



INTERNAL AUDIT REPORT

OPERATIONAL AUDIT
NOISE MONITOR DATA ACCURACY

JANUARY 2017 – FEBRUARY 2021

ISSUE DATE: March 25, 2021
REPORT NO. 2021-05



INTERNAL AUDIT

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Executive Summary

Internal Audit (IA) completed an audit of Noise Monitor Data Accuracy, for the period January 2017 through February 2021. The audit was performed to assess compliance with policies, procedures, and contractual obligations, and to evaluate internal controls governing noise program operations specifically with regards to accuracy of noise data.

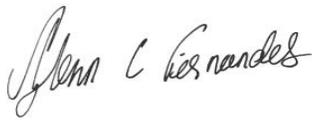
The Port owns 26 data monitoring terminals that capture airplane noise. The Port provides the data from these terminals to a third party, L3Harris, who among other functions, correlates the information to SEA flight data. Once the data is correlated, it is provided to the Port's Business Intelligence team, who using Tableau, generates reports for public viewing.

In general, Port Management complied with policies and procedures governing the Noise Program Operations. However, our audit identified an opportunity where internal controls needed to be enhanced.

This issue is listed below and discussed in more detail beginning on page seven of this report.

Medium – Our review of the noise monitoring program identified an opportunity to enhance the monitoring process so that the information provided to the public can be relied on. We identified instances where data was missing or appeared to be inconsistent, which could indicate that the monitoring terminals were not working as intended or that internal processes didn't process the data completely or accurately. This information is provided as a public service and no regulatory requirement exists for inaccurate or incomplete data. However, as a public agency, information that can be relied on should be available regardless of how it is used.

We extend our appreciation to Port management and staff for their assistance and cooperation during this audit.



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Responsible Management Team

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Background

The Port of Seattle has established a Noise Monitoring Program. The airport's flight tracking system, by use of 24 permanent noise monitoring sites, helps the Port monitor aircraft operations and flight paths, aircraft noise levels, and enables it to investigate citizen inquiries and identify trends.

The Port of Seattle offers the PublicVue flight tracking tool, which allows citizens to view flight activity at SEA. This tool provides additional information about flights, including aircraft type, airline, and altitudes. PublicVue can be accessed through the Port's Noise Programs website.

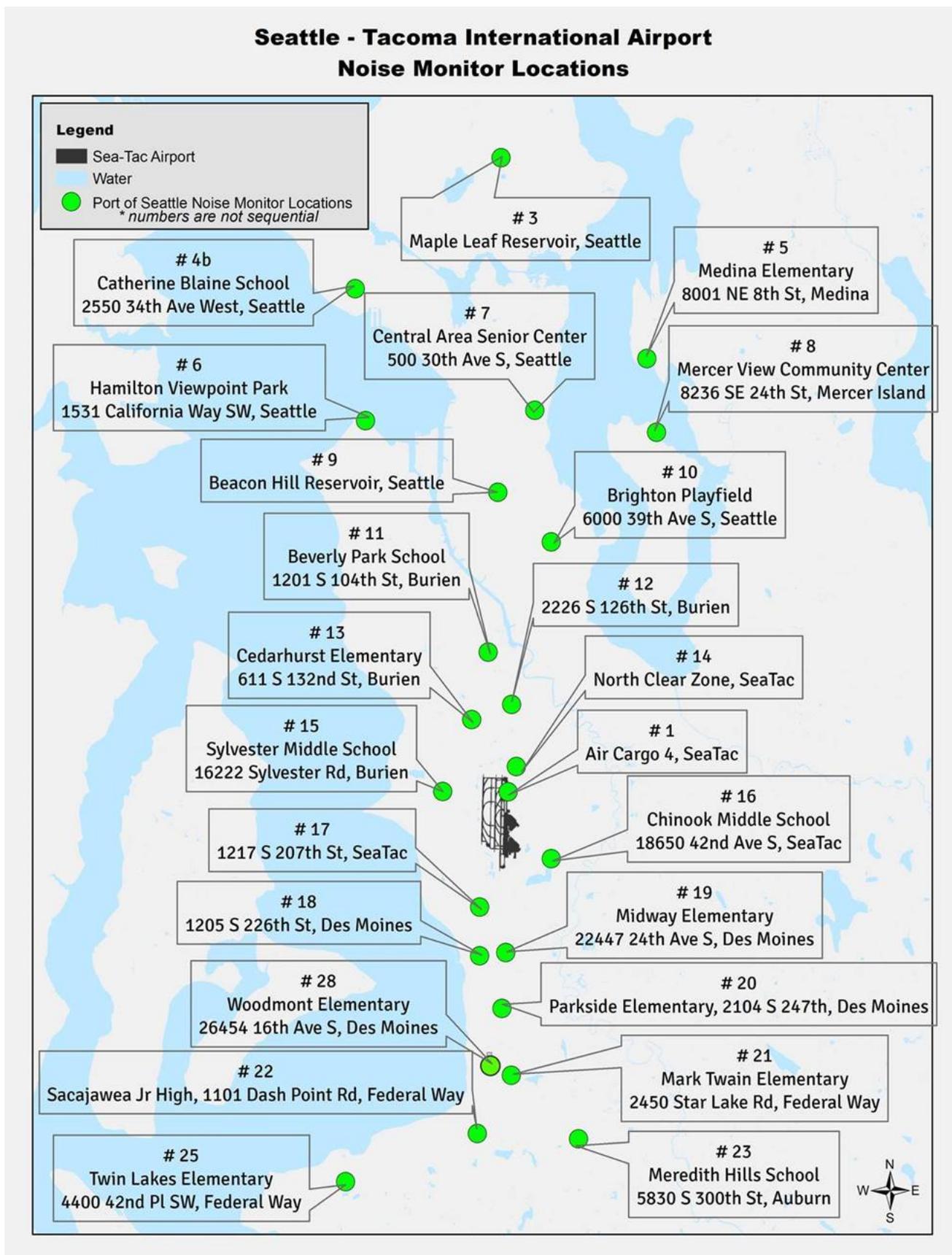
The following data sets are available to the public:

- Equivalent Continuous Sound Level (Aircraft Noise) – a cumulative metric that averages aircraft noise levels over a 24-hour period.
- Equivalent Continuous Sound Level (Community Noise) - a cumulative metric that averages community noise (all recorded noise not correlated with an aircraft overflight) over a 24-hour period.
- Equivalent Continuous Sound Level (Total Noise) - a cumulative metric that averages aircraft and community noise over a 24-hour period.
- Sound Exposure Level – a single event measurement of the total sound energy for one aircraft overflight.

The Port has contracted L3Harris, who provides the following services:

- Software – Provides the Port with user licenses for hardware and software use.
- Hosting Services – Application access and data storage of up to 10 years of data i.e. flight, noise, complaint, and weather data.
- Support and Maintenance – Includes annual calibration of noise monitors and maintenance response to meet service goals within contract.
- Complaint Management – Provides a web based application to capture public complaints.
- Public Portal – Provides a public to view noise data reports.

Noise Monitor Data Accuracy
Figure 1



Audit Scope and Methodology

We conducted this engagement in accordance with Generally Accepted Government Auditing Standards and the International Standards for the Professional Practice of Internal Auditing. Those standards require that we plan and conduct an engagement to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our engagement objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our engagement objectives.

The period audited was January 2017 through to February 2021 and included the following procedures:

Process and Procedure Review

- Reviewed documentation to determine whether L3Harris complied with key provisions stipulated in their contracts.
- Reviewed the noise data capturing and reporting process to determine if controls exist to facilitate complete and accurate data.
- Reviewed the complaint management process to evaluate how complaints are managed.

Data Analysis

- Obtained noise data for a two-year period to assess completeness and accuracy of the data.

Management Interviews

- Conducted interviews with management and staff, from various departments, to gain a better understanding of the various processes within the Noise program.

Schedule of Findings and Recommendations

1) RATING: MEDIUM

Our review of the noise monitoring program identified an opportunity to enhance the monitoring process so that the information provided to the public can be relied on. We identified instances where data was missing or appeared to be inconsistent, which could indicate that the monitoring terminals were not working as intended or that internal processes didn't process the data completely or accurately. This information is provided as a public service and no regulatory requirement exists for inaccurate or incomplete data. However, as a public agency, information that can be relied on should be available regardless of how it is used.

