EAGAN MOBILE NOISE MONITORING REPORT

July 2019

Community Relations Office

Metropolitan Airports Commission
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Contents

1 INTRODUCTION

A request for mobile noise monitoring was made in 2018 by the Eagan Airport Relations Commission (ARC), and approved by the Minneapolis – St. Paul International Airport (MSP) Noise Oversight Committee (NOC), to evaluate the quality of aircraft noise events currently being collected by the Metropolitan Airports Commission (MAC) at two of its permanent sound monitoring locations in the City of Eagan.

Since 1992, the MAC has operated one of the most sophisticated and comprehensive computerized aircraft noise and flight track data collection and processing systems of its kind. The MAC Noise and Operations Monitoring System (MACNOMS) is a tool to help MAC staff analyze aircraft noise impacts around MSP and provide public access to flight tracking and detailed aircraft noise data. MAC staff can make informed decisions about aircraft noise and operations impacts and assess specific operations in a timely way. Community members can access near real-time flight operations information and can review detailed historical information at their convenience.

MACNOMS' data collection, processing and analysis and reporting tools are made up of customized software programs and instruments that provide system flexibility to conduct detailed analyses and reporting of aircraft operations and associated noise. The system does this by fusing aircraft flight tracks, aircraft operator information, noise measurements from sound monitoring stations, geographic information, and information on other variables that influence aircraft operations.

The sound data collection is conducted through an array of 39 permanently installed sound monitoring stations that operate continuously. Several MACNOMS sound monitoring sites are located within the City of Eagan; these sites are numbered as 14, 16, 24, 25, 35, 37, 38 and 39. It's important to note that the data recorded at the MACNOMS sound monitoring sites are not used in determining residential noise mitigation eligibility, nor are they used in the development of airport noise contours. These activities are strictly regulated by the Federal Aviation Administration (FAA), which requires the use of a modeling software.

The MAC's first installation of permanent sound monitors included 24 sites located primarily off the ends of the parallel runways and the crosswind runway, Runway 4/22. In 1998, the Metropolitan Sound Abatement Council (MASAC) focused on increasing the noise monitoring coverage predicated on existing runway geometry and associated operational patterns. The analysis resulted in the addition of five new monitoring towers, bringing the total to 29. The last augmentation of the noise monitoring system occurred in 2001 with the installation of ten additional locations south of the airport to measure noise levels on Runway 17/35. Citing the permanent sound monitoring stations all required a thorough and objective process. MASAC established the location of the five additional sites in 1998 using requirements that were established as part of the initial system installation, in addition to further data consideration and the utilization of increased spatial analysis capabilities. The additional ten locations were established through a Runway 17-35 Remote Noise Monitoring Tower Location Task Force. The Task Force applied requirements consistent with previous installations in addition to more robust Geographical Information System (GIS) data. These sites and the cylindrical areas of influence were sent to each respective city for the exact location and area of influence determination.

The Eagan ARC communicated concerns related to the coverage area and whether enough aircraft noise is being captured by the MACNOMS sound monitoring sites installed in Eagan. Another concern is related to the quality and accuracy of aircraft sound data collected by MACNOMS sites 25 and 37 because of their proximity to the I-35E freeway.

The concerns expressed by the ARC formulate the objectives of this study, as follows:

1. The MAC will evaluate sound data collected in Eagan and determine if gaps exist in the MACNOMS site coverage area within in the City of Eagan, and
2. determine if MACNOMS sites 25 and 37 properly capture aircraft sound levels given the ambient freeway noise being generated by 1-35E.

2 PARAMETERS & METHODOLOGY

2.1 PURPOSE

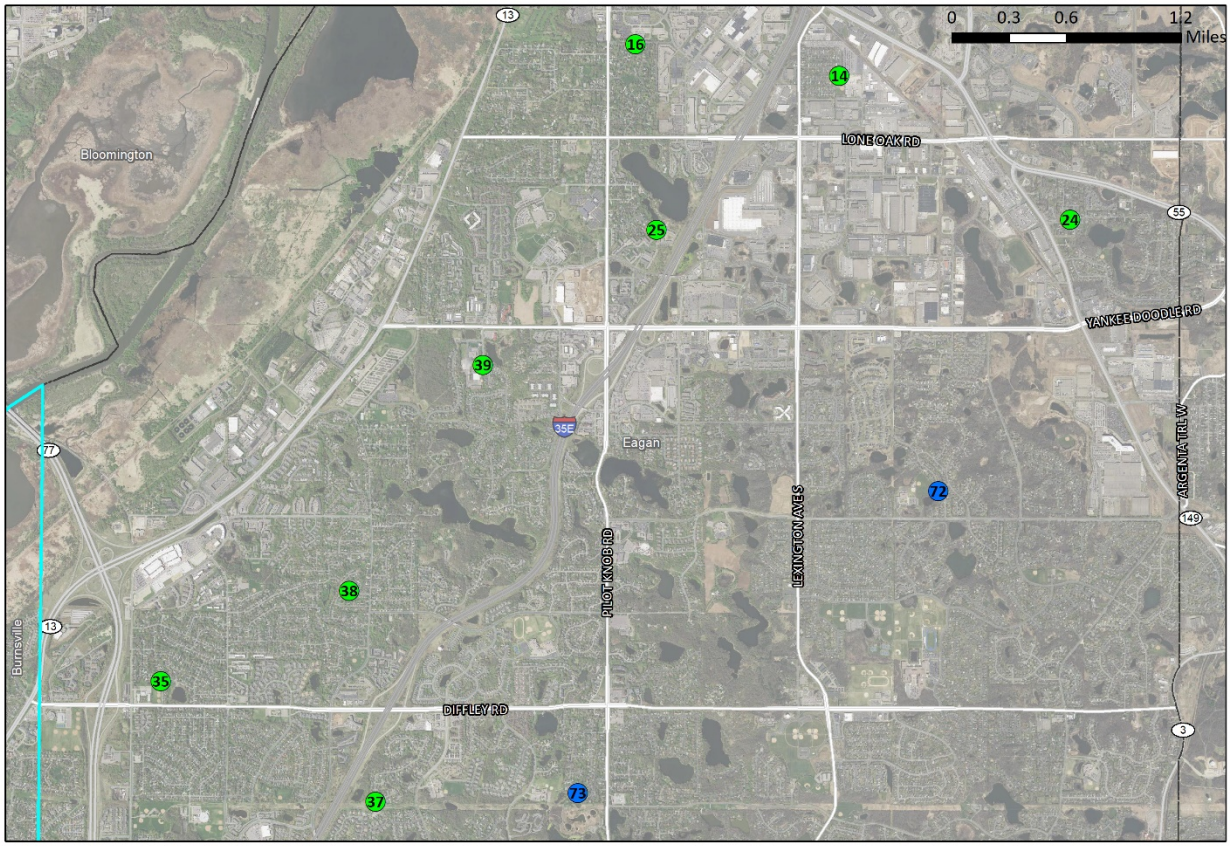
Collect quality recordings and measurements of aircraft noise events associated with MSP Airport that occur in the City of Eagan, in accordance with established Mobile Sound Monitoring Guidelines. The objectives of the study are to determine if gaps exist within the City of Eagan and to compare data collected from the mobile equipment with data being collected at the RMTs 25 and 37.

2.2 STUDY PERIOD

By mutual agreement with the Eagan ARC, the study period extended for two consecutive weeks. Mobile sound monitors were deployed on May 1st, 2019 and retrieved on May 16th, 2019. The official two-week data collection period started at 12:00 A.M. on Thursday May 2nd and concluded at 11:59:59 P.M. Wednesday May 15th.

