Potential Noise Abatement Measures

INTRODUCTION. The purpose of this Chapter is to:

- Provide a document/chapter that explains the roles and responsibilities of various parties in noise abatement planning and the implementation of various noise abatement measures.
- Identify the range of noise reduction/abatement measures that are either required to be considered in a Part 150 Noise Compatibility Study or are suggested as having the potential to address specific local noise issues.

This chapter describes how each noise reduction measure might affect noise exposure conditions. In this initial draft, the measures presented in this chapter are general in nature. This chapter provides a broad perspective of how each measure (or categories of measures) could address specific noise issues and identifies any known issues with implementation. It is expected that this document will assist the Study Input Committee with developing an understanding of the range of alternative measures s available. With that understanding, Committee members will be encourages to assist the Airport management and consultants in identifying additional noise abatement measures that could target specific local issues.

This working paper identifies the following:

- The roles and responsibilities of the parties responsible for noise abatement planning;
- Measures available to the airport operator (Ted Stevens International Airport);
- Measures available to state and local agencies; and
- Measures dependent upon the federal government (primarily the FAA).

Roles and Responsibilities

Before considering specific measures to reduce aircraft noise and land use incompatibilities, it is important to understand the authority various parties have to make a change that results in additional noise reduction. This is referred to as the roles and responsibilities. The FAA's 1976 *Noise Abatement Policy* established the following policies regarding roles and responsibilities:

> "The **Federal Government** has the authority and responsibility to control aircraft noise by the regulation of source emissions, by flight operational procedures, and by management of the air traffic control system and navigable airspace in ways that minimize noise impact on residential areas, consistent with the highest standards of safety. The federal government also provides financial and technical assistance to airport proprietors for noise reduction planning and abatement activities and, working with the private sector, conducts continuing research into noise abatement technology."
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> "**Airport Proprietors** are primarily responsible for planning and implementing action designed to reduce the effect of noise on residents of the surrounding area. Such actions include optimal site location, improvements in airport design, noise abatement ground procedures, land acquisition, and restrictions on airport use that do not unjustly discriminate against any user, impede the federal interest in safety and management of the air navigation system, or unreasonably interfere with interstate or foreign commerce."
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> **State and Local Governments and Planning Agencies** provide for land use planning and development, zoning, and housing regulation that will limit the uses of land near airports to purposes compatible with airport operations.
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> The **Air Carriers** are responsible for retirement, replacement, or retrofit of older jets that do not meet federal noise level standards, and for scheduling and flying airplanes in a way that minimizes the impact of noise on people.

Residents and Prospective Residents in areas surrounding airports should seek to understand the noise problem and what steps can be taken to minimize its effect on people. Individual and community responses to aircraft noise differ substantially and, for some individuals, a reduced level of noise may not eliminate the annoyance or irritation. Prospective residents of areas impacted by airport noise thus should be aware of the effect of noise on their quality of life and act accordingly.

As such, when considering various means of reducing aircraft noise exposure, the roles and responsibilities identified by the FAA must be considered. Also, it should be noted, that while a measure may be possible to implement, it is not always practicable to implement due to various constraints both internal and external to an organization or group. The State of Alaska (as airport proprietor for Ted Stevens International Airport) has a long history of studying and then implementing practicable measures that are compatible with national efforts designed to reduce aircraft noise. Thus, through the conduct of this study, the Airport is committed to continuing such efforts. The following paragraphs briefly describe these activities and actions.

National Noise Reduction Efforts

In the early 1980s, the FAA began issuing rules and regulations that set standards for the control of aircraft noise at the source, the aircraft engine. These aircraft engine noise standards, established by the federal government, must be met by aircraft manufacturers in their design and performance of engines and aircraft. The government established timetables that, over time, have increased the stringency with the noise standards, commonly known as Stage 1, Stage 2, Stage 3, and Stage 4. Internationally, these stages are referred to as Chapter 1 through Chapter 4. Currently all engines are to be manufactured to meet Stage 4 standards. With some exceptions, all aircraft in operation must meet Stage 3 standards.

In 1990, Congress passed the ANCA (The Airport Noise and Capacity Act of 1990 [ANCA], PL 101-508, 104 Stat. 1388), which established two broad directives for the FAA. The first directive established a method to review aircraft noise and airport use or access restrictions imposed by airport proprietors, and the second was to institute a program of phase-out of Stage 2 aircraft over 75,000 pounds by December 31, 1999. In early 2000, the International Civil Aviation Organization established the Stage 4 requirements that require newly manufactured aircraft engines to meet Stage 4 levels by December 31, 2006. There are a few exceptions but the vast majority of the fleet has achieved Stage 3. Congress has recently amended ANCA to require the phase-out of all Stage 2 jet aircraft weighing less than 75,000 pounds to be achieved by December 31, 2015.

