Ted Stevens Anchorage International Airport AeroNexus®

Ted Stevens Anchorage International Airport FAR Part 150 Noise Compatibility Study Update

THE Barnard Dunkelberg Company TEAM
a Mead & Hunt company

Ted Stevens Anchorage International Airport FAR Part 150 Noise Compatibility Study Update

December 2015

The preparation of this document was financed in part through a planning grant from the Federal Aviation Administration (FAA) as provided under Section 505 of the Airport and Airway Improvement Act of 1982 as amended by the Airway Safety and Capacity Expansion Act of 1987. The contents do not necessarily reflect the views or policy of the FAA.

Acceptance of this report does not in any way constitute a commitment on the part of the United States to participate in the development depicted herein, nor does it indicate that the proposed development is environmentally acceptable in accordance with appropriate public law. This document is intended to be a planning document by Ted Stevens Anchorage International Airport. Final decisions concerning implementation of the recommendations shall be made by Ted Stevens Anchorage International Airport.

The Noise Exposure Map and accompanying documentation for the Noise Exposure Maps and Noise Compatibility Program for Ted Stevens Anchorage International Airport, submitted in accordance with FAR Part 150 with the best available information, are hereby certified as true and complete to the best of my knowledge and belief.

In addition, it is hereby certified that the airport sponsor has afforded persons adequate opportunity to submit their views, data, and comments concerning the correctness and adequacy of this draft noise compatibility study and draft noise exposure maps.

Signed: ______________________________

Dated: ______________________________

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14 CFR PART 150
NOISE COMPATIBILITY PROGRAM

Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base
Anchorage, Alaska

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DISAPPROVED

RECORD OF APPROVAL

Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base Anchorage, Alaska

The Ted Stevens Anchorage International Airport (ANC) and Lake Hood Seaplane Base (LHD) Noise Compatibility Program (NCP) includes measures to abate aircraft noise, control land development, mitigate the impact of noise on non-compatible land uses, and implement and update the program. Title 14 Code of Federal Regulations (CFR) Part 150 requires that the NCP apply to a period of no less than five years into the future, although it may apply to a longer period if the sponsor so desires. The airport sponsor has requested that the NCP be applied to the Future 2020 Noise Expose Map (NEM) NCP (Figure I1).

ANC and LHD are both included in this Part 150 Study Update. For purposes of this update, ANC and LHD were analyzed as a single airport with one set of contours. All previous Part 150 Studies completed to date included both facilities. The reasons for this include:

- The airports are physically linked by connecting taxiways and share a boundary.
- The runways and sea lanes are as proximate to each other as many other airports operating with several runways.
- The ANC Airport Traffic Control Tower controls both aircraft operations on the ground and within designated airspace at ANC and air traffic at LHD. With this integrated airspace, where departures and arrivals occurring in such close proximity, ANC and LHD function as one airport.

Because of these factors, the two airports act in many ways as one facility. Therefore the noise contours were modeled together. ANC and LHD are both included in this Part 150 Study Update.

The objective of the NCP is to improve the compatibility between aircraft operations and noise-sensitive land uses in the area while allowing ANC and LHD to continue to serve the community, state, and nation. This NCP is an update to an existing program that the FAA approved in the 2000 Record of Approval (ROA). The NCP includes new measures, and continues and revises some currently approved measures from the 2000 NCP ROA. As outlined in Chapter I of the NCP, the currently approved Abatement Measures include: Use of Noise Abatement Departure Profiles on Runways 6L/6R, and 14 (now 7L / 7R and 15) were determined not to show a noise benefit and are not carried forward in this NCP. A detailed Noise Abatement Departure Procedure (NADP) Study and a detailed ground noise study were approved measures in the 2000 ROA and both studies were completed. Neither of these measures were included in this NCP.

The FAA's approval or disapproval of each specific measure proposed by an airport sponsor in an ROA is determined by applying approval criteria prescribed in 14 CFR §150.35(b). Only measures that meet the approval criteria can be approved. Note that FAA approval or disapproval of a measure only indicates whether that measure would, if implemented, be consistent with the purposes of 14 CFR Part 150. When an ROA measure is disapproved by the FAA, airport sponsors are not precluded from and are encouraged to work with the FAA and their communities outside of the rigors of the Part 150 process to implement initiatives that provide noise benefits for the surrounding community.

Approval of a measure does not constitute an FAA funding commitment or a decision to implement that measure. The FAA will make funding eligibility determinations as funds are requested by the airport sponsor. Later decisions concerning possible implementation of measures approved in this ROA will be subject to all applicable environmental compliance and other procedures and requirements including, but not limited to, the National Environmental Policy Act and Section 106 of the National Historic Preservation Act.

The operational land use control and program management measures below summarize as closely as possible the airport operator's recommended measures in the NCP and are cross-referenced to the NCP. The NCP measures below have been summarized and do not represent the opinions or decisions of the FAA.

The FAA has provided technical advice and assistance to the airport to ensure that the operational elements are feasible (see 14 CFR §150.23(c)).

NOISE ABATEMENT RECOMMENDED MEASURES

N1. Noise Barrier – Lake Hood Seaplane Base

This is a new measure and would involve the design and construction of a noise barrier / wall generally along the eastern boundary of LHD east of the gravel strip. It is intended to reduce aircraft noise impacts to neighborhoods. A noise barrier is an obstruction to the path of the sounds that reduces noise for receivers "behind" the barrier relative to the noise source and reduce noise levels by interrupting, or blocking the direct path between the noise source and the receiver.

(NCP, pages G.16 – G.30 and I.12 – I.18)

> **FAA Determination**: Disapproved for purposes of Part 150. The FAA has determined all land uses east of the gravel strip to be to be compatible with noise levels below 65 DNL. Residential land uses in this area are compatible with DNL below 65, Appendix A, Sec. AI50.101(a). This measure benefits land uses below the 65 DNL noise contour and therefore does not meet the Part 150 requirement of reducing noncompatible uses within the 65 DNL.

N2. Ground Run-Up Enclosure

This new measure would construct a Ground Run-up Enclosure (GRE) where engine run-ups could be conducted. The GRE is intended to reduce run-up noise to neighborhoods close to ANC.

(NCP, pages G.31 – G.39 and I.19 – I.21)

> **FAA Determination**: Disapproved for purposes of Part 150. Residents adjacent to the four areas identified for possible location of a GRE are outside the 65 DNL and considered to be compatible land uses. Residential land uses are compatible with DNL below 65, Appendix A, Sec. AI50.101(a). This measure benefits land uses below the 65 DNL noise contour and therefore does not meet the Part 150 requirement of reducing noncompatible uses within the 65 DNL.

N3. Voluntary Reduced Use of Reverse Thrust

This is a new measure and would reduce the use of reverse thrust by pilots on an "as able" basis. This measure is intended to reduce noise levels from landing jets where pilots typically deploy reverse thrust to slow the aircraft. When runway conditions allow for a dry, uncontaminated surface and low congestion activity, among other variables, it may be possible for the pilot to reduce the use of reverse thrust upon landing.

This measure is a voluntary and is entirely up to the discretion of the pilot in command and only implemented when conditions allow. This option cannot be monitored or enforced.

(NCP, pages G.40 – G.41 and I.23)

> **FAA Determination**: Approved as voluntary and it is entirely up to the discretion of the pilot in command and only when conditions allow.

LAND USE RECOMMENDED MEASURES

L1. Voluntary Sound Insulation of Noise Sensitive Structures Within the 65 DNL Noise Contour

This is a continuation of a measure approved in the 2000 ROA to reduce noise levels experienced inside the residential structures. The measure would insulate existing eligible residential structures within the 65 DNL or greater noise levels of the 2020 contour created for this Part 150 Study Update.

The only noncompatible land uses within the 2020 65 DNL and greater contours are residential uses. The updated contours indicate that airport-related noise above 65 DNL occurs in areas where it previously did not, primarily in the area east of LHD.

(NCP, pages H.6 – H.8 and I.24 – I.29)

> **FAA Determination**: Approved as a continuation of a voluntary measure in the 2000 ROA. The Airport Improvement Program (AIP) Handbook funding requirements must be met to be eligible for funding. Habitable rooms in the existing the structure must have been built prior to October 1, 1998; the property must be within the approved 65 DNL; the property must meet the interior noise level requirements of experiencing existing interior noise levels that are 45 dB or greater.

L2. Disclosure Statements/Buyer Notification

This measure is a continuation from the 2000 ROA and is intended to inform potential homeowners / renters that they are purchasing / renting a home in an area where they might experience aircraft noise levels that could cause annoyance.

(NCP, pages H.13 and I.31 – I.32)

> **FAA Determination**: Approved as a continuation measure from the 2000 ROA and a local measure. The Federal government does not have local land use control authority. The local jurisdictions have the authority to pursue proposed land controls.

L3. Building Code Requirements – Sound Attenuation Required for New Development

This measure is a continuation from the 2000 ROA and a local measure. It is intended to reduce the number of future non-compatible land uses through mandatory sound attenuation requirements for new construction of noise sensitive uses. This measure proposes to amend building code requirements to include sound attenuation standards for any new construction of noise sensitive uses.

(NCP, pages H.14 and I.35 – I.36)

> **FAA Determination**: Approved as a continuation measure from the 2000 ROA and a local measure. The Federal government does not have local land use control authority. The local jurisdictions have the authority to pursue proposed land controls.

L4. Comprehensive Plan Amendments

This measure is a continuation from the 2000 ROA and is intended to prevent the introduction of new non-compatible land uses through the land use planning and development policy process. The measure proposes to amend the existing adopted Anchorage 2020 Comprehensive Plans and West Anchorage District Plan to achieve long-term land use compatibility of lands with aircraft exposure from the ANC and LHD.

(NCP, pages H.16 – H.17 and I.37 – I.38)

> **FAA Determination**: Approved as a continuation from the 2000 ROA and a local measure. The Federal government does not have local land use control authority. The local jurisdictions have the authority to pursue proposed land controls.

L5. Zoning Code Changes/Noise Overlay Zone

This is a continuation from the 2000 ROA and involves changes to the Municipality of Anchorage Title 21 Land Use Code to guide compatible development near the airport. The zoning code can prescribe development standards that new development must meet and can include sound attenuation, creating of an avigation (noise) easement, disclosure notification, and other related standards.

(NCP, pages H.18 and I.39 – I.40)

> **FAA Determination**: Approved as a continuation measure from the 2000 ROA and a local measure. The Federal government does not have local land use control authority. The local jurisdictions have the authority to pursue proposed land controls.

ADMINISTRATIVE RECOMMENDED MEASURES

A1. Development of Fly Quiet Report Card and Pilot Awareness Program

This measure is a continuation from the 2000 ROA and involves the creation / update of a Fly Quiet Program for ANC and LHD to address noise issues and promote fly quiet procedures for pilots. A Fly Quiet Program has been completed for ANC; however, this effort would build upon what was previously created and focus on creating an official Fly Quiet Program for LHD.

(NCP, pages H.20 and I.41 - I.42)

> **FAA Determination**: Approved as a continuation measure from the 2000 ROA.

A2. Continuation of Public Information Program and Noise Information Page on the Website

This is a continuation measure from the 2000 ROA. This measure would keep the noise section of the Airport's website active and accessible to the public with information about existing noise reduction measures, the current Noise Exposure Map (NEM), noise comment submittal information, and other noise related information.

(NCP, pages H.21 and I.43)

> **FAA Determination**: Approved as a continuation measure from the 2000 ROA.

A3. Public Comment Submittal Form

This is a continuation measure from the 2000 ROA. This measure would continue to make available the noise comment submittal form on the website easily accessible to the public. The comment submittal form allows the Airport to track comments received to better understand what types of operations cause single event concerns. These comments are reviewed and responded to by Airport staff.

(NCP, pages H.22 and I.44)

> **FAA Determination**: Approved as a continued measure from the 2000 ROA.

A4. Addressing of Noise Comments

This is an updated measure approved in the 2000 ROA. This measure involves using existing Airport staff to monitor and respond to noise comments rather than a single dedicated staff position.

(NCP, pagesH.23 and I.45)

> **FAA Determination**: Approved as updated.

A5. Flight Tracking

This updated measure approved in the 2000 ROA would involve the acquisition of a new flight tracking system that can also track aircraft noise. This information would be used to response to noise comments. The previous flight tracking system was approved in the 2000 ROA and operated until 2009.

(NCP, pages H.24 and I.46 – I.47)

> **FAA Determination**: Approved as updated. Approval of this measure does not obligate the FAA to participate in funding the software or hardware required to establish a flight tracking system. Note for the purposes of aviation safety, this approval does not extend to the use of monitoring equipment for enforcement purposes by in-situ measurement of any pre-set noise thresholds.

A6. Review and Update Part 150 Study As Needed

This is a continuation measure from the 2000 ROA and would involve updating the NEM and NCP as conditions change.

(NCP, pages H.25 and I.48 – I.49)

> **FAA Determination**: Approved as a continued measure from the 2000 ROA. 14 CFR 150.23(e)(9) is the provision for revising the NCP if made necessary by revision of the NEM. In accordance 14 CFR 150.21(d), an update to the NEM is necessary if there is either a substantial increase (+1.5 dB or more) creating new non-compatible land uses use within the DNL 65 dB contour, or if there is a significant reduction in noise over existing non-compatible land uses.

FACILITY RECOMMENDED MEASURES

F1. Install Electrictrification and Preconditioned Air at All Jet Bridges and Areas

This is a new measure that would involve installing gate electrification and reconditioned air gates and cargo areas that do not currently have these features. This measure would reduce aircraft engine noise while aircraft is on the ground.

(NCP, pages H.26 and I.50 – I.51)

> **FAA Determination**: Disapproved. Terminal based power AC is funded as a terminal development reference AIP Handbook, Appendix N. Terminal Building Projects, Table N-5 Typical Eligible/Equipment within a Terminal Building, Line o.

Chapter A - Inventory

INTRODUCTION. Ted Stevens Anchorage International Airport (ANC) is the primary air transportation facility serving the Municipality of Anchorage (MOA), and the State of Alaska in general. Because of its airfield capabilities and strategic location, Ted Stevens Anchorage International Airport is also a vital part of the national system of airports. The Airport serves not only as Anchorage's front door by providing visitors with an important first impression of the community, but also as the state's largest commercial service airport. The Airport provides transportation facilities that are an absolute necessity for some businesses and a "required" convenience for others. ANC is also the second busiest cargo airport in the United States in terms of landed weight. Additionally, Ted Stevens Anchorage International Airport provides recreational and leisure travelers convenient access to air transportation with non-stop and connecting service to many popular destinations.

For purposes of this Part 150 Study, Ted Stevens Anchorage International Airport (ANC) and Lake Hood Seaplane Base are included in one study, with one set of noise contours. All previous Part 150 Studies completed to date included both facilities. The reasons for this includes several factors. The ANC Airport Traffic Control Tower (ATCT) controls aircraft operations on the ground and within designated airspace at ANC, and it also controls air traffic at Lake Hood Seaplane Base. With this integrated airspace, departures and arrivals occur within such close proximity, that it functions as one airport. The community also perceives Lake Hood and ANC as operating as one facility. Additionally, ANC and LHD are physically linked by connecting taxiways and share a boundary. The runways and sea lanes are as close in proximity to each other as many other airports operating with several runways.

Because of these factors, the noise contours could not be separated, as they act in many ways as one facility. Therefore, for the purposes of this Study, they are included together.

This Federal Aviation Regulation (FAR) Part 150 Noise Compatibility Study (Study) is an update of a 1998 Study that was adopted by Alaska Department of Transportation and Public Facilities (DOT&PF). The Noise Exposure Maps were accepted and the Noise Compatibility Program was approved by the Federal Aviation Administration (FAA) in 2000.

The Airport has implemented several of the recommendations contained in the previous FAR Part 150 Study. However, since completion of the previous study, there have been changes to the airfield, types of aircraft, and the number of aircraft operating at the Airport. As such, many of these changes have likely resulted in changes to noise exposure and therefore justify the need for an update to the previous Study.

The purpose of this Inventory chapter of the Part 150 Study is to establish a baseline of information about existing airport facilities and operations, as well as local land use. Much of this inventory data will be used to model new aircraft noise exposure contours showing the areas exposed to significant aircraft noise, as defined by the FAA. The inventory includes data concerning airport facilities, flight procedures, noise abatement procedures, noise complaints, and land use conditions and policies within the environs of the Airport.

About the Airport

ANC is the primary air transportation hub of the state of Alaska. The Airport (including the Lake Hood Seaplane Base) resides on approximately 4,600 acres located four miles southwest of the Anchorage central business district. ANC is located entirely within the MOA, which is considered a consolidated city-borough under state law. The Airport is bordered to the north by the coastline of the Knik Arm of Cook Inlet and Earthquake Park. To the west, the Airport is bordered by municipal land or the coastline, while the southwestern airport boundary abuts Kincaid Park. The wastewater treatment plant, Clithroe Center, and former composting operation are facilities located on MOA land in this area. The southern portion of the Airport is bounded by Sand Lake neighborhood. The southeastern airport boundary borders Jewel Lake Road, Delong Lake, Air National Guard Road, and Raspberry Road, except for land north of Raspberry Road owned by the Federal Communication Commission (FCC). The eastern portion of ANC is referred to as Connors Bog and is bounded by International Airport Road to the north, Northway Drive to the east, and Connors Lake subdivision to the south. Finally, the northeast portion of the Airport is bounded by the residential neighborhoods of Turnagain and Spenard. The generalized airport location is illustrated on Figures A1 and A2, *AIRPORT LOCATION MAP* and *AIRPORT VICINITY MAP*.