2.3 MONITORING LOCATIONS

MAC Community Relations staff, in collaboration with the Eagan ARC, identified two locations for temporary placement of the mobile sound monitoring equipment. These sites are labeled 72 and 73 to



EAGAN SOUND MONITORING SITES

distinguish these sites from the MACNOMS sites. After consideration of various site location, the Eagan ARC approved use of Mueller Farm Park and Evergreen Park, which both met the following criteria:

- The sites were able to be secured
- The sites were located on public land, owned by the City (parks, easements, out-lots, etc.)
- The sites were located appropriate distances from known sources of community noises, such as major roadways, active construction, crowd assembly areas, railroad tracks, etc.
- The City and the MAC agreed that the sites were reasonable and adequate to obtain the necessary data to meet the project objectives

The following are the details for the mobile sound monitoring data collection sites, labeled 72 and 73:

Site #72 – Mueller Farm Park

The Mueller Farm Park site was located along east side of the park along Wescott Hills Dr, north of a walking path.

This location was chosen due to its position in a low-activity area while still on public property, and its proximity to MSP flight activity.

Site #73 – Evergreen Park

Evergreen Park abuts Thomas Lake Park to the North. The monitoring location was along Lodgepole Ct.

This location is directly east of site 37 and located in a low-activity area near while still on public property, and its proximity to MSP flight activity.

2.4 EQUIPMENT AND INSTRUMENTATION

A secured weatherproof enclosure was used at each mobile monitoring site to contain the measurement and recording devices. The instrumentation is manufactured by Larson Davis and consists of a laboratory quality sound level analyzer (831A class/type 1 instrument), preamplifier (PRM831), and microphone (377B02). The preamplifier and microphone were housed within environmental protection coverings to allow sound measurements during adverse weather elements. The components used at these sites is the same equipment that is used at the permanent sound-monitoring locations.

The instruments are certified annually, and each site was calibrated at the start of the study. During the study period, inspections were performed throughout the study at both sites to verify instruments were operating and within tolerances, and to inspect for tampering and damage. A final calibration check was performed at the end of the study and found to be within tolerances.

2.5 MEASUREMENT PARAMETERS

The sound monitoring instrumentation was configured to monitor sound continuously utilizing slow response with A-weighting, as directed by 14 CFR Part 150 and consistent with the MACNOMS data collection. Under this configuration, the analyzer uses a sound pressure level - time trigger (when the A-weighted sound pressure level exceeds 65dB for a minimum period of eight seconds) to identify and document sound events. A two-second continuation period is used to extend the sound event if the sound

below the threshold level. These parameters are consistent with the configurations employed at the permanent sites.

The measurement parameters used by the sound monitoring instrumentation only account for sound level and therefore both aircraft and community events will be documented. Additionally, aircraft do not have to fly directly over a measurement site to be recorded.

2.6 AIRCRAFT-EVENT CORRELATION

This study employed a process for correlating mobile site sound data with MSP flight track data; the same process is used for correlating MACNOMS sound data with MSP flights. The process uses both temporal (time) and spatial components to match a sound event with an aircraft overflight. The majority of sites in Eagan include a cylindrical area of influence with a radius of 2,500 meters and a ceiling of 1,830 meters. Permanent sites in Eagan also include a time window of at least one minute around an event. Mobile sites 72 and 73 used those same dimensions of the study. Sound events that could not be correlated were classified as “community” events.

3 DISCUSSION / SUMMARY OF FINDINGS

This report presents both sound measurement and aircraft operations data collected between May 2nd through May 15th, 2019. The objectives of the study are to evaluate the coverage of the MACNOMS array within the City of Eagan and determine to what degree MACNOMS sites 25 and 37 are affected by their unique proximity to I-35E.

While this study was requested by the Eagan ARC and approved by the NOC in 2018, the study was intentionally delayed until May 2019 to increase the likelihood that South Flow configurations would be prevalent at MSP. In a South flow, aircraft use Runways 12L, 12R and 17 for departures while Runways 12L and 12R are used for arrivals. This provides the most ideal configuration to conduct monitoring for the purpose of this study. Section 4.1 provides further data on specific runway use. For the 14 days of the study, a South Flow was utilized for 37.5% of the time. Additionally, 50 hours, or 16.6%, of all hours were in a Straight South Flow. In a Straight South Flow, Runways 12L and 12R are used for arrival and departure and the use of Runway 17 for departure is discontinued. The combined 54.1% provided a reasonable amount of opportunity to collect sound data for the study.

Sites 72 and 73 both proved to be conducive locations for measuring aircraft sounds because of the regularity of MSP flight activity over the area and limited levels of community noises. There were 477 sound events (383 aircraft correlated) recorded at Site 72, and 466 events (300 aircraft correlated) were recorded at Site 73. The estimated average background sound level (utilizing the statistical LA_{90} method) was 50.4 dBA for Site 72 and 45.5 dBA for Site 73. At both sites, the loudest measured sound events were identified as community-based (e.g. lawn mowers, fireworks, motorcycle, people, etc.).

Section 4.5 shows a summary of the temperature and reported wind speeds during the two-week study period. Moderate temperatures from 35° - 76° were experienced throughout the study period. Additionally, precipitation was recorded during six days of the study. A wind rose depicting all reported winds for the study period is also included in section 4.5.

3.1 DNL

The Day-Night Average Sound Level (DNL) metric is an average of noise exposure, or dose metric, of the total accumulation of all sound energy spread uniformly over a 24-hour period. The DNL calculation applies a 10-decibel penalty on aircraft operations between 10:00 P.M. and 7:00 A.M. Aircraft DNL reflects noise exposure associated with aircraft noise events only, while community DNL reflects noise exposure for all other noises.

The Federal Aviation Administration Office of Environment and Energy (FAA-AEE) recognizes that the environmental consequences stemming from the operation of commercial aviation – primarily noise, emissions, and fuel consumption – are highly interdependent and occur simultaneously throughout all phases of flight. The Aviation Environmental Design Tool (AEDT) is a software system that is designed to model aviation related operations in space and time to compute noise, emissions, and fuel consumption.

AEDT is the federally prescribed model required to develop the annual DNL contour, which is the basis for the MSP Annual Noise Contour Report and related noise mitigation program. While the focus on traditional AEDT modeling efforts is typically a DNL contour, the software has the capability to produce alternate noise metrics.

The MAC's system of 39 RMTs is one of the most extensive aircraft noise monitoring systems in the world. The data collected provides important information about sound levels and aircraft activity in the areas where the monitors exist. To augment the permanent system, AEDT can be used to determine the modeled events at specific points around MSP that are not covered by an RMT.

Aircraft noise is generally considered by the FAA to be significant when levels reach DNL 65 or greater, (average measure of 365 days). An annual aircraft DNL at or above 65 dB is considered by the FAA to be incompatible with residential areas and other noise sensitive land uses.

The measured daily aircraft DNL is shown in section 4.4 while the measured and calculated average DNL for the two-week study period is shown below.

14-Day Study Period	72 - Mueller Farm Park	73 - Evergreen Park
Measured DNL	47.5	46.6
AEDT Modeled DNL	51.2	49.5

Aircraft flying over Sites 72 and 73 are typically flying at higher altitudes than when they fly over the MACNOMS sites 25 and 37. This is because Sites 72 and 73 are located further away from MSP than Sites 25 and 37 and aircraft typically continue their climb as they travel away from the airport. The increased distance and altitude has several effects. First, it can reduce the measured DNL due to physical constraints of meeting the parameters of the event detection trigger, which causes a reduced measured DNL level. Secondly, a greater difference emerges between the measured vs. modeled DNL levels. This occurs because modeled DNL is capable of projecting all aircraft into its calculation whereas the measured DNL can only include measured and correlated aircraft sounds that do not compete with community noises.

3.2 EAGAN COVERAGE ASSESSMENT

Aircraft sound events were recorded during the study period at all eight MACNOMS sites located within the City of Eagan and the mobile equipment at the study sites 72 and 73. The study sites performed well with the MACNOMS sites in Eagan. 98.5% of all correlated events recorded at the study sites were also recorded and correlated at a permanent site in Eagan. Of the combined 683 identified aircraft events, only 10 aircraft were not recorded at the MACNOMS sites within Eagan. Site 72 had a 100% correlation while Site 73 had a 97.4% correlation. See section 4.3 for more details.

