City of Manassas, Virginia

# Manassas Regional Airport Commission Meeting

## AGENDA

---

## Manassas Regional Airport Commission Meeting
## Terminal Building - 1st Floor Conference Room
## 10600 Harry Parrish Boulevard
## Manassas, VA 20110
## Thursday, May 19, 2022

**Call to Order and Roll Call - 7:00 p.m.**

**Pledge of Allegiance**

**1. Approval of Minutes**

**1.1 Approval of Meeting Minutes for April 21, 2022**
May Manassas Regional Airport Commission - April 21 Minutes.docx

**2. Review of Expenses**

**2.1 Review Expenses**
May Bill Sheet.xlsx

**3. Comments from the Public**

*The "Comments from the Public" agenda item is for members of the public to address the Airport Commission for less than three (3) minutes each. Please state your full name, your city/county and state of domicile, and your interest in, and/or affiliation with, the Airport prior to speaking. No prior notice is necessary to speak during this portion of the agenda. Members of the public may also address the Airport Commission for longer than three (3) minutes if they ask the Airport Director for a place on the agenda at least five (5) working days before the meeting or if a member of the public is specifically requested by a Commission Member to address the Commission.*

**4. Airport Director's Report**

**4.1 Airport Director's Report**
May 2022.docx

**4.2 Tie-Down and Hangar Occupancy Reports, and Citizen's Monthly Noise Concerns**
April 2022 Tie-Down Occupancy.pdf
April 2022 Hangar Occupancy.pdf
April 2022 Noise.pdf

**4.3 Aging, Revenue, and Expenditure Reports**
Expenses Report.xlsx
Revenue Report.xlsx
Aging Report.pdf

**4.4 Airport Master Plan Status Update**
Airport Master Plan Status Update.pdf

## 5. Presentations

**5.1 Review of Runway 10K/5K Event**
Agenda Statement - May 19 2022 Presentation - Commission.docx

**5.2 Review of ACRP Report 237: Airport Noise Operations Monitoring System**
Pages from Primer and Framework - Noise NOMS (Appendices).pdf
Primer and Framework - Noise NOMS.pdf
acrp_rpt_237Appendices.pdf
Agenda Statement - May 19 2022 ACRP - Commission.docx

## 6. Old Business

## 7. Consent Agenda

## 8. Committee Reports (If Available)

**8.1 Airport Operations Committee Report (Mr. John Snider, Chair, 5 minutes)**

## 9. New Business

## 10. Information Items

## 11. Commission Comments

### 11.1 Council Representative Comments

## Adjournment

City of Manassas, Virginia
Manassas Regional Airport Commission Meeting

MINUTES

# Manassas Regional Airport Commission Meeting
# Terminal Building - 1st Floor Conference Room
# 10600 Harry Parrish Boulevard
# Manassas, VA 20110
# Thursday, April 21, 2022

The Manassas Regional Airport Commission held its regular meeting in the Airport Conference Room on the above date, attended by Chairman Tom Lemmon, Richard Seraydarian, Anthony McGhee, James L. Uzzle, Larry Pigeon, John Snider, Howard Goodie and Ross Snare..

Member Vanslyn Augustus and Council Member Theresa Coates Ellis was not present.

Airport Personnel in Attendance: Juan E. Rivera (Airport Director), Patty Bibber (Admin Fiscal Coordinator) and Jolene Berry (Airport Operations).

Chairman Lemmon called the meeting to order at 7:01 p.m.

Pledge of Allegiance

1. Approval of Meeting Minutes
   Member Snider MOVED to approve the minutes for the March 17, 2022 meeting, SECONDED by Member Pigeon and CARRIED UNANIMOUSLY

2. Review of Expenses
   Mr. Rivera suggested that the Bill Sheet be amended to include only the previous months expenses.

3. Comments from the Public

   *The "Comments from the Public" agenda item is for members of the public to address the Airport Commission for less than three (3) minutes each. Please state your full name, your city/county and state of domicile, and your interest in, and/or affiliation with, the Airport prior to speaking. No prior notice is necessary to speak during this portion of the agenda. Members of the public may also address the Airport Commission for longer than three (3) minutes if they ask the Airport Director for a place on the agenda at least five (5) working days before the meeting or if a member of the public is specifically requested by a Commission Member to address the Commission.*

4. Airport Director's Report

4.1 Airport Director's Report

Mr. Rivera noted that staff had a meeting on April 1 with three school divisions regarding the CTE program. Career day will be sometime in the fall and will get back with dates. The schools will be here in June to give a presentation to the Commission regarding the regional aviation academy.

Mr. Rivera stated that a letter would be posted regarding Rising Phoenix being in default of their contract. He will also be sending the letter to those who have a stake in the property.

Mr. Rivera noted that a kick off meeting was held on May 5 with FAA to talk about the tower site analysis. He noted that the Airport's points of contact with Michael Baker are leaving and the staff is waiting to see who the new contact will be.

Mr. Rivera mentioned that the Runway run on Sunday April 24 has around 440 runners signed up.

Mr. Rivera noted that the Airport was select as Honorable Mention for the large general aviation category for the 2021-2022 Balchen/Post Award. This award recognizes airports that have demonstrated excellence in the performance of ice and snow removal.

Mr. Rivera stated that he had a conversation with company out of Norfolk interested in building a hangar here at the airport.

Mr. Rivera mentioned that Doug McCauley would be leaving the airport to go to the streets department, which is a part of Public Works, as a supervisor, he will be greatly missed here at the airport. He stated that Doug has been with the airport for 13 years and started out in Public Work and will be returning there.

Mr. Rivera briefed the Commission regarding the passing of Boiling DeSouza. Mr. DeSouza had a business on the airport since 2004. His wife and Son will be taking over the business. The funeral was held on April 8 along with a celebration of life at the hangar.

Mr. Rivera indicated that Mr. Berry and he have selected 3 Interns and they have been called to interview on Friday, April 29.

4.3 Aging, Revenue, and Expenditure Reports.

Mr. Rivera stated that the aging report is mostly from Rising Phoenix and less than 60-day late hangar rents.

5. Presentations

5.1 Quarterly Fuel and Aircraft Operations Report (Mrs. Jolene Berry, 10 Minutes).

5.2 Quarterly Airport Maintenance Report (Mr. Doug McCauley, 10 Minutes).
Mr. McCauley also thank Mr. Rivera for comments about his leaving the airport. Mr. McCauley expressed his goodbyes to the commission. Mr. Rivera expressed concern about the ability to replace him with the current job market.

6. Old Business

6.1 Review and Approve project(s) for the use of BIL funding (Mr. Juan Rivera, 10 minutes)
Mr. Rivera recommended using the BIL Funding for the renovations to the Observation Rd relocation and Drainage improvement to be addressed first, it is eligible for federal dollars and improves drainage. Vice Chairman Seraydarian MOVED to approve the Observation Rd and Drainage renovations to move forward SECONDED by Member Pigeon and CARRIED UNANIMOUSLY

7. Consent Agenda

8. Committee Reports (If Available)

8.1 Airport Operations Committee Report (Mr. John Snider, 5 minutes)
Member Snider conceded to Member Goodie to give update because Member Snider was not present for Operations meeting. Member Goodie briefed the committee that they were impressed with the wide range of issue that have to be dealt with on a daily basis.

Mr. Goodie indicated that the two big takeaways are they are looking to get another security company and City of Manassas will start sweeping the runways.

9. New Business

9.1 Review the updated Airport Wildlife Plan (Mrs. Jolene Berry, 10 minutes)
Member Snider MOVED to approve Wildlife Plan, Vice Chairman Seraydarian SECONDED and CARRIED UNANIMOUSLY.

10. Information Items

11. Commission Comments

11.1 Chairman Lemmon reached out to his counterpart at Leesburg regarding Dulles Airport. Both FBO's went out to bid, but both FBO's have major renovations. They are ramping up to take on more Corporate traffic and more improvements are being done.

Chairman Lemmon noted that Leesburg had a situation with an individual being very belligerent and having to call Leesburg police, which led to discussion about security and the quality of security companies.

Member Uzzle MOVED to adjourn the meeting. SECONDED by Vice Chairman Seraydarian and CARRIED UNANIMOUSLY.

Meeting adjourned at 8:12PM.

_____ _____

Secretary Chairman

_____

Date

| Vendor | Description |
|---|---|
| A R C WATER TREATMENT | Water Treatment |
| BOLAND TRANE SERVICES INC. | Replace the supply fan motor |
| CINTAS CORP. #145 | Tower/Terminal Mats/Misc/Uniforms |
| CINTAS FIRST AID & SAFETY | Shop First Aid Kit resupply |
| COMCAST COMMUNICATIONS | Cable |
| CONSTELLATION ENERGY CORPORATION | Gas at 10400 Wakeman |
| NAT'L ELEVATOR INSP SVC INC | Terminal Elevator Inspection |
| ORACLE ELEVATOR HOLDCO INC | Monthly Maintenance Fee |
| PARAMOUNT MECHANICAL CORPORATION | 10600 boiler room repair |
| REYNOLDS SMITH & HILLS INC | Observation Road Relocation and Drainage Improv. |
| SECURADYNE SYSTEMS INTERMEDIATE LLC | Camera Repair/Replace |
| SUNBELT RENTALS | Air Conditioner Rental for Office |
| THE ADT SECURITY CORPORATION | Panic Monitoring |
| U S PLANTS INC | Plant Maintenance |
| UNITED SITE SERVICES | Porta Johns for Water Outage |
| VA BUSINESS SYSTEMS | Copier Contract |
| VERIZON | Phone Charges |
| VIRTOWER LLC | VirTower 24/7 monitoring airport software |
| WALKERS CRPT CRE/JANTRL SVC | Janitorial Services |
| WASHINGTON GAS | 10493 Observation Gas |
| WASHINGTON GAS | 10509 Wakeman Drive Gas |
| WASHINGTON GAS | 10603 Observation Gas |
| WASHINGTON GAS | 10400 Wakeman |

| Net Amount |
|---|
| 190.00 |
| 7,205.00 |
| 491.61 |
| 69.28 |
| 129.57 |
| 710.53 |
| 195.80 |
| 162.50 |
| 1,823.00 |
| 5,621.61 |
| 2,569.64 |
| 754.35 |
| 31.50 |
| 627.84 |
| 918.45 |
| 348.30 |
| 10.25 |
| 500.00 |
| 2,110.10 |
| 35.73 |
| 175.89 |
| 47.55 |
| 958.86 |

# Airport Director's Office
# Juan E. Rivera

## Memorandum

May 12, 2022

TO: Manassas Regional Airport Commission

FROM: Juan E. Rivera, Airport Director

**RE: AIRPORT DIRECTOR'S REPORT FOR MAY 2022**

CITY COUNCIL ACTIONS IN REGARDS TO THE AIRPORT

a. On May 9, 2022, the City Council approved the Airport FY 2023 Operating and CIP Budgets.

b. The review of the updated Airport Bylaws sent to City Council has been scheduled for the Committee of the Whole on May 16, 2022.

HANGAR OCCUPANCY RATE
West T-Hangars: 55 out of 59 Rented
93% Rented - **3 tenants vacated. 1 moved to east side.**
East T-Hangars: 97 out of 97 Rented
100% Rented – **1 new tenant**
**East and West Hangars – 153 out of 156 – 98% Rented**

Waiting List Status – Emails will be sent out next week for available hangars.
Emails were sent out last week. I have 4 individuals that are all interested and have scheduled viewings on hangars this week.

*Breakdown*
**Total on List – 103**
**East Side - 90**
**West Side – 69**
**60x50- 14**

TIE-DOWN OCCUPANCY RATE
West Tie-Down: 43 out of 85 Rented
51% Rented – **1 tenant vacated. 1 tenant moved into a hangar.**
East Tie-Down: 84 out of 86 Rented
98% Rented – **No change.**
**East and West Tie-Down – 127 out of 171 Rented – 74% Rented**

Squatters: There is one potential squatter (N4453U) on the west tie-down areas. The owner has reached out to the me to execute a tie-down lease agreement. Communication has been positive and we are working through the paperwork and charging them back rent for the time in the spot.

NOISE COMPLAINTS

There were two (2) noise complaints recorded by Airport Operations in the month of April 2022.

1 – Helicopter Departure
1 – Airplane Departure

A noise complaint form is available on the Airport's website for citizens who have noise concerns. The form can be completed and submitted online, or a citizen can call the Noise Hotline 24/7 at (703) 257-2576. Staff is continuing to exercise contacts with operators in an effort to educate on Noise Program. A good percentage of the recent complaints are from operators outside of our based tenants, particularly military.

MASTER PLAN UPDATE

The Airport Staff's next bi-monthly meeting with the staff of RS&H, FAA and the Airport Staff is scheduled for May 18, 2022. RS&H has updated the Aviation Activity Forecast to incorporate TAF Data published in March by the FAA. The critical aircraft has been identified in accordance with AC 150/5200-17 (Critical Aircraft and Regular Use Determination) by grouping most demanding aircraft with similar characteristics together instead of identifying a single aircraft type with regular use. The FAA and the State have provided comments on the airport forecast. The latest task completion report is attached.

OBSERVATION ROAD RELOCATION AND DRAINAGE IMPROVEMENTS

The Airport staff will be meeting with the FAA and Department on May 13, 2022 to discuss the schedule and funding for this project. The plan is to use AIG funding for this project. The Airport would front some of the cost and get reimbursed by the FAA over the course of five years. The City staff is reviewing the final documents and final approvals are coming in and ongoing. The FAA Form 7460-1 and CSPP have been reviewed by the FAA and are complete. This project will be scheduled to start in the spring of 2023 to take advantage of the Federal and State funding availability.

TAXIWAY B REHABILITATION

Delta has completed the 30% report in house. A meeting was held with the FAA, State, airport staff and Delta Airport Consultants to discuss the 30% design. The cost of the project is estimated to be over $8 million. This is roughly $2.5 million over the current budget. It looks like the widening of the pavement is out of the scope along with the paved shoulders. The work along Taxilane Y and Zulu will be placed in the bid package as a bid alterative due to budget constraints. The scope of this project will still include the replacement of the lighting system. Delta Engineers are looking for ways to include a portion of the paved shoulders. Once Delta has a chance to evaluate the comments and do some more research, they will update the 30% design document and the Airport, FAA and State will determine the final scope of work.

RUNWAY 16R/34L REHABILIATION AND LIGHTING UPGRADES

The project has been completed and is awaiting close-out. The contractor, Chemung Contracting Corporation has submitted a claim with a request to drop liquidated damages. The Airport contends that the contractor did not complete the project on time and went over the contract time by nine (9) days.

The liquidated damages are $3,000 a day for a total of $27,000.00. The contractor is seeking $31,912.50 for additional work. Chemung Contracting submitted additional information to the City for review and evaluation. The City Attorney will respond to their request as appropriate once the information is evaluated.

TAXIWAY A DESIGN EFFORT

RS&H has finalized the design and the City has completed their review and the Site Plan is approved. RS&H is working with Jerry Burke on front end of the specification and project manual. An Independent Fee Estimate (IFE) for the CA/RFR scope of work has been completed and approved by the FAA. The FAA has requested that the Airport submit a grant application for the funding of this project by June 30th. The project will start in the spring of 2023. The concern the Airport Director has for this project is if the bids come in higher than the budget.

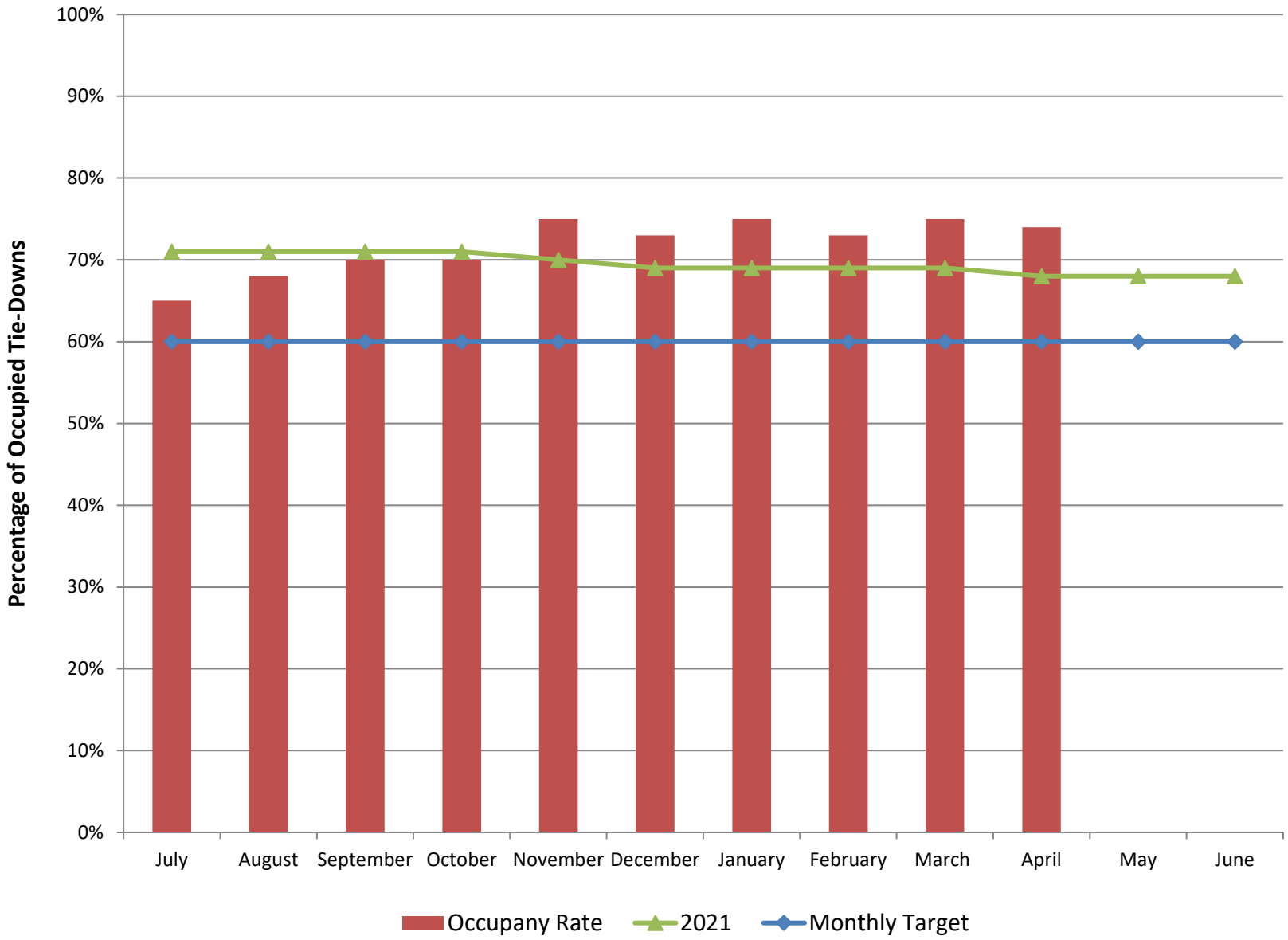
UPCOMING EVENTS

N/A

*Juan E. Rivera*
Juan E. Rivera, Director
Manassas Regional Airport

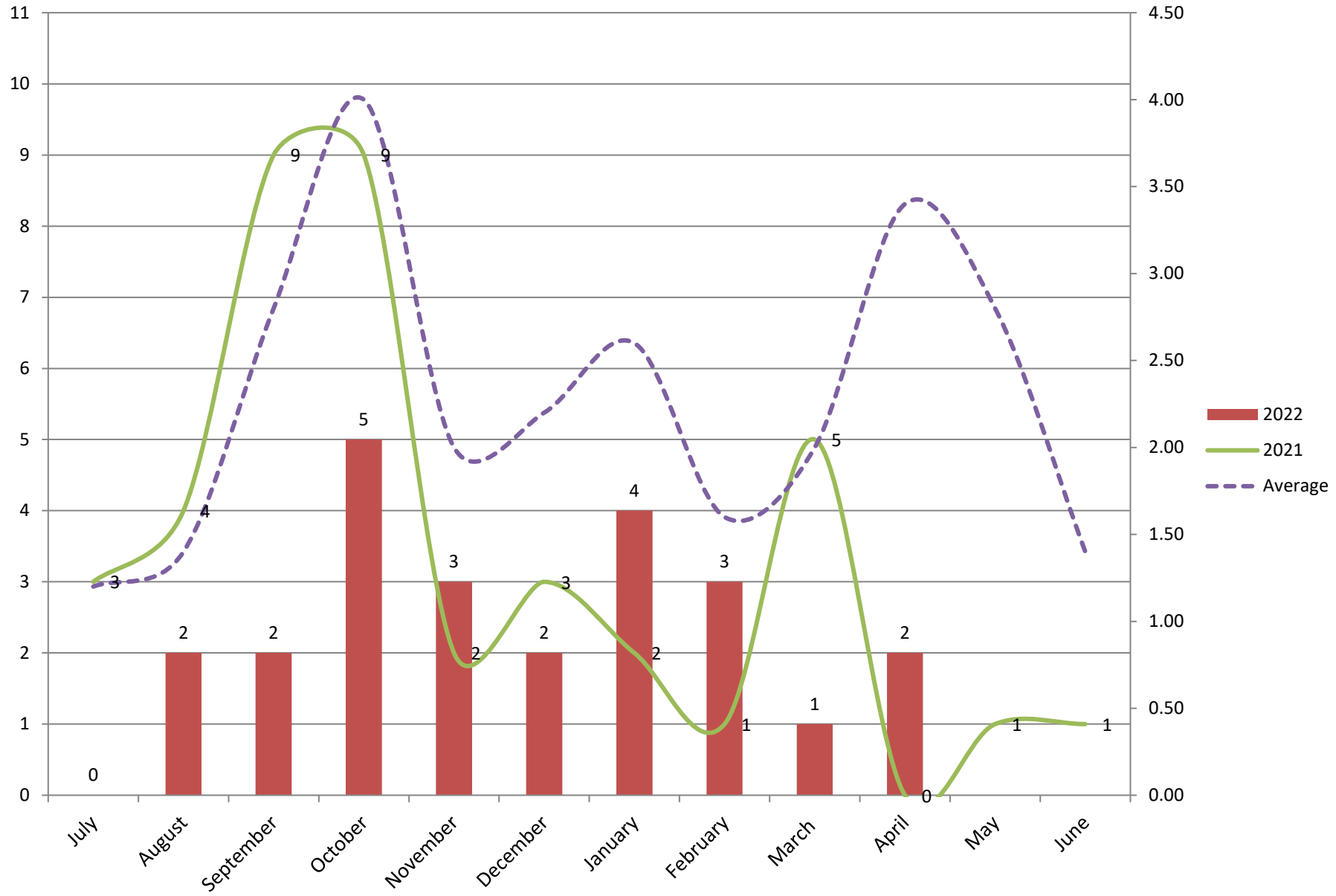
Attachments: Airport Master Plan Status Update
Noise Complaints & YTD Tie-Down and Hangar Occupancy Rates
Master Plan Updated Schedule

# FY2022 Tie-Down Occupancy Rates



# FY2022 Hangar Occupancy Rates

# Noise Complaints FY 2021-2022



| ORG | OBJ | ACCOUNT DESCRIPTION | ORIGINAL APPROP |
|---|---|---|---|
| 57003703 | 411000 | Salaries and Wages | 607,700 |
| 57003703 | 411020 | Board and Elections Stipends | 10,000 |
| 57003703 | 412000 | S&W-On-Call | 23,300 |
| 57003703 | 416000 | S&W-Overtime | 25,000 |
| 57003703 | 416010 | Hours Worked on a Holiday | 800 |
| 57003703 | 416015 | Call-Back Overtime | 0 |
| 57003703 | 420000 | Employee Benefits | 266,500 |
| 57003703 | 420002 | Deferred Compensation | 0 |
| 57003703 | 420004 | FICA | 0 |
| 57003703 | 420006 | Virginia Retirement System | 0 |
| 57003703 | 420008 | Group Health | 0 |
| 57003703 | 420010 | Worker's Compensation | 0 |
| 57003703 | 420012 | Group Term Life Insurance | 0 |
| 57003703 | 420014 | Long Term Disability | 0 |
| 57003703 | 420016 | Unemployment | 0 |
| 57003703 | 420031 | Car Allowance | 6,030 |
| 57003703 | 431000 | Professional Services | 75,000 |
| 57003703 | 431004 | Legal Fees | 25,000 |
| 57003703 | 432000 | Temporary Help Services | 2,500 |
| 57003703 | 435000 | Print Bind Photo Services | 1,500 |
| 57003703 | 436000 | Advertising Services | 60,000 |
| 57003703 | 439000 | Other Purchased Services | 18,000 |
| 57003703 | 441000 | Information Technology Charges | 57,830 |
| 57003703 | 441005 | Phones and Voicemail Charges | 18,170 |
| 57003703 | 441045 | IT GIS Mapping Charges | 8,020 |
| 57003703 | 441050 | IT Purchases Mid-Year | 1,000 |
| 57003703 | 442000 | Motor Vehicle Charges | 49,380 |
| 57003703 | 444000 | Cost Allocation Charges | 182,960 |
| 57003703 | 447000 | Radio Charges | 1,550 |
| 57003703 | 451001 | Utilities | 20,000 |
| 57003703 | 451002 | City Utility Charges | 127,000 |
| 57003703 | 452003 | Cell Phone Charges | 4,500 |
| 57003703 | 452007 | Cable/Satellite TV Service | 3,000 |
| 57003703 | 452008 | Telephone Service Charges | 500 |
| 57003703 | 453000 | Insurance | 55,500 |
| 57003703 | 454001 | Operating Leases | 3,500 |
| 57003703 | 455001 | Mileage | 1,000 |
| 57003703 | 455002 | Training and Travel | 12,500 |
| 57003703 | 455005 | Meeting / Business Expense | 8,000 |
| 57003703 | 458000 | Dues Memberships & Other Exp | 6,500 |
| 57003703 | 458099 | Miscellaneous Expense--Airport | 25,000 |
| 57003703 | 461000 | Office Supplies | 3,500 |
| 57003703 | 462000 | Other Supplies | 5,000 |
| 57003703 | 463000 | Books and Subscriptions | 500 |
| 57003703 | 464000 | Uniforms and Safety Apparel | 3,500 |
| 57003703 | 471000 | Equipment & Machinery Purch | 46,000 |

| | | | |
|---|---|---|---|
| 57003703 | | Total 57003703 Airport Operations | 1,765,740 |
| 57003710 | 433000 | Maintenance Services | 55,000 |
| 57003710 | 433001 | Refuse Collection Services | 6,000 |
| 57003710 | 433003 | Janitorial Services | 25,000 |
| 57003710 | 433006 | Mowing Services | 17,200 |
| 57003710 | 433008 | HVAC | 8,000 |
| 57003710 | 433009 | Elevator Services | 6,000 |
| 57003710 | 433010 | Snow Removal | 25,000 |
| 57003710 | 433012 | Airfield Lighting Maintenance | 2,500 |
| 57003710 | 433014 | Elevator Inspections | 2,000 |
| 57003710 | 433015 | Vehicle/Apparatus Maintenance | 35,000 |
| 57003710 | 439000 | Other Purchased Services | 36,000 |
| 57003710 | 439004 | Paving Services | 65,000 |
| 57003710 | 439008 | Hazmat Disposal | 17,000 |
| 57003710 | 439014 | Security Services | 92,000 |
| 57003710 | 454004 | Miscellaneous Rentals | 2,000 |
| 57003710 | 462000 | Other Supplies | 26,000 |
| 57003710 | 462001 | Tools | 10,000 |
| 57003710 | 462044 | Airfield Lighting Supplies | 15,000 |
| 57003710 | 462046 | Airport Hanger Supplies | 20,000 |
| 57003710 | 462047 | Airfield Supplies | 11,000 |
| 57003710 | 462048 | Security Supplies | 20,000 |
| 57003710 | 462052 | Terminal Grounds Supplies | 5,000 |
| 57003710 | 462067 | Maintenance Supplies | 2,500 |
| 57003710 | 466000 | Building and Repair Materials | 35,000 |
| 57003710 | 467000 | Fuels/Oils/Lubricants | 11,500 |
| 57003710 | 468000 | Vehicle/Equipment Parts/Supp | 25,000 |
| 57003710 | 471000 | Equipment & Machinery Purch | 60,000 |
| 57003710 | | Total 57003710 Airport Maintenance | 634,700 |
| 57003711 | 433000 | Maintenance Services | 14,000 |
| 57003711 | 433008 | HVAC | 2,500 |
| 57003711 | 433009 | Elevator Services | 3,000 |
| 57003711 | 433014 | Elevator Inspections | 1,000 |
| 57003711 | 462000 | Other Supplies | 3,000 |
| 57003711 | | Total 57003711 FAA Tower Nonreimbur | 23,500 |
| 57003712 | 433000 | Maintenance Services | 14,000 |
| 57003712 | 451002 | City Utility Charges | 18,500 |
| 57003712 | 451003 | Heating Fuel Oil or Gas | 1,000 |
| 57003712 | | Total 57003712 FAA Tower Reimbursab | 33,500 |
| 57003713 | 416000 | S&W-Overtime | 3,000 |
| 57003713 | 433003 | Janitorial Services | 2,500 |
| 57003713 | 439000 | Other Purchased Services | 15,000 |
| 57003713 | 439014 | Security Services | 500 |
| 57003713 | 462000 | Other Supplies | 12,000 |
| 57003713 | | Total 57003713 Airport-Special Proj | 33,000 |
| 57003793 | 462000 | Other Supplies | 100,000 |
| 57003793 | 481001 | Principal - Bonds Payable | 211,030 |

| | | | |
|---|---|---|---|
| 57003793 | 481021 | Interest - Bonds Payable | 30,170 |
| 57003793 | 492575 | Transfer to Airport Capital | 1,682,000 |
| 57003793 | 496004 | Contrib to Net Position | 456,460 |
| 57003793 | | Total 57003793 Airprt Capex-Finance | 2,479,660 |
| | | | |
| | | Expense Total | 4,970,100 |

| TRANFRS/ADJSMTS | REVISED BUDGET | YTD EXPENDED | ENCUMBRANCES | AVAILABLE BUDGET |
|---|---|---|---|---|
| 148,000 | 755,700 | 406,985.19 | 0.00 | 348,715 |
| 0 | 10,000 | 10,050.00 | 0.00 | -50 |
| 0 | 23,300 | 18,968.59 | 0.00 | 4,331 |
| 0 | 25,000 | 13,026.62 | 0.00 | 11,973 |
| 0 | 800 | 1,230.50 | 0.00 | -431 |
| 0 | 0 | 362.19 | 0.00 | -362 |
| 0 | 266,500 | 0.00 | 0.00 | 266,500 |
| 0 | 0 | 1,907.58 | 0.00 | -1,908 |
| 0 | 0 | 36,796.36 | 0.00 | -36,796 |
| 0 | 0 | 57,371.00 | 0.00 | -57,371 |
| 0 | 0 | 49,741.07 | 0.00 | -49,741 |
| 0 | 0 | 4,523.21 | 0.00 | -4,523 |
| 0 | 0 | 5,570.62 | 0.00 | -5,571 |
| 0 | 0 | 1,751.99 | 0.00 | -1,752 |
| 0 | 0 | 281.77 | 0.00 | -282 |
| 0 | 6,030 | 4,892.32 | 0.00 | 1,138 |
| 0 | 75,000 | 6,052.65 | 12,962.35 | 55,985 |
| 0 | 25,000 | 0.00 | 0.00 | 25,000 |
| 0 | 2,500 | 0.00 | 0.00 | 2,500 |
| 0 | 1,500 | 0.00 | 0.00 | 1,500 |
| 0 | 60,000 | 5,043.29 | 0.00 | 54,957 |
| 192 | 18,192 | 10,351.08 | 1,691.66 | 6,149 |
| 0 | 57,830 | 53,011.00 | 0.00 | 4,819 |
| 0 | 18,170 | 16,656.00 | 0.00 | 1,514 |
| 0 | 8,020 | 7,352.00 | 0.00 | 668 |
| 0 | 1,000 | 3,945.72 | 0.00 | -2,946 |
| 0 | 49,380 | 45,265.00 | 0.00 | 4,115 |
| 0 | 182,960 | 167,714.00 | 0.00 | 15,246 |
| 0 | 1,550 | 1,421.00 | 0.00 | 129 |
| 1,924 | 21,924 | 15,390.90 | 1,924.36 | 4,609 |
| 0 | 127,000 | 91,615.84 | 0.00 | 35,384 |
| 0 | 4,500 | 4,512.05 | 0.00 | -12 |
| 0 | 3,000 | 1,331.90 | 0.00 | 1,668 |
| 61 | 561 | 87.25 | 0.00 | 473 |
| 0 | 55,500 | 39,100.00 | 0.00 | 16,400 |
| 1,407 | 4,907 | 2,293.91 | 1,233.22 | 1,380 |
| 0 | 1,000 | 264.82 | 0.00 | 735 |
| 0 | 12,500 | 2,061.35 | 0.00 | 10,439 |
| 0 | 8,000 | 1,967.49 | 0.00 | 6,033 |
| 0 | 6,500 | 5,686.00 | 0.00 | 814 |
| 0 | 25,000 | 0.00 | 0.00 | 25,000 |
| 0 | 3,500 | 825.15 | 0.00 | 2,675 |
| 0 | 5,000 | 5,139.84 | 0.00 | -140 |
| 0 | 500 | 0.00 | 0.00 | 500 |
| 0 | 3,500 | 3,171.76 | 0.00 | 328 |
| 0 | 46,000 | 24,776.50 | 0.00 | 21,224 |

| | | | | |
|---|---|---|---|---|
| 151,584 | 1,917,324 | 1,128,495.51 | 17,811.59 | 771,017 |
| 810 | 55,810 | 35,270.07 | 635.34 | 19,905 |
| 594 | 6,594 | 4,153.32 | 0.00 | 2,440 |
| 1,709 | 26,709 | 13,678.12 | 1,709.44 | 11,322 |
| 0 | 17,200 | 0.00 | 0.00 | 17,200 |
| 0 | 8,000 | 14,319.96 | 7,957.00 | -14,277 |
| 0 | 6,000 | 0.00 | 0.00 | 6,000 |
| 0 | 25,000 | 22,544.38 | 0.00 | 2,456 |
| 0 | 2,500 | 0.00 | 0.00 | 2,500 |
| 0 | 2,000 | 195.80 | 0.00 | 1,804 |
| 0 | 35,000 | 0.00 | 0.00 | 35,000 |
| 0 | 36,000 | 19,829.58 | 0.00 | 16,170 |
| 0 | 65,000 | 0.00 | 0.00 | 65,000 |
| 348 | 17,348 | 8,339.88 | 348.03 | 8,660 |
| 20,683 | 112,683 | 38,137.65 | 31,152.52 | 43,393 |
| 0 | 2,000 | 1,981.41 | 0.00 | 19 |
| 0 | 26,000 | 653.26 | 0.00 | 25,347 |
| 0 | 10,000 | 3,061.72 | 0.00 | 6,938 |
| 0 | 15,000 | 2,303.91 | 0.00 | 12,696 |
| 0 | 20,000 | 3,217.08 | 0.00 | 16,783 |
| 0 | 11,000 | 1,700.50 | 0.00 | 9,300 |
| 5,875 | 25,875 | 11,259.49 | 0.00 | 14,616 |
| 0 | 5,000 | 908.83 | 0.00 | 4,091 |
| 0 | 2,500 | 4,389.27 | 0.00 | -1,889 |
| 0 | 35,000 | 6,867.25 | 0.00 | 28,133 |
| 0 | 11,500 | 4,062.18 | 0.00 | 7,438 |
| 0 | 25,000 | 13,547.54 | 0.00 | 11,452 |
| 0 | 60,000 | 47,350.00 | 0.00 | 12,650 |
| 30,020 | 664,720 | 257,771.20 | 41,802.33 | 365,146 |
| 0 | 14,000 | 0.00 | 0.00 | 14,000 |
| 0 | 2,500 | 0.00 | 0.00 | 2,500 |
| 0 | 3,000 | 1,993.75 | 0.00 | 1,006 |
| 0 | 1,000 | 1,115.90 | 0.00 | -116 |
| 0 | 3,000 | 59.00 | 0.00 | 2,941 |
| 0 | 23,500 | 3,168.65 | 0.00 | 20,331 |
| 401 | 14,401 | 8,223.84 | 400.66 | 5,776 |
| 0 | 18,500 | 14,737.99 | 0.00 | 3,762 |
| 1,013 | 2,013 | 47.55 | 1,013.03 | 952 |
| 1,414 | 34,914 | 23,009.38 | 1,413.69 | 10,491 |
| 0 | 3,000 | 0.00 | 0.00 | 3,000 |
| 0 | 2,500 | 0.00 | 0.00 | 2,500 |
| 0 | 15,000 | 5,918.45 | 0.00 | 9,082 |
| 0 | 500 | 0.00 | 0.00 | 500 |
| 0 | 12,000 | 0.00 | 0.00 | 12,000 |
| 0 | 33,000 | 5,918.45 | 0.00 | 27,082 |
| 0 | 100,000 | 0.00 | 0.00 | 100,000 |
| 0 | 211,030 | 536,414.25 | 0.00 | -325,384 |

| | | | | |
|---|---|---|---|---|
| 0 | 30,170 | 27,548.17 | 0.00 | 2,622 |
| 0 | 1,682,000 | 1,582,000.00 | 0.00 | 100,000 |
| 0 | 456,460 | 0.00 | 0.00 | 456,460 |
| 0 | 2,479,660 | 2,145,962.42 | 0.00 | 333,698 |
| 183,017 | 5,153,117 | 3,564,325.61 | 61,027.61 | 1,527,764 |

| % USED |
|---|
| 53.90 |
| 100.50 |
| 81.40 |
| 52.10 |
| 153.80 |
| 100.00 |
| 0.00 |
| 100.00 |
| 100.00 |
| 100.00 |
| 100.00 |
| 100.00 |
| 100.00 |
| 100.00 |
| 100.00 |
| 81.10 |
| 25.40 |
| 0.00 |
| 0.00 |
| 0.00 |
| 8.40 |
| 66.20 |
| 91.70 |
| 91.70 |
| 91.70 |
| 394.60 |
| 91.70 |
| 91.70 |
| 91.70 |
| 79.00 |
| 72.10 |
| 100.30 |
| 44.40 |
| 15.60 |
| 70.50 |
| 71.90 |
| 26.50 |
| 16.50 |
| 24.60 |
| 87.50 |
| 0.00 |
| 23.60 |
| 102.80 |
| 0.00 |
| 90.60 |
| 53.90 |

| |
|---|
| 59.80 |
| 64.30 |
| 63.00 |
| 57.60 |
| 0.00 |
| 278.50 |
| 0.00 |
| 90.20 |
| 0.00 |
| 9.80 |
| 0.00 |
| 55.10 |
| 0.00 |
| 50.10 |
| 61.50 |
| 99.10 |
| 2.50 |
| 30.60 |
| 15.40 |
| 16.10 |
| 15.50 |
| 43.50 |
| 18.20 |
| 175.60 |
| 19.60 |
| 35.30 |
| 54.20 |
| 78.90 |
| 45.10 |
| 0.00 |
| 0.00 |
| 66.50 |
| 111.60 |
| 2.00 |
| 13.50 |
| 59.90 |
| 79.70 |
| 52.70 |
| 70.00 |
| 0.00 |
| 0.00 |
| 39.50 |
| 0.00 |
| 0.00 |
| 17.90 |
| 0.00 |
| 254.20 |

| |
|---|
| 91.30 |
| 94.10 |
| 0.00 |
| 86.50 |
| |
| 70.40 |

| ORG | OBJ | ACCOUNT DESCRIPTION | ORIGINAL APPROP |
|---|---|---|---|
| 57097400 | 315001 | Interest on Pooled Cash | 0 |
| 57097400 | 315200 | Leases and Rents | -2,179,340 |
| 57097400 | 315204 | Hangar Rentals | -958,790 |
| 57097400 | | Total 57097400 Use of Money & Prope | -3,138,130 |
| 57097600 | 317510 | Airport Tie-Down Fees | -70,000 |
| 57097600 | 317520 | Airport Fuel Flowage Fees | -208,390 |
| 57097600 | 317530 | Airport Security Surcharge | -52,000 |
| 57097600 | 317535 | Airport Car Rental Revenue | -16,000 |
| 57097600 | | Total 57097600 Sales & Connections | -346,390 |
| 57097700 | 318000 | Miscellaneous Revenues | -2,500 |
| 57097700 | 318426 | Card Replacement Fees | -200 |
| 57097700 | 318650 | Airport Commercial Op Permit | -6,600 |
| 57097700 | 318710 | Cash Over/Short-Airport | 0 |
| 57097700 | | Total 57097700 Other Local Rev-Gene | -9,300 |
| 57097900 | 322071 | VA State Reimbursements | -35,000 |
| 57097900 | | Total 57097900 State Non-Categorica | -35,000 |
| 57098200 | 332010 | FAA Tower Rent from Fed Govt | -15,580 |
| 57098200 | 332011 | FAA Tower Reimbursements | -25,700 |
| 57098200 | | Total 57098200 Federal Non-Categori | -41,280 |
| 57098400 | 333010 | CARES Act/COVID-19 Funding | 0 |
| 57098400 | | Total 57098400 Federal Categorical | 0 |
| 57099100 | 346400 | Contr Surplus-Net Position | -1,400,000 |
| 57099100 | 346500 | Contr Surplus-Encumbrances | 0 |
| 57099100 | | Total 57099100 OFS-Contribution fro | -1,400,000 |
| | | | |
| | | Revenue Total | -4,970,100 |

| TRANFRS/ADJSMTS | REVISED BUDGET | YTD ACTUAL | AVAILABLE BUDGET | % USED |
|---|---|---|---|---|
| 0 | 0 | -3,413.56 | 3,414 | 100.00 |
| 0 | -2,179,340 | -1,988,804.87 | -190,535 | 91.30 |
| 0 | -958,790 | -861,266.81 | -97,523 | 89.80 |
| 0 | -3,138,130 | -2,853,485.24 | -284,645 | 90.90 |
| 0 | -70,000 | -118,697.64 | 48,698 | 169.60 |
| 0 | -208,390 | -232,549.90 | 24,160 | 111.60 |
| 0 | -52,000 | -56,336.60 | 4,337 | 108.30 |
| 0 | -16,000 | -49,464.20 | 33,464 | 309.20 |
| 0 | -346,390 | -457,048.34 | 110,658 | 131.90 |
| 0 | -2,500 | -92,466.09 | 89,966 | 3,698.60 |
| 0 | -200 | -175.00 | -25 | 87.50 |
| 0 | -6,600 | -5,990.00 | -610 | 90.80 |
| 0 | 0 | -2.75 | 3 | 100.00 |
| 0 | -9,300 | -98,633.84 | 89,334 | 1,060.60 |
| 0 | -35,000 | 0.00 | -35,000 | 0.00 |
| 0 | -35,000 | 0.00 | -35,000 | 0.00 |
| 0 | -15,580 | -14,278.00 | -1,302 | 91.60 |
| 0 | -25,700 | -32,422.53 | 6,723 | 126.20 |
| 0 | -41,280 | -46,700.53 | 5,421 | 113.10 |
| -148,000 | -148,000 | 0.00 | -148,000 | 0.00 |
| -148,000 | -148,000 | 0.00 | -148,000 | 0.00 |
| 0 | -1,400,000 | 0.00 | -1,400,000 | 0.00 |
| -35,017 | -35,017 | 0.00 | -35,017 | 0.00 |
| -35,017 | -1,435,017 | 0.00 | -1,435,017 | 0.00 |
| | | | | |
| -183,017 | -5,153,117 | -3,455,867.95 | -1,697,249 | 67.10 |

| Bill # | Cust Id | Customer Name | 30 to 60 Days Past | 61 to 90 Days Past | 91 to 120 Days Past | Over 120 Days Past |
|---|---|---|---|---|---|---|
| 108001 | 11204 | VIRGINIA RAILWAY EXPRESS | $0.00 | $0.00 | $0.00 | $1,812.70 |
| 1174 | 36062 | TEXTRON AVIATION LLC | $680.00 | $0.00 | $0.00 | $0.00 |
| 1166 | 36065 | ENTERPRISE RENT-A CAR | $680.00 | $0.00 | $0.00 | $0.00 |
| 1169 | 36069 | MERONES, LLC | $680.00 | $0.00 | $0.00 | $0.00 |
| 1171 | 36070 | PHI AIR MEDICAL, INC. | $25.00 | $0.00 | $0.00 | $0.00 |
| 1163 | 36072 | AVIS RENT A CAR SYSTEM LLC | $25.00 | $0.00 | $0.00 | $0.00 |
| 78002 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $1,681.75 |
| 78003 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $1,681.75 |
| 89102 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $400.00 |
| 89103 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $400.00 |
| 105601 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $1,681.75 |
| 105602 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $1,681.75 |
| 105603 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $1,681.75 | $0.00 |
| 105604 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $1,681.75 | $0.00 | $0.00 |
| 105605 | 36079 | RISING PHOENIX AVIATION, INC. | $1,681.75 | $0.00 | $0.00 | $0.00 |
| 105701 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $400.00 |
| 105702 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $400.00 |
| 105703 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $0.00 | $320.00 |
| 105704 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $0.00 | $320.00 | $0.00 |
| 105705 | 36079 | RISING PHOENIX AVIATION, INC. | $0.00 | $320.00 | $0.00 | $0.00 |
| 105706 | 36079 | RISING PHOENIX AVIATION, INC. | $320.00 | $0.00 | $0.00 | $0.00 |
| 101505 | 36451 | JOHNSON, CHRIS | $0.00 | $80.00 | $0.00 | $0.00 |
| 99205 | 36864 | COWAN GROUP | $0.00 | $3,176.00 | $0.00 | $0.00 |
| 99206 | 36864 | COWAN GROUP | $3,176.00 | $0.00 | $0.00 | $0.00 |
| 115206 | 38127 | GARCIA, MICHAEL | $335.00 | $0.00 | $0.00 | $0.00 |
| 110004 | 38602 | DONBUSH, KEN | $0.00 | $0.00 | $80.00 | $0.00 |
| 110005 | 38602 | DONBUSH, KEN | $0.00 | $80.00 | $0.00 | $0.00 |
| 110006 | 38602 | DONBUSH, KEN | $80.00 | $0.00 | $0.00 | $0.00 |
| 112704 | 42203 | DULLES AVIATION INC | $0.00 | $0.00 | $45.71 | $0.00 |
| 112705 | 42203 | DULLES AVIATION INC | $0.00 | $240.00 | $0.00 | $0.00 |
| 112706 | 42203 | DULLES AVIATION INC | $240.00 | $0.00 | $0.00 | $0.00 |
| 2989 | 74842 | ZIMMERMAN, DANIEL | $0.00 | $0.00 | $80.00 | $0.00 |
| 3016706 | 74842 | ZIMMERMAN, DANIEL | $0.00 | $0.00 | $0.00 | $80.00 |
| 3017506 | 78055 | INDULGENCE AERO LLC | $0.00 | $0.00 | $80.00 | $0.00 |
| 3017507 | 78055 | INDULGENCE AERO LLC | $0.00 | $80.00 | $0.00 | $0.00 |
| 3017508 | 78055 | INDULGENCE AERO LLC | $80.00 | $0.00 | $0.00 | $0.00 |
| 2488 | 78057 | COLTON, JON | $0.00 | $0.00 | $0.00 | $449.73 |
| 3017607 | 78201 | EYBERS, JOHN M | $0.00 | $1,835.00 | $0.00 | $0.00 |
| 3017608 | 78201 | EYBERS, JOHN M | $1,835.00 | $0.00 | $0.00 | $0.00 |
| 2951 | 82269 | N146SB, LLC | $0.00 | $0.00 | $0.00 | $110.97 |
| 2870 | 82272 | MB AVIATION LLC | $0.00 | $0.00 | $0.00 | $258.06 |
| 3119 | 82272 | MB AVIATION LLC | $0.00 | $240.00 | $0.00 | $0.00 |
| 3020101 | 82272 | MB AVIATION LLC | $80.00 | $0.00 | $0.00 | $0.00 |
| 3101 | 83998 | FLEETSHARES CORP | $0.00 | $160.00 | $0.00 | $0.00 |
| 3019401 | 83998 | FLEETSHARES CORP | $0.00 | $0.00 | $80.00 | $0.00 |
| 1154 | 87078 | STETTIN, EDWARD R | $35.00 | $0.00 | $0.00 | $0.00 |

**Airport Master Plan Status Update**

| | |
|---|---|
| **Date Written**: May 4, 2022 **Submitted By**: *Lanre Olaniyan* | **Update Number:** 26 |
| **Period:** Week of May 2, 2022 | **Look Ahead:** May 2022 |

**Work in Progress**:

~~Project Formulation (MB)~~
- ~~Phase is complete.~~

Aviation Demand Forecast (JG)
- ~~Analysis and narrative production (Completed)~~
- ~~Client Review – Delivered, February 8th~~
  - ~~Zoom review scheduled for February 16th (Completed)~~
    - ~~Analysis of OPS discrepancies/assumptions~~
  - ~~Follow up Zoom review scheduled for March 2nd~~
  - ~~HEF to share final comments by COB March 4th~~
- ~~FAA /VDOA Coordination Meeting – March 16th~~
  - ~~Update Forecast to include new TAF data~~
  - ~~Update Critical Aircraft per FAA request~~
- ~~Forecast Submittal to FAA – April 8th~~

AGIS/Survey (RF-MTZ)
- ~~Processing digital imagery (RF)~~
  - ~~The field survey data on HEF is processed and looks good.~~
- Topographical survey (Spring 2022)
  - Planimetrics and imagery are expected this spring.