The Airport is served by eight major domestic legacy and low cost airlines including: Alaska Airlines, American Airlines, Continental Airlines, Delta Airlines, Frontier Airlines, JetBlue Airways, United Airlines, and US Airways[1]. The Airport is also served by five regional/commuter airlines including: Ravn (formerly Era Aviation), Frontier Flying Service, Grant Aviation, and Pen Air. International Airlines providing scheduled passenger service include Air Canada and Condor Airlines. There are also a number of domestic and international charter airlines operating at the Airport, including: Japan Airlines, Korean Air, and North American Airlines.

[1] Ted Stevens Anchorage International Airport website, December 2011

Domestic cargo operations are conducted by approximately 16 different airlines including both Federal Express and United Parcel Service. International cargo operations are conducted by approximately 15 different airlines. In terms of activity, ANC was the 60th busiest US airport in 2010 with respect to scheduled enplaned passengers and the 2nd busiest US airport in 2010 with respect to air cargo landed weight. The Lake Hood Seaplane Base is also the world's largest and busiest seaplane base.

As mentioned previously, ANC is owned by the State of Alaska and operated by the DOT&PF. The Airport Manager is responsible for the day-to-day operations. The Airport's stated mission is to "Develop – Operate – Maintain The Airport for Anchorage – Alaska – the World."

The DOT&PF initiated a Master Plan Update in 2007 completing an airport inventory, aviation forecasts, and facility requirements before the study was terminated due to the economic recession and the resulting reduction in aviation activity levels. A new ANC Master Plan Update was completed in 2014. A Lake Hood Seaplane Base Master Plan Update was initiated in the fall of 2014 and scheduled for completion in 2016.

Airside Inventory

Runways. ANC has an Airport Reference Point (ARP) of Latitude 61° 10' 26.700"N, Longitude 149° 59' 53.500"W and an elevation of approximately 152 feet above mean sea level (AMSL). The Airport currently has the following three runways:

- **Runway 7R/25L – 12,400 feet long and 200 feet wide.**
- **Runway 7L/25R – 10,600 feet long and 150 feet wide.**
- **Runway 15/33 – 10,960 feet long and 150 feet wide.**

ANC has several declared distances for Runway 07R/25L and15/33, which are explained in Table A1 below.

Table A1
RUNWAY DECLARED DISTANCE INFORMATION

Runway	TORA	TODA	ASDA	LDA
07L	10,600	10,600	10,600	10,600
25R	10,600	10,600	10,600	10,600
07R	10,900	10,900	10,900	12,400
25L	12,400	12,400	12,000	12,000
15	10,760	10,760	10,094	10,094
33	10,960	11,960	10,960	10,694

Source: Draft Master Plan Update, June 2014.
TORA – Takeoff Run Available; TODA – Takeoff Distance Available;
ASDA – Accelerate-Stop Distance Available; LDA – Landing Distance Available.

Runway 7R/25L (east/west orientation) is 12,400 feet total length and 200 feet in width. Runway 7R/25L has published declared distances as listed in Table A1; 10,900 feet of runway is available for takeoff on Runway 7R, while the entire 12,400 feet of runway is available for takeoff on Runway 25L. Runway 7R/25L is equipped with High Intensity Runway Edge Lights (HIRL). Runway 7R has precision instrument runway markings. Runway 7R has a Category I, II, and III Instrument Landing System (ILS)/Distance Measuring Equipment (DME) approach with ALSF-2 (approach lighting system with centerline sequenced flashing lights) approach lights. Runway 25L also has precision runway markings, but the only available approach procedure is what is referred to as the "Seward Visual" approach, which follows the new Seward Highway. Runway 25L does not have an approach lighting system.

Runway 7L/25R (also east/west orientation) is 10,600 feet total length and 150 feet in width. Runway 7L/25R is equipped with High Intensity Runway Edge Lights (HIRL). Runway 7L has precision instrument runway markings. Runway 7L has a Category I and II Instrument Landing System (ILS)/Distance Measuring Equipment (DME) approach with MALSR (medium intensity approach lighting system with runway alignment indicator) approach lights. Runway 25R also has precision runway markings, but the only available approach procedure is what is referred to as the "Highway Visual" approach, which follows the new Seward Highway. Runway 25R does not have an approach lighting system.

Runway 15/33 (north/south orientation) has published declared distances, meaning that 10,760 feet of runway is available for takeoff on Runway 15; the entire 10,690 feet of runway is available for takeoff on Runway 33. Like the other two runways, Runway 15/33 is also equipped with HIRL and has precision runway markings. Runway 15 has a Category I ILS approach with an Omni Directional Approach Lighting System (ODALs). Runway 33 is the only runway end at ANC with no published approach procedure.

FIGURE A1 **Airport Location Map**

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FIGURE A2 Airport Vicinity Map

Taxiways. All runways are provided with taxiway access to runway ends and connector or exit taxiways. Runway 15/33 has two full length parallel taxiways on each side (Taxiways "Y" and "R"). Runway 7L/25R has one full length parallel taxiway on the north side (Taxiway "K"). Runway 7R/25L technically does not have a full length parallel taxiway, but does have connector taxiways to parallel Taxiway "K".

The taxiway system has been designed primarily to provide quick and safe access to and from runway ends and either the main passenger terminal or the various cargo areas. The taxiway system also provides aircraft access to maintenance areas, aircraft parking areas, and hangar areas. Taxiway width and pavement characteristics vary depending on the aircraft specifications that utilize the facilities and runways that the taxiways serve.

Landside Inventory

Terminal Complex. ANC has two separate passenger terminals (North and South) within the 228 acre passenger terminal complex. International Airport Road, a four-lane controlled access roadway, provides the primary access to the Airport from the east. The west end of the road transitions to a loop serving the South Terminal arrival, departure, and commercial vehicle ramps. Exit ramps provide access to vehicle parking, the railroad depot, and the Airport Traffic Control Tower (ATCT) within the loop.

The two terminals at ANC are separated by approximately 700 feet with a covered walkway connecting them to each other. There are a total of 34 designated gates between the two terminals. Airline usage of each gate varies and some gates are currently unused. There are eight air carrier gates at the North Terminal labeled "N" gates. There are 26 functioning air carrier gates at the South Terminal labeled "A", "B", or "C" gates. Some of the commuter gates at the South Terminal provide access for more than one aircraft parking position though they are defined as a single gate. In addition, there are 11 remote aircraft parking positions located west of the terminal complex used for fueling and overnight aircraft parking.

Cargo. There are over 250 acres dedicated to air cargo facilities at ANC. Combined these areas include over one million square feet of buildings, 471,000 square yards of aircraft parking aprons, and 37 acres of vehicle parking/landside support. These facilities are located in each of the three principal development areas of the Airport, including the North Airpark and the East Airpark, with a small amount of cargo at the South Airpark. The North Airpark serves the majority of the air cargo operations including the following operators: FedEx, UPS, Alaska CargoPort, among others. The East Airpark cargo operators include Alaska Airlines and Northern Air Cargo. Lynden Air Cargo is the single cargo operator located in the South Airpark.

Lake Hood Seaplane Base General Aviation. The majority of General Aviation (GA) activity takes place at Lake Hood Seaplane Base. Lake Hood Seaplane Base includes three waterlanes (East-West, North-South, and Northwest-Southeast) and the Lake Hood Airstrip, which includes one gravel-surface runway (Runway 13/31) and one taxiway connects the lake to the airstrip. Nearly 1,000 GA aircraft are based at either the seaplane base or the airstrip.

General Aviation. There are two primary GA areas at ANC, the South Airpark and to a lesser extent the East Airpark. Over 40 GA aircraft are based in these two areas. These aircraft are typically higher performance and larger aircraft that require longer, paved runways and instrument approaches available at the Airport. Two full-service Fixed Base Operators (FBOs) serve GA aircraft at three locations at ANC. Signature Flight Support has separate facilities at both the East and South Airparks. Era FBO, dba Million Air, also has an FBO complex at South Airpark. Other airport tenants provide specific GA services, such as aircraft maintenance, charter flights, and fuel sales.

Airport Maintenance Facility. The Field Maintenance Building is located on an 8.6 acre site just north of the North Terminal. This 116,000 square foot building opened in 2005 and provides offices, shop space for equipment maintenance, and storage for material and equipment.

Airport Rescue and Fire Fighting Facility (ARFF). The Aircraft Rescue and Fire Fighting (ARFF) facility is located at the southwest corner of the North Airpark. The facility is a consolidation of the two former ARFF facilities. The ARFF facility has direct access to Taxiways "R" and "V" to provide reduced response time to all areas of the airfield. An ARFF training area is located on the southwest side of the airfield. Additionally, the airport certification manual includes the fire station in the former Kulis Air National Guard Base to help meet their ARFF response requirements.

Airport Traffic Control Tower (ATCT) Facility. The FAA ATCT is located south of Tower Road, along the South Terminal access road. There is a one story building accommodating FAA offices at the base of the tower. The tower contains the ATC equipment and additional FAA offices.

Kulis Air National Guard Base. Opened in 1955, Kulis Air National Guard (ANG) Base was located east of South Airpark on 129 acres leased from the Airport. The 176th Wing of the ANG conducted its federal and state missions with a fleet of C130 fixed wing, HC130 (C130 with rescue platform) fixed wing, and HH60 Pave Hawk rotary wing aircraft. Kulis Base was vacated in the fall of 2011 and the 176th Wing relocated to Elmendorf Air Force Base. A Kulis Reuse Plan has been developed for the area previously occupied by the 176th Wing. This re-use plan indicates that the area will be redeveloped for both aeronautical uses and non-aeronautical revenue purposes. The former Kulis Base has been incorporated into the Airport lands, and existing development constraints allow for non-aeronautical use in a portion of this area.

Existing airside and landside facilities are shown on Figure A3, *EXISTING AIRPORT LAYOUT*.

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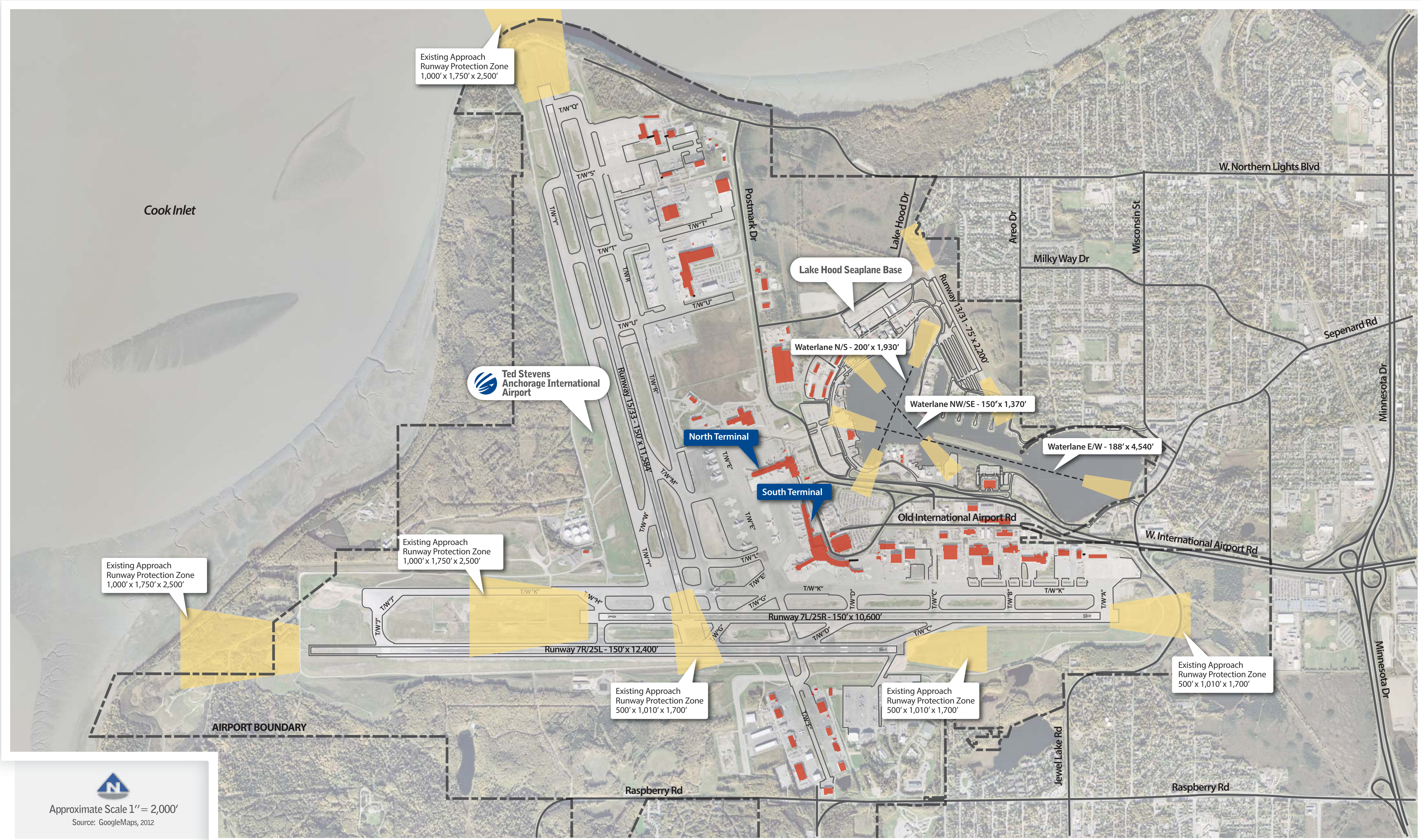

FIGURE A3 **Existing Airport Layout**

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Air Traffic Operations Activity

A summary of airport activity for ANC is provided in the Table A2, *SUMMARY OF HISTORICAL AVIATION ACTIVITY*. Between 1990 and 2000, total aircraft operations increased from approximately 218,657 to 319,239, representing an average annual growth rate of approximately 3.1 percent. Closely following national trends, aircraft activity declined from 2000 to 2003 to 295,549 operations. It should be noted that the decrease in overall operations and enplanements for 2001 and 2002 was influenced by the downturn in commercial passenger traffic following the terrorist events of September 11, 2001, the temporary closure of airports in the U.S., and the subsequent economic downturn.

Between 1990 and 2000, passenger enplanements increased from approximately 1.6 million to almost 2 million, representing an average annual growth rate of approximately 2 percent. Passenger activity declined in 2002 to 1,954,530 and then continually grew until peaking in 2008 at 2,382,355 passenger enplanements. This peak was followed by a down-turn in enplanements in 2009 to 2,148,020.

There were 2,398,512 total passenger enplanements in 2010. In 2010, the Airport provided for the transportation of 19.4 billion pounds of landed weight air cargo. This was a 25.4 percent increase from the 2009 level of 15.5 billion pounds. The 2010 total landed weight was only 0.4 percent less landed weight than Memphis International Airport (19.5 trillion pounds), the home of FedEx and the busiest air cargo airport in the country.

Forecasts, as they relate to this Part 150 Study Update are further described in Chapter B, Forecasts.

Table A2
SUMMARY OF HISTORICAL AVIATION ACTIVITY, 1990-2010

Year	Passenger Enplanements	Air Carrier Operations	Air Taxi/ Commuter Operations	General Aviation Operations	Military Operations	Total Operations
1990	1,599,363	97,142	60,325	58,487	2,703	218,657
1991	1,510,380	92,840	77,339	54,602	3,651	228,432
1992	1,638,302	98,226	82,725	52,027	3,741	236,719
1993	1,637,564	94,946	69,567	50,075	3,691	218,279
1994	1,810,684	97,387	68,456	45,961	3,837	215,641
1995	1,876,072	96,946	73,500	43,425	3,897	217,768
1996	1,911,784	105,593	77,538	96,977	3,503	283,611
1997	1,978,035	111,276	95,310	103,729	3,824	314,139
1998	1,914,673	113,094	88,344	104,726	4,311	310,475
1999	1,981,634	112,942	81,417	108,466	5,313	308,138
2000	1,988,294	117,812	89,921	106,345	5,157	319,235
2001	2,029,578	114,795	87,442	96,363	6,388	304,988
2002	1,954,530	116,681	87,263	94,923	5,741	304,608
2003	1,970,849	121,252	77,442	91,436	5,419	295,549
2004	2,123,220	125,489	82,706	92,680	5,590	306,465
2005	2,215,802	132,869	87,256	87,611	5,978	313,714
2006	2,216,976	131,490	86,429	82,526	4,163	304,608
2007	2,264,568	131,419	85,330	78,171	5,010	300,476
2008	2,382,355	120,949	86,258	77,750	5,239	287,541
2009	2,146,642	98,113	73,096	80,204	4,588	256,001
2010	2,171,982	113,263	73,906	80,565	4,302	272,036
2011[1]	2,260,521	110,897	78,251	83,975	3,008	276,131

Source: FAA Terminal Area Forecasts, January 2012.
[1] Forecast Data

Airspace

The following section is presented to help the public better understand the complexities of airspace and Air Traffic Control. The source of the majority of this information is the 2008 Master Plan Study Report for ANC, and much of the information has been adopted from the study report.