To implement ANCA, the FAA amended FAR Part 91 and issued a new FAR Part 161. Part 91 addresses the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. FAR Part 161 was promulgated as a stringent review and approval process for implementing use or access restrictions by airport proprietors, such as curfews and caps on operations. This is in keeping with one of the major reasons for the Act, which was to discourage local restrictions more stringent than the Act's 1999 Stage 2 phase-out. Part 161 makes it more difficult for the Airport or any others to implement use or access restrictions, especially those associated with Stage 3 aircraft. These difficulties are so significant that to date there has been only one Part 161 plan approved by the FAA. This was approved for Naples Airport in Florida. Worth noting, airport/aircraft use restrictions in place at airports before the passage of ANCA were "grandfathered" and therefore allowed to remain in place as long as the airports did not modify the restrictions making them more stringent.

As stated above, there are several exemptions to FAR Part 91. Alaska and Hawaii are exempt from Stage 3 requirement. However, if an operator of a non-stage 3 aircraft changes ownership, then the exemption disappears. The old B737-200 that were operated by Alaska Airlines and Aloha Airlines are the more significant Stage 2 aircraft still in the U.S. fleet, but Alaska Airlines and Aloha Airlines no longer operate these aircraft, but they are operated by other cargo airlines. For that reason, these aircraft were retrofitted with hushkits, making them technically Stage 3 (but are still very loud for a Stage 3 aircraft). These aircraft are included in the 2009 and 2020 model but were replaced in the 2030 case because the aircraft will be at the end of its usable life at that point.

Airports and state and local governments are preempted from regulating the operations of aircraft, with one exception. They may exclude aircraft from an airport for noise reasons as long as the exclusion is reasonable and nondiscriminatory. In addition, it must comply with the provisions of the ANCA, through FAR Part 161, and it must not regulate military aircraft.

The outcome of a Part 150 Noise Compatibility Study is intended to define a balanced and cost-effective program for reducing existing and future noise exposure. The development of reasonable measures is the focus of the FAR Part 150 noise compatibility planning process. The objective is to explore a wide range of feasible measures of land use patterns, noise control actions and noise exposure patterns, seeking optimum accommodation of both airport users and airport neighbors within acceptable safety, economic and environmental parameters. Each measure should:

1) Have the potential of resolving the problem;
2) Be implementable within acceptable economic, environmental, and social costs; and,
3) Be implementable in compliance with federal, state, and local legislation, regulations, and ordinances.

This section contains a description of potential noise abatement and mitigation measures or actions that may be considered for Ted Stevens Anchorage International Airport. A general evaluation of each is made on the basis of the three factors listed above, and will be presented in three different categories: a) those measures available to the airport proprietor; b) those measures available to the state or local unit of government; and, c) those measures dependent on federal government concurrence for implementation.

In addition, FAR Part 150 identifies a number of measures that the FAA has determined must be considered in developing a Part 150 Noise Compatibility Plan; this list of measures must be addressed in the Noise Compatibility Plan (NCP) document. These required measures are:

- Acquisition of land or interest therein;
- Construction of barriers and acoustical shielding, including soundproofing of public buildings;
- The use of flight procedures (including modification of flight tracks) to control the operation of aircraft to reduce exposure to individuals;
- Implementation of any restriction on the use of airport by any type or class of aircraft based on the noise characteristics of those aircraft;
- Implementation of a preferential runway use system;
- Other actions or combination of actions which would have a beneficial noise control or abatement effect on the public; and
- Other actions as recommended by the FAA.

These measures are explained in greater detail in the following sections. Each measure is assigned to one of three categories identifying whether the airport operator, a state/local government, or the federal government is responsible for implementing the measure if it is included in the final Noise Compatibility Program (NCP).1 The potential measures presented in the following paragraphs are general in nature. It is expected that the Study Input Committee will assist the Airport and consultant in identifying more specific measures to evaluate for noise abatement or mitigation. As these more specific measures are identified, they will be evaluated and presented in subsequent Working Papers.

Tables F1 and F2 list a range of noise abatement and land use compatibility measures that will be discussed, as well as specific noise issues these measures are designed to address.

General Measures Available to the Airport Proprietor

[1] The Noise Compatibility Program refers to the final work product of the study that documents the recommended noise abatement and land use compatibility actions.

Denial of Use of Airport to Aircraft Not Meeting FAR Part 36 Standards. This measure might be implemented by limiting access to the Airport for aircraft that do not meet certain noise standards (i.e., aircraft that do not conform with certain FAR Part 36, Stage 2, noise level requirements). Most turboprops and other large aircraft produced after 1964 were required to meet those FAR Part 36 standards. Relative to Anchorage, the current fleet mix consists of two categories – 1) aircraft weighing less than 75,000 lbs that are not required to meet Stage 3 levels, and 2) aircraft that weigh over 75,000 lbs that meet Stage 3 levels. Older, non-complying (Stage 1) turbojets over 75,000 pounds maximum gross takeoff weight, which have standard airworthiness certificates, were required (with a few exceptions) to be retrofitted or cease operating in U. S. airspace as of January 1, 1985 (Part 91, Subpart E). Effective December 31, 1999, all civilian aircraft weighing more than 75,000 lbs met Stage 3 noise levels. Aircraft types weighting less than 75,000 lbs are now required to be Stage 3 by the end of 2015.

