City and Borough of Juneau

Flightseeing Noise Measurement and Assessment Study

Proposed Work Plan

BACKGROUND AND STUDY OBJECTIVES

The objective of the flightseeing noise measurement program is to provide sufficient base information concerning the acoustic environment within the Juneau community so that acoustics concerns can be incorporated into potential flightseeing decisions. The "natural quiet" is an asset of the community in much the same manner the scenery and forests are also an asset that is to be preserved and enjoyed by the community. This proposed scope of services is designed to provide an acoustic database and mechanism that will quantify the existing ambient and flightseeing noise environment and evaluate potential alternatives to minimize the potential noise impacts. This analysis should provide a technically complete and legally sound framework from which the CBJ may judiciously plan the future of flightseeing activities within the region.

The foundation of a successful study of this type is the accurate measurement and prediction of ambient and flightseeing noise environment in a manner that can be correlated with community response to sound from potential existing and potential flightseeing activities. Policy decisions resulting from this study will be subject to intense scrutiny from all interested parties. Any findings must have a strong technical basis if they are to be implemented. It is extremely important that the methodology in measuring and predicting noise impacts have an accepted technical basis of understanding, or else the CBJ would be forced into the position of having to define not only the proposed recommendations, but also the basis for which these recommendations are developed.

The purpose for the analysis is to provide comparative data to the CBJ as to the potential affects of various alternatives and noise abatement measures. *The key to this methodology is that it is not simply presenting complex and difficult to understand noise number. The methodology also attempts to relate that information back to what the potential affects are to people. The methodology also utilizes both traditional methods of analysis and non-traditional methods. It is important for all stakeholders to understand the value of each measure and the degree of impact that research suggests occurs.*

The following paragraphs discuss the methodology we propose to use to evaluate the flightseeing noise environment through a noise measurement and prediction survey. This technical approach discussion is divided into the following sections:

- Provide Mechanism for Meaningful Public Input Into Noise Assessment Study
- Develop Flightseeing Noise Assessment Criteria

- Noise Measurement Survey Methodology
- Noise Impacts Evaluation
- Mitigation Analysis

SECTION 1: PUBLIC INPUT

The Juneau community has had a long history of utilizing public input in the development planning decisions. The assessment of flightseeing noise is no different and public input is an important element in defining the purposes, goals and methodology of the noise assessment.

The public process should be a two way educational process. The public process will inform the CBJ what is important in terms of noise and noise affects. The process should also educate the public concerning what information a noise assessment can provide them and what noise abatement options are available.

Public Meeting

In the first public meeting, an important task is the review of the noise assessment methodology. The consulting team will present information on noise measurements, and noise assessment methodologies.

Citizens will also be asked to provide input on the noise analysis study. An important objective to be achieved in the public process is the selection of the number and location of the noise monitoring sites and on the methodology used to quantify potential impacts. The public will be able to provide input into what factors are important in terms of impacts to their environment. Factors that may be considered include:

- Time of day of flightseeing operations
- Number of flights
- Time duration of each overflights
- Location of impacts (indoor or outdoor)
- Indoor noise environment (windows open or windows closed)
- Type of Activity Interference
- Speech interference
- Communication

SECTION 2: FLIGHTSEEING NOISE ASSESSMENT CRITERIA

The description analysis and reporting of flightseeing helicopter and fixed wing noise levels is made difficult by the complexity of human response to sound the myriad of noise metrics that have been developed for describing acoustic impacts. The purpose of this element is to present background information on the characteristics of helicopter noise as it relates to the Juneau flightseeing, and present the types of acoustic information necessary to describe its impacts. It is important that the acoustic parameters used to describe the ambient and flightseeing noise levels are adequate for assessing potential noise impacts from helicopters and fixed wing aircraft.

A-weighted (dBA) Scale

Various rating scales have been devised to approximate the human subjective assessment to the loudness of a sound. Loudness is the subjective judgment of an individual as to how loud or quiet a particular sound is perceived. The human ear is not equally sensitive to all frequencies with some frequencies judged to be louder for a given signal than another. In order to simplify the measurement and computation of sound loudness levels, frequency weighted contours have obtained wide acceptance. The A-weighted (dBA) scale has become the most prominent of these scales and is widely used in community noise analysis. It gives a single number rating of the sound using a weighting of the different frequency components of the sound. Its advantages are that it has shown good correlation with human response to sound and is easily measured.