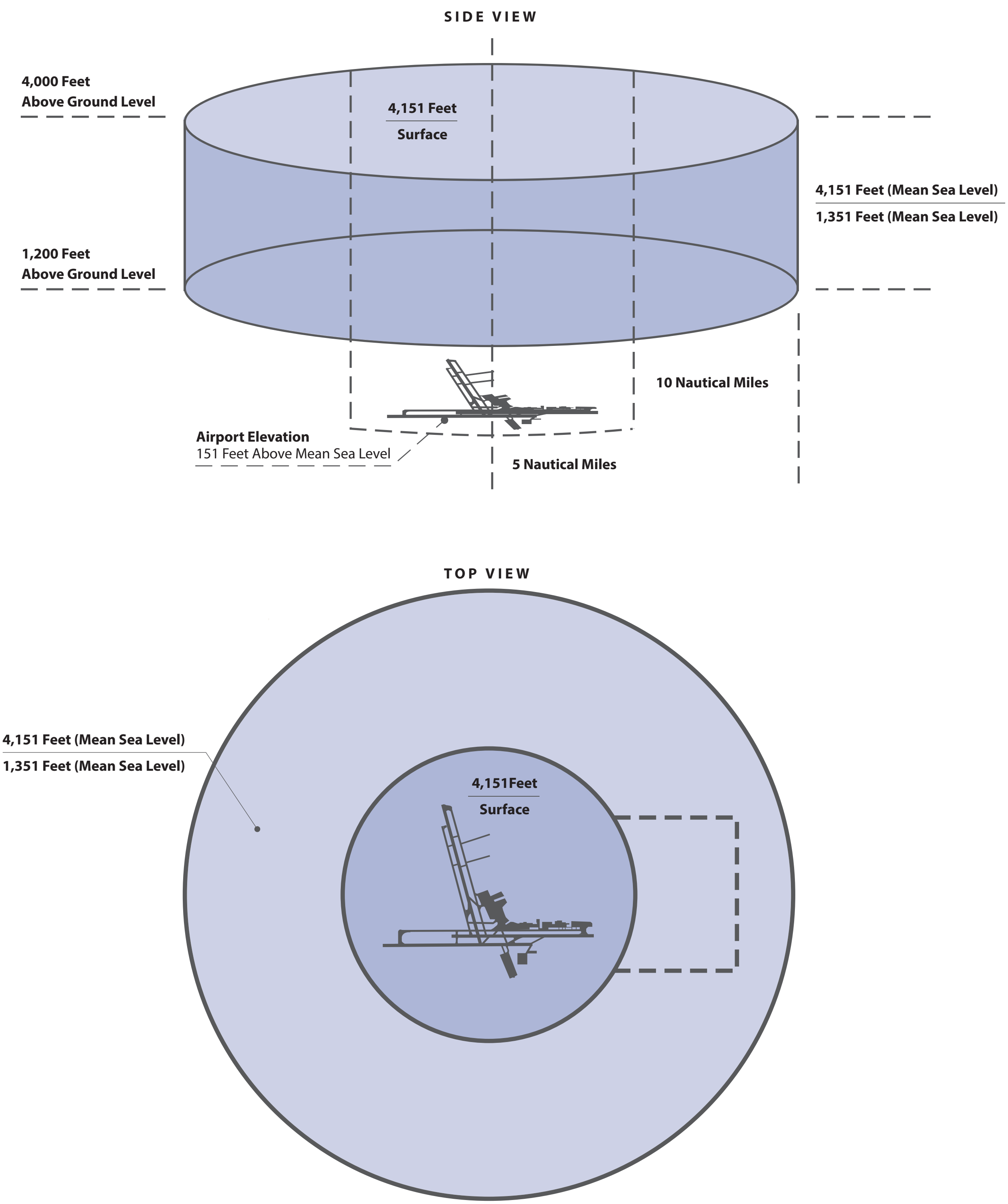
The airspace over the Anchorage area, and all of the US, is under the jurisdiction of the FAA. This authority was granted by Congress via the Federal Aviation Act of 1958. The FAA established the National Airspace System (NAS) to protect persons and property on the ground and to establish a safe and efficient airspace environment for civil, commercial, and military aviation. The NAS is defined as the common network of US airspace, including air navigation facilities; airports and landing areas; aeronautical charts; associated rules, regulations, and procedures; technical information; personnel; and material. System components shared jointly with the military are also included.

Local airspace surrounding ANC is designated as Class C airspace. Class C airspace is the airspace surrounding airports that have an operational control tower, are serviced by a radar approach control, and have a certain number of Instrument Flight Rules (IFR) operations or passenger enplanements. Pilots must establish two-way radio communications with the airport traffic control personnel prior to entering Class C, maintain this communication while within the airspace, and have a transponder with mode C capability.

Figure A4, *GENERALIZED CLASS C AIRSPACE*, is shown on the following pages. Unique conditions in Anchorage such as the Airport's proximity to Elmendorf Air Force Base and the Lake Hood Seaplane Base add to the overall complexity of the local airspace. The mountainous terrain and the physical shape of Cook Inlet also affect the airspace. The exact configuration of each Class C airspace area is tailored to the individual airport. However, Class C airspace usually consists of an inner tier with a five Nautical Mile (NM) radius circle and an outer tier with a 10 Nautical Mile radius surrounding an airport; the floor and ceiling of the airspace is unique to each airport. Class C airspace in the Anchorage area is centered on ANC and contains a 5.2 NM radius core surface area and a 10 NM radius shelf service. The circles are truncated significantly to the east of the Airport. The elevation of the airspace within the core circle extends from the Airport elevation of 152 feet MSL up to 4,100 feet MSL, with the exception of an area south of Campbell Lake where the elevation extends from 600 feet MSL to 4,100 feet MSL. The elevation of the shelf surface extends from 1,400 feet MSL up to 4,100 feet MSL, with the exception of an area located north of the Airport across the Knik Arm where the elevation extends from 1,900 feet MSL to 4,100 feet MSL. The Class C airspace centered on ANC is active 24 hours per day.

Class D airspace is typically associated with airports having instrument procedures, but fewer operations than airports associated with Class C airspace. Aircraft operating within Class D airspace are required to maintain radio communication with the ATCT. Class D airspace encompasses three airports and one seaplane base in the vicinity of ANC, including Merrill Field, Elmendorf Air Force Base, and Lake Hood Seaplane Base. The Class D airspace for Lake Hood Seaplane Base is encompassed and intersected by Class C airspace for ANC. The ATCT for ANC controls the Class D airspace in areas that intersect the Anchorage Class C airspace up to 2,500 feet MSL.

International boundaries, military airports, military operations areas, restricted areas, temporary flight restrictions, and prohibited areas can also impact airspace use in the vicinity of a civil airport. All aircraft flights are governed by either Visual Flight Rules (VFR) or Instrument Flight Rules (IFR). Definitions are contained in FAR Part 91 and in Figure A4. The basic difference between VFR and IFR rules is that the pilot maintains spatial orientation of an aircraft by reference to the earth's surface for VFR and by reference to aircraft instruments for IFR. Under IFR rules, a pilot can operate in poor visibility conditions within controlled airspace. Flights under VFR rules require good visibility and maintenance of specified distances from clouds.



Source: Anchorage (JUNE 2010)/McGrath (JULY 2010) Sectionals

FIGURE A4 **Generalized Class "C" Airspace**

Air Route Traffic Control Center

ANC is located in one of the nation's 22 FAA operated Air Route Traffic Control Centers (ARTCCs). These facilities control aircraft operating under IFR within controlled airspace while in the en route phase of flight. The Anchorage ARTCC controls airspace that encompasses all of Alaska. A Letter of Agreement (LOA) between the ANC Terminal Radar Approach Control (TRACON) and the ARTCC formalizes the two parties' lines of authority. Control of the airspace in the vicinity of Anchorage has been delegated to the TRACON by the ARTCC.

The Anchorage ARTCC controls activity into and out of the ANC TRACON area through remote radar and radio facilities located throughout the region. All air controllers employed by the Anchorage ARTCC are located at a single operation site near Elmendorf. From this location, controllers manage air traffic throughout the Alaskan region. The Anchorage ARTCC maintains LOAs with other FAA agencies and users throughout the ARTCC's area of responsibility. These agreements establish procedures for handing off air traffic from one agency to another, and define local ATC procedures and responsibilities. The ARTCC also maintains a LOA with other radar-equipped FAA agencies to assume en route ATC responsibilities in the event of an emergency that renders any agency incapable of control.

VFR Operations

Aircraft operating under VFR and departing ANC are under positive control of the Anchorage ATCT. Pilots of aircraft transitioning from ANC Class D airspace to ANC Class C airspace must establish radio contact with ANC TRACON. Pilots must receive clearance to transition from ANC Class D airspace to Elmendorf Air Force Base (EDF) or Merrill Field (MRI) Class D airspace and must comply with local airspace restrictions. Pilots landing at ANC must contact ANC TRACON prior to entering ANC's Class C airspace. Pilots of aircraft transitioning from ANC Class C airspace to ANC Class D airspace for arrivals must contact ANC ATCT and receive permission prior to entering. The arrival procedure will vary, depending on the operational flow and volume of traffic. A unique aspect of the Anchorage airspace is that it is governed by procedures outlined in Federal Aviation Regulation (FAR) Part 93 Special Air Traffic Rules and Airport Traffic Patterns. FAR Part 93 dictates special procedures that VFR aircraft must follow when arriving in or departing from the general Anchorage area. The purpose of this FAR is to help separate slower VFR aircraft traveling into and out of the area from the high-performance aircraft using ANC and EDF. In general, FAR 93 specifies the six segments— International, Merrill, Lake Hood, Elmendorf, Bryant and Seward Highway—of VFR approach procedures and airport traffic patterns that aircraft are to fly when going to or from any given airport in the area.

Specific altitudes are associated with each segment. The following are the general rules outlined by FAR Part 93 for the Anchorage area:

- **Each person operating an aircraft to, from, or on an airport within the Anchorage Terminal Area shall operate that aircraft according to the rules set forth in FAR Part 93 as applicable, unless otherwise authorized or required by ATC.**
- **Each person operating an airplane within the Anchorage Terminal Area shall conform to the flow of traffic depicted on the appropriate aeronautical charts.**
- **Each person operating a helicopter shall operate it in a manner so as to avoid the flow of airplanes.**
- **Except as provided in FAR Part 93, each person operating an aircraft in the Anchorage Terminal Area shall operate that aircraft only within the designated segment containing the arrival or departure airport.**
- **Except as provided in FAR Part 93, each person operating an aircraft in the Anchorage Terminal Area shall maintain two-way radio communications with the ATCT serving the segment containing the arrival or departure airport.**

The VFR arrival/departure procedures for the Anchorage and Lake Hood segments are briefly described below. These procedures are published by the FAA's Air Traffic Organization and can be found online at the following link:
http://www.faa.gov/about/office_org/headquarters_offices/ato/tracon/anchorage/pilots_info/locproc/

ANC VFR Departure and Arrival Procedures:

- **NORTH SHORE DEPARTURE—issued to aircraft departing ANC westbound through northeast bound.**
- **CHICKALOON DEPARTURE—issued to aircraft departing ANC to the south.**
- **LITTLE SU DEPARTURE—issued to aircraft departing ANC westbound.**
- **MACKENZIE ARRIVAL—issued to aircraft arriving to ANC from the north.**
- **DIMOND MALL ARRIVAL—issued to aircraft arriving to ANC from northeast or south.**

LHD VFR Departure and Arrival Procedures:

- **WEST ROUTE ARRIVAL/DEPARTURE—issued when LHD is operating in a west flow (landing and departing west, north, or northwest waterlanes and Runway 31).**
- **EAST ROUTE ARRIVAL/DEPARTURE—issued when LHD is operating in an east flow (landing and departing east, south, or southeast waterlanes and Runway 13).**
- **TUDOR OVERPASS ARRIVAL/ DEPARTURE—used to provide an orderly route for entering and exiting LHD airspace while avoiding Class C airspace and reducing potential conflict with aircraft using established routes to and from adjacent airports.**
- **LITTLE SU DEPARTURE—issued to aircraft departing LHD westbound.**
- **GRAVEL PIT ARRIVAL—direct routing to LHD from the south (not used when ANC is departing Runway 15).**

- **CHICKALOON DEPARTURE – departing aircraft fly directly to the east shore of Campbell Lake before turning south.**

IFR Operations

Aircraft under IFR are generally under control of the ARTCC outside of Anchorage TRACON airspace. When ARTCC personnel prepare to transfer arriving turbojet or other high-performance IFR aircraft to Anchorage TRACON control, they clear aircraft to ANC via a Standard Terminal Arrival Route (STAR). A STAR is a preplanned IFR ATC arrival procedure published for pilot use. STARs use a combination of published VOR radials and intersections and ATC assigned vectors, altitudes, and speeds to route aircraft into the arrival flow sequence.

The arrival and departure procedures used by Anchorage ARTCC and Anchorage TRACON/ATCT personnel for arrivals to and departures from ANC and EDF are currently being revised and updated. The revised procedures are used in the noise modeling for this study.

Navigation and Communication Aids

ANC, like all US airports, functions within the local, regional, and national system of airports and airspace. Figure A5 below, *AIRSPACE/NAVAIDS SUMMARY*, and narrative provide a brief description of ANC's role as an element within these systems. Please refer to http://www.faa.gov/library/manuals/aviation/instrument_flying_handbook/ for a more detailed explanation of the following discussion.

Anchorage Area Air Traffic Control

There are two levels of ATC in the Anchorage area: TRACON surrounding ANC, and tower control by the Airport Traffic Control Tower (ATCT) for ANC, LHD, EDF, and MRI.

ANC TRACON

The ANC TRACON controls arriving and departing aircraft within the ANC area. According to agreements between ANC TRACON and the ARTCC, the TRACON is responsible for airspace within an irregularly shaped area extending approximately 33 nautical miles north, 22 nautical miles south, 20 nautical miles east, and 36 nautical miles west of ANC. The TRACON airspace extends from the surface to 20,000 feet MSL (Flight Level 200). The ANC TRACON is also responsible for the Class C airspace centered on ANC, except for that portion delegated to ANC ATCT. The TRACON has control of both IFR and VFR aircraft within the Class C airspace. The TRACON controls operations 24 hours per day.

ANC ATCT

The ANC ATCT controls aircraft operations on the ground and within designated airspace at ANC. The ANC ATCT also controls air traffic at Lake Hood Seaplane Base.

EDF ATCT

The EDF ATCT controls aircraft operations on the ground and in the airport traffic control area (Class D) at EDF. The EDF Class D airspace is located outside the ANC Class C airspace and extends from the ground to 3,000 feet MSL.

FIGURE A5 Airspace/NAVAIDS Summary

Instrument Approach Procedures

There are several published instrument approach procedures to various runway ends at ANC. The procedures are summarized in the Table A3, *INSTRUMENT APPROACH PROCEDURES*.

Table A3
INSTRUMENT APPROACH PROCEDURES

Approach	Designated Runway	Ceiling Minimums (AGL)[1]	Visibility Minimums[1]
ILS	7L	328'	1,800', 2,400'[2]
LOC	7L	460'	2,400', 4,000'[2]
ILS	7R	332'	1,800'
LOC	7R	520'	2,400', 3,500', 5,000', 1 ½ miles[2]
S-ILS CAT I[3]	7R	100'	1,400'
ILS	15	351'	4,000'
S-ILS CAT II[3]	7L	108'	1,200'
S-ILS CAT II[3]	7R	115'	1,200'
S-ILS CAT III[3]	7R	--	RVR 700', RVR 600'[2]
RNAV (GPS) LPV	7L	390'	2,400
RNAV (GPS) LNAV/VNAV	7L	740'	2 ¼ miles
RNAV (GPS) LNAV	7L	620'	2,400', ¾; 1 miles[2]
RNAV (GPS) LPV	7R	332'	2,400'
RNAV (GPS) LNAV/VNAV	7R	660'	2 3/8 miles
RNAV (GPS) LNAV	7R	640'	½ miles, ¼ miles[2]
RNAV (GPS) LPV	15	410'	4,000', 5,000'[2]
RNAV (GPS) LNAV/VNAV	15	500'	5,000', 6,000'[2]
RNAV (GPS) LNAV	15	500'	5,000', 6,000'[2]
VOR	7R	700'	5,000', 6,000', 1 ½ miles[2]

Source: U.S. Terminal Procedures, Alaska Terminal Procedures, 15 December 2011.
[1] Circling Approach Procedure and Minimums not listed.
[2] Depending on category of aircraft.
[3] Special Aircrew and Aircraft Certification Required

Current Noise Management Program

The Airport has developed and continues to refine a Noise Compatibility Program designed to reduce impacts on the surrounding community. The Program consists of land use and noise abatement measures. The Airport implemented a Residential Sound Insulation Program based on recommendations from the previous Study. Until 2009, it also operated a Flight Track and Noise Management System to quantify noise levels in the community. In addition, the Airport researches and responds to noise complaints, communicates with local planners about appropriate land use to encourage compatible development surrounding the Airport, and works cooperatively with the ATCT, the Airlines, and the local community to minimize impacts whenever possible.