ALP /Exhibit 'A" (TM)
- Sheets
  - ~~Airfield Basemap files provided 04.05.2022~~
  - Set up the sheets

Inventory and Facility Requirements (LO)
- Data gathering – Underway

- ~~Review the 1990 MP and the 2002 ALPU~~

- Flight tracks and critical aircraft data (Alberts – Underway)
  - ~~VirTower data shared with Alberts to incorporate into noise model~~
  - Draft 2021 DNL Contours complete and under review
  - Noise Model memo under revision to include 2021 ops/fleet

» Aircraft Parking and Storage
  - Based aircraft parking locations provided

» Aviation Support Facilities
  - Airport staff shared maintenance/storage facility inventory, maintenance storage facility drawings, and Terminal drawings
  - Airport staff shared ARFF feasibility study and details of existing ARFF vehicles
  - Fuel Farm and fueling operations details shared by airport staff

» ALP Data Tables and BLDG Tables
  - Reviewed by airport staff and feedback provided.

» Airfield Design
  - Runway length analysis underway.
    - RWY length analysis (Appendix B) from 16L-34R Extension EA has been located for reference

» Environmental Conditions
  - Draft report under review

» CLOMRS – underway (Wilson, Souto, Yankey)
  - ~~Steven to begin discussions with City and FEMA~~
  - ~~Expect update from Steven in 2 weeks (week of 03/07)~~
  - ~~Meeting with City of Manassas (MP Drainage Coordination) – 04.27.2022~~
  - Narrative/summary of findings forthcoming from Steven W.

» ~~Broad Run (Becker – On hold) (Complete)~~
  - Generate narrative regarding moving Broad Run (ASG, ESR, and ESG preliminary findings are the moving Broad Run is not a reasonable idea)
  - Steven W., Lindsay M, Dave Albers, Kate L. to provide narrative regarding Broad Run in Facility Requirements section

» Airport Financial Plan
  - Airport Financial Plan update for 2022 expected in June. Summary of key financial data will reference June 2022 Airport Financial Plan.

» Landside Facilities
  - Airport Regional Access coordination underway.
    - Prince William Parkway (SR 234) and I-66 improvement coordination ongoing.
    - Broad Run Station Expansion meeting with VRE – May 12, 2022
    - Land Use review ongoing

- Schedule a site visit (TBD)
    - ETA – Anticipate site visit near completion of Inventory and Facility Requirements chapter

Public Communication (RS)

- Website
    - Next step: create MP intro video (Becker)
    - Next step: create Airport Director video
- Social Media
    - No action
- Establish Public Communication Program (on hold - Souto)
    - Update PCP, save and share file – Task complete until Spring.
- Advisory Committees
    - Spring
        - ETA – FAA Forecast approval prior to next Advisory Committee

Project Management (LO)

- May Invoice submitted May 5, 2022
- Next Invoice – July 2022
- Next meeting with FAA/VDOA – Anticipated May 18, 2022

Manassas Regional Airport
VIRGINIA

**AIRPORT COMMISSION AGENDA STATEMENT**

| | |
|---|---|
| **MEETING DATE:** | May 19, 2022 |
| **TIME ESTIMATE:** | 5 minutes |
| **AGENDA ITEM TITLE:** | Review of Runway 10K/5K Event |
| **DATE THIS ITEM WAS LAST CONSIDERED BY COMMISSION:** | N/A |
| **SUMMARY OF ISSUE/ TOPIC:** | This will be a presentation on the results of the Runway 10K/5K that was held at the airport on April 24, 2022. Information will be presented on PowerPoint slides. |
| **STAFF RECOMMENDATION:** | N/A |
| **DISCUSSION (IF NECESSARY):** | No Discussion |
| **BUDGET/FISCAL IMPACT:** | N/A |
| **STAFF:** | Richard Allabaugh, 257-8402 |

Airport Director

Attachment

#### *H.4.1.3 Lessons Learned*

Airport staff expressed the importance of education as being the key to success in the handling of noise issues. For example, a local developer is a member of the AAC to provide a development perspective regarding land use issues; developers with potential land use projects are invited to meet directly with airport staff and the ACC to discuss their projects and the impacts and concerns that airport noise has on residential development close to the airport. Through this effort, a large residential development near the airport is incorporating some noise mitigation efforts, not currently required by local codes, but recommended in the draft compatibility plan.

### H.4.2 Manassas Regional Airport, VA (HEF)

#### *H.4.2.1 Background*

Manassas Regional Airport (HEF) is designated as a National General Aviation - Reliever airport located approximately 30 miles southwest of Washington, D.C. The airport proprietor is the city of Manassas, VA. HEF has two runways and aircraft operations include 54% itinerant General Aviation, and 46% local General Aviation[24]. **Table H-9*, HEF Statistical Highlights,*** presents some basic information about the airport.

**Table H-9 HEF Statistical Highlights**

| Statistical Category | Quantity |
|---|---|
| Number of Operations (2019) | 85,701 |
| Number of Noise Complaints (2019) | 11 |
| Number of Noise Staff | 2 |

Source: Landrum & Brown, 2021.

#### *H.4.2.2 Key Findings*

HEF's noise environment involves operations by fixed-wing and helicopter flight schools and also involves corporate jets, including on hush-kitted Gulfstream II. The airport has voluntary noise abatement procedures, which coincides with strict climb rates (ARSENAL 5 Departure), which takes into account air traffic from Dulles International Airport (IAD), approximately 16 miles north of HEF. Since 2007, the airport has received an average of 20 aircraft noise complaints per year. Noise complaints can be submitted online via the City's public issue reporting system. Approximately 80% of noise complaints are related to helicopter traffic, medical and law enforcement operations flying relatively low on flight corridors between airports and around the D.C. region. In addition to the City's complaint database, staff uses off-the-shelf electronic spreadsheets developed in-house to log and document noise complaints. Staff reports the number of aircraft noise complaints but does not publish complaint statistics online.

[24] FAA Air Traffic Activity System (ATADS) for 2019.

In recent years, airport staff used the IAD public online flight tracking tool to investigate aircraft operations. However, HEF currently has its own flight tracking tool to investigate aircraft operations and also partners with the ATCT to receive feedback on flights that may not be available on third party platforms.

Prior to procuring the flight tracking tool, the airport used grant funding to procure a noise meter, which was used to monitor aircraft operations. The transfers and analysis of data was challenging, however. Staff reached out to an airport that operated a NOMS to receive information about the factors associated with the NOMS including cost. Given the high cost of a NOMS and the relatively small noise issues, the procurement of a NOMS could not be justified.

Two of the most challenging aspects of handling noise issues are informing the public that helicopters are allowed to fly at relatively low altitudes and handling repeat complaints by the same individuals when no new information can be provided to them that will resolve their complaints.

#### *H.4.3.3 Lessons Learned*

When responding to community members who complain often, staff should provide information about aircraft operations – although it may be repetitive – in a customer-service-based honest and engaging way and try to connect with the complainants so they feel understood.

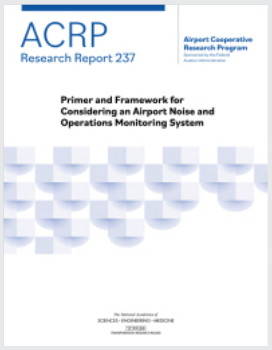
For airports that are beginning to develop their noise programs, understand that noise programs generally do not show signs of noise reduction from the onset. It takes time for noise programs to mature and become effective. Staff should invest time and effort into engaging the various types of pilots that fly into and out of their airports and engaging ATCT staff to assist in the utilization of noise abatement procedures. Lastly, if funding for a NOMS cannot be secured, staff should research other sources that may provide pieces to a noise monitoring system, such as a city's complaint tool or a larger airport's flight tracking tool.

### H.4.3 Georgetown Municipal Airport, TX (GTU)

#### *H.4.3.1 Background*

Georgetown Municipal Airport (GTU) is a General Aviation - Reliever airport located approximately 28 miles north of downtown of Austin, TX. The airport proprietor is the City of Georgetown, TX. GTU has two runways and aircraft operations include less than 1% Air taxi, 47% Itinerant General Aviation, and 53% local General Aviation[25]. **Table H-10*, GTU Statistical Highlights,*** presents some basic information about the airport.

[25] FAA Air Traffic Activity System (ATADS) for 2019.




# Primer and Framework for Considering an Airport Noise and Operations Monitoring System (2022)



## DETAILS

50 pages | 8.5 x 11 | PDF
ISBN 978-0-309-09465-8 | DOI 10.17226/26527

## CONTRIBUTORS

Christian Valdes, Vincent Mestre, Alan Hass, Sarah Farsalas, Bernard Barry; Airport Cooperative Research Program; Transportation Research Board; National Academies of Sciences, Engineering, and Medicine

## SUGGESTED CITATION

National Academies of Sciences, Engineering, and Medicine 2022. *Primer and Framework for Considering an Airport Noise and Operations Monitoring System*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26527.

AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP RESEARCH REPORT 237

# Primer and Framework for Considering an Airport Noise and Operations Monitoring System

**Christian Valdes**
**Vincent Mestre**
**Alan Hass**
**Sarah Farsalas**
LANDRUM & BROWN, INC.
Cincinnati, OH

IN ASSOCIATION WITH

**Bernard Barry**
BARRY TECHNOLOGIES, INC.
Chicago, IL

*Subscriber Categories*
Aviation • Environment

Research sponsored by the Federal Aviation Administration

*The National Academies of*
SCIENCES • ENGINEERING • MEDICINE

TRB
TRANSPORTATION RESEARCH BOARD

2022

## AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). ACRP carries out applied research on problems that are shared by airport operating agencies and not being adequately addressed by existing federal research programs. ACRP is modeled after the successful National Cooperative Highway Research Program (NCHRP) and Transit Cooperative Research Program (TCRP). ACRP undertakes research and other technical activities in various airport subject areas, including design, construction, legal, maintenance, operations, safety, policy, planning, human resources, and administration. ACRP provides a forum where airport operators can cooperatively address common operational problems.

ACRP was authorized in December 2003 as part of the Vision 100—Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), Airlines for America (A4A), and the Airport Consultants Council (ACC) as vital links to the airport community; (2) TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academy of Sciences formally initiating the program.

ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for ACRP are solicited periodically but may be submitted to TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel appointed by TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended users of the research: airport operating agencies, service providers, and academic institutions. ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties; industry associations may arrange for workshops, training aids, field visits, webinars, and other activities to ensure that results are implemented by airport industry practitioners.

## ACRP RESEARCH REPORT 237

Project 02-89
ISSN 2572-3731 (Print)
ISSN 2572-374X (Online)
ISBN 978-0-309-09465-8
Library of Congress Control Number 2022931559



### COPYRIGHT INFORMATION



### NOTICE

The research report was reviewed by the technical panel and accepted for publication according to procedures established and overseen by the Transportation Research Board and approved by the National Academies of Sciences, Engineering, and Medicine.

The opinions and conclusions expressed or implied in this report are those of the researchers who performed the research and are not necessarily those of the Transportation Research Board; the National Academies of Sciences, Engineering, and Medicine; or the program sponsors.

The Transportation Research Board; the National Academies of Sciences, Engineering, and Medicine; and the sponsors of the Airport Cooperative Research Program do not endorse products or manufacturers. Trade or manufacturers' names or logos appear herein solely because they are considered essential to the object of the report.

*Published research reports of the*

**AIRPORT COOPERATIVE RESEARCH PROGRAM**

*are available from*

Transportation Research Board
Business Office
500 Fifth Street, NW
Washington, DC 20001

*and can be ordered through the Internet by going to*

https://www.mytrb.org/MyTRB/Store/default.aspx

Printed in the United States of America

## *The National Academies of*
## SCIENCES • ENGINEERING • MEDICINE

The **National Academy of Sciences** was established in 1863 by an Act of Congress, signed by President Lincoln, as a private, non-governmental institution to advise the nation on issues related to science and technology. Members are elected by their peers for outstanding contributions to research. Dr. Marcia McNutt is president.

The **National Academy of Engineering** was established in 1964 under the charter of the National Academy of Sciences to bring the practices of engineering to advising the nation. Members are elected by their peers for extraordinary contributions to engineering. Dr. John L. Anderson is president.

The **National Academy of Medicine** (formerly the Institute of Medicine) was established in 1970 under the charter of the National Academy of Sciences to advise the nation on medical and health issues. Members are elected by their peers for distinguished contributions to medicine and health. Dr. Victor J. Dzau is president.

The three Academies work together as the **National Academies of Sciences, Engineering, and Medicine** to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions. The National Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine.

Learn more about the National Academies of Sciences, Engineering, and Medicine at **www.nationalacademies.org**.

---

The **Transportation Research Board** is one of seven major programs of the National Academies of Sciences, Engineering, and Medicine. The mission of the Transportation Research Board is to provide leadership in transportation improvements and innovation through trusted, timely, impartial, and evidence-based information exchange, research, and advice regarding all modes of transportation. The Board's varied activities annually engage about 8,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

Learn more about the Transportation Research Board at **www.TRB.org**.

# COOPERATIVE RESEARCH PROGRAMS

## CRP STAFF FOR ACRP RESEARCH REPORT 237

**Christopher J. Hedges,** *Director, Cooperative Research Programs*
**Lori L. Sundstrom,** *Deputy Director, Cooperative Research Programs*
**Marci A. Greenberger,** *Manager, Airport Cooperative Research Program*
**Joseph D. Navarrete,** *Senior Program Officer*
**Stephanie L. Campbell-Chamberlain,** *Senior Program Assistant*
**Natalie Barnes,** *Director of Publications*
**Heather DiAngelis,** *Associate Director of Publications*
**Ellen M. Chafee,** *Senior Editor*

## ACRP PROJECT 02-89 PANEL
### Field of Environment

**Sandra J. Lancaster,** *Dallas-Fort Worth International Airport, DFW Airport, TX* (Chair)
**Paul Hagerty,** *ALL4 LLC, Kennett Square, PA*
**Xiaobo Liu,** *Port Authority of New York and New Jersey, New York, NY*
**Loren Olson,** *City of Minneapolis, Minneapolis, MN*
**Bruce Rineer,** *Maryland Aviation Administration, BWI Airport, MD*
**Hua He,** *FAA Liaison*
**Veronica Bradley,** *Airlines for America Liaison*
**Melinda Z. Pagliarello,** *Airports Council International–North America Liaison*

# FOREWORD

By Joseph D. Navarrete
Staff Officer
Transportation Research Board

*ACRP Research Report 237: Primer and Framework for Considering an Airport Noise and Operations Monitoring System* is a comprehensive resource to help airport industry practitioners assess the potential benefits and costs of acquiring, maintaining, and updating a Noise and Operations Monitoring System (NOMS) or flight tracking tools without permanent noise monitors. The report will be valuable not only for practitioners who might be considering acquiring a NOMS but also for those who might be exploring enhancements to their current system.

---

Airports use NOMSs to collect, manage, analyze, and communicate data such as flight tracks and procedures, aircraft identification, noise measurements, noise abatement program performance, and weather. NOMSs are also used to respond to community noise complaints and provide stakeholders with information about aircraft activity and noise, thus fostering trust and transparency. These systems may also be employed for other, non-noise-related tasks, such as monitoring airfield activity and air traffic delays and landing fee reconciliation. While a NOMS can be beneficial, it requires both financial and technical investment; moreover, airports may not have the resources and industry knowledge to adequately evaluate the benefits and costs of these systems. Research was needed to help airports decide whether a NOMS would be appropriate for their situation and evaluate the benefits and costs of acquiring, maintaining, and updating such systems.

The research, led by Landrum & Brown, began with a review of regulations, guidelines, and standards regarding the application, funding, and operations of a NOMS. This was followed by a survey to determine the types and number of airports using these systems, the current state of NOMS utilization, and the benefits and disbenefits of a NOMS. The research team then undertook case studies of three airports using a NOMS and four that were not employing the technology. The research concluded with interviews of NOMS vendors to gain an understanding of trends and technology enhancements. The analysis and findings from the research were then used to prepare this report.

The report provides a summary of the steps undertaken to conduct the research. It then describes the history of NOMS technology, its various uses, and the reasons airports acquire a NOMS. The report then provides financial, technical, and staffing requirements. The guidance concludes with a helpful decision-making framework to assist airports in determining if a NOMS would be appropriate for their unique situation.

Appendices A through K include a literature review, list of airports with an active NOMS, questionnaires used during the research, survey results, case study findings, input from NOMS vendors, a guide for NOMS installation and maintenance, and a guide for developing a noise management program. The appendices can be accessed at www.nap.edu by searching on *"ACRP Research Report 237: Primer and Framework for Considering an Airport Noise and Operations Monitoring System"*.

# CONTENTS



Note: Photographs, figures, and tables in this report may have been converted from color to grayscale for printing. The electronic version of the report (posted on the web at www.trb.org) retains the color versions.

SUMMARY

# Primer and Framework for Considering an Airport Noise and Operations Monitoring System

This Primer describes a methodology to assist airports and other stakeholders to decide whether a Noise and Operations Monitoring System (NOMS) is appropriate for their situation; evaluate the benefits and costs of acquiring and updating such a system; and determine the general resources needed to acquire, operate, and maintain the system.

In addition to the information gathered through a literature review, the research team contacted NOMS vendors, airports operating a NOMS, and airports not operating a NOMS. This information gathering provided insight on the current and future state of NOMSs and airport use of noise monitoring data, flight tracking data, other off-the-shelf products, and proprietary solutions to address noise issues.

Research showed that the handling of noise issues is truly unique to an airport's situation. Airports handle noise issues based on several factors, including local regulations or agreements, available funding and staffing resources, airport planning and public outreach objectives, and the public's need for information and engagement. Whether an airport should operate a NOMS that includes noise monitors, a flight tracking system, and a noise complaint database largely depends on the type of information that airport staff needs to provide to other airport staff and the public. Case studies showed that some airports without a NOMS found that relatively simple and inexpensive flight tracking systems were capable of providing sufficient information to achieve their complaint handling and public engagement objectives. Other airports without a NOMS meet their complaint handling and public engagement objectives without a NOMS or flight tracking system.

Research also showed that airports procured a NOMS as part of a reactive strategy, responding to aircraft noise issues as they became apparent, or a proactive strategy, allocating airport resources to prepare the airport and staff to handle potential noise issues before they became apparent. Airport management should pay close attention to events that may increase aircraft noise complaints and aircraft noise annoyance when considering a NOMS as part of their noise-handling strategy.

During the preparation of this Primer, two major events occurred that may have an impact on the future need and use of a NOMS: The coronavirus (COVID-19) pandemic and the FAA's Neighborhood Environmental Survey (NES). The combination of the perceived increase in airport operations due to the lifting of travel restrictions related to the COVID-19 and the NES findings related to annoyance with aircraft noise may compound the public's interest in engaging airports to solve noise problems. This may lead to an increase in aircraft noise complaints and an increased need for airport resources.

2 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

Lastly, the Primer provides decision-making frameworks, tools, and diagrams in order to assist airport management in assessing its airport's handling of noise issues and developing strategies to meet their objectives. Given the unique noise-handling factors that airports experience, those planning to use tools such as a NOMS should customize and expand their content to fully accommodate the airport's specific situation.

CHAPTER 1

# Introduction

This document describes the work performed by the research team of Landrum & Brown, Inc., and Barry Technologies, Inc., on ACRP Project 02-89, "A Primer and Framework for Considering an Airport Noise and Operations Monitoring System (NOMS)." Airports use NOMSs to collect, manage, analyze, and communicate data such as aircraft flight tracks and flight procedures, flight altitude, aircraft identification, noise measurements, aircraft noise complaints, and weather. These systems can also be used to respond to complaints from the community and engage stakeholders with information about aircraft activity and related noise, thus fostering trust and transparency between an airport and its community. An airport NOMS generally consists of components such as software, computer processors, noise monitors, peripherals (printers, plotters, speakers, etc.), and, most importantly, staff.

Airports that make the best use of and derive benefits from a NOMS do so by incorporating it into their overall noise management program. It is critical for an airport to establish clear tasks and programs to achieve its noise-related objectives such as active monitoring of airport operations, ongoing efforts to minimize aircraft noise exposure, and continuous handling of stakeholder expectations. A NOMS is an important tool in the airport noise management toolbox, but it cannot be solely relied on to improve the handling of airport noise issues. The proper operation, maintenance, and updating of a NOMS, supplemented by the development of a customized airport noise management program—designed to consider the airport's operational, political, and environmental factors—has proven to be a wise investment for many airports.

The objective of this Primer is to guide airports that are considering the installation of a NOMS by describing the benefits and costs of acquiring, maintaining, operating, and updating an airport NOMS. Additionally, the Primer describes the factors involved in deciding whether a NOMS is an appropriate tool to address airport noise issues or whether other tools and efforts are appropriate.

The Primer provides information that is based on a literature review, airport questionnaires, vendor discussions, and the experience of the research team working with airports on noise-related issues; community engagement; noise management program development; and NOMS specifications, installations, and upgrades.

Appendices A through K of the Primer include in-depth information referenced within the main body of the Primer. The appendices are not available herein, but can be found at www.nap.edu by searching on *"ACRP Research Report 237: Primer and Framework for Considering an Airport Noise and Operations Monitoring System"*.

CHAPTER 2

# Research Background

This Primer includes an overview of the history of NOMSs in the United States, the current status of NOMS operations (including general NOMS features and functions), resource requirements for the operation of a NOMS, and potential funding sources for acquisition. The Primer also includes case studies of airports that have installed a NOMS and airports that elected to use other tools such as stand-alone flight tracking systems, handheld noise meters, off-the-shelf spreadsheet software, city complaint tools, and paper records. Lastly, this Primer includes a strategic decision framework designed to help airports thoughtfully review the quantitative and qualitative benefits and costs of acquiring, maintaining, and updating a NOMS.

## 2.1 Literature Review

The research team gathered and reviewed documentation related to the regulations, guidelines, and standards regarding the application, funding, and operations of a NOMS. The synthesized information is meant to provide the reader of this Primer with information on the regulations applicable to such a system, best practice guidance documents, a summary of technical literature published in recent years on topics relevant to current systems, and a summary of FAA guidance on noise measurements. This literature review is included in Appendix A: Literature Review. There is no comparison of NOMS products in Appendix A, nor does this appendix address the multitude of vendor and consultant literature that can be readily found online, as this literature is not peer reviewed.

## 2.2 Airport NOMS Questionnaire

The research team developed questionnaires to gather information from U.S. airports on the following:

- Types and approximate number of airports using a NOMS,
- Types of data being collected,
- How NOMSs are being used,
- Degree of public access,
- Resource requirements,
- Funding sources,
- Reasons for acquiring or not acquiring a NOMS, and
- Quantitative and qualitative benefits.

The questionnaires were divided between airports that operate a NOMS and airports that do not operate a NOMS in the 50 states and the territories, including American Samoa, Guam, the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands. The questionnaires were based on the following milestones in the life cycle of the airport NOMS experience:

- **Evaluation**—The airport evaluates whether a NOMS will serve the desired purpose and whether the airport will meet the financial and staffing requirements.
- **Procurement**—The airport obtains funding and reaches a contractual agreement with a NOMS vendor.
- **Installation**—The NOMS vendor installs all NOMS components per the contractual agreement and airport satisfaction.
- **Activation/Operations**—The NOMS vendor activates the NOMS, and the airport begins to operate the system under contractual specifications.

The full list of airports that received the questionnaires is included in Appendix B: List of NOMS, Non-NOMS, & Other Airports. The questionnaires are shown in Appendices C through F, and the results from the airport NOMS questionnaires are presented in Appendix G: Airport NOMS Questionnaire & Summary of Findings.

## 2.3 Airport Case Studies

For a closer look at the factors involved when deciding whether a NOMS is an appropriate tool to address airport noise issues or whether other tools and efforts are appropriate, the research team contacted seven airports as case studies. The case studies of three airports operating a NOMS include

- Nantucket Memorial Airport (ACK),
- George Bush Intercontinental Airport (IAH), and
- Santa Monica Airport (SMO).

The case studies of four airports that address noise issues while not operating a NOMS include

- Georgetown Municipal Airport (GTU),
- Kissimmee Gateway Airport (ISM),
- Manassas Regional Airport (HEF), and
- Colorado Springs Airport (COS).

Appendix H: Case Study Findings provides background on the selection of the case study candidates and the summary of findings.

## 2.4 NOMS Vendor Discussion

The research team also contacted the following NOMS vendors to discuss current and future technologies that will improve NOMS functionality and issues that impact airports and system installations:

- ACOEM/01dB (France-based with 0 U.S. system installations),
- Casper Aero (Netherlands-based with 6 U.S. system installations),
- Envirosuite Ltd. (Australia-based with 38 U.S. system installations),
- L3Harris Technologies (U.S.-based with 32 U.S. system installations),
- TopSonic (Germany-based with 0 U.S. system installations),
- Vector Airport Systems (U.S.-based with 9 U.S. system installations), and
- Virtower LLC (U.S.-based with 40 U.S. system installations).

The number of NOMS installations by each vendor is based on data collected in early 2021. The information from the vendor discussions is included in Appendix I: NOMS Vendor Discussion & Summary of Findings.

CHAPTER 3

# NOMS Overview

Since the 1960s, basic tools to monitor aircraft noise and operations have developed into useful and integrated NOMSs. A growing number of airports have procured a NOMS and flight tracking tools to assist with the handling of aircraft noise issues. As overall technology, processing speeds, and software capabilities improve over time, so do NOMS features and functions. Aviation forecasts predict that the number of flights will continue to increase, which will potentially increase the need for aircraft noise and operations analysis. The following sections describe the history and future of NOMSs; the current state of NOMSs, including current events that may impact the need and use of NOMS; and the fundamentals of NOMSs.

## 3.1 History of Airport NOMSs

The early years of noise monitoring systems in the United States are not well documented. Bragdon (1985) provides one of the earliest attempts to describe the history of noise monitoring. He identifies the systems installed at John F. Kennedy Airport (JFK) in 1967 as the first such system in the United States, but in fact, two airports on the West Coast installed noise monitoring systems that same year: Santa Monica Airport (SMO) and John Wayne Airport (SNA), both in Southern California. JFK and SNA both installed systems to enforce a single event noise limit for aircraft departure noise while SMO installed a system to limit departure and approach noise. Commercial aviation had been growing steadily for decades, but the introduction of commercial jet aviation in 1958 ignited a controversy regarding aircraft overflight of residential communities that continues to this day. By 1967, enough conflict had arisen between airports and communities regarding jet aircraft to warrant the monitoring of aircraft noise.

There was little additional development of airport noise monitoring systems until California adopted the "California Airport Noise Regulations" in 1970,[1] which were implemented in 1973. The implementation was preceded by a background document in 1971 (Wyle Laboratories 1971). The California regulations were landmark legislation for airport noise. The legislation established a mandatory noise limit of 65 Community Noise Equivalent Level (CNEL) for residential uses around airports, and airports were required to develop a management plan for achievement, single event noise limits for aircraft noise, and a requirement for noise monitoring in the vicinity of civilian airports deemed to have a "noise problem." A noise problem was defined as having residential uses within the 65 CNEL contour. The noise monitoring system had two purposes: first to enforce the single event noise limits and second to verify the location of the 65 CNEL contour. The single event noise limits were challenged by litigation and deemed in conflict with federal law and that portion of the regulation was repealed in 1975. The remainder

[1] California Administrative Code, Title 21, Division of Aeronautics, Subchapter 6, Noise Standards, 1970.

of the regulation remains in place to this day. As a result of this legislation, airport noise monitoring systems were established at San Francisco International Airport (SFO), Norman J. Mineta San Jose International Airport (SJC), Oakland International Airport (OAK), Hollywood Burbank Airport (BUR), Long Beach Airport (LGB), Ontario International Airport (ONT), Los Angeles International Airport (LAX), San Diego International Airport (SAN), and Torrance Municipal Airport (TOA) in addition to systems already in place at SNA and SMO. In fact, of the 24 systems in the United States that were documented in 1985 by Bragdon (1985), 11 were in California.

The California regulation was important because it defined the key components of an airport noise monitoring system and the required performance of such systems. The regulation identified several requirements that are still in place today and are excerpted below:

- The noise monitoring system shall measure with an accuracy within plus or minus 1.5 dB on the CNEL scale.
- Specific locations of the monitoring system shall be chosen whenever possible, such that the CNEL from sources other than aircraft in flight is equal to or less than 55 dB.
- The measurement microphone shall be placed 20 feet above the ground level, or at least 10 feet above neighboring roof tops, whichever is higher and has a clear line of sight to the path of aircraft in flight. No obstructions, which significantly influence the sound field from the aircraft, shall exist within a conical space above the measurement position, the cone being defined by a vertical axis and by a half angle of 75 degrees from that axis.
- For continuous monitoring systems the number of monitoring locations will increase where necessary to provide ample information to ensure the accuracy tolerance of plus or minus 1.5 dB CNEL for location of the noise impact boundary in areas where land use is incompatible.[2]

Sections of the regulation dealing with the technical specifications of the monitoring system applied to 1970s technology and are now obsolete. These sections were mostly eliminated in a 1990 update of the regulation. All of the systems of the 1970s and 1980s were minicomputer-based systems, usually running on UNIX operating systems. At that time, "mini" appears to have meant "not larger than a full-size refrigerator." Flight track data (discussed later) were transferred from FAA air traffic control to the airport via tape reels. At JFK, a day's worth of tracks required 15 reels (1-inch tape and reels about 12 inches in diameter).

Bragdon (1985) identified reasons for an airport to install a noise monitoring system:

- Assess noise control for alternative flight procedures;
- Assist in the investigation of specific public inquiries and complaints;
- Instill public confidence that airport-related noise is being monitored to protect the public's interest;
- Validate noise modeling efforts for an extended period (1 year);
- Address land use planning and noise-impact issues;
- Indicate official concern for airport noise by the jurisdiction and its governing body;
- Detect unusual flight events;
- Educate airplane pilots, airlines, the airport proprietor, and the public about airport noise and its characteristics;
- Obtain valid statistical data using an objective and scientific resource;
- Apply research tools to assist the airport in performing certain tasks, as required or mandated; and
- Assess compliance with some voluntary or mandatory noise level, established by a governmental entity.

Interestingly, these are still valid reasons for establishing an airport noise monitoring plan and later sections of this Primer will provide additional rationale for such programs.

[2] California Administrative Code, Title 21, Division of Aeronautics, Subchapter 6, Noise Standards, 1970.

8 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

There is a history of flight track analysis that is worth noting. In 1985, only two airports had flight track recording systems: Dulles International Airport (IAD) and what is now known as Ronald Reagan Washington National Airport (DCA). The proprietor for both of these airports at the time was the FAA. Because the FAA was both the proprietor of these two airports (DCA and IAD) and the operator of the air traffic control system and its associated flight tracking system, airport staff was able to access to the flight tracking data. Such access was readily granted within the FAA. The same access was not granted for other airports. The Port of New York pioneered, over approximately a 10-year period, a process by which other airports could obtain flight tracking data. By the late 1990s, access to flight tracking data greatly improved the accuracy of airport noise monitoring systems. Before airport systems had access to flight tracking data, they relied on noise pattern mapping to assist in identifying aircraft noise events. For example, at SNA, there are seven monitors in the departure corridor. An aircraft would fly over Sites 1 and 2 first, then Site 3, and then Sites 4 and 5 nearly simultaneously (as they were on either side of the flight path), and finally Sites 6 and 7. Based on the speed of the aircraft, an expected time window relative to the first sites would allow the system to determine the likelihood that a noise event belonged to an aircraft. Flight tracking data greatly improved event identifications as long as the noise monitor clocks were synchronized to the radar system clock, a serious issue in the early days of obtaining radar data.

## 3.2 The Current State of NOMSs

To ensure that the current state of NOMSs in the United States was broadly evaluated and to gather relevant information from airports in the United States, the research team developed a list of airports that operate a NOMS (NOMS airports), airports that do not operate a NOMS (non-NOMS airports), and a separate hybrid category (other airports).

The research team contacted each of the worldwide NOMS vendors and asked them to provide a client list of NOMS airports in the United States. For the non-NOMS airports, the research team developed a list of all U.S. commercial service and general aviation (GA) airports in the 50 states and the territories of American Samoa, Guam, Northern Marianas, Puerto Rico, and the U.S. Virgin Islands that did not already operate a NOMS. Other airports were a hybrid form of the non-NOMS airport list. The sections that follow provide more detailed information on the development of the airport lists.

### 3.2.1 NOMS Airports

As the name implies, a NOMS includes components that capture noise and aircraft operations. However, not all airports choose to procure noise monitors. Therefore, the research team contacted vendors that provide noise monitors as well as those that do not provide noise monitors. As previously mentioned, NOMS vendors worldwide were contacted and asked to supply a list of the systems they had installed in the United States. The vendors include the following:

- Virtower LLC (U.S.-based with 40 U.S. systems),
- Envirosuite Ltd. (Australia-based with 38 U.S. systems),
- L3Harris Technologies (U.S.-based with 32 U.S. systems),
- Vector Airport Systems (U.S.-based with 9 U.S. systems),
- Casper Aero (Netherlands-based with 6 U.S. systems),
- HMMH (U.S.-based with 3 U.S. systems),
- Other (U.S.-based with 1 U.S. system),
- ACOEM/01dB (France-based with 0 U.S. systems), and
- TopSonic (Germany-based with 0 U.S. systems).

The total number of airports in the United States (including all 50 states and the territories) that have installed a NOMS was 89. Virtower provided an additional 40 systems that do tracking and operations monitoring without noise monitoring. Since this research was conducted, additional installations may have occurred.

### 3.2.2 Non-NOMS Airports

Several sources were used to develop the list of airports in the United States (including all 50 states and territories) that have not installed a NOMS. First, an online search was performed of all U.S. airports that offered commercial service. Any airports that were already classified as NOMS airports were removed from the list. The total amount of commercial service, non-NOMS airports was 306. Second, data from the FAA Air Traffic Activity Data System (ATADS) listing for 2019 itinerant GA activity ranked the 200 top GA airports in the United States, including all 50 states and territories. Once the NOMS GA airports were removed from the list, the total number of GA service, non-NOMS airports was 110.

### 3.2.3 Other Airports

Two other groups of airports were placed in the "other" airport category. These airports fit neither of the categories previously discussed, but instead fall into a hybrid category. These airports were identified through industry knowledge and discussion with some of the NOMS vendors. Some airports initiated the procurement process but did not complete the installation process. A total of three airports fall into this portion of the category. The remaining two airports procured and installed a NOMS, but for various reasons, the systems are no longer operable.

## 3.3 Future of NOMSs

The technology of NOMSs has evolved since the late 1960s when the first aircraft noise monitoring system appeared in the United States. It wasn't until the mid-1980s that the first flight tracking system appeared at U.S. airports. As mentioned previously, at the time, all of the systems were minicomputer-based systems, usually running on UNIX operating systems. Flight track data were transferred manually from FAA air traffic control to the airport via tape reels, making public portals and public access to the data non-existent. Since then, NOMSs have become highly integrated and provide virtually real-time access to noise and flight track data. The computers are smaller, more efficient, and highly automated. At many airports, the public has direct access to noise and flight data to research and file aircraft noise complaints. The aircraft noise and operations monitoring industry has come a long way in the last 50 years. In the next 50 years, the industry will likely improve exponentially.

The future of the noise and operations monitoring industry will focus on two main areas, as described in the following sections.

### 3.3.1 Software Development and Hardware Technology

As NOMSs evolve in the future, new software enhancements/concepts and new hardware technology will greatly improve NOMS functionality. New software enhancements will likely include increased use of cloud storage, more use of virtual noise monitoring terminals (NMTs),[3]

[3] Virtual NMTs are user-selected points around the airport where noise exposure is calculated by the NOMS. The noise exposure calculations are based on noise modeling data and NOMS noise event-to-track correlations algorithms.

10 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

more automation of reports and complaint investigation, and more data analytics and business intelligence tools. New hardware technology will soon include increased use of tablets and other mobile platforms, a better radar data capture rate, air quality/emissions monitoring, more affordable NMTs, increased use of Automatic Dependent Surveillance-Broadcast (ADS-B) transmitters and less reliance on passive transmitters, and fully live (no delay) public display of data.

A wish list of the future for NOMSs includes real-time data feeds, better ability to track area navigation (RNAV) and required navigation performance (RNP) procedures, higher quality tools for the public to use in self-service noise complaint monitoring, more accurate noise prediction models, enhanced tools to communicate with the public, better reports for making informed decisions, improved data quality and reduction in data loss from the source, and superior noise-to-flight track correlation rates.

### 3.3.2 Urban Air Mobility/Unmanned Aerial Vehicles

The new frontiers in air transportation include urban air mobility (UAM) and unmanned aerial vehicles (UAVs). These are likely to become the fastest-growing sectors in aviation, and airports need to consider how to accommodate these new aircraft in their NOMS. UAVs, or "drones," are being used to inspect infrastructure, provide emergency response support, survey agriculture, and deliver supplies and products to customers in urban and rural environments. UAMs are small vehicles used to transport people by air and are used to reduce traffic on congested highways and roads.

Most vendors are already layering in features for the inclusion of UAM/UAV into NOMSs. Within 5 years, it is expected that UAMs and UAVs will be in common use. Package use (UAVs) will likely come first, followed by personal vehicles (UAMs). Airports will need to consider a fundamental change in aircraft monitoring as the potential exists for a large number of UAMs/UAVs to be flying and possibly creating noise issues well outside the environs of the airport. Many, if not most, of these operations will not be associated with an airport. While aircraft noise levels will become less of an environmental and annoyance issue, visual pollution and privacy issues will become the main concern. It is likely that including UAM/UAV monitoring will be a separate module within existing NOMSs or flight tracking systems. The new UAM/UAV aircraft will be required to operate a transponder that will respond to Mode-S interrogation. These new aircraft will have registration/tail numbers and Mode-S codes and will show up in standard registry databases, although the registry may be separated from conventional aircraft. Either way, the new aircraft registries will be able to recognize aircraft ownership through a NOMS.

## 3.4 Current Events That Could Impact the Need for and Use of a NOMS

As research was being conducted for this Primer, two major events occurred that may have an impact on the future need and use of NOMSs: The COVID-19 pandemic and the FAA's Neighborhood Environmental Survey (NES). The potential impacts of these events on airports and the need for NOMSs are briefly discussed below.

### 3.4.1 Coronavirus (COVID-19) Pandemic

The COVID-19 virus was discovered in December 2019. Millions of people worldwide have contracted the virus and died. To prevent the spread of COVID-19, countries around the world closed their borders and restricted air travel to minimal levels in the spring of 2020. Global

passenger counts decreased to 52% of pre-COVID-19 levels. As air travel restrictions lifted later in 2020 and into 2021, flight operations and passenger counts increased. In 2023, global passenger counts are expected to be approximately 105% of pre-COVID-19 levels (IATA 2021).

In addition to air travel restrictions, "stay at home" restrictions were enforced by various states, counties, and private businesses. Online meetings replaced face-to-face meetings in a matter of weeks. Many people were able to work from home while essential workers and first responders were allowed at their place of work. The spatiotemporal distribution (Metron Aviation, Inc., and DGW Consulting Group, LLC 2020) of population shifted from office buildings and educational facilities to residential areas. Depending on their location relative to an airport and flight paths, some people that worked from home experienced increased annoyance from aircraft noise during working hours compared to their experience in office building environments.

Whether people continue to work from home or return to their normal workplace environment, air traffic will increase by approximately 100% by 2023. This increase in aircraft operations from COVID-19 reduced levels could potentially significantly increase reports of aircraft noise annoyance and complaints and increase airport staff workload relative to aircraft noise complaints, investigation, and analysis.

As described in Appendix G: Airport NOMS Questionnaire & Summary of Findings, over half of the airports that responded to the questionnaire said that they would evaluate procuring a NOMS if complaints increased. Approximately 15% of airports would evaluate procuring a NOMS if there was political/public pressure to monitor aircraft operations. Therefore, the perceived increase in aircraft operations due to the lifting of travel restrictions related to the COVID-19 pandemic could potentially increase public/political pressure on airports and increase the demand for flight tracking systems, NOMSs, and the analysis of aircraft operations.

### 3.4.2 NES

To update the aircraft noise-to-annoyance relationship represented by the Schultz Curve,[4] the FAA conducted a nationwide survey, the NES, on annoyance associated with aircraft noise (Miller et al. 2021). More than 10,000 residents living near 20 representative airports in the United States responded to the survey. The NES results, published in 2021, showed a substantial increase in the percentage of people who are highly annoyed by aircraft noise over the entire range of noise levels considered, including at lower noise levels.

The NES findings were included in an FAA Federal Register notice soliciting public comment. The comment period closed in April 2021 with over 4,000 comments, indicating substantial interest from the public, airports, and aviation industry groups. The FAA's responses to these comments were not available while research was being conducted for this project. However, the research team believes that the combination of increased aircraft noise-related annoyance and the FAA's solicitation for public feedback on the next steps to aircraft noise-related analysis could potentially increase public desire for airports to verify the location of the day-night average sound level (DNL) 50 through 65, and perform aircraft noise and operations analysis. Additionally, NES results may shape revisions to policy on airport sound insulation programs and "significant" noise impacts, which are both currently based on the location of the DNL 65. A revision in policy may also lead to an increased need for aircraft noise and operations analysis.

[4] The Schultz Curve is the accepted standard for describing the transportation noise exposure-annoyance relationship. Results of the Schultz Curve are based on surveys conducted in the 1970s and revalidated in 1992. Results from the NES show that the standards based on the Schultz Curve are outdated.

12 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

### 3.4.3 Current Events Summary

Together, the perceived increase in airport operations due to the lifting of travel restrictions related to the COVID-19 pandemic, the NES results, and the FAA's solicitation for public feedback may increase the public's interest in engaging airports to solve noise problems. This could lead to the following outcomes:

- Increase in aircraft noise complaints;
- Increase in the public's need for aircraft noise and operational information and flight tracks;
- Increase in airport staff workload;
- Increased need for airport staff resources;
- Increased need for noise and airspace analysis beyond the DNL 65;
- Increased need for noise measurement, flight data, and technological tools to process and analyze data (a NOMS);
- Increased need for comprehensive environmental analyses;
- Increased need for developing creative ways to describe noise impacts to the general public; and
- Increased need to develop airport noise management programs that engage the public on an ongoing basis to discuss noise abatement performance.