The Port owns 24 data monitoring terminals that capture airplane noise. The Port is also responsible for monitoring the information that the terminals produce and notifying L3Harris of the need for repairs or replacement. L3Harris was selected by the Port to perform a daily download of the noise data captured from the noise monitors and correlates that information to flight tracking data. Once the data is correlated, it is provided to the Port's Business Intelligence team, who then uses Tableau to generate reports for public viewing.

To assess the reasonableness of the data provided for public consumption, we obtained public testimony and traced them to source reports. We also identified anomalies, for the 26-month period ending February 2021, and inquired with management and L3Harris as to the cause and whether remediation efforts were performed.

Below are three examples that illustrate inconsistencies in the data:

- Monitor 9 did not remit LEQ aircraft noise data for approximately three months, from April 30 to August 08, 2020. On July 27, L3Harris identified the missing data and concluded the monitor was not functioning and needed to be replaced.
- The table below identifies the terminal and days where no aircraft noise data was captured for the two-year period ending December 2020. While explanations may exist for some, others could represent a more pervasive issue requiring proactive steps to address.

Noise Monitoring Terminal	No of Days with No Aircraft Noise Recorded	
	2019	2020
SEA03	4	7
SEA04	1	3
SEA05	1	N/A
SEA06	6	21
SEA07	1	1
SEA08	93	128
SEA09	25	99
SEA15	1	6
SEA16	8	23
SEA23	3	34
SEA25	11	24

Noise Monitor Data Accuracy

- The schedule below contains various examples that compromised the integrity of the information. The causes are varied and include a blown fuse, power outages, and communication issues.

Year	NMT #	Issue Noted By	Issue	Date Issue Noted	Root Cause	Resolution Date
2020	SEA09	L3Harris	The monitor was not recording any data from May until early August	07/27/2020	There was a breakage and the noise monitor was replaced. Issue appears to have started on 04/30/2020	08/08/2020
2019	SEA09	N/A	Missing data from 13th to 26th May	N/A. No ticket was raised	Not determined as the issues were not reported to L3Harris	As per L3Harris, this was a temporary issue that resolved itself
	SEA15	N/A	Missing data from 07th to 31st March	N/A. No ticket was raised		As per L3Harris, there was no issue and the missing data is available in the L3Harris system
2018	SEA07	L3 Harris	Missing data on the following dates <ul style="list-style-type: none"> April 23-30 May 1-8 	4/24/2018	L3Harris performed a site visit to confirm power and communication	NMT operational on 05/09/2018
	SEA12	Port of Seattle	Missing data from May 17th to 31st	5/17/2018	Blown fuse in the monitor hand-hole. Thinking it was possibly a connection problem, we had Seattle City Light troubleshoot first. Seattle City Light confirmed that it wasn't their issue and found that there as a blown fuse in the hand-hole. POS Electric Shop replaced the blown fuse	NMT operational on 05/31/2018
	SEA19	L3 Harris	Missing data on the following dates; <ul style="list-style-type: none"> May 17-31 June 1-30 July 1-2 	5/19/2018	L3Harris performed a site visit to reset power, re-seat connector on bottom unit and finally to replace LD831 monitor after spare was available	NMT operational 07/03/2018

Recommendation:

Management should develop a process to proactively identify and resolve system outages. This process should also include establishing criteria (i.e. frequency of breakdowns, variance analysis) to trigger servicing and replacement decisions, in line with the service response goals outlined in the agreement with L3Harris.

Management Response/Action Plan

The Noise Programs Office has taken many steps in recent years to provide as much information as possible to the public via our website. This includes (among other items) monthly complaint reports, late night operations information and monthly noise monitor data. It is very important to our team to provide the most complete noise data possible.

This audit was a great opportunity to have a team that may not be familiar with noise monitoring systems evaluate our data and processes. This exercise, and the auditors' recommendations, have highlighted ways in which we can improve the reliability and completeness of our noise data. As a result, we have put into place measures that will greatly limit the possibility of data gaps and prolonged interruptions in the future.

Action Items

A system report email to Noise Programs staff now arrives each morning from L3Harris displaying the status and performance of each monitor. This report is reviewed daily by Noise Program staff to more proactively address any data interruptions. If flight track to noise correlations are missing from a normally busy monitor or if any electrical interruptions are shown, Noise Program staff will immediately contact L3Harris support to initiate investigation and resolution.

L3Harris has also instituted a process for daily internal checks of the monitor system and a more proactive response. We have seen this proactive process come to fruition in recent weeks as we have established our portable noise monitoring program.