While the 10 aircraft sound events identified by the study area and not identified within the MACNOMS Eagan sites are statically small, there are several reasons why they occur. When approaching the 65dBA – 8 second threshold, other small variables like aircraft state including, power settings, the angle of attack in relation to the sound monitor, direction and positioning, and the distance between the aircraft and the sound monitor as well as tolerances of measurement instrumentation all have impact on whether an event is detectable and identifiable using the sound event parameters.

9,871 aircraft events from 4,709 aircraft were captured by the MACNOMS permanent sound monitors within Eagan. Of those aircraft operations, 4,054 or 86% of the operations triggering events at one of the permanent sites did not trigger an event at one of the mobile sites. This can be due to several factors but is largely due to the flight track of the operation and the three dimensional distance between the aircraft and the site.

The primary directive of the MACNOMS system is to measure aircraft noise to provide actual noise data at sites within the community. With a 98.5% study-to-permanent event correlation along with measured and modeled DNL below the 60 DNL contour, the study data suggests additional monitoring within the City is not required.

3.3 Evaluation of Measurement Sites Next to the I-35E

MACNOMS sites 25 and 37 are in close proximity to I-35E freeway and often record sounds of vehicles that are louder than aircraft that overfly the area. The following table contains performance measures that compare data from sites 25 and 37 to the other MACNOMS sites located within the City of Eagan and the mobile sites 72 and 73.

Site	Total Sound Events	Aircraft Events	Aircraft Event Correlation Ratio	Average Event Duration (seconds)	Primary Runway(s) and Flight Activity
14	3,065	2,570	0.84	18.3	30L ARRIVALS
16	2,974	2,370	0.80	19.8	30L ARRIVALS
24	2,925	2,382	0.81	17.5	30L ARRIVALS
25	1,646	469	0.28	56.1	12R, 17 DEPARTURES
35	598	476	0.80	16.9	35 ARRIVALS, 17 DEPARTURES
37	1,481	297	0.20	46.9	17 DEPARTURES
38	896	635	0.71	19.2	17 DEPARTURES
39	894	672	0.75	18.9	17 DEPARTURES
72	477	300	0.63	30.3	12R, 17 DEPARTURES
73	466	383	0.82	16.6	17 DEPARTURES

The table above compares data collected and correlated to aircraft activity at sound monitoring sites in the City of Eagan. It is not realistic to capture a sound event at each of the monitoring sites because of operating characteristics of aircraft, flight paths, environmental conditions, and other community sounds; however, the goal of the MAC's sound monitoring efforts is to capture as much quality sound data as possible given situational conditions. The number of sound events documented for the monitoring sites in Eagan during the study period is higher than the number of aircraft events because there are many non-aircraft sounds that fit the measurement parameters and consequently are recorded. Site 14 recorded the highest number of Total Sound Events and Aircraft Events. Site 73 recorded the lowest number of Total Sound Events, but Site 37 recorded the lowest number of Aircraft Events. These numbers by themselves are not as meaningful as the Aircraft Event Correlation Ratio.

The Aircraft Event Correlation Ratio describes the overall correlation rate between the number of measured sound events with those sound events that are correlated with aircraft activity. This metric summarizes how many sound events were associated with aircraft activity. A higher ratio means more aircraft were correlated with measured sounds than a lower ratio. The highest Correlation Ratio occurred at Site 14, and the lowest ratio occurred at Site 37.

The Average Event Duration helps to reveal how community sounds may be affecting the measures of aircraft sounds. Sites with longer community events that are occurring while aircraft are flying overhead may be preventing the site from capturing the aircraft activity sounds, particularly if the community event is louder than the aircraft event. This situation is known to occur on very windy days, or when lawn mowing takes place, or birds are singing near a monitoring site. Extended periods of vehicle traffic also contribute to sound events with extended durations. During the study period, Sites 25 and 37 recorded sound events with the highest average durations due to the unique proximity of these sites to the 1-35E freeway.

While sites 25 and 37 do record far more community events than other permanent sites, the ambient environmental sound generated by the freeway is not negatively impacting their ability to collect aircraft noise data. Given the distance of aircraft from the sites, the probability that an aircraft creates an event at sites 25 and 37 are consistent with other permanent sites in Eagan. The following tables highlights this relationship. In the first table, Runway 12R departures for June 2018 through June 2019 are evaluated at the four permanent sites and one mobile site that typically record traffic from this runway. Candidate Departures represent any flight that flew within the cylindrical area of influence (radius of 2,500 meters and a ceiling of 1,830 meters) for that site while Valid Correlated Events are the number of events at that site. In this instance Site 25 records far fewer candidate operations than other sites in Eagan. The reason, however, is not due to the freeway, but instead due to its proximity to typical Runway 12R departure tracks. The average distance between the site and the tracks of 1,615 meters is almost double the average distance at site 16, which has a much better correlation rate. Site 72 recorded a lower rate of events than any of the permanent sites.

RMT	CANDIDATE DEPARTURES	VALID CORRELATED EVENTS	RATE	AVERAGE 3D DISTANCE (meters)
14	14,693	10,815	74%	921
16	14,852	12,202	82%	815
24	13,405	7,124	53%	1,124
25	11,829	4,027	34%	1,615
72*	306	68	22%	1,157

**Mobile Sites only include data from 5/2/2019 – 5/15/2019*

The same data was analyzed for departures from Runway 17.

RMT	CANDIDATE DEPARTURES	VALID CORRELATED EVENTS	RATE	AVERAGE 3D DISTANCE (meters)
25	14,199	5,419	38%	1,597
35	30,478	7,389	24%	1,129
37	14,529	5,468	38%	1,260
38	24,561	11,199	46%	1,017
39	29,010	13,209	46%	915
72*	663	224	34%	1,225
73*	1,042	368	35%	1,103

**Mobile Sites only include data from 5/2/2019 – 5/15/2019*

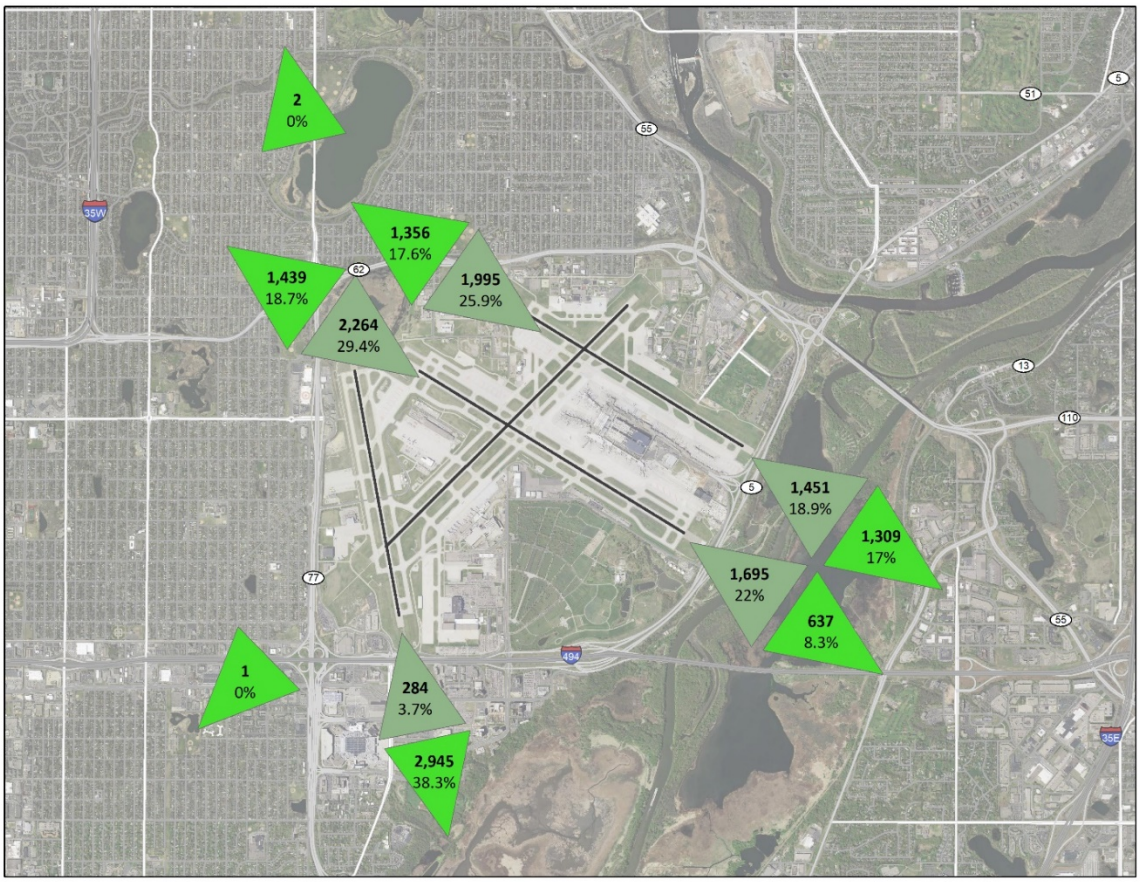
These sites show the same relationship between distance and correlation rate. Sites 25 and 37 have a lower rate than sites 38 and 39 but the distance between the tracks and the sites are further away. Sites 25 and 37 correlate at a higher rate than Site 25 despite being farther from the tracks. Sites 72 and 73 also had lower event rates than all of the permanent sites except Site 35. Because Sites 25 and 37 have correlation rates similar to other sites under Runway 17 departures, the data does not support a change to the location of the permanent monitoring sites.