Managing the above outcomes would be challenging for airports, especially those without a NOMS or flight tracking system. An airport without a NOMS could propose the use of a NOMS during noise compatibility planning efforts and include this in its noise compatibility program (NCP), which is prepared pursuant to 14 CFR Part 150.[5] Additionally, the use of a NOMS may be recommended during an analysis pursuant to the National Environmental Policy Act (NEPA). As described in Section 5.1, System Funding, (in this Primer) and Section A.2, FAA Guidance (in Appendix A), airports seeking federal financial assistance for a NOMS have to meet certain requirements to be eligible for federal funding (e.g., use of a NOMS specified in the NCP or in a decision document associated with an environmental review under NEPA).

If noise mitigation measures such as a NOMS or NOMS components (NMTs) are not eligible for federal funding, airports may use airport, state, and local funding sources.

## 3.5 Fundamentals of a NOMS

A NOMS is a technical tool used by airports for data and information gathering and is designed to meet an airport's need to plan, monitor, and update noise abatement and other airport programs. A NOMS is an advanced computer-controlled system used for recording and measuring noise, tracking flights, gathering weather data, and storing noise complaints and airport staff's responses to those complaints. It uses a relational database that combines geographic information with ongoing noise and flight data acquisition. A NOMS includes many components, including a network of permanent and/or portable noise monitors that measure the noise environment around an airport, a system that receives data from FAA's air traffic control radar or passive antennas that capture aircraft flight tracks, and other external data such as weather and radio voice recordings.

All of the collected data are stored in local computers and/or hosted by the NOMS vendor remotely or on the cloud. Today's systems can be accessed from anywhere with internet access, giving airport staff the flexibility to work on the system from their home office or their airport office.

[5] Code of Federal Regulations, Part 150, "Airport Noise Compatibility Planning," 1984.

The data from a NOMS are generally utilized to facilitate the development and management of noise abatement programs at an airport. However, data from a NOMS can also be used to support other airport functions such as planning, gate management, and accounting.

### 3.5.1 Core NOMS Features and Functions

A NOMS provides an airport with an integrated approach to addressing noise issues. A NOMS is an information system that allows airport personnel to plan, monitor, and update a noise abatement program and to provide information for other airport departments.

The system includes the following components:

- Advanced computer-controlled devices for recording and measuring noise, flight tracks, and weather;
- Relational database combining existing geographical information with ongoing data acquisition; and
- Data input interface to manage information and produce customized letters, reports, and maps.

A NOMS gathers and combines data from numerous sources including aircraft noise recorded on remote permanent or portable NMTs, operations data from the FAA Terminal Radar Approach Control (TRACON) facility's System-Wide Information Management (SWIM) data, proprietary NOMS vendor data, flight track data from a non-FAA multilateration or ADS-B passive receiver, concerns and complaints reported by the community surrounding an airport, information about aircraft registration (owners), local weather data, census data, and geographic map data.

A NOMS processes and integrates data by automatically linking noise events at each of the NMTs to specific aircraft operations and logged complaints. As a result, the system user can accurately and efficiently identify the aircraft noise source and its effect on the community. The NOMS focuses on data acquisition, processing, and analysis.

The NOMS user can apply NOMS data and features to address and solve local noise problems and engage the impacted community.

Finally, a typical NOMS can produce numerous standard tables, graphs, maps, letters, and reports that assist the NOMS user in communicating aircraft noise and operations information to the public.

NOMS data are used in many ways, including:

- **Processing**—Processing includes matching noise events to aircraft operations (flight tracks), matching complaints to noise events and flight track operations, and generating input data for the FAA's airport noise contouring program.
- **Analysis**—Reporting tools are provided for examining the data. These tools include both textual and graphical approaches.
- **Replay**—Replay shows animated tracks and noise events in two or three dimensions.
- **Browsers/modules**—Browsers or modules display lists of complaints, noise events, and operations for a specified time period. Matches between operations and noise events or complaints can be edited.
- **Flight track profile**—Flight track profile graphs display the flight altitude versus range for selected tracks.
- **Gate penetration analysis**—Gate analysis graphs display gate penetrations for selected tracks through a gate, which is a two-dimensional cross-section of airspace.
- **Point of closest approach (PCA)**—The distance from each flight track to a noise monitor or complaint location is calculated and stored in the database. PCA tables show the closest (shortest) distance between a point on the ground and a flight track.

14 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

- **Reporting**—A NOMS contains a query generator for producing text reports and/or displaying flight track data. There are also several preformatted reports delivered with each system.
- **Billing**—A NOMS can produce operations information to be used by an airport's billing department for landing fees.
- **Gate management**—A NOMS can assist an airport with aircraft arrival and departure information to assist in the management of gates.
- **Geofencing**—A NOMS can count and identify aircraft that cross geographic boundaries on airport property, such as taxiways and runways, and airspace boundaries near noise-sensitive areas.

Note that non-NOMS tools like stand-alone flight tracking systems and video camera logging systems may perform some of the listed functions that are not related to noise monitoring.

### 3.5.2 Types of Data Collected

A NOMS gathers and combines data from numerous information sources, as follows:

- Noise, audio, and weather data from permanent and portable NMTs;
- Operations data from FAA's flight track feed and aircraft databases;
- Flight track data from SWIM (or passive multilateration and/or an ADS-B sensor);
- Aircraft owner data from SWIM aircraft registration databases;
- Noise complaints logged by NOMS users and submitted by the airport community;
- Weather data from local National Weather Service or local weather sensors;
- Air traffic control and pilot voice transmissions from voice recorders;
- Video of aircraft operations from video recording systems; and
- Geographic information system (GIS) data from system vendor at installation and imported from various sources.

Additional information on data being collected is provided in the following sections.

#### *Noise Data*

A NOMS acquires noise data from noise monitors placed around the airport. These monitors can be either permanent (fixed to the ground) or portable (on tripods or handheld) and powered by public utilities, batteries, or solar panels. Permanent noise monitors have a fixed location and are integrated into a NOMS. Portable noise monitors need special consideration relative to security and theft protection.

Noise data may be obtained from a noise monitor by the NOMS via a phone land line or a wireless cellular signal in multiple daily uploads or in real time. A NOMS has noise event detection algorithms based on a fixed noise level threshold or a floating (not fixed) threshold. A floating threshold is generally used at locations with fluctuating background (non-aircraft) noise.

The audio of noise events may also be recorded, uploaded, and stored by the NOMS. This feature is often used when trying to determine whether noise events were caused by aircraft, the community (e.g., lawnmower, barking dog, or motorcycle,), or weather (e.g., wind or lightning).

#### *Operations, Flight Track, and Aircraft Owner Data*

Operations, flight track, and aircraft owner data are obtained from the FAA aircraft databases and air traffic control systems, often delayed by a few minutes. A NOMS combines the flight and operations data in a table format with records that at a minimum include the following:

- Date and time of operation,
- Airport code of origin and destination of flight,
- Operation type (arrival, departure, touch and go, overflight),

- Runway used,
- Aircraft type,
- Airline and flight ID,
- Aircraft registration and owner name, and
- Beacon code.

Additional operational information may be provided depending on the type of data origin and system. Flight track data provide the information listed plus information at specific points of the flight track such as aircraft speed, altitude, heading, and climb/descent rate.

#### *Noise Complaints*

Airports generally receive aircraft noise complaints from the public via phone, e-mail, postal mail, online complaint form, phone applications, NOMS vendor applications, third-party applications, or in person. Noise complaints can be manually entered into the NOMS complaint database via a system user interface or automatically entered from an online complaint form, phone applications, or third-party applications. Third-party complaint applications may submit complaints to the NOMS via a web form or programmed "buttons" or "clickers" that can instantly submit complaints without much complainant interaction. Third-party complaint applications have been increasing in popularity over the last few years and, at some airports, have been the medium for the majority of complaints. The third-party application developer formats complaints to be accepted by an airport NOMS, and the airport and NOMS vendor allow the NOMS complaint database to accept the complaints. Once a complaint is in the complaint database, NOMS users can investigate and respond to it, if necessary.

#### *Weather Data*

Weather data can be collected from sensors placed at certain noise monitors, separate National Weather Service sensors at other locations, and weather radar imagery that show the effects of weather patterns. The data can be useful for analyzing flight operation modes and noise. The NOMS will store weather data including temperature, humidity, barometric pressure, wind speed, and wind direction with noise events and can store hourly weather data averages.

#### *Geographic Data*

GIS features are generally integrated into a NOMS. At a minimum, NOMS GIS data include a large-scale map that covers the extent of flight track coverage for generally 25 to 50 nautical miles from the airport. Additional GIS data include streets, water, municipal boundaries, landmarks, land use, and aerial imagery. Other GIS data that may be collected and imported by NOMS users include flight corridors/gates and airport noise contours. Flight track data shown on a NOMS interface can be exported as GIS files and loaded onto separate GIS software for mapping and analysis.

### 3.5.3 How NOMSs Are Used

Airports and NOMS vendors have worked together to expand basic NOMS features to address airport-specific, NOMS-related needs. Modern NOMSs have become informational tools to support airport needs beyond just monitoring noise. A NOMS can support needs such as Remain Overnight management, monitoring of runway crossings, pavement utilization, and airport planning. The list in "How Airports Use a NOMS" presents the many ways that airports can use a NOMS that were noted in the Airport Questionnaire developed for this research.

16 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

**How Airports Use a NOMS**

- Monitor flights in general
- Monitor specific noise abatement flight procedures
- Monitor noise abatement runway use
- Monitor noise levels/limits at monitors
- Monitor airspace use
- Monitor aircraft departure and approach profiles
- Monitor community noise levels
- Monitor compliance with agreements/mandates, i.e., community commitments
- Monitor nighttime curfews
- Monitor run-ups
- Monitor taxiing
- Monitor nighttime noise levels
- Support special studies by consultants
- Monitor pavement utilization
- Monitor capacity utilization of departures
- Manage Remain Overnight parking
- Produce and validate airport noise contours*
- Educate and communicate with the public
- Investigate noise ordinance/limits violations
- Support airport planning
- Assess fleet mix
- Supplement information to other airport proprietor departments and government agencies
- Investigate incursions
- Analyze performance-based navigation/Metroplex route impacts and compliance
- Cross-check airlines' self-reporting records
- Measure off-airport temporary helistops
- Monitor runway crossings
- Monitor airspace utilization (geofencing)

*NMT noise measurements provide better estimates of aircraft noise compared to noise modeling wherever the signal-to-noise ratio in the vicinity of the monitor is satisfactory. Where the signal-to-noise ratio is poor, noise modeling will provide a better estimate. The uncertainty of noise measurements, where signal-to-noise ratio is satisfactory, is +/- 1.5 decibels (dB). Modeling uncertainty is far less well defined. Large contributors to modeling uncertainty are estimates of actual aircraft thrust and modeling assumptions of a homogenous atmosphere, among others. Note that noise modeling is the only practical way to determine the community noise impacts related to future or proposed airport operational scenarios.

### 3.5.4 Degree of Public Access

A NOMS allows airport staff to disseminate a variety of information related to aircraft operations and related noise through an airport's complaint handling process and community outreach programs. Airports may share NOMS information as part of a complaint investigation and response process, a special report for an individual or group, or upon request. Additionally, airports may prepare periodic reports and announcements relative to topics such as noise abatement procedure or operational agreement compliance, runway use, run-ups, complaint statistics, and noise levels at monitors. These reports and announcements can be shared in printed format during public meetings, in electronic format as e-mails, and posted on the airport's website and social media platforms.

NOMS vendors also provide online resources to share information with the public. Online NOMS data include near-live flight tracking, flight replay, address locator, and noise levels at noise monitors.

Many airports facilitate various levels of public access to NOMS data as part of their community outreach. While some airports allow limited or no public access to NOMS information, many permit the public to follow and review operations in the vicinity of their homes. Airports with comprehensive community outreach programs develop robust public websites or portals that offer community engagement solutions that provide self-investigation, education, and reporting tools, which have improved trust and transparency between airports and their surrounding communities.

CHAPTER 4

# Benefits and Disbenefits of Operating a NOMS

## 4.1 Reasons for and Benefits of Acquiring a NOMS

In the course of the literature review for this research, the research team discovered that reasons for an airport to install a noise monitoring system include the following:

- Assess noise control for alternative flight procedures;
- Assist in the investigation of public inquiries and complaints;
- Validate noise modeling efforts;
- Educate pilots, airlines, and the public about airport noise; and
- Manage public expectations and replace perceptions with facts.

Additionally, FAA guidelines indicate that continuous airport noise monitoring systems can enhance the effectiveness of airport NCPs by providing single event and cumulative noise levels at monitoring sites, differentiating between ambient and aircraft contributions to noise exposure levels, and providing the ability to develop a statistical database of noise levels for each aircraft type category. Furthermore, "airport noise monitoring systems provide an important tool for assessing noise levels around airports and provide concrete evidence that airport proprietors, state governments and the Federal Government are serious about controlling aviation noise impact on communities surrounding airports" (Newman 1980).

A NOMS is not only a technological tool that provides benefits to airports, it is also an investment that provides information and requires airport resources. The types of benefits gained by an airport and the magnitude of resources utilized by airports to operate a NOMS are largely dependent on the airport's objectives relative to monitoring aircraft operations and aircraft noise. When an airport objective is to have readily available information about aircraft operations including the location of aircraft in flight, then a flight tracking system would meet that objective. Additionally, when the objective is to have readily available aircraft noise information at specific sites around the airport, then a flight tracking system with noise monitors would meet that objective. Additional airport objectives and whether a technological tool would meet those objectives can be evaluated on a case-by-case basis.

Airports may acquire a flight tracking system (a partial NOMS) or a full NOMS as a reactive or a proactive strategy for managing aircraft noise. A reactive strategy involves responding to aircraft noise issues as they arise and allocating resources to handle the issues as needed. When the noise issues become noise problems that the airport can no longer address successfully without readily available and detailed flight information, the airport would benefit from acquiring a flight tracking system or partial NOMS. When the noise problem includes temporary or permanent and continuous measurement of aircraft noise, then the airport would benefit from a full NOMS. A proactive strategy involves allocating airport resources to prepare the airport and staff to handle potential noise issues before they become apparent.

The airport may acquire a flight tracking system or a full NOMS depending on the potential for noise issues in the foreseeable future (e.g., prior to a runway opening or residential developments encroaching on airport property or flight paths).

Aircraft noise issues generally begin with airport staff receiving complaints or inquiries from the public about aircraft operations. The process for handling aircraft noise complaints and inquiries includes investigating the aircraft operations in question and responding to the complainant. To successfully complete this process, airport staff needs a certain level of information about aircraft operations, such as the time and the proximity of the aircraft relative to the complainant. With this information about aircraft operations, airport staff can respond to the complainant with factual operational details including typical flight patterns, typical airspace and runway use, aircraft altitude, airport origin/destination, type of aircraft, whether the operation complied with noise abatement procedure, and at times, the purpose of certain flights (e.g., medical, law enforcement, air show, or crop dusting), and reasons for flight anomalies. Aircraft flight tracking systems can readily provide airports with aircraft information so they don't need to contact third parties such as FAA air traffic control. Without this information, airport staff can only respond to the complainant in general terms that may not address the complainant's concerns or claims about specific aircraft operations.

Airports have the option to develop preferred or desired air traffic routes, runway use, taxiway use, or other noise abatement procedures in order to minimize the noise impact on nearby communities as much as possible. Aircraft flight tracking systems can provide the necessary monitoring of noise abatement procedures to meet the desired compliance.

A benefit of acquiring a flight tracking system or a NOMS is to meet the airport's noise-related objectives. Responses to the Airport Questionnaires developed for this research indicated reasons for acquiring these systems and benefits gained from doing so. The text boxes that follow list the reasons for and benefits of acquiring and operating a NOMS, respectively.

**Reasons for Acquiring a NOMS**

- Proactive strategy
- Part 150 NCP
- Public request/pressure
- Land use compatibility plan
- Legal requirement/agreement
- NEPA mitigation requirement
- State reporting compliance
- NOMS replacement
- Litigation
- Sponsor interest
- Secondary enforcement of noise curfews
- Community interest
- To address community concern

**Benefits of Operating a NOMS**

- Improved complaint investigation and reporting
- Improved community engagement
- Improved transparency
- Document compliance with legal obligations
- Efficient use of staff time
- Increased credibility
- Increased trust
- Noise abatement procedure monitoring and continuous improvement
- Improved community education

*(continued on next page)*

20 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

**Benefits of Operating a NOMS (*Continued*)**

- Consistent message
- Contour and noise event validation
- Accounting/landing fee disputes
- Noise modeling data
- New procedure (Metroplex) development to protect noise-sensitive areas
- Noise reduction program tracking
- Noise mitigation tool
- Established accountability to the community
- Safety/incursions tool
- Elected official engagement
- Identify noise impact and trends
- Geofence monitoring

Once the flight tracking system or NOMS becomes operational, detailed information becomes available to airport staff to address noise issues. Airport staff can use the information provided by these systems to more effectively handle complaints and inquiries and improve community engagement. This change in community engagement generally improves the relationship between the airport and its community by developing transparency, gaining trust, and educating stakeholders. General strategies for successful community engagement include these (Woodward et al. 2009):

- Have a community/service-oriented commitment;
- Develop progressive communication strategies;
- Establish continuous proactive engagement;
- Acquire good listening skills;
- Develop quality, rather than quantity, information;
- Build lasting relationships and establish trust;
- Manage community expectations through transparency;
- Address emotional feelings and do hard things; and
- Decide when help is needed.

The text box that follows lists the changes that can occur in an airport-community relationship after acquiring and using a NOMS, based on responses to the Airport Questionnaire.

**Changes to the Airport-Community Relationship After Acquiring and Using a NOMS**

- Improved due to data/information sharing
- Improved in terms of transparency
- Gained trust
- Community empowerment due to self-investigation tools
- Relationship improved through monthly roundtable meetings
- Reestablished trust
- Fostered engagement
- Educated the public
- Relationship improved
- Replaced perceptions with facts
- From contentious to trusting
- Community feels like airport is more responsive
- Implemented a proactive and engaged approach with community
- Built relationships with community leaders

## 4.2 Disbenefits of Acquiring a NOMS

As described in the previous section, flight tracking systems and NOMSs are investments that require airport resources. The costs associated with the procurement of these systems and the allocation of staff are the most common disbenefits reported by airports. Additionally, the processes to develop system specifications, prepare the request for proposals (RFPs), secure funds, perform system installation, perform acceptance testing, and train staff are considered to be time-consuming. The text box that follows lists the disbenefits that come with the acquisition of a NOMS, based on responses to the Airport Questionnaire.

**Disbenefits of Operating a NOMS**

- Cost/expensive
- None (airport reported that there were no disbenefits)
- Public expectation that the airport can fix air traffic issues
- Public always wants more data
- Public expectation that airport staff address repetitive complaints
- System data verification/validation
- Responding to noise complaints
- Improvements in technology have resulted in higher complaint counts
- Public distrust of data
- Plan/coordinate upgrades
- Expense to maintain system
- Required technical support
- Flight data integration
- Expect 100% accuracy
- Increased demand for permanent noise monitors
- Delays to upgrade
- Inaccurate data
- System hackers
- 24-hour delay on data

CHAPTER 5

# NOMS Resource Requirements

The planning process for a NOMS includes the complexities of procuring and staffing the operation of the system. However, equally important is how a system installation is funded and deciding where permanent noise monitors in the field will be placed. Once the system is installed and operational, the question becomes what to do with the voluminous amounts of data and how to develop a noise management program to deal with the data analysis and public outreach requirements. The following sections describe system funding, noise monitor installation and maintenance, and noise management program development.

## 5.1 System Funding

### 5.1.1 Background

Funding options for installation of a NOMS (full or partial system) are described in the following sections. These sections provide information on eligibility, funding limitations, and the funding share provided by federal Airport Improvement Program (AIP) grants and the airport/state/local share. For more detailed information, airports should refer to the Airport Improvement Program Handbook (FAA 2019). Funding information contained in the Airport Improvement Program Handbook is also summarized in Section A.2.2 of Appendix A.

### 5.1.2 Eligibility

To be eligible for AIP funding, a noise compatibility or noise mitigation project must meet one of the requirements in Table R-1, General Eligibility Requirements for Noise Compatibility Projects, of the Airport Improvement Program Handbook. These are (1) "Included in an FAA approved 14 CFR part 150 Program," (2) "A Facility Used Primarily for Medical or Educational Purposes," (3) "In a Land Use Compatibility Plan," and (4) "In a Record of Decision" (FAA 2019).

An airport requiring funding for a NOMS would either have a NOMS specified in the NCP of an approved Part 150 study or a Record of Decision (ROD) for an environmental study on an airport development project (Option #1 or #4). Airports would not be eligible under Option #2 since they are not facilities used for medical/education purposes. The Reauthorization Act of 2018 extended airports eligibility under Option #3, under a Land Use Compatibility Plan to September 30, 2023.

Almost all NOMSs are acquired through an approved Part 150 study or a ROD for an environmental study. A NOMS would be required to be part of the defined mitigation options in the Part 150 study or ROD to move forward.

### 5.1.3 Limitations

While the AIP provides a major share of the funding for an airport's NOMS, the limitations on what features can be funded are described in Table R-6, Noise Compatibility Planning/Project Requirements, of the Airport Improvement Program Handbook (FAA 2019). The limitations on features or use are listed in the following:

- Monitoring systems are limited to outdoor monitoring systems;
- Portable noise monitors cannot be used for enforcement of noise rules;
- Fixed noise monitors are only eligible if placed within DNL 65 (at time of installation);
- Sponsors need to justify fixed noise monitors, i.e., portable noise monitors are not feasible;
- Data ownership to remain with the sponsor (airport) not with the vendor;
- Federal share limited to the least costly system to satisfy project requirements and basic functionality;
- Sponsor responsible for ongoing service costs to access FAA tracking data; and
- Systems are eligible to be replaced after useful life (10 years).

### 5.1.4 Sources

#### *Federal AIP Share*

Airport sponsors can apply for federal funding through AIP grants. Airport sponsors can be a public agency or a private entity owning a public-use airport. Public agencies include a state, state agency, city, other municipality, or an Indian tribe. Once approved, these grants can be used to pay for a major share of the acquisition costs. Grant monies come from several sources, including entitlements from passenger boarding and cargo landed weight at an airport, discretionary set asides for noise and environmental purposes, and other potential AIP discretionary supplementals and funds.

The federal share of the AIP grants for noise projects varies by airport type. These varieties are detailed in Table 4-7, Federal Share by Airport Type (Including Exceptions), of the Airport Improvement Program Handbook and are summarized as follows (FAA 2019):

- Large hub/medium hub—80%,
- Small hub/non-hub primary—90%,
- Non-primary commercial service—90%,
- General aviation—90%, and
- Reliever—90%.

The federal share also has numerous exceptions. For states with a large amount of public land, the federal share may increase. Airports in American Samoa, Guam, the U.S. Virgin Islands, and the Northern Mariana Islands may not require a local share. Other exceptions include airports transitioning from small to medium hubs or those that are in economically distressed areas.

#### *Airport/State/Local Share*

Once airports receive their share of federal funding, the remaining share—usually 10% to 20%, depending on the airport—must be made up from airport, state, or local sources. These sources for airport capital projects, listed from largest to smallest (excluding AIP grants), include the following:

- Proceeds of bonds,
- Passenger facility charge (PFC) revenues,
- Internal generated capital (from retained airport revenues),
- State grants, and
- Local financial sources.

24 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

While bonds are usually used for larger capital projects, PFC revenue, airport revenues, and state/local grants are more likely to be used for noise projects such as a NOMS. Besides the use of PFCs, airport revenue sources may include the following:

- Airport parking revenues,
- Rental car revenues,
- Terminal concessions,
- Advertising sales programs, and
- Revenue-producing leases.

## 5.2 Noise Monitor Installation and Maintenance

Noise monitor installation is an important part of the installation and development of a NOMS. Installing and maintaining the noise monitors can be an expensive and time-consuming process. The noise monitor site assessment includes the selection of potential technical sites that will assist in validation of the DNL 60 and 65 contour location and non-technical sites that will measure noise exposure at noise-sensitive locations such as schools and residential areas. Additionally, potential sites are evaluated against installation criteria that include electrical power access, data communication, property ownership, surface shielding, ambient noise, proximity to sources of noise (airport and non-airport), future airport operations, and potential vandalism. The feasibility of the noise monitor installations is a key component of the NOMS decision-making process. Appendix J: Noise Monitor Installation & Maintenance Guide provides practical assistance to an airport considering installing (and maintaining) noise monitors. The issues addressed include

- NMT overview,
- Site selection,
- Maintenance requirements, and
- Procurement.

## 5.3 Noise Management Program

Whether an airport installs a simple flight tracking system or a full NOMS, the development of a noise management program is likely to be the most important aspect of post-system installation. The development of a noise management program includes the use of a system to monitor airport operations and engage communities exposed to aircraft noise. Once a system is procured, the allocation of qualified staff (existing staff or new hires) and noise management training of staff are key. A NOMS is an effective aircraft noise, operations monitoring, and public outreach tool that, when operated by staff with the right combination of technical and soft skills, can extract data from the system and convey information to stakeholders in clear and useful ways. While system vendors generally provide training on the use of all system features, this type of training is limited and does not include training on how to use the system to develop and monitor actual noise abatement procedures and supplement a noise management program.

To overcome these hurdles, airports must view noise management as an important and valued environmental practice area and must allocate the proper amount of recruiting, compensation, and incentives (conference attendance, training/education, and a positive working environment) to staff this area. Additionally, airports must train staff on the application of a system to address airport noise issues and the development of noise management and public outreach programs.

Appendix K: Noise Management Program Development Guide provides practical assistance to airports considering the development of a noise management program. This resource will be useful for airports that are deciding to include a system as part of a noise management program. This resource provides ideas for maintaining and training staff and for further developing or enhancing a program by applying best practices.

The issues addressed include

- Noise office setup,
- Noise office staffing,
- Noise office policies and procedures, and
- Noise office training.

CHAPTER 6

# NOMS Strategic Decision Framework

Deciding on whether to invest resources in a NOMS or in other methods to address airport noise issues is challenging. Numerous questions and factors are related to airport objectives within the context of handling airport noise. This chapter describes frameworks, checklists, and diagrams that can assist airport management in assessing the state of noise issue handling at the airport and develop strategies to meet its objectives. The tools described in this section can be used as guides to airport noise-related strategic decision-making. Those planning to use these tools should customize and expand their content to fully suit the airport's specific situation. The following subsections include

- Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis;
- Need, Purpose, and Requirements Checklist;
- Decision-Making Process; and
- Funding Options.

## 6.1 SWOT Analysis

A SWOT analysis is a framework for making planned, informed, and strategic decisions, based on a specific context and objectives, which may be applied during the preliminary stages of a decision-making process. The origin of SWOT analysis remains obscure; however, research shows that Albert Humphrey developed SWOT analysis while working at the Stanford Research Institute in Menlo Park, California, during the 1960s and 1970s (Sarsby 2016). There are hundreds of resources and guides on how to conduct a SWOT analysis. This Primer simply describes the general components of a SWOT analysis and how they could be applied to a NOMS procurement decision. This description is based on responses to the Airport Questionnaire for this research project and research team experience. An actual SWOT analysis would involve a team composed of airport staff and management and would preferably be led by a project manager.

For airport noise management and the process of deciding whether to procure a NOMS or pursue other means to address airport noise issues, a SWOT analysis would provide a framework for understanding the airport's noise environment, factors associated with existing noise issues, airport resources used to address noise, and the need for information on aircraft noise and operations. Note that within an airport organization, the objectives of different parts of the organization may conflict. For example, airport planning, business development, and marketing objectives generally involve increasing the number of aircraft operations. In contrast, noise management objectives involve decreasing aircraft noise, which could be accomplished by reducing the number of aircraft operations.

The first step of a SWOT analysis is to develop a clear purpose statement that will help identify the factors to consider later in the decision-making process. Airport staff may develop multiple

**Table 6-1. SWOT quadrants.**

| | Positive Impact Factors ⇩ | Negative Impact Factors ⇩ |
|---|---|---|
| Internal Factors ⇨ | Strengths | Weaknesses |
| External Factors ⇨ | Opportunities | Threats |

purpose statements related to airport noise that might include developing noise abatement procedures, improving relationships with external stakeholders, or providing staff training. An example of a simple purpose statement is "To review the airport's noise environment and consider the procurement of a NOMS."

The second step is to gather information about the input factors that should be considered in the SWOT analysis. Table 6-1 shows the quadrants, rows, and columns that include the input factors to collect and analyze.

A description of the types of factors follows:

- **Internal Factors**—Factors over which airport noise management has control.
- **External Factors**—Factors over which airport noise management has little or no control.
- **Positive Impact Factors**—Factors that help airport noise management meet its objectives.
- **Negative Impact Factors**—Factors that delay or prevent airport noise management from meeting its objectives.

Internal factors that have either a positive or a negative impact are further described in the following:

- **Strengths** are internal factors that have a positive impact relative to airport noise management objectives. Strengths support an opportunity or neutralize a threat. Strengths may include
  - Staff with skills in technology and public relations;
  - A good relationship and strong lines of communication with airport tenants, airlines, flight schools, fixed-base operators, and so forth; and
  - Established noise abatement procedures.
- **Weaknesses** are internal factors that have a negative impact relative to airport noise management objectives. Weaknesses do not support taking advantage of an opportunity and are susceptible to threats. Weaknesses may include
  - The inability to allocate staff to new noise abatement duties;
  - Staff who lack skills in technology or public relations; and
  - Difficulty accessing information about airport operations, which leads to delayed aircraft noise complaint response.

External factors that have either a positive or a negative impact are further described in the following:

- **Opportunities** are external factors that have a positive impact relative to airport noise management objectives. Opportunities may include
  - Airport growth that warrants airport expansion, environmental review, or a Part 150 study (although airport growth can be viewed as being within the airport's control, it is generally out of noise management control);

28 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

  - Airport noise exposure (DNL 65) reaching residential areas; and
  - Airport planning or accounting needing an aircraft operation counting tool.
- **Threats** are external factors that have a negative impact on airport noise management objectives. Threats may include
  - New flight school plans to increase training flights by 200%,
  - New residential development to be built underneath existing flight paths, and
  - New city council members putting political pressure on the airport to reduce its noise impacts.

Once the input factors are identified, the third step is to restructure the quadrants shown in Table 6-1 into a TOWS analysis ("SWOT" backward), which is used to guide the decision-makers toward the development of actionable strategies. Table 6-2 shows the rearranged quadrants and describes the generalized strategies.

The fourth step is to develop and test the strategies to ensure that they are aligned with the purpose statement. Based on some of the example input factors previously mentioned, the following strategies might be developed:

- **Opportunities × Strengths**—Coordinate airport planning efforts to find an operations counting tool (Opportunity) with noise management efforts to track the performance of the established noise abatement procedures (Strength).
- **Opportunities × Weaknesses**—An upcoming airport expansion project requires an Environmental Assessment (Opportunity). Include a NOMS as a noise mitigation project to be eligible for AIP funding and improve lack of funding (Weakness).
- **Strengths × Threats**—Have staff with skills in public relations (Strength) develop a relationship with new city council members (Threat) and establish a reporting program to track noise abatement performance.
- **Threats × Weaknesses**—The airport expects an increase in noise complaints from residents in new residential development that will be built underneath existing flight paths (Threat). This will require an increase in noise complaint response and information gathering, which is currently a lengthy process (Weakness). Explore ways to speed up complaint response and information gathering.

Once the strategies are finalized, airport management evaluates whether a NOMS should be a part of implementing the strategies or not. In some cases, the airport noise problems are significant enough to warrant procuring a technological tool such as a NOMS or a flight tracking system to assist in handling noise complaints and aircraft operations investigation. In other cases, the airport noise problems are not significant enough to warrant procuring a NOMS or flight tracking system. In either case, a SWOT analysis will help in the identification and analysis of factors involved in a specific airport noise environment, which can serve as a decision-making framework for the strategic discussions of airport management.

**Table 6-2. TOWS quadrants.**

| | Opportunities ↓ | Threats ↓ |
|---|---|---|
| Strengths → | Strategies that take advantage of the Opportunity by utilizing the Strengths | Strategies that use Strengths to minimize the Threat or convert it to an Opportunity |
| Weaknesses → | Strategies that utilize Opportunity to improve the Weaknesses | Strategies that minimize Weaknesses and avoid Threats |

The last step of the SWOT analysis is to deploy the strategies. There are various ways to deploy strategies, but the primary themes for deployment include

- Gaining stakeholder approval or buy-in,
- Planning and assigning roles,
- Implementing and communicating progress, and
- Measuring performance.

## 6.2 Needs, Purpose, and Requirements Checklist

Airports should not install a NOMS because of pressure to install one or because other airports have one. An airport considering the installation of a NOMS should decide why it wants a NOMS, how it will use a NOMS, and what its noise management program would be. To inform this decision, the airport should talk to airports that have a NOMS. Once an airport has all this information in hand, it should develop its requirements for the system. Every system and airport is different, so an airport needs to determine what NOMS features it would expect to use. Blindly rushing into acquiring a NOMS system will likely result in higher upfront installation costs and potentially higher operating and maintenance costs in the future.

It is important for an airport to prioritize what it will want out of a NOMS before entering into the selection and procurement process. With no prior knowledge of the features, cost, and labor requirements of a NOMS, an airport might install a system unaware of the complexities involved. The checklist in Table 6-3 does not represent all the needs and requirements associated with a NOMS, but it can be used as a starting point for the decision-making process and in development of an airport's RFP for a NOMS.

An airport considering the installation and operation of a NOMS should review the information in Table 6-3 and respond to the listed questions. In the context of problem-solving or decision-making, a "need" describes the problem(s) that a proposed decision is intended to solve; the "purpose" of a proposed decision is to address the issues that cause the problem(s). Generally, for an airport considering installation of a NOMS, many of the problems listed under "Needs" in Table 6-3 originate from the lack of readily available information about aircraft noise and operations that airport staff needs to respond to inquiries and complaints from external stakeholders (e.g., the public, elected officials, pilots, and airlines) and internal stakeholders (e.g., airport management and other airport staff/departments). The objectives listed under "Purpose" in Table 6-3 describe desired changes in handling of airport noise issues.

The "Requirements" section of the checklist lists some key questions that can help identify major NOMS requirements. Note that if an airport answers the questions in the "Needs" section in ways that indicate that there are no problems to solve relative to noise handling, then a review of the remaining sections of Table 6-3 is not necessary.

## 6.3 Decision-Making Process

To assist with the decision-making process, Figure 6-1 presents selected questions from the Needs and Purpose sections of Table 6-3 in a flowchart where the questions lead to one of two responses: that the airport should consider the procurement of a NOMS, or that the airport does not likely need a NOMS.

## 6.4 Funding Options

The funding options for a NOMS are summarized in Section 5.1 and Appendix A: Literature Review**.** An airport considering the installation of a NOMS should review the funding flowchart shown in Figure 6-2.

**Table 6-3. Airport NOMS considerations—needs, purpose, and requirements checklist.**

| Item No. | NOMS Considerations | Response |
|---|---|---|
| | ***Needs*** | |
| | **Does your airport:** | |
| 1 | Handle noise inquiries or complaints from internal or external stakeholders? | |
| 2 | Provide staff with sufficient information to appropriately respond to noise issues/concerns from internal and external stakeholders? | |
| 3 | Have special reasons for acquiring a NOMS, i.e., Environmental Impact Statement (EIS) ROD, Part 150, public pressure, etc.? | |
| 4 | Expect a future increase in aircraft operations or change in flight paths that could potentially result in an increase in noise complaints? | |
| 5 | Expect a future residential land use development that could potentially result in an increase in noise complaints? | |
| 6 | Have legal requirements or agreements to monitor aircraft noise and/or operational levels? | |
| | ***Purpose*** | |
| | **Are the airport's objectives to:** | |
| 7 | Improve its noise inquiry or complaint handling process? | |
| 8 | Optimize staff time spent handling aircraft noise issues? | |
| 9 | Mitigate aircraft noise? | |
| 10 | Provide staff with access to readily available aircraft noise and/or operations information? | |
| 11 | Address legal requirements, agreements, or obligations relative to aircraft noise and/or operational levels? | |
| 12 | Monitor aircraft operational counts (i.e., runway/taxiway use, Remain Over Night use, etc.)? | |
| 13 | Monitor noise abatement procedure performance? | |
| 14 | Develop a strong public outreach program that fosters an airport-community partnership? | |
| 15 | Engage the public in discussions relative to aircraft noise and operations? | |
| 16 | Manage community expectations through education and sharing factual aircraft information? | |
| | ***Requirements*** | |
| | **Will the airport:** | |
| 17 | Develop an RFP in house that is clear and concise and defines exactly what the airport wants in a NOMS? | |
| 18 | Hire a consultant to help with the RFP, system design, and the procurement process? | |
| 19 | Ensure that its system design and technical specifications are not generic and fit the airport's wants and needs? | |
| 20 | a. Have unique requirements in developing the system, i.e., noise abatement procedures/paths, flight tracking only, ground noise issues, validation of the 65 DNL, etc.?<br>b. If so, has the airport prepared a comprehensive list of requirements? | |
| 21 | Have available federal and/or local funding for the system? | |
| 22 | Secure and use airport funds? | |
| 23 | Want a flight tracking system only (no microphones) or a full NOMS? | |
| 24 | Require additional monitoring equipment (radios, cameras)? | |
| 25 | Prefer a hosted system where the data remains off-site or prefer that all data remain on-site? | |

**Table 6-3. (Continued).**

| Item No. | NOMS Considerations | Response |
|---|---|---|
| 26 | Require permanent, portable, and/or virtual noise monitoring terminals? | |
| 27 | Have locations for NMT site selection in mind? | |
| 28 | Require an integrated complaint database? | |
| 29 | Want the ability to import and export GIS data? | |
| 30 | Want certain types of reports (complaint statistics, operational statistics)? | |
| 31 | Want other airport departments (accounting, gate management, etc.) to have access to the system data? | |
| 32 | The staff to operate a system or will new staff be hired? | |
| 33 | Plan on providing special training to staff (e.g., acoustics, public relations/communications, noise modeling, GIS)? | |
| 34 | Use an existing manual of policies and procedures specific to handling noise issues such as complaint response or would a new manual have to be developed? | |
| 35 | Prefer to outsource certain operations of the system (routine data validation and reporting)? | |
| 36 | Want the public to have online access to the data for self-investigation of noise complaints? | |
| 37 | Provide in-house or outsourced staff to maintain the system hardware? | |
| 38 | Require UAM/UAV monitoring now or in the future? | |

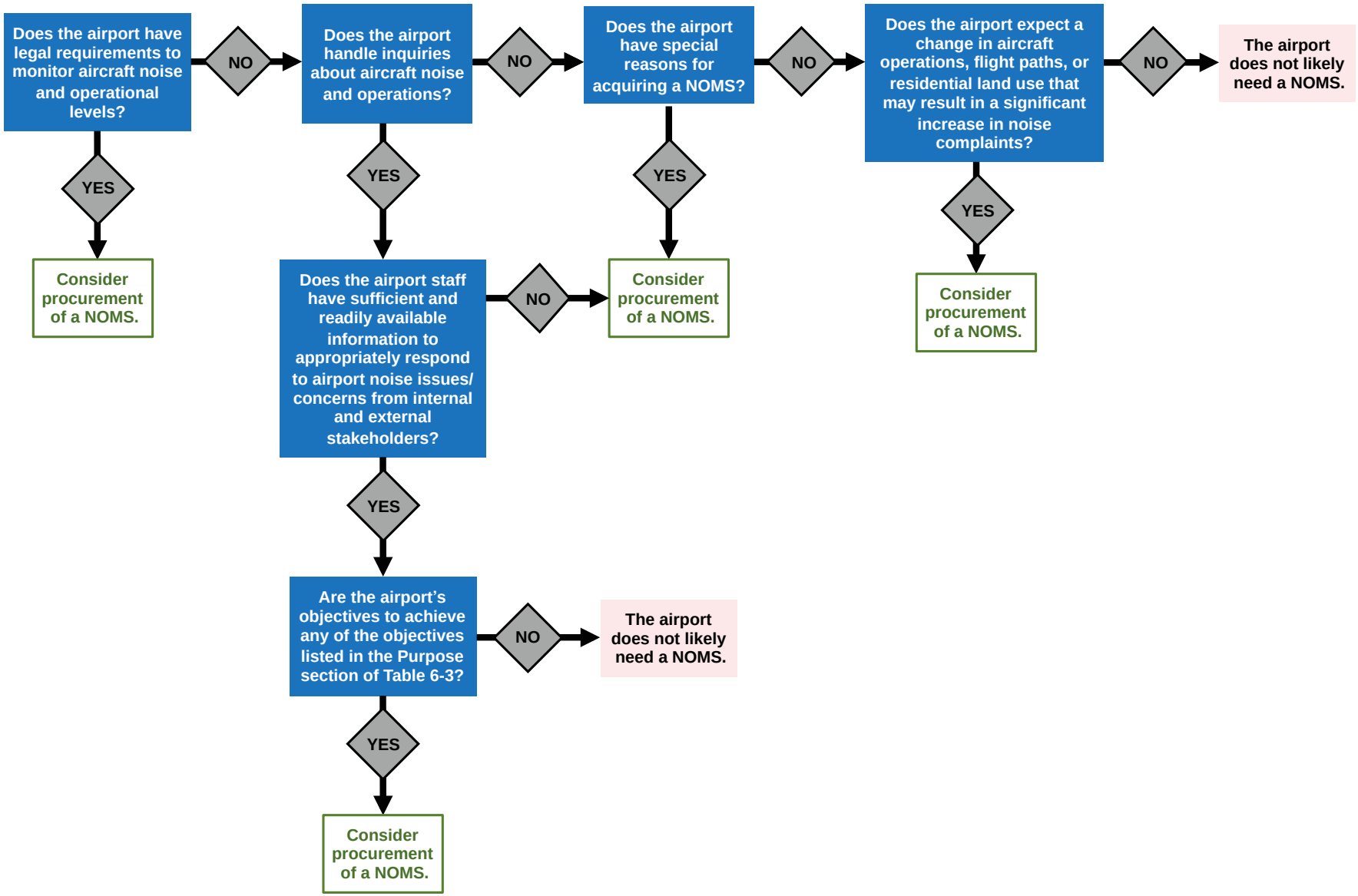



***Figure 6-1. Decision-making flowchart.***

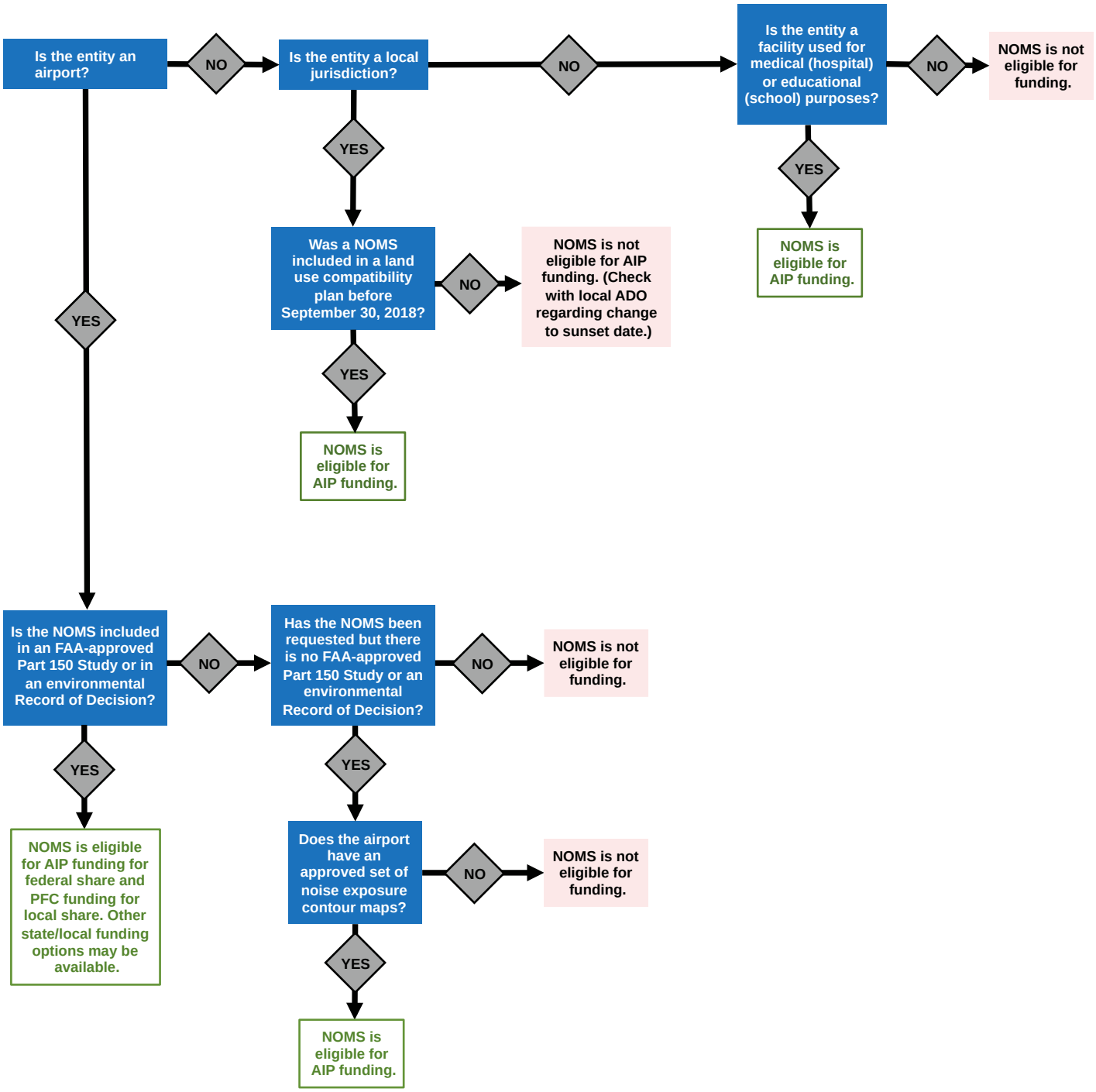



***Figure 6-2. Airport NOMS funding flowchart.***

# Glossary

**Airport Improvement Program (AIP):** A federal funding program for airport improvements. AIP is periodically reauthorized by Congress with funding appropriated from the Aviation Trust Fund. Proceeds to the Aviation Trust Fund are derived from excise taxes on airline tickets, aviation fuel, and so forth.