The Noise Programs staff will work with the Port's Business Intelligence staff to identify ways to improve the transfer of noise data to the external web Tableau site and establish checks for data set completeness. As part of the auditor's recommendations, the Tableau site is now being updated to include public messaging on data gaps and system issues.

For the comprehensive management response, refer to Appendix B.

DUE DATE: Immediately

Appendix A: Risk Ratings

Findings identified during the audit are assigned a risk rating, as outlined in the table below. Only one of the criteria needs to be met for a finding to be rated High, Medium, or Low. Findings rated Low will be evaluated and may or may not be reflected in the final report.

Rating	Financial Stewardship	Internal Controls	Compliance	Public	Commission/ Management
High	Significant	Missing or not followed	Non-compliance with Laws, Port Policies, Contracts	High probability for external audit issues and / or negative public perception	Requires immediate attention
Medium	Moderate	Partial controls Not functioning effectively	Partial compliance with Laws, Port Policies Contracts	Potential for external audit issues and / or negative public perception	Requires attention
Low	Minimal	Functioning as intended but could be enhanced to improve efficiency	Mostly complies with Laws, Port Policies, Contracts	Low probability for external audit issues and/or negative public perception	Does not require immediate attention

Appendix B: Comprehensive Management Response

The Noise Programs Office welcomes the opportunity to improve the process for addressing monitor maintenance issues, as well as the completeness of noise data reporting to the community. Based upon the maintenance issue at one of the monitors in 2020, and early feedback from the auditing team, our office has already taken steps to improve these processes. Those changes, as well as responses to the specific issues referenced in the report, are discussed below.

Overall Assessment

Overall, the noise monitoring system has operated exceptionally well given the challenging environments and weather conditions that they often operate under. Total yearly days without pairing noise events with aircraft overflights (known as correlation, which is needed to interpret the results) is less than 3% for all monitors in 2020.¹ The yearly percent of operational time for all monitors remained high at 98.5%. Only 3 of the 24 permanent monitors had mechanical issues that resulted in downtime in 2020.²

Noise Monitor SEA09 outage in 2020

In late April 2020 Noise monitor SEA09 began to display a constant dB reading while appearing to be operational on the PublicVue site. However, the monitor was not correlating noise events to aircraft overflights and this was not noted until July when L3Harris was investigating a different issue at the site. This monitor issue was unusual in nature and never encountered before therefore checks were not in place to identify the issue at the time by either L3Harris or Port staff. An L3Harris technician visited the site in early August and found that the monitor was inoperable and needed replacement. The replacement monitor was then put into service.

Multiple days in 2019 and 2020 noted in report without noise event correlations

The 24 permanent noise monitors are sited to capture aircraft noise from various operational conditions and flight paths. A large portion of the monitors are placed directly under established flight paths to the north and south of the runways, while others are placed in further-out locations to capture noise during specific operational conditions. One of the factors that influences correlations at these monitor locations is the direction of SEA operations – south-flow or north-flow. As such, it is not unusual for many of the monitors noted to have days with no aircraft noise events, as shown in the report. This is typically not a mechanical or software issue but rather a lack of aircraft in the vicinity at the time and is a condition that applies to many of monitors noted in the report. We have included additional related information and maps at the end of this document.

Various maintenance issues noted in 2018-2020

Noise monitors are sensitive instruments that are exposed to the elements and the uncertainties of

¹ The system can never operate at 100% correlation, because it includes noise monitors that are designed to capture only specific conditions.

² The system experienced downtime at Monitors #25 with a minor communications issue, #17 which was struck by a car, and #9 with a complete failure of the unit.

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their immediate environments, all while operating 24 hours per day. As the maintenance issues that are listed indicate, many challenges can and will arise in the operation of an extensive system. It has been beneficial to Noise Programs staff to compile and research these maintenance items from the past as part of this audit process.

Action Items

A system report email to Noise Programs staff now arrives each morning from L3Harris displaying the status and performance of each monitor. This report is reviewed daily by Noise Program staff to more proactively address any data interruptions. If flight track to noise correlations are missing from a normally busy monitor or if any electrical interruptions are shown, Noise Program staff will immediately contact L3Harris support to initiate investigation and resolution.