ANC's existing Noise Compatibility Program includes measures to reduce noise generated at the Airport and to mitigate impacts off airport when possible and reasonable. Airport noise is a community issue though, and the community, the aviation industry, the MOA, and the Airport all need to work together to address airport noise impacts in a manner that allows continued development of this important economic and transportation resource and also minimize noise impact on the community.

The following information describes the integration of noise abatement procedures with safe and expeditious air traffic control procedures. The procedures are part of a runway use program and participation by pilots and aircraft operators is voluntary.

The FAA has a primary function to determine under what conditions flight operations may be conducted without causing degradation of safety. Under ideal conditions aircraft takeoffs and landings should be conducted into the wind. Considerations such as delay and capacity problems, runway length, approach aids, noise abatement, and other factors may require aircraft operations to be conducted in a specific manner.

Noise Compatibility Program

The previous Noise Compatibility Program (NCP) was approved by the FAA in 2000. Many of the operational and land use measures approved in the 2000 study have been completed or are continuing to be implemented. The approval allowed the Airport to obtain federal noise discretionary funding for approved measures in the Noise Compatibility Program, such as property acquisitions, residential sound insulation, school sound insulation, and purchase assurance.[2] Several recommendations in the previous Plan have been implemented and the fleet mix has since changed. Thus, the Noise Compatibility Program needed updating.

[2] Purchase assurance refers to a program that would guarantee fair market value to a property. In this type of program, the operator does not take title to the property, but rather compensates the property owner for the difference between fair market and the value offered by the purchaser, in exchange for an avigation easement.

Operational actions approved in the previous Noise Compatibility Program which have been implemented or are underway include the following noise abatement procedures, and are discussed in more detail in the Runway Use Procedures section below:

- **Implement consistent Noise Abatement Departure Profiles (NADP's) on Runways 6R, 6L (Now 7R and L), and 14 (now 15).**
- **Conduct detailed Noise Abatement Departure Procedure (NADP) Study.**

Land use actions approved in the previous Noise Compatibility Program which have been implemented, are underway or are being examined as part of local land use planning efforts, include:

- **Compatible Use Zoning**
- **Mobile Home and Camper Park Restrictions**
- **Soundproofing Requirement for New Development**
- **Noise Levels on Plats**
- **Comprehensive Planning**
- **Planning Commission Review**
- **Public Land Development Criteria**
- **Noise Overlay Zone**
- **Fair Disclosure Policy**
- **Land Banking**
- **Soundproofing for Existing Development Program (became the Residential Sound Insulation Program)**
- **Investigate Sound Buffers/Barriers on the Airport**
- **Conduct Detailed Aircraft Ground Noise Study (Aircraft Engine Run-Up Noise)**

Most of these land use recommendations, with the exception of those noted in parentheses, are discussed in the Residential Sound Insulation and the Land Use sections below. Many of the land use planning recommendations are being examined as considerations of other local land use planning efforts.

Continuing program measures approved in the previous Noise Compatibility Program which have been implemented or are underway include:

- **Noise Advisory Committee (not active since the beginning of the Residential Sound Insulation Program)**
- **Noise Monitoring (although not currently operational) - Flight Track and Noise Monitoring System**
- **Complaint Response**
- **Regulations and Agreements (dissemination of noise abatement measures to operators)**
- **NEM and NCP Review and Revision as Needed**
- **Establish a Noise Program Manager Position at the Airport**
- **Noise Information Page on Anchorage International Airport Website**
- **Airfield Signs (signs describing key noise abatement procedures for pilots)**
- **Public Information Program**
- **Pilot Manual Insert**

Portions of these continuing program measure recommendations are described in the sections below, including: Flight Track and Noise Monitoring System, Residential Sound Insulation Program, and Noise Complaints and Response.

Runway Use Procedures

These procedures apply to all turbojet/turbofan aircraft and all other aircraft with a Maximum Takeoff Weight (MTOW) of 11,500 lbs. or more with two or more engines operating at Ted Stevens Anchorage International Airport. The following procedures and programs were developed to ensure aircraft noise is minimized in residential neighborhoods surrounding the Airport, consistent with safe operations.

Noise Sensitive Runways. Runways 7R, 7L, and 15 are noise sensitive runways for departures. The Airport has indicated that departures from these runways result in the most severe noise impacts. These runways should only be used for departures when operational or safety considerations limit the use of Runways 33, 25L, and 25R.

Noise Abatement Procedures/Preferential Runway Use Program. The Airport has established a preferential runway use program to minimize noise impacts on nearby residential areas. The normal flow of traffic operations, contingent upon weather, is as follows:

- **Arrivals to the east or south.**
- **Departures to the north or west.**

The preferential runways selected for arrivals and departures are shown below in the Table A4, *PREFERENTIAL RUNWAY USE PROGRAM (IN PRIORITY ORDER)*. Daytime procedures are in effect from 0700 to 2200 hours local time. Nighttime procedures are in effect from 2200 to 0700 hours local time.

Air Traffic Control will issue a noise sensitive advisory message for departures from Runways 7R/7L or Runway 15 during clearance delivery or ground control departure procedures 24 hours a day when a pilot requests a noise sensitive runway different from the ATC designated active runway.

Table A4
PREFERENTIAL RUNWAY USE PROGRAM (IN PRIORITY ORDER)

Operation	Daytime (0700-2200)	Nighttime (2200-0700)
Departures	Runway 33	Runway 33
	Runway 7R[1]	Runway 25L
	Runway 7L[1]	Runway 25R
	Runway 25L[1]	Runaway 7R
	Runway 25R	Runway 7L
	Runway 15	Runway 15
Arrivals	Runway 7R	Runway 7R
	Runways 7L/15	Runways 7L/15
	Runway 33	Runway 33
	Runways 25L/25R	Runways 25L/25R

Source: Ted Stevens Anchorage International Airport Noise Abatement Procedures and Preferential Runway Use Program.
[1] Runway 25L should be used as the second priority departure runway during daytime hours if weather and traffic conditions allow. Runways 7R and 7L are only listed as the second and third priority during daytime hours in recognition of air traffic considerations.

Selection of the next preferential runway is allowed under any of the following conditions:

- **If the runway is not clear and dry (i.e. adversely affected by snow, slush, ice, water, mud, rubber, oil, or other substances).**
- **When winds, including gusts, as recorded by airport wind sensors exceed:**
  - ***Crosswind components of 15 knots, or***
  - ***Tailwind components of 5 knots.***
- **When wind shear has been reported or forecast, or thunderstorms are expected to affect the departure or approach.**
- **When the combined traffic levels at Elmendorf AFB and ANC result in excessive airfield traffic congestion and cause unacceptable departure delays.**
- **Delay alone does not constitute a reason for pilots to request a noise sensitive runway for departure.**
- **When a preferred runway is closed for snow removal, construction, maintenance, or other reasons.**

The wind parameters cited above are used by the Airport to determine compliance with the Preferential Runway Use Program. Under FAA regulations (FAR 91.3), the pilot in command is solely responsible for aircraft safety and the final decision on runway selection. If a preferred runway cannot be used for any of the cited conditions, the next priority runway should be used, if feasible, given air traffic and other considerations.

Runway 33 Extension Departure Policies. Normally, only aircraft whose weight, stage length, or other condition necessitates an extended length departure from Runway 33 may request the extension. Aircraft requiring an extended departure will notify ATC prior to taxi.

Knik Five Departure. Runway 7R/7L Knik Five departure is not available for use during nighttime hours. The FAA ATCT will not initiate this flight path during these hours.

Thrust Cut Back Procedures. The designated Noise Abatement Departure Profiles (NADPs) for departures from Runways 7R/7L or 15 are the FAA Close-in NADP or ICAO Procedure B NADP. All turbojet/turbofan aircraft should employ either of these NADPs on departure from Runaways 7R/7L or 15 when safety permits.

Training Flight Operations. Touch-and-go and other training operations are allowed contingent upon traffic conditions. Training operations should use the following guidelines.

- **Training operations should not occur during nighttime hours (Mon-Fri/2200-0600) (Sat-Sun/2200-0800).**
- **Circle to land training maneuvers should minimize noise exposure to residential areas south and east of the Airport by using an approach to Runways 7R/7L and circle to Runway 33.**

Aircraft Engine Run-Up Noise

One recommendation of the previous Noise Compatibility Program was to conduct a detailed study of aircraft ground noise. This study, the *Ted Stevens Anchorage International Airport Comprehensive Ground Noise Study* was completed in 2002. The study recommended mitigation options for seven sources of aircraft ground noise including start of takeoff; reverse thrust; taxiing and idle; auxiliary power units; maintenance run-ups; GA aircraft start-up and departure; and field maintenance equipment. The mitigation options seek to limit the amount of noise exposure to adjacent noise sensitive areas and are summarized in Table A5 below.

Table A5
SUMMARY OF GROUND NOISE MITIGATION OPTIONS

Noise Source	Mitigation Option
Start of Takeoff	Once an FAA low-frequency noise standard is in place, assess the feasibility and costs associated with incorporating low-frequency treatments/standards during residential sound insulation.
	Utilize Taxiway K, L, and M intersection departures on Runway 33 whenever feasible.
	Relocate Runway 07R/25L to west, utilize Taxiway D intersection departures on Runway 25L, coordinate with Master Plan process and Air Traffic Control (ATC)
Reverse Thrust	Once an FAA low-frequency noise standard is in place, assess the feasibility and costs associated with incorporating low-frequency treatments/standards during residential sound insulation
	Construct additional high-speed taxiways; examine feasibility of preferential taxiway use with airlines, coordinate with Master Plan process.
	Examine feasibility of reduced-thrust procedures with airlines
	Relocate Runway 07R/25L to west to reduce noise effects of thrust reversers, coordinate with Master Plan process and ATC
	Prioritize arrivals on Runway 07R, coordinate with ATC
Taxiing and Idle	Construct new taxiways, including high-speed exists and a west-side north/south taxiway, in context of overall airport efficiency and the Master Plan process.
	Queue Runway 33 departures on Taxiways K and L (rather than R), coordinate with Master Plan process and ATC.
	Implement voluntary reduced-engine taxi procedures on carrier-specific basis in coordination with aircraft operators and ATC.
Auxiliary Power Units	Provide access to ground power and pre-conditioned air at all existing and new passenger terminals and cargo facilities.
	In coordination with tenants, design new North Airpark cargo facilities to provide noise shielding.
	Park aircraft with APU exhaust directed away from residences, coordinate with ATC to assess impact on line-of-sight from ATC tower.
	In coordination with aircraft operators, develop recommendations on the reduction of APU use, educate tenants in benefits of reduced APU use.
	If operational measures insufficient, conduct design study and construct East Airpark barrier or berm.
Maintenance Run-Ups	Develop new run-up location west of Runway 15/33 in coordination with planning for proposed taxiway improvement projects, coordinate with ATC, Airport Operations, tenants.
	Amend Airport Bulletin 2000-16 to include additional Taxiway J run-up heading; provide airfield markings and signs, coordinate with Airport Operations and Planning.
	Require reporting of actual run-up data; consider implementing additional nighttime restrictions.
	If operational measures and/or a new location deemed insufficient, construct a noise barrier or berm at new run-up location.
GA Aircraft Start-up and Departure	Conduct noise barrier/berm design study in conjunction with affected community to evaluate alternative locations near gravel strip.
	Provide education to GA pilots in noise-sensitive departure procedures.
	In coordination with GA Operations and Planning personnel, optimize orientation of any new tie-downs near residential areas.
Field Maintenance Equipment	As feasible, limit nighttime field maintenance operations near residential areas.
	Require use of variable-volume back-up alarms on all new ANC maintenance equipment and all contractor equipment.

Source: Ted Stevens Anchorage International Airport Comprehensive Ground Noise Study, Final Report, HMM&H, March 2002.

Engine run-ups (above idle) are not permitted on any apron or ramp area. Engine run-ups are permitted only at the designated engine run-up locations. The engine run-up locations and aircraft headings are summarized in Table A6, *ENGINE RUN-UPS ABOVE IDLE POWER*.

Table A6
ENGINE RUN-UPS ABOVE IDLE POWER

Engine Run-Up Location	Aircraft Heading (True)	Aircraft Heading (Magnetic)
Taxiway Q	165	170
Taxiway J	090	060

Source: Ted Stevens Anchorage International Airport Noise Abatement Procedures and Preferential Runway Use Program.
Note: Locations of Taxiways can be seen on Figure A3.

Engine run-ups during nighttime hours are restricted to those aircraft that are hard scheduled for a flight prior to 0800 local time. Every effort should be made to avoid engine run-ups during quiet hours. Any violation of engine run-up policies during quiet hours will result in the aircraft being directed back to the parking apron with no further engine runs authorized until after 0700. Run-ups during nighttime hours must be done in accordance with the following procedures.

The airline requiring the run-up must request prior approval from the Airport Operations Officer on duty at 266-2600. Approval will not be directed for run-ups in progress.

The aircraft operator must provide Airport Operations with the following data:

- **Aircraft type**
- **Aircraft tail number**
- **Expected power settings**
- **Run-up location**
- **Flight # and departure time**
- **Run-up start time**
- **Aircraft orientation (heading used)**
- **Run-up end time**
- **Actual run-up power settings**
- **Upon approval, Taxiways Juliet and Quebec must be utilized as described above. Any variance in compass heading must be coordinated with Airport Operations.**

Taxi Training

Taxi training involves the operation of an aircraft by a non-certificated pilot (mechanic) on the taxiways and runways of the ANC for purposes of familiarization with the aircraft or airfield. Repositioning from gate to gate or to a run-up location for an authorized engine run is not considered taxi training.

Taxi training requires prior approval from Airport Operations. The company requesting authorization to conduct taxi training must provide Airport Operations with the estimated start and stop times along with the anticipated route of travel. Dependent on airfield conditions, configuration, and traffic levels Airport Operations may approve, delay, or deny taxi training operations.

Permission from Airport Operations to conduct taxi training does not relieve the aircraft operator of the responsibility to receive appropriate ATC clearances prior to entering the movement area.

Residential Sound Insulation Program (RSIP)

Through the previous Part 150 Study approved by the FAA in 2000, the Airport initiated a residential sound insulation program. The goal of the program is to reduce the level of aircraft noise within the interior of homes within the federally-approved 65 DNL and greater noise contours. Residential construction modifications to homes within the previous federally-approved noise contours established in 2000 include replacement of existing windows and doors with acoustical windows and doors, attic insulation if required, and air conditioning if required.

Since 2001, insulation modifications have been completed for over 880 eligible dwellings at a cost of approximately $50,000 per single family house. The sound insulation program is voluntary on the part of the homeowner with the goal of reducing the level of aircraft-related noise within the interior of the homes. The FAA has set two goals for Anchorage residents included in the program. The first goal is a reduction of the interior noise levels by at least 5 dB. The second goal is to reduce interior noise to a level equivalent to DNL 45 dB. This sound level will allow for normal speech with minimal disruption from aircraft noise. The program is free; there are no out-of-pocket expenses for eligible participants. A field inspector works on behalf of each home owner to ensure all work is satisfactory to the owner. Additionally, an avigation easement is generally required, which grants the Airport the right to fly over a particular piece of property and create noise or vibration.

Flight Track and Noise Monitoring System

The Flight Track and Noise Monitoring System (FT&NMS, ANOMS) was one component of ANC's Noise Compatibility Plan. The Flight Track component of the system allowed the Airport to monitor the flight path, altitude and speed of aircraft that arrive, depart, or transfer through the airspace over Anchorage and match them to the corresponding decibel levels captured by the Noise Monitoring Terminals of the system.

The Airport realized that aircraft noise is a by-product of the operation of the Airport and has committed to taking reasonable actions to minimize aircraft noise exposure. The FT&NMS measured actual aircraft noise exposure on a daily basis.

The FT&NMS used several permanently located noise monitors to measure aircraft noise exposure 24 hours a day, 365 days per year. Currently the system is not operational, and the upgrade and continued operation of the system will be evaluated as part of this Part 150 Study Update. The locations of the noise monitoring sites are shown on Figure A6, *EXISTING NOISE MONITORS*. Note that not all monitors are sequentially numbered due to alterations in the initial monitoring locations due to right-of-way and legal issues that prevented certain locations from being used.