**Airport operations:** Arrivals, departures, and touch-and-gos from a local airport, and an overflight from a non-local airport.

**Air traffic control:** A service operated to promote the safe, orderly, and expeditious flow of air traffic.

**Airport traffic control tower (ATCT):** The airport traffic control facility located on an airport that is responsible for traffic separation within the immediate vicinity of the airport and on the surface of the airport in order to provide for safe and efficient flow of aircraft.

**Ambient noise:** The noise level that is typical at a site where a noise meter is located without any aircraft or significant community noise taking place. Also referred to as background noise.

**Area Navigation (RNAV):** RNAV enables aircraft to fly on any desired flight path within the coverage of ground- or space-based navigation aids, within the limits of the capability of aircraft self-contained systems, or a combination of both capabilities.

**Attenuation:** An acoustical phenomenon whereby sound energy is reduced between the noise source and the receiver. This energy loss can be attributed to atmospheric conditions, terrain, vegetation, other natural features, and human-made features (e.g., sound insulation).

**Automated Radar Terminal System (ARTS):** Computer-aided radar display subsystems that are capable of associating alphanumeric data—such as aircraft identification, altitude, and airspeed—with aircraft radar returns.

**Aviation Environmental Design Tool (AEDT):** FAA-developed software system that models aircraft performance in space and time in order to estimate fuel consumption, emissions, noise, and air quality consequences.

**A-weighted sound (dBA):** A system for measuring sound energy that is designed to represent the response of the human ear to sound. Sound energy at frequencies more readily detected by the human ear is more heavily weighted in the measurement, while less-well-detected frequencies are assigned lower weights. A-weighted sound measurements are commonly used in studies where the human response to sound is the object of the analysis.

**Background noise:** See ambient noise.

**Community Noise Equivalent Level (CNEL):** See day-night average sound level (DNL).

**Commuter aircraft:** Commuters are commercial operators that provide regularly scheduled passenger or cargo service with aircraft seating fewer than 60 passengers. A typical commuter flight operates over a trip distance of less than 300 miles.

**Controlled airspace:** Airspace of defined dimensions within which air traffic control service is provided to flights subject to instrument flight rules (IFR) and flights subject to visual flight rules (VFR) in accordance with the airspace classification. Controlled airspace is designated as Class A, Class B, Class C, Class D, or Class E. Aircraft operators are subject to certain pilot qualifications, operating rules, and equipment requirements as specified in federal aviation regulation (FAR), Part 91, depending upon the class of airspace in which they are operating.

**Coronavirus (COVID-19) pandemic:** The COVID-19 pandemic began in December 2019 and significantly reduced air travel worldwide. As the COVID-19 situation has evolved, air travel has increased, and people living around airports may perceive an increase in noise, which may increase the need for noise and aircraft operations analysis, flight tracking systems, and Noise and Operations Monitoring Systems (NOMSs).

**Day-night average sound level (DNL):** A noise measure used to describe the average sound level over a 24-hour period, typically an average day over the course of a year. In computing DNL, an extra weight of 10 decibels (dB) is assigned to noise occurring between the hours of 10:00 p.m. and 7:00 a.m. to account for increased annoyance when ambient noise levels are lower and people are trying to sleep. The CNEL is used by airports in California and includes an additional 5 dB penalty assigned to noise occurring between 7:00 p.m. and 10:00 p.m. to account for increased annoyance during evening hours. CNEL/DNL may be determined for individual locations or expressed in noise contours.

**Decibel (dB):** Sound is measured by its pressure or energy in terms of decibels. The decibel scale is logarithmic. A 10-decibel increase in sound is equal to a tenfold increase in sound energy.

**Easement:** The legal right of one party to use part of the rights of a piece of real estate belonging to another party. This may include, but is not limited to, the right of passage over, on, or below the property; certain air rights above the property, including view rights; and the rights to any specified form of development or activity.

**Enplanements:** The number of passengers boarding an aircraft at an airport. Does not include arriving or through passengers.

**Environmental Assessment (EA):** A concise document that assesses the environmental impacts of a proposed federal action. It discusses the environmental impacts of the proposed action and alternatives. An EA should provide sufficient evidence and analysis for a federal determination of whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI). The cornerstone of the EA process is public participation and consultation with other federal, state, and local agencies.

**Environmental Impact Statement (EIS):** An EIS is a document that provides a discussion of the significant environmental impacts that would occur as a result of a proposed project and informs decision-makers and the public of reasonable alternatives that would avoid or minimize adverse impacts. The cornerstone of the EIS process is public participation and consultation with other federal, state, and local agencies.

**Equivalent sound level (Leq):** The steady A-weighted sound level over any specified period of time (not necessarily 24 hours) that has the same acoustic energy as the fluctuating noise during that period (with no consideration of nighttime weighting). It is a measure of cumulative acoustical energy. Because the time interval may vary, it should be specified by a subscript (such as $Leq_8$ for an 8-hour exposure to noise) or be clearly understood from the context.

36 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

**Federal Aviation Administration (FAA):** The FAA is the federal agency responsible for ensuring the safe and efficient use of the nation's airspace, fostering civil aeronautics and air commerce, and supporting the requirements of national defense. The activities required to carry out these responsibilities include safety regulations; airspace management and the establishment, operation, and maintenance of a system of air traffic control and navigation facilities; research and development in support of the fostering of a national system of airports, promulgation of standards and specifications for civil airports, and administration of federal grants-in-aid for developing public airports; various joint and cooperative activities with the Department of Defense; and technical assistance (under State Department auspices) to other countries.

**Federal Aviation Regulations (FARs):** The body of federal regulations relating to aviation. Published as Title 14 of the Code of Federal Regulations.

**Geographic information system (GIS):** An information system that is designed for storing, integrating, manipulating, analyzing, and displaying data referenced by spatial or geographic coordinates.

**Global positioning system (GPS):** A system of 24 satellites used as reference points to enable navigators equipped with GPS receivers to determine their latitude, longitude, and altitude. The accuracy of the system can be further refined by using a ground receiver at a known location to calculate the error in the satellite range data. This is known as differential GPS (DGPS).

**Hub:** An airport that services airlines that have centralized operations.

**Instrument flight rules (IFR):** That portion of the FARs (14 CFR 91) specifying the procedures that are to be used by aircraft during flight in instrument meteorological conditions. These procedures may also be used under visual conditions and provide for positive control by air traffic control. (See also VFR).

**Instrument Landing System (ILS):** An electronic system installed at some airports that helps to guide pilots to runways for landing during periods of limited visibility or adverse weather.

**Integrated Noise Model (INM):** A computer model developed, updated, and maintained by the FAA to predict the noise exposure generated by aircraft operations at an airport. INM has been replaced by AEDT as the approved computer noise model.

**Landing and takeoff (LTO) cycle:** The time that an aircraft is in operation at or near an airport. An LTO cycle begins when an aircraft starts its final approach (arrival) and ends after the aircraft has made its climb-out (departure).

**Land use compatibility:** The ability of land uses surrounding the airport to coexist with airport-related activities with minimum conflict.

**Leq:** See equivalent sound level.

**National Environmental Policy Act of 1969 (NEPA):** The original legislation establishing the environmental review process for proposed federal actions.

**Neighborhood Environmental Survey (NES):** An FAA-sponsored national survey that collected information relative to aircraft noise annoyance from residents living around airports in the United States. The NES provided an update to past aircraft annoyance surveys conducted in the 1970s.

**Noise abatement:** A measure or action that minimizes the impact of noise on the environs of an airport. Noise abatement measures include aircraft operating procedures and use or disuse of certain runways or flight tracks.

**Noise and Operations Monitoring System (NOMS):** An airport NOMS generally consists of components such as software, computer processors, noise monitors, and peripherals (printers, plotters, speakers, etc.). Airports use a NOMS to collect, manage, analyze, and communicate data such as aircraft flight tracks and flight procedures, flight altitude, aircraft identification, noise measurements, aircraft noise complaints, and weather.

**Noise compatibility program (NCP):** A program developed in accordance with FAR Part 150 guidance that contains provisions for the abatement of aircraft noise through aircraft operating procedures, air traffic control procedures, or airport facility modifications. It also includes provisions for land use compatibility planning and may include actions to mitigate the impact of noise on incompatible land uses and recommendations for amending local land use controls in order to affect future land uses and development. The program must contain provisions for updating and periodic revision.

**Noise compatibility study:** The processes, methods, and procedures provided in FAR Part 150 to develop an NCP, including the development of noise exposure maps and public participation.

**Noise contour:** A map feature representing average annual noise levels summarized by lines connecting points of equal noise exposure.

**Primary runway:** The runway on which the majority of operations take place.

**Profile:** The position of the aircraft during an approach or departure in terms of altitude above the runway and distance from the runway end.

**Reliever airport:** An airport which, when certain criteria are met, relieves the aeronautical demand on a busier air carrier airport.

**Required navigation performance (RNP):** Similar to RNAV, with the addition of an onboard performance monitoring and alerting capability. RNP enables the aircraft navigation system to monitor the navigation performance it achieves and inform the crew if the requirement is not met during an operation. This onboard monitoring and alerting capability enhances the pilot's situational awareness and can enable reduced obstacle clearance.

**Run-up:** A routine procedure for testing aircraft systems by running one or more engines at a high power setting. Engine run-ups are normally conducted by airline maintenance personnel checking an engine or other onboard systems following maintenance.

**Runway use program:** A noise abatement runway selection plan crafted to further noise abatement efforts for communities around airports. A runway selection plan is developed into a runway use program. It typically applies to all turbojet aircraft that are 12,500 pounds or heavier. Turbojet aircraft that weigh less than 12,500 pounds are included only if the airport proprietor determines that the aircraft creates a noise problem. These programs are coordinated with the FAA in accordance with FAA Order 8400.9, National Safety and Operational Criteria for Runway Use Programs, and are administered as either "formal" or "informal" programs. A "formal" program is an approved runway use program outlined in a Letter of Understanding among the FAA Flight Standards District Office, FAA Air Traffic Service, the airport proprietor, and the users. It is mandatory for aircraft operators and pilots as provided for in FAR Section 91.87. An "informal" program is an approved runway use program that does not require a Letter of Understanding. Participation in the program by aircraft operators and pilots is voluntary.

**Schultz Curve:** The accepted standard for describing the transportation noise exposure–annoyance relationship. Results of the Schultz Curve are based on surveys conducted in the 1970s and surveys that were revalidated in 1992. Results from recent international surveys

38 Primer and Framework for Considering an Airport Noise and Operations Monitoring System

show that aircraft noise annoyance levels are higher than those shown on the Schultz Curve. Results from the recent NES show that the standards based on the Schultz Curve are outdated.

**Single event:** One noise event. For many kinds of analysis, the sound from single events is expressed using the sound exposure level (SEL) metric.

**Slant-range distance:** The distance along a straight line between an aircraft and a point on the ground.

**Sound:** Sound is the result of vibration in the air. The vibration produces alternating bands of relatively dense and sparse particles of air, spreading outward from the source in the same way as ripples do on water after a stone is thrown into it. The result of the movement is a fluctuation in the normal atmospheric pressure or sound waves.

**Sound exposure level (SEL):** A standardized measure of a single sound event, expressed in A-weighted decibels, that takes into account all sound above a specified threshold set at least 10 decibels below the maximum level. All sound energy in the event is integrated over 1 second.

**Terminal Radar Approach Control (TRACON):** An FAA air traffic control facility that uses radar and two-way communication in order to provide separation of air traffic within a specified geographic area in the vicinity of one or more airports.

**Traffic:** The traffic flow for aircraft landing and departure at an airport. Typical components of the traffic pattern include upwind leg, crosswind leg, downwind leg, base leg, and final approach.

**Unmanned aerial vehicle (UAV)/urban air mobility (UAM):** UAVs or "drones" are aircraft (generally lighter than 50 lb) that are being used to inspect infrastructure, provide emergency response support, survey agriculture, and deliver supplies and products to customers in urban and rural environments. UAMs are small vehicles used to transport people by air and are used to reduce traffic on congested highways and roads.

**Visual flight rules (VFR):** Rules and procedures specified in 14 CFR 91 for aircraft operations under visual conditions. Aircraft operations under VFR are not generally under positive control by air traffic control. The term VFR is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, VFR is used by pilots and controllers in order to indicate a type of flight plan.

# Bibliography

Bragdon, C. R. "Airport Noise Monitoring Systems in North America." *Transportation Research Record*, No. 1033, 1985, pp. 43–46.

FAA. Advisory Circular 150/5020-1: Noise Control and Compatibility Planning for Airports. (FAR Part 150 Guidelines). 1983.

FAA. Order 1050.1F: Environmental Impacts: Policies and Procedures. 2015.

FAA. Order 5100.38D: Airport Improvement Program Handbook—Change 1. February 26, 2019.

FAA. Order 5500.1: Passenger Facility Charge Document Information. 2001.

FHWA. "Sound Level Descriptors." FHWA-HEP-17-053.

International Air Transport Association (IATA). "Optimism When Borders Reopen." Press Release 33, May 26, 2021. https://www.iata.org/en/pressroom/pr/2021-05-26-01/.

International Code Council (ICC). International Building Code. 2018.

Metron Aviation, Inc., and DGW Consulting Group, LLC. *ACRP Web-Only Document 48: Evaluating the Use of Spatially Precise Diurnal Population Data in Aviation Noise Studies*, Transportation Research Board, Washington, D.C., 2020.

Miller, N. P., J. J. Czech, K. M. Hellauer, B. L. Nicholas, S. Lohr, E. Jodts, P. Broene, D. Morganstein, J. Kali, X. Zhu, D. Cantor, J. Hudnall, and K. Melia. *Analysis of the Neighborhood Environmental Survey.* DOT/FAA/TC-21/4. Prepared for the FAA, 2021.

Newman, J. S. *The Need for Airport Noise Monitoring Systems, Their Uses and Value in Promoting Civil Aviation*. FAA Office of Energy and Environment, 1980.

Nichol, C. *ACRP Synthesis 1: Innovative Finance and Alternative Sources of Revenue for Airports.* Transportation Research Board of the National Academies, Washington, D.C., 2007.

Sarsby, A. *SWOT Analysis: A Guide to SWOT for Business Studies Students*. Leadership Library, United Kingdom, 2016.

Society of Automotive Engineers (SAE). Aerospace Recommended Practice (ARP) 4721: "Monitoring Aircraft Noise and Operations in the Vicinity of Airports." 2007.

Ward, S., L. Wilson, R. Schnug, J. Pickering, D. Mericas, L. Morland, M. Hooper, R. Dunkelberg, P. Van Pelt, S. Landau, A. Blair, N. Stein, S. Marr, S. Arnold, and M. Cardwell. *ACRP WebResource 1: Aligning Community Expectations with Airport Roles*. Transportation Research Board, Washington, D.C. 2017.

Woodward, J. M., L. L. Briscoe, and P. Dunholter. *ACRP Report 15: Aircraft Noise: A Toolkit for Managing Community Expectations.* Transportation Research Board of the National Academies, Washington, D.C., 2009.

Wyle Laboratories. "Supporting Information for the Adopted Noise Regulations for California Airports." Report No. WCR 70-3(R). January 1971.

# Acronyms

| | |
|---|---|
| ADO | Airports District Office |
| ADS-B | Automatic Dependent Surveillance-Broadcast |
| AIP | Airport Improvement Program |
| ATADS | Air Traffic Activity Data System |
| CNEL | Community Noise Equivalent Level |
| DCA | Ronald Reagan Washington National Airport |
| DNL | Day-night average sound level |
| EIS | Environmental Impact Statement |
| GA | General aviation |
| GIS | Geographic information system |
| IAD | Dulles International Airport |
| JFK | John F. Kennedy Airport |
| NCP | Noise compatibility program |
| NEPA | National Environmental Policy Act |
| NES | Neighborhood Environmental Survey |
| NMT | Noise monitoring terminal |
| NOMS | Noise and Operations Monitoring System |
| PCA | Point of closest approach |
| PFC | Passenger facility charge |
| RFP | Request for proposal |
| RNAV | Area navigation |
| RNP | Required navigation performance |
| ROD | Record of Decision |
| SMO | Santa Monica Airport |
| SNA | John Wayne Airport |
| SWIM | System-Wide Information Management |
| SWOT | Strengths, weaknesses, opportunities, and threats |
| TRACON | Terminal Radar Approach Control |
| UAM | Urban air mobility |
| UAV | Unmanned aerial vehicle |

# Appendices A Through K

Appendices A through K are not published herein but are available on www.nap.edu by searching on *"ACRP Research Report 237: Primer and Framework for Considering an Airport Noise and Operations Monitoring System"*. Appendix titles are listed below.

Appendix A: Literature Review
Appendix B: List of NOMS, Non-NOMS, & Other Airports
Appendix C: Airport NOMS Questionnaire Type A
Appendix D: Airport NOMS Questionnaires Type B1 & B2
Appendix E: Airport NOMS Questionnaire Type B3
Appendix F: Airports NOMS Questionnaire Type B4
Appendix G: Airport NOMS Questionnaire & Summary of Findings
Appendix H: Case Study Findings
Appendix I: NOMS Vendor Discussion & Summary of Findings
Appendix J: Noise Monitor Installation & Maintenance Guide
Appendix K: Noise Management Program Development Guide

*Abbreviations and acronyms used without definitions in TRB publications:*

| | |
|---|---|
| A4A | Airlines for America |
| AAAE | American Association of Airport Executives |
| AASHO | American Association of State Highway Officials |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI–NA | Airports Council International–North America |
| ACRP | Airport Cooperative Research Program |
| ADA | Americans with Disabilities Act |
| APTA | American Public Transportation Association |
| ASCE | American Society of Civil Engineers |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| ATA | American Trucking Associations |
| CTAA | Community Transportation Association of America |
| CTBSSP | Commercial Truck and Bus Safety Synthesis Program |
| DHS | Department of Homeland Security |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FAST | Fixing America's Surface Transportation Act (2015) |
| FHWA | Federal Highway Administration |
| FMCSA | Federal Motor Carrier Safety Administration |
| FRA | Federal Railroad Administration |
| FTA | Federal Transit Administration |
| GHSA | Governors Highway Safety Association |
| HMCRP | Hazardous Materials Cooperative Research Program |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISTEA | Intermodal Surface Transportation Efficiency Act of 1991 |
| ITE | Institute of Transportation Engineers |
| MAP-21 | Moving Ahead for Progress in the 21st Century Act (2012) |
| NASA | National Aeronautics and Space Administration |
| NASAO | National Association of State Aviation Officials |
| NCFRP | National Cooperative Freight Research Program |
| NCHRP | National Cooperative Highway Research Program |
| NHTSA | National Highway Traffic Safety Administration |
| NTSB | National Transportation Safety Board |
| PHMSA | Pipeline and Hazardous Materials Safety Administration |
| RITA | Research and Innovative Technology Administration |
| SAE | Society of Automotive Engineers |
| SAFETEA-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005) |
| TCRP | Transit Cooperative Research Program |
| TDC | Transit Development Corporation |
| TEA-21 | Transportation Equity Act for the 21st Century (1998) |
| TRB | Transportation Research Board |
| TSA | Transportation Security Administration |
| U.S. DOT | United States Department of Transportation |

Transportation Research Board
500 Fifth Street, NW
Washington, DC 20001

ADDRESS SERVICE REQUESTED

*The National Academies of*
SCIENCES • ENGINEERING • MEDICINE

The nation turns to the National Academies of Sciences, Engineering, and Medicine for independent, objective advice on issues that affect people's lives worldwide.
**www.nationalacademies.org**

ISBN 978-0-309-09465-8

# A Primer and Framework for Considering an Airport Noise and Operations Monitoring System (NOMS)

# Appendices A Through K

**Appendix A: Literature Review**

**Appendix B: List of NOMS, Non-NOMS, & Other Airports**

**Appendix C: Airport NOMS Questionnaire Type A**

**Appendix D: Airport NOMS Questionnaires Type B1 & B2**

**Appendix E: Airport NOMS Questionnaire Type B3**

**Appendix F: Airports NOMS Questionnaire Type B4**

**Appendix G: Airport NOMS Questionnaire & Summary of Findings**

**Appendix H: Case Study Findings**

**Appendix I: NOMS Vendor Discussion & Summary of Findings**

**Appendix J: Noise Monitor Installation & Maintenance Guide**

**Appendix K: Noise Management Program Development Guide**

# Appendix A: Literature Review

## A.1 Best Practice International Guidance Documents and Building Code Standards

### A.1.1 Guidance Documents

Two international documents provide guidance on the installation and operation of airport permanent noise monitoring systems: the Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 4721[1] document [and the International Standards Organization (ISO) 20906 (ISO 2009). The following sections outline the contents of ARP 4721 and ISO 20906 and include comments particularly relevant to *ACRP Research Report 237*. These documents are both technical in nature but provide very useful information.

#### *A.1.1.1 SAE ARP 4721 Part 1:*

This SAE ARP provides guidance for monitoring aircraft noise and operations in the vicinity of airports using either attended portable or unattended monitoring systems[2]. Part 1 provides guidance on the components, installation, and administration of permanent systems and guidance on analysis of data collected from temporary monitoring of aircraft noise.

The topics addressed in Part 1 are identified in seven subsections. Sections 2 and 3 give References and Definitions. Sections 4 through 6 provide guidance and information intended for those who have had little experience with the design, installation, and use of permanent aircraft noise and operations monitoring system. Section 4, System Description, describes the basic components of a complete airport noise and operations monitoring system and gives minimum requirements. Section 5, Site Selection and Installation, describes what steps should be taken in locating noise monitors and provides minimum requirements for monitor and microphone installation. Section 6, System Administration, describes basic administrative and maintenance activities that are necessary in order to ensure an installed system performs as intended. Lastly, Section 7 provides detailed guidance for making and reporting on aircraft noise measurements made using unattended portable noise monitors. Note that ARP 4721 is currently being revised with expected publication in early 2022.

#### *A.1.1.2 SAE ARP 4721 Part 2:*

As automated noise and operations monitoring systems have become widely installed at airports, the airports, vendors, and surrounding communities, reliable methods for validating the data reported by the systems are needed. Were systems providing reliable data? What uncertainties might be associated with the data? This ARP provides two levels of tests for validating system data. The first level, Post-installation Screening Tests, describes simple methods that use only data readily available from most systems. The second, System Validation for Special Studies, uses alternative data collection methods,

[1] Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 4721. https://www.sae.org/standards/content/arp4721/1/

[2] International Organization for Standardization (ISO), Acoustics — Unattended monitoring of aircraft sound in the vicinity of airports, ISO 20906, 2009. https://www.iso.org/obp/ui/#iso:std:iso:20906:ed-1:v1:en

and provides detailed statistical methods for assessing the uncertainties associated with system measured data.

The topics addressed in Part 2 are identified in six subsections. Sections 2 and 3 give References and Definitions. Section 4, Post-Installation Screening Tests, identifies tests that may be conducted immediately after a system has been installed and is operational.

These tests use only data directly from the system and should efficiently identify any major short comings, such as missing significant numbers of operations or missing or erroneous aircraft noise event data. These tests may also be run at any time that some major portion or type of system reported data is in question, airport operations have changed, or community noise levels have changed. Section 5, System Validation for Special Studies, provides more rigorous and time-consuming methods for quantifying a permanent system's capabilities when special needs require detailed, quantitative analysis of system data.

#### *A.1.1.3 ISO 20906:*

The guidance provided in ISO 20906 is solely for permanent airport noise monitoring systems. Its guidance is generally similar to ARP 4721. One area of difference is the guidance provided relative to microphone location. ISO 20906 recommends microphone locations that are well removed from any buildings or obstructions, so much so that its location guidance is not very practical for built communities near airports.

ISO 20906 provides guidance in the following areas:

- Typical application for a permanently installed sound-monitoring system around an airport;
- Performance specifications for instruments and requirements for the installation and operation to enable the airport to determine continuously monitored sound pressure levels of aircraft sound at selected locations;
- Requirements for monitoring the sound of aircraft operations from an airport;
- Requirements for the quantities to be determined to describe the sound of aircraft operations;
- Requirements for data to be reported and frequency of publication of reports;
- Procedure for determining the expanded uncertainty of the reported data.

#### *A.1.1.4 Guidance on Calibration for Airport Permanent Noise Monitoring Systems*

It is impractical to go through the ARP and ISO document in detail for the purpose of *ACRP Report 237*, but there is one area worth highlighting for readers regarding the guidance provided for calibrating an airports permanent noise monitoring system.

The SAE standard provides the following guidance for calibration:

*"It is recommended that every 1 to 3 years each instrument is tested to verify that it is operating within the original specifications of the instrument. The interval for performing these tests is dependent on the*

*use of the system. If a system is used to enforce single event noise limits, noise budgets, or other regulatory limits the system should be tested every year."*

The ISO standard provides the following guidance for calibration:

*"Means shall be provided to apply an acoustical calibration signal by a sound calibrator to each microphone to check the acoustical sensitivity of the measurement system.*

*The calibration signal shall be a sinusoidal tone in the range 250 Hz to 1 000 Hz. The sound pressure level of the tone shall be in the range 90 dB to 125 dB. A coupler or other means may be provided to exclude ambient sound during calibration. Also, means shall be provided at the microphone site to read out the data corresponding to the calibration level and to adjust the latter as necessary to the sound pressure level in the cavity of the coupler at the time of checking the sensitivity. The calibrator used shall conform to the requirements of International Electrotechnical Commission (IEC) 60942 for a class 1 instrument and shall be calibrated by an accredited or otherwise nationally recognized laboratory at least once every 12 months. Such an acoustical calibration shall be performed for each sound monitor at least once per year. More frequent calibrations (e.g. quarterly) are recommended."*

While the particulars of the calibrations may vary between the two documents, both detail annual calibration, which is common practice at most airports with permanent noise monitoring systems.

### A.1.2 The Building Codes

The International Building Code[3] (IBC) is the current building code used throughout the U.S. Local jurisdictions may adopt parts of the IBC rather than the content in its entirety in addition to adding their own local codes. The IBC is published every three years (2018 is current version, the next version will be published in 2021) and replaces the Uniform Building Code (UBC). Note that in some states, school districts and hospitals may have separate and unique building code requirements for schools and hospitals. The building code is of interest to airport noise monitoring system development because it guides the health and safety provisions of system installation. Of most concern are structural and soils requirements and electrical code provisions, including lightening protection. The structural requirements primarily related to foundations and soils conditions for the microphone pole installation vary considerably from state to state, depending on seismic requirements and local soils conditions. Care should be taken when siting microphones for adverse conditions that could greatly affect installation costs. Poles mounted near the top of slopes may require substantial footings beyond normal standards. Similarly, installation in soils subject to settling or liquefaction may be impractical. The electrical code requirements are for the safety of service personnel or any member of the public that has potential to contact the field installation. This may include lightening protection in some parts of the U.S. While system vendors have standard designs for their field monitors, local conditions and building code requirements may require substantial upgrades.

[3] International Code Council (ICC), International Building Code, 2018

# A.2 FAA Guidance

## A.2.1 FAA Guidance - Needs and Uses

In 1980, the FAA Office of Energy and Environment published "The Need for Airport Noise Monitoring Systems, Their Uses and Value in Promoting Civil Aviation"[4] Despite its age, the document provides useful guidance on the needs and uses of systems. Given the age of the document, the information on system costs and graphics, particularly flight track maps, are woefully out of date.

From the Abstract:

*"The need for airport noise monitoring systems is addressed from a variety of perspectives focusing on potential benefits to airport proprietors, the airlines, noise impacted airport communities and civil aviation in general. The operation and cost of typical noise monitoring systems is discussed. Various techniques for noise data presentation are also reviewed. The uses of radar tracking data in providing aircraft identification, position and ground track information is explored. Legal requirements for monitoring are specified and airport use restrictions are discussed. A list of U.S. and foreign airports with noise monitoring systems is presented. FAA research efforts pertaining to airport noise monitoring systems are also outlined"*

From the Introduction:

*"Airport noise monitoring systems provide an important tool for assessing noise levels around airports and provide concrete evidence that airport proprietors, state governments and the Federal Government are serious about controlling aviation noise impact on communities surrounding airports."*

## A.2.2 FAA Guidance - Funding

### *A.2.2.1 Federal Aviation Administration (FAA) – Order 5100.38D (change 1), "Airport Improvement Program Handbook", February 26, 2019*

FAA Order 5100.38D (change 1) "Airport Improvement Program Handbook" describes the Airport Improvement Program (AIP) grant program. This order explains the AIP process and grant program and is of high importance for airports looking to receive funding for noise programs including a Noise and Operations Monitoring System (NOMS). The most important information is contained in the following chapters:

- Chapter 2: "Who can get a Grant?"
- Chapter 3: "What projects can be funded?"
- Chapter 4: "What AIP funding is available?"

[4] Federal Aviation Administration, J.S Newman, "The Need for Airport Noise Monitoring Systems, Their Uses and Value in Promoting Civil Aviation," FAA Office of Energy and Environment, 1980.

- Chapter 5: "How does the grant process work?"

Chapter 4 is important in that it specifies that large hub/medium hub airports can receive AIP grants that total a normal Federal share of 75% to 80%, while small hub/non-hub/general aviation/reliever airports can receive AIP grants that total a normal Federal share of 90%.

*Appendix R.* Noise Compatibility Planning/Projects outlines everything related to noise projects. *Table R-1. General Eligibility Requirements for Noise Compatibility Projects* outlines the four (4) types of justification for a noise compatibility project to be AIP eligible include the following:

- Included in an FAA approved 14 CFR part 150 Program;
- A Facility Used Primarily for Medical or Educational Purposes;
- In a Land Use Compatibility Plan;
- In a Record of Decision.

*Table R-6. Noise Compatibility Planning/Project Requirements (k) & (l)* for installing a Noise and Operations Monitoring System (NOMS) outlines the factors to consider justification and eligibility for NOMS funding.

*Appendix C. Prohibited Projects and Unallowable Costs* outlines costs and projects that are prohibited. *Table C-5. Examples of Prohibited Projects/Costs for Noise Mitigation* shows certain aspects of NOMS installations that are not considered eligible costs and includes (16), (17), (18), & (21).

#### *A.2.2.2 Federal Aviation Administration (FAA) – Order 5500.1, "Passenger Facility Charges", August 9, 2001*

FAA Order 5500.1 "Passenger Facility Charge"[5] (PFC) describes the PFC process. As explained under the AIP grant program above, airports often use the PFC revenue as one option for the matching local share contribution for an AIP project. If a project is AIP eligible, it is also eligible for PFC funding. As long as the PFC funded project will "reduce noise or mitigate noise impacts resulting from an airport……," it is eligible to use PFCs. Noise project eligibility under the PFC program is the same as described above in FAA Order 5100.38D, except that the project does not have to be included in an approved Part 150 Noise Compatibility Plan (NCP). If a project would qualify for inclusion in a Part 150 NCP, but the agency/airport did not undertake or complete the Part 150, the project may be PFC eligible but not AIP eligible, however, noise contours would be required to support the project.

[5]Federal Aviation Administration, Order 5500.1 – Passenger Facility Charge Document Information. 2001 https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/12947

### *A.2.2.3 Title 14 Code of Federal Regulations (CFR) Part 158 - (158.13 – Use of PFC Revenue, 158.15 - Project Eligibility at PFC levels of $1, $2, or $3, & 158.17 – Project Eligibility at PFC levels of $4 or $4.50), current as of May 13, 2020*

The Federal Aviation Regulations (FARs) are rules prescribed by the FAA governing all aviation activities in the U.S. The FARs are part of Title 14 of the Code of Federal Regulations (CFR)[6]. Title 14 CFR Part 158 describes Passenger Facility Charges or PFC'S.
Section 158.13 describes the use of the revenue from PFCs. Section 158.15 discusses eligibility for projects funded under PFCs levels of $1, $2, or $3. This does include projects that "Reduce noise or mitigate noise impacts resulting from an airport." Section 158.17 discusses eligibility for projects funded under PFCs levels of $4 or $4.50. This does include projects at large or medium airports for "reducing the impact of aviation noise on people living near the airport."

### *A.2.2.4 ACRP WebResource 1: Aligning Community Expectations with Airport Roles, 2017*

*ACRP WebResource 1* contains an Aviation Toolkit for airports that includes information on funding sources for airports. The section "Federal, State and Local Funding Sources for Airports,"[7] provides excellent background information on airport funding options including AIP funding, PFC funding, State government funding, local funding sources, and tax-exempt bond funding. The AIP and PFC options were explained in detail previously. State funding particulars may vary between states, but funding can be provided by fees and taxes on aircraft owners and users. This funding is usually through a State Department of Transportation or Aviation. Local funding can be provided through various tax revenues and usage fees. Tax-exempt or general obligation bonds are backed by credit from the public-at-large residing within the local general tax authorities.

### *A.2.2.5 Airport Cooperative Research Program (ACRP) – ACRP Synthesis 1: "Innovative Finance and Alternative Sources of Revenue for Airports," 2007[8]*

This report is intended to inform airport operators about alternative financing options and revenue sources that are currently available to airport operators in the U.S. It provides an overview of common capital funding sources, a review of capital financing mechanisms, and a description of the various revenue sources developed by airport operators. The principal sources of funds for airport capital projects, listed from largest to smallest, include the following:

- Proceeds of bonds;
- PFC revenues;
- AIP grants (from the Airport and Airways Trust Fund);

[6] Electronic Code of Federal Regulations, Part 158 – Passenger Facility Charges. https://ecfr.io/Title-14/cfr158_main

[7] https://crp.trb.org/acrp0331/federal-state-and-local-funding-sources-for-airports/

[8] Nichol, Cindy, *ACRP Synthesis 1: Innovative Finance and Alternative Sources for Revenue for Airports*, 2007. http://www.trb.org/Publications/Blurbs/158669.aspx

- Internally generated capital (from retained airport revenues);
- Security grants (administered by the Transportation Security Administration (TSA) but not applicable to non-security projects);
- State grants and local financial support (Some states provide funding for airport and aviation-related projects in the form of outright grants or matching share for federal.

Airport operators regularly participate in the municipal bond markets to finance capital projects, utilizing:

- Numerous types of bonds - includes general obligation bonds, general airport revenue bonds, bonds backed by PFCs, bonds backed by customer facility charges (CFCs; fees paid by rental car customers), bonds to be paid with future AIP or state grants, and special facility bonds to finance capital projects;
- Other financial instruments – includes commercial paper, bond anticipation notes, grant anticipation notes, pooled credit programs, and capital leases;
- Minimized interest expenses – includes reduced interest rates on outstanding bonds and manages interest rate risk by entering into interest rate swaps with investment banks.

New projects can also be funded with other airline revenues, such as:

- Airport parking revenues – Parking has long been a major revenue source for airports and can be enhanced by offering premium services and enhancements;
- Rental car revenues – Airports change fees and rentals, and sometimes a CFC is collected from rental car customers and used to pay the operating and capital costs of a consolidated rental car facility or transportation to the terminals;
- Terminal concessions – Airport concession sales are a major revenue source and airports have been able to maximize revenues by enhancing terminal concession programs;
- Advertising programs – Airport advertising programs can generate income through sales of advertising at airports;
- Commercial development and land use – Revenue-producing leases can be generated from non-airline operations including manufacturing, warehousing, freight forwarding, and others.

#### *A.2.2.6 U.S. General Accounting Office (GAO) – RCED-98-71, "Airport Financing: Funding Sources for Airport Development", March 12, 1998*[9]

This report by the U.S. General Accounting Office (GAO) provides background information on funding options for airports. These include tax-exempt bonds, AIP grants, PFC fees, state and local contributions, and other airport revenues. Although this report tracks the split of funding sources from the early 1980's

[9] https://www.gao.gov/products/RCED-98-71

up until 1996, it demonstrates how funding sources vary widely between large/medium hub airports and all other airports.

#### *A.2.2.7 U.S. General Accounting Office (GAO) – GAO-20-298, "Airport Infrastructure: Information on Funding and Financing for Planned Projects", February 13, 2020*[10]

This report by the GAO provides updated background information on the funding options for airports. These options include AIP grants, PFC fees, municipal bonds, state and local contributions, and other airport-generated revenue. For larger airports, PFC fees and airport-generated revenue are the largest sources of funding. The airport-generated revenue includes both "airside" aeronautical and "landside" non-aeronautical sources. Aeronautical revenue can be collected through fixed-base operator fees, airline and cargo landing fees, fuel sales, cargo and hangar rentals, airline arrival fees, and rents. Non-aeronautical sources include hotel charges, terminal services including food and beverage, facility leases, terminal retail, rental cars, parking fees, and ground transport.

#### *A.2.2.8 Airports Council International – North America (ACI-NA) Website – Advocacy for "Airport Infrastructure Funding", 2020*[11]

The Airports Council International-North America (ACI-NA) represents over 300 commercial airports in the U.S. and Canada. Part of its mission is to advocate for policies in Washington D.C. that help airports operate efficiently and safely. This advocacy extends to "Airport Infrastructure Funding." The website provides excellent background information on airport funding options, including federal grants through the FAA's AIP, PFC user fees, tenant rents and fees, and also tax-exempt municipal bonds. AIP grants and PFC fees typically provide the majority of funding for AIP projects. Currently, ACI-NA is urging the U.S. Congress to eliminate the current cap on PFC user fees.

#### *A.2.2.9 Federal Aviation Administration (FAA) – Airport and Airway Trust Fund (AATF) Fact Sheet, Updated: April 2020*[12]

The FAA provides a fact sheet on the Airport and Airway Trust Fund (AATF) that was recently updated in April 2020. This fact sheet explains how revenues are derived from aviation-related excise taxes on passengers, cargo, and fuel and provides a breakdown of the tax revenue sources and corresponding rates as of January 1, 2020. These taxes provide funding for capital improvement projects through grants at U.S. airports.

### A.2.3 FAA Guidance – Planning and Environmental Studies

This section addresses the guidance in the FAA noise/land use planning process (Federal Aviation Regulation Part 150) and the FAA environmental order regarding environmental documents (FAA Order

[10] https://www.gao.gov/products/GAO-20-298

[11] https://airportscouncil.org/advocacy/airport-infrastructure-funding/

[12] https://www.faa.gov/about/budget/aatf/media/AATF_Fact_Sheet.pdf

1050.1F[13]). Neither Part 150 nor FAA Order 1050 requires the use of, or installation of, a permanent noise monitoring system. The following addresses the use of noise measurements in both documents:

#### *A.2.3.1 Part 150, Airport Noise Compatibility Planning*

The appendix of FAR Part 150 includes Section A150.5 "Noise measurement procedures and equipment." This appendix outlines the measurement standards and references methods for short-term portable noise monitoring and provides no guidance relative to permanent noise monitoring systems. This appendix states: "Whenever noise monitoring is used, under this part, it should be accomplished in accordance with Sec. A150.5 of this appendix," thus indicating that noise measurements are not a requirement for a Part 150 study. It is important to note that FAA funding of a permanent noise monitoring system may depend on permanent noise monitoring being a part of an accepted Part 150 Noise Control Plan.

Part 150 Guidelines (FAA, 1983): In 1983, the FAA published guidelines for implementing FAR Part 150 programs. It includes the following section describing potential uses and reasons for including a permanent noise monitoring system as part of a Noise Control Program. This is the entirety of the discussion.

*"226. CONTINUOUS AIRPORT NOISE MONITORING SYSTEMS. There are several optional measures which may be undertaken as part of an airport noise compatibility program and which can enhance its effectiveness. Continuous airport noise monitoring systems fall into this category. Such systems can provide important input to the process of refining airport noise contours. (Contact AEE-120 for specific details). In brief, any FAA approved noise monitoring system would have the following minimum capabilities:*

- *Provides continuous measurement of dBA at each site;*
- *Provides hourly Leq data;*
- *Provides daily DNL data;*
- *Provides single event maximum A-weighted sound level data.*

*Desirable but nonessential capabilities include:*

- *Aircraft event discrimination ability;*
- *Single event LAE data for each aircraft event;*
- *Differentiation between ambient and aircraft contributions to hourly Leq and Ldn;*
- *Monitoring data can be used to develop a statistical database of noise levels for each aircraft type category."*

[13] Federal Aviation Administration, Order 1050.1F- Environmental Impacts: Policies and Procedures, 2015

The above text from the Part 150 guidelines on 'desirable but nonessential capabilities" is woefully out of date. Aircraft event discrimination and differentiation between ambient and aircraft contributions to hourly Leq and daily Ldn should be mandatory for any modern system. At the time these guidelines were written, 1983, radar data was not available to airports and these tasks were quite difficult, expensive, and not very reliable.

#### *A.2.3.2 FAA Order 1050.1F- Environmental Impacts: Policies and Procedures*

The FAA order, specifying in detail the requirements for compliance with the National Environmental Policy Act (NEPA), does not provide any requirements or guidance on the use of permanent noise monitoring systems:

*"Noise monitoring data is not required for FAA noise analyses but may optionally be included in a National Environmental Policy Act (NEPA) document."*

In practice, when noise measurement data is provided in an Environmental Assessment or Environmental Impact Statement, the guidance provided in the FAR Part 150 guidelines[14] is used.

## A.3 Technical Papers

There is a relatively small amount of recently published literature on the general topic of airport noise monitoring systems. Technical bulletins and sales literature from system vendors are readily available online and are thus not presented here. The technical papers that are reviewed herein all relate to the difficult task of recognizing aircraft noise in the built environment where other background noise makes source identification very difficult.

Close to the airport where aircraft noise levels are much higher than the community noise sources like cars, trucks, buses, motorcycles, lawnmowers, leaf blowers, etc., aircraft noise is easy to identify and early noise monitoring systems installed around airports generally were close to the airport and source classification was relatively easy. In more recent years, the aircraft noise levels in communities farther from the airport have become more of an interest and aircrafts are much quieter than in the early years, making source identification more difficult. In this case, the problem of distinguishing aircraft noise from other community noise sources is much more difficult. The problem is generally and technically called a signal to noise ratio (SNR or s/n) problem. The holy grail of this industry is finding an acoustical method to determine the aircraft portion of the total community noise.

### A.3.1 Papers

The papers discussed below are published efforts to solve this problem, but none have led to a practical solution that can be incorporated into today's noise monitoring systems.

[14] Federal Aviation Administration, Advisory Circular AC 150/5020-1, "Noise Control and Compatibility Planning for Airports" (aka, FAR Part 150 Guidelines), 1983

#### *A.3.1.1 "Environmental noise monitoring using source classification in sensors," Maijala, P. et al, Applied Acoustics, 2017.*

This technical paper attempts to use pattern classification algorithms and artificial neural networks to separate the desired source noise from community and wind noise. The authors test the system using rock quarry noise but identify these techniques as applicable to aircraft noise. Note that approaches like this have been attempted since the first digital audio processors were developed in the late 1970s. Because jet aircraft noise has few, if any, unique identifying frequency characteristics, this paper is yet another example of the search for the key to audio aircraft identification.

#### *A.3.1.2 "Noise Pattern Recognition of Airplanes Taking Off: Task for a Monitoring System," Fernández L., et al, Progress in Pattern Recognition, Image Analysis and Applications. CIARP 2007. Lecture Notes in Computer Science, vol 4756. Springer, Berlin, Heidelberg.*

This paper, based on conference proceedings, is another example of using complex spectral analysis to identify aircraft noise from background noise. The paper provides significant insight into the difficult mathematics needed to characterize the spectral content of aircraft noise and concludes with some good examples of aircraft spectral data. The paper recommends additional work needed to complete the task of finding this spectral signature within background noise.

#### *A.3.1.3 Aircraft Noise Monitoring: Noise Level Shape and Spectrum Pattern Recognition Applied to Aircraft Noise Detection," C. Rosin, et al, Internoise 2010.*

This paper provides a very good example of a practical method to identify aircraft noise from background noise using traditional and spectral methods. The work was done using the permanent noise monitoring system at Aéroports de Paris by their staff. The paper goes through the process in some detail and includes the following steps:

- Cut off the noise level signal in items by slope analysis;
- Filter out the improbable aircraft noise items on duration and noise level threshold;
- Validate the probable aircraft items by a pattern recognition from the noise spectrum;
- Correlate with the flight path from radar information.

This process of aircraft noise identification is similar to what is currently done in most airport noise monitoring systems, but includes the added step of pattern recognition from the noise spectrum. This is somewhat useful, but their method still requires the noise event exceed a noise event threshold which does not solve the problem of aircraft noise mixed in with high background noise levels.

#### *A.3.1.4 "Convolutional Neural Networks for Aircraft Noise Monitoring," N. Heller, et al, arXiv:1806.04779, 2018*

The paper is a preprint article not yet subjected to peer review but is notable because it was done in conjunction with the noise staff at the Metropolitan Airports Commission (Minneapolis) using data from their airport noise monitoring system. They summarize the problem as follows:

*"Noise monitoring and analysis is complicated by the fact that aircraft are not the only source of noise. In this work, we show that a Convolutional Neural Network is well-suited for the task of identifying noise events which are not caused by aircraft."*

Their approach of using complex spectral analysis of neural networks is beyond the scope of this review. They report good success for aircraft events that exceed the noise event threshold. That is, when there are noise events that exceed the noise threshold, but not caused by an aircraft, the system was mostly successful in classifying the event as non-aircraft. The authors go on to state the key step needed for distinguishing aircraft noise from high background noise as follows:

*"In the future, we plan to extend this work to examining the entire time-stream from each monitoring station in order to attempt classification of noises that fall short of the event threshold, but still may have been caused by aircraft."*

This next step would improve noise monitoring at sites removed from the airport where community noise competes with aircraft noise.