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Summary

The Noise Programs Office has taken many steps in recent years to provide as much information as possible to the public via our website. This includes (among other items) monthly complaint reports, late night operations information and monthly noise monitor data. It is very important to our team to provide the most complete noise data possible.

This audit was a great opportunity to have a team that may not be familiar with noise monitoring systems evaluate our data and processes. This exercise, and the auditors' recommendations, have highlighted ways in which we can improve the reliability and completeness of our noise data. As a result, we have put into place measures that will greatly limit the possibility of data gaps and prolonged interruptions in the future.

Additional Monitor Information:

Monitor SEA03 – The northernmost of the monitors located in the Maple Leaf neighborhood. This monitor is positioned to capture south-flow arrivals. The high altitudes and varied flight paths can make this challenging on some days. It may not capture any noise events on north-flow days.

Monitor SEA04 – Located in Magnolia. This monitor captures a portion of south-flow arrivals and the number of overflights can vary from day to day. It may not have noise events on some north-flow days.

Monitor SEA05 – Located in Medina. This monitor is intended to capture some north-flow departures and perhaps a few south-flow arrivals. In both instances, the aircraft are at high altitude which can make correlations challenging.

Monitor SEA06 – Located at the north end of West Seattle. This monitor is sited to capture noise events from south-flow arrivals and north-flow departures. However, in accordance with SEA noise

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abatement flight procedures, these aircraft are required to stay to the north of West Seattle over the water. Therefore, the monitor will likely only capture a noise event if an aircraft fails to adhere to the procedure or passes very close to shore. On many days, aircraft will remain distant from the monitor over the water and not cause any correlations to occur. This is a preferred outcome.

Monitor SEA07 – Located in central Seattle. This monitor is sited to capture north-flow departure aircraft as they begin to turn east. It can also monitor south-flow arrivals; however, it is sited east of the path and may not correlate on some days.

Monitor SEA08 – Located on the northern end of Mercer Island. This monitor is intended specifically to capture north-flow departure aircraft as they fly eastbound over Lake Washington. However, it may not capture any aircraft events on south-flow days.

Monitor SEA09 – Located on Beacon Hill. The days of missing noise events are due to maintenance issues previously noted.

Monitor SEA15 – Located west of the runways in Burien. This monitor has very few direct overflights – some days none. It is intended to capture the noise from aircraft on the ground from landing, taxiing and takeoff roll. Direct correlations can be sporadic from day to day.

Monitor SEA16 – Located east of the runways in SeaTac. This monitor has very few direct overflights – some days none. It is intended to capture the noise from aircraft on the ground from landing, taxiing and takeoff roll. Direct correlations can be sporadic from day to day.

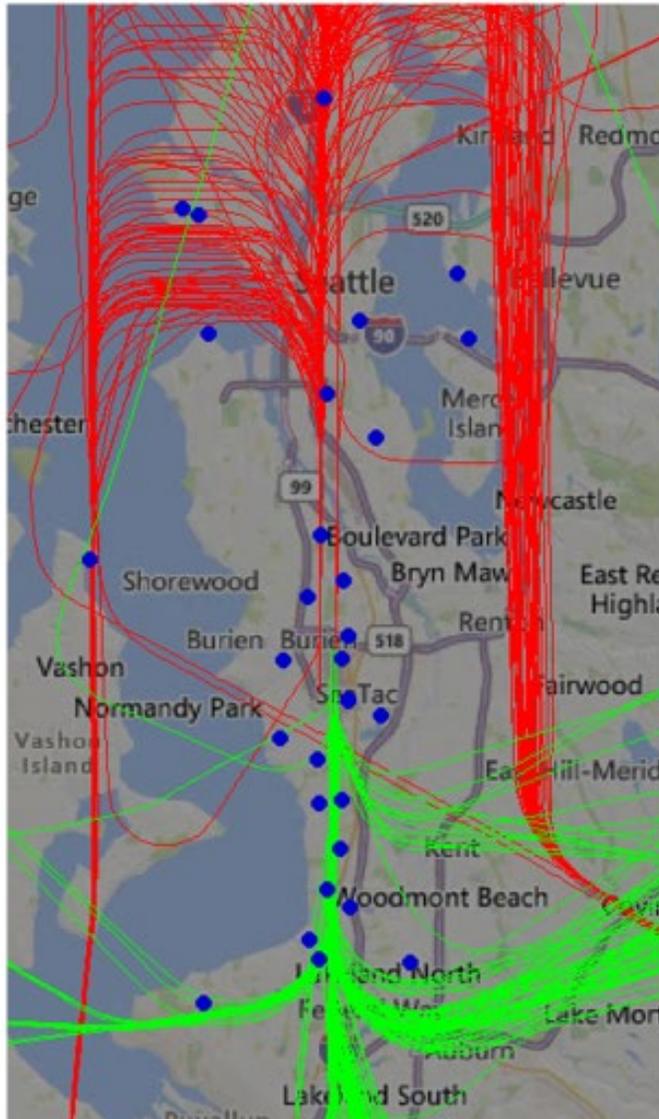
Monitor SEA23 – Located in eastern Federal Way. This monitor is sited to capture south-flow departures as they turn east. Due to high altitudes and varied flight paths, correlations can be challenging on certain days. It may not have any correlations on north-flow days.