Thus, this study could require aircraft weighting less than 75,000 to meet Stage 3 or better levels or require aircraft weighting more than 75,000 lbs to meet Stage 4 levels. Requiring aircraft to meet Stage 3 levels or levels more stringent than Stage 3 is an option only if the action is not unjustly discriminatory, does not constitute a burden on interstate and foreign air commerce, and does not conflict with any airport policy or requirement. To date, only one airport's new noise program that would affect Stage 2 aircraft weighing less than 75,000 lbs has met the FAR Part 161 regulatory requirements, and even that action has not been implemented for other regulatory reasons. In addition, military aircraft do not have to comply with these regulations.

This measure is feasible where the majority of the aircraft fall within the parameters of FAR Part 36. However, to restrict Stage 3 or Stage 2 aircraft less than 75,000 pounds, the provisions of Part 161 must be complied with. This includes a cost/benefit analysis of the proposed restriction (with FAA approval of the methodology or results) and proper notice must be given, not only to the public, but to all affected parties. This is a very difficult task, which can be very expensive and very time-consuming. Further, actions of this nature are viewed by the FAA as actions of last resort; airport operators must show that all other actions have been exhausted and that a noise concern remains. As noted, to date, no such Part 161 plans addressing Stage 3 aircraft have been approved (only one addressing Stage 2 aircraft has been approved).

Table F1

OPERATIONAL AND FACILITY MEASURES

Measures For Consideration		Ground noise	Departure flight noise	Approach Flight Noise	Landing Roll Noise	Maintenance Activity Noise	Ground Equip. Noise	Sample Implementation Measure
Airport Plans	Changes in Runway location, length or strength	◆	◆	◆	◆			New parallel runway. Runway extension. Pavement overlay.
	Displaced Thresholds[1]	◆		◆				Relocated existing runway threshold.
	High Speed Exit Taxiways	◆			◆			Examine locations of taxiway exits to reduce use of reverse thrust.
	Relocated Terminals	◆				◆	◆	Construct new terminal buildings and/or concourses.
	Isolating Maintenance Run-ups Use of Barriers	◆				◆	◆	Barriers. Hush House/Ground Run-up Enclosure.
Airport and Airspace Use	Preferential or Rotational Runway Use	◆	◆	◆	◆			Increased east flow or Increased west flow Balanced flow.
	Preferential Flight Tracks Use of Modification to Approach and Departure Procedures		◆	◆				Monitor compliance with existing corridors. Greater compliance with departure procedures. Develop "minimum" population flight tracks.
	Restrictions on Ground Movement of Aircraft	◆						Implement taxiway use restrictions.
	Restrictions on Engine Run-ups or Use of Ground Equipment					◆	◆	Minimize the number of nighttime run-ups.
	Limits on Number or Types of Operations or Types of Aircraft	◆	◆	◆	◆	◆	◆	Conduct a Part 161 Study. Minimize number of late night flights (10:00-7:00). Limit number of nighttime Stage 2 <75,000 lbs ops
	Use Restrictions	◆	◆	◆	◆		◆	Part 161 Studies.
	Raise Glide Slope Angle or Intercept			◆				Modify glide slope antennas
Aircraft Operations	Power and Flap Management		◆	◆				Identify appropriate departure climb profile to reduce noise.
	Limited use of Reverse Thrust				◆			Implement reverse thrust reduction procedures.
Noise Program Management	Noise-related Landing Fees	◆	◆	◆	◆			Charge increased fees for louder aircraft.
	Noise Monitoring		◆	◆		◆		Noise Monitoring upgrades.
	Establish Citizen Complaint Mechanism	◆	◆	◆	◆	◆	◆	Establish a noise complaint hotline
	Establish Community Participation Program	◆	◆	◆	◆	◆	◆	Host quarterly public airport workshops

[1] Displaced Threshold describes a situation where the actual landing area on a runway is not at the physical end of the runway, but at some distance on the runway from the physical end.

Table F2

LAND USE MEASURES

Measure For Consideration		Sample Implementation Measure	Ground noise	Departure flight	Approach Flight	Landing Roll	Training Flights	Maint. Activity	Ground Equip.
Corrective	Acquisition	Acquisition of single family residences Acquisition of vacant residential land Acquisition of multi-family residential	◆	◆	◆	◆	◆	◆	
	Sound Insulation	Insulation of single family residential Insulation of multi-family residential Insulation of public buildings Insulation of schools	◆	◆	◆	◆	◆	◆	
	Mobile Homes	Relocate mobile homes to another location	◆	◆	◆	◆	◆	◆	
	Identify Noise Remedy Boundaries	Areas of Eligibility	◆	◆	◆	◆	◆	◆	◆
Preventative	Zoning		◆	◆	◆	◆	◆	◆	◆
	Building Code Modifications		◆	◆	◆	◆	◆	◆	◆
	Comprehensive Plans		◆	◆	◆	◆	◆		
	Noise Overlay Zone		◆	◆	◆	◆	◆	◆	◆

Capacity Limits Based on Defined Noise Levels.

The following capacity limit measures are required to be addressed by FAR Part 150. However, they all would require a FAR Part 161 Cost/Benefit Study prior to adoption. One of the requirements of Part 161 is to explore all non-restrictive measures prior to adopting a restriction. Therefore, this Part 150 Noise Compatibility Study will evaluate the non-restrictive measures and a Part 161 restriction will only be evaluated subsequent to the submittal and approval of this study, if appropriate at that time.