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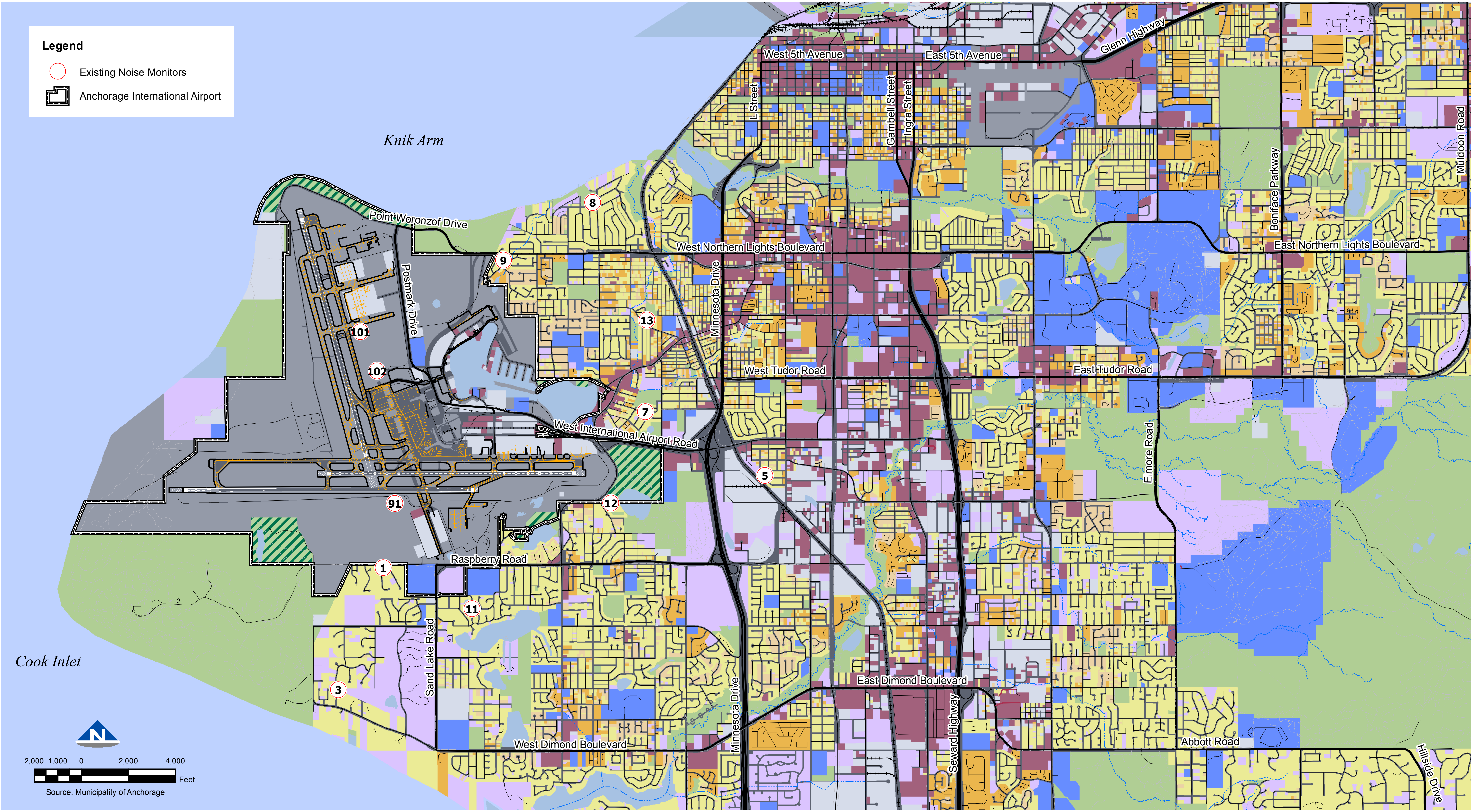

FIGURE A6 **Existing Noise Monitors**

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Noise Complaint Response

Until recently, ANC operated a Noise Complaint Hotline that is available 24 hours a day to receive public comments. Filing of noise complaints was done directly via telephone to the Noise Programs Office. Recently, this process switched and callers are directed to submit comments/complaints on the website. However, the Airport's main line is available for those who want to call in a complaint.

Noise complaints are evaluated to identify the cause of the noise event and determine if an aircraft is operating outside the noise plan parameters. Noise complaints are not necessarily reflective of the severity of the noise, but can be useful to the Airport in identifying problems and issues that are important to the various communities surrounding the Airport.

The airport staff investigates the source of each noise complaint. If an aircraft is found to be outside the procedures outlined in the Preferential Runway Use Program, additional research will be done to determine why, and this information will be forwarded to the airline and/or the FAA as appropriate. In 2011, the Noise Programs Office received 232 complaints and in 2010 there were 194 complaints. This reflects a continued downward trend in the overall noise complaints received at the Airport considering that in 2003 there were 492 complaints and in 1999 there were 1,146 complaints. The number of complaints vary by season. The following Figures A7a and A7b, entitled *YEAR 2010 NOISE COMPLAINTS BY MONTH* and *YEAR 2011 NOISE COMPLAINTS BY MONTH* show the noise complaints by month for 2010 and 2011. The difference in 2010 and 2011 is likely due to differences in weather between the two years and due to changes in runway use associated with runway closures during construction.

Aircraft noise complaint information was obtained as part of the baseline data for this FAR Part 150 Study. These complaints, when coupled with the aircraft noise exposure contours and flight track maps, provide one means of an illustration of the locations where individuals are concerned with aircraft noise exposure. In some cases, specific noise concerns are identified that help determine which issues should be included in this FAR Part 150 Study or help identify new issues as they arise. However, because some citizens will not call noise complaint hotlines or submit complaints in writing, the complaint information is not the sole determinate of where and how people are concerned with aircraft noise.

Figure A7a
YEAR 2010 NOISE COMPLAINTS BY MONTH

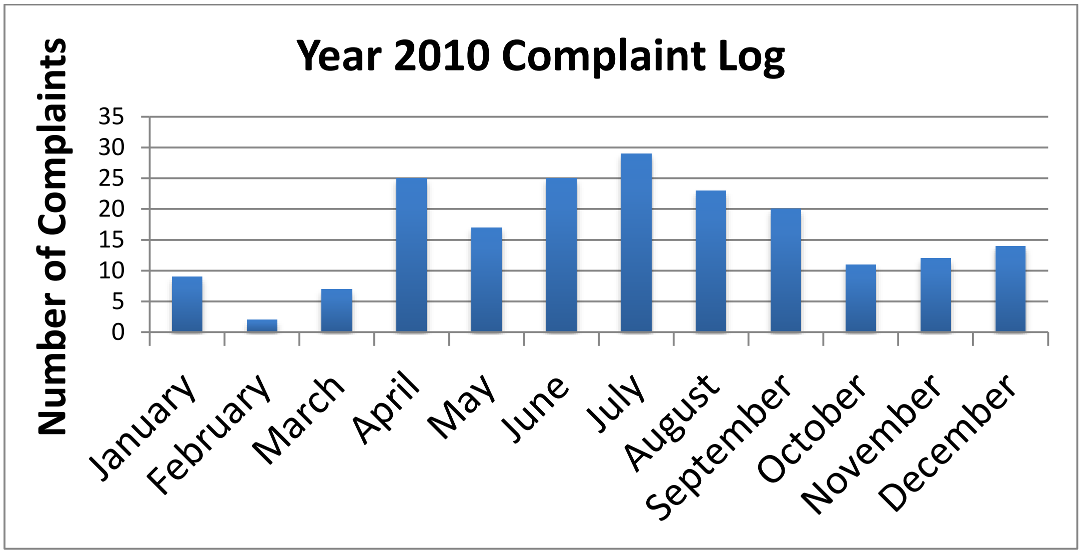
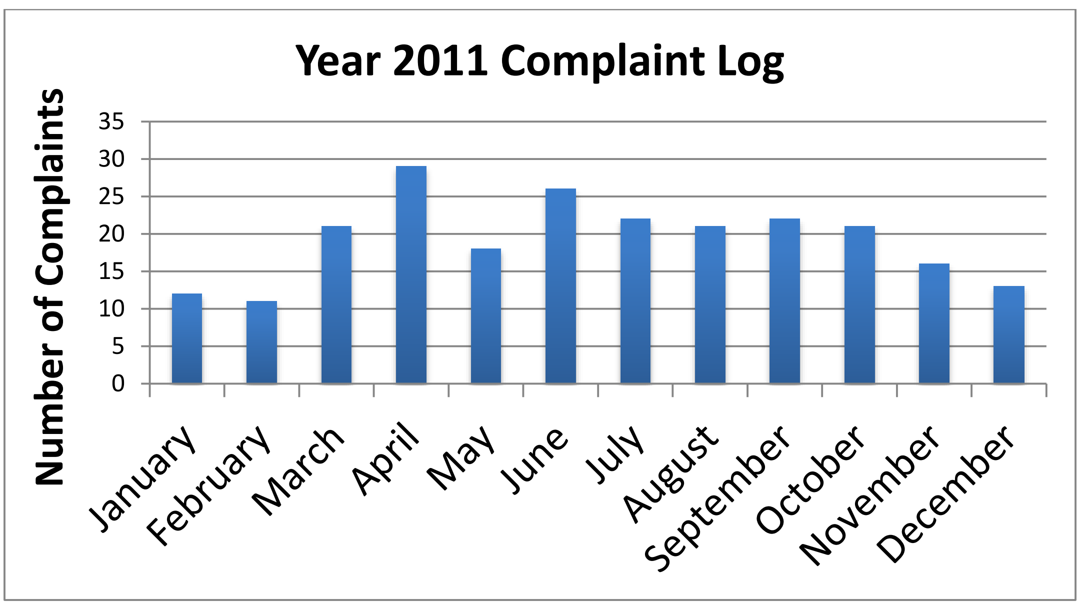


Figure A7b
YEAR 2011 NOISE COMPLAINTS BY MONTH



The noise complaint data for the year 2011 were analyzed to determine the nature of the complaints. It is important to note that a good portion of the comments recorded (about 10 percent) were in relation to questions about the Residential Sound Insulation Program, and these calls were included in a separate category from complaints in Table A7 below. Of the number of complaints, approximately 12 percent of the comments came from two phone numbers, with the rest of the individuals averaging one complaint a year. The complaints were reviewed by the following categories and the number of complaints by category (note that some complaints noted multiple categories so this table does not match the total number of complaints):

Table A7
NOISE COMPLAINT CATEGORIES

Noise Questions	**Number of Comments**
Inquiry on RSIP	13
Complaint Category	**Number of Complaints**
General Non-Specific	20
Departure Noise	1
Nighttime Noise	4
Over-flight Noise	10
Runway Noise	5
Too Loud	24
Too Frequent	15
Vibration	*3*
Low Flying Aircraft	*3*
Off Flight Track	3
Airport Construction Noise	2

Source: Ted Stevens Anchorage International Airport.
RSIP: Residential Sound Insulation Program
*Representative Sample

Airport Environs

ANC is the primary air transportation hub of the state of Alaska. The Airport (including the Lake Hood Seaplane Base) resides on approximately 4,743 acres located four miles southwest of the Anchorage central business district. ANC is located entirely within the MOA, which is considered a consolidated city-borough under state law. There are no other municipalities in the vicinity of ANC.

However, there are two additional boroughs in the vicinity of ANC including the Matanuska-Susitna Borough located north of the Airport across Knik Arm and the Kenai Peninsula Borough located south of the Airport across Turnagain Arm. Most of the land in the Matanuska-Susitna Borough adjacent to the Knik Arm is undeveloped, and most of the land to the south in Kenai Peninsula Borough is mountainous and also undeveloped.

Existing Land Use

Existing land uses surrounding ANC are characterized primarily by residential development and park/open space lands, with institutional and some commercial uses. Development to the east, northeast, and southeast beyond the lands directly adjacent to ANC are increasingly urban with a mixture of residential, commercial, and industrial uses.

Important public and recreational lands adjoin ANC including Earthquake Park, Kincaid Park, and the Coastal Wildlife Refuge to the west. The Tony Knowles Coastal Trail, one of the area's most popular recreation facilities, links downtown Anchorage to Kincaid Park via the coast line and is located along the north and west perimeters of ANC. Portions of the trail cross airport land and are accommodated via airport maintenance agreements which allow the temporary use of the property for a public recreation, recognizing that the property may be needed in the future for aviation purposes. There are currently five airport-owned parcels that are used and managed as municipal parks, which are listed below. These have been available to the MOA via maintenance agreements, all of which expired and now fall under month to month extension. ANC lands under permit to MOA for interim public recreational use until they are needed for aviation purposes include:

- **Point Woronzof Overlook**
- **Little Campbell Lake Park**
- **Delong Lake Park (part of)**
- **Connors Lake Park**
- **Spenard Beach Park**

Figure A8, *GENERALIZED EXISTING LAND USE*, depicts the existing generalized land uses for areas near the Airport. An estimate of population, residential units, and noise sensitive facilities exposed to aircraft noise levels of 65 DNL and higher are presented in the Land Use Analysis chapter.

Existing Zoning

Existing land use adjacent to ANC is controlled primarily through the implementation of the MOA zoning regulations, Title 21 of the Anchorage Municipal Code. Title 21 applies not only to development, but also to design and modifications of buildings, roads, and landscaping. Figure A9, *GENERALIZED EXISTING ZONING*, depicts the existing generalized zoning for the areas near the Airport.

Airport Zoning

The current MOA zoning map contains a variety of zoning districts within airport property. There are currently ongoing discussions between the MOA Planning Department and airport staff on the possible formation and provisions of a new airport zoning district. It would be adopted as part of Title 21 and define land uses and/or permitted activities on airport property. "Airport overlay districts" are strategies used by other communities to help manage compatible uses adjacent to airport property. Such an ordinance was proposed and considered by the Planning and Zoning Commission in 1977, but was postponed by the Anchorage Assembly in 1998 and never implemented. The *West Anchorage District Plan*, adopted in 2012, also recommends an overlay district. A Height Zoning Overlay District already exists in Title 21, as described in the following section.

Airport Height Zones

The Airport Height Zones are unrelated to specific zoning districts; however, they are codified in the zoning regulation - AMC 21.65. They are described and defined by Federal Aviation Regulations Part 77 to provide safe approach paths to certain airports. The five affected airports in the MOA are: ANC, Lake Hood Seaplane Base, Merrill Field, Birchwood Airport, and Girdwood Airport.

The Airport Height Zone contours are shown on the zoning maps. The contours give the maximum elevation above mean sea level (MSL) allowed for structures, including radio antennas. Plot plans for building and land use permits within Airport Height Zones may be required to show elevations referenced to mean sea level to verify that structures don't encroach vertically into the Airport approach and departure surfaces.

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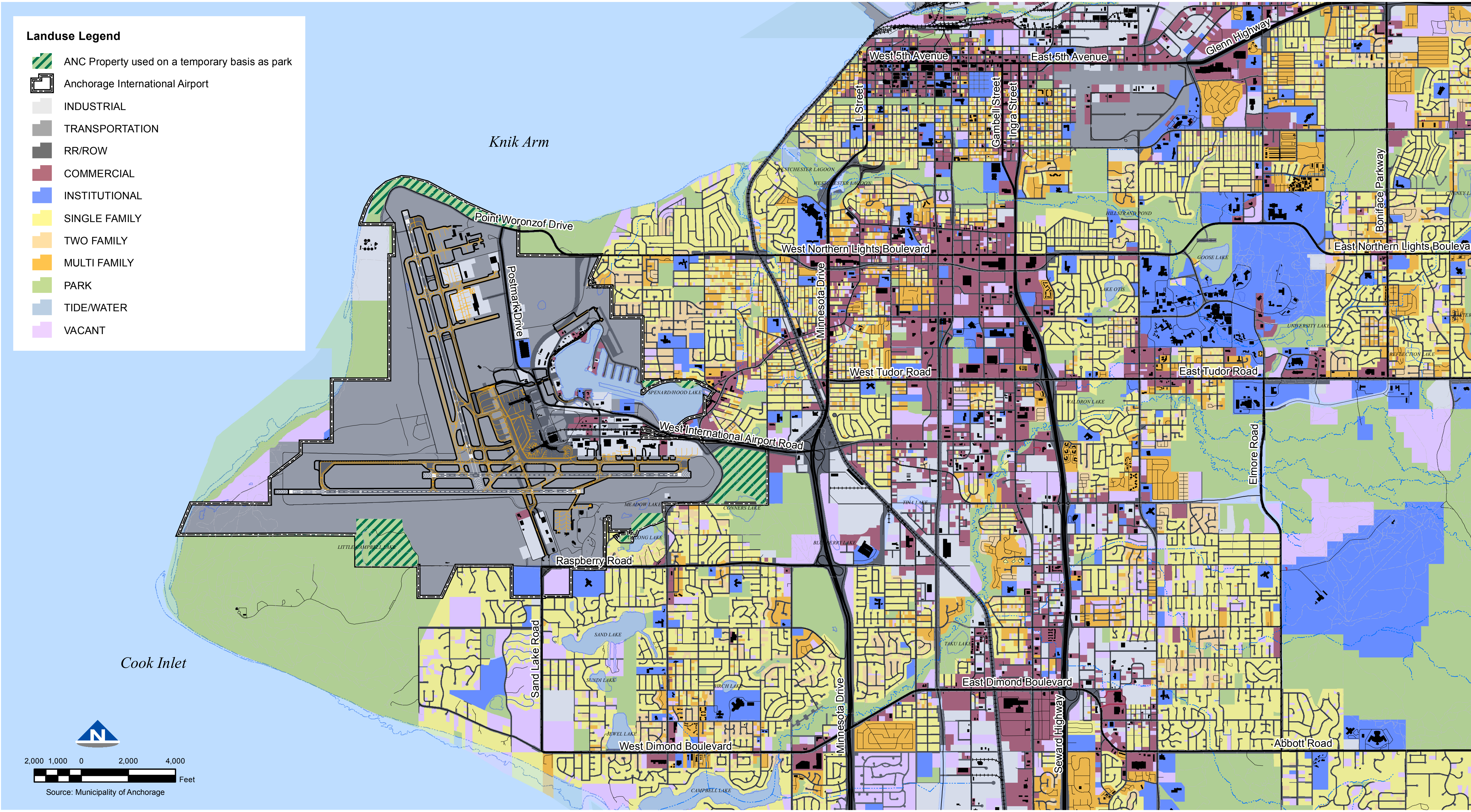