The location of all sites is impacted by normal community activities. Each site within the MAC system records events with sound sources that are not aircraft related. The MAC has a robust system in place to determine whether the sound source of events is community generated or aircraft related. As discussed in Section 2.6, the MAC uses an automated system to correlate events to known MSP aircraft traffic using spatial and temporal data. Additionally, MAC staff reviews events and related attributes monthly to improve this matching process. Recently, the MAC developed a noise event classification system using a convolutional neural network which is generally referred to as machine learning to further determine the likelihood that a noise event was created by an aircraft or by a community source. Because we believe this to be the first of its kind, the MAC is seeking protection from the United States Patent and Trademark Office. These current protocols and process enhancements reduce the impact that all community events, including road noise from I-35E, have on the data produced at the permanent sites.

4 APPENDIX

4.1 AIRCRAFT OPERATIONS

MSP Runway Use



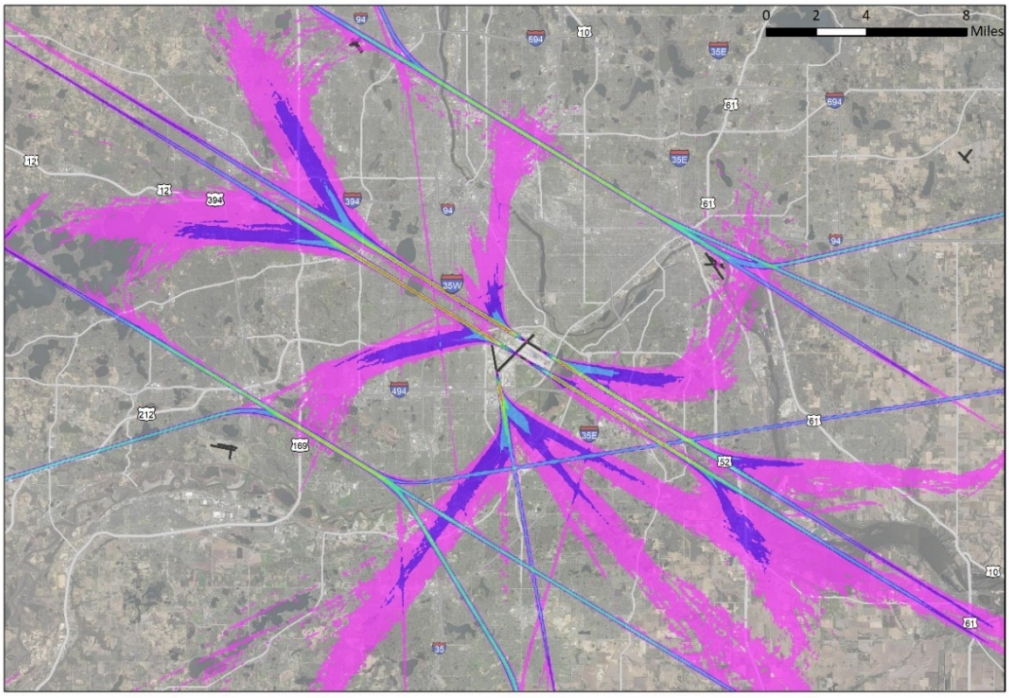
Runway	Operation	Count	Percent		Operation	Count	Percent
4	Arr	0	0.0%		Dep	0	0.0%
12L	Arr	1,995	25.9%		Dep	1,309	17.0%
12R	Arr	2,264	29.4%		Dep	637	8.3%
17	Arr	0	0.0%		Dep	2,945	38.3%
22	Arr	0	0.0%		Dep	1	0.0%
30L	Arr	1,695	22.0%		Dep	1,439	18.7%
30R	Arr	1,451	18.9%		Dep	1,356	17.6%
35	Arr	284	3.7%		Dep	2	0.0%
Total		**7,689**	**100%**	**Total**		**7,689**	**100%**

Airport Configuration (# of Hours by Day)

Day	Mixed A	Mixed B	North	Straight North	Opposite	South	Straight South	Unusual	Total
2-May	14	2	1	3				1	21
3-May	2			1	3	14	2		22
4-May	9			2	1	4	7		23
5-May			2	17	3				22
6-May			3	11	3	2	2		21
7-May			1		2	13	2		18
8-May						6	18		24
9-May			5	14	2				21
10-May	8		4	8	3				23
11-May					2	14	6		22
12-May		1				15	3		19
13-May					3	16	2		21
14-May						17	5		22
15-May	1		1	4	1	12	3		22
Total	**34**	**3**	**17**	**60**	**23**	**113**	**50**	**1**	**301**

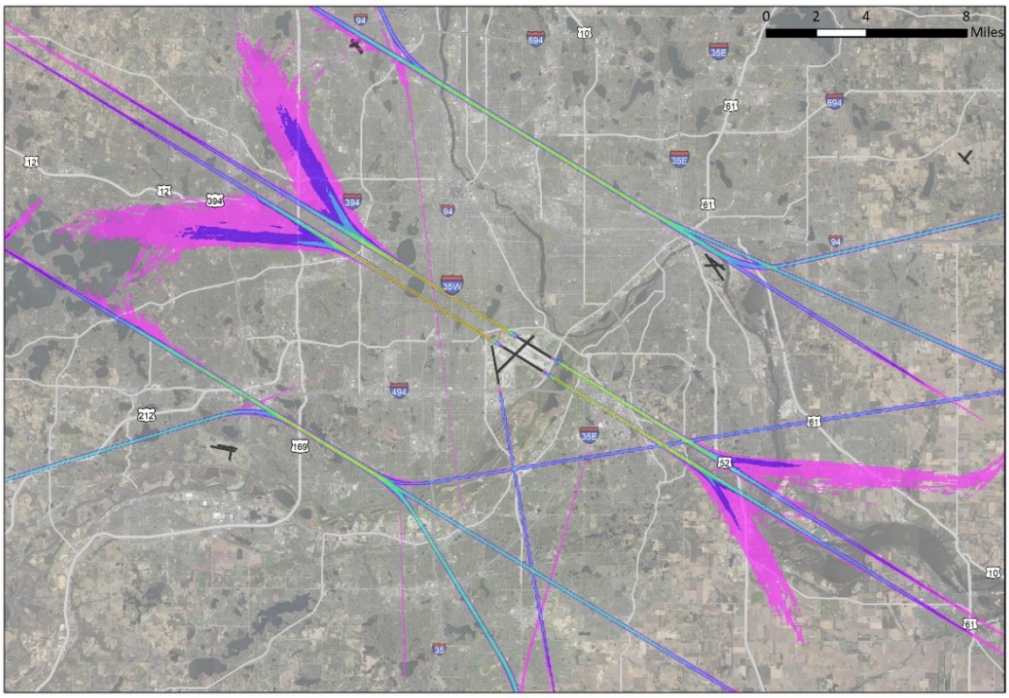
HOURS WITHOUT DATA MAY INCLUDE HOURS DURING CONFIGURATION TRANSITION OR HOURS WITHOUT OPERATIONS