# Appendix B: List of NOMS, Non-NOMS, & Other Airports

| NOMS Airports (89)* | |
|---|---|
| ABQ – Albuquerque International Airport | ACK – Nantucket Memorial Airport |
| APA – Centennial Airport | APF – Naples Airport |
| ATL – Hartsfield-Jackson Atlanta International Airport | AUS – Austin-Bergstrom International Airport |
| BCT – Boca Raton Airport | BDL – Bradley International Airport |
| BED – Laurence G. Hanscom Field | BFI – Boeing Field/King County International Airport |
| BNA – Nashville International Airport | BOS – General E.L. Logan International Airport |
| BUR – Hollywood Burbank Airport | BWI – Baltimore-Washington International Airport |
| CLE – Cleveland Hopkins International Airport | CLT – Charlotte-Douglas International Airport |
| CMH – John Glenn Columbus International Airport | CRG – Jacksonville Executive Airport |
| CRQ – McClellan-Palomar Airport | CVG – Cincinnati/Northern Kentucky International Airport |
| DAL – Dallas Love Field | DCA – Ronald Reagan Washington National Airport |
| DEN – Denver International Airport | DFW – Dallas/Ft. Worth International Airport |
| EFD – Ellington Field | EWR – Newark Liberty International Airport |
| FLL – Fort Lauderdale-Hollywood International | FXE – Fort Lauderdale Executive Airport |
| GSO – Piedmont-Triad International Airport | HNL – Daniel K. Inouye International Airport |
| HOU – William P. Hobby Airport | HPN – Westchester County Airport |
| HTO – East Hampton Airport | HWD – Haywood Executive Airport |
| HYA – Barnstable Municipal Airport | IAD – Washington Dulles International Airport |
| IAH – George Bush Intercontinental Airport | IND – Indianapolis International Airport |
| ITO – Hilo International Airport | IWA – Phoenix-Mesa Gateway Airport |
| JAX – Jacksonville International Airport | JFK – John F. Kennedy International Airport |
| LAS – McCarran International Airport | LAX – Los Angeles International Airport |
| LGA – LaGuardia Airport | LGB – Long Beach Airport |
| LUK – Lunken Airport | MCO – Orlando International Airport |
| MDW – Chicago Midway International Airport | MIA – Miami International Airport |
| MKE – Milwaukee Mitchell International Airport | MSP – Minneapolis-Saint Paul International Airport |
| MYF – Montgomery Field | OAK – Oakland International Airport |
| ONT – Ontario International Airport | ORD – Chicago O'Hare International Airport |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| NOMS Airports – (cont.) | |
|---|---|
| PAE – Paine Field/Snohomish County Airport | PBI – Palm Beach International Airport |
| PDK – DeKalb-Peachtree Airport | PDX – Portland International Airport |
| PGD – Punta Gorda Airport | PHL – Philadelphia International Airport |
| PHX – Phoenix Sky Harbor International Airport | PVD – Theodore Francis Green State Airport |
| PWM – Portland International Jetport | RDU – Raleigh-Durham International Airport |
| RNO – Reno/Tahoe International Airport | SAN – San Diego International Airport |
| SAT – San Antonio International Airport | SBA – Santa Barbara Municipal Airport |
| SDF – Louisville International Airport | SEA – Seattle-Tacoma International Airport |
| SFB – Orlando Sanford International Airport | SFO – San Francisco International Airport |
| SJC – Norman J. Mineta San Jose International | SMF – Sacramento International Airport |
| SMO – Santa Monica Airport | SNA – John Wayne Airport |
| SQL – San Carlos Airport | SRQ – Sarasota-Bradenton International Airport |
| STL – St. Louis Lambert International Airport | STS – Charles M. Schulz-Sonoma County Airport |
| SUA – Witham Field Martin County Airport | SWF – Stewart International Airport |
| TOA – Torrance Municipal Airport | TEB – Teterboro Airport |
| TRK – Truckee Tahoe Airport | TPA – Tampa International Airport |
| VQQ – Cecil Airport | VNY – Van Nuys Airport |

* Received the Type A Airport Questionnaire.
Source: Landrum & Brown, 2021.

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – Commercial Services Airports (306)* | |
|---|---|
| (Including 50 States, American Samoa, Guam, Northern Marianas, Puerto Rico, & U.S. Virgin Islands) | |
| Alabama (5) | |
| MOB – Mobile Regional Airport | MGM – Montgomery Regional Airport |
| HSV – Huntsville International Airport | DHN - Dothan Regional Airport |
| BHM - Birmingham Shuttlesworth International Airport | |
| Alaska (25) | |
| MRI – Merrill Field | ANI – Aniak Airport |
| BRW – Wiley Post-Will Rogers Memorial Airport | BET – Bethel Airport |
| CDV – Merle K. (Mudhole) Smith Airport | SCC – Deadhorse Airport |
| DLG – Dillingham Airport | FAI – Fairbanks International Airport |
| GAL – Edward G. Pitka St. Airport | HOM – Homer Airport |
| JNU - Juneau International Airport | ENA – Kenai Municipal Airport |
| KTN – Ketchikan International Airport | AKN – King Salmon Airport |
| ADQ – Kodiak Airport | OTZ – Ralph Wien Memorial Airport |
| OME – Nome Airport | PSG – Petersburg James A. Johnson Airport |
| SIT – Sitka Rocky Gutierrez Airport | KSM – St. Mary's Airport |
| UNK – Unalakleet Airport | VDZ – Valdez Airport |
| DUT – Unalaska Airport | WRG – Wrangell Airport |
| YAK – Yakutat Airport | |
| Arizona (7) | |
| TUS - Tucson International Airport | IFP – Laughlin/Bullhead International Airport |
| FLG – Flagstaff Pulliam Airport | GCN – Grand Canyon National Park Airport |
| PGA – Page Municipal Airport | YUM – Yuma International Airport |
| GCW – Grand Canyon West Airport | |
| Arkansas (4) | |
| XNA – Northwest Arkansas Regional Airport | FSM – Fort Smith Regional Airport |
| LIT – Bill and Hillary Clinton National Airport | TXK – Texarkana Regional Airport |
| California (10) | |
| ACV – Arcata Airport | BFL – Meadows Field |
| FAT – Fresno Yosemite International Airport | MMH – Mammoth Yosemite Airport |
| MRY – Monterey Regional Airport | PSP – Palm Springs International Airport |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – Commercial Services Airports (cont.) | |
|---|---|
| (Including 50 States, American Samoa, Guam, Northern Marianas, Puerto Rico, & U.S. Virgin Islands) | |
| California (10) (cont.) | |
| RDD – Redding Municipal Airport | SBP – San Luis Obispo County Regional Airport |
| SMX – Santa Maria Public Airport | SCK – Stockton Metropolitan Airport |
| Colorado (8) | |
| ASE – Aspen-Pitkin County Airport | COS – Colorado Springs Municipal Airport |
| DRO – Durango-La Plata County Airport | EGE – Eagle County Regional Airport |
| GJT – Grand Junction Regional Airport | GUC – Gunnison-Crested Butte Regional Airport |
| HDN – Yampa Valley Airport | MTJ – Montrose Regional Airport |
| Connecticut (1) | |
| HVN – Tweed New Haven Regional Airport | |
| Delaware (1) | |
| ILG – Wilmington Airport | |
| Florida (11) | |
| DAB – Daytona Beach International Airport | RSW – Southwest Florida International Airport |
| VPS – Destin-Fort Walton Beach Airport | GNV – Gainesville Regional Airport |
| EYW – Key West International Airport | MLB – Orlando Melbourne International Airport |
| ECP – Northwest Florida Beaches International Airport | TLH – Tallahassee International Airport |
| PNS – Pensacola International Airport | UST – Northeast Florida Regional Airport |
| PIE – St. Pete-Clearwater International Airport | |
| Georgia (6) | |
| ABY – Southwest Georgia Regional Airport | AGS – Augusta Regional Airport |
| BQK – Brunswick Golden Isles Airport | CSG – Columbus Metropolitan Airport |
| SAV – Savannah/Hilton Head International Airport | VLD – Valdosta Regional Airport |
| Hawaii (5) | |
| OGG – Kahului Airport | KOA – E. Onizuka Kona International Airport |
| MKK – Molokai Airport | LNY – Lanai Airport |
| LIH – Lihue Airport | |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – Commercial Services Airports (cont.) | |
|---|---|
| (Including 50 States, American Samoa, Guam, Northern Marianas, Puerto Rico, & U.S. Virgin Islands) | |
| Idaho (5) | |
| IDA – Idaho Falls Regional Airport | LWS – Lewiston-Nez Perce County Airport |
| PIH – Pocatello Regional Airport | SUN – Friedman Memorial Airport |
| TWF – Magic Valley Regional Airport | |
| Illinois (9) | |
| BLV – MidAmerica St. Louis Airport | BMI – Central Illinois Regional Airport |
| CMI – University of Illinois-Willard Airport | MWA – Williamson County Regional Airport |
| MLI – Quad City International Airport | RFD – Chicago Rockford International Airport |
| UIN – Quincy Regional Airport | SPI – Abraham Lincoln Capital Airport |
| PIA – General Wayne A. Downing Peoria International Airport | |
| Indiana (3) | |
| EVV – Evansville Regional Airport | FWA – Fort Wayne International Airport |
| SBN – South Bend International Airport | |
| Iowa (5) | |
| CID – Eastern Iowa Airport | DSM – Des Moines International Airport |
| DBQ – Dubuque Regional Airport | SUX – Sioux Gateway Airport |
| ALO – Waterloo Regional Airport | |
| Kansas (4) | |
| GCK – Garden City Regional Airport | MHK – Manhattan Regional Airport |
| FOE – Topeka Regional Airport | ICT – Wichita Dwight D. Eisenhower National Airport |
| Kentucky (3) | |
| LEX – Blue Grass Airport | OWB – Owensboro-Daviess County Regional Airport |
| PAH – Barkley Regional Airport | |
| Louisiana (7) | |
| AEX – Alexandria International Airport | LFT – Lafayette Regional Airport |
| LCH – Lake Charles Regional Airport | MLU – Monroe Regional Airport |
| SHV – Shreveport Regional Airport | MSY – Louis Armstrong New Orleans Int. Airport |
| BTR – Baton Rouge Metropolitan Airport | |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – Commercial Services Airports (cont.) | |
|---|---|
| (Including 50 States, American Samoa, Guam, Northern Marianas, Puerto Rico, & U.S. Virgin Islands) | |
| Maine (3) | |
| BGR – Bangor International Airport | PQI – Northern Maine Regional Airport |
| RKD – Knox County Regional Airport | |
| Maryland (2) | |
| HGR – Hagerstown Regional Airport | SBY – Salisbury-Ocean City Regional Airport |
| Massachusetts (3) | |
| PVC – Provincetown Municipal Airport | MVY – Martha's Vineyard Airport |
| ORH – Worcester Regional Airport | |
| Michigan (14) | |
| APN – Alpena County Regional Airport | ESC – Delta County Airport |
| FNT – Bishop International Airport | GRR – Gerald R. Ford International Airport |
| CMX – Houghton County Memorial Airport | IMT – Ford Airport |
| AZO – Kalamazoo/Battle Creek International Airport | TVC – Cherry Capital Airport |
| LAN – Capital Region International Airport | MQT – Sawyer International Airport |
| MKG – Muskegon County Airport | PLN – Pellston Regional Airport |
| MBS – Saginaw International Airport | CIU – Chippewa County International Airport |
| Minnesota (7) | |
| BJI – Bemidji Regional Airport | BRD – Brainerd Lakes Regional Airport |
| DLH – Duluth International Airport | HIB – Range Regional Airport |
| INL – Falls International Airport | RST - Rochester International Airport |
| STC – St. Cloud Regional Airport | |
| Mississippi (3) | |
| GTR – Golden Triangle Regional Airport | GPT – Gulfport-Biloxi International Airport |
| JAN – Jackson-Evers International Airport | |
| Missouri (4) | |
| COU – Columbia Regional Airport | JLN – Joplin Regional Airport |
| SGF – Springfield-Branson National Airport | MCI – Kansas City International Airport |
| Montana (8) | |
| BIL – Billings L International Airport | BZN – Bozeman Yellowstone International Airport |
| BTM – Bert Mooney Airport | GTF – Great Falls International Airport |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – Commercial Services Airports (cont.) | |
|---|---|
| (Including 50 States, American Samoa, Guam, Northern Marianas, Puerto Rico, & U.S. Virgin Islands) | |
| Montana (8) (cont.) | |
| HLN – Helena Regional Airport | FCA – Glacier Park International Airport |
| MSO – Missoula International Airport | SDY – Sidney-Richland Municipal Airport |
| Nebraska (3) | |
| GRI – Central Nebraska Regional Airport | LNK – Lincoln Airport |
| OMA – Eppley Field | |
| Nevada (3) | |
| BLD – Boulder City Municipal Airport | EKO – Elko Regional Airport |
| VGT – North Las Vegas Airport | |
| New Hampshire (3) | |
| LEB – Lebanon Municipal Airport | MHT – Manchester-Boston Regional Airport |
| PSM – Portsmouth International Airport | |
| New Jersey (2) | |
| ACY – Atlantic City International Airport | TTN – Trenton Mercer Airport |
| New Mexico (3) | |
| HOB – Lea County Regional Airport | ROW – Roswell International Air Center |
| ROW – Roswell International Air Center | |
| New York (13) | |
| ALB – Albany International Airport | BGM – Greater Binghamton Airport |
| BUF – Buffalo Niagara International Airport | ELM – Elmira/Corning Regional Airport |
| FRG – Republic Airport | ISP – Long Island MacArthur Airport |
| ITH – Ithaca Tompkins International Airport | IAG – Niagara Falls International Airport |
| ROC – Greater Rochester International Airport | PBG - Plattsburgh International Airport |
| ART – Watertown International Airport | SYR – Syracuse Hancock International Airport |
| North Carolina (7) | |
| AVL – Asheville Regional Airport | USA - Concord Regional Airport |
| FAY - Fayetteville Regional Airport | PGV – Pitt-Greenville Airport |
| OAJ – Albert J. Ellis Airport | EWN – Coastal Carolina Regional Airport |
| ILM – Wilmington International Airport | |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – Commercial Services Airports (cont.) | |
|---|---|
| (Including 50 States, American Samoa, Guam, Northern Marianas, Puerto Rico, & U.S. Virgin Islands) | |
| North Dakota (6) | |
| BIS – Bismarck Municipal Airport | DIK – Dickinson Theodore Roosevelt Int. Airport |
| FAR – Hector International Airport | GFK – Grand Forks International Airport |
| MOT – Minot International Airport | XWA – Williston Basin International Airport |
| Ohio (5) | |
| CAK – Akron-Canton Regional Airport | LCK – Rickenbacker International Airport |
| DAY – James M. Cox Dayton International Airport | TOL – Toledo Express Airport |
| YNG – Youngstown-Warren Regional Airport | |
| Oklahoma (3) | |
| LAW – Lawton-Fort Sill Regional Airport | OKC – Will Rogers World Airport |
| TUL – Tulsa International Airport | |
| Oregon (4) | |
| EUG – Eugene Airport | MFR – Rogue Valley-Medford International Airport |
| OTH – Southwest Oregon Regional Airport | RDM – Redmond Municipal Airport |
| Pennsylvania (8) | |
| ABE – Lehigh Valley International Airport | ERI - Erie International Airport |
| MDT – Harrisburg International Airport | LBE – Arnold Palmer Regional Airport |
| PIT - Pittsburgh International Airport | SCE – University Park Airport |
| AVP – Wilkes-Barre/Scranton International Airport | IPT – Williamsport Regional Airport |
| Rhode Island (2) | |
| BID – Block Island State Airport | WST – Westerly State Airport |
| South Carolina (6) | |
| CHS - Charleston International Airport | CAE – Columbia Metropolitan Airport |
| FLO – Florence Regional Airport | GSP – Greenville-Spartanburg International Airport |
| HHH – Hilton Head Airport | MYR – Myrtle Beach International Airport |
| South Dakota (3) | |
| ABR – Aberdeen Regional Airport | RAP – Rapid City Regional Airport |
| FSD – Sioux Falls Regional Airport | |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – Commercial Services Airports (cont.) | |
|---|---|
| (Including 50 States, American Samoa, Guam, Northern Marianas, Puerto Rico, & U.S. Virgin Islands) | |
| Tennessee (4) | |
| CHA – Chattanooga Metropolitan Airport | TYS – McGhee Tyson Airport |
| MEM – Memphis International Airport | TRI – Tri-Cities Regional Airport |
| Texas (16) | |
| ABI – Abilene Regional Airport | AMA – Rick Husband Amarillo International Airport |
| BPT – Jack Brooks Regional Airport | BRO – Brownsville/South Padre Island Int. Airport |
| CLL – Easterwood Airport | CRP – Corpus Christi International Airport |
| ELP – El Paso International Airport | HRL – Valley International Airport |
| GRK – Killleen-Fort Hood Regional Airport | LRD – Laredo International Airport |
| MFE – McAllen Miller International Airport | MAF – Midland International Airport |
| SJT – San Angelo Regional Airport | TYR – Tyler Pounds Regional Airport |
| ACT – Waco Regional Airport | SPS – Wichita Falls Municipal Airport |
| Utah (5) | |
| SLC – Salt Lake City International Airport | OGD – Ogden-Hinckley Airport |
| PVU – Provo Municipal Airport | SGU – St. George Regional Airport |
| CDC – Cedar City Regional Airport | |
| Vermont (1) | |
| BTV – Burlington International Airport | |
| Virginia (6) | |
| CHO – Charlottesville-Albermale Airport | LYH – Lynchburg Regional Airport |
| PHF – Newport News/Williamsburg International Airport | ORF – Norfolk International Airport |
| RIC – Richmond International Airport | ROA – Roanoke-Blacksburg Regional Airport |
| Washington (8) | |
| BLI – Bellington International Airport | FRD – Friday Harbor Airport |
| PSC – Tri-Cities Airport | PUW – Pullman/Moscow Regional Airport |
| GEG – Spokane International Airport | ALW – Walla Walla Regional Airport |
| EAT – Pangborn Memorial Airport | YKM – Yakima Air Terminal |
| West Virginia (4) | |
| CRW – Yeager Airport | CKB – North Central West Virginia Airport |
| HTS – Tri-State Airport | MGW – Morgantown Municipal Airport |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – Commercial Services Airports (cont.) | |
|---|---|
| (Including 50 States, American Samoa, Guam, Northern Marianas, Puerto Rico, & U.S. Virgin Islands) | |
| Wisconsin (7) | |
| ATW - Appleton International Airport | EAU – Chippewa Valley Regional Airport |
| LSE – La Crosse Regional Airport | CWA – Central Wisconsin Airport |
| RHI – Rhinelander-Oneida County Airport | MSN – Dane County Regional Airport |
| GRB – Green Bay Austin Straubel International Airport | |
| Wyoming (6) | |
| CPR – Casper/Natrona County International Airport | COD – Yellowstone Regional Airport |
| GCC – Gillette-Campbell County Airport | JAC – Jackson Hole Airport |
| LAR – Laramie Regional Airport | RKS – Southwest Wyoming Regional Airport |
| American Samoa (1) | |
| PPG – Pago Pago International Airport | |
| Guam (1) | |
| GUM – Antonio B. Won Pat International Airport | |
| Northern Marianas (3) | |
| SPN – Saipan International Airport | ROP – Rota International Airport |
| TIQ – Tinian International Airport | |
| Puerto Rico (7) | |
| SJU – Luis Munoz Marin International Airport | BQN – Rafael Hernandez International Airport |
| NRR – Jose Aponte de la Torre Airport | CPX – Benjamin Rivera Noriega Airport |
| PSE – Mercedita International Airport | SIG – Fernando Luis Ribas Dominicci Airport |
| VQS – Antonio Rivera Rodriguez Airport | |
| U.S. Virgin Islands (2) | |
| STX – Henry E. Rohlsen Airport | STT – Cyril E. King Airport |

* Received the Type B Airport Questionnaire.
Source: Landrum & Brown, 2021.

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – General Aviation Airports (110)* | |
|---|---|
| (Busiest 200 GA Airports from 2019 FAA ATADS & not included on other lists, w/ or w/o NOMS) | |
| Arizona (8) | |
| DVT – Deer Valley Airport | SDL – Scottsdale Airport |
| CHD – Chandler Municipal Airport | FFZ – Falcon Field Airport |
| PRC – Prescott Regional Airport | GYR – Phoenix Goodyear Airport |
| RYN – Ryan Airfield | GEU – Glendale Municipal Airport |
| California (20) | |
| SAC – Sacramento Executive Airport | CMA – Camarillo Airport |
| SEE – Gillespie Field | APC – Napa County Airport |
| SDM – Brown Municipal Field | SQL – San Carlos Airport |
| MHR – Sacramento Mather Airport | EMT – San Gabriel Valley Airport |
| HHR – Hawthorne Municipal Airport | WHP – Whiteman Airport |
| POC – Brackett Field | LVK – Livermore Municipal Airport |
| CNO – Chino Airport | FUL – Fullerton Municipal Airport |
| RNM – Ramona Airport | RAL – Riverside Municipal Airport |
| SNS – Salina Municipal Airport | CCR – Buchanan Field |
| PAO – Palo Alto Airport | BFL – Meadows Field |
| Colorado (2) | |
| FTG – Front Range Airport | BJC – Rocky Mountain Metropolitan Airport |
| Connecticut (1) | |
| GON – Groton-New London Airport | |
| Florida (20) | |
| TMB – Miami Executive Airport | OPF – Miami Opa Locka Executive Airport |
| VRB – Vero Beach Municipal Airport | BKV – Brooksville-Tampa Bay Regional Airport |
| TIX – Space Coast Regional Airport | LEE – Leesburg International Airport |
| SPG – Albert Whitted Airport | OMN – Ormond Beach Municipal Airport |
| DTS – Destin Executive Airport | OCF – Ocala International Airport |
| FIN – Flagler Executive Airport | SGJ – Northeast Florida Regional Airport |
| EVB – New Smyrna Beach Municipal Airport | ORL – Orlando Executive Airport |
| FMY – Paige Field | LAL – Lakeland Linder Regional Airport |
| PMP – Pompano Beach Airpark | FPR – St. Lucie County International Airport |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – General Aviation Airports (cont.) | |
|---|---|
| (Busiest 200 GA Airports from 2019 FAA ATADS & not included on other lists, w/ or w/o NOMS) | |
| Florida (20) (cont.) | |
| ISM – Kissimmee Gateway Airport | HWO – North Perry Airport |
| Georgia (3) | |
| FTY – Fulton County Airport | RYY – Cobb County International Airport |
| LZU – Gwinnett County Airport | |
| Illinois (3) | |
| ARR – Aurora Municipal Airport | PWK – Chicago Executive Airport |
| DPA – Dupage Airport | |
| Indiana (2) | |
| BAK – Columbus Municipal Airport | LAF – Purdue University Airport |
| Kentucky (1) | |
| LOU – Bowman Field | |
| Louisiana (1) | |
| NEW – Lakefront Airport | |
| Maryland (2) | |
| MTN – Martin State Airport | FDK – Frederick Municipal Airport |
| Massachusetts (2) | |
| OWD – Norwood Memorial Airport | BVY – Beverly Regional Airport |
| Michigan (3) | |
| ARB – Ann Arbor Municipal Airport | BTL – W.K. Kellogg Airport |
| PTK – Oakland County International Airport | |
| Minnesota (2) | |
| ANE – Anoka County Airport | FCM – Flying Cloud Airport |
| Missouri (2) | |
| MKC – Charles B. Wheeler Downtown Airport | SUS – Spirit of St. Louis Airport |
| Nevada (1) | |
| HND – Henderson Executive Airport | |
| New Hampshire (1) | |
| ASH – Boire Field | |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| Non-NOMS Airports – General Aviation Airports (cont.) | |
|---|---|
| (Busiest 200 GA Airports from 2019 FAA ATADS & not included on other lists, w/ or w/o NOMS) | |
| New Jersey (2) | |
| CDW – Essex County Airport | MMU – Morristown Municipal Airport |
| New York (1) | |
| FOK – Francis S. Gabreski Airport | |
| North Carolina (1) | |
| JQF – Concord Regional Airport | |
| Ohio (1) | |
| OSU – Ohio State University Airport | |
| Oklahoma (3) | |
| PWA – Wiley Post Airport | SWO – Stillwater Regional Airport |
| RVS – Richard Lloyd Jones Jr Airport | |
| Oregon (2) | |
| UAO – Aurora State Airport | HIO – Portland-Hillsboro Airport |
| Pennsylvania (2) | |
| LNS – Lancaster Airport | PNE – Northeast Philadelphia Airport |
| South Carolina (1) | |
| GMU – Greenville Downtown Airport | |
| Tennessee (1) | |
| MQY – Smyrna/Rutherford County Airport | |
| Texas (17) | |
| DWH – David Wayne Hooks Memorial Airport | |
| FTW – Fort Worth Meacham International Airport | ADS – Addison Airport |
| CXO – Conroe-North Houston Regional Airport | DTO – Denton Enterprise Airport |
| AFW – Fort Worth Alliance Airport | GTU – Georgetown Municipal Airport |
| RBD – Dallas Executive Airport | GYI – North Texas Regional Airport |
| FWS – Fort Worth Spinks Airport | LBB – Lubbock Preston Smith International |
| GKY – Arlington Municipal Airport | SGR – Sugar Land Regional Airport |
| HYI – San Marcos Regional Airport | SSF – Stinson Municipal Airport |
| GPM – Grand Prairie Municipal Airport | TKI – McKinney National Airport |

# List of NOMS, Non-NOMS, & Other Airports (continued)

| **Non-NOMS Airports – General Aviation Airports (cont.)** | |
|---|---|
| (Busiest 200 GA Airports from 2019 FAA ATADS & not included on other lists, w/ or w/o NOMS) | |
| Virginia (1) | |
| HEF – Manassas Regional Airport | |
| Washington (3) | |
| OLM – Olympia Regional Airport | TIW – Tacoma Narrows Airport |
| RNT – Renton Municipal Airport | |
| Wisconsin (1) | |
| ENW – Kenosha Airport | |
| **Other Airports (3)**** | |
| (Initiated & did not complete installation process) | |
| BOI – Boise Airport | DTW – Detroit Metropolitan Airport |
| RHV – Reid-Hillview Airport | |
| **Other Airports (2)***** | |
| (Procured & currently not operable) | |
| ANC – Ted Stevens Anchorage International Airport | SUA – Whitham Field (eventually acquired Vector) |

* Received the Type B-1 and B-2 Airport Questionnaire.
** Received the Type B-3 Airport Questionnaire.
*** Received the Type B-4 Airport Questionnaire.
Source: Landrum & Brown, 2021.

# Appendix C: Airport NOMS Questionnaire Type A

(Questionnaire Type A included questions for 89 airports that currently operate a Noise and Operations Monitoring System (NOMS). The pages were exported from the Survey Monkey questionnaire web page.)

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Background

**The objective of ACRP Research Project 02-89 is to develop a primer and a decision-making framework to help airports and other stakeholders assess the benefits and costs of acquiring, maintaining, and updating an airport Noise and Operations Monitoring System (NOMS).**

**The following questionnaire developed by Landrum & Brown and Barry Technologies (The Research Team) will be part of the research that will assist airports decide if a NOMS is appropriate for their situation, evaluating the benefits and costs of acquiring and updating such systems, and determining the general resources needed to acquire, operate, and maintain these systems.**

**The questions are grouped into the following sections:**

- **Background**
- **NOMS Use**
- **Data Collection**
- **Data Distribution**
- **Requirements**
- **Benefits**
- **Reasoning, and**
- **Funding**

**The survey format allows you to skip most questions, but we ask that you answer every question if possible. The questionnaire is compatible with computers, phones, and tablets.**

**Thank you in advance for your participation,**

**The Research Team**

* 1. Please provide the following information for your airport:

| | |
|---|---|
| Name(s) of airport(s): | |
| 3-letter identifier: | |
| Owner/Operator of the airport: | |

2. Does the Owner/Operator manage multiple airports?

- ◯ Yes
- ◯ No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Background

3. If the Owner/Operator manages multiple airports, do all airports operate a NOMS?

- ◯ Yes
- ◯ No

4. When was your NOMS procured?

Month/Year

5. If you've procured multiple NOMS, please provide all procurement dates:

Month/Year

Month/Year

6. When did your NOMS become fully operational?

Month/Year

7. If you've operated multiple NOMS, please provide multiple operational dates:

Month/Year

Month/Year

8. Has the NOMS gone through major upgrades?

- ◯ Yes
- ◯ No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Background

9. If the NOMS has gone through major upgrades, please describe the upgrade(s):

10. What years were major NOMS upgrades done?

11. Were permanent noise monitors installed?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Background

12. How many permanent noise monitors were installed?

13. Of the permanent monitors installed, how many were requested by a municipality/community?

14. Please select the following items that apply relative to the permanent noise monitor installation:

- [ ] Mount - Utility Pole
- [ ] Mount - Custom pole or mount
- [ ] Mount - Combination
- [ ] Power Source - Solar or A/C Power
- [ ] Power Source: D/C Power
- [ ] Power Source - Combination
- [ ] Data Connectivity - Wireless
- [ ] Data Connectivity - Phone Line
- [ ] Data Connectivity - Manual Download
- [ ] Data Connectivity - Combination

15. Were portable noise monitors provided with the NOMS?

- ( ) Yes
- ( ) No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Background

16. How many portable monitors were provided?

17. Please describe how the portable noise monitors are used:

18. Were additional portable noise monitors purchased separately?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Background

19. How many portable noise monitors were purchased separately?

20. Please describe the reasons the portable noise monitors were purchased separately:

21. Was a site selection analysis/study performed?

- Yes, in-house
- Yes, outsourced by consultant
- Yes, by NOMS vendor
- No

22. Was the public involved in site selection?

- Yes
- No

23. Are sites on public or private property?

- Public
- Private
- Both

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Background

24. For sites on private property, do you pay a short/long-term lease or an annual stipend for access and use?

- ◯ Yes
- ◯ No

25. Does your airport use Virtual Noise Monitors (computed noise events instead of measured events)?

- ◯ Yes, at all monitoring locations
- ◯ Yes, to supplement permanent/portable noise monitors
- ◯ No

26. Does your airport use different vendors for NOMS components (e.g. one vendor for flight tracking, another vendor for complaint data, and another vendor for noise monitors)?

- ◯ Yes
- ◯ No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Background

27. How many vendors supply your NOMS components?

28. Has your airport always used one NOMS vendor/software, or has your airport used multiple NOMS vendor/software services over time?

- ◯ One NOMS software
- ◯ Multiple NOMS software

29. How many years did you use each vendor/software?

Vendor/Software #1 Years:

Vendor/Software #2 Years:

Vendor/Software #3 Years:

30. If you switched from one NOMS software to a different NOMS software, please describe the reasons for switching:

31. Has your airport always used one model/brand of noise monitors, or has your airport used multiple models/brands over time?

- ◯ One NOMS Monitor
- ◯ Multiple NOMS Monitors

32. How many years did you use each model?

Model/Brand #1 Years

Model/Brand #2 Years

Model/Brand #3 Years

33. If you switched to a different model/brand of noise monitors, please describe the reasons for switching:

34. Does your airport currently plan to relocate or increase the number of noise monitoring terminals at your airport?

- Yes
- No

35. Besides the hardware and software components of the NOMS, please describe the types of tools (including hardware and software) your airport is using to handle flight data requests from the public, airport noise complaints, and noise-to-flight matching (if applicable):

36. Relative to maintaining and operating a NOMS; does your airport use an asset management system (i.e. Excel spreadsheets, Access Database, Other Program Software, etc.) to track NOMS monitoring sites and your inventory of equipment?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Background

37. Please describe your asset management system:

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### NOMS Use

38. How is your NOMS used? (Check all that apply):

- ☐ To monitor flights in general
- ☐ To monitor specific noise abatement flight procedures
- ☐ To monitor noise abatement runway use
- ☐ To monitor noise levels/limits at monitors
- ☐ To monitor run-ups
- ☐ To monitor taxiing
- ☐ To monitor airspace use
- ☐ To monitor nighttime curfews
- ☐ To monitor aircraft departure and approach profiles
- ☐ To monitor community noise levels
- ☐ To monitor compliance with agreements/mandates i.e. community commitments
- ☐ Other (please specify)

39. Which methods/platforms does your community use to submit complaints? (Check all that apply).

- ☐ Postal mail
- ☐ Phone
- ☐ E-mail
- ☐ Other (please specify)
- ☐ Airport website noise complaint form
- ☐ Third-party platforms (e.g. Airnoise.io)

40. Do you use the NOMS for noise complaint data management or do you use a separate database or complaint software?

- ◯ NOMS
- ◯ Separate software

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

NOMS Use

41. Please describe the reasons for choosing a separate noise complaint management software:

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Data Collection

42. Does your airport log/document noise complaints?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Data Collection

43. How many noise complaints did your airport receive in 2019?

44. Does your airport publish/report the number of complainants or complaints per time period (i.e. month, year, etc.)?

- Complainant only
- Complaints only
- Both
- No

45. Does your airport publish noise complaint statistics on the airport's website?

- Yes
- No

46. Please describe the NOMS operational data type and source your system collects (e.g., SWIM, ADS-B, ASDE-X)?

47. Does your airport collect/integrate other types of data to supplement the NOMS data (e.g., video, radio transmission, weather)?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Data Collection

48. Please describe what kind of supplemental data your airport uses:

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

## Data Distribution

49. Describe how NOMS data is shared with or distributed to the public (Check all that apply):

- [ ] Community meetings or roundtables
- [ ] Airport website
- [ ] Airport Newsletters
- [ ] Social Media
- [ ] Other (please specify)

50. Does the airport provide reports to the public based on NOMS data?

- ◯ Yes
- ◯ No

51. Can the public access NOMS data via an online platform (e.g., online version of the NOMS flight tracking, dashboards, web portals)?

- ◯ Yes
- ◯ Yes, on a limited data access platform
- ◯ No
- ◯ Other (please specify)

52. Was NOMS data used to produce noise exposure contours?

- ◯ Yes
- ◯ No

53. Does your airport provide the noise exposure contours to the public (e.g., online, hard copies, during public meetings)?

- ◯ Yes
- ◯ No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Requirements

54. How many Full-time (including manager/supervisor) and Part-time personnel staff your Airport Noise Abatement Office?

Full-time:

Part-time:

55. How many Full-time (including manager/supervisor) and Part-time personnel operate the NOMS to regularly respond to noise complaints and prepare reports?

Full-time:

Part-time:

56. How many contractors work for the Airport Noise Abatement Office?

57. How many contractors operate the NOMS?

58. Is noise monitor maintenance and troubleshooting performed by in-house personnel, NOMS vendor, or third-party outsourced?

- ◯ In-house
- ◯ NOMS vendor
- ◯ Third-party outsourced

59. If known, what was the start-up (e.g., first year) cost to procure your NOMS, the annual cost to maintain/support/update your NOMS, and the cost of the major upgrades to your NOMS?

Start-up($):

Annual Maintenance/Support/ Update ($/year):

Major Upgrade(s) ($):

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Benefits

60. Beyond the core NOMS features/functions (e.g., noise-to-track matching, complaint logging, flight track display, basic queries, etc.), what are your secondary functions of having a NOMS (e.g., noise exposure contour validation, special analysis, noise abatement procedure development)? (Check all that apply):

- ☐ Noise exposure contour validation
- ☐ Special stand-alone analysis (non-periodic analysis)
- ☐ Noise abatement procedure development
- ☐ Other (please specify)

61. Please explain how the relationship between your airport and the community changed after the NOMS became operational:

62. Please describe the NOMS data/feature that has been the most effective at informing the public about airport noise:

63. Please describe what benefits your airport has experienced from operating a NOMS:

64. Please describe the disbenefit or downside to your airport having/operating a NOMS:

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Reasoning

65. What type of study prompted your airport to acquire a NOMS? (Check all that apply):

- [ ] Part 150 NCP
- [ ] EIS/EA ROD
- [ ] Land Use Compatibility Plan
- [ ] Other (please specify)

66. For what reasons did your airport decide to procure and install a NOMS? (Check all that apply):

- [ ] NEPA mitigation requirement
- [ ] Legal requirement/agreement
- [ ] Public request/pressure
- [ ] Proactive strategy
- [ ] Other (please specify)

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Funding

67. Was the NOMS a Noise Mitigation Measure of a Part 150 Study?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

## Funding

68. Assuming you use NOMS data to update your Part 150 on a regular basis, when was the last time a Part 150 was updated and when are you planning on undertaking the next one?

69. Which funding sources contributed to the NOMS procurement? Please check all that apply:

- [ ] AIP Grants
- [ ] State Sources
- [ ] PFCs
- [ ] Local (e.g. City, County) Sources
- [ ] Airport Proprietor Sources
- [ ] Other (please specify)

70. May we contact you to highlight your airport as a Case Study that would be included in this ACRP report?

- ◯ Yes
- ◯ No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire A)

### Funding

71. Please provide your preferred contact information:

| | |
|---|---|
| **Name:** | |
| **Title:** | |
| **Email Address:** | |
| **Phone Number:** | |

72. Would your airport prefer to remain anonymous in this ACRP project?

- ◯ Yes
- ◯ No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire A)

Thank you!

73. Thank you for taking the time to complete this survey. Please let us know if there is anything else you would like to share regarding your NOMS system.

# Appendix D: Airport NOMS Questionnaires Type B1 & B2

(Questionnaires Type B1 & B2 included questions for 416 airports that currently do not operate a Noise and Operations Monitoring Systems (NOMS) and may haveevaluated the procurement of a NOMS. Pages were exported from Survey Monkey questionnaire web page.)

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B1/B2)

### Background

**The objective of ACRP Research Project 02-89 is to develop a primer and a decision-making framework to help airports and other stakeholders assess the benefits and costs of acquiring, maintaining, and updating an airport Noise and Operations Monitoring System (NOMS).**

**The following questionnaire developed by Landrum & Brown and Barry Technologies (The Research Team) will be part of the research that will assist airports decide if a NOMS is appropriate for their situation, evaluating the benefits and costs of acquiring and updating such systems, and determining the general resources needed to acquire, operate, and maintain these systems.**

**The questions are grouped into the following sections:**

- **Background**
- **Data Collection**
- **Data Distribution, and**
- **Reasoning**

**The survey format allows you to skip most questions, but we ask that you answer every question if possible. The questionnaire is compatible with computers, phones, and tablets.**

**Thank you in advance for your participation,**

**The Research Team**

* 1. Please provide the following information about your airport:

Name(s) of airport(s):

3-letter identifier:

Owner/Operator of the airport:

2. Does your airport have staff or contractors who handle airport noise?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B1/B2)

### Background

3. How many full-time (including manager/supervisor) and part-time personnel handle airport noise?

Full-time:

Part-Time:

4. How many contractors work for the Airport Noise Abatement Office?

5. Does your airport log/document noise complaints?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B1/B2)

### Data Collection/Data Distribution

6. How many noise complaints did your airport receive in 2019?

7. Which methods/platforms does your community use to submit complaints? (Check all that apply):

- [ ] Postal mail
- [ ] Airport website noise complaint form
- [ ] Phone
- [ ] Third-party platforms (e.g., Airnoise.io)
- [ ] E-mail
- [ ] Other (please specify)

8. Does your airport publish/report the number of complainants or complaints per time period (i.e. month, year, etc.)?

- ( ) Complainant only
- ( ) Complaints only
- ( ) Both
- ( ) No

9. Does your airport publish noise complaint statistics on the airport's website?

- ( ) Yes
- ( ) No

10. Besides the hardware and software components of the NOMS, please describe the types of tools (including hardware and software) your airport is using to handle flight data requests from the public, airport noise complaints, and noise-to-flight matching (if applicable):

11. Has your airport evaluated the procurement of a NOMS?

- ( ) Yes
- ( ) No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B1/B2)

## Reasoning

12. For what reasons did your airport evaluate the procurement of a NOMS?

- [ ] Increase in noise complaints
- [ ] Political/public pressure to monitor aircraft operations
- [ ] Political/public pressure to view aircraft noise and flight path data
- [ ] Other (please specify)

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B1/B2)

### Reasoning

13. For what reasons did your airport decide not to procure a NOMS?

- [ ] Decrease in noise complaints
- [ ] Noise issues are being handled successfully without a NOMS
- [ ] Could not obtain funding
- [ ] Could not obtain staff to operate the NOMS
- [ ] Other (please specify)

14. Under what conditions would your airport decide to procure a NOMS?

- [ ] Increase in noise complaints
- [ ] Political/public pressure to monitor aircraft operations
- [ ] Political/public pressure to view aircraft noise and flight path data
- [ ] Obtained funding
- [ ] Obtained staff to operate the NOMS
- [ ] Other (please specify)

15. For what reasons has your airport not evaluated the procurement of a NOMS?

- [ ] There are no noise issues to address (If selected, please also select "Other" to describe what has led the airport to this conclusion)
- [ ] Noise issues are being handled successfully without a NOMS
- [ ] Did not know a NOMS exisited
- [ ] Other (please specify)

16. Under what conditions would you consider the evaluation of procuring a NOMS?

- ( ) Increase in noise complaints
- ( ) Political/public pressure to monitor aircraft operations
- ( ) Political/public pressure to view aircraft noise and flight path data?
- ( ) Other (please specify)

17. Is your airport currently planning on evaluating the procurement of a NOMS?

- ◯ Yes
- ◯ No

18. Has your airport produced an airport noise exposure contour?

- ◯ Yes
- ◯ No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B1/B2)

19. Please describe the airport operational data and sources used to produce the noise exposure contour:

20. Does your airport provide the noise exposure contours to the public (e.g., online, hardcopies, during public meetings)?

- Yes
- No

21. Does your airport plan on performing a Part 150 Study and including a NOMS as a Noise Mitigation Measure?

- Yes
- No

22. When was the last time your Part 150 was updated and when are you planning on undertaking the next one?

23. May we contact you to highlight your airport as a Case Study that would be included in this ACRP report?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B1/B2)

24. Please provide your preferred contact information:

**Name:**

**Title:**

**Email Address:**

**Phone Number:**

25. Would your airport prefer to remain anonymous in this ACRP project?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B1/B2)

Thank you!

26. Thank you for taking the time to complete this survey. Please let us know if there is anything else you would like to share regarding your airport.

# Appendix E: Airport NOMS Questionnaire Type B3

(Questionnaire Type B3 included questions for three (3) airports that procured a Noise and Operations Monitoring Systems (NOMS), but did not complete the NOMS installation process. Pages were exported from the Survey Monkey questionnaire web page.)

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B3)

### Background

**The objective of ACRP Research Project 02-89 is to develop a primer and a decision-making framework to help airports and other stakeholders assess the benefits and costs of acquiring, maintaining, and updating an airport Noise and Operations Monitoring System (NOMS).**

**The following questionnaire developed by Landrum & Brown and Barry Technologies (The Research Team) will be part of the research that will assist airports decide if a NOMS is appropriate for their situation, evaluating the benefits and costs of acquiring and updating such systems, and determining the general resources needed to acquire, operate, and maintain these systems. The questionnaire is compatible with computers, phones, and tablets.**

**The questions are grouped into the following sections:**

- **Background**
- **NOMS Use**
- **Data Collection**
- **Requirements**
- **Reasoning, and**
- **Funding**

**The survey format allows you to skip most questions, but we ask that you answer every question if possible.**

**Thank you in advance for your participation,**

**The Research Team**

* 1. Please provide the following information for your airport:

| | |
|---|---|
| Name(s) of airport(s): | |
| 3-letter identifier: | |
| Owner/Operator of the airport: | |

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B3)

### Background

2. When was your NOMS procured?

Month/Year

3. If you've procured multiple NOMS, please provide multiple procurement dates:

Month/Year

Month/Year

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Background

4. Were permanent noise monitors installed?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Background

5. How many permanent noise monitors were installed?

6. Of the permanent monitors installed, how many were requested by a municipality/community?

7. Were portable noise monitors provided with the NOMS?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Background

8. How many portable monitors were provided?

9. Please describe how the portable noise monitors are used:

10. Were additional portable noise monitors purchased separately?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Background

11. How many portable noise monitors were purchased separately?

12. Please describe the reasons the portable noise monitors were purchased separately:

13. Was a site selection analysis/study performed?

- Yes, in-house
- Yes, outsourced by consultant
- Yes, by NOMS vendor
- No

14. Was the public involved in site selection?

- Yes
- No

15. Were the sites on public or private property?

- Public
- Private
- Both

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B3)

### Background

16. For sites on private property, did/do you pay a short/long-term lease or an annual stipend for access and use?

- ◯ Yes
- ◯ No

17. Does your airport plan on using Virtual Noise Monitors (computed noise events instead of measured events)?

- ◯ Yes, at all monitoring locations
- ◯ Yes, to supplement permanent/portable noise monitors
- ◯ No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Background

18. Please describe the types of tools (including hardware and software) your airport is using to handle flight data requests from the public, airport noise complaints, and noise-to-flight matching (if applicable):

19. Has your airport produced airport noise exposure contours?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B3)

### Background

20. What airport operational data and sources were used to produce the noise exposure contours?

21. Does your airport provide the noise exposure contours to the public (e.g., online, hard copies, during public meetings)?