Contrary to the vast literature on impacts of aircraft noise on residents of areas near major metropolitan airports, which emphasizes the measurement of *annoyance* caused by aircraft noise, there is little research relative to impacts from in route tour operations in more remote settings. This is because it was argued that one of the primary reasons people give living in the Juneau area is to experience the soundscape generated by the natural world in the absence of human mechanical devices, which is not only qualitatively different but also usually much quieter than the typical urban or suburban soundscape. Thus, “natural quiet” has been argued for utilizing lower standards relative to the impacts in this study.

Research on the Affects of Aircraft and Helicopter Noise

Research that has been completed relative to aircraft and helicopter noise will be presented to citizens. It will include research completed by the Federal Aviation Administration (FAA), as well as other agencies responsible for aircraft noise evaluation. Other agencies that will be presented include research completed by the following organizations:

- FAA
- Federal Interagency Committee on Noise (FICON)
- Department of Defense
- National Park Service
- United States Forest Service
- Other Foreign Agencies that have studied aircraft noise

Research on Impacts from Aircraft Noise on People

Noise, often described as unwanted sound, is known to have several adverse effects on people. From these known adverse effects of noise, criteria have been established to help protect the public health and safety and prevent disruption of certain human activities. These criteria are based on effects of noise on people such as hearing loss (not a factor with typical community noise), communication interference, sleep interference, physiological responses and annoyance. Each of these potential noise impacts on people relative to the Juneau flightseeing issues will be presented.

Alternative Methods of Evaluating Impacts of Aircraft Noise

The description, analysis, and reporting of community sound levels is made difficult by the complexity of human response to sound and the myriad of sound-rating scales and metrics that have been developed for describing acoustic effects. Various rating scales have been devised to approximate the human subjective assessment to the "loudness" or "noisiness" of a sound. Noise metrics have been developed to account for additional parameters such as duration and cumulative effect of multiple events.

Noise metrics can be categorized as single event metrics and cumulative metrics.

Single event metrics describe the noise from individual events, such as an aircraft flyover.

Cumulative metrics describe the noise in terms of the total noise exposure throughout the day.

Noise metrics that may be utilized in this study will be presented for review to the CBJ and the public. The presentation will include a discussion of both single event and cumulative metrics.

- Single Event Measures
- Maximum level
- Sound Equivalent Level
- Time Duration
- Detectability
- Cumulative Measures
- Day Night Noise Level
- Daytime Equivalent Level
- Time Above Noise Levels

Final Methodology

The consultant will present a final methodology for evaluating the potential noise affects from Flightseeing noise. This final plan will be developed and presented based upon input from the CBJ and the interested public as they describe those factors that are important to them. The following is a preliminary methodology that may be modified based upon input received in the previous tasks. The key to this methodology is that it is not simply presenting complex and difficult to understand noise numbers, but also attempts to relate that information back to what the potential affects are to people. The methodology also utilizes both traditional methods of analysis and non-traditional methods. It is important for all stakeholders to understand the value of each measure and the degree of impact that research suggests occurs.

Many of the community areas to be evaluated (both those currently and potentially affected) lie outside the boundary defined by FAA as the significant noise impact area. *This analytical approach – using the available metrics and standards – will be based on accepted scientific studies.* The methodology suggested attempts to *combine various acoustic metrics, demographic data and mapping technology to paint a comparative picture of likely impacts* on people. The areas of impact that are being considered are as follows:

- flight frequency
- population affected by annoyance
- speech interference

For each of these issues, the consultant will recommend an appropriate metric, and as far as possible, present the results in a graphic format.

Different neighborhoods or individuals may find one metric or segment of the analysis more convincing than others, while some data may be considered less important. From an analytical perspective, however, each of these metrics and techniques is based on internationally accepted acoustic principles and on a significant amount of published, peer reviewed, technical research. *The goal is that this information in its totality can help describe the character of aircraft noise as it is experienced on the ground*.

Three types of analysis of affects on people will be conducted, each using the noise metric deemed most appropriate to answer the question posed. The data will be presented for helicopter operations, fixed wing tour operations, other aircraft operations, and other non-aircraft noise sources. The analytical areas are as follows:

- Probable Number of Aircraft Overflights by Area
- Probable Degree of Population Annoyed by Aircraft Noise
- Probable Degree of People Experiencing Speech Interference

Probable Number of Overflights by Geographic Area.

This measure will present the number of overflights by each type of aircraft activity. The noise value used will be the single event metric SEL (Sound Exposure Level). It takes into account not only how loud the event, but also the duration of the event. How the data may be presented in listed below:

Dispersion Map: A map that shows the estimated geographic distribution of daily flights. After flights have been properly distributed, the number of overflights per geographic area will be calculated and mapped.