Density Maps



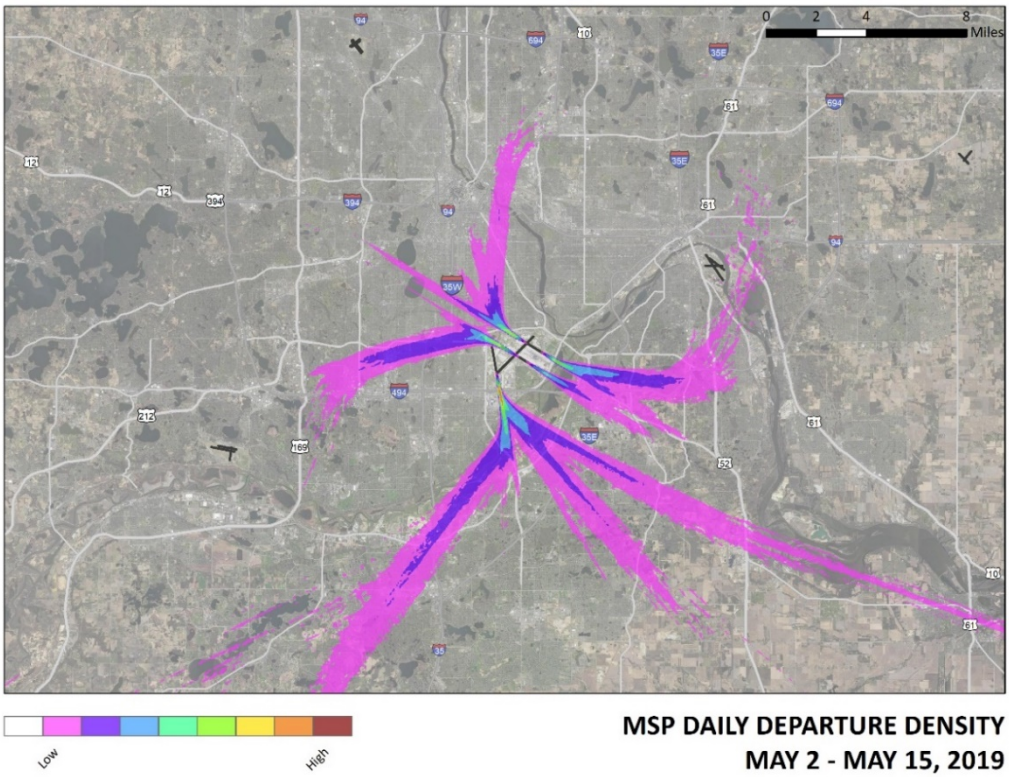
Low High

MSP DAILY OPERATION DENSITY
MAY 2 - MAY 15, 2019



Low High

MSP DAILY ARRIVAL DENSITY
MAY 2 - MAY 15, 2019



MSP DAILY DEPARTURE DENSITY
MAY 2 - MAY 15, 2019

Fleet Composition - Top 10

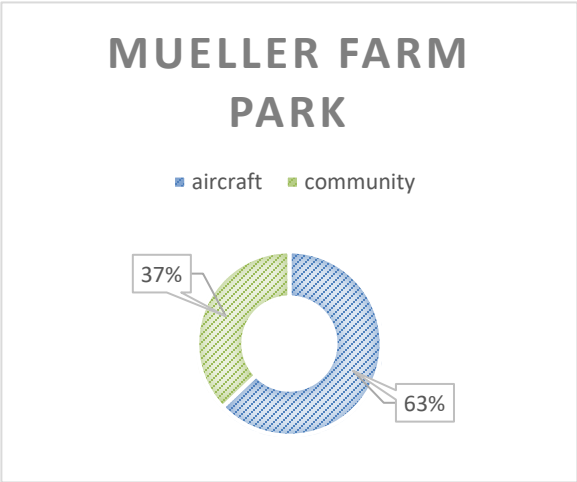
Category	Aircraft Type	Operations
Regional Jet	Canadair CRJ-900	2,098
Regional Jet	Canadair CRJ-200	2,009
Narrowbody	Boeing 737-800	1,682
Narrowbody	Airbus A320	1,419
Narrowbody	Boeing 737-900	1,137
Narrowbody	Boeing 717-200	1,108
Narrowbody	Airbus A321	1,092
Narrowbody	Airbus A319	1,056
Regional Jet	Embraer E-175	858
Narrowbody	Boeing 737-700	653

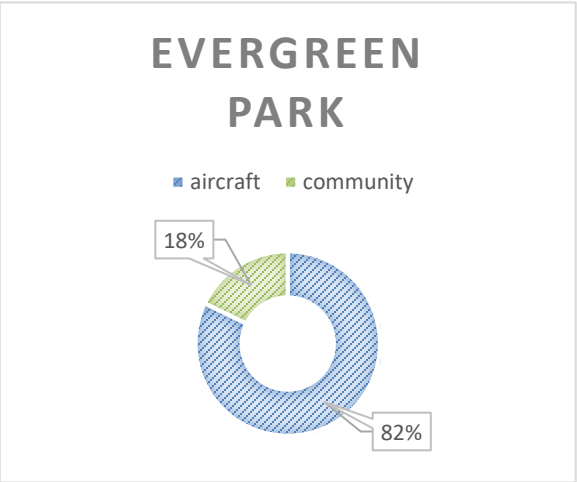
4.2 SOUND EVENTS

Summary of Measured Events

Date	72 - Mueller Park			73 - Evergreen Park		
	Aircraft	Community	(total)	Aircraft	Community	(total)
5/2/2019	1	17	18	-	1	1
5/3/2019	32	6	38	62	1	63
5/4/2019	5	6	11	20	2	22
	-	-	-	-	1	1
5/6/2019	4	5	9	8	8	16
5/7/2019	14	5	19	40	1	41
5/8/2019	34	3	37	13	6	19
5/9/2019	-	1	1	-	3	3
5/10/2019	1	4	5	-	2	2
5/11/2019	36	2	38	28	11	39
5/12/2019	45	1	46	55	1	56
5/13/2019	55	2	57	70	12	82
5/14/2019	52	17	69	43		43
5/15/2019	21	108	129	44	34	78
Grand Total	**300**	**177**	**477**	**383**	**83**	**466**
Total Aircraft Events						**683**
Total Community Events						**260**
Total Events						**943**

Measured Sound Events – Category Breakdown





Aircraft Count Above - $N_{(level)}$

Mueller Farm Park – Count Above (Aircraft)				
$N_{(n)}$	N_{65}	N_{80}	N_{90}	N_{100}
5/2/2019	1	-	-	-
5/3/2019	32	-	-	-
5/4/2019	5	-	-	-
5/5/2019	-	-	-	-
5/6/2019	4	-	-	-
5/7/2019	14	-	-	-
5/8/2019	34	1	-	-
5/9/2019	-	-	-	-
5/10/2019	1	-	-	-
5/11/2019	36	-	-	-
5/12/2019	45	-	-	-
5/13/2019	55	-	-	-
5/14/2019	52	-	-	-
5/15/2019	21	-	-	-
Total	**300**	**1**	**-**	**-**