FIGURE A8 **Generalized Existing Land Use**

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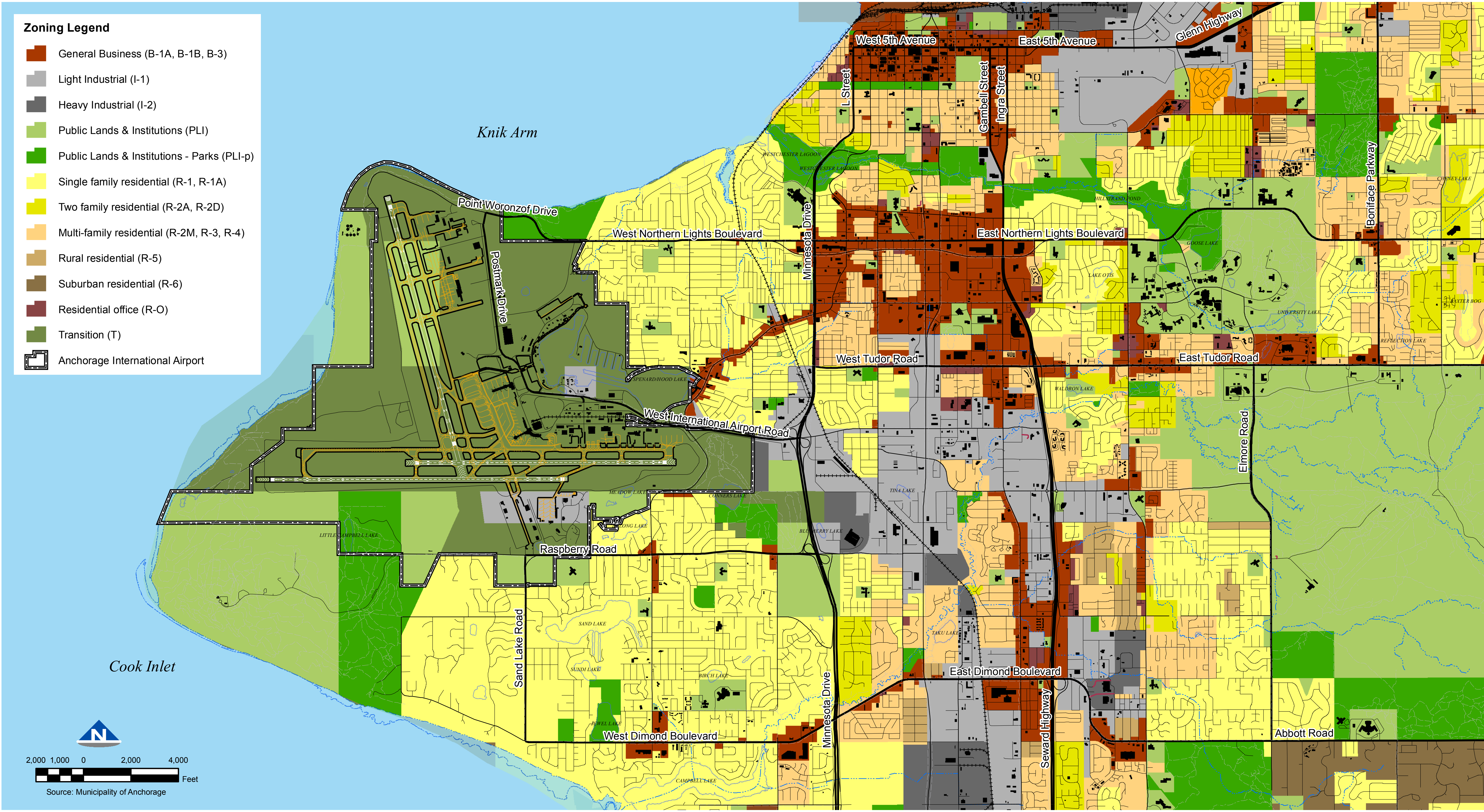

FIGURE A9 **Generalized Existing Zoning**

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Future Land Use

The MOA Assembly adopted the *Anchorage Bowl Comprehensive Plan – Anchorage 2020*, on February 20, 2001 to serve as a guide for future development within the Anchorage Bowl. The plan recognizes the importance of the Airport as an economic resource, as well as a transportation resource. The plan also recognizes the potential for airport expansion, primarily within the existing airport boundaries. At the same time, it recognizes the relationship between the Airport and surrounding community, and designates a West Anchorage Planning Area to serve as a mechanism to identify, address, and resolve land use conflicts within and near the Airport. The Plan committed the MOA to development of a *West Anchorage District Plan* (WADP), which was adopted by the Assembly in July 2012, to collaboratively address airport activities and airport impacts on the community, as well as impacts of adjacent land uses on the Airport. Key recommendations in the WADP include the following:

- Adoption of an Airport Zoning District inside the airport boundary;
- Adoption of an "Airport Influence Overlay" District, with expanded real estate disclosures on properties within the 60 or 65 DNL and enhanced building code requirements for sound attenuation; and
- Exchange of Airport and MOA land to accommodate MOA recreational uses and address residential separation concerns and future airport development needs.

Many of the land use recommendations from the NCP are also recommended in the WADP.

Chapter B - Forecasts

INTRODUCTION. Ted Stevens Anchorage International Airport (ANC) is a vital part of the Alaska International Airport System (AIAS). Concurrent to this Part 150 Study Update, the Alaska International Airport System was conducting an update to the system-wide forecasts including Ted Stevens Anchorage International Airport, Lake Hood Seaplane Base, and Fairbanks International Airport. Forecasts were developed for 2015, 2020, 2025, and 2030. These forecasts are presented in detail in the *Alaska International Airport System Plan Forecast Tecnhical Report*. Because these forecasts were completed concurrent with the start of the Part 150 Study Update, it was decided to use these forecasts as a basis for the Part 150 Study to keep the Study consistent with the other planning studies.

Background

Projections of aviation demand that were developed as part of the *AIAS Forecast Technical Report* were prepared in accordance with guidance found in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B, Airport Master Plans. These forecasts were then used to provide the basis for several operational inputs into the Integrated Noise Model (INM) for this Part 150 Study. The forecasts were approved by the FAA on September 13, 2012. The approval letter can be found in the **Forecast Appendix** of this Study.

In preparing a Federal Aviation Regulation (FAR) Part 150 Noise Compatibility Plan, one of the key products is the preparation of the Noise Exposure Maps (NEMs). The NEMs identify the existing and future noise exposure (typically five years into the future from the date of submission of the NEMs), and are prepared using the FAA's INM. For this case, 2009 was used as the existing base case year because it was the last full year of operations without operational changes (such as runway closures due to maintenance). This information was pulled from airport tower counts. The future base case examined will be 2020, which is approximately five years from the date of expected submission of the contours to FAA. Additionally, a 2030 scenario will be developed for planning/informational purposes only.

To prepare a noise exposure contour map for a particular year, the INM requires information concerning the number of aircraft operations, the types of aircraft (fleet mix), and the time of day (day or night) that the activity occurs. As stated above, the 2009 data was pulled from airport tower counts and flight track data. For 2020 and 2030, the methods of the forecast development can be found within the *Alaska International Airport System Plan Forecast Technical Report*. The results are summarized here with respect to those operations that provide the basis for the Part 150 Noise Compatibility Study contours (2009, 2020, and 2030).

Existing Operations and Forecasts Summary

This section presents the summary of the existing operations for the year 2009. At the onset of this study, 2009 provided the last full year of data available that represented "normal" operations, without major operational changes (such as runway closures due to maintenance). The breakdown for Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base are included in Table B1 below.

Additionally, this section presents the summary of the forecasts developed in the *Alaska International Airport System Plan Forecast* for the years 2020 (Future), and 2030 (Out-Year for informational purposes). These are included in Table B1 below for reference. These operations are further broken down by aircraft type for the INM analysis.

Table B1
SUMMARY OF 2009, 2020, AND 2030 AIRCRAFT OPERATIONS BY TYPE

Year	Air Carrier Operations	Cargo Operations	Air Taxi Operations	General Aviation Operations	Military Operations	Total Operations
2009						
ANC	91,092	65,014	2,280	35,685	4,385	198,456
LHD		-	12,291	45,885	-	58,176
Total	***91,092***	***65,014***	***14,571***	***81,570***	***4,385***	***256,632***
2020						
ANC	101,540	95,812	2,793	39,863	2,267	242,275
LHD		-	15,793	49,667	-	65,460
Total	***101,540***	***95,812***	***18,586***	***89,530***	***2,267***	***307,735***
2030						
ANC	111,212	118,714	2,036	47,713	2,267	281,942
LHD		-	18,902	59,446	-	78,348
Total	***111,212***	***118,714***	***20,938***	***107,159***	***2,267***	***360,290***

Source: 2009 data from Airport tower counts; 2020, 2030 forecasts from the Alaska International Airport System Forecast Technical Report, 2012.

Chapter C - Background on Noise

INTRODUCTION. Noise, by its definition, is unwanted sound. Noise is perceived by, and consequently affects people in a variety of ways. This chapter presents background information on the characteristics of sound and provides insight into the human perception of noise. This section also provides a means to relate the sound made by aircraft operating to and from Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base to the noise in the surrounding communities. This chapter also presents the metrics (the way noise is measured or described in decibels) and methodologies used in the Part 150 Noise and Land Use Compatibility Study (Study) to describe noise from aircraft operating at Ted Stevens Anchorage International Airport. These metrics enable the characterization of existing and future noise. This chapter is divided into the following sub-sections:

- **Characteristics of Sound**. Presents properties of sound that are important for describing noise in the airport setting.
- **Factors Influencing Human Response to Sound.** Discusses sound level conditions and their response in humans.
- **Health Effects of Noise**. Summarizes the potential health effects of noise to humans.
- **Sound Description Metrics**. Presents various sound rating scales and how these scales are applied to assessing noise from aircraft operations.
- **Noise/Land Use Compatibility Standards and Guidelines**. Summarizes the current guidelines and regulations used to control the use of land in areas affected by aircraft noise.
- **Airport Noise Assessment Methodology.** Describes computer modeling and on-site sound level measurements used to measure aircraft and other noise in the vicinity of airports.

Characteristics of Sound

Sound Level and Frequency. Sound is described in terms of the sound pressure (amplitude) and frequency (similar to pitch).

Sound pressure is a direct measure of the magnitude of a sound without consideration for other factors that may influence its perception. The range of sound pressures that occur in the environment is so large that it is convenient to express them on a logarithmic scale. The standard unit of measurement for sound pressure is the "decibel" or dB. One decibel is used to describe the reference point of 20 micro Pascals or about 0.000000003 pounds per square inch of energy. Thus, 65 decibels (65 dB) is that amount to the 65th power (10^{65}). A logarithmic scale is used because of the difficulty in expressing such large numbers.

On the logarithmic scale, a sound level of 70 dB has 10 times the energy as a level of 60 dB, while a sound level of 80 has 100 times as much acoustic energy as 60 dB. This differs from the human perception of noise, which typically judges a sound 10 dB higher to be twice as loud, 20 dB higher to be four times as loud, and so forth.

Highlights of Sound

Noise by definition is unwanted sound. There are many ways to describe noise (metrics), however, the most commonly used metric is the decibel (dB), which includes a weighting system that most closely reflects the human ear (the A-weighted decibel – dBA).

A number of factors affect sound, including weather, ground effects, as well as human reaction to the noise source. Health effects associated with aircraft noise typically include impacts to sleep and communication, which cause stress.

Federal law requires the use of a common noise metric to quantify aircraft noise - the Day-Night Average Level (DNL). The DNL is a 24-hour average sound level that includes a weighting for noise during the nighttime hours. The Federal Aviation Administration (FAA) and other federal agencies have established land use compatibility guidelines based on the DNL, that identify the acceptability of various types of land use with aircraft noise exposure.

The frequency of a sound is expressed as Hertz (Hz) or cycles per second. The normal audible frequency range for young adults is 20 Hz to 20,000 Hz. The prominent frequency range for community noise, including aircraft and motor vehicles, is between 50 Hz and 5,000 Hz. The human ear is not equally sensitive to all frequencies, with some frequencies judged to be louder for a given sound than others. As a result, research studies have analyzed how individuals make relative judgments as to the "loudness" or "annoyance" of a sound.

The most prominent of these scales includes "loudness level," "frequency-weighted" scale (such as the A-weighted scale), and Perceived Noise Level. Noise metrics used in aircraft noise assessments are based upon these frequency weighting scales.

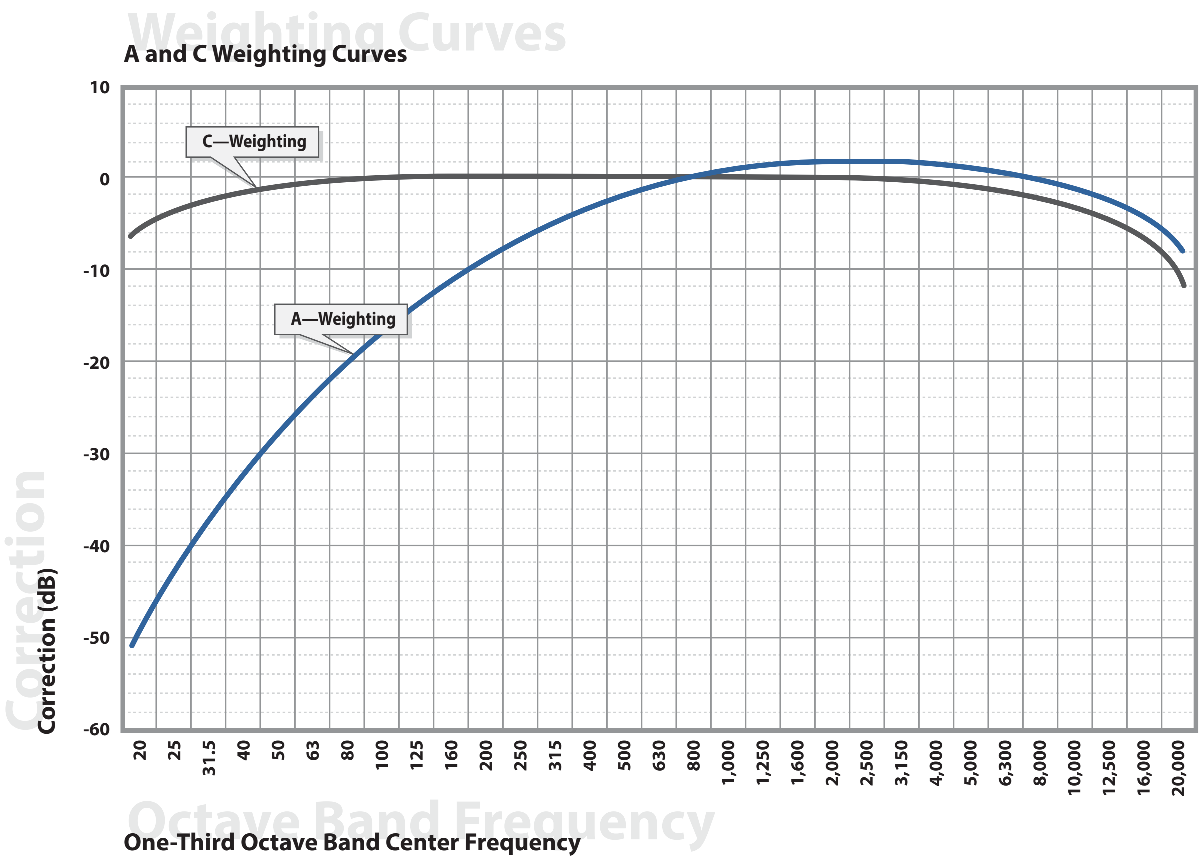
Loudness Level. This scale has been devised to approximate the human subjective assessment of the "loudness" of a sound. Loudness is the subjective judgment of an individual as to how loud or quiet a particular sound is perceived.