- Yes
- No

22. Relative to maintaining and operating a NOMS; does your airport use an asset management system (i.e. Excel spreadsheets, Access Database, Other Program Software, etc.) to track NOMS monitoring sites and your inventory of equipment?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Background

23. Please describe your asset management system:

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B3)

### NOMS Use

24. If installed, how would the airport use the NOMS? (Check all that apply):

- ☐ To monitor flights in general
- ☐ To monitor specific noise abatement flight procedures
- ☐ To monitor noise abatement runway use
- ☐ To monitor noise levels/limits at monitors
- ☐ To monitor run-ups
- ☐ To monitor taxiing
- ☐ To monitor airspace use
- ☐ To monitor nighttime curfews
- ☐ To monitor aircraft departure and approach profiles
- ☐ To monitor community noise levels
- ☐ To monitor compliance with agreements/mandates i.e. community commitments
- ☐ Other (please specify)

25. Which methods/platforms does your community use to submit complaints? (Check all that apply).

- ☐ Postal mail
- ☐ Phone
- ☐ E-mail
- ☐ Other (please specify)
- ☐ Airport website noise complaint form
- ☐ Third-party platforms (e.g. Airnoise.io)

26. If NOMS is installed, would you use the NOMS for noise complaint data management or a separate database or complaint software?

- ◯ NOMS
- ◯ Separate software

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

NOMS Use

27. Please describe the reasons for choosing a separate noise complaint management software:

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Data Collection

28. Does your airport log/document noise complaints?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Data Collection

29. How many noise complaints did your airport receive in 2019?

30. Does your airport publish/report the number of complainants or complaints per time period (i.e. month, year, etc.)?

- Complainant only
- Complaints only
- Both
- No

31. Does your airport publish noise complaint statistics on the airport's website?

- Yes
- No

32. Please describe the NOMS operational data type and source your system collects (e.g., SWIM, ADS-B, ASDE-X)?

33. If NOMS is installed, would your airport collect/integrate other types of data to supplement the NOMS data (e.g., video, radio transmission, weather)?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Data Collection

34. Please describe what kind of supplemental data your airport would use:

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Requirements

35. Does your airport have staff or contractors who handle airport noise?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B3)

### Requirements

36. How many Full-time (including manager/supervisor) and Part-time personnel handle airport noise?

Full-time:

Part-time:

37. How many Full-time (including manager/supervisor) and Part-time personnel would have operated the NOMS to regularly respond to noise complaints and prepare reports?

Full-time:

Part-time:

38. How many contractors work on airport noise?

39. How many contractors would have operated the NOMS?

40. If NOMS is installed, would noise monitor maintenance and troubleshooting be performed by in-house personnel, NOMS vendor, or third-party outsourced?

- ◯ In-house
- ◯ NOMS vendor
- ◯ Third-party outsourced

41. If known, what was the start-up (e.g., first year) cost to procure your NOMS, the annual cost to maintain/support/update your NOMS, and the cost of the major upgrades to your NOMS?

Start-up($):

Annual Maintenance/Support/ Update ($/year):

Major Upgrade(s) ($):

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B3)

### Reasoning

42. What type of study prompted your airport to acquire a NOMS? (Check all that apply):

- [ ] Part 150 NCP
- [ ] EIS/EA ROD
- [ ] Land Use Compatibility Plan
- [ ] Other (please specify)

43. For what reasons did your airport decide to procure and install a NOMS? (Check all that apply):

- [ ] NEPA mitigation requirement
- [ ] Legal requirement/agreement
- [ ] Public request/pressure
- [ ] Proactive strategy
- [ ] Other (please specify)

44. For what reasons did the NOMS installation process stop? (Check all that apply)

- [ ] Decrease in noise complaints
- [ ] Noise issues are being handled successfully without a NOMS
- [ ] Other (please specify)

45. Please describe under what conditions would the NOMS installation process continue.

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Funding

46. Was the NOMS a Noise Mitigation Measure of a Part 150 Study?

- ◯ Yes
- ◯ No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

## Funding

47. Assuming you update your Part 150 on a regular basis, when was the last time a Part 150 was updated and when are you planning on undertaking the next one?

48. Which funding sources contributed to the NOMS procurement? (Check all that apply):

- ☐ AIP Grants
- ☐ PFCs
- ☐ Airport Proprietor Sources
- ☐ State Sources
- ☐ Local (e.g. City, County) Sources
- ☐ Other (please specify)

49. May we contact you to highlight your airport as a Case Study that would be included in this ACRP report?

- ○ Yes
- ☐ No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

## Funding

50. Please provide your preferred contact information:

| | |
|---|---|
| **Name:** | |
| **Title:** | |
| **Email Address:** | |
| **Phone Number:** | |

51. Would your airport prefer to remain anonymous in this ACRP project?

- ◯ Yes
- ◯ No

Survey on Airport Noise and Operations Monitoring Systems
(Questionnaire B3)

Thank you!

52. Thank you for taking the time to complete this survey. Please let us know if there is anything else you would like to share regarding your NOMS system.

# Appendix F: Airports NOMS Questionnaire Type B4

(Questionnaire Type B4 included questions for two (2) airports that procured and installed a Noise and Operations Monitoring Systems (NOMS), but the NOMS is currently not operable. Pages were exported from Survey Monkey questionnaire web page.)

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Background

**The objective of ACRP Research Project 02-89 is to develop a primer and a decision-making framework to help airports and other stakeholders assess the benefits and costs of acquiring, maintaining, and updating an airport Noise and Operations Monitoring System (NOMS).**

**The following questionnaire developed by Landrum & Brown and Barry Technologies (The Research Team) will be part of the research that will assist airports decide if a NOMS is appropriate for their situation, evaluating the benefits and costs of acquiring and updating such systems, and determining the general resources needed to acquire, operate, and maintain these systems.**

**The questions are grouped into the following sections:**

- **Background**
- **NOMS Use**
- **Data Collection**
- **Data Distribution**
- **Requirements**
- **Benefits**
- **Reasoning, and**
- **Funding**

**The survey format allows you to skip most questions, but we ask that you answer every question if possible. The questionnaire is compatible with computers, phones, and tablets.**

**Thank you in advance for your participation,**

**The Research Team**

* 1. Please provide the following information for your airport:

| | |
|---|---|
| Name(s) of airport(s): | |
| 3-letter identifier: | |
| Owner/Operator of the airport: | |

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Background

2. When was your NOMS procured?

Month/Year

3. If you've procured multiple NOMS, please provide all procurement dates:

Month/Year

Month/Year

4. When did your NOMS become fully operational?

Month/Year

5. If you've operated multiple NOMS, please provide multiple operational dates:

Month/Year

Month/Year

6. Has the NOMS gone through major upgrades?

- ◯ Yes
- ◯ No

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

Background

7. If the NOMS has gone through major upgrades, please describe the upgrade(s):

8. What years were major NOMS upgrades done?

9. Were permanent noise monitors installed?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Background

10. How many permanent noise monitors were installed?

11. Of the permanent monitors installed, how many were requested by a municipality/community?

12. Please select the following items that apply relative to the permanent noise monitor installation:

- [ ] Mount - Utility Pole
- [ ] Mount - Custom pole or mount
- [ ] Mount - Combination
- [ ] Power Source - Solar or A/C Power
- [ ] Power Source: D/C Power
- [ ] Power Source - Combination
- [ ] Data Connectivity - Wireless
- [ ] Data Connectivity - Phone Line
- [ ] Data Connectivity - Manual Download
- [ ] Data Connectivity - Combination

13. Were portable noise monitors provided with the NOMS?

- ( ) Yes
- ( ) No

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

Background

14. How many portable monitors were provided?

15. Please describe how the portable noise monitors are used:

16. Were additional portable noise monitors purchased separately?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Background

17. How many portable noise monitors were purchased separately?

18. Please describe the reasons the portable noise monitors were purchased separately:

19. Was a site selection analysis/study performed?

- Yes, in-house
- Yes, outsourced by consultant
- Yes, by NOMS vendor
- No

20. Was the public involved in site selection?

- Yes
- No

21. Are sites on public or private property?

- Public
- Private
- Both

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Background

22. For sites on private property, do you pay a short/long-term lease or an annual stipend for access and use?

- ◯ Yes
- ◯ No

23. Does your airport use Virtual Noise Monitors (computed noise events instead of measured events)?

- ◯ Yes, at all monitoring locations
- ◯ Yes, to supplement permanent/portable noise monitors
- ◯ No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Background

24. How many vendors supply your NOMS components?

25. Has your airport always used one NOMS vendor/software, or has your airport used multiple NOMS vendor/software services over time?

- ◯ One NOMS software
- ◯ Multiple NOMS software

26. How many years did you use each vendor/software?

Vendor/Software #1 Years:

Vendor/Software #2 Years:

Vendor/Software #3 Years:

27. If you switched from one NOMS software to a different NOMS software, please describe the reasons for switching:

28. Has your airport always used one model/brand of noise monitors, or has your airport used multiple models/brands over time?

- ◯ One NOMS Monitor
- ◯ Multiple NOMS Monitors

29. How many years did you use each model?

Model/Brand #1 Years

Model/Brand #2 Years

Model/Brand #3 Years

30. If you switched to a different model/brand of noise monitors, please describe the reasons for switching:

31. Besides the hardware and software components of the NOMS, please describe the types of tools (including hardware and software) your airport is using to handle flight data requests from the public, airport noise complaints, and noise-to-flight matching (if applicable):

32. Has your airport produced noise exposure contours?

- Yes
- No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Background

33. Please describe the airport operational data and sources used to produce the noise exposure contours:

34. Does your airport provide the noise exposure contours to the public (e.g., online, hard copies, during public meetings)?

- Yes
- No

35. Relative to maintaining and operating a NOMS; does your airport use an asset management system (i.e. Excel spreadsheets, Access Database, Other Program Software, etc.) to track NOMS components?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

Background

36. Please describe your asset management system:

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### NOMS Use

37. While the NOMS was operable, how was the NOMS used? (Check all that apply):

- ☐ To monitor flights in general
- ☐ To monitor specific noise abatement flight procedures
- ☐ To monitor noise abatement runway use
- ☐ To monitor noise levels/limits at monitors
- ☐ To monitor run-ups
- ☐ To monitor taxiing
- ☐ To monitor airspace use
- ☐ To monitor nighttime curfews
- ☐ To monitor aircraft departure and approach profiles
- ☐ To monitor community noise levels
- ☐ To monitor compliance with agreements/mandates i.e. community commitments
- ☐ Other (please specify)

38. Which methods/platforms does your community use to submit complaints? (Check all that apply):

- ☐ Postal mail
- ☐ Phone
- ☐ E-mail
- ☐ Other (please specify)
- ☐ Airport website noise complaint form
- ☐ Third-party platforms (e.g. Airnoise.io)

39. Did you use the NOMS for noise complaint data management or did you use a separate database or complaint software?

- ○ NOMS
- ○ Separate software

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

NOMS Use

40. Please describe the reasons for choosing a separate noise complaint management software:

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

Data Collection

41. Does your airport log/document noise complaints?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

Data Collection

42. How many noise complaints did your airport receive in 2019?

43. Does your airport publish/report the number of complainants or complaints per time period (i.e. month, year, etc.)?

- Complainant only
- Complaints only
- Both
- No

44. Does your airport publish noise complaint statistics on the airport's website?

- Yes
- No

45. Please describe the NOMS operational data type and source your system collected (e.g., SWIM, ADS-B, ASDE-X)?

46. While the NOMS was operable, did your airport collect/integrate other types of data to supplement the NOMS data (e.g., video, radio transmission, weather)?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

Data Collection

47. Please describe what kind of supplemental data your airport used:

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Data Distribution

48. Describe how NOMS data was shared with or distributed to the public (Check all that apply):

- [ ] Community meetings or roundtables
- [ ] Airport website
- [ ] Airport Newsletters
- [ ] Social Media
- [ ] Other (please specify)

49. While the NOMS was operable, did your airport provide reports to the public based on NOMS data?

- ( ) Yes
- ( ) No

50. Was the public able to access NOMS data via an online platform (e.g., online version of the NOMS flight tracking, dashboards, web portals)?

- ( ) Yes
- ( ) Yes, on a limited data access platform
- ( ) No
- ( ) Other (please specify)

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Requirements

51. How many Full-time (including manager/supervisor) and Part-time personnel staff your Airport Noise Abatement Office?

Full-time:

Part-time:

52. How many Full-time (including manager/supervisor) and Part-time personnel operated the NOMS to regularly respond to noise complaints and prepare reports?

Full-time:

Part-time:

53. How many contractors work for the Airport Noise Abatement Office?

54. How many contractors operate the NOMS?

55. Is/was noise monitor maintenance and troubleshooting performed by in-house personnel, NOMS vendor, or third-party outsourced?

- ◯ In-house
- ◯ NOMS vendor
- ◯ Third-party outsourced

56. If known, what was the start-up (e.g., first year) cost to procure your NOMS, the annual cost to maintain/support/update your NOMS, and the cost of the major upgrades to your NOMS?

Start-up($):

Annual Maintenance/Support/ Update ($/year):

Major Upgrade(s) ($):

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Benefits

57. Beyond the core NOMS features/functions (e.g., noise-to-track matching, complaint logging, flight track display, basic queries, etc.), what were your secondary functions of having a NOMS (e.g., noise exposure contour validation, special analysis, noise abatement procedure development)? (Check all that apply):

- [ ] Noise exposure contour validation
- [ ] Special stand-alone analysis (non-periodic analysis)
- [ ] Noise abatement procedure development
- [ ] Other (please specify)

58. Please explain how the relationship between your airport and the community changed after the NOMS became operational:

59. Please describe the NOMS data/feature that was the most effective at informing the public about airport noise:

60. Please describe what benefits your airport experienced from operating a NOMS:

61. Please describe the disbenefit or downside to your airport having/operating a NOMS:

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Reasoning

62. What type of study prompted your airport to acquire a NOMS? (Check all that apply):

- ☐ Part 150 NCP
- ☐ EIS/EA ROD
- ☐ Land Use Compatibility Plan
- ☐ Other (please specify)

63. For what reasons did your airport decide to procure and install a NOMS? (Check all that apply):

- ☐ NEPA mitigation requirement
- ☐ Legal requirement/agreement
- ☐ Public request/pressure
- ☐ Proactive strategy
- ☐ Other (please specify)

64. Please describe the reasons your NOMS is no longer in operation.

65. Please describe under what conditions, if met, would the NOMS become operable again.

66. What have you done with the system equipment (noise monitors/system software) following deactivation? (Check all that apply):

- [ ] Returned to vendor
- [ ] Left in place
- [ ] Disassembled and put into storage
- [ ] Disassembled and sold
- [ ] Other (please specify)

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

Funding

67. Was the NOMS a Noise Mitigation Measure of a Part 150 Study?

- Yes
- No

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

## Funding

68. Assuming you update your Part 150 on a regular basis, when was the last time a Part 150 was updated and when are you planning on undertaking the next one?

69. Which funding sources contributed to the NOMS procurement? Please check all that apply:

- [ ] AIP Grants
- [ ] State Sources
- [ ] PFCs
- [ ] Local (e.g. City, County) Sources
- [ ] Airport Proprietor Sources
- [ ] Other (please specify)

70. May we contact you to highlight your airport as a Case Study that would be included in this ACRP report?

- ( ) Yes
- ( ) No

Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

## Funding

71. Please provide your preferred contact information:

| | |
|---|---|
| **Name:** | |
| **Title:** | |
| **Email Address:** | |
| **Phone Number:** | |

72. Would your airport prefer to remain anonymous in this ACRP project?

- ○ Yes
- ○ No

## Survey on Airport Noise and Operations Monitoring Systems (Questionnaire B4)

### Thank you!

73. Thank you for taking the time to complete this survey. Please let us know if there is anything else you would like to share regarding your NOMS system.

# Appendix G: Airport NOMS Questionnaire & Summary of Findings

## G.1 Background

The airport questionnaires included 73 questions for airports operating a Noise and Operations Monitoring Systems (NOMS) (Type A Airports), 26 questions for airports that had not procured a NOMS (Type B-1 and Type B-2 Airports), 52 questions for airports that had not completed the NOMS installation process (Type B-3 Airports), and 73 questions for airports with non-operational NOMS (Type B-4 Airports). The results of the airport questionnaires are summarized relative to the types of information required by this research. The questionnaire format allowed airports to skip questions, provide multiple applicable responses, and provide other responses and descriptions.

## G.2 Airport Questionnaires

### G.2.1 Type A Airport Questionnaire

The **Type A** Airport questionnaire was sent to large hub and medium hub commercial service airports and to GA airports that currently operate NOMS. This airport recipient list was compiled through industry knowledge of airports by the Research Team and information provided by the NOMS vendors. At the time of the questionnaire's deployment, there were 89 airports in the U.S. that met the **Type A** definition.

A list of all 89 airports is provided in the **Appendix A: List of NOMS, Non-NOMS, & Other Survey Airports**. **Appendix C: Airport NOMS Questionnaire – Type A**, provides the list of questions provided to the **Type A** airports grouped relative to the required information, as well as background questions to add context to their responses.

### G.2.2 Type B Airport Questionnaire

The **Type B** Airport questionnaire was sent to commercial service large hub and medium hub airports and to larger general aviation airports known to not currently operate a NOMS. This airport recipient list was compiled through industry knowledge of airports that are known not to operate NOMS and airports not in NOMS vendors installation lists. At the time of the questionnaire's deployment, there were 422 airports in the study area that did not operate NOMS. Of these airports, 306 were commercial service airports and 110 were general aviation airports (from the 200 busiest GA airports) and were considered **Type B-1** or **Type B-2** airports that have either never evaluated a NOMS or evaluated but never procured a NOMS. Five (5) airports are **Type B-3** or **Type B-4** airports that either procured, but did not complete installation of a NOMS, or procured and installed a NOMS, but the NOMS was not operable.

The following questionnaires were customized according the **Type B** Airport subgroups B-1 through B-4. A list of all 422 airports is provided in the **Appendix A: List of NOMS, Non-NOMS, & Other Survey Airports.**

**Appendix D: Airport NOMS Questionnaire – Type B1 & B2, Appendix E: Airport NOMS Questionnaire – Type B3**. **Appendix F: Airport NOMS Questionnaire – Type B4,** provides the list of questions to the **Type B** airports grouped relative to the required information, as well as background questions to add context to their responses.

### G.2.3 Questionnaire Response Summary

During the initial round of questionnaire outreach, airports within each group were contacted by email, which included the Airport Cooperative Research Program (ACRP) research project information and a SurveyMonkey[15] link to the relevant group of questions. To ensure the questionnaire response rate provided sufficient research information, the Research Team followed up by contacting non-responsive airports by phone.

**Table G-1, *Airport NOMS Questionnaire Response Summary,*** presents the target and actual responses for all airport type surveys. For the **Type A** Airports, the response rate was 51% (45 out of 89 airports), just slightly above the goal of 50%. Of those responses, 30 airports volunteered to be candidates for the case studies. Some of these airports are part of multi-airport systems (ex: Chicago O'Hare International and Chicago Midway International airports), so the 45 responses represent 69 airports.

Given the large number of non-NOMS airports, with many of whom having little or no noise problems, the response rate was expected to be smaller. For the **Type B-1** and **Type B-2** Airports, the response rate was 28% (115 out of 416 airports), again just slightly above the goal of 25%. Of those responses, 52 airports volunteered to be candidates for the case studies. **Type B-3** and **Type B-4** airports (3 each) had one (1) response each, or a 33% response rate.

**Table G-1 Airport NOMS Questionnaire Response Summary**

| Airport Type | Airports (No.) | Target Responses (No.) | Target Responses (%) | Actual Responses (No.) | Actual Responses (%) | Case Study Candidates (No.) |
|---|---|---|---|---|---|---|
| A | 89 | 44 | 50% | 45 | 51% | 30 |
| B-1/B-2 | 416 | 106 | 25% | 115 | 28% | 52 |
| B-3 | 3 | --- | --- | 1 | 33% | --- |
| B-4 | 3 | --- | --- | 1 | 33% | --- |

Source: Landrum & Brown, 2021

[15] SurveyMonkey is an online platform used to conduct surveys and questionnaires.

## G.3 NOMS (Type A) Airports

### G.3.1 Types of Data Being Collected

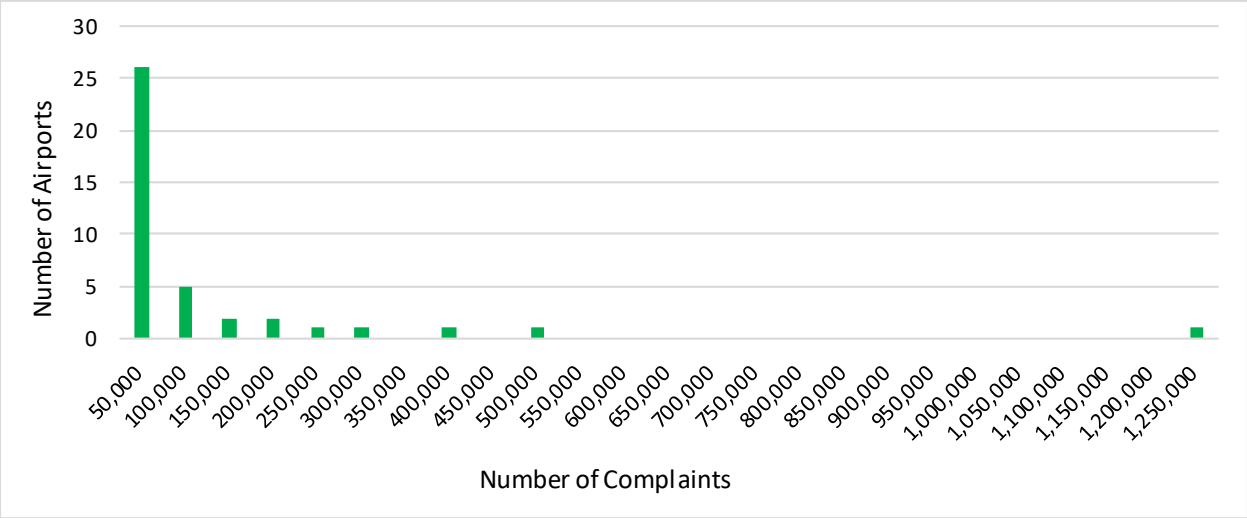
As described in Section 3.2, the first NOMS were installed in the 1967. NOMS installations continued in the 1980's and peaked at nine (9) installations between 1996 and 2000. Approximately 70% of airports installed permanent Noise Monitoring Terminals (NMTs), and a few airports used virtual NMTs for all noise monitoring or to supplement permanent noise monitoring.

The basic features of a NOMS collect and display noise and flight data, correlate aircraft operations to noise events, query system databases, output reports, and provide and interface to log noise complaints. Most airports collected flight operations data via the FAA's Automated Radar Terminal System (ARTS) or the System Wide Information Management (SWIM) feed. Several airports used multiple aircraft tracking data such as Automatic Dependent Surveillance-Broadcast (ADS-B), Airport Surface Detection Equipment – Model X (ASDE-X), Standard Terminal Automation Replacement System (STARS), and multi-lateration sources. The majority of airports supplemented NOMS flight and noise data with additional information such as run-up data, weather data, aircraft performance data, Air Traffic Control (ATC) transmissions, and passenger data.

Airports generally received noise complaints via phone, email, an airport website noise complaint form, and to a lesser extent, postal mail. In recent years, third-party platforms (apps) were developed to provide the public with easier and faster ways to submit aircraft noise complaints directly to airports, which contributed to significant increases in the number of noise complaints. In 2019, the number of aircraft noise complaints ranged from 22 to 1,228,420[16]. These are illustrated in **Figure G-1*, Aircraft Noise Complaints in 2019.*** Seventy percent of airports use the complaint logging feature of the NOMS. However, 30% of airports used a separate database or complaint software. Reasons for using separate software included the use of better features and continuing the use of legacy systems.

[16] At this particular airport, the large number of aircraft noise complaints were primarily related to a shift in departure paths and the location of a new proposed departure procedure. Approximately 98% of these complaints were submitted though the "button," which is an automated way for the public to submit aircraft noise complaints. The "button" is described in **Section 3.5.2.3 Noise Complaints**.

**Figure G-1 Aircraft Noise Complaints in 2019**




Source: Landrum & Brown, 2021.

## G.3.2 How NOMS are Being Used

Airports and NOMS vendors have worked together to expand basic features to address an airport's specific NOMS-related needs. Modern NOMS have become informational tools to support additional airport needs beyond just noise, such as Remain Over Night management and airport planning. **Table G-2, *How Airports Use NOMS,*** presents 11 ways to use a NOMS as provided on the questionnaire and the percentage of responses received. The table is followed by other ways to use NOMS provided by responders.

### Table G-2 How Airports Use NOMS

| How is your NOMS used? | Response (%) |
|---|---|
| To monitor flights in general | 97% |
| To monitor specific noise abatement flight procedures | 84% |
| To monitor noise abatement runway use | 74% |
| To monitor noise levels/limits at monitors | 61% |
| To monitor airspace use | 61% |
| To monitor aircraft departure and approach profiles | 61% |
| To monitor community noise levels | 61% |
| To monitor compliance with agreements/mandates; i.e. community commitments | 53% |
| To monitor nighttime curfews | 42% |
| To monitor run-ups | 24% |
| To monitor taxiing | 3% |

Source: Landrum & Brown, 2021.

In addition to the above options, airports provided other ways to use their NOMS, which include the following:

- NOMS use by other airport proprietor departments and government agencies;
- Capacity utilization of departures;
- Remain Over Night management;
- NOMS data for annual noise contour production and validation;
- Use NOMS as an education and communication tool for the community;
- Investigate noise violations;
- NOMS data for airport planning;
- NOMS data for fleet mix assessments;
- Investigate incursions;
- Metroplex route impacts and compliance;
- Monitor nighttime noise thresholds;
- Cross-check airline self-reporting records;
- Measure off-airport temporary helistops using portable monitors;
- Special studies by consultants.

### G.3.3 Degree of Public Access

Airports were asked whether the public could access NOMS data via an online platform. One third of airports responded that they did provide online access to the NOMS. One third of airports responded that they provided online access to the NOMS, but on a limited basis, and the remaining one third responded that they did not provide public access to the NOMS. Common features of online platforms include flight data replay, flight identification, noise event visualization, noise and operations-related reports, complaint logging, and complaint self-investigation.

For airports surveyed, 75% of airports shared NOMS data with the public via public meetings/roundtables and airport websites. To a lesser extent, airports shared NOMS data via airport newsletters and social media. Airports also shared NOMS data through the complaint response process and upon requests, and approximately 75% of airports provided reports based on NOMS data to the public.

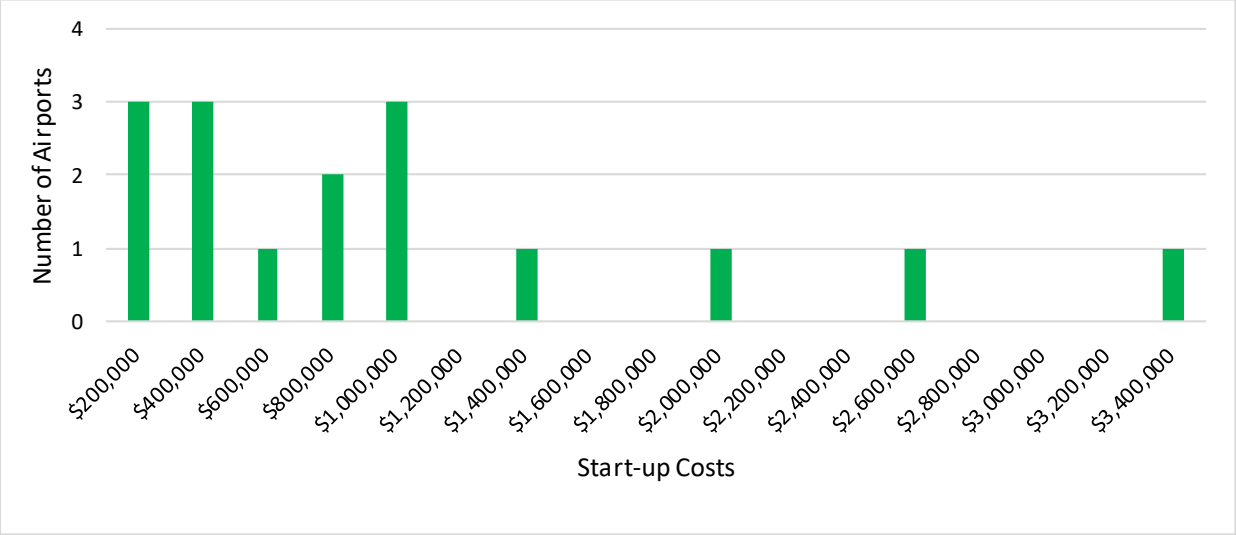
### G.3.4 Resource Requirements

Airports were asked to provide information on their Airport Noise Abatement Office staffing levels, noise monitor maintenance requirements, and costs. Airports responded that staffing levels ranged between one (1) to seven (7) full-time staff with an average of 2.3 full-time staff and ranged between zero (0) to three (3) part-time staff with an average of less than one (1) part-time staff. In addition to staff, an average of two (2) contractors/consultants had access to the airport's NOMS.

To perform NOMS maintenance, most airports used the NOMS vendors. Approximately 10% of airports used in-house staff to perform NOMS maintenance and 10% of airports outsourced NOMS maintenance.

The NOMS start-up cost may vary greatly depending on the contractual specifications, such as the number of monitors, contract term, added maintenance, and added support services. The responses relative to start-up cost ranged between $100,000 to $3,264,700 (two-airport system and two-year maintenance). **Figure G-2*, NOMS Start-up Costs,*** are illustrated per airport:

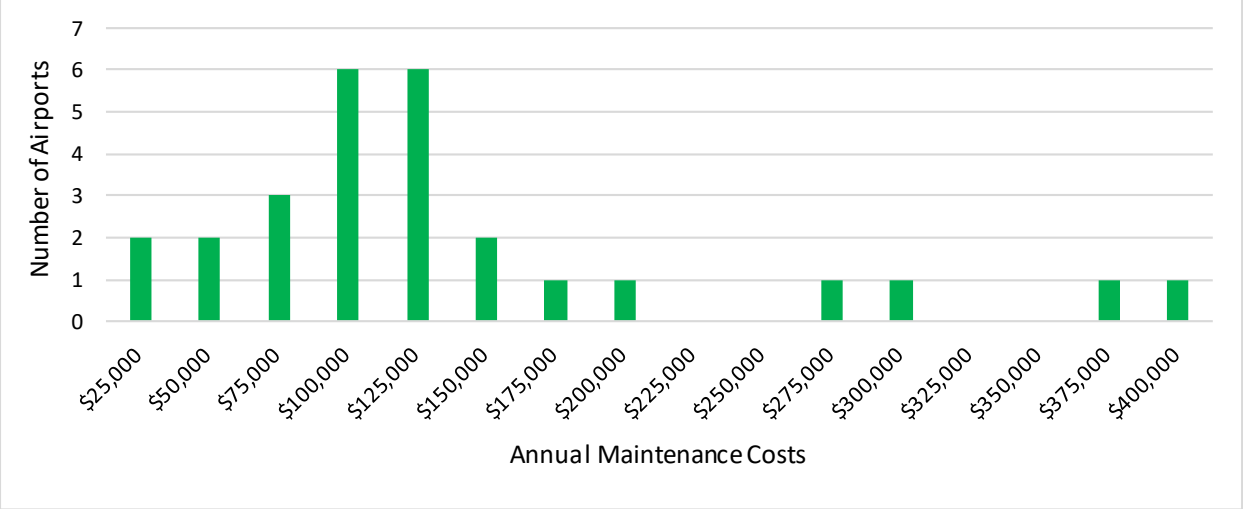
**Figure G-2 NOMS Start-up Costs**



Source: Landrum & Brown, 2021.

Annual NOMS maintenance costs may also vary by airport due to contract specifications. **Figure G-3, *NOMS Annual Maintenance Costs,*** illustrates the cost per airport:

### Figure G-3 NOMS Annual Maintenance Costs




Source: Landrum & Brown, 2021.

## G.3.5 Funding Sources

Funding for a NOMS can be obtained from various sources. **Table G-3, *NOMS Funding Sources,*** lists the percentages of responses received.

### Table G-3 NOMS Funding Sources

| NOMS Funding Sources | Response (%) |
|---|---|
| AIP Grants | 29% |
| PFCs | 12% |
| Airport Proprietor Sources | 34% |
| State Sources | 10% |
| Local (e.g. City, County) Sources | 15% |

Source: Landrum & Brown, 2021.

In addition to the above options, airports provided other funding sources. These sources include:

- Airport Revenue;
- Bonds;

- City's emergency funding[17].

### G.3.6 Reasons for Acquiring a NOMS

Various reasons can support the acquisition of a NOMS including internal factors such a proactive strategy and external factors such as noise ordinance and public pressure for the airport to provide information about aircraft operations. **Table G-4, *Reasons for Acquiring a NOMS,*** lists the percentages of responses received.

**Table G-4 Reasons for Acquiring a NOMS**

| Reasons for Acquiring a NOMS | Response (%) |
|---|---|
| Proactive strategy | 34% |
| Part 150 NCP | 23% |
| Public request/pressure | 15% |
| Land Use Compatibility Plan | 11% |
| Legal requirement/agreement | 11% |
| EIS/EA ROD | 3% |
| NEPA mitigation requirement | 3% |

Source: Landrum & Brown, 2021.

In addition to the above options, airports provided other reasons for acquiring a NOMS, which include the following:

- State reporting compliance;
- NOMS replacement;
- Litigation;
- Sponsor interest;
- Secondary enforcement of noise curfew;
- Community interest;
- To address community concerns.

### G.3.7 Quantitative and Qualitative Benefits

A NOMS is not only a technological tool that provides benefits to airports, but also an investment that requires airport resources. The types of benefits gained by an airport and the magnitude of resources utilized by airports to operate a NOMS are largely dependent on the airport's goals and objectives relative to airport noise. Airports were asked to describe some of the benefits and disbenefits of

[17] The airport received funds set aside for matters related to the health and wellness of the community to fix their NOMS which had crashed.

operating a NOMS, and how the relationship between the airport and the community changes once the NOMS became operational.

**Table G-5*, Benefits from Operating a NOMS,*** lists the percentages of responses received.

### Table G-5 Benefits from Operating a NOMS

| Benefits | Response (%) |
|---|---|
| Improved complaint investigation and reporting | 25% |
| Improved community engagement | 15% |
| Improved transparency | 11% |
| Document compliance with legal obligations | 7% |
| Efficient use of staff time | 7% |
| Increased credibility | 5% |
| Increased trust | 5% |
| Noise abatement procedure monitoring and continuous improvement | 2% |
| Improved community education | 2% |
| Consistent message | 2% |
| Contour and noise event validation | 2% |
| Accounting/Landing fee disputes | 2% |
| Noise modeling data | 2% |
| New procedure (Metroplex) development to protect noise sensitive areas | 2% |
| Noise reduction program tracking | 2% |
| Noise mitigation tool | 2% |
| Established accountability to the community | 2% |
| Safety/Incursions tool | 2% |
| Elected Official Engagement | 2% |
| Identify noise impact and trends | 2% |

Source: Landrum & Brown, 2021.

**Table G-6*, Disbenefits from Operating a NOMS,*** lists the percentage of responses received.

### Table G-6 Disbenefits from Operating a NOMS

| Disbenefits | Response (%) |
|---|---|
| Cost/Expensive | 23% |
| None | 21% |
| Public expectation that the airport can fix air traffic issues | 5% |
| Public always wants more data | 5% |
| Public expectation to address continuous complaints | 5% |
| System data verification/validation | 5% |
| Responding to noise complaints | 5% |
| Improvements in technology have resulted in higher complaint counts | 3% |
| Public distrust of data | 3% |
| Expense to maintain system | 3% |
| Required technical support | 3% |
| Flight data integration | 3% |
| Expect 100% accuracy | 3% |
| Increased demand for permanent noise monitors | 3% |
| Delays to upgrade | 3% |
| Inaccurate data | 3% |
| System hackers | 3% |
| 24-hour delay on data | 3% |
| Plan/coordinate upgrades | 3% |

Source: Landrum & Brown, 2021.

**Table G-7*, Changes to the Airport-Community Relationship,*** are listed after the NOMS became operational and the percentage of responses received.

**Table G-7 Changes to the Airport-Community Relationship**

| Changes in Relationship | Response (%) |
|---|---|
| Improved due to data/information sharing | 23% |
| Improved in terms of transparency | 21% |
| Gained trust | 5% |
| Community empowerment due to self-investigation tools | 5% |
| Relationship improved through monthly roundtable meetings | 5% |
| Reestablished trust | 5% |
| Fostered engagement | 5% |
| Educated the public | 3% |
| Relationship improved | 3% |
| Replaced perceptions with facts | 3% |
| From contentious to trusting | 3% |
| Community feels like airport is more responsive | 3% |
| Implemented a proactive and engaged approach with community | 3% |
| Built relationships with community leaders | 3% |

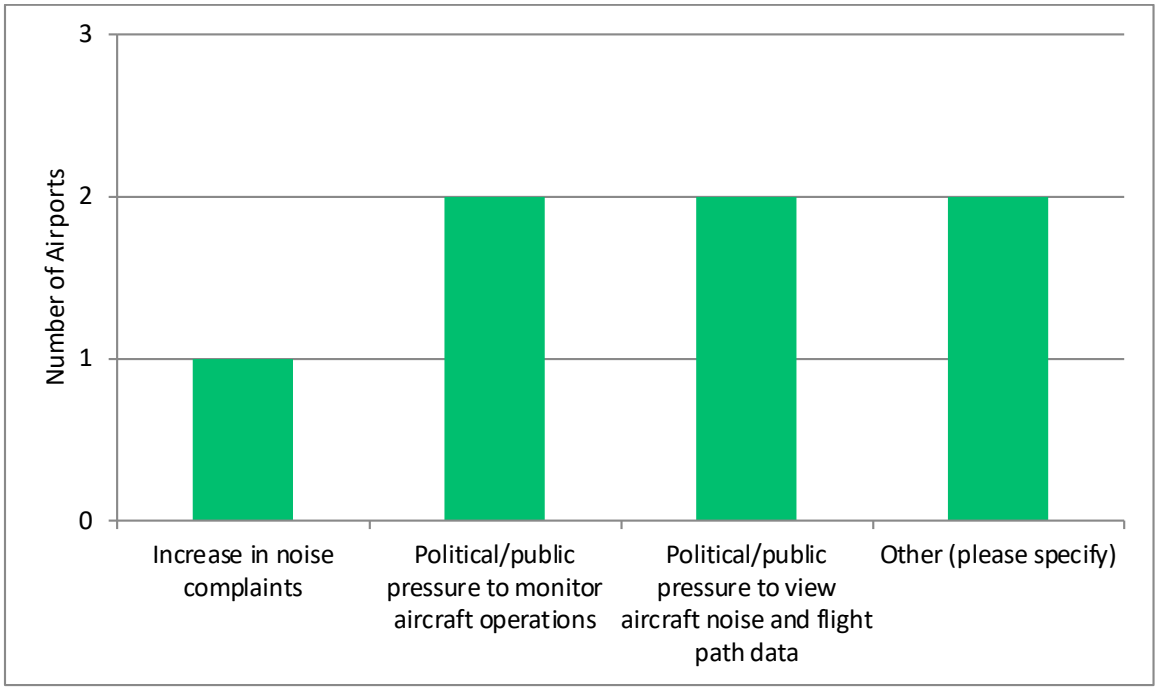
Source: Landrum & Brown, 2021.

## G.4 Non-NOMS (Type B-1 & B-2) Airports

Among the 115 Type B-1 and B-2 airports that did not operate a NOMS, 45% had staff or contractors who handled airport noise issues and 64% logged airport noise complaints. Seven (7) airports evaluated the procurement of a NOMS for the reasons shown on **Figure G-4, *Reasons Airport Evaluated the Procurement of a NOMS.*** The two (2) other reasons for NOMS evaluation were:

- Proactive measure for individuals to monitor/report aircraft noise;
- Local fighter wing switching from F-16's to F-35's.

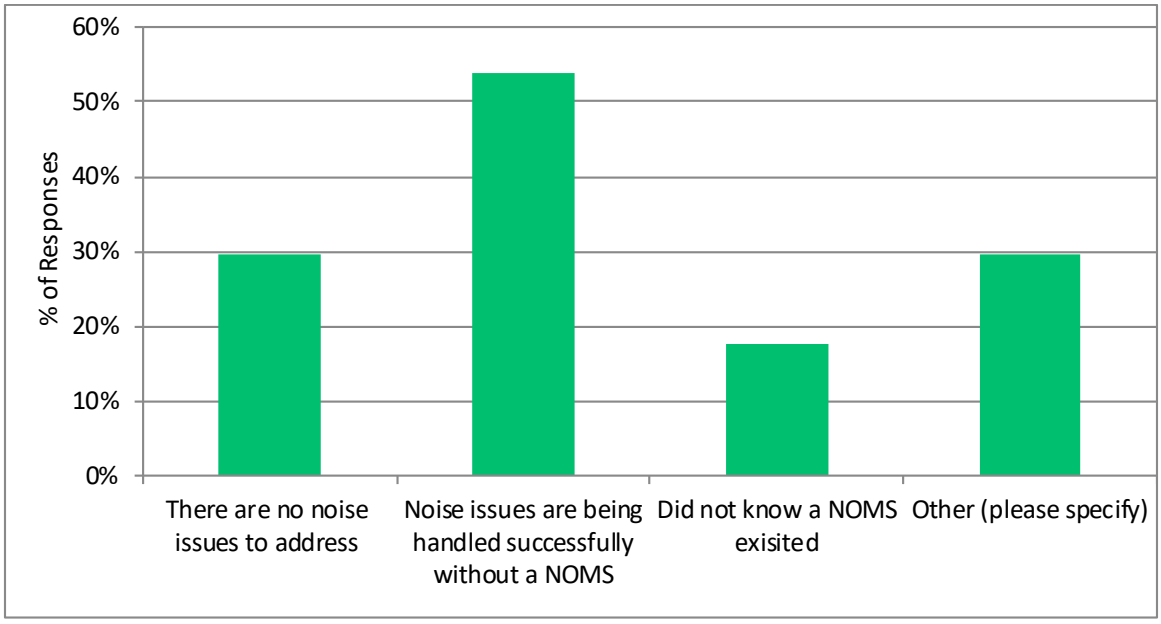
### Figure G-4 Reasons Airports Evaluated the Procurement of a NOMS




Source: Landrum & Brown, 2021.

One hundred and eight (108) non-NOMS airports provided reasons for not having a NOMS. This information is presented in **Figure G-5*, Reasons Airports Have Not Evaluated the Procurement of a NOMS,*** with the percentages of responses received:

### Figure G-5 Reasons Airports Have Not Evaluated the Procurement of a NOMS




Source: Landrum & Brown, 2021.

In addition to the above options, airports provided other reasons for not evaluating a NOMS, which include the following:

- Zero noise complaints;
- Few noise complaints;
- No noise issues;
- Airport is located in rural area;
- Most of the areas above DNL 65 are on airport property and are not residential areas;
- A NOMS is not requested by County Department of Public Works;
- Budgetary constraints;
- Monitoring, logging, and community involvement has been working successfully.

Over half of the airports answered that they would consider the evaluation of procuring a NOMS if complaints increased. Approximately 15% of airports would consider the evaluation of procuring a NOMS if there was political/public pressure to monitor aircraft operations and view aircraft noise and flight path data.

The airports that applied resources to handling noise complaints used various tools and methods to log, investigate, and respond to noise complaints. These tools and methods included:

- Coordinating flight data requests and noise incident reviews with local Air Traffic Control Tower (ATCT) or Terminal Radar Approach Control (TRACON) facility;
- Working directly with local ATCT to run radar/flight tracking report;
- Using County Information Technology department to run airport noise complaint database;
- Utilizing relationship with the FAA to track aircraft as well as public available radar tracking data;
- Using video to identify aircraft related to a noise complaint;
- Use online flight tracking website of nearest airport;
- Coordinate complaint investigation/response with nearest airport with a NOMS;
- Use hand-held noise meter to take aircraft noise measurements;
- Use Microsoft Excel for complaint logging;
- Use Flight Aware, Passur antenna, Aero Tracking, and Virtower flight tracking tools.

## G.5 Other (Type B-3 & B-4) Airports

Among the three (3) **Type B-3** airports that procured, but did not complete their installation, one (1) responded. That airport had a relatively small number of noise complaints in 2019 (approximately 200).

After procurement, the system vendor could not comply with contractual requirements. In the end, funding and support for the NOMS was no longer available and the final installation was never completed.

Among the three (3) **Type B-4** airports that procured & installed a NOMS, but the system is currently not operable, one (1) responded. The airport felt that in the end, the NOMS provided no real benefits as the community thought the NOMS would help reduce noise. The NOMS was decommissioned in 2013.

# Appendix H: Case Study Findings

## H.1 Case Study Candidates

### H.1.1 Purpose

The purpose of the case studies is to take a closer look at the factors involved when deciding whether a Noise and Operations Monitoring Systems (NOMS) is an appropriate tool to address airport noise issues or whether other tools and efforts are appropriate. The airport questionnaires identified several airports that would take part in this research project as case studies.

### H.2.1 Selection Criteria

#### *H.2.1.1 Airports Operating NOMS*

It is understood that from the group of airports that operate a NOMS, those with low levels of noise complaints would relate better to airports that do not currently operate a NOMS (Primer's target audience). Airport questionnaire findings showed that common characteristics among airports that do not operate a NOMS are either not having a noise problem with zero noise complaints or having a manageable noise problem with relatively few noise complaints.

Note that some airports responded that they would participate as case studies, but also preferred to be anonymous. The criteria listed below were used to select the case study candidates from the group of airports that currently operate a NOMS:

- Currently operating a NOMS;
- Airports that responded "yes" to being in a case study;
- Airports that responded "no" to preferring to remain anonymous;
- Relatively low number of noise complaints;
- Selected case study candidates are not located in the same State;
- Selected case study candidates do not represent the same airport service type and size.

