Flightseeing Noise Study

Methodology Presentation

Paul Dunholter, BridgeNet, International

Public Meeting
July 27, 2000
Centennial Hall

The following text is a summary of the methodology presentation given by Paul Dunholter, Managing Director of BridgeNet International and acoustic consultant for the project.

STUDY OBJECTIVES

1. ***Quantify flightseeing noise levels using a variety noise metrics***

The Baker Project team will quantify flightseeing noise levels by focusing on measurement factors that are important to and have been identified by members of the public who are affected by flightseeing noise. The study will not rely on only the one metric recommended by the FAA.

2. ***Quantify other sources of noise*****.**

The Baker Project Team will determine how flightseeing noise affects noise levels relative to the existing background noise.

3. ***Identify what factors are important when determining the impact of flightseeing noise on affected citizens.***

The Baker Project Team will gather information from impacted citizens to determine what it is that impacts citizens the most. Is it the constant flights, the duration, the time of day when it occurs, etc.?

4. Validate the noise model.

An important objective of the noise measurements is to validate a noise model so the Baker Project Team can predict what happens when factors change. Ultimately, we want to measure how loud the helicopters, the flightseeing floatplanes, and other aircraft activities are, but first it is necessary to make sure the model is accurate relative to the local situation. We can't measure the future, but we can predict or model the future. We are refining a tool that allows us to see what would happen if we change some of the factors.

5. Identify potential mitigation measures.

The Baker Project Team’s role is not to implement mitigation measures. Rather, it is to identify mitigation measures (based on citizens’ recommendations and the study data) that are worth pursuing and have potential for improving the flightseeing noise situation.

Propagation of Noise

Noise generates a certain noise level that changes as it moves away from the source. Meteorology in Juneau creates a unique situation. It not only affects where aircraft fly, it also affects how aircraft noise is propagated. The high humidity, inversion conditions, and tunnel off the mountains, means that Juneau gets louder noise per type of operation than you would get in normal conditions. The noise tends to propagate much farther than it would in a desert type environment. Meteorological data will be important to collect as part of this study because it influences how the noise propagates.

Frequency Weighting Scales

Noise is complex and it is made up of many frequencies. This creates problems when doing noise studies. Normally, studies relate frequency to how the human ear hears noise. People do not hear low frequency noise as well as they hear mid-range or higher frequency noise. In community noise analysis, we try and weight the frequency to how the human ear hears noise by using what is called an A-weighted noise metric. It gives a single number rating of the sound and is the most common metric used for community noise studies. We will use it in the study along with spectral data.

Types of Noise Metrics

There are lots of different ways to describe noise, but we can categorize it into single event metrics and cumulative, or metrics that average events over time.

Single Event: How loud is one helicopter or plane as it goes overhead? What is the noise level from one aircraft?

Cumulative: Something that is summed over time. What is the total noise from all 20 of those helicopters in the last hour or so? How many minutes did I hear helicopters in the last 2 hours?

The primary metrics, both single event and cumulative that we will be looking at in the study at are as follows:

Single Event Metrics

Maximum Noise Level. A single event is when you have a plane going overhead. The noise is quiet, increases to a peak and drops back down again as it goes overhead. The maximum noise level is the highest level that it reached.

Sound Exposure Level (SEL). This metric has been a good predictor for aircraft noise because it takes into count not only how loud the sound is but also the duration of that sound. If you were to compress that noise energy into seconds, how loud would it be?

Cumulative Metrics

LEQ (Noise Equivalent Level). Research for community noise has found that if you were to sum the total noise energy of what a person is exposed to over time, it would relate back to whether a person was bothered or not. So the more noise energy they get, the more potential for annoyance. Noise is on this logarithmic scale, so a sound going from 70 dB to 80 dB is 10 dB louder or 10 times the amount of noise energy. If you go from 70 dB to 90 dB, it is 20 dB louder, but has 100 times as much noise energy. If you have 15 minutes of continuous noise with four to five overflights, the energy average of the noise would be the LEQ. It is a common metric in community noise and it is also the building block of the DNL.