Restrictions on airport use or airport access might be structured based on the desire to keep noise below some specific level. However, such restrictions often have varied economic consequences and should only be considered after all other attempts at noise reduction have been exhausted. The implementation of this type of restriction might take three broad forms:

Restrictions Based on Cumulative Impact. With this measure, a maximum cumulative impact (such as the total area within the existing DNL 65, 70 or 75 contour) would be established as the baseline cumulative impact and then an airport's operations and/or fleet mix (mix of aircraft types) would be adjusted or limited so as not to exceed that maximum in the future. This could be accomplished through "capacity limitations", whereas either the aircraft types, based upon their relative "noisiness", or the numbers and mix of aircraft, would be limited or adjusted so as not to exceed the existing noise impact. One variation of this measure can be referred to as a "noise budget".

Restrictions Based on Certificated Single-Event Noise Levels. Most aircraft today have been certificated by the FAA, as part of the FAR Part 36 process described earlier. The certificated noise levels are published as part of Advisory Circular 36. Based on the published noise levels, it might be possible to devise limitations that could prevent aircraft from operating that exceed those noise levels. This measure could be formulated so as to set a threshold noise level that cannot be exceeded at any time, or different noise levels can be implemented for either daytime or nighttime operations. An aircraft's compliance with this limit would be determined from the published FAA certification data. It should be noted that aircraft can be operated at less than certificated noise levels under certain operational conditions, which then becomes a means that air carriers continue to operate despite the noise level limit.

Restrictions Based on Measured Single-Event Noise Levels. Recognizing that aircraft noise levels vary widely, it might be possible to set limits based on actual, measured single-event noise levels. Aircraft that exceed this limit would be prohibited from using an airport. This does not mean that the airport, the community, or citizen groups can set up a microphone and noise level limit and challenge the pilots to "beat the box." Compliance with the single-event level would be measured over an extended period of time for many single events, and violation would then be determined from repeated excess noise.

The following are also types of operation restrictions that are under the jurisdiction of Part 161 and are historically used in place of an aircraft restriction or ban. In all instances, military aircraft are exempt from noise restrictions.

Landing Fees Based on Noise. A landing fee is the charge that aircraft incur in using a commercial airport that is based on the landed weight of the aircraft. This measure is based on the premise that all or part of the landing fee for each aircraft could be focused on the noise emitted by that individual aircraft. This would apportion the "cost" of producing the noise to those aircraft that contribute the most to it. This measure in theory would be designed to encourage the use of quieter aircraft and might actually generate additional revenue for the Airport. To avoid discrimination, the noise fee would need to be based upon a published standard for single event noise levels, such as those contained in Advisory Circular (AC) 36. The opposite strategy might also be used. In other words, quieter aircraft could be apportioned a lesser fee than noisier aircraft, thus serving as an incentive for quieter aircraft. In this manner, operators that reduce noise generated by their aircraft might be rewarded.

The cost of implementing this measure, in terms of manpower, finances and public relations, would not be offset by the revenue or benefit derived from it. The administrative cost involved in maintaining records of aircraft types and numbers, and billing statements would not be commensurate with the noise reduction achieved. In addition, this measure would not apply to military aircraft as they do not pay landing fees. The implementation of this measure would require a Part 161 Study.

Complete or Partial Curfews. A curfew is an action that prevents all or some aircraft from operating during certain hours of a day, typically during the nighttime hours. Airport curfews can be an effective but costly means of controlling noise intrusion into areas adjacent or close to an airport. However, curfews can have a significant negative effect on both aviation interests and the community, having economic impacts on airport users, those providing airport-related services, and on the community as a whole. In addition, other communities may also be impacted if flights are

discontinued and passengers are unable to obtain the required air service. Thus, curfews can create an unreasonable burden to interstate or foreign commerce.

A curfew can take various forms, from restrictions on some or all flights during certain times of the day or night, or restrictions based upon noise levels/thresholds or based on certificated aircraft noise levels contained in AC 36. Curfews were once implemented to restrict operations during periods when people are most sensitive to noise intrusion. This most often occurs during the nighttime hours, particularly between the hours of 11:00 p.m. and 7:00 a.m.; these measures can be effective if there are a significant number of night flights. Curfews implemented prior to ANCA have been upheld by a Federal District Court in California for a general aviation airport (Santa Monica Airport),[2] while at the same time, they have been denied by a Federal District Court in New York (Westchester County).[3] The implementation of a complete or partial curfew would require a Part 161 Study.

Ban All Jet Aircraft. This measure is sometimes proposed at airports to relieve noise impacts, but it has been well settled and documented by case law that this is not legally possible. It not only puts an unreasonable burden on interstate commerce (which is an area of regulation reserved for the federal government) but it also results in a discriminatory regulation that violates the tenets of the U.S. Constitution. This measure also violates the equal protection clause. An outright ban on all jet aircraft cannot be legally implemented.