Measurement Point Analysis: The measurement sites used in several of the analyses for purposes of comparison both among and between alternatives. These sites will be chosen as representative locations for their surroundings, and will include areas where current flight paths exist as well as areas where alternate flight paths may occur. Demographic data will be combined with the noise data to predict the environment at each of the points. In this case, the estimated number of overflights at each site will be calculated by noise level and will be presented.

Degree of Population Annoyed by Aircraft Noise.

LEQ and DNL. Although human annoyance levels are individual and vary considerably, research in the field has established certain generally accepted criteria, which will be adopted in this study. These criteria derive from published research on the effects of noise. This will be based upon the daytime LEQ (Noise Equivalent Level) and DNL (Day Night Level) noise level. DNL is the metric used by the FAA to assess aircraft noise impacts. The daytime LEQ is similar to one of the measures of how the National Park Service and USFS propose to assess aircraft noise impacts. These measures are useful because they take into account not only the loudness of the aircraft event, but also how often they occur and the duration of the noise event. How the data may be presented in listed below:

Measurement Point Analysis: Utilizing the GIS demographic database the population and housing units associated with each representative location will be determined and probable DNL/LEQ noise level and annoyance levels predicted.

Grid density contour map: A grid density map of the DNL and LEQ noise levels will be prepared. These results will be presented in terms of different colors reflecting different noise levels.

Degree of People Experiencing Speech Interference

Speech interference is one of the issues most commonly mentioned by the public as a source of annoyance. The term applies not only to conversations, but also to listening to radio and TV and talking on the phone. For the evaluation of speech interference, the Time Above (TA) different noise levels are the metric that best relates to speech interference. The Time Above level is similar to the other measures of how the National Park Service and USFS propose to assess aircraft noise impacts. TA measures the number of minutes a day during which the noise level exceeds, for example, 65 dBA, and the noise level where speech interference begins to occur. The ability to communicate decreases as sound levels increase, unless individuals move closer to one another or raise their voices. How the data may be presented in listed below:

Measurement Point Analysis: Potential impact on speech intelligibility at the identified measurement sites will be presented. Utilizing the GIS demographic database, the population and housing units associated with each representative location will be determined.

Grid density contour map: A grid density map of the Time Above noise levels will be prepared. These results will be presented in terms of different colors reflecting different noise levels.

SECTION 3. NOISE MEASUREMENT SURVEY METHDOLOGY

This section presents an outline of the proposed noise measurement plan for flightseeing aircraft operations. The proposed noise-monitoring program utilizes a network of simultaneous noise monitors that are located in the field to continuously measure and record the noise data. BridgeNet documents noise event information from both aircraft and non-aircraft noise sources through field observations and Bridge Explorer software developed. This network-monitoring plan will be supplemented with data from an additional spectral noise monitor that will be shifted among each of the network sites. The proposed noise-monitoring plan describes the type of equipment to be used and the methodology used to collect and process the noise data. Each of the elements is described below.

Noise Measurement Sites

The project scope includes an estimated 15 aircraft noise-monitoring locations to be measured for a two-week period. An additional 10 ambient only noise-monitoring sites will also be included in the measurement program. The measurement program would be divided into two series of measurements with roughly half the sites used to measure in the Douglas Island and Juneau town area for a one-week period. The remaining one-half the sites in the airport area and Mendenhal for an additional one-week period.

Site Selection Criteria

The following is examples of criteria that will be used for the specific siting of each of the noise monitoring locations. The intention of the site selection is to identify locations to correlate the noise data with visitor experience to aircraft noise exposure both throughout the day and in times of presumed expected quiet.

- Exposed to aircraft activity and other sources of noise
- Representative of the potential exposure of residences
- Representative of the noise environment in the environs study area
- Not in close proximity to localized noise sources
- Not in locations exposed to excessive higher wind speeds
- Not in locations that are severely shielded from the aircraft activity
- Security and access for noise monitor

Noise Measurement

This task is to complete the noise measurement survey of flightseeing operations. The survey is designed to measure and distinguish the noise from the following noise sources:

- Helicopter flightseeing noise
- Fixed wing flightseeing noise
- Other aircraft noise sources
- Other non-aircraft noise sources
- Ambient noise sources

The proposed noise measurement survey consists of the following number of noise measurement sites and duration of measurements. The number of sites and durations can be modified based upon the final scope and the results of the public input process.

Fifteen Aircraft Noise Measurement Sites. Each site will be measured for a period of seven days of noise measurement. The sites will be continuously measured with equipment that is designed to measure all sources of noise and is able to distinguish the different sources of noise causing the events. Each site will measure each of the noise sources listed above. A minimum of seven sites will be measured simultaneously.