**Table H-1*, Case Study Airport Candidates Operating a NOMS,*** lists the airports that meet the criteria above in order of lowest to highest number of noise complaints. The reasons for procuring and installing a NOMS are also listed as reference. The Case Study Selection column shows three (3) proposed selections: a Medium-Hub Commercial airport, a Non-Hub Commercial airport, and a General Aviation airport. **Table H-2*, Case Study Airports Operating a NOMS,*** lists the airports that met the criteria above and were interviewed by the Research Team.

### Table H-1 Case Study Airport Candidates Operating a NOMS

| Case Study Selection | Airport Code | Airport Name (Categories) | State | Complaints in 2019 | Reason for Procuring a NOMS |
|---|---|---|---|---|---|
| 1 | ACK | Nantucket Memorial Airport (Commercial, Non-Hub) | MA | 102 | Public request/pressure, proactive strategy, sponsor interest |
| 2 | DAL | Dallas Love Field (Commercial, Medium-Hub) | TX | 200 | Public request/pressure, proactive strategy |
| Alt. to 1 | PVD | T.F. Green Airport (Commercial, Small-Hub) | RI | 238 | Legal requirement/agreement |
| Alt. to 2 (IAH) | IAH, HOU, EFD | George Bush Intercontinental Airport (Commercial, Large-Hub), William P. Hobby Airport (Commercial, Medium-Hub), Ellington Airport (Reliever) | TX | 350 | Proactive strategy |
| | DFW | Dallas-Fort Worth International Airport (Commercial, Large-Hub) | TX | 539 | NEPA mitigation requirement |
| 3 | TRK | Truckee Tahoe Airport (General Aviation) | CA | 771 | Public request/pressure, proactive strategy |
| Alt. to 3 | SMO | Santa Monica Municipal Airport (Reliever) | CA | 855 | Legal requirement/agreement |
| | PDX | Portland International Airport (Commercial, Large-Hub) | OR | 1,400 | Public request/pressure, proactive strategy |
| | TPA | Tampa International Airport (Commercial, Large-Hub) | FL | 3,795 | Proactive strategy |
| | HPN | Westchester County Airport (Commercial, Small-Hub) | NY | 74,177 | Legal requirement/agreement, public request/pressure |
| | SAN | San Diego International Airport (Commercial, Large-Hub) | CA | 185,771 | Legal requirement/agreement, public request/pressure, proactive strategy |
| | LAX, VNY | Los Angeles International Airport (Commercial, Large-Hub), Van Nuys Airport (Reliever) | CA | LAX - 67,587 as of 8/2020 VNY - 148,641 as 8/2020 | Legal requirement/agreement, public request/pressure |
| | ORD, MDW | Chicago O'Hare International Airport (Commercial, Large-Hub), Midway International Airport (Commercial, Large-Hub) | IL | ORD - 298,192; MDW - 7,588 | Public request/pressure, proactive strategy |

Source: Landrum & Brown, 2021.

**Table H-2 Case Study Airports Operating a NOMS**

| Airport Code | Airport Name (Categories) | State |
|---|---|---|
| ACK | Nantucket Memorial Airport (Commercial, Non-Hub) | MA |
| IAH | George Bush Intercontinental Airport (Commercial, Large-Hub) | TX |
| SMO | Santa Monica Municipal Airport (Reliever) | CA |

Source: Landrum & Brown, 2021.

### *H.2.1.2 Airports Not Operating NOMS*

Airport questionnaire findings showed that most airports without a "noise problem" and noise complaint documentation would not justify the procurement of a NOMS. Therefore, from the group of airports that do not operate a NOMS, those airports that provide efforts to address a "noise problem" and log or document complaints would relate better to the target audience. In other words, airports that are handling noise issues without a NOMS can provide ideal information to the NOMS decision-making process and that noise issues may be handled without a NOMS. Lessons learned show that operating a NOMS is not required to handle airport noise problems and therefore, there are other tools and methods to handle airport noise problems. The proposed case study airports below will provide valuable information on how to handle airport noise problems without a NOMS.

The criteria listed below were used to select the case study candidates from the group of airports that currently do not operate a NOMS:

- Airports currently not operating a NOMS;
- Airports that responded "yes" to being a case study;
- Airports that responded "no" to preferring to remain anonymous;
- Airports that log or document the noise complaints;
- Selected case study candidates are not located in the same State;
- Selected case study candidates do not represent the same airport service type and size.

**Table H-3*, Case Study Airport Candidates Not Operating a NOMS,*** lists the airports that meet the criteria above, in order of highest to lowest number of noise complaints. Additional columns show whether an airport has or is evaluating a NOMS and the number of full-time staff in the noise office as references. The Case Study Selection column shows four (4) proposed selections: a Small-Hub Commercial airport and three (3) Reliever airports. **Table H-4*, Case Study Airports Not Operating a NOMS,*** lists the airports that met the criteria above and were interviewed by the Research Team.

### Table H-3 Case Study Airport Candidates Not Operating a NOMS

| Case Study Selection | Airport Code | Airport Name (Categories) | State | Complaints in 2019 | Has evaluated or is evaluating a NOMS | Noise Staff |
|---|---|---|---|---|---|---|
| 1 (GEG) | GEG, SFF | Spokane International Airport (Commercial, Small-Hub), Felts Field (Reliever) | WA | 25 | No | 0 |
| | RAL | Riverside Municipal Airport (Reliever) | CA | 15 | No | 1 |
| Alt. to 1 | COS | Colorado Springs Airport (Commercial, Small-Hub) | CO | 14 | No | 1 |
| | BZN | Bozeman Yellowstone Int'l Airport (Commercial, Small-Hub) | MT | 12 | No | 1 |
| | EUG | Eugene Airport (Commercial, Small-Hub) | OR | 12 | No | 0 |
| 2 | HEF | Manassas Regional Airport (Reliever) | VA | 11 | Yes | 2 |
| Alt. to 2 | GTU | Georgetown Municipal Airport (Reliever) | TX | 10 | No | 0 |
| Alt. to 3 | PGV | Pitt Greenville Airport (Commercial, Non-Hub) | NC | 10 | No | 0 |
| | DAY | Dayton International Airport (Commercial, Small-Hub) | OH | 10 | No | 0 |
| | DAB | Daytona Beach International Airport (Commercial, Non-Hub) | FL | 10 | No | 0 |
| | SGU | St George Regional Airport (Commercial, Non-Hub) | UT | 4 | No | 0 |
| 3 | ISM | Kissimmee Gateway Airport (Reliever) | FL | 4 | No, but getting a flight tracking tool | 4 |

Source: Landrum & Brown, 2021.

### Table H-4 Case Study Airports Not Operating a NOMS

| Airport Code | Airport Name (Categories) | State |
|---|---|---|
| COS | Colorado Springs Airport (Commercial, Small-Hub) | CO |
| HEF | Manassas Regional Airport (Reliever) | VA |
| GTU | Georgetown Municipal Airport (Reliever) | TX |
| ISM | Kissimmee Gateway Airport (Reliever) | FL |

Source: Landrum & Brown, 2021.

# H.3 Case Studies of Airports Operating a NOMS

## H.3.1 Nantucket Memorial Airport, MA (ACK)

### *H.3.1.1 Background*

Nantucket Memorial Airport (ACK) is a Commercial, Non-Hub airport located on the southern side of the Island of Nantucket, MA. The airport proprietor is the Town of Nantucket. ACK is the second-busiest airport in the state of Massachusetts behind Boston Logan International Airport. ACK's top passenger markets are Boston, MA, New York, NY, Hyannis, MA, and Washington, DC. The airport has three (3) runways and the majority of aircraft operations include 3% Air Carrier, 61% Air Taxi, and 36% General Aviation[18]. **Table H-5, *ACK Statistical Highlights,*** presents some basic information about the airport.

**Table H-5 ACK Statistical Highlights**

| Statistical Category | Quantity |
|---|---|
| Number of Operations (2019) | 77,960 |
| Number of Enplanements (2019) | 126,610 |
| Number of Noise Complaints (2019) | 102 |
| Number of Noise Staff | 1 |

Source: Landrum & Brown, 2021.

### *H.3.1.2 Key Findings*

During the late 1980's, scheduled Air Taxi (i.e. Part 135 Commuter) flights operating predominantly under Visual Flight Rules (VFR) flew over various parts of the island and generated a substantial volume of noise complaints. To try to remedy the low and annoying (not necessarily loud) piston aircraft overflights, a group of homeowner associations collaborated with airport staff and staff from the local FAA Air Traffic Control Tower (ATCT) to develop voluntary VFR noise abatement flight corridors. The airport had a process to track the number of flights on a monthly basis, but without sufficient information to understand where on the island the noise problems existed or to identify the type of aircraft operation that generated a noise complaint, noise complaints were simply logged without in-depth investigation.

In 1988, the airport included a flight tracking tool as a noise mitigating measure in a Part 150 Airport Noise Compatibility Study with the objective to identify VFR aircraft information and flight tracks. A passive antenna was then installed to track flight operations. In 2014, the passive antenna system was replaced by a partial NOMS product (a system without noise monitors) and supplemented with ATCT recordings and historical weather data. The airport procured a stand-alone hand-held noise meter to measure ground noise from Auxiliary Power Units (APU). The system is used to monitor flights in general, noise abatement flight procedures, and runway use. This system was procured by using airport funds.

[18] FAA Air Traffic Activity System (ATADS) for 2019.

In recent years, airport operations have shifted from VFR propeller aircraft operations to Instrument Flight Rules (IFR) jet aircraft operations. This shift in aircraft operations brought on new challenges related to IFR corridors and ground noise, which the airport has less control of compared to VFR corridors.

Relative to the staffing plan, the airport established that a major component of the Environmental Coordinator position was to address and manage the noise program, which included the operation of the NOMS.

The Nantucket Memorial Airport Commission meets monthly and airport staff reports on noise complaint statistics and noise issues. Airport noise-related information is published on the airport website and in airport newsletters, and the airport does provide an online flight tracking platform for public use. As shown on Table H-5, the airport received 102 noise complaints in Fiscal Year 2019 via postal mail, phone, e-mail, and the airport website noise complaint form. Airport staff was able to respond to 95% of those complainants.

Once the partial NOMS became operational, the relationship between the airport and the community improved because airport staff responded to aircraft noise complaints and inquiries with more certainty and provided accurate and factual information about aircraft operations. The partial NOMS allowed the airport to focus its resources more appropriately and efficiently to the noise issues where it has ownership or the ability to influence.

#### *H.3.1.3 Lessons Learned*

Airport staff explained the importance of preparing a document describing the minimum system performance specifications and features needed to accomplish the airport's objectives. Additionally, the staff believes that all airports recipients of Airport Improvement Funds (AIP) would benefit from at least a flight tracking system to not only use in addressing aircraft noise issues, but in also using aircraft operations information for airport planning. Lastly, the public has access to various tools that provide aircraft operations information. Airport staff should have their own aircraft operations information tools for community engagement.

### H.3.2 George Bush Intercontinental Airport, TX (IAH)

#### *H.3.2.1 Background*

George Bush Intercontinental Airport (IAH) is a Commercial, Large-Hub airport located approximately 16 miles north of downtown Houston, TX. The airport proprietor is the city of Houston, TX. IAH is the second-busiest airport in the state of Texas behind Dallas-Ft. Worth International Airport. IAH's top passenger markets are Denver, CO, Chicago, IL, Los Angeles, CA, Dallas, TX, and Atlanta, GA. The airport has five (5) runways and the majority of aircraft operations include 61% air carrier, 26% itinerant General Aviation, and12% air taxi[19]. **Table H-6*, IAH Statistical Highlights,*** presents some basic information about the airport.

[19] FAA Air Traffic Activity System (ATADS) for 2019.

**Table H-6 IAH Statistical Highlights**

| Statistical Category | Quantity |
|---|---|
| Number of Operations (2019) | 478,070 |
| Number of Enplanements (2019) | 21,905,309 |
| Number of Noise Complaints (2019) | 376[20] |
| Number of Noise Staff | 1 |

Source: Landrum & Brown, 2021.

### *H.3.2.2 Key Findings*

Prior to Runway 08L/26R opening in 2003, IAH received very few aircraft noise complaints, which warranted minor and simple complaint logging and responding tools. However, for approximately one year prior to the Runway 08L/29R opening, the airport proactively planned for the procurement and installation of a NOMS. One staff member was assigned the project management tasks associated with the NOMS installation and development of an airport noise office. Once Runway 08L/26R opened, air traffic flew over several residential areas resulting in thousands of noise complaints, extensive community engagement efforts, and lawsuits. An additional staff member was added to the noise office to address the overwhelming number of noise complaints. The high number of noise complaints continued for approximately three years. Since then, the implementation of a robust community engagement and education strategy and the reduction in aircraft operations have led to a reduction in noise complaints to more manageable levels. The airport staff publishes the number of complainants and complaint statistics, but not on the airport's website.

During the planning period of the NOMS procurement, IAH opted to not include permanent noise monitors to minimize cost and system complexity, but purchased two portable noise monitors, which are deployed to residents on request.

Airport staff considers working with the NOMS to be fairly simple and effective. IAH noise office staff appreciates using the system's data viewing tools like pivot tables and flight tracking to research and respond to noise complaints. Airport staff outside of the noise office also use some of the system tools to view airport operational data. However, relaying NOMS information to the public is challenging at times because the public does not believe the NOMS information.

### *H.3.2.3 Lessons Learned*

Having factual information about your airport's aircraft operations – as opposed to generalized assumptions – is essential when responding to noise complaints and engaging the community. Without technical tools, some community members may provide information such as aircraft altitude or number of flights per day that are overstated. Additionally, the speed in which systems gather, process, and display aircraft operational data allows staff to respond to noise issues equally as fast without needing to contact third parties like FAA Tower staff or airline staff. At one point, the NOMS was temporarily out of service for months.

[20] The complaint count includes IAH, William P. Hobby Airport (HOU), and Ellington Airport (EFD) noise complaints.

During this time, staff had to contact third parties for information and their lengthy response time delayed staff's response to the public.

## H.3.3 Santa Monica Municipal Airport, CA (SMO)

### *H.3.3.1 Background*

Santa Monica Municipal Airport (SMO) is a General Aviation - Reliever airport located approximately 12 miles west of downtown Los Angeles, CA. The airport proprietor is the city of Santa Monica, CA. SMO has a single runway and aircraft operations include 5% air taxi, 59% Itinerant General Aviation, and 36% Local General Aviation[21]. **Table H-7, *SMO Statistical Highlights,*** presents some basic information about the airport.

**Table H-7 SMO Statistical Highlights**

| Statistical Category | Quantity |
|---|---|
| Number of Operations (2019) | 77,280 |
| Number of Noise Complaints (2019) | 855 |
| Number of Noise Staff | 1 |

Source: Landrum & Brown, 2021.

### *H.3.3.2 Key Findings*

SMO was one of the first airports in the U.S. to install a NOMS in 1967. The NOMS was installed to enforce a single event noise limit for aircraft departure and arrival noise levels. The system printed noise event information and aircraft operations information such as the aircraft registration number and time of operations were handwritten on a paper log. Once California implemented its "California Airport Noise Regulations" in 1973, which required California "noise problem" airports to produce the 65 dB Community Noise Equivalent Level (CNEL) noise impact boundary, the NOMS was used to validate the CNEL 65. These primary functions of the NOMS continue to be performed today. Because the airport issues fines to pilots who exceed the noise limits, an important NOMS feature is to capture an aircraft's registration number. To supplement the capturing of the registration numbers, the airport installed video cameras near the runway.

In 2017, the airport upgraded the NOMS by installing new software and replacing the outdated permanent noise monitors. Unlike other airports that install a single noise meter at each permanent monitoring site, during the upgrade, SMO opted to install two side-by-side noise meters at two monitoring sites to ensure the recording of noise limit violations. One of the side-by-side monitors acts as a secondary backup in case the primary monitor fails. During the NOMS upgrade and vendor selection process, selecting the system that would most effectively fulfill the least-loss-of-data requirement became a challenge.

[21] FAA Air Traffic Activity System (ATADS) for 2019.

However, according to staff, the selected system has proven to be very effective. The noise monitoring equipment that the airport installed over the years was procured with airport funds.

Historically, jet aircraft noise had been the large contributor to noise complaints. However, at the end of 2017 the runway was shortened preventing larger jet aircraft to operate at SMO effectively reducing the number of jet aircraft operations and noise complaints. As jet aircraft operations decreased, the community shifted the focus of the noise complaints to propeller aircraft operations. Although the low sound level from propeller aircraft operations at times does not register noise events at the airport monitors, the airport continues to receive noise complaints about these relatively quieter aircraft. The airport provides an online tool for the public to view near-live and historical replays of aircraft operations, view noise levels at the noise monitors, and submit noise complaints. The SMO Airport Commission oversees airport operations and noise issues and meets ten times per year.

After decades of legal action and community protest against the airport, the airport announced in 2017 that SMO will close completely in 2028 to be replaced by a complex with a park, recreational facility, and other non-aviation uses.

#### *H.3.3.3 Lessons Learned*

Proper planning for the NOMS Request for Proposal (RFP) is essential to ensure that a system not only fulfills current needs, but also future needs. Switching vendors and performing major component upgrades can cause system-use disruptions and can temporarily increase staff workload. Therefore, a thorough RFP preparation process that includes language relative to current and future system requirements will minimize the risk of not having the right system tools in the future, which may lead to contract renegotiations or the installation of a new system by a new vendor. To supplement the RFP planning process, the airport hired a consultant that provided detailed NOMS specifications that addressed SMO's specific technical needs. The staff believes that adding support by a consultant who specializes in NOMS specifications, operation, and acceptance testing is fundamental to successful NOMS selection, procurement, and installation processes.

In addition to a thorough RFP planning process, staff recommends that airports that are evaluating the procurement of a NOMS or flight tracking system have clear goals in mind relative to addressing airport noise issues. Every airport's noise issues and airport staff's responses to the community are different. NOMS vendors generally know how to address noise issues, but their products and services need to be in line with the airport's noise abatement and community engagement goals.

## H.4 Case Studies of Airports Not Operating a NOMS

### H.4.1 Colorado Springs Airport, CO (COS)

#### *H.4.1.1 Background*

Colorado Springs Airport (COS) is a Commercial, Small-Hub airport located southeast of Colorado Springs, CO. The airport proprietor is the city of Colorado Springs. COS is the second-busiest airport in the state of Colorado behind Denver International Airport. COS's top passenger markets are Dallas, TX, Denver, CO, Phoenix, AZ, Las Vegas, NV, and Chicago, IL.

The airport has three (3) runways and aircraft operations include 10% air carrier, 11% air taxi, 54% General Aviation, and 25% Military[22]. Peterson Air Force Base (PAFB) is located on the north side of the airport and is a major tenant. **Table H-8*, COS Statistical Highlights,*** presents some basic information about the airport.

### Table H-8 COS Statistical Highlights

| Statistical Category | Quantity |
|---|---|
| Number of Operations (2019) | 135,431 |
| Number of Enplanements (2019) | 828,429[23] |
| Number of Noise Complaints (2019) | 14 |
| Number of Noise Staff | 1 |

Source: Landrum & Brown, 2021.

#### *H.4.1.2 Key Findings*

COS is a case study airport that does not operate a NOMS, although staff logs noise complaints. Complaints are generally submitted by phone and email. However, complaints are not published or shared on the airport website. Due to the low number of noise complaints on the order of only a few per month, COS feels that noise issues are handled successfully without a NOMS. Most of the current noise complaints are a result of military operations from PAFB. Commercial operations are also increasing as a result of increased Frontier and Southwest Airlines operations. If noise complaints were to increase and pressure from the public and/or political area forced them to monitor aircraft operations and/or to view noise and flight track data, a NOMS might be considered in the future.

COS has been very successful with working with local and regional jurisdictions and local developers to update zoning ordinances, implement avigation easements, and restrict residential development. Additional measures are also in the works. The airport created the Airport Advisory Commission (AAC) which meets monthly to review all land use development projects and to discuss noise issues. A recent Airport Land Use Compatibility Study proposes a limit on residential development to ensure the airport is protected from future incompatibilities. A newly annexed area will establish zones to limit residential development, require development between DNL 60 and 65 to require construction methods to reduce interior noise to DNL 40, avigation easements, reduced lighting impacts, and rental/real estate disclosures.

[22] FAA Air Traffic Activity System (ATADS) for 2019.

[23] FAA Passenger Boarding and All-Cargo for U.S. Airports for 2019

#### *H.4.1.3 Lessons Learned*

Airport staff expressed the importance of education as being the key to success in the handling of noise issues. For example, a local developer is a member of the AAC to provide a development perspective regarding land use issues; developers with potential land use projects are invited to meet directly with airport staff and the ACC to discuss their projects and the impacts and concerns that airport noise has on residential development close to the airport. Through this effort, a large residential development near the airport is incorporating some noise mitigation efforts, not currently required by local codes, but recommended in the draft compatibility plan.

### H.4.2 Manassas Regional Airport, VA (HEF)

#### *H.4.2.1 Background*

Manassas Regional Airport (HEF) is designated as a National General Aviation - Reliever airport located approximately 30 miles southwest of Washington, D.C. The airport proprietor is the city of Manassas, VA. HEF has two runways and aircraft operations include 54% itinerant General Aviation, and 46% local General Aviation[24]. **Table H-9*, HEF Statistical Highlights,*** presents some basic information about the airport.

**Table H-9 HEF Statistical Highlights**

| Statistical Category | Quantity |
|---|---|
| Number of Operations (2019) | 85,701 |
| Number of Noise Complaints (2019) | 11 |
| Number of Noise Staff | 2 |

Source: Landrum & Brown, 2021.

#### *H.4.2.2 Key Findings*

HEF's noise environment involves operations by fixed-wing and helicopter flight schools and also involves corporate jets, including on hush-kitted Gulfstream II. The airport has voluntary noise abatement procedures, which coincides with strict climb rates (ARSENAL 5 Departure), which takes into account air traffic from Dulles International Airport (IAD), approximately 16 miles north of HEF. Since 2007, the airport has received an average of 20 aircraft noise complaints per year. Noise complaints can be submitted online via the City's public issue reporting system. Approximately 80% of noise complaints are related to helicopter traffic, medical and law enforcement operations flying relatively low on flight corridors between airports and around the D.C. region. In addition to the City's complaint database, staff uses off-the-shelf electronic spreadsheets developed in-house to log and document noise complaints. Staff reports the number of aircraft noise complaints but does not publish complaint statistics online.

[24] FAA Air Traffic Activity System (ATADS) for 2019.

In recent years, airport staff used the IAD public online flight tracking tool to investigate aircraft operations. However, HEF currently has its own flight tracking tool to investigate aircraft operations and also partners with the ATCT to receive feedback on flights that may not be available on third party platforms.

Prior to procuring the flight tracking tool, the airport used grant funding to procure a noise meter, which was used to monitor aircraft operations. The transfers and analysis of data was challenging, however. Staff reached out to an airport that operated a NOMS to receive information about the factors associated with the NOMS including cost. Given the high cost of a NOMS and the relatively small noise issues, the procurement of a NOMS could not be justified.

Two of the most challenging aspects of handling noise issues are informing the public that helicopters are allowed to fly at relatively low altitudes and handling repeat complaints by the same individuals when no new information can be provided to them that will resolve their complaints.

#### *H.4.3.3 Lessons Learned*

When responding to community members who complain often, staff should provide information about aircraft operations – although it may be repetitive – in a customer-service-based honest and engaging way and try to connect with the complainants so they feel understood.

For airports that are beginning to develop their noise programs, understand that noise programs generally do not show signs of noise reduction from the onset. It takes time for noise programs to mature and become effective. Staff should invest time and effort into engaging the various types of pilots that fly into and out of their airports and engaging ATCT staff to assist in the utilization of noise abatement procedures. Lastly, if funding for a NOMS cannot be secured, staff should research other sources that may provide pieces to a noise monitoring system, such as a city's complaint tool or a larger airport's flight tracking tool.

### H.4.3 Georgetown Municipal Airport, TX (GTU)

#### *H.4.3.1 Background*

Georgetown Municipal Airport (GTU) is a General Aviation - Reliever airport located approximately 28 miles north of downtown of Austin, TX. The airport proprietor is the City of Georgetown, TX. GTU has two runways and aircraft operations include less than 1% Air taxi, 47% Itinerant General Aviation, and 53% local General Aviation[25]. **Table H-10*, GTU Statistical Highlights,*** presents some basic information about the airport.

[25] FAA Air Traffic Activity System (ATADS) for 2019.

**Table H-10 GTU Statistical Highlights**

| Statistical Category | Quantity |
|---|---|
| Number of Operations (2019) | 112,296 |
| Number of Noise Complaints (2019) | 10 |
| Number of Noise Staff | 1 |

Source: Landrum & Brown, 2021.

### *H.4.3.2 Key Findings*

Historically, GTU has received very few aircraft noise complaints over the years largely in part to the airport's small noise footprint. Recently, however, GTU received noise complaints on a bi-weekly basis, sometimes multiple calls about the same event from neighbors, especially during the summer months, and when aircraft are using the crosswind runway. GTU's main noise issues involve a wide range of issues including low-flying fixed-winged aircraft and helicopters, aircraft in the touch-and-go and landing patterns, aircraft departing Class D airspace, training flights, and large business jets. When the crosswind runway is in use, citizens who normally do not hear or see aircraft overhead become alarmed from aircraft noise.

GTU's noise issues are currently being handled successfully without a NOMS. However, the airport is in the process of securing airport funds to procure a flight tracking system that will provide information for staff to respond noise complaints and inquiries and to provide the necessary statistical information to justify future airport projects and improvements. The flight tracking system will provide staff with the date, time, and location of aircraft. In combination with system's address locator tool, staff will be able to inform the complainant about specific flights. Since the GTU ATCT is closed during nighttime hours, the system will also provide an accurate way to count the number of aircraft operations.

The airport procured a hand-held noise meter recently to perform aircraft noise measurements at noise sensitive areas around the airports. Aircraft noise event levels are not automatically correlated to aircraft noise events as is the case with a NOMS. Staff had to keep hand-written notes about the noise event, and then query the flight tracking system to find the aircraft operation that likely created the noise event. With this noise measurement data, staff was able to inform residents on actual aircraft noise levels gathered by a calibrated device as opposed to phone apps or other tools that are not calibrated.

The airport's most difficult challenge associated with addressing aircraft noise issues is land use management. Unfortunately, due to the way that county land is regulated, residential land use was allowed right up to the airport's north and northwest fence lines. To the southwest of the airport, residences are approximately 2,000 feet from the fence line. At these distances, aircraft fly directly over houses in very close proximity to the ground.

### *H.4.3.3 Lessons Learned*

Accurate data is very important when engaging the public and explaining aircraft operations. The public can easily access aircraft noise apps and online flight tracking tools, but those tools are not calibrated.

Also important is the ability to explain the differences between types of aircraft and the reasons why all aircraft do not fly in the same airspace.

Another issue is the fact that staff receives calls about aircraft that are outside GTU airspace and all the staff can do is refer the caller to the Flight Standards District Office (FSDO). The complainant feels like staff is simply passing the issue to someone else and really does not care to respond to them.

For airports evaluating the procurement of a NOMS or flight tracking system, the staff suggests obtaining a tool that is cost effective and provides simple tools that will provide a time stamp of flights over a given location. Additionally, staff suggests that airports maintain updated noise contours maps that clearly identify the airport's noise exposure boundaries in case a more comprehensive FAR Part 150 Noise Compatibility Study is necessary.

If an airport performs a FAR Part 150 Study and the DNL 65 contour reaches residential land use, then the airport can apply for federal funding for a full NOMS.

## H.4.4 Kissimmee Gateway Airport, FL (ISM)

### *H.4.4.1 Background*

Kissimmee Gateway Airport (ISM) is a Reliever general aviation airport located in Kissimmee, FL. The airport proprietor is the City of Kissimmee. The airport has two (2) runways and the majority of aircraft operations include 50% transient general aviation and 48% local General Aviation[26]. **Table H-11*, ISM Statistical Highlights,*** presents some basic information about the airport.

**Table H-11 ISM Statistical Highlights**

| Statistical Category | Quantity |
|---|---|
| Number of Operations (2019) | 133,583 |
| Number of Noise Complaints (2019) | 4 |
| Number of Noise Staff | 4* |

*Noise abatement duties are shared among staff
Source: Landrum & Brown, 2021.

### *H.4.4.2 Key Findings*

ISM's noise environment involves fixed-wing and helicopter flight schools as well as helicopter and World War II vintage aircraft sightseeing operations. In 2018, the airport received a significant amount of aircraft noise complaints due to the primary runway's rehabilitation project, which moved air traffic to the secondary runway and over residential areas. Other than noise complaints during the runway rehabilitation project, the airport mostly received noise complaints about aircraft operations three to five miles away from the airport. When responding to these aircraft noise complaints, the airport had little information to provide to the complainant about the aircraft operation.

[26] FAA Air Traffic Activity System (ATADS) for 2019.

Since ISM installed a flight tracking system in 2021, staff has been able to pin-point the location of the aircraft associated with the noise complaints and provide this information to the complainant. The flight tracking system was procured by the airport's operations and maintenance budget from airport funds. The airport does not have staff specifically dedicated to a noise office, so noise abatement duties are shared by staff.

One of the challenges that staff faces when dealing with noise complaints is complainant education. Therefore, airport staff often needs to inform complainants about aspects, such as how aircraft are allowed to fly, when the airport is allowed to be open, and why law enforcement and medical flights are allowed to operate under special flight rules.

The airport currently logs complaints in a complaint form binder where staff inputs information about the complainant, complaint, and response. The level of complaints is relatively low and currently, staff does not feel the need to move to an electronic complaint format.

In addition to the flight tracking feature, the airport also uses the system to count the number of aircraft that cross the primary runway to monitor and coordinate possible safety issues with the FAA. The airport selected their particular system partly to monitor aircraft operations to address noise issues and partly to monitor runway crossings to support future taxiway planning and airport growth. Additionally, because the ATCT is closed during nighttime hours, the system allows the airport to log an accurate count of total airport operations.

#### *H.4.4.3 Lessons Learned*

Gathering sufficient information to fully address a noise complainant's needs was challenging, because at times the sources of information were not readily available or accessible. The flight tracking system provided an accurate and efficient way to investigate and gather noise complaint response information at an office setting or from remote access (home), which was a useful option in case staff had to quarantine due to COVID-19 illness or contact tracing.

Public education is key, especially on the positive aspects of airport operations and noise abatement. Airports should invest the time and resources to inform the public on the types of activities airports support such as the local economy, law enforcement and medical operations, the use of quieter aircraft, and the monitoring of noise abatement procedures to minimize aircraft noise to the extent possible.

# Appendix I: NOMS Vendor Discussion & Summary of Findings

## I.1 Objectives

The objective of the discussions with the Noise and Operations Monitoring Systems (NOMS) vendors was to gather information on the future of NOMS within the next 20 years and to discuss issues that impact airports relative to NOMS procurement, installation, operation, and support.

## I.2 Focus of Discussions

The focus of the discussion was based on four main areas. Each of the main areas had multiple questions that were asked of each vendor. It should be noted that not all of the vendors answered all of the questions.

Per Airport Cooperative Research Program (ACRP) guidelines, the names of the NOMS vendors within this discussion were to remain anonymous, and this task will only describe the vendors' perspective in terms of future developments and issues that impact airports. This task was dependent on the vendor's willingness to participate in discussion and be forthcoming about future noise monitoring needs and development, which vendors may withhold as a competitive advantage. It should be noted that all of the vendors were very open regarding the future of their product and the industry.

The main areas of discussion are presented in the following sections and are, as follows:

- What are the benefits from operating a NOMS?
- How will inclusion of new aircraft such as Urban Air Mobility (UAM) and/or Unmanned Aerial Vehicles (UAV) broaden NOMS utilization?
- Discuss how future software development and technology will enhance NOMS functionality;
- Other issues that impact airports or system installations.

## I.3 Vendor Database Development

### I.3.1 Background

A total of nine (9) vendors were identified that supplied NOMS worldwide. One-on-one discussions were held with seven (7) of the major worldwide vendors. No discussions were held with two (2) of the vendors. One airport had a custom self-built system and the other vendor had only a few NOMS and was phasing out of the business. It was decided that no useful information could be gathered by discussions with these vendors regarding the future of NOMS. It should also be noted that only five (5) of the vendors currently have installations at U.S. airports, but the Research Team felt that valuable input could be obtained from all vendors.

All told, seven (7) of the vendors operate 89 NOMS, plus an additional 40 hybrid NOMS operated by Virtower at airports throughout the U.S. It should also be noted that all of the vendors identified supply software, but not all the vendors provide the noise monitoring hardware.

#### *I.3.1.1 U.S. Vendors*

The vendors based within the U.S. and the number of systems they operate includes:

- Virtower LLC (U.S.-based with 40 U.S. systems);
- L3Harris Technologies (U.S.-based with 32 U.S. systems);
- Vector Airport Systems (U.S.-based with 9 U.S. systems);
- HMMH (U.S.-based with 3 U.S. systems);
- Other (U.S.-based with 1 U.S. system).

Virtower currently operates 40 U.S. systems, L3Harris currently operates 32 U.S. systems, Vector operates nine (9) U.S. systems, and Harris Miller Miller & Hanson, Inc. (HMMH) operates (3) U.S. systems. Minneapolis-St. Paul International Airport (MSP) currently operates its own system with software written internally. All of these vendors operate NOMS exclusively with in the U.S.

#### *I.3.1.2 International Vendors*

The vendors based outside the U.S. and the number of systems they operate includes:

- ACOEM/01dB (France-based with 0 U.S. systems);
- Casper Aero (Netherlands-based with 6 U.S. systems);
- Envirosuite Ltd. (Australia-based with 38 U.S. systems);
- TopSonic (Germany-based with 0 U.S. systems).

ACOEM/01dB currently operates no U.S. systems, but has numerous installations throughout Europe and Asia. Casper Aero currently operates six (6) U.S. systems and has numerous other installations throughout Europe. Envirosuite Ltd., formerly known as EMS B&K, operates (38) U.S. systems and has numerous installations throughout Europe, Asia, Middle East, and Africa. TopSonic currently operates no U.S. systems, but is found throughout Europe and has some Asian installations. Of the International vendors, only Casper and Envirosuite operate NOMS within the U.S.

# I.4 NOMS Vendor Discussion Points

## I.4.1 What are the benefits from operating a NOMS?

### *I.4.1.1 From a vendor's perspective, what benefits do airports experience by getting a NOMS?*

Almost all of the vendors presented the same list of benefits with regard to operating a NOMS. The list included:

- Factual information;
- Ability to develop new procedures;
- Ability to monitoring the implementation of new procedures;
- Tracking trends with changes in operations;
- Obtaining a complete picture on how the airport operates;
- Better airfield awareness;
- Public relations using noise, operations, and complaint data;
- Use of data for internal billing;
- Compliance with National laws - in some countries permission to operate an airport is linked to the installation of a NOMS;
- Use in 3rd party apps such as the FAA's Integrated Noise Model (INM) / Aviation Environmental Design Tool (AEDT), SoundPlan, etc.;
- To answer community questions;
- Data collection for future airfield development such as new runways;
- Data can be used to develop a compensation plan for impacted people;
- Data can be used to develop a balance between operations and noise;
- Better social responsibility;
- Ability to use different metrics;
- Ability to have different tools for different communities;
- Building environmental capacity;
- Building stakeholder engagement;
- Build trust and be transparent, use the facts to help people understand the issues.

#### *I.4.1.2 For an airport with no documented or perceived noise impact, how would you explain to them that a NOMS might be beneficial?*

Many of the answers given above to describe the benefits of a NOMS also fit the reasons given to airports as to why it is beneficial to acquire a NOMS. They mention it is not just for noise, one vendor saying that it is not just the noise or "N" part of NOMS, but it can be used more for the "OMS" part of NOMS. It can be used for billings, tracking operations, baggage handlers, determining operational efficiency, and developing operational awareness of how an airport operates. It can also be used for better public relations more than anything and it is good marketing for the airport. It allows an airport to know the who, what, where, and when related to aircraft operations. It can also be used to document a major change at the airport, such as the introduction of a major new aircraft (F-35) or the change due to the addition of a new runway.

#### *I.4.1.3 How are airports using a NOMS and NOMS data/output outside of normal use, i.e. most unique application of a NOMS?*

Several vendors offered unique uses of NOMS, including:

- Tracking operational changes due to Covid-19;
- Use by a non-airport operator to track flights from several nearby airports;
- Several military airports in Europe that offer up nearly all data on-line – very open and transparent;
- An airport in South America that uses NOMS to maximize daily operations by finding a balance between aircraft operations and noise per aircraft;
- Used to support a legal requirement to meet certain noise levels at many locations or the airport pays a fine;
- One airport used it to predict when F-16s were returning to an airport so the public knew when to go outside and watch them;
- Emergency Locator Transmitter (ELT) Beacon (ELT) for the detection of where aircraft are or for crash detection;
- Monitoring unauthorized crossing of active runways;
- Monitoring ground traffic into or out of a specific airport area;
- YVR used it to reduce delays for aircraft getting deiced;
- LHR used it to determine why some A380 aircraft on arrival could not make the first high-speed taxiway exit;
- FRA airports used it to determine why some earlier A320 aircraft were louder than others.

#### *I.4.1.4 Do you believe that it is beneficial for airports to show NOMS data on-line in all cases?*

All the vendors agreed that it is beneficial for airports to show NOMS data online, but with a few exceptions. Sometimes too much detail may not be beneficial. Openness and transparency helps to build trust and goodwill. However, it was also important to be careful so data cannot be misinterpreted. They believe that having this data available to the public will not only reduce noise complaints, but it will also increase the quality of the noise complaints they do receive. The airport needs to be more open or the public will think they are trying to hide something. Also keeping in mind airports are competing with many phone apps which tend to give sub-standard data. One vendor stated it was best to avoid showing "N" registration numbers, especially for general aviation aircraft. Corporate aircraft can often have fake or blocked registrations.

#### *I.4.1.5 Do you provide multiple levels of your NOMS software such as a "basic" system that is scalable allowing clients to choose the right level for their budget?*

All the vendors mentioned that they can offer a low-cost basic system and can add "modules" or features to the system to increase the value and flexibility of the system per the client's request. Several vendors only offered a low-cost basic system. Some venders seemed to more advanced with the development of a modular and scalable system. One vendor thinks a modular system will be the way of the future. Another vendor mentioned their systems are geared more toward billing using flight track data and can be upgraded with a camera system for better data capture and the option to add noise monitors. They do not yet offer any sort of complaint management system.

#### *I.4.1.6 Do you feel you can offer a NOMS to airports that requires little or no use of airport staff?*

All the vendors, with one exception, offer a hosted system to minimize the need for an airport staff/noise office. Several vendors exclusively offer a hosted system, while the rest of the vendors offer both options. One vendor noted that in some countries like China and Israel, the data must remain in the country and a hosted system would not be allowed. One vendor mentioned that more and more airports did not want to own a system and instead only wanted to subscribe and pay a fee for the data they want without all the hassles of owning.

### I.4.2 How will inclusion of new aircraft such as Urban Air Mobility (UAM) and/or Unmanned Aerial Vehicles (UAV) broaden NOMS utilization?

#### *I.4.2.1 Related to an airport NOMS installation, do you have plans to include UAM/UAV monitoring in future installations?*

The vendors here had varying responses for this evolving industry.

One vendor said they are deeply involved with and are already layering in features for the inclusion of Urban Air Mobility (UAM)/Unmanned Aerial Vehicles (UAV). This will involve a fundamental change, as the focus will be on the large number of vehicles flying point to point vs. the traditional airport focus on arrivals/departures. In addition, they think it will not be an issue of noise levels, but more visual pollution and privacy issues.

One vendor said they are holding a "wait and see" attitude and are waiting for the industry to evolve. Once the requirements were clear, deployment would occur. Another vendor believed it would be mostly for tracking package delivery and personal taxis, thus likely not much of a concern for airports.

One vendor mentioned that they will update their system to detect and track UAM/UAV as soon as the government determines the frequency to be used by these aircraft.

Still, several other vendors were heavily involved in UAM/UAV planning, including one that was working to help define policy. They said it would fit right into their system as an additional aircraft using a new aircraft ID.

Another vendor stated they will consider it when asked to do so by an airport.

UAM/UAV was considered a new industry, so overall the responses varied across all of the vendors.

#### *I.4.2.2 How many years before your system would be able to offer UAM/UAV monitoring?*

One vendor stated soon and another within 5 years UAM/UAV should be in common use. It likely would be for package vehicle first, followed by people vehicles and they stated they are already working on the technology. Another vendor thought it would be more like a 5-10 year timeframe. The other vendors did not offer up a timeline.

#### *I.4.2.3 How do you view the inclusion of UAM/UAV aircraft in your NOMS?*

All of the vendors mentioned that the inclusion of UAM/UAV aircraft would be a separate UAM/UAV module within their NOMS. They would include it as a new aircraft type, although there would be nuances needed to incorporate it into NOMS. They mentioned they will have to build new aircraft registries to recognize aircraft ownership. One vendor also thought that this would be a move away from airports only NOMS and would include cities and new droneports. That also brought up an issue of funding as it would need to move away from the FAA-centric model that currently exists. They stated that this would also move more away from ownership of a system to a fee-based subscription system. One vendor mentioned it might be an add-on to a city noise module that they already offer, since it would be required to be detected within a city and classified in a way that a city has different noise sources from an aircraft.

#### *I.4.2.4 Do you think that some airports might be more interested in only UAM/UAV monitoring in a NOMS?*

Multiple vendors thought there could only be a UAM/UAV monitoring system. Cities might have a lot of interest in a stand-alone system, although one vendor thought a city may rely on an airport to provide that service. Another vendor highlighted that the City of Sunnyvale, CA presently has a NOMS, but is not an airport.

## I.4.3 Discuss how future software development and technology will enhance NOMS functionality.

### *I.4.3.1 Besides the potential for UAM/UAV monitoring discussed earlier, what new software might be available to airports using NOMS in the near future?*

All the vendors seemed to be working on new software enhancements/concepts for the future. These included increased use of cloud storage, more use of Virtual Noise Monitors (VNMTs), and more and better metrics linked to personal well-being. One vendor said they had many new and interesting updates coming soon, but was unwilling to share specific details. However, they did say it would include more automation and more business intelligence.

### *I.4.3.2 Besides the potential for UAM/UAV monitoring discussed earlier, what new technology might be available to airports using NOMS in the near future?*

Vendors offered up many thoughts on new technology coming soon, including the increased use of tablets and other mobile platforms, better radar data capture rate, air quality/emissions monitoring, cheaper Noise Monitoring Terminals (NMTs), increased use of active Automatic Dependent Surveillance-Broadcast (ADS-B) transmitters, less reliance on passive transmitters, and fully live (no delay) public displays of data.

### *I.4.3.3 What do you feel is the software and/or technology needed most in a NOMS today?*

Many ideas were offered up here from the vendors, including the need for real-time data feeds, better data quality, in that System Wide Information Management (SWIM) data is tolerable, but improvement is needed, better ability to track RNAV/RNP procedures, enhanced ability to do "DIY" (do it yourself) or self-service noise complaint monitoring, more accurate noise prediction models, more effective tools to communicate with the public, improved reports to make informed decisions, higher quality data from the source, and advanced noise/flight track correlation rate. One vendor mentioned the need for more modularity, the current lack of soundscape mapping, and the need to develop different user profiles for all users with tailored access granted for various modules including noise, operations, billing, baggage, wildlife, forecasting, gate management, flight delay management, etc. One vendor mentioned that low cost and 100% capture rate on tracking is the way of the future and is what airports want.

### *I.4.3.4 What new NOMS features do you see NOMS having in the future?*

The thoughts and ideas provided here included the ability to offer emissions monitoring (especially particulates), to offer the ability to offer the public a means to better understand the data, and to provide much cheaper systems so more airports are willing to purchase.

One vendor mentioned that having every aircraft (anything that flies) equipped with an ADS-B receiver will create better situational awareness for pilots and will allow better real time communication between airports and pilots using new technology (not texting). Pilots could automatically make real-time decisions to minimize noise and air quality impacts on the ground, (i.e. an autopilot to minimize noise). Routes, thrust, profiles could be adjusted, and ground routes could be flown to minimize ground impacts.

One vendor wanted better identification of aircraft events at the source. They are working with another vendor to develop a mini array of microphones at each NMT. The NMT would be able to detect the difference between aircraft and ground sources using both vertical and horizontal noise detection.

Another vendor mentioned the ability to track Instrument Landing System (ILS) approaches by aircraft type, which is a new feature coming out.

Another vendor foresaw more community portals, more centralized databases for use by multiple users, and the broadening of environmental parameters.

### I.4.4 Other issues that impact airports or system installations.

#### *I.4.4.1 Are NOMS installations and data/output in other parts of the World such as Europe and Asia different than in the United States?*

Almost all of the vendors presented some ideas to this list. Obviously, of the six (6) worldwide vendors, four (4) of them are not headquartered in the U.S. and two (2) of those do not have any U.S. systems at the present time. The list of differences included:

- Outside the U.S. airports placed more emphasis on compliance and fines;
- Inside the U.S. airports were more about complex stakeholder engagement;
- Data privacy laws are much stricter in Europe;
- Data output more of an issue for the Swiss/Germans – a minor data anomaly is a major issue;
- Missing data is more of an issue in Europe than in the U.S.;
- Noise regulations are much stricter;
- Europe has more procedures to monitor and more requirements to track;
- Monitoring is a more complex process due to government and airport requirements;
- Every European country has different issues;
- Every European country has different radar data service providers;
- The European public demands more NMT – at every house and don't care about cost;
- Virtual NMT not in use as of yet in Europe;
- Virtual NMT would not be allowed in at least one country in Europe since it would require an independent agency to verify the data;
- India and China clients are very different from European clients in terms of contractual factors;
- Clients in Korea and Taiwan want full data service contracts;
- China wants to own the software, own the source code, and wants nothing in the cloud;

- Other parts of Asia want to own the system, but want nothing to do with operating the system;
- Europe has better situational awareness of using data;
- Europe tends to require more data details;
- European airports and the public demand more data to be available on-line.

