	**1.0**	**0.0**	**2.0**
Single Engine	**1.0**	**1.0**	**0.0**	**2.0**
Bell 206B-3	1.0	1.0	0.0	2.0
Grand Total	**159.1**	**153.8**	**550.1**	**863.0**

A.4 21D Weather Details



Source: [Mesonet Iowa State]

Table A.1: Model Weather Inputs	
Average Temp	74.7
Average Wind Speed	14.5
Average Dew Point	64.8
Average Sea Level Pressure (SLP)	29.0
Average Relative Humidity	70.5
Average SLP (millibar)	982.9

A.5 Glossary

Aircraft Operation

Aircraft arriving or departing from 21D, or an aircraft that performed both an arrival and departure (touch and go).

A-Weighting

A-Weighting is a standard filter used by acoustic measurement devices and can be applied to acoustic measurements. It is frequency filter that attempts to emulate the way human hear.

Day-Night Level (DNL)

The FAA established DNL as the primary metric for aircraft noise analysis and expressing aircraft noise exposure in the United States. "DNL" is the acronym for Day-Night Average Sound Level, which represents the total accumulation of all sound energy, with a 10-decibel penalty applied for each sound event between 10:00 P.M. and 7:00 A.M. DNL has been widely accepted as the best available method to describe aircraft noise exposure and is the industry standard for use in aircraft noise exposure analyses and noise compatibility planning. It also has been identified by the U.S. Environmental Protection Agency as the principal metric for airport noise analyses.

Decibel (dB/dBA)

Sound levels are measured in Decibels, a logarithmic scale of energy referenced to human hearing. Sound levels are reported in dB; dBA is the Decibel value after the A-Weighting filter is applied.

LA_{eq} (Equivalent Sound Level) Equivalent sound level

The representation of a time-varying sound as an equivalent steady state A-weighted sound level for the period or interval of interest.

LA_{max} (Maximum A-weighted Sound Level)

This is maximum A-Weighted Sound Level observed for the period, event, or interval of interest.

LA_{90} (Sound Level Exceeded 90 Percent of the Time)

The LA90 is a common and typical method to estimate ambient sound levels or background sound levels seen most of the time. It is a statistical based metric which provides us with which A-Weighted sound level that is exceeded 90 percent of the time.

Number Above

The "Number Above", also referred to as N-level sound metric or Count Above, is the total number of aircraft sound events that exceeded a specified sound level threshold (LA_{max}). This report contains a count of departure events and arrival events recorded with field-measurement equipment when the maximum sound level of those events exceeds 65, 80, 90, and 100 dB levels.

SEL (Sound Exposure Level)

Sound Exposure Level is the total sound energy expressed in one second. Numerically, the energy is equivalent but allows for the comparison of sound events with varying durations.

Time Above Metric

The "Time Above" noise metric measures the total time or percentage of time that the A-weighted aircraft noise level exceeds an indicated level. Time Above data are summarized for arrival and departure events based on one-second intervals.

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This report is for informational purposes only.