Time Above Noise Level. This metric measures the amount of time the noise event is above a certain noise level. Often people relate that to how often one is hearing the helicopters or aircraft overflights. Is it two minutes a day or is it five hours a day? It is often a good measure of your exposure. We measure continuous noise and find a threshold or some value that is common. The time above (TA) 65 dBa would be the amount of minutes that you might experience speech interference. We would count how many minutes, add those up overtime, and that would tell us how many minutes a day it the noise event is above a certain noise level. It can be a good indicator of what the impacts are to you.

DNL (Day Night Level). The Federal Aviation Administration's (FAA) criteria and most commonly metric used in aircraft noise assessment is DNL. It was the metric used in the Part 150 Noise Study that was done at Juneau International Airport. The FAA, the Environmental Protection Agency (EPA), and almost every government aircraft organization in the world recommend it. DNL is a sum of all the noise, but it is not very well liked by a lot of communities. In part it is because the measurement averages the noise over time. Helicopter and tour operations don't have a lot of night activity, and that can push the numbers down a bit.

Noise Effects on People

Noise has some adverse effects on people that have been studied through research funded by different government agencies. There are a lot of studies on it, and it's ongoing continuous research. The effects have not been fully understood, but most of the research has dealt with noise relative to commercial airports.

1. *Hearing Loss* (Not typically an issue with aircraft noise.)

2. *Communication Interference.* When aircraft overflights occur above a certain noise level, you may have to raise your voice to talk, you may have to stop talking altogether, or it may be difficult to understand someone when they are talking. There are different ranges of interference and researchers relate that to distance vs. noise level. How much do you have to raise your voice to be able to talk? Most people talk about 65 dBa or so, and anytime the noise gets above that, you start to have speech interference. You could have a different value when you are indoors.

3. *Sleep Interference.* This is not so much an issue here, but there is research where they put electrodes on people living near airports to see what noise levels tend to wake up. Kind of a hard thing to really study because it isn't exactly the noise, because some people can sleep through anything happening at night, but the muffled cry of your child will wake you up instantly. Your brain is in there listening for things all the time and it can filter out noise.

4. *Responses*. Does the noise get your heart beat going, etc.

5. *Annoyance and Community Response*. This is something that is very controversial and important relative to some of the issues at Juneau and the helicopter noises. Researchers have taken surveys of people asking if they annoyed by aircraft noise, while at the same time, they try to document what the probable noise levels are that people are exposed to. They come up with a curve that says what the noise level is vs. the percent of people annoyed. This is a curve that is pretty well accepted throughout the United States and worldwide in terms of aircraft noise exposure. What the common criteria is used is around 65 DNL. What it ends up saying is about 12 percent of the people are really annoyed.

Research on Helicopter Noise

What is really most important to Juneau citizens is that there isn't a single one of the 500-600 research studies that were done specifically for helicopter noise. So, there is well-funded and established research, but the research never really has been done relative to the situation citizens are exposed to here.

An agency that has done the most amount of studies relative to in-route noise and flightseeing noise is the National Park Service (NPS). They have done some similar curves (annoyance vs. noise level) based upon a couple of other metrics like the LEQ or audible duration of noise. This is another type of annoyance curve that we can look at in this study to describe the Juneau situation. It is a similar sort of thing in that if noise goes up, the potential for people being bothered also goes up.

Study Methodology

What we are proposing here tonight is to get your input on where to measure the noise, talk about the sort of data we propose to collect, and give you an idea of what some of the results might look like.

The measurement data that we will get first is acoustic data. We have noise monitors that we have put out in the field so we can collect noise continuously. We will digitally record each one second value and store it so we have a continuous record of what happens. We put that information into our software programs and calculate metrics of interest.

Second, we will also do sample periods of frequency data to get those spectra information, as well.

Additionally, we need to know what is causing the noise so we will be getting aircraft flight information. We will have our people here watching what's going on, watching when the aircraft are taking off, what their path and altitude are, and what procedure the aircraft are using. We will document the information by the type of aircraft. We will also use flight path information so we can reconstruct the paths the aircraft generally fly.

We will also obtain noise complaint data that the CBJ has been collecting over time so we can see trends from that information. We will have weather data for the same time period that we are getting noise and flight information in order to correlate all of the data together. When we measure a noise event, we will be able to say what operation or what flight caused that noise and know information relative to the event. When we have a massive data base, we can compare that to what we would predict from a model, make adjustments to the model and predict anywhere at that point in time.