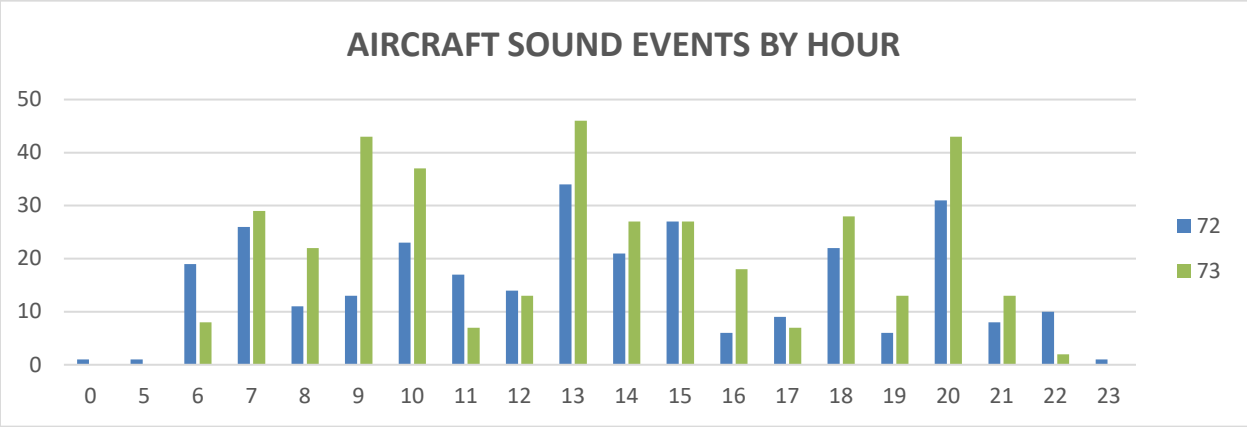
Evergreen Park – Count Above (Aircraft)				
$N_{(n)}$	N_{65}	N_{80}	N_{90}	N_{100}
5/2/2019	-	-	-	-
5/3/2019	62	-	-	-
5/4/2019	20	-	-	-
5/5/2019	-	-	-	-
5/6/2019	8	-	-	-
5/7/2019	40	-	-	-
5/8/2019	13	-	-	-
5/9/2019	-	-	-	-
5/10/2019	-	-	-	-
5/11/2019	28	-	-	-
5/12/2019	55	-	-	-
5/13/2019	70	-	-	-
5/14/2019	43	-	-	-
5/15/2019	44	-	-	-
Total	**383**	**-**	**-**	**-**

Aircraft Time Above – $TA_{(level)}$

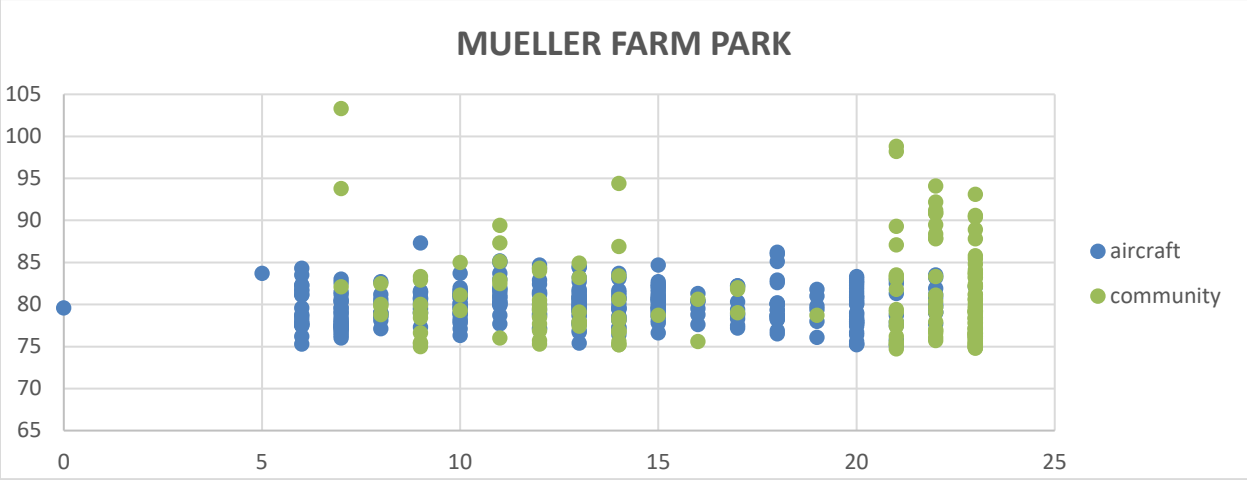
Mueller Farm Park – Time Above (Aircraft)				
$TA_{(n)}$	TA_{65}	TA_{80}	TA_{90}	TA_{100}
5/2/2019	9	-	-	-
5/3/2019	439	-	-	-
5/4/2019	63	-	-	-
5/5/2019	-	-	-	-
5/6/2019	44	-	-	-
5/7/2019	145	-	-	-
5/8/2019	452	-	-	-
5/9/2019	-	-	-	-
5/10/2019	18	-	-	-
5/11/2019	500	-	-	-
5/12/2019	593	-	-	-
5/13/2019	748	-	-	-
5/14/2019	696	-	-	-
5/15/2019	332	-	-	-
Total	**4039**	**-**	**-**	**-**

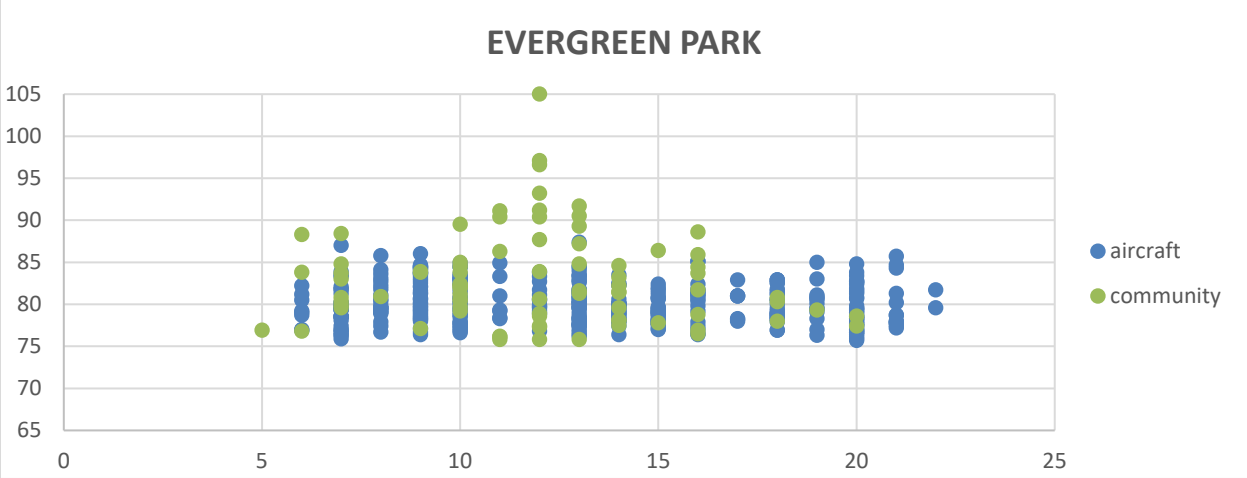
Evergreen Park – Time Above (Aircraft)				
$TA_{(n)}$	TA_{65}	TA_{80}	TA_{90}	TA_{100}
5/2/2019	-	-	-	-
5/3/2019	943	-	-	-
5/4/2019	290	-	-	-
5/5/2019	-	-	-	-
5/6/2019	93	-	-	-
5/7/2019	526	-	-	-
5/8/2019	169	-	-	-
5/9/2019	-	-	-	-
5/10/2019	-	-	-	-
5/11/2019	459	-	-	-
5/12/2019	792	-	-	-
5/13/2019	1042	-	-	-
5/14/2019	586	-	-	-
5/15/2019	612	-	-	-
Total	**5512**	**-**	**-**	**-**