*Ten Ambient Only Noise Measurements.*Each site will be measured for different periods of time over the course of the measurements. The sites will be used to measure ambient noise sources. Each site will be measured during different times of the day and different meteorological conditions. Each site will be measured at least four different times for at least one combined day of total noise measurement.

Noise Measurement Equipment

The noise monitoring equipment to be used in the study is both 01dB spectral analyzers and Bruel & Kjear A-weighted noise monitors. The primary noise monitors are B&K 2236 sound level meters, B&K 4188 ½ inch microphones and a HP200 palm top computer. The study will utilize a minimum of seven simultaneous sites. The meters continuous measure the A-weighted noise level and store each one-second LEQ noise level to the computer. These meters and microphones have a very low noise floor for measuring the quiet ambient conditions that exist in the Juneau area. One noise monitor will be located at each of the noise monitoring locations for continuous measurement.

Two supplemental spectral monitor to be used in the study is a 01dB Symphony spectral noise monitor. This noise monitor is also attached to a notebook computer. This equipment is capable of measuring the spectral noise characteristics of the sound and does special event detection that distinguishes between aircraft and helicopter noise sources as well as other noise sources. The equipment also records the actual sound of the event, so it is possible to play that sound back to positively identify the source of the noise and to illustrate the different noise levels in different areas of Juneau.

Noise Measurement Procedures

The following is a brief description of the proposed noise measurement procedure.

Microphone location. The microphone will be located at a height of 5 feet directed vertically.

Windscreen. The B&K standard foam windscreen (UA0207 for ½ microphones) will be placed over the microphone for each of the noise monitoring sites.

Calibration. The meters will be calibrated at the beginning and end of measurement period, as well as any time the site is visited during the course of the measurements.

Noise Data Collection.

B&K 2236 – For these measurements, the meters will be set to continuously measure and store the 1-second A-weighted LEQ noise level. This data is stored on a palm top computer that also places an accurate time stamp with the noise data. A-weighted noise metrics of interest can be later calculated from this stored 1-second noise data using our Bridge noise monitoring software.

Symphony Noise Monitor – This monitor will be moved around to each of the 15 sites at different times during the two-week measurements to measure the spectral content of the noise and provide for use in the indoor noise measurements.

Duration of Measurements

The B&K 2236 monitors will be setup at the beginning of the measurements and will continuously measure on a 24-hour basis the noise levels for two one-week periods. The measurements are unattended, but two field engineers will be located in the study area during the study and will spend time at each site document information about aircraft and non-aircraft noise events.

The Symphony monitor will be moved around to each of the locations measured by the B&K 2236s and at the ten ambient noise sources. The measurements will consist of approximately eight hours of measurements per day, between 8 a.m. and 10 p.m. A field engineer who will document information about aircraft and non-aircraft noise events will attend these measurements. During the course of the study, each of the ambient sites will be measured about a full day (Each site will average four visits of about two hours in duration per visit).

Aircraft Identification Methods

Various sources will be utilized to document, identify and correlate the aircraft operations during the noise measurement period. Based upon historical records, we expect to have about two to three hundred operations at each site during the two weeks of monitoring. Each of these sources of flight information is described below.

Field Engineers. Two field engineers will be managing the noise measurements. They will be responsible for setting up and maintaining the equipment as well as documenting the aircraft activity. Each site will have some days of directly attended measurements where the engineer will document the times of events and information about those events. The type of data that will be collected include:

Start and end time of noise events (audible time)

Aircraft information (type, category, flight track, airport, procedure, altitude)

Non-aircraft event information (type, activity)

ASD Flight Information. BridgNet maintains a live feed of all of the IFR aircraft activity in the United States directly from FAA center data. This includes all domestic civilian IFR aircraft. This data includes aircraft type, position and altitude by time. This data will be correlated with the noise event data using our Bridge Reports software for IFR operations at Juneau Airport.

Bridge Explorer Software. Bridge noise monitoring software will be used to help correlate aircraft flight activity to the noise data. This software utilizes such methods as aircraft position information, noise event sequencing and noise event profiling to correlate noise data to the aircraft activity. The noise event profiling is used to identify characteristics of both the aircraft and non-aircraft noise events.

Indoor Noise Measurements

The noise from flightseeing aircraft is also audible within the homes. This task would involve conducting indoor noise measurements to determine the levels within the homes. Indoor measurements are more costly, time consuming and inconvenient to residences than outdoor measurements. It is possible to conduct a smaller subset of measurements of indoor levels than for outdoor levels.

The proposed methodology is to conduct simultaneous measurements between indoor and outdoor sites at sample residences around the community. An assumed five homes will be used for this survey. Roughly a full day of simultaneous measurements will be completed for both indoor and outdoor measurements.