There are a certain number of sites that we've identified, but not the location. The monitor will be setup to gather about a week's worth of data, maybe a little bit more. It will not necessarily be a continuous measurement. We might be moving the monitors around, but we would be continuously be measuring all the noise. Then we would be able to compute the DNL, LEQ, Single Event, Time Above, or whatever metrics we are interested in finding out at each of those sites.

In addition, we have another fifteen shorter term background sites where we will do similar kinds of measurements, but not as long (number of hours a day for a few days). The measurements will provide another snapshot to fill in different areas of noise.

Finally, we will take indoor measurements at four homes. We want to measure what the relative difference is between and outdoor and indoor noise event and we can use that information to predict what the indoor noise levels might be.

Site Measurement Criteria

We want to measure where the aircraft are flying and where other noise sources are happening that are important to people. The locations need to be representative of the exposure of a community and of the noise environment in the study area. It must be a representative spot of background and aircraft noise. The monitors must be situated in order to receive a variety of exposure so that we measure noise in different environments. They must be spatially distributed around the whole Juneau area. Generally we are looking at sites down the Gastineau Channel, up in the Mendenhall Valley and glacier area. We also want to spread the monitors around on Douglas and North Douglas. In addition, the following limitations apply to the placement of monitors.

Monitors cannot be next to a highway if most of the homes are not on that highway.

Monitors cannot be close to a localized noise source such as right next to a stream.

Monitors cannot be located in a spot where there is a lot of high wind noise that is different than everywhere else.

Monitors cannot be severely shielded from aircraft noise.

Measuring the Noise

Since we have a bunch of monitors out at once, we call it a network of monitors. If you have monitor sites down the Gastineau Channel, when the helicopters go down the channel, the monitors will record an event at each site as they go by. We will get a sequence of noise as the aircraft pass each of the sites.

Time history plots of an overflight and how loud they get will help us calculate the SEL value. We do a plot that of the daily noise events so that you can see graphically what time of the day has the most impacts relative to number of events. Once we've correlated noise to the aircraft that caused the event, we can look at lots of data, and see which sort of activities are causing the highest single event noise.

Spectral noise measurements data will show us the noise frequency. Helicopters have a lot of the blade slap sound, and that kind of noise will show on this measurement data.

From the indoor/outdoor measurements we can measure the reduction from outdoor to indoor. Once we measure at a few houses we can use that information to know at other locations, as well. If we know what it is outside we can then predict what it would be inside.

We will be able to identify the relative contribution of different sources of noise. Which is the biggest contribution to the noise at any particular spot and other things such as the ambient noise or how quiet it gets when nothing else is going on.

In a weather vs. noise graph, we can plot noise in overcast vs. clear weather conditions and show the relative difference.

We can do some modeling with the aircraft flights paths, what the different altitudes might be, and what the noise might be in different situations.

We will present some noise contours on single event noise levels, a foot print of a certain operation, typical operations under different procedures at each of the different sites.

We have a model that shows a plane flying and the width of the noise exposure and how that sound changes as the plane gets higher and farther away. We can predict how that noise would change at a different altitude or if you had a bunch of aircraft in sequence vs. one a time.

With the information at the measurement points, we will also have a model that is able to predict noise if you did some sort of scenario change like different flights paths or different procedures. How would the noise level change. Then we are able to predict the change and see how it might vary relative to the metrics that have been described.

Validating a Model

What we are really wanting is to get a model that is reasonably accurate in predicting noise levels, not only where we are measuring, but in other places you would like to know about. We can also make predictions on some alternatives that you are interested in knowing about such as different procedures for flight paths. A lot has been done, a lot has been talked about, and this is not the first meeting you have ever had on this subject matter. There are no easy solutions left out there. What would be the effect of new technology? Are there regulation options? We evaluate Fly Quiet Programs which are like the Voluntary Compliance Program, but another step beyond.

We will start placing monitors tomorrow (July 28, 2000), and we would like to get your input on some of the sites to use. We will be monitoring for most of the summer, and will be moving around. We won't be at the same sites all the time.