Acquisition of Land or Interest Therein. The most complete method of controlling and mitigating noise is to purchase the impacted property (referred to as **acquisition in fee simple**). However, this method is also the most costly since it removes the property from the tax base of the community. Certain land areas are more impacted than others and it may be appropriate to purchase land to mitigate severe noise impact where the purchase of full or partial interest may be the only means of achieving compatibility. This is especially true for residences within the 75 DNL noise contour. It is important to note that FAA Land Use Compatibility guidelines note that without appropriate attenuation, certain land uses (such as residential uses) are not compatible with aircraft noise over 65 DNL and that exposure within the 75 DNL is considered severe. In the case of Ted Stevens Anchorage International Airport there are no residences within the existing or future Base Case 75 DNL noise contours and there are a few homes in the 65-75 DNL contour.

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2 Santa Monica Airport Assoc. v. City of Santa Monica, 659 F. 2d. 100, [9th Cir., 1981

3 Westchester County v. United States of America, 571 F. Supp. 786 [Southern District of New York, 1983]

Instead of acquiring property, airports sometimes purchase an easement from the property owner that effectively purchases the right to create noise. An ***easement*** is sometimes preferred because it keeps property on the tax roll, but may cost as much as the entire fee (acquisition cost). There are two main types of easements associated with airports: 1) a Clear Zone Easement associated with the runway protection zone (RPZ) to ensure there are no obstacles to air navigation; 2) a noise easement, which is the right to fly over a property and make noise; and an avigation easement that combines portions of both. Easements can be purchased, condemned, or dedicated through the land use subdivision process. Easements are also acquired by airports when the airport provides sound insulation, which is discussed later.

Another method of keeping noise affected residential property on the tax rolls is to **purchase the property and then resell it for a compatible use** or to resell it for residential use but retain the rights to create noise (such as placing an easement on the property when it is sold). In other words, an airport operator could purchase a property and then resell it to the original homeowner or anyone else, but retain a covenant or easement which identifies the airport's right to fly over the property and to create noise. This would result in the property owner giving up his/her right to initiate litigation against the airport due to the specified noise impact. In addition, this method would allow the market to set the price and value of the noise easement which would be retained by the airport. An airport could also develop or resell the property to another government agency or private company to develop it as a compatible use (golf course, nature area, cemetery, public works, light industry, commercial, etc.), or the agency could purchase the property outright for its own use. This would have to be coordinated with the airport staff and management to ensure redevelopment with a compatible use.

Instead of purchasing land, **sound attenuation (or insulation)** is often recommended for areas near airports. Sound attenuation is the process of adding structural components, such as insulation, to a building to reduce the inside noise levels to a specific degree. Normally, a 25 to 30 dB(A) reduction from outside to inside noise levels is recommended. Such noise reductions are normally achieved by adding acoustically rated windows, installing solid core doors, installing special ventilation systems, and providing attic insulation. Many residents prefer this measure because it reduces the inside noise levels and allows the homeowner to remain in his/her home (versus being acquired by an airport). Sound attenuation, when funded with public monies, often requires the granting of a noise easement in return. The Airport has had a successful sound attenuation program for homes in the 65 DNL contour that arose from the previous Part 150 Study.

No matter what interest of land is purchased, if federal assistance is used, the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 (also known as the Uniform Act) must be followed.

Noise Barriers (Shielding, including earth berms and walls). Noise generated from ground-level sources on an airport can result from engine run-up4 and maintenance operations, aircraft movement on the runways and taxiways, and aircraft engine reverse thrust on landing. Noise intrusion from these sources is usually only annoying to those areas close to an airport. One method of mitigating this type of noise is through the use of noise barriers or earth berms. These barriers can protect adjacent areas from unwanted noise by blocking the path of noise. Another method is through the strategic and well-planned location of airport buildings and structures that can provide shielding to adjacent areas to block noise. Run-up and maintenance areas can often be moved to locations which are away from noise-sensitive uses adjacent to an airport, and if necessary "hush houses" or "ground run-up enclosures" (GRE) can be constructed to redirect sound for specific run-up and maintenance operations.

Construct a New Runway in a Different Orientation. Often the construction of a new runway with a different orientation will shift noise away from noise sensitive uses to either less populated areas or compatible areas (commercial lands, rivers etc). For instance, at airports that have a north-south runway orientation, perhaps an east-west orientation or slightly different angle might be considered. The orientation of a runway is dependent upon many factors, including prevailing winds, topography, obstacles and other conditions. A new runway cannot be constructed if wind direction and topographic conditions are such that safety criteria cannot be met. In addition, both existing and future land uses must be considered so that the noise is not shifted to other populated areas. This is an expensive measure that must be beneficial to both the airport users and the surrounding community.

Runway Extensions. Often a runway extension can reduce noise impacts to areas close to an airport. A runway extension can allow aircraft to gain altitude sooner and produce less noise exposure relative to how the aircraft would operate without the extension. In addition, a runway extension may enable aircraft to fly certain flight paths (such as making turns after departure) that might not be possible with an existing runway length. However, there are tradeoffs with an extension that must be considered. With an extension, the area closest to the extended end can experience greater noise levels due to lower approach altitudes at this end of the runway, and aircraft beginning their departure roll closer to those areas. This can sometimes be corrected by

4 Aircraft operators must regularly conduct maintenance or repairs on aircraft systems and engines. For certain types of aircraft maintenance, engine run-up tests are conducted to demonstrate that the aircraft's in-flight systems are working properly before the aircraft can be put back into service. A run-up is a pre-flight test of the engine systems, where various levels of engine power are applied while the aircraft remains stationary.

establishing a **displaced threshold**[5] so that aircraft land farther down the runway and maintain altitude over the area beyond the extension. Displaced thresholds are not generally recommended by the FAA.