#### *I.4.4.2 Are their components (software, technology, data output) of a NOMS used in other parts of the World such as Europe and Asia that could useful to systems in the United States?*

Most vendors could not offer up any thoughts on what U.S. systems might be missing, although one vendor mentioned that Europeans shared data well above the level shared in the U.S. and the U.S. might learn something from that. Another vendor did mention that many cities in Europe are required to map city noise and for airports close to a city, the mapping of noise from both the city and airport are combined. Another vendor mentioned that airports in Canada and Europe tend to have more personalized and focused data.

#### *I.4.4.3 What do you foresee as the biggest hurdles with a NOMS installation in the United States?*

Almost all of the vendors added some ideas to this list, keeping in mind that 2 of the vendors do not have any U.S. systems at the present time. The list included:

- Availability of funding for a system – especially for a smaller airport;
- Need to find a good local or regional partner for installation and NMT maintenance;
- Need to have local or regional presence for support;
- Requests for Proposals (RFP) are often unclear as to what an airport truly wants;
- Consultants often "recycle" specs and the airport does not know the difference. Vendors tend to know which consultant did which spec for an airport;
- NMT site selection is a challenging process in U.S. This was an issue raised by several international vendors especially those based in Europe and Asia. They said in Asia, NMT are mostly installed on private property and require negotiation with individual property owners and often times a payment. In the U.S., usually NMT are installed on public property, i.e. parks, schools, rights-of-way, etc. This usually involves negotiations with only a few parties and no payment required beyond any necessary permits;
- Tough to find a good acoustical site for NMT;
- Many have issues with obtaining local permits for NMT installations especially if many jurisdictions are involved;
- Right now, a main issue is with the pandemic – some airports are starting to ask for money back;

- Some airports calling to have billing systems integrated so landing fees can support city budget deficits;
- Radar interface, especially in Europe and Asia.

#### *I.4.4.4 Please describe the lessons learned from a NOMS procurement, installation, testing, operations, and support.*

Vendors had many things to say here. One vendor speaking mostly about non-U.S. installations stated that one should assume that the money is not used wisely and many times a system is installed and just left to rot. They recommend a push for full maintenance options to keep it running and with the aid of a strong local partner. First to help with the installation and afterwards to keep up with the maintenance.

For installation, the ability to have a good, fast internet connection is a key for many installations.

Another vendor mentioned that this is an industry that relies on low-bids and it always ends up being a "race to the bottom." They blamed generic specs for a lot of the problems and it equates to a system having way more features than an airport wants or needs.

Another vendor mentioned that the preparing the specifications and procurement process is taking way too much time to implement and many times the system cost is too much for an airport – both in the purchase price, but also the labor costs required to operate the system.

Still, another vendor took a more general approach. Every system is different, every airport is different, and they all need a different approach. They have different software requirements and all the bid/tender requirements are different. There is way too much standard information in the spec (90%) and only about 10% is tailored to the airport. More effort should be taken to tailor the requirements to the airport's needs.

The last vendor mentioned that during procurement, the airport should not start with the idea that they only want to measure noise. They should decide what their system will be used for and what their noise management program will look like, and then work down to the basics of what they actually need in a system. Focus on the program and system needs and then develop a specification tailored to those needs.

Lastly, another vendor states that airports are less concerned with receiving the best system, but rather they concentrate on "checking all the boxes" in the procurement process. They also stated that the procurement process takes too long – and it is long everywhere in the world. Airports (or their consultants) tend to over specify the system requirements. Airports want the best system and a low price, but the two do not tend to go hand-in-hand. They state that installation is a long process, especially for the NMT. Obtaining radar data is also a large issue. In the U.S., it is easy with one source, but in Europe, each country and each airport is different and requires separate negotiations with local Air Traffic Control (ATC). Airports also have issues with receiving the right reports. Reports should be tailored for each airport and the needs of their public. Finding the right complaint management system is also an issue. This vendor thinks European airports are much more demanding when it comes to system support. They all think all airports are special and different.

#### *I.4.4.5 What are the biggest airport concerns or requests related to a NOMS procurement, installation, testing, operations, and support?*

Vendors summarized the biggest airport concerns below:

- Airports really do not want to spend money on something they do not want;
- If they do spend money on a system, they want the system to be inexpensive;
- Airports never seem to know which department handles the procurement, but many times it is outside the full control of the airport or the department asking for it;
- Airports want to spend less on NMTs and use more virtual NMTs (U.S. only);
- System specifications tend to have a lack of knowledge about radar surveillance;
- System specifications need more specific information about noise and community relations;
- Smaller airports tend to think a system is too expensive and too complex to operate with limited funding and staffing;
- #1 issue for U.S. airports is that they do not receive adequate support from the vendor.

#### *I.4.4.6 Are you aware of instances where the operation of a NOMS is a shareable cost/shared venture between the airport and local communities/municipalities?*

When presented with this question, most vendors thought it was an interesting concept and could happen in the future. One vender knew of a small airport in Thailand that has a joint venture system between an airport and an airline. The airline runs the airport and the local community demanded the system.

#### *I.4.4.7 In addition to the NOMS, do you offer the manpower to support the day-to-day operation of the NOMS to assist airport that do not have the staff to do so?*

Having a hosted system would allow the vendor to do most of the work that airport staff would normally be required to do. An airport could run a noise program with minimal staff. Most of the vendors offer a hosted system as an option to airports. Some only offer a hosted system, one vendor is transitioning to a hosted system, and one vendor does not yet offer a hosted system but is hoping to in the future. Another vendor offers a hosted system and believes it is the way of the future, as airports do not want to own and staff a system, but would rather pay a fee for a subscription service to obtain the data they need.

# Appendix J: Noise Monitor Installation & Maintenance Guide

## J.1 Introduction

The objective of a Noise and Operations Monitoring Systems (NOMS) and the installation of portable and permanent Noise Monitoring Terminals (NMT) is to monitor noise levels generated from aircraft operations. Using data collected by the NMTs, a NOMS can quantify aircraft noise exposure around the airport and compare noise levels with standard noise annoyance criteria and modeled noise contours. The noise levels can be used to inform airport stakeholders on the measured noise exposure in noise sensitive areas, to justify mitigation measures, and to minimize the noise impact on these areas.

## J.2 NMT Overview

A sound level meter is an electronic instrument that measures sound pressure levels. A sound level meter in an integral part of the noise monitor of an NMT. They are produced by several different manufacturers and can vary in quality and noise collection capabilities. Sound level meters are divided into two classes: Class 1 and Class 2. For the purposes of monitoring noise at airports, it is required that Class 1[27] instruments are used due to their wider frequency range and tighter tolerance.

Noise monitors are just one component of a very comprehensive suite of tools used to understand aircraft noise impacts. Measuring sound levels provides:

- Aircraft and non-aircraft sound levels at a specific location for the time period measurements were made;
- Historical records and historical trends of the sound levels at a specific location.

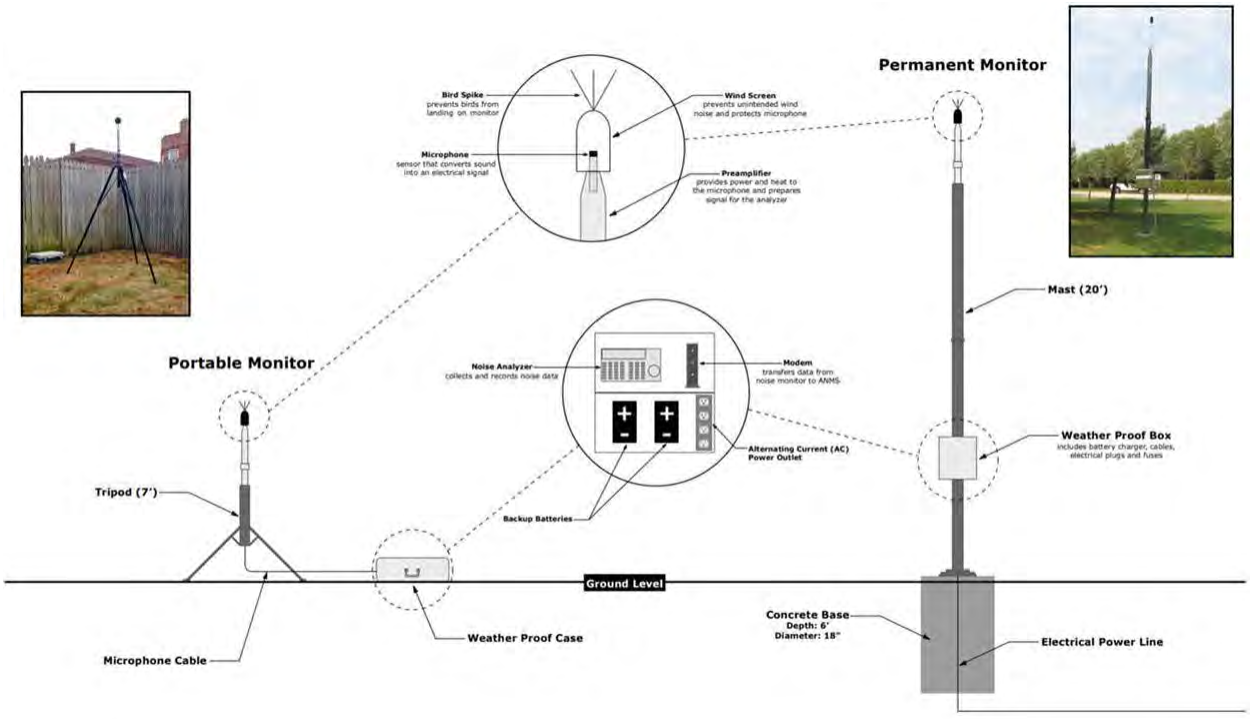
The following sections provide an overview on NMTs and the important considerations in the process of installing noise monitors.

### J.2.1 NMT Types

There are two (2) types of NMTs that can be utilized within a NOMS. Permanent NMTs are fixed long-term equipment that measure, record, store, and transmit noise data and are specifically designed for independent outdoor monitoring. Portable NMTs are ideal for short-term, yet continuous, sound level measurements. The portable noise monitors enable data to be recorded at locations where long-term monitors cannot be installed or where the measurement objective does not require permanent monitoring. A diagram of portable and permanent NMTs are presented in **Figure J-1, *Schematic of Portable and Permanent NMTs*.**

[27] Based on ARP 44721, Section 3.1.1.

**Figure J-1 Schematic of Portable and Permanent NMTs**




Source: NMT Schematic courtesy of the Chicago Department of Aviation (2021).

## J.2.2 NMT Components

There are certain NMT components that will be in both permanent and portable noise monitors, and some components are specific to each respective type of NMT.

### *J.2.2.1 Permanent and Portable NMT Components*

- *Noise meter* – This is the device that measures the pressure in sound waves in order to recognize them as noise events. The type of device required for this is a Class 1 sound level meter. This is determined by specifications outlined by the International Electrotechnical Commission (*IEC) 61672-1:2002*. Meters in this category will be able to measure sound pressure, LAeq, and peak sound pressure.
- *Microphone* – The microphone picks up the differences in pressure created by sound waves and transmits this information through the preamplifier via the microphone cable to the noise meter. The microphone must be up to the specifications of *IEC 60651* Type 1 to conform to standards in use with Class 1 sound level meters.
- *Microphone cable* – The microphone cable in use must have the ability to reliably transmit the pressure changes in sound waves, as picked up by the microphone transferred through the preamplifier to the noise meter.

- *Preamplifier* – The preamplifier amplifies low level signals to line level. This will allow for the information of pressure of sound waves to be translated as audible noise by the noise meter.
- *Microphone housing, windscreen, and bird spike* – These devices serve as protection for the microphone, preamplifier, and microphone cable connection. The windscreen shields the microphone from gusts of wind, allowing it to filter out actual noise that is generated by aircraft or the surrounding community. The bird spike prevents avian related interference with the microphone.
- *Backup battery* – The backup battery serves as an external power source to keep the noise meter running while A/C power or solar rays are unavailable.
- *Wireless modem* – A wireless (cellular) connection is typically the medium of communication with the NMT, replacing outdated telephone serial modems ("Dial-Up"). The modem transmits the data files generated by the noise meter, to a centralized server that can upload the files to a program which interprets the raw noise data for analysis. Wireless modems can also be used to communicate with the NMT to perform analysis or maintenance functions.

#### *J.2.2.2 Permanent NMT Components*

- *Mast (retractable, bi-folding, or other)* – The mast is used to mount and operate the noise meter equipment. It can be engineered metal with lowering capability for microphone service. Wooden utility poles can also be adapted to serve as an equipment mast.
- *Cabinet* – The cabinet is where the noise meter, power connections, microphone cable, backup battery, and modem are located. This cabinet should have the ability to be locked securely and be weatherproof for a variety of conditions.
- *Concrete base* – The concrete base will have the required electrical connection in conduit with four (4) bolts to mount the mast onto. It must be level and have a diameter large enough to accommodate the base of the mast.
- *Electrical power meter* – This meter will be used to determine the amount of energy that is being used by the noise meter and associated equipment. It is typically located within a few feet of the concrete base.
- *External A/C power shutoff* – This is an electrical breaker box located outside of the cabinet, either attached to the cabinet or an electrical power meter. It serves as a way to safely shut off power to the devices inside the cabinet for maintenance.
- *Grounding wire for mast/cabinet* - The ground wire is attached to the mast and cabinet and runs into the ground below the concrete base. Its purpose is to absorb any electrical shock from a lightning strike or other phenomena and to distribute the power safely into the ground without affecting the noise meter or other devices.
- *Mast adapter to microphone mount* – This adapter may be used on certain masts, which will allow the mast to be connected to the microphone housing via the microphone mount.

- *(Solar): Solar panel and power cables* – The solar panel is mounted on the mast near the top of it and is angled to face the sun depending on geographical location. The power cables deliver the energy generated by the sun to the solar controller.
- *(Solar): Solar power controller* – This controller has the ability to safely distribute power from the solar panel to the noise meter and other devices in the cabinet. It also sends power to the 12v backup batteries.
- *(Solar): Dual backup 12v batteries* – The backup batteries serve as a way to power the site reliably during times of limited sun exposure during daytime hours due to weather or at night.

#### *J.2.2.3 Portable NMT Components*

- *Tripod and ground stakes* – This is used to support the microphone mount and microphone housing in order to prevent the microphone from falling over.
- *Weatherproof box* – The weatherproof box is used as a safeguard to withstand harsh outdoor conditions while protecting the noise meter and associated equipment inside to allow for uninterrupted reporting.
- *Chain and lock for weatherproof box* – The chain and lock help to keep the noise meter secured when in use at a remote site.
- *Electrical extension cord* – The extension cord powers the site from a local power outlet, which also stores energy in the backup batteries.

### J.2.3 Data Collection Features

- *Leq and A-weighted frequency* - Leq or LAeq is the equivalent continuous sound pressure level. It is the constant noise level that would result in the same total sound energy being produced over a given period.
- *Reports* – After the raw noise file is sent from the noise meter to the server, a program will interpret this data and produce a numerical report on it. For example, reports such as these can be used to determine high levels of aircraft or community noise at certain times of day.
- *Flight data*- When using a noise meter network in conjunction with air traffic radar data, new metrics can be seen highlighting what aircraft affect a community at what time of day. This information can also display air traffic altitude, speed, and position in relation to the location of the noise meter.
- *Clock settings* – When collecting data, it is important to determine at what time the noise meter should report to the server. Standardizing all noise meters to Coordinated Universal Time (UTC) is a common act done to maintain consistency.
- *Ambient noise level* – The ambient noise level is the noise level that is typical at the site where the noise meter is located without any aircraft or significant community noise taking place.

- *Noise thresholds and continuation period* – The threshold is set as a certain noise level that must be exceeded in order for a noise event to be created by the noise meter. The continuation period relates to this as it is a set time duration that must occur in order for the exceedance of the threshold to be considered an event. There also must be a set time duration of noise levels to be below the prescribed threshold in order for the noise event to have a definite beginning and end.

## J.3 Site Selection

Selecting locations for the NMTs (permanent or portable) should be one of the first steps in the installation process. Depending on the airport's ownership by local governments or private authorities, locations for all monitors will vary. Typically, NMTs should be installed in the relative flight path of air traffic on approach or departure from the airport at which the monitors are intended for use. With these ideas in mind, it is important to determine policies as to how the sites should be selected. Additional guidance can be found in Society of Automotive Engineers (SAE) ARP4721/1.[28] The criteria below include some starting points for location selection that can be supplemented by other criteria identified by the airport owner/sponsor.

- Proximity to Flightpaths;
- Proximity to Existing NMTs;
- Ambient Noise Levels;
- Permanent vs Portable NMT Deployment;
- Policy Considerations;
- Technical Considerations.

### J.3.1 Portable NMT Deployment

Portable NMTs are deployed to collect data at locations that are temporary, in areas that cannot be served by a permanent location, special request, noise studies, or to validate data from other NMTs.

Portable NMTs can be placed at locations on Alternating Current (A/C) power or can be powered by solar or batteries depending on the duration of the deployment. If powered solely by batteries, power consumption calculations should be performed to determine how often batteries should be changed to avoid data loss.

Portable units are versatile relative to placement. Items to consider when choosing a location and unit deployment include the following:

- **Security** – Portable unit equipment boxes can be locked and chained to a structure (tree, pole, gate etc.). However, microphone, microphone cables, and tripod can remain vulnerable;

[28] Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 4721, Monitoring Aircraft Noise and Operations in the Vicinity of Airports.

- **Placement** - Microphone should be in an open area away from tree coverage or other obstructions;
- **Ambient Noise** – Undesired noise sources should be kept at a distance for best data collection. Air conditioning units, traffic, and community noise can vary throughout data collection time period and can thus effect data. The ambient noise level can be measured by the NMT and calculated as the noise level that occurs 90% of the time ($L_{90}$)[29];
- **Noise Event Threshold** – At most locations, the noise event threshold should be set at 7 to 10 dB higher than the ambient noise[30];
- **Access** – In the event of service needs, available access should be considered;
- **Connectivity** – If modems are not used to connect and download data for a measurement, manual downloads will be needed;
- **Calibration** – Portable NMTs are designed to be relocated frequently and can lose calibration during transport. Microphones should be calibrated with certified pistonphone or acoustical calibrator (depending on equipment type) upon set up at each location.

### J.3.2 Proximity to Flightpaths

In order for noise events to be properly recorded and correlated with aircraft operations, the NMTs should be located in an area that will have frequent flyovers of arriving or departing aircraft. For flight track analysis and the evaluation of noise abatement alternatives, the NMTs should be placed in specific flight corridors or where the noise abatement alternative is most critical. Lastly, if specific communities have a concern about aircraft noise or file regular complaints, NMTs can be located in these areas on a permanent or temporary basis.

### J.3.3 Proximity to Existing NMTs

When selecting locations for new NMTs, consideration should be given to the proximity of the NMT relative to other existing or planned NMTs. Potential sites should be located at a minimum of one (1) nautical mile[42] away from other NMTs to provide different noise exposures.

### J.3.4 Ambient Noise Levels

In order to improve the accuracy of correlating aircraft noise events, NMTs should be placed in areas with relatively low ambient noise levels. Ideally, there would be no exposure to other noise sources or intermittent high noise levels. NMTs should be located where ambient noise is minimized to maximize effectiveness of the monitoring system.

[29] "Sound Level Descriptors", U.S. Department of Transportation, Federal Highway Administration, https://ntlrepository.blob.core.windows.net/lib/79000/79300/79315/FHWA-HEP-17-053.pdf

[30] The Noise Event Threshold level and NMT distance apart are based on experience and engineering judgement. The Noise Event Threshold level is set after an in-the-field evaluation.

### J.3.5 Permanent vs Portable NMT

Determining whether a noise monitor site should be permanent or portable depends on the application to which the data will be used. Permanent noise sites are typically near community centers such as parks, schools, or on parkways in neighborhoods and are used to cover a larger area of aircraft noise. These sites may be connected to a power source via an electric company in conjunction with a backup battery or may be solar powered through a large panel and backup batteries. Portable noise sites can be used to determine location eligibility for a permanent noise site location based on the governing entity's reaction to the collected data. Portable sites are typically powered through a power connection via extension cord to a power outlet used in conjunction with a backup battery.

### J.3.6 Policy Considerations

Policy Considerations ensure the fair placement of NMTs and help to select the general area for placement of the NMTs. Placement should be based on an equal distribution among communities surrounding an airport. In addition, consideration should be given to an equal placement of monitors off each runway end and certain consideration may also be given to placement of NMTs based on the local terrain. Residential areas affected by aircraft traffic are first priority, followed by schools, parks, or recreation areas. Commercial or industrial areas are not considered as desirable locations for NMTs. The focus should remain on noise-sensitive areas for the quantification of aircraft noise impacts and in addressing noise complaints.

### J.3.7 Technical Considerations

Once a general area for placement of a noise monitor has been considered, Technical Considerations help determine where exactly the noise monitor should be placed. The monitor needs to be located away from any reflective surfaces (large building or solid surfaces, trees or other sources of wind noise) that might affect the measurements and should be located with good line-of-sight to an aircraft, so no shielding of noise occurs. Ultimately, the site location should not be located in the vicinity of existing electrical service lines to avoid high installation costs.

The following guidance is provided in ARP 4721, Section 3.1.2:

The issue is addressed in ARP 4721 Section 3.1.2. In ARP 4721 the following guidance is given: "Microphone Height: The microphone for permanent noise monitoring purposes in a fixed system shall be placed at least six (6) m above the ground level or at least three (3) m above neighboring rooftops, whichever is higher above the ground. Where a rooftop location is necessary, location near the center of a flat roof is preferred to ensure that reflection effects are more-or-less uniform throughout the measurement duration. Portable or temporary noise monitoring may use microphone heights ranging from 1.2 to six (6) m in height or higher as necessary to meet the obstruction criteria presented in the next paragraph. In the case where a portable system is used in parallel with a permanent microphone for purposes of validation of system data (per Section 5.8, Part 2), the portable microphone shall be at the same height as the permanent microphone. Obstructions in the Sound Field: There should be no solid objects within a conical region around a microphone that would significantly interfere with the measurement of the sound from an aircraft. The conical region is one with its apex centered on the

microphone and extending upwards to a height of at least 13 m above the microphone. The included conical angle is 90°."

The site should also provide good access in order to permit routine maintenance and calibration of the unit, as needed. A long-term easement should ensure that the site will not have to be relocated within the next several years. NMTs in areas slated for redevelopment or in/near a reserved transit corridor are not considered desirable locations. Sites should also be located away from any electromagnetic radiation sources to minimize signal interference. Lastly, the site should be located in a secure area to provide adequate space for provision of security.

## J.4 Maintenance Requirements

When installing a new NMT, it is important for the airport to understand the Maintenance Requirements of the NMT and incorporate these aspects into the management of their NOMS. The NMTs require both preventative maintenance as well as regular corrective repairs. The airport needs to consider if this is something that can be handled in-house or if contractors will be used to perform these duties.

- **Security** – Site security is crucial to the successful daily reporting of the noise meter. A secured and tamper-proof cabinet and secured mast should be used to prevent any interference of data recording. If the NMT is located in area with major security concerns, the NMT site can be secured with fencing and a locked gate.
- **Insects & rodents** – Proper measures must be taken to ensure the cabinet and mast are secure from wildlife threats. Protective shielding at the base of the mast may be used to prevent rodent infestation while bug traps may be set to prevent the colonization of a variety of insects within the site.
- **Tree and landscaping growth** – Trees and other obstructions must be considered when performing maintenance at a site. The mast must be able to be lowered without interference from tree branches and the cabinet must be accessible and free from obstructions for a technician to safely perform the maintenance required.
- **Corrosion and lubrication** – Due to weather exposure, locks, hinges, and other metal parts that move about the mast or cabinet must be lubricated regularly to prevent corrosion damage to the site.
- **Vandalism** – The cabinets and masts must be checked regularly for vandalism. If the site is vandalized with graffiti, a standardized cover-up paint color must be used to impede on these activities.
- **Traffic protection / visibility** – The site must be located somewhere where it can be safely accessed without being a danger to pedestrians or traffic.
- **Microphone calibration** – The microphone must be calibrated on a regular basis to ensure the data being collected is not unusable or skewed by any factor. Noise meters have a set decibel level that they are calibrated to. The calibrator will emit this set decibel level to which the noise

meter will recognize the calibration and display an offset of how skewed the reported data previously was.

## J.5 Procurement

Below are some key items that can assist an airport in the creation of their procurement documents. These items can be used as guidelines that can be tailored to each individual airport and may vary based on the local codes/regulations.

### J.5.1 Microphone Height

The microphone should be mounted with its axis of vertical symmetry. The microphone height should be placed at least six (6) meters above the ground level or at least three (3) meters above neighboring rooftops, whichever is higher above the ground[31]. No obstructions which influence the sound field from the aircraft should exist within three (3) meters of the microphone. The mounting pole used for the microphone should include a tilting mechanism to present the microphone at or near ground level for servicing and calibration.

The tilting mechanism should be operable by one person safely, and the mounting pole and tilt mechanism should be of materials and design to withstand the weather and exposure of the local weather environments.

### J.5.2 Clock

Clock or time is used to correlate noise data with aircraft radar data. The remote site noise monitor internal clock should be synchronized to the central system clock, such that the remote site clock and central clock do not differ by more than plus or minus two (2) seconds at any time. Central site communication should report the comparison of remote site clock and central system clock on a daily basis. The system should automatically adjust for Daylight Savings Time and leap years. Respondents should describe how the system clock will synchronize with the radar system clock. Respondents should also describe the time standard to be used to set the master clock (National Institute of Standards and Technology (NIST), Global Positioning System (GPS), etc.).

### J.5.3 Data Transmission Requirements

Data Transmission from the NMTs to the central location should be continuous for near real-time display or should provide for intermittent download. The transmission hardware and software should provide for a resolution of at least 0.1 dB in all data and for appropriate validity checking of all transmitted data. Data download from NMTs should be done at least once per day, and more frequent downloads may be included. At the airport's discretion, as commanded from the central computer site, noise data should be collected real-time for observation in the noise office. During such real-time reporting, normal collection, storage, and downloading of data should not be interrupted. Provision should be made for

[31] Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 4721, Monitoring Aircraft Noise and Operations in the Vicinity of Airports, Section 3.1.2 Microphone Requirements.

indicating calibration status and specific periods of lost data caused by memory overflow, power loss, or equipment malfunction. In the event of power loss or failure to pass a calibration test, the NMTs should initiate communication with the central station and report the malfunction. Such communication should be repeated on a regular basis until the central system acknowledges receipt of the information. All data transmission should include error checks to verify quality of data transmitted.

### J.5.4 Backup Electrical Power

Each NMT should provide backup electrical power of sufficient capacity to allow full operation of the site for at least three (3) days, with seven (7) days preferred. Respondents should identify any additional costs associated with backup power longer than three (3) days. Said system should be self-resetting after any power failure. Further, all stored data should remain in the system and be retrievable for a period of at least 30 days after loss of power. In the event of a loss of power, NMTs should provide indication of such to their central computer. This latter requirement is not in effect if loss of power and loss of telephone communication occur simultaneously (however, once telephone/wireless communication is re-established, the NMT should report the power loss). The central computer will give an alert to system users if communication has been lost with the remote unit.

The remote unit should have provision for the manual application of external power from a battery to allow continued operation when main power cannot be restored in three (3) days. Provision for this external battery should be accommodated within the site enclosure and the NMTs should include auto-restart capability should there be an interruption of power.

## J.6 Additional Resources

An airport can also refer to the following documents for more information on NMTs. These documents also referenced in **Appendix A: Literature Review.**

1. *Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 4721, Monitoring Aircraft Noise and Operations in the Vicinity of Airports: Part 1 System Description, Acquisition, and Operation & Part 2 System Validation, 2007.*

   This SAE ARP provides guidance for monitoring aircraft noise and operations in the vicinity of airports using either a portable or unattended monitoring system. Part 1 provides guidance on the components, installation, and administration of permanent systems and guidance on the analysis of data collected from the temporary monitoring of aircraft noise. Part 2 provides detailed statistical methods for assessing the uncertainties associated with system measured data.

2. *International Standards Organization (ISO) 20906:2009, Unattended Monitoring of Aircraft Sound in the Vicinity of Airports, 2009.*

   ISO 20906 is solely for permanent airport noise monitoring systems and is generally similar to ARP 4721. ISO 20906 provides guidance in the following areas, including performance specifications for instruments, requirements for the installation and operation, requirements for monitoring the sound of aircraft operations, requirements for the quantities to be determined

to describe the sound of aircraft operations, requirements for data to be reported, and procedure for determining the expanded uncertainty of the reported data.

# Appendix K: Noise Management Program Development Guide

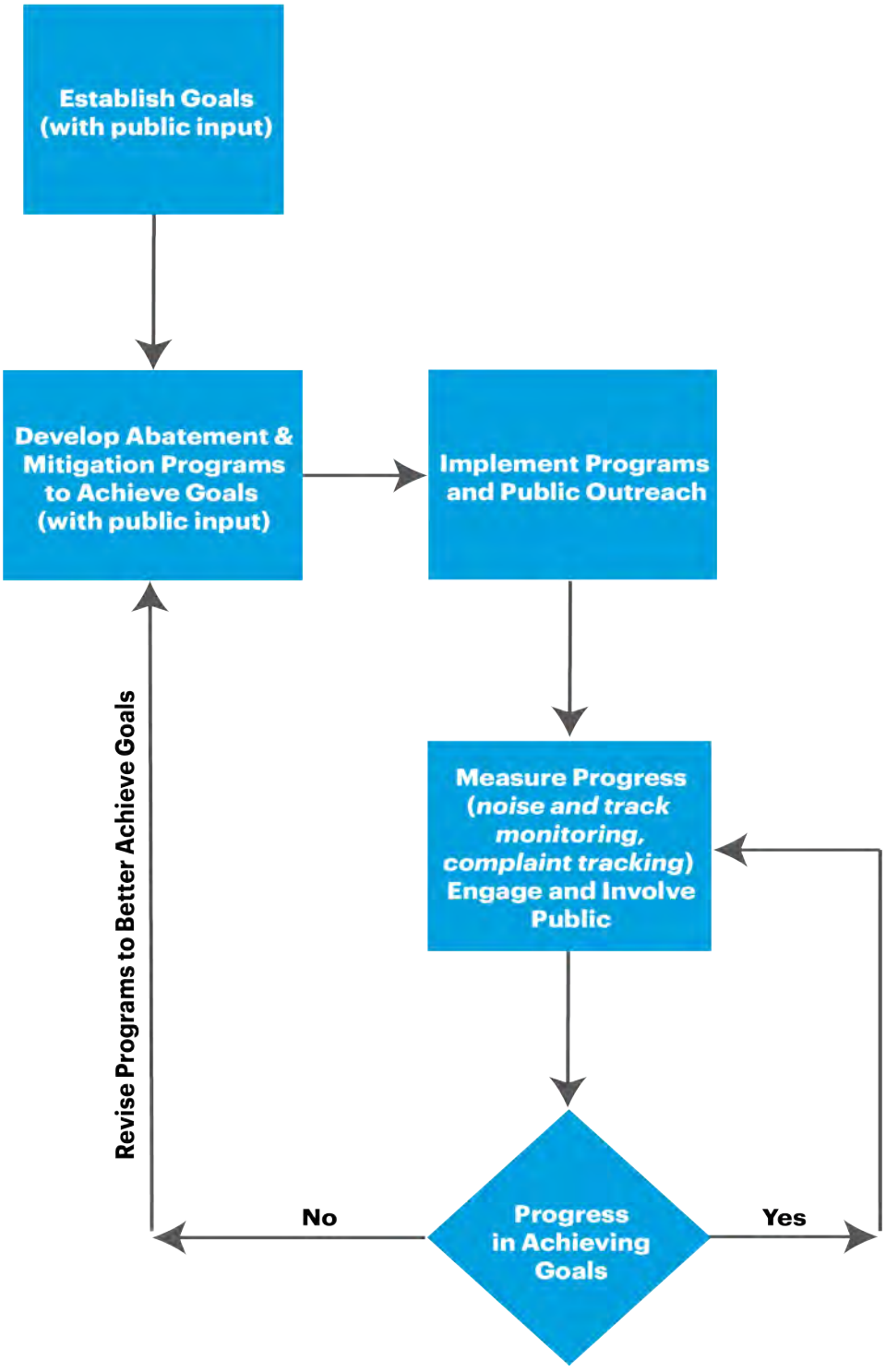
## K.1 Introduction

This guide is provided to assist in the development of an airports noise management program. It is presented as a two-level program. First, there is the overall airport noise management program of which the noise monitoring system is a component. Secondly, there is the management of the noise monitoring system itself. The information in this guide is based on the Research Team member experience working with airport noise issues and a Noise and Operations Monitoring Systems (NOMS). This experience includes assisting dozens of airports with NOMS specifications, NOMS installation and acceptance testing, NOMS updates and training, noise analysis, noise measurements/modeling, noise monitor site selection, and development of noise management programs. Additionally, by working closely with airports, Research Team members have observed best-in-class noise management programs and lessons learned.

An airport's overall noise problem is highly unique to a particular airport; this discussion is meant to be general in terms and suitable for a major metropolitan airport or a smaller general aviation airport. There may be any number of issues that a noise management program attempts to manage, including large numbers of noise complaints, pressure from the community to change operations and local opposition to airport development programs, and threats of or initiation of legal action. The term, "manage" airport noise, is used here in the true sense of actively managing the situation using modern management tools. Unfortunately, once airport noise problems start, they often will continue to require ongoing management to seek community cooperation and allow the airport to meet the region's air transportation needs.

An airport noise management program can be defined as a process shown in **Figure K-1*, Airport Noise Management as a Process***. The steps of the management process are to set goals, develop noise mitigation and noise abatement programs, implement noise abatement programs and public outreach programs, measure program progress and compliance/performance using the NOMS, periodically review progress and maintain or modify programs as needed, and engage stakeholders. In the overall context of the noise management program, the NOMS is the means of generating data to assist in the development of programs and measurement of progress to achieving the airports objectives. The NOMS is much like a business accounting system. Accounting does not produce any revenue but is essential in determining the success of the business and providing data to grow or manage problems. A NOMS by itself does not reduce noise, but is a key tool to analyzing problems, developing programs, and measuring the success of those programs.

## Figure K-1 Airport Noise Management as a Process




Source: Landrum & Brown, 2021.

## K.2 Managing the Operation of the Noise Monitoring System

Challenges that airports may face once a NOMS is procured include the allocation of qualified staffing resources (existing staff or new hire) and noise management training of staff. A NOMS is an effective noise monitoring and public outreach tool when operated by staff with the right combination of technical skills and software skills that can extract data from the system and convey information to stakeholders in clear and useful ways. Historically, the employment field of airport noise management has not been populated by a vast number of qualified candidates. Airports have generally had difficulty hiring staff to expand noise management offices or to backfill open positions. Potential staff may have an aviation background but not a background in aviation noise and community relations. Vendors generally provide NOMS training to understand the use of all system features. However, this type of training is limited and often does not include training on how to use the system to develop and monitor actual noise abatement procedures and supplement a noise management program.

A NOMS is a tool that is operated by trained staff that are a part of a proactive and innovative noise management program. Airports should view noise management as an important and valued environmental practice area and should allocate the proper amount of recruiting, compensation, and incentives (conference attendance, training/education, positive working environment, etc.). Additionally, airports should provide staff training and guidance associated with the application of a NOMS in order to address the airport-specific noise issues and the development of a noise management and public outreach programs.

The following subsections will address the needs in the key areas of office setup, staffing, developing policies and procedures, training, reporting, NOMS operation, and community relations.

### K.2.1 Noise Office Setup

This section describes the physical aspects of the noise office workspace. Considerations include space for meetings, including small conference type meetings or small public meetings (Note that the COVID-19 Pandemic required many business and public meetings to take place virtually online in 2020 and 2021. At the time of this research, it is unclear to know whether virtual online meetings will become the norm or a secondary option to face-to-face meetings). This will dictate the need for wall monitors or projection screens, workspace or cubicles for staff, locations of printers, plotters, servers, and storage space. If the airport has other space set aside for conferences or public meetings, then only the workspace for staff, equipment, and storage needs to be accommodated. The number of staff is addressed in the next section. When considering the staff workspace, it is common for staff to have workstations with a computer and commonly two large (at least 24-inch) video monitors. Additional equipment includes printers, data servers, an air traffic radio console and recorder, and possibly a large-scale plotter. Storage requirements include usual office supplies, noise monitor consumables (windscreens, spare parts, portable noise monitors, if any, etc.), file cabinets, and sufficient wall space for several aerial maps of the airport and the nearby communities affected by aircraft noise.

### K.2.2 Noise Office Staffing

The number of the noise office staff is not a fixed number. Generally, at minimum, staff would include one noise officer/manager and one technical staff. It is not recommended that the noise officer fulfill both roles of the office manager and technical operation of the NOMS because the number of technical

staff will vary with the complexity and output (complaint response, report production, number of community meetings, etc.) of the noise management program. At airports with strict noise rules, like noise limits, operating restrictions, and noise fines, the office staff may include 4 or 5 full-time positions. Airports with less rigorous data analysis requirements may require fewer positions. Often, the noise office will be called upon for making or developing presentations, brochures, or online reports including mappings and charts. The number of staff will ultimately depend on how much product is expected each month. The skill sets desired cover a wide range of needs. Ideally staff with have technical skills for operating the NOMS, troubleshooting the field measurement equipment, producing default system reports, developing custom reports including complex database queries, developing written reports, brochures, and presentations, responding to noise complaints (need for strong customer service skills), and making presentations to management and the public. Additionally, staff should understand airspace procedures and understand how and why aircraft utilize airspace in order to help the public understand the relationship between flights over their homes and flight procedures. To hire and retain an individual with all of the skills above is a challenging task in itself.

A noise office works best with a team of people whose skills mesh into a cohesive unit that is oriented towards high quality production. An additional task to consider is whether public relations/communications will be a part of noise office staff tasks or fulfilled by another group within the airport. This affects the skills needed in the noise office and the number of staff. In general, the public relations/communications for a noise office start-up may be handled by the noise officer and/or the airport manager.

### K.2.3 Noise Office Policies & Procedures

Every noise office should develop a Policies and Procedures Manual (PPM) to standardize methods within the office. The following outlines the contents needed in the PPM:

- **Noise Complaints** – Airports should have policies in place on whether complaints will be taken real-time, recorded on voice mail, or tabulated from online complaint entry. Note that some airports do not respond to each complaint while others provide personal call backs for each complaint. If complaints are answered live on telephone or telephone calls are returned to complainers, there needs to be clear policies on how to interact with the caller and there must be policies in place for dealing with callers that use inappropriate tone or language, including threats of any kind, and reporting such incidents to airport management and local or Federal law enforcement. Additionally, for complaint reporting purposes, airports should have policies relative to the number of days allowed for complaint response and whether one complaint entry (call, email, online entry, etc.) equals one complaint, or whether multiple noisy events identified in a complaint entry equal to multiple noise complaints.
- **Reporting Requirements** – A noise office may want to publish regular reports for internal and public use. Generally, these are done on a monthly and annual basis and may include complaint summaries, noise abatement procedure performance metrics, flight track map summaries, and measured noise level summaries. Standardized report formats should be used.
- **Workflow Procedures** – The most important aspect of a NOMS is that it is "healthy" with maximum uptime. Meaning, that it is collecting the correct amount of data and that it performs the internal processes necessary to maintain all of the system functionalities and features

agreed upon in the system specifications, procurement, and maintenance contract. Current NOMS are more stable compared to systems in the past, requiring less system health oversight by airport staff. However, system health checks should be a primary function of noise staff and procedures to perform these checks should be developed in coordination with the system vendor. Procedures should describe tasks to perform when data gaps appear, including field monitor troubleshooting when noise measurement anomalies occur or when connection is lost. Additional workflows should include data grooming to verify that noise-to-flight track correlation is correct and that the system calculates noise metrics correctly.

Other workflow procedures should include standard methodologies to produce the reporting requirements.

- **File Management** – Current systems will generally store data remotely on servers hosted by system vendors or in the cloud. Some airports will store data on their own servers. In any case, a staff member should verify at least weekly that backups of the airport data are being stored at the appropriate location depending on the system setup. The system vendor should have a standard report that documents file status and backup status.
- **Personnel Policy** – Airports will have policies in place and documented in the PPM. The noise office should have policies in place for adjusting staff responsibilities when someone is on sick leave, vacation, or is absent for any other reason (jury duty, maternity leave, etc.). The policy should clearly describe who covers for whom and what tasks can be delayed if a staff shortage occurs, as well as what tasks cannot be delayed and should be of the highest priorities (daily system health check and complaint response, for example).

### K.2.4 Noise Office Training

NOMS training is often considered only just prior to the NOMS becoming operational. This initial training generally covers basic system functionality and brief exercises using NOMS features; it is often not sufficient in terms of providing staff the knowledge to customize system utilization in order to monitor and report on the airport's specific noise abatement procedures (runway use, flight procedures, violations, etc.).

First, for a new system, the vendor training can be overwhelming, with too much information provided over too short a period of time. Second, there will always be a need for advanced training to cover more complex tasks in the system such as data grooming and noise metric calculations. Finally, the airport needs to recognize that there ultimately will be turnover in staff. If there is a staff of one, essentially all of the system experience walks out the door if that person leaves. There needs to be a policy in place on how to train new staff. The various aspects of staff training are presented as follows:

- **Develop Noise Office Training Manual** – This manual should be part of the deliverable from the system vendor(s). It should include all of the topics described below.
- **Initial On-Site Training** (1-2 weeks) – Initial on-site training needs to cover the following topics:
    - Terminology and noise metrics;

- Federal and State noise regulations;
- Office management;
- Development of report packages;
- System operation relative to that airport's noise management program;
- Customer service / Live complaint response;
- Portable noise monitoring (if applicable);
- Preparing information for the public;
- Public speaking/presentations.

While this training is key and is very important, it may overwhelm the noise office staff with a large amount of information. It should have as much hands-on experience as possible, with live airport data (as opposed stored data from another airport) and "cheat sheets" for reference for later use. Even with this effort, there will be a need for continuing or advanced on-site training on a biannual or annual basis.

- **Advanced On-Site Training** (1-2 weeks) - Advanced training, which is ideally conducted annually, should go over all materials included in the initial training and more advanced topics. This should be customized to fit the needs of the airport and may include the following topics:
  - **Query building** – It is preferred that a noise office should have at least one staff member that can build advanced database queries. For example, a query to know the average airline Sound Exposure Level (SEL) for the month of June including only night flights for operations on a particular runway by airline. An alternative is to have a service contract with the vendor or consultant to provide this support.
  - **Monitoring noise abatement procedures** – This is usually a mapping function to track aircraft that fall within or outside the desired flight corridors or runway use. This may include advanced query building.
  - **Noise complaint handling** – This is one of the most resource-intensive tasks within a noise office where complaints are frequent. The advent of phone apps to submit aircraft noise complaints means that airports may receive thousands of noise complaints in a short amount of time. In this case, responding to every complaint within a brief turn-around period would be challenging, if not impossible. Advanced training could be provided to develop and manage automated methods in order to respond to a large quantity of noise complaints.
  - **Noise modeling techniques** – Noise modeling is usually done by consultants outside the noise office, but the noise contours are typically loaded into the NOMS so that contour mapping can be done, sometimes with complaint locations or flight tracks shown.
  - **Equipment and system maintenance** – The noise monitoring system includes a great deal of hardware and software. In general, the software maintenance is done by the system vendor, but the staff should be able to monitor and ensure the vendor is doing

the job. The noise office staff is usually the first line of effort to diagnose hardware problems. They may do so by completing simple tasks such as verifying power is on, verifying the modem as operational, rebooting of hardware including modem, and possibly swapping out spares for major system components. Staff should be familiar and practiced on these tasks.

- **GIS training** – Airport NOMS are becoming more dependent on Geographic Information System (GIS) tools to analyze data. While many airports have separate GIS departments, the extent to which noise office staff can use the NOMS built-in GIS capabilities to perform spatial database analysis determines how powerful the system will be. The system vendor can provide some GIS training and it may be useful for selected staff to take GIS courses at a local college or online. These courses are widespread and are very useful for staff training.

- **Supplemental Support** (as required) – Every airport is unique. Staff, the vendor, or consultants may need to supplement the basic system operation. This may include setting up portable noise monitors, downloading portable noise monitor data, interacting with FAA regarding flight track acquisition, developing brochures for public distribution or the airport website, as well as responding to airport management requests for special studies.

Manassas Regional Airport
VIRGINIA

**AIRPORT COMMISSION AGENDA STATEMENT**

| | |
|---|---|
| **MEETING DATE:** | May 19, 2022 |
| **TIME ESTIMATE:** | 5 minutes |
| **AGENDA ITEM TITLE:** | Review of ACRP Report 237: Airport Noise Operations Monitoring System |
| **DATE THIS ITEM WAS LAST CONSIDERED BY COMMISSION:** | N/A |
| **SUMMARY OF ISSUE/ TOPIC:** | Last June, staff took part in a discussion with Landrum and Brown on Noise Monitoring Systems. Manassas was one of the three general aviation airports studied along with several air carrier airports. Virtower was also featured in the report. Staff will introduce aspects of the report and highlight the areas where Manassas participated in. The full primer and the excerpt from the Appendix is included in the packet. Information will be presented on PowerPoint slides. |
| **STAFF RECOMMENDATION:** | N/A |
| **DISCUSSION (IF NECESSARY):** | No Discussion |
| **BUDGET/FISCAL IMPACT:** | N/A |
| **STAFF:** | Richard Allabaugh, 257-8402 |

Airport Director

Attachment