Frequency-weighted Scales (dBA and dBC). To simplify the measurement and computation of sound loudness levels, frequency-weighted metrics are used. These frequency-weighted scales demonstrate different aspects of noise, and are presented in Figure C1, *FREQUENCY WEIGHTED CONTOURS (dBA, dBC)*. The most common frequency weighting is the A-weighted frequency scale. The A-weighted decibel scale (dBA) focuses on frequencies approximating the sensitivity of the human ear. In the A-weighted decibel scale, everyday sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Most community noise analyses are based upon the A-weighted decibel scale. Examples of various sound environments, expressed in dBA, are presented in Figure C2, *EXAMPLES OF VARIOUS SOUND ENVIRONMENTS*.

Some interest has developed in using a noise scale that measures lower frequency noise sources. For example, the C-weighted frequency scale is used for the analysis of the noise impacts from artillery noise, which captures the low rumble that many associate with vibration.

Perceived Noise Level. Perceived noisiness was originally developed for the assessment of aircraft noise. Perceived noisiness is defined as "the subjective impression of the unwantedness of a not unexpected, non-pain or fear-provoking sound as part of one's environment…" (Kryter, 1970). The "noisiness" scale differs from "loudness" scales in that they have been developed to rate the noisiness or annoyance of a sound as opposed to the loudness of a sound (e.g., perception of the noise).

As with loudness, the noisiness scale has been developed from laboratory surveys of individuals. However, in noisiness surveys, individuals are asked to judge in a laboratory setting when two sounds are equally noisy or disturbing if heard regularly in their own environment. These surveys are more complex and are therefore subject to greater variability. Aircraft certification data are based upon these types of noisiness curves (see Federal Aviation Regulation (FAR) Part 36 Regulations presented in the Noise and Land Use section of this chapter).



SOURCE: BridgeNet International

FIGURE C1
Frequency Weighted Contours (dBA, dBC)

EXAMPLES OF VARIOUS A-WEIGHTED DECIBEL SOUND ENVIRONMENTS

dB(A)	OVER-ALL LEVEL Sound Pressure Level Approx. 0.0002 Microbar	COMMUNITY (Outdoor)	HOME or INDUSTRY	LOUDNESS Human Judgement of Different Sound Levels
130		Military Jet Aircraft Takeoff with Afterburner from Aircraft Carrier @ 50 ft. (130)	Oxygen Torch (121)	120 dB(A) 32 Times as Loud
120 110	UNCOMFORTABLY LOUD	Concorde Takeoff (113)	Riveting Machine (110) Rock and Roll Band (108-114)	110 dB(A) 16 Times as Loud
100		Boeing 747-200 Takeoff (101)		100 dB(A) 8 Times as Loud
90	VERY LOUD	Power Mower (96) DC-10-30 Takeoff (96)	Newspaper Press (97)	90 dB(A) 4 Times as Loud
80		Car Wash @ 20 ft. (89) Boeing 727 Hushkit Takeoff (89)	Food Blender (88) Milling Machine (85) Garbage Disposal (80)	80 dB(A) 2 Times as Loud
70	MODERATELY LOUD	High Urban Ambient Sound (80) Passenger Car, 65 mph @ 25 ft. (77) Boeing 757 Takeoff (76)	Living Room Music (76) TV-Audio, Vacumn Cleaner	70 dB(A)
60		Propeller Airplane Takeoff (67) Air Conditioning Unit @ 100 ft. (60)	Cash Register @ 10 ft. (65-70) Electric Typewriter @ 10 ft. (64) Conversation (60)	60 dB(A) 1/2 Times as Loud
50	QUIET	Large Transformers @ 100 ft. (50)		50 dB(A) 1/4 Times as Loud
40		Bird Calls (44) Low Urban Ambient Sound (40)		40 dB(A) 1/8 Times as Loud

"Aircraft takeoff noise measured 6,500 meters from beginning of takeoff roll
(Source: Advisory Circular AC-36-3G)"

SOURCE: Reproduced From Melville C. Branch And R. Dale Beland, "Outdoor Noise In The Metropolitan Environment". Published By The City Of Los Angeles. 1970.

FIGURE C2
Examples of Various Sound Environments

Propagation of Noise. Outdoor sound levels decrease as a result of several factors, including increasing the distance from the sound source, atmospheric absorption (characteristics in the atmosphere that actually absorb sound), and ground attenuation (characteristics on the ground that absorb sound). Sound typically travels in spherical waves, similar to waves created from dropping a stone into water. As the sound wave travels away from the source, the sound energy is spread over a greater area, dispersing the sound power of the wave.

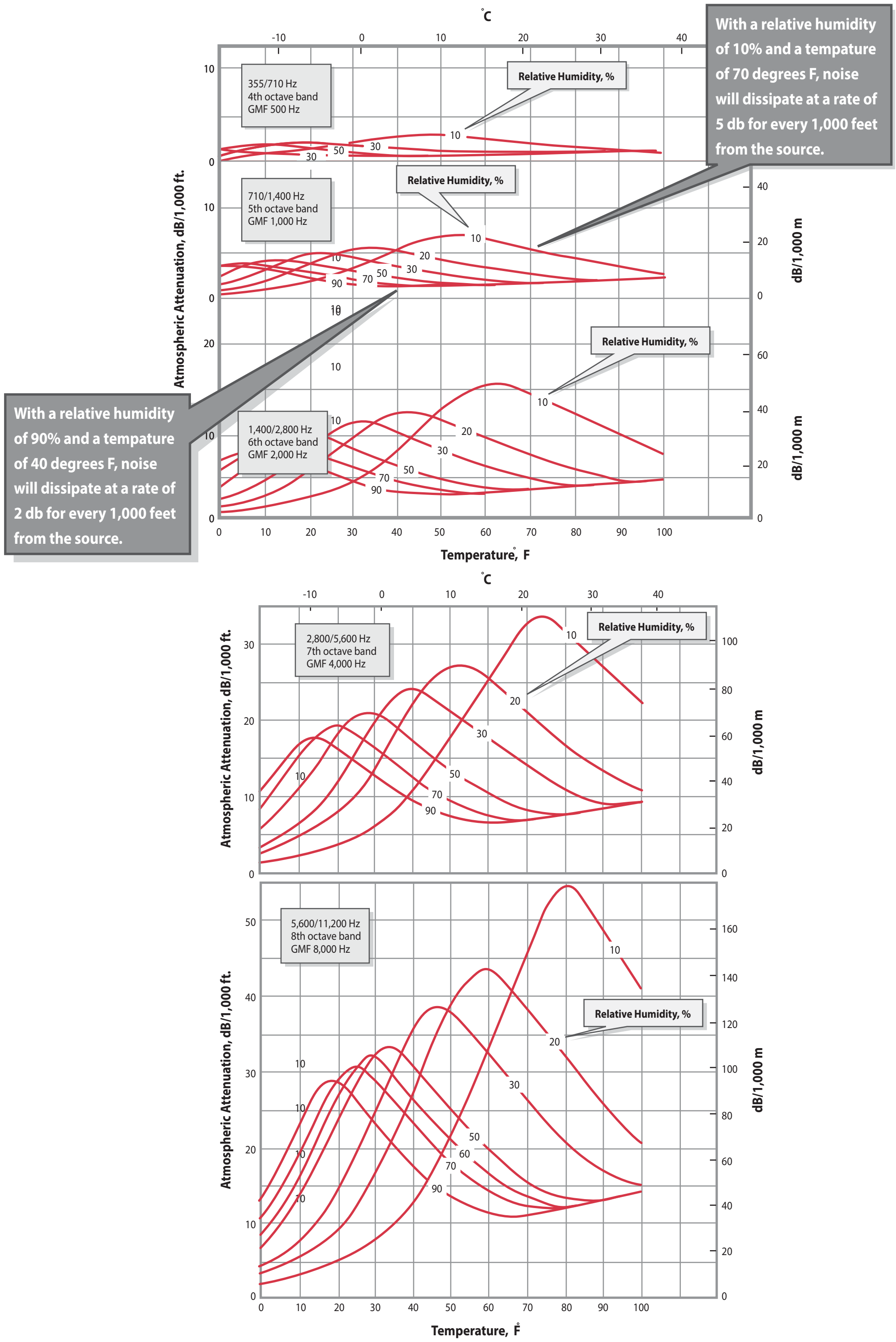
Temperature and humidity of the atmosphere also influence the sound levels at a particular location. These influences increase with distance and become particularly important at distances greater than 1,000 feet. The degree of absorption depends on the frequency of the sound, as well as humidity and air temperature. For example, when the air is cold and humid, and therefore denser, atmospheric absorption is lowest. Higher frequencies are more readily absorbed than the lower frequencies. Over large distances, lower frequency sounds become dominant as the higher frequencies are attenuated.

Aircraft noise propagates differently under dry and wet meteorological conditions. During rainy conditions, aircraft noise propagates further due to the denser air molecules. Moisture-laden air is a better conductor of sound than dry air, so moist air carries sounds farther. If the air is warm and moist, the rule holds. If the air is very cold, it is also very dense and a better sound conductor than warm air.

Examples of the effects of temperature and humidity on sound absorption are presented in Figure C3, *ATMOSPHERIC ATTENUATION GRAPHS– HOW NOISE CHANGES OVER DISTANCE BASED ON HUMIDITY AND TEMPERATURE*.

Duration of Sound. Duration of a noise event is an important factor in describing sound in a community setting. The longer the noise event, the more likely that the sound will be perceived as annoying. The “effective duration” of a sound starts when a sound rises above the background sound level and ends when it drops back below the background level. Studies have confirmed a relationship between duration and annoyance and established the amount a sound must be reduced to be judged equally annoying over an increased duration time.

This relationship between duration and noise level forms the basis of how the equivalent energy principal of sound exposure is measured. Reducing the acoustic energy of a sound by one-half results in a three dB reduction. Conversely, doubling the duration of the sound event increases the total energy of the event by three dB. This *equivalent energy principle* is based upon the premise that the potential for a noise to impact a person is dependent on the total acoustical energy content of the noise. Noise descriptors explained below (DNL, LEQ, and SEL) are all based upon this *equivalent energy principle*.



SOURCE: Beranek , 1981.

FIGURE C3
Atmospheric Attenuation Graphs– How Noise Changes Over Distance Based on Humidity and Temperature

Change in Noise Levels. The concept of change in sound levels is related to the reaction of the human ear to sound. The human ear detects relative differences between sound levels better than absolute values of levels. Under controlled laboratory conditions, a human listening to a steady unwavering pure tone sound can barely detect a change of approximately one decibel for sound levels in the mid-frequency region. However, when ordinary noises are heard, a young healthy ear can only detect changes of two to three decibels. A five-decibel change is noticeable while a 10-decibel change is judged by the majority of people as a doubling effect of the sound, which can generate aircraft noise complaints.

Masking Effect. One characteristic of sound is its ability to interfere with the listener's ability to hear another sound. This is defined as the masking effect. The presence of one sound effectively raises the threshold of audibility for the hearing of a second sound. For a sound to be heard, it must exceed the threshold of hearing for that particular individual and exceed the masking threshold for the background noise.

The masking characteristic is dependent upon many factors, including the spectral (frequency) characteristics of the two sounds, the sound pressure levels, and the relative start time of sound events. The masking effect is greatest when it is closest to the frequency of the signal. Low frequency sounds can mask higher frequency sounds; however, high frequency sounds do not easily mask low frequency sounds.

Ground Effects. This term describes the effects of vegetation on noise. As sound travels away from the source, some of it is absorbed by grass, plants, and trees. The amount of such ground attenuation (rate that noise level reduces at distances farther from the noise source) depends on the structure and density of trees and foliage, as well as the height of both the source and receiver and the frequency of the sound being absorbed. If the source and the receiver of the sound are both located below the average height of the intervening foliage, the ground covering will be most effective. If either the source or the receiver rises above the height of the ground covering, the excess attenuation will become less effective. Reflected sound, however, will still be reduced.

Factors Influencing Human Response to Sound

Many factors influence how a sound is perceived and whether or not it is considered annoying to the listener. This includes not only physical characteristics of the sound, but also secondary influences such as sociological and external factors. These factors are summarized in Table C1, *FACTORS THAT AFFECT INDIVIDUAL ANNOYANCE TO NOISE*.

Table C1
FACTORS THAT AFFECT INDIVIDUAL ANNOYANCE TO NOISE

Primary Acoustic Factors
Sound Level
Frequency
Duration
Secondary Acoustic Factors
Spectral (Frequency) Complexity
Fluctuations in Sound Level
Fluctuations in Frequency
Rise-time of the Noise
Localization of Noise Source
Non-Acoustic Factors
Physiology
Adaptation and Past Experience
How the Listener's Activity Affects Annoyance
Predictability of When a Noise Will Occur
Whether the Noise is Necessary
Individual Differences and Personality

Source: C. Harris, 1979.

Sound rating scales were developed to account for how humans respond to sound and how sounds are perceived in the community. Many non-acoustic parameters affect individual response to noise. Background sound, which is an additional acoustic factor, is important in describing sound in rural settings. Research has identified a clear association of reported noise annoyance and fear of an accident. In particular, there is firm evidence that noise annoyance is associated with: (1) the fear of an aircraft crashing or of danger from nearby surface transportation; (2) the belief that aircraft noise could be prevented or reduced by pilots or authorities related to airlines; and, (3) an expressed sensitivity to noise generally. Thus, it is important to recognize that such non-acoustic factors, as well as acoustic factors, contribute to human response to noise.

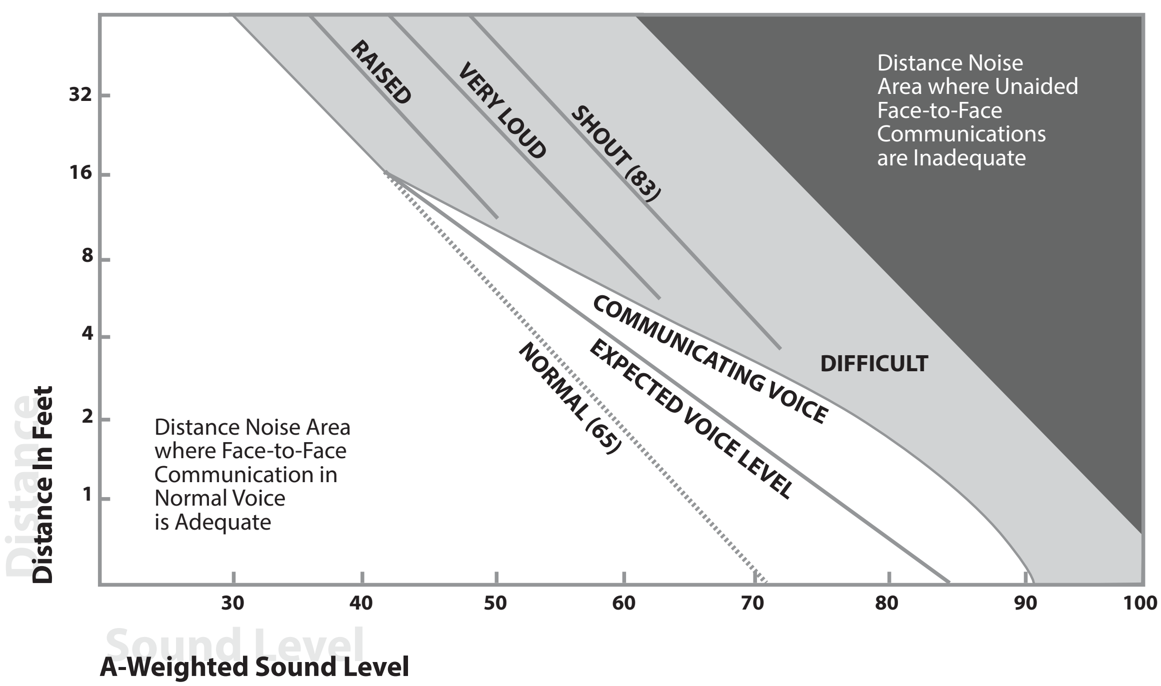
Health Effects of Noise

Noise is known to have adverse effects on people. From these effects, 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 is briefly discussed in the following points:

- *Hearing Loss* is generally not a concern in community/aircraft noise situations, even when close to a major airport or a freeway. The potential for noise induced hearing loss is more commonly associated with occupational noise exposure in heavy industry; very noisy work environments with long-term, sometimes close-proximity exposure; or, certain very loud recreational activities such as target shooting, motorcycle, or car racing, etc. The Occupational Safety and Health Administration (OSHA) identifies a noise exposure limit of 90 dBA for eight hours per day to protect from hearing loss (higher limits are allowed for shorter duration exposures). Noise levels in neighborhoods near airports, even in very noisy neighborhoods, do not exceed the OSHA standards and are not sufficiently loud to cause hearing loss.
- *Communication Interference* is one of the primary concerns with aircraft noise. Communication interference includes interference with hearing, speech, or other quiet enjoyment forms of communication such as watching television and talking on the telephone or being able to use the outdoor deck or patio without aircraft noise interruption. Normal conversational speech produces sound levels in the range of 60 to 65 dBA, and any noise in this range or louder may interfere with the ability of another individual to hear or understand what is spoken. There are specific methods for describing speech interference as a function of the distance between speaker, listener, and voice level. Figure C4, *QUALITY OF SPEECH COMMUNICATION IN RELATION TO THE DISTANCE BETWEEN THE TALKER AND THE LISTENER* shows the relationship between the quality of speech communication and various noise levels.