Aircraft Count by Hour



LA_{sel} vs Hour





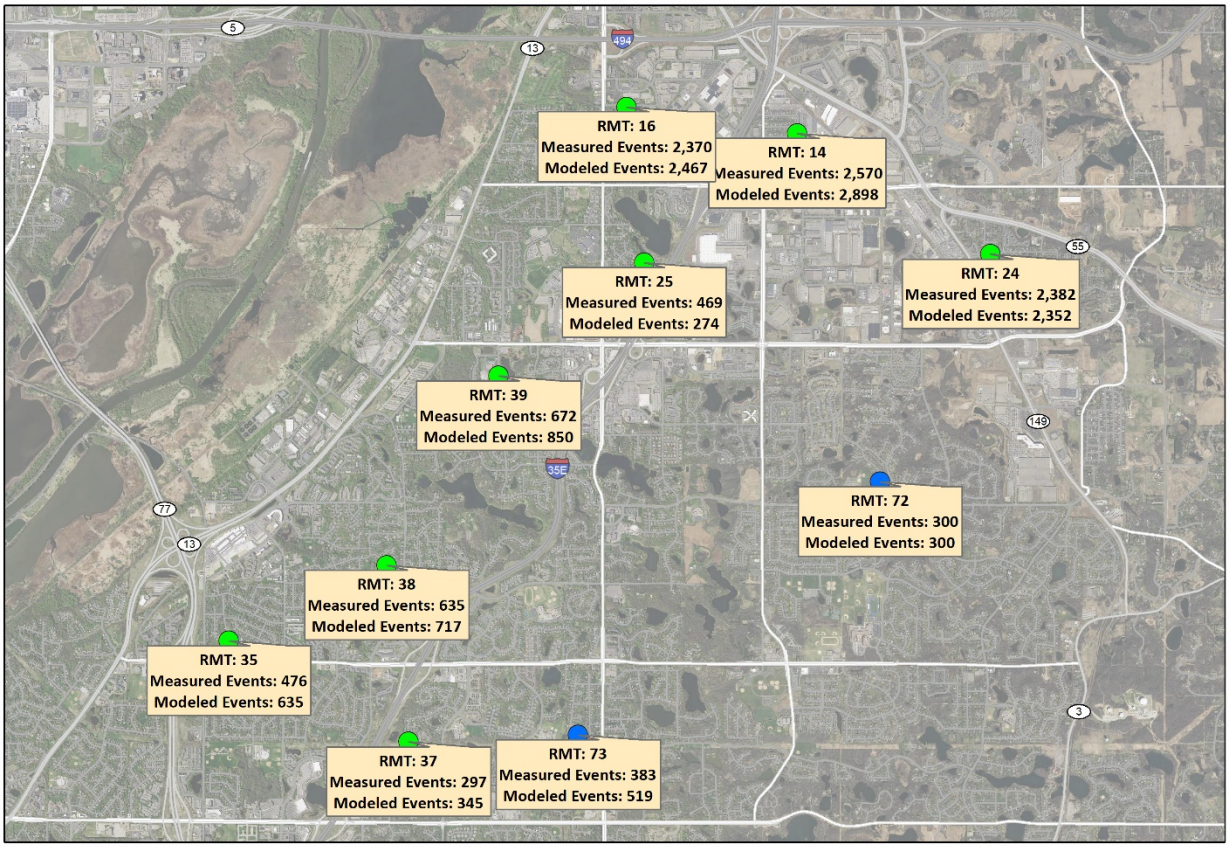
Top 10 Aircraft Events - Mueller Park

Date/Time	Flight Number	Aircraft	Operation	Runway	LA_{max} (dB)	Duration (seconds)	Distance (ft)
5/8/2019 18:21	DAL884	A321	D	12R	80.1	16	2488
5/3/2019 9:22	DAL375	A321	D	12R	78.3	18	2209
5/8/2019 18:30	DAL928	A321	D	12R	77.4	17	2769
5/14/2019 18:25	DAL1505	B739	D	12R	77.1	19	2488
5/13/2019 11:28	DAL1981	B739	D	12R	76.9	20	2580
5/8/2019 11:59	DAL1543	B753	D	12R	76.6	18	4231
5/8/2019 14:53	DAL696	A321	D	12R	76.3	14	3319
5/3/2019 15:44	DAL968	A321	D	17	76.2	15	2770
5/12/2019 13:03	DAL2376	A321	D	17	76	14	3138
5/13/2019 13:12	DAL2548	A321	D	12R	76	17	2526

Top 10 Aircraft Events - Evergreen Park

Date/Time	Flight Number	Aircraft	Operation	Runway	LA_{max} (dB)	Duration (seconds)	Distance (ft)
5/11/2019 7:50	FDX420	MD11	D	17	77.7	27	3568
5/3/2019 9:19	DAL515	B739	D	17	76.6	21	2802
5/7/2019 8:24	UPS2557	B744	D	17	76.2	24	3189
5/14/2019 21:49	UPS559	MD11	D	17	76.1	22	4194
5/12/2019 9:22	DAL550	A320	D	17	76	21	3206
5/12/2019 9:26	DAL1504	A321	D	17	76	22	3663
5/3/2019 11:37	DAL1557	A320	D	17	76	21	2908
5/13/2019 16:51	DAL307	B752	D	17	75.9	21	3868
5/3/2019 13:04	DAL2560	B739	D	17	75.8	18	3767
5/4/2019 9:07	DAL1936	A319	D	17	75.7	21	3331

Measured vs. Modeled Aircraft Sound Events



MEASURED VS. MODELED AIRCRAFT SOUND EVENTS
MAY 2 - MAY 15, 2019

Site	Modeled Events	Measured Events	(+/-)
14	2,898	2,570	(328)
16	2,467	2,370	(97)
24	2,352	2,382	30
25	274	469	195
35	635	476	(159)
37	345	297	(48)
38	717	635	(82)
39	850	672	(178)
72 - Mueller Farm Park	**300**	**300**	**-**
73 - Evergreen Park	**519**	**383**	**(136)**

4.3 UNCORRELATED AIRCRAFT EVENTS

Aircraft events at study sites not seen at permeant sites located in Eagan unknown factors (1.5% of total)

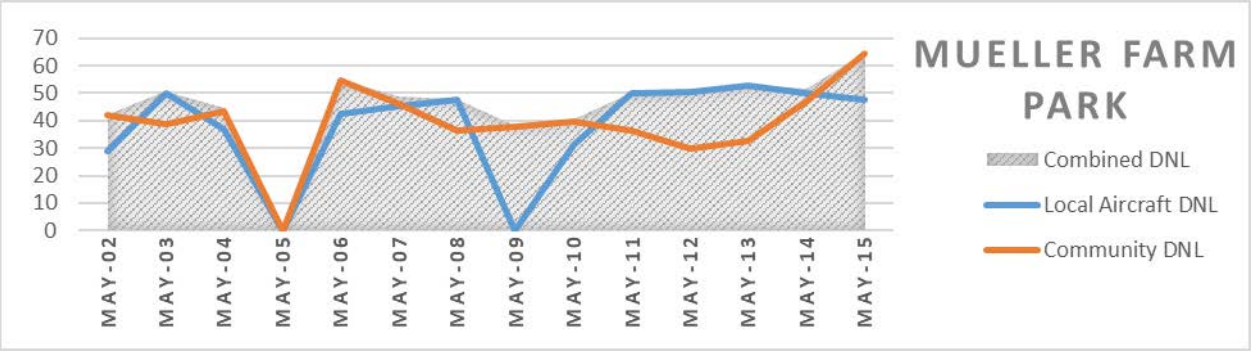
Site	Date/Time	LA_{max}	Operation	Aircraft	Runway	Factor
Evergreen Park	5/3/19 13:14:44	69.2	DEP	CRJ9	17	No Events
Evergreen Park	5/3/19 13:17:24	69.1	DEP	CRJ9	17	No Events
Evergreen Park	5/4/19 9:04:52	68.6	DEP	CRJ9	17	No Events
Evergreen Park	5/4/19 10:07:44	68.6	DEP	CRJ9	17	No Events
Evergreen Park	5/4/19 10:23:56	70.7	DEP	B712	17	No Events
Evergreen Park	5/7/19 20:50:55	69	DEP	CRJ7	17	No Events
Evergreen Park	5/11/19 20:38:40	70.1	DEP	CRJ9	17	No Events
Evergreen Park	5/12/19 16:57:19	68.9	DEP	CRJ9	17	No Events
Evergreen Park	5/13/19 19:19:19	67.8	DEP	CRJ9	17	No Events
Evergreen Park	5/13/19 20:24:41	67.3	DEP	E75L	17	No Events