An additional factor to consider with a runway extension is that many times a longer runway will enable heavier, larger aircraft to use the runway that were unable to operate previously. This may be desirable since many of the larger, heavier aircraft are new generation aircraft and are actually quieter than smaller aircraft presently operating. Runway extensions can also be used as a noise abatement measure to help reduce the need for using reverse thrust upon landing, which can generate a considerable amount of ground-level noise for those areas close to an airport. The Airport is preparing a Master Plan, and any recommended facility changes in that Plan to be built within the time-frame of the Future Noise Exposure Map will be evaluated as an alternative in this Study.

Touch and Go Restrictions. Restrictions on training flights performing touch-and-go operations can mitigate noise impacts at airports where there are a significant number of training operations, especially jet training. Touch-and-go operations occur where the pilot approaches the runway as if landing, the aircraft touches down on the runway and then lifts up for departure in a series of practice runs. Restricting touch-and-go training is particularly effective if the operations are occurring during the nighttime and early morning hours, when such operations can be most intrusive. However, such restrictions may not be legal as they are often found to limit access or be a capacity restriction. Capacity restrictions are different from access restrictions based on noise (which may be possible subsequent to a Part 161 Study) as they are beyond the ability of an airport operator to implement. They are pre-empted by federal regulation.

High-Speed Taxiway Exits. High-speed taxiway exits can help reduce noise impacts by allowing aircraft to exit the runway quicker and reduce the use of reverse thrust.

Two types of taxiway exits typically are developed on an airport:

1) a regular taxiway exit that is angled at 90 degrees (thereby requiring the aircraft to come to a near stop before turning); and
2) a high-speed exit that is typically angled.

[5] The runway threshold is the marking on the runway that identifies the end of the runway available for landing or departure. A displaced threshold occurs when the runway marking is not at the physical end of the runway, but rather moved down the runway.

This measure is viable only with runways of adequate length to allow aircraft the opportunity to slow down sufficiently to safely exit the runway and must be placed at locations convenient to the operations at that airport. High-speed taxiway exits do little good as an independent measure, and typically must be implemented along with other measures.

Noise Monitoring Program. Noise monitoring or sound level measurement programs can enhance the effectiveness of noise abatement and compatibility programs. Airports use continuous sound level measurement devices (called noise monitoring systems) to demonstrate changes in aircraft noise exposure and to identify noise levels associated with specific aircraft events. Noise monitoring is often used as a means of showing progress toward reducing the problem. Most systems have several remote microphone units that sample the weighted sound level once or twice per second, record the samples, and transmit the data to a minicomputer system with printouts. Any FAA approved noise monitoring system would have the following minimum capabilities: continuous measurement of dBA at each site; hourly Leq data; daily DNL data (which could be aggregated into an annual DNL); and single-event; maximum A-weighted sound level data. The Airport has such a program in place but it is no longer properly functioning. Noise monitoring can also be of assistance with a Fly Quiet Program.

Noise Complaint/Citizen Liaison Program. Many airport operators (such as the Airport) provide staff in a Noise Office to receive and respond to citizen complaints of aircraft noise. A comprehensive noise complaint system has many advantages, including identification of unusual conditions based on citizen complaints that lead to a notice sent to an aberrant pilot, public accessibility of information about the airport operation and noise conditions, data collection to identify sensitive areas, and positive public relations. At most airports, one person is designated to receive and address noise complaints from citizens. The complaint officer keeps a file on each complaint, noting the time, place, type of complaint, type of aircraft and N-number or other identifying characteristics of the aircraft, if known. This gives citizens a central location to lodge noise complaints and to obtain information concerning aircraft operations or changes in flight procedures. Staff at the Airport currently maintain such a system and is keeping records of noise complaints. This system will be reviewed and recommendations made regarding program status, as necessary and appropriate.

Options Available to State or Local Governments

In this instance, many airport operators do not have land use control over the land use development around an airport, such is the case of the Ted Stevens Anchorage International Airport. Therefore, this section discusses the actions that local land use powers can take to improve the compatibility of land uses near an airport,

Land Use Controls. Federal guidelines contained in FAR Part 150 indicate that residential development, along with other noise sensitive uses such as schools, religious facilities, hospitals, rest homes, etc. should not be located with areas exposed to 65 DNL or greater noise levels. These guidelines are recognized not only by the FAA but also by the Department of Housing and Urban Development, Department of Defense, and the Environmental Protection Agency, as well as numerous state and local agencies. Land use and development controls are one method of ensuring such noise sensitive uses will be limited within the noise contours. It should be remembered that it is within the discretion and authority of the local unit of government to determine the types of lands that are incompatible with noise levels and to define their own threshold of sensitivity.