Monitor SEA25 – Located in western Federal Way, it is the southernmost monitor from the airport. This monitor is sited to capture south-flow departures flying west. Due to high altitudes and varied flight paths, correlations can be challenging on certain days. It may not have any correlations on north-flow days. A few of the days indicated may be due to maintenance issues.

Example of South Flow Flight Tracks and Noise Monitor Locations



P.O. Box 1209
Seattle, WA 98111-1209
Tel: (206) 787-3000



South-flow operations and the monitor locations (includes 3 temporary locations)



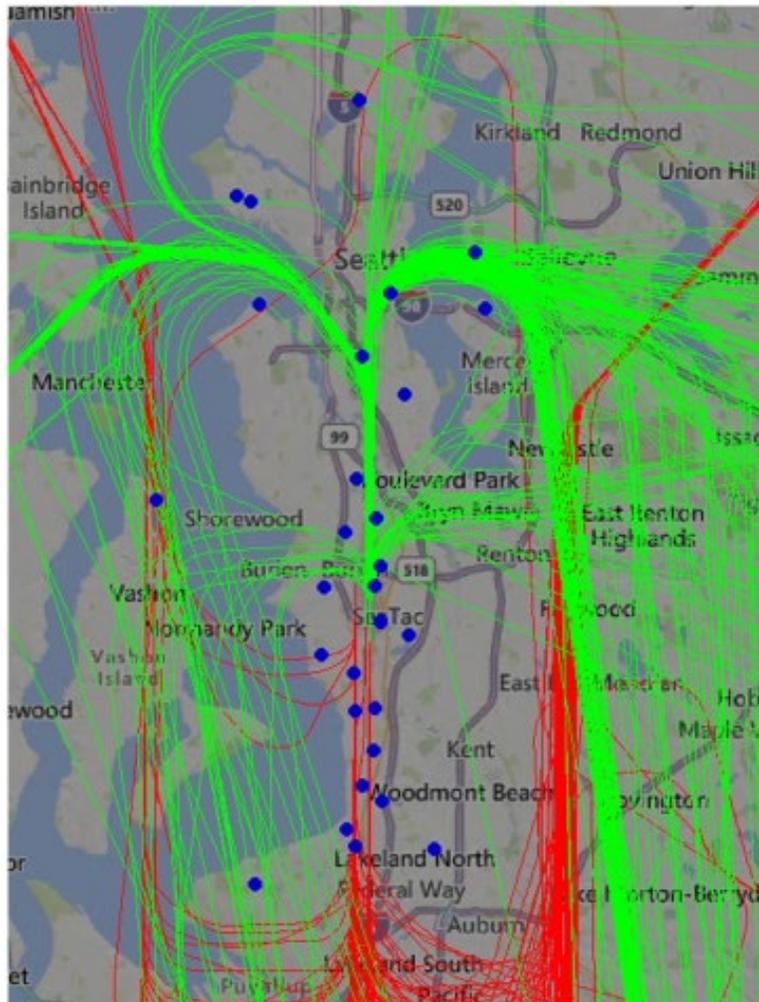
Legend

- Departures
- Arrivals

Example of North Flow Flight Tracks and Noise Monitor Locations



P.O. Box 1209
Seattle, WA 98111-1209
Tel: (206) 787-3000



North-flow operations and the monitor locations (includes 3 temporary locations)



Legend

- Departures
- Arrivals