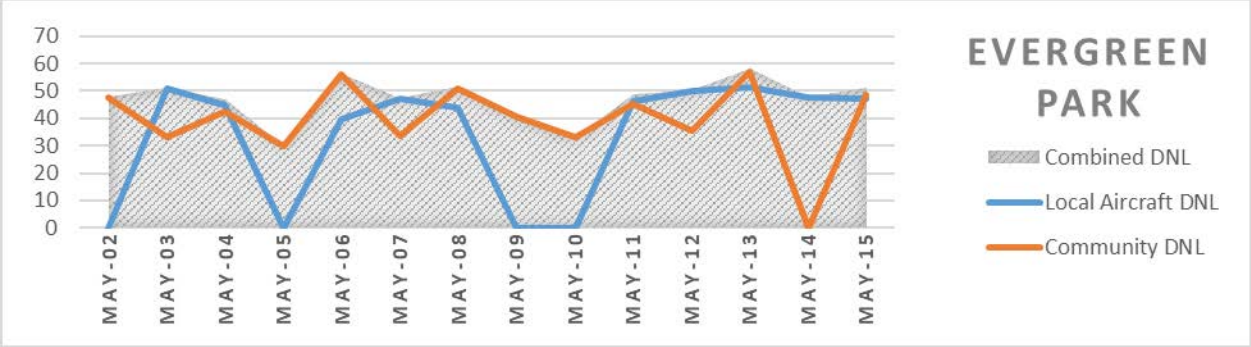
Aircraft events at study sites not seen at permanent sites located in Eagan due to known factors (1%)

Site	Date/Time	LA_{max}	Operation	Aircraft	Runway	Factor
Mueller Farm Park	5/2/19 14:46:01	70.4	ARR	C208	30L	Flight Track
Evergreen Park	5/7/19 14:26:49	70.3	DEP	B712	17	Missing Flight Track
Evergreen Park	5/13/19 10:09:49	75	DEP	A319	17	Combined Event
Evergreen Park	5/13/19 13:19:02	69.1	DEP	A319	17	Combined Event
Evergreen Park	5/13/19 14:48:16	73.2	DEP	E170	17	Combined Event
Mueller Farm Park	5/13/19 15:53:02	73.2	DEP	A321	17	Combined Event
Evergreen Park	5/15/19 13:28:13	69.1	DEP	E75L	17	Combined Event

4.4 DNL

Measured DNL by Date

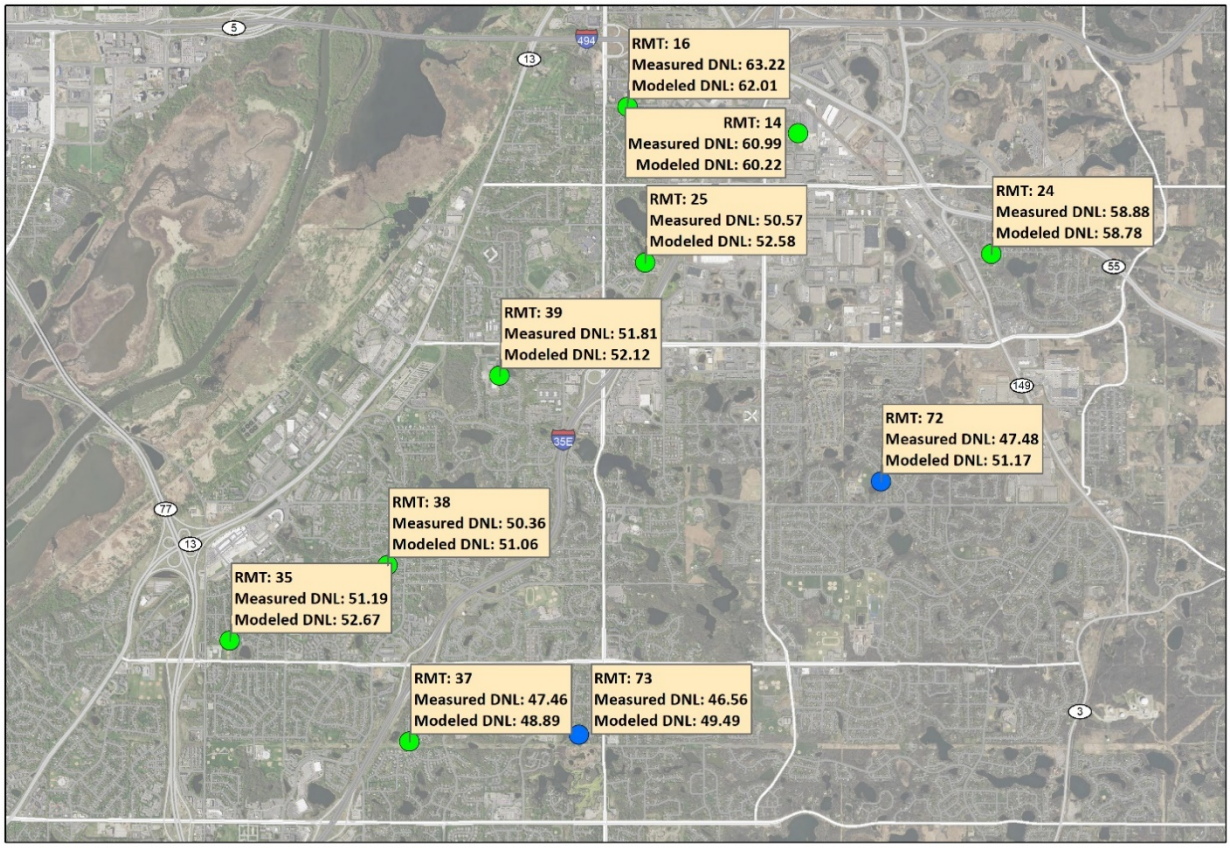




Measured DNL by Date

Date	Evergreen Park	Mueller Farm Park
5/2/2019	-	28.84
5/3/2019	51.07	50.21
5/4/2019	44.94	36.95
5/5/2019	-	-
5/6/2019	39.57	42.47
5/7/2019	47.17	45.22
5/8/2019	43.68	47.75
5/9/2019	-	-
5/10/2019	-	31.04
5/11/2019	46.46	49.85
5/12/2019	49.98	50.51
5/13/2019	51.26	52.85
5/14/2019	47.73	49.95
5/15/2019	47.33	47.87
Average	**49.49**	**46.56**

Measured vs. Modeled Aircraft DNL



Site	Modeled ADNL	Measured ADNL	(+/-)
14	60.22	60.99	-0.77
16	62.01	63.22	-1.21
24	58.78	58.88	-0.10
25	52.58	50.57	2.01
35	52.67	51.19	1.48
37	48.89	47.47	1.42
38	51.06	50.36	0.70
39	52.12	51.81	0.31
72 - Mueller Farm Park	51.17	47.48	3.69
73 - Evergreen Park	49.49	46.56	2.93

4.5 WEATHER

Daily Observation – NOAA MSP Station

Date	Day	Low (f)	High (f)	Rain (in)	Wind (mph)
5/2/2019	1	41	57	-	13
5/3/2019	2	35	62	0.15	17
5/4/2019	3	45	71	-	16
5/5/2019	4	49	64	-	20
5/6/2019	5	47	59	-	17
5/7/2019	6	40	63	-	15
5/8/2019	7	36	55	1.45	28
5/9/2019	8	35	54	0.02	25
5/10/2019	9	38	61	-	14
5/11/2019	10	42	65	0.01	22
5/12/2019	11	43	62	-	13
5/13/2019	12	40	67	-	13
5/14/2019	13	48	73	0.04	14
5/15/2019	14	54	76	0.12	13