One of the primary tools used by local communities to guide development within the jurisdiction is through the **Comprehensive Planning process**. Land use and development controls which are based on a well-defined and thoroughly documented comprehensive plan are among the easiest and most powerful tools available to the local unit of government to ensure land use compatibility. It is the responsibility of the local unit of government having land use jurisdiction to implement these controls to protect its residents from aircraft noise impacts and to protect the airport from encroachment of incompatible land uses. This is particularly important where more than one unit of government has land use control authority for the area outside an airport's boundary. It is extremely critical that the local unit of government accept the responsibility for ensuring land use compatibility in their planning and development actions. It is also important that the state government provide the necessary enabling legislation that will allow the local unit of government to institute land use controls. ***The most common forms of land use controls available to the local governments include: zoning, easements, transfer of development rights, building code modifications, capital improvement programs, subdivision regulations, and comprehensive planning.*** These forms of land use controls will only be briefly outlined in the following paragraphs.

Zoning. Zoning is the most common and traditional form of land use control used in the United States today. It controls the type and placement of different land uses within designated areas. It is used to encourage land use compatibility while leaving property ownership in the hands of private individuals or business entities, thus leaving the land on the tax rolls. Zoning is not applied retroactively and is not necessarily permanent. It is most effective in areas that are not presently developed and that can be encouraged to develop with compatible uses. As stated earlier, all jurisdictions have typical zoning ordinances in effect concerning the way use districts are delineated.

Easements. An easement is a right held by one party to make use of the property of another for a limited purpose, as defined in the easement.

Transfer of Development Rights. The transfer of development rights involves separate ownership of the "bundle of rights" associated with property ownership. The concept involves the transfer of the right to develop a certain parcel of property to a certain density/intensity to another parcel of property under separate ownership. This would allow the property that obtains the added development rights to develop to an intensity/density that is beyond that which would normally be allowed. An airport operator could also purchase these rights from the landowner and retain them or sell them to another landowner. This concept can be used to retain property in compatible uses and still compensate the landowner for his loss of development. The idea depends upon market conditions of the area and (there is some disagreement on this point) upon the availability of state enabling legislation authorizing the development of the concept at the local level.

Building Code Modifications. This measure is to modify existing or potential building codes to include specific sound attenuation provisions for structures within areas affected by aircraft noise. Recommendations may be made to the various jurisdictions concerning sound attenuation, as appropriate.

Capital Improvements Program. This is a document that establishes priorities and costs on the funding and development of public facilities (roads, streets, sewers, libraries, etc.). It can be used very successfully, in concert with subdivision regulations and a comprehensive plan, to control not only the areas of development but also the timing of development, by controlling the timing and location of public facilities construction.

Subdivision Regulations. Subdivision regulations are used to control the design and placement of public and private facilities in the conversion of raw land to developed property.

Comprehensive Planning. Comprehensive future land use planning, when it is coordinated with the zoning ordinance, subdivision regulations and the capital improvements program, can reduce or avoid land use incompatibilities in the future.

All of the land use controls mentioned above will be analyzed in greater depth as to their feasibility for implementation when the final noise contours are produced and a Future Noise Exposure Map is presented.

Options Dependent Upon the Federal Government Approval

As noted earlier there are several actions that are required for study that must undergo a Part 161 if recommended for implementation. Those actions discussed previously that would affect restrict Stage 3 aircraft must be approved by the FAA under FAR Part 161. That discussion is not repeated, and thus readers are referred to the earlier discussion.

Departure Thrust Cutback (Departure Climb Profile). During initial takeoff, the power or thrust used by the aircraft to gain altitude is usually at its maximum. This measure would involve the application of thrust cutbacks at various stages of the take-off. Because of system-wide needs, each operator has developed its own standardized take-off procedure. This measure is recommended where aircraft operators have the opportunity to use a different departure thrust setting and still be within safety limits as per the particular type of aircraft they are flying, given the characteristics of the particular airport. Often it is better for aircraft to climb faster and turn earlier than to fly over noise-sensitive areas at lower power. In addition, this measure cannot be implemented without the direct concurrence of the FAA, taking into account operational, safety, and airspace considerations. The FAA's Advisory Circular (AC) 91-53A titled "Noise Abatement Departure Profile" defines two standard departure procedures for aircraft: a "close-in" departure and a "distant" departure. The close-in departure typically reduces noise, but may increase noise further from an airport (such as 8 to 10 miles away). Conversely, the distant procedure concentrates noise closer to an airport (such as within 3-5 miles), but reduces noise further away.

Designated Noise Abatement Take-off/Approach Paths (Flight Tracks). This measure would result in the identification of designated paths that aircraft would follow on approach or takeoff to minimize the overflight of noise sensitive residential areas. Such take-off/approach flight tracks specify the location relative to the ground of aircraft during certain altitude and turning procedures. These procedures are dictated by the relative location of noise-sensitive land uses and considerations of operational safety and air traffic control procedures.