- *Sleep Interference*, particularly during nighttime hours, is one of the major causes of annoyance due to noise. Noise may make it difficult to fall asleep, create momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages, and may cause awakenings that a person may not be able to recall.

  Research has shown that once a person is asleep in their own home, it is much more unlikely that they will be awakened by a noise. Some of this research has been criticized because it has been conducted in areas where subjects had become accustomed to aircraft noise. On the other hand, some of the earlier laboratory sleep studies have been criticized because of the extremely small sample sizes of most laboratory studies and because the laboratory was not necessarily a representative sleep environment.



SOURCE: Noise Effects Handbook , EPA.

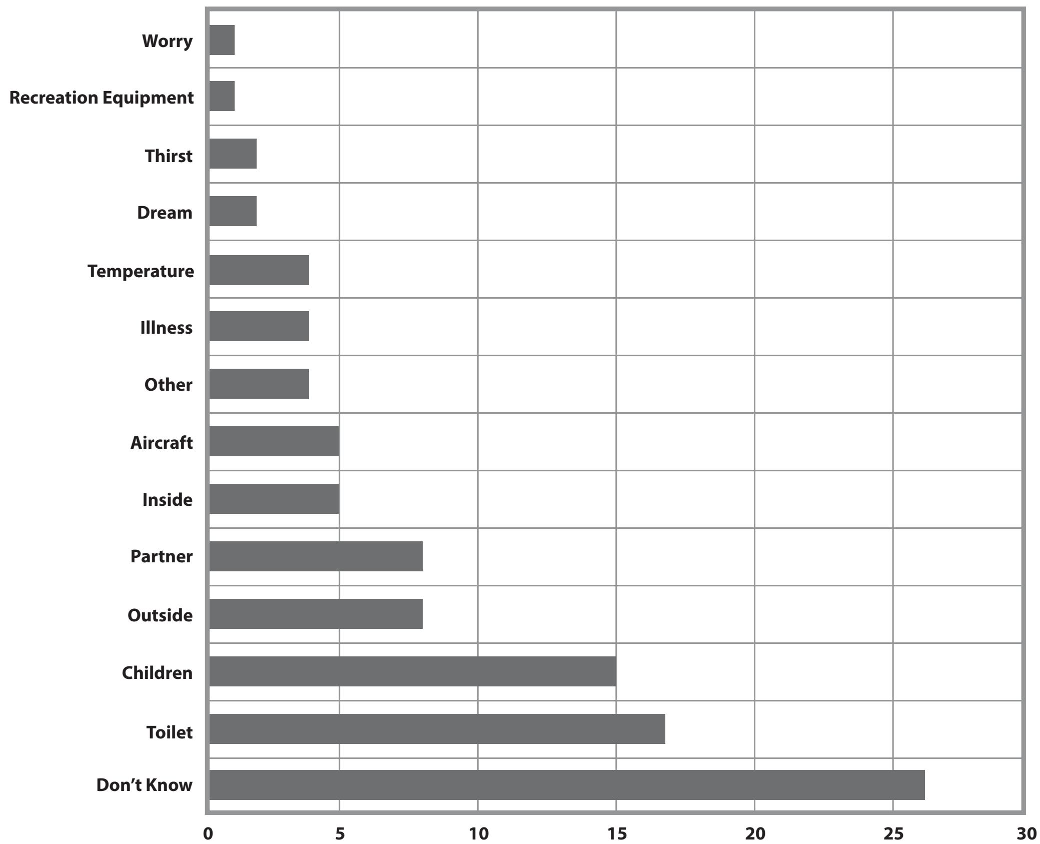
FIGURE C4
Quality of Speech Communication in Relation to the Distance Between the Talker and the Listener

An English study assessed the effects of nighttime aircraft noise on sleep in 400 people (211 women and 189 men; 20-70 years of age; one per household) living at eight sites adjacent to four U.K. airports, with different levels of night flying. The main finding was that only a minority of aircraft noise events affected sleep, and, for most subjects, that domestic and other non-aircraft factors had much greater effects. As shown in Figure C5, *CAUSES OF REPORTED AWAKENINGS*, aircraft noise is a minor contributor among a host of other factors that lead to awakening response. Likewise, the Federal Interagency Committee On Noise (FICON) in a 1992 document recommended that sleep disturbance be assessed based on laboratory studies of sleep disturbance. This review was updated in June 1997, when the Federal Interagency Committee on Aviation Noise (FICAN) replaced the FICON recommendation with an updated curve based on the more recent in-home sleep disturbance studies. The FICAN recommended consideration of the "maximum percent of the exposed population expected to be behaviorally awakened," or the "maximum awakened." The FICAN recommendation is shown in Figure C6, *SPEECH INTERFERENCE WITH DIFFERENT BACKGROUND NOISE,* along with a more common statistical curve. The differences indicate, for example, a 10% awakening rate at a level of approximately 100 dB SEL, while the "maximum awakened" curve prescribed by FICAN shows the 10% awakening rate being reached at 80 dB SEL. (The full FICAN report can be found on the internet at www.fican.org). Sleep interference continues to be a major concern to the public and an area of debate among researchers.

- *Physiological Responses* reflect measurable changes in pulse rate, blood pressure, etc. Generally, physiological responses reflect a reaction to a loud short-term noise, such as a rifle shot or a very loud jet over-flight. While such effects can be induced and observed, the extent to which these physiological responses cause harm is not known.

- *Annoyance* is the most difficult of all noise responses to describe. Annoyance is an individual characteristic and can vary widely from person to person. What one person considers tolerable may be unbearable to another of equal hearing capability. The level of annoyance also depends on the characteristics of the noise (e.g., loudness, frequency, time, and duration), and how much activity interference (e.g., speech interference and sleep interference) results from the noise. However, the level of annoyance is also a function of the attitude of the receiver. Personal sensitivity to noise varies widely. It has been estimated that two to 10% of the population are highly susceptible to annoyance from noise not of their own making, while approximately 20% are unaffected by noise. Attitudes are affected by the relationship between the listener and the noise source (Is it your dog barking or the neighbor's dog?). Whether one believes that someone is trying to abate the noise will also affect their level of annoyance.

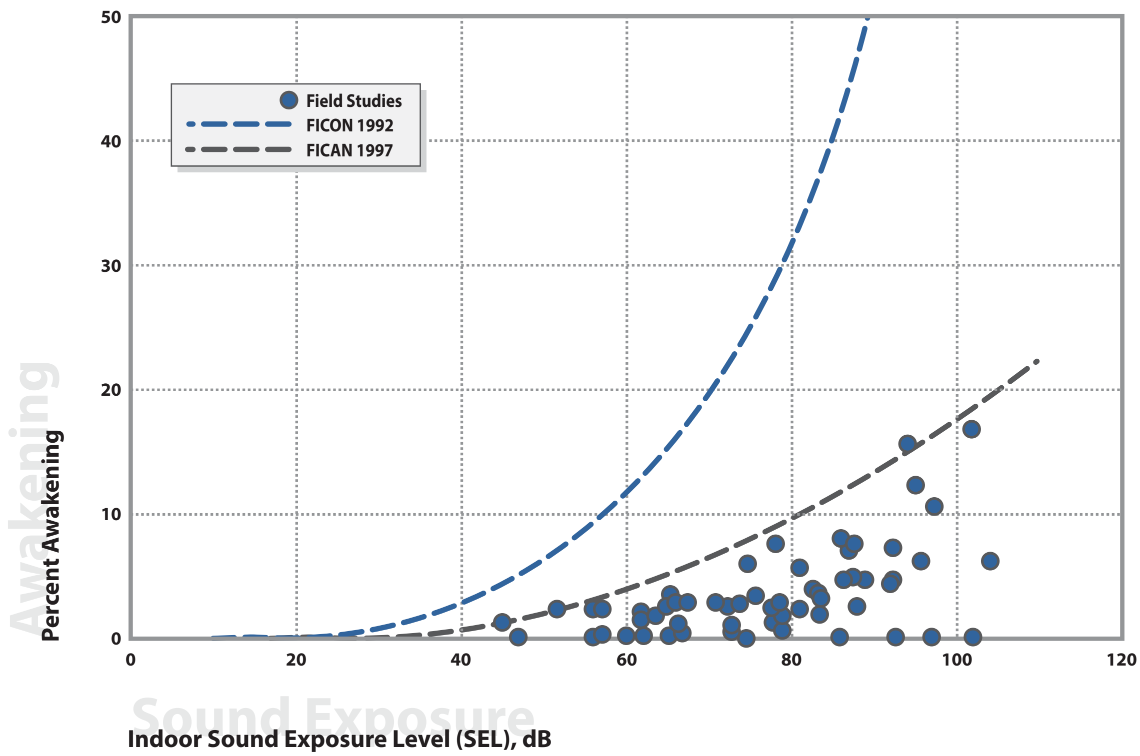
Cause of Reported Awakening



Percentage

SOURCE: Report Of A Field Study Of Aircraft Noise And Sleep Disturbance, 1992. London Department Of Safety.

FIGURE C5
Causes of Reported Awakenings



SOURCE: FICAN Report, 1997.

FIGURE C6
Speech Interference with Different Background Noise

Sound Description Metrics

The description, analysis, and reporting of community sound levels are 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 of "loudness" or "noisiness" of a sound.

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, or a car horn, etc. Cumulative metrics describe the noise in terms of the total noise exposure throughout the day. In accordance with federal requirements, this Part 150 Study focuses on cumulative metrics, using the Day-Night Average Level (DNL). The noise metrics used in this Study are summarized below:

Single Event Metrics.

- **A-Weighted Frequency Level (dBA).** To simplify the measurement and computation of sound loudness levels, frequency weighted metrics have obtained wide acceptance. The A-weighting (dBA) scale has become the most prominent of these scales and is widely used in community noise analysis. This metric has shown good correlation with community response and may be easily measured. The metrics used in this Study are all based upon the dBA scale.
- **Maximum Noise Level.** The highest noise level reached during a noise event is called the "Maximum Noise Level," or Lmax. For example, as an aircraft approaches, the sound of the aircraft begins to rise above ambient noise levels. The closer the aircraft gets, the louder it is until the aircraft is at its closest point directly overhead. As the aircraft passes, the noise level decreases until the sound level settles to ambient levels. This is plotted at the top of Figure C7, *EXAMPLES OF LMAX, SEL, LEQ, and DNL NOISE LEVELS*. It is this metric to which people generally respond when an aircraft flyover occurs.
- **Single Event Sound Exposure Level (SEL).** The duration of a noise event, or an aircraft flyover, is an important factor in assessing annoyance and is measured most typically as SEL. The effective duration of a sound starts when a sound rises above the background sound level and ends when it drops back below the background level. An SEL is calculated by summing the dB level for each second of the area within the top 10 dB of a noise event and compressing that noise energy into one second. The SEL value is the integration of all the acoustic energy contained within the event.

This metric takes into account the maximum noise level of the event and the duration of the event. For aircraft flyovers, the SEL value is numerically about 10 dBA higher than the maximum noise level. Single event metrics are a convenient method for describing noise from individual aircraft events. Airport noise models contain aircraft noise data based upon the SEL metric. In addition, cumulative noise metrics such as Equivalent Noise Level (LEQ) and Day Night Noise Level (DNL) can be computed from SEL data (these metrics are described in the next paragraphs).

Cumulative Metrics. Cumulative noise metrics have been developed to assess community response to noise. They are useful because these scales attempt to include the loudness and duration of all noise, the total number of noise events, and the time of day and frequency which these events occur into one rating scale.

- **Equivalent Noise Level (LEQ).** LEQ, often considered the average sound level, is the sound level corresponding to a steady-state A-weighted sound level containing the same total energy as a time-varying signal (noise that constantly changes over time) over a given sample period. LEQ is the "energy" average taken from the sum of all the sound that occurs during a certain time period; however, it is based on the observation that the potential for a noise to impact people is dependent on the total acoustical energy content. This is graphically illustrated in the middle graph of Figure C7. LEQ can be measured for any time period, but is typically measured for 15 minutes, one hour, or 24 hours. LEQ for one hour is used to develop the DNL values for aircraft operations.
- **Day Night Noise Level (DNL).** The DNL describes noise experienced during an entire (24-hour) day. DNL calculations account for the SEL of aircraft, the number of aircraft operations, and include a penalty for nighttime operations. In the DNL scale, noise occurring between the hours of 10 p.m. to 7 a.m. is weighted by 10 dB. This penalty was selected to account for the higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur at night. DNL is required by the FAA for the measurement of aircraft noise and in evaluating noise during a Part 150 Study. In addition, it is used by other federal agencies including the Environmental Protection Agency (EPA), the Department of Defense (DOD), and the Department of Housing and Urban Development (HUD). The FAA, with the support of these agencies, has developed land use compatibility guidelines that identify the acceptability of various land uses with aircraft noise, as measured in DNL. DNL is graphically illustrated in the bottom of Figure C7. Examples of various noise environments in terms of DNL are presented in Figure C8, *TYPICAL OUTDOOR NOISE LEVELS IN TERMS OF DNL*.

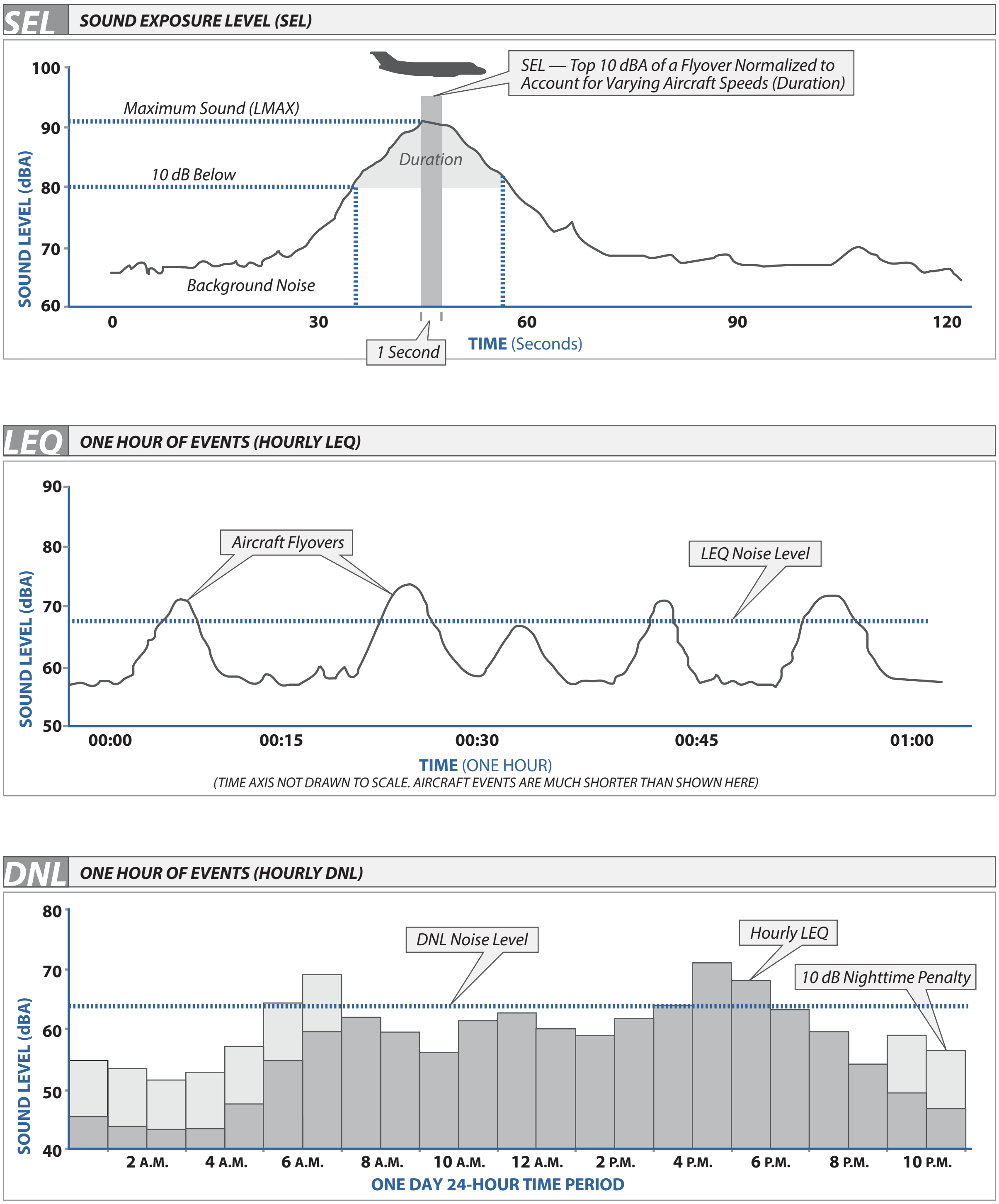