The purpose of these measurements is to determine the relative difference between the outdoor noise levels and indoor noise levels from flightseeing operations. Once this difference is determined it is possible to then identify the indoor noise levels from the more complete outdoor noise measurement survey. For example, if the results show that the building noise reduction from outdoor to indoors is 20 dBA, then that factor can be applied to the outdoor measurements. Using this methodology it is a more efficient method of identifying indoor noise levels without the need for the more costly and time-consuming long-term indoor sampling. This is a common methodology used in aircraft noise assessments. This methodology is commonly applied to airport home insulation programs.

Meteorological Data Collection

The meteorological data is an important element in the noise evaluation. Outdoors sound levels decrease as a function of distance from the source, and as a result of wave divergence, atmospheric absorption, and ground attenuation. If sound is radiated from a source in a homogeneous and undisturbed manner, the sound travels as spherical waves. As the sound wave travels away from the source, the sound energy is dispersed over a greater area dispersing the sound power of the wave. Spherical spreading of the sound wave reduces the noise level at a rate of 6 dB per doubling of the distance. Atmospheric absorption also influences the levels that are received by the observer. The greater the distance traveled, the greater the influence of the atmosphere and the resultant fluctuations. The degree of absorption is a function of the frequency of the sound as well as the humidity and temperature of the air. For example, atmospheric absorption is lowest at high humidity and higher temperatures. Turbulence and gradients of wind, temperature and humidity also play a significant role in determining the degree of attenuation. Certain conditions, such as inversions or low cloud cover, can also result in higher noise levels than would result from spherical spreading as a result of channeling or focusing the sound waves.

The meteorology also affects where the aircraft operate. For example, the helicopter flightseeing tours operate at a lower altitude under overcast conditions. The paths that the helicopters fly also change under different weather conditions.

The following is a description of the weather data that will be determined during the time period of the survey. The summer weather report from the Juneau International Airport weather station will also be collected to determine the percentage of time different weather conditions are presented. This information will be important in the mitigation analysis. The weather data to be determined includes:

- Cloud Cover
- Precipitation
- Humidity
- Temperature
- Wind Speed
- Wind Direction

SECTION 4. NOISE IMPACTS EVALUATION

The methodology used to collect and store the noise data allows for the post processing of the noise data. This allows for the calculation of different noise metrics of interest. This includes Ambient (natural), non-aircraft event and aircraft events (flightseeing helicopter, fixed wing and other aircraft sources). . The types of noise metrics that can be calculated from this methodology are listed below:

Aircraft Noise Levels

Aircraft DNL

Aircraft LEQ (for the daytime aircraft activity hours)

Time Above Noise Levels (audible durations and time above dBA values)

Detectability Levels

Ambient Noise Levels

Percentile Noise Levels (L%)

The analysis will present not only the noise metrics of interest, but also the potential affects on the community utilizing the methodology presented in Section 2.

SECTION 5. MITIGATION ANALYSIS

One of the important elements of the study is the evaluation of the potential methods to minimize the noise levels. This analysis will evaluate the different options and determine the potential impacts on the noise environment. Examples of mitigation options are listed below:

- New Technology
- Flight Path Analysis
- Flight Procedures
- Fly Quiet Programs

Fly Quiet is a family of programs encouraging airlines and pilots to operate aircraft as quietly as possible for people living around an airport. As a voluntary program, Fly Quiet has the advantage of reinforcing desirable flight procedures without going through the onerous regulatory requirements. A Fly Quiet program could be built upon the results of the measurement survey that may identify the procedures and conditions when impacts are less. Using data produced by the Fly Quiet program, the airlines, pilots, and the public can be informed about how each type of operation, aircraft type, and airline compares to others in adherence to new programs that may be developed. This information, combined with incentives, should result in continued improvements to the noise environment in Juneau.

A Fly Quiet program has the potential of reducing single event noise levels and encouraging greater compliance with preferential flight corridors and procedures. Identification of how individual aircraft operate at specific locations compared to the way the majority of aircraft operate, can help encourage the noisier operations to lower noise levels and/or adhere to established flight tracks.

- Potential elements of a Fly Quiet program could include:
- Noise abatement flight path compliance
- Tracking adherence to noise abatement departure climb profiles
- Maintaining arrival glide slope use during VFR conditions
- Maintaining desirable minimal altitudes
- Late night departure procedures
- Analysis of noisiest single event flights
- Monitoring adherence with nighttime run-up rules
- Special studies

These and other options will be evaluated as part of the mitigation analysis (see scope of work for additional description of mitigation options).