Generally, air traffic control procedures can be identified to avoid specific areas; however, the resolution may create unintended consequences that reduce airport and airspace capacity or increase noise to other areas that had not previously been overflown. Turns during the last three (3) to four (4) miles of the final approach in good weather, and within the final six (6) to seven (7) miles during poor weather, are undesirable for safety reasons because they do not allow pilots of jets to establish and maintain a stabilized approach. Aircraft bank angles near the ground need to be restricted to no more than 15-20 degrees and generally are not encouraged when the aircraft is below 500 feet above ground level (AGL). These procedures cannot be implemented without the concurrence of the FAA, taking into account both safety, and airspace considerations.

When evaluating noise abatement flight tracks, consideration should be given to identifying the objectives of the tracks. Based on experience at other airports, these objectives are often summarized as:

- Equalizing or dispersion noise – this is often an approach when attempting to fairly distribute operations around an airport.
- Concentrating noise – this is the opposite of equalizing/dispersing noise. By concentrating noise, paths are established that result in consistent overflight of specific area(s) to concentrate noise over that area. This approach often provides predictability of overflight for nearby areas sought by residents. New technology, such as Performance Based Navigation (PBN/RNP), enables a greater ability to concentrate noise if desired. Concentrating noise typically enables land use compatibility actions (such as sound insulation) to remedy any residual incompatibilities.
- Concentrating noise within 3-4 miles, and dispersing noise further away – this approach would result in concentration of noise primarily in the 65 DNL contour, but would make attempts to disperse noise outside the 65 DNL.

When considering flight paths, **the Study Input Committee should indicate its desires relative to the above approaches.**

Performance Based Navigation (PBN) – also called in various venues Flight Management (FMS)/ Required Navigation Performance (RNP). Historically, the path of air navigation has been specified exclusively in terms of ground based sensors (navigation beacons). However, with the improvement in electronics and the availability of Global Positioning Systems (GPS), a navigation path that includes the requirement for on-board electronic navigation performance monitoring and alerting is referred to as a Required Navigation Performance (RNP). RNP enables aircraft to fly on virtually any desired flight path within the coverage of ground- or spaced-based navigation aids, within the limits of the capability of the systems. The RNP monitors the performance and alerts the pilot if the performance is not being met.

Global positioning satellite (GPS) systems have enabled a wide range of new flight procedures at airports that effectively rely on computer technology to direct the flight path of the aircraft. These systems use satellites to determine exact aircraft location, and with the addition of a ground unit, can very accurately determine altitude. Computers onboard the aircraft use this information to direct the flight. The use of GPS for approaches, coupled with FMS (Flight Management Systems) or Required Navigation (RNAV) for departures will be explored as part of this study to assess whether flight tracks can be more accurately followed; and whether this would assist in reducing noise levels over noise sensitive areas.

As part of the FAA's program to modernize the air traffic control system, the FAA has begun to develop and implement RNP arrival flight tracks at airports around the country. Anchorage International Airport was selected as one of five airports that the FAA will implement arrival tracks. As this Part 150 Study is being initiated in 2012, the FAA has begun a process of considering two arrival tracks using RNP. Airport staff and the Part 150 Study consultants are monitoring the FAA's RNP process and will attempt to coordinate the noise abatement needs with the opportunity of that RNP development.

Preferential Runway Use System. A preferential runway use system typically identifies the runway end(s) that for departures creates the least impact on the surrounding community and emphasizes the use of that runway(s). Such programs use these preferred runway end(s) the majority of the time, establishing operations in a certain direction, with operations occurring in the opposite direction held to a minimum. This measure is very closely related to wind direction and airspace safety considerations. The FAA has the responsibility to implement this measure through air traffic routing, with aircraft safety being the prime concern. This is only available for use during certain wind conditions and is only recommended when there is a severe noise compatibility problem directly off one end of the runway. The Airport currently has a preferential runway system in place that results in most aircraft approaches and departures occurring over water, which has resulted in a significant reduction in noise sensitive uses being affected by aircraft noise.

Power and Flap Settings. A variety aircraft operating procedures are possible for implementation by airlines using an airport. These include minimum flap landings and delaying flap and gear deployment. On approach, an increasing level of noise is generated as flaps are applied to slow the aircraft. Similarly, noise levels typically increase when the landing gear is lowered. To help minimize fuel costs and flight time, most operators of large jet aircraft have adopted procedures for reduced flap settings and delaying flap and gear extension, consistent with safety and current aircraft and air crew capabilities. During VFR (good) weather conditions and low traffic conditions, large jet aircraft generally land with minimum flap settings.

One of the benefits of the previously identified Required Navigation Performance (RNP) is that often the arrivals are conducted on what is referred to as an optimized profile descent (OPD). Without RNP, aircraft approach an airport in a series of stair steps down to the runway, except close to the runway where there is generally a 3 degree approach slope. With RNP, the arrival track can be defined to include OPD for some distance away from an airport so as to minimize noise associated with deploying flaps.

Summary

The potential measures presented in this Chapter are general in nature and provide a broad perspective of actions that could be recommended for further study and implementation. It is expected that the Study Input Committee will assist the Airport and consultants in identifying more specific measures to evaluate for noise abatement or mitigation using the guidelines and information provided. As these more specific measures are identified, they will be evaluated and presented in subsequent Working Papers.

The Airport encourages members of the Study Input Committee to identify specific noise issues and to suggest additional measures that should be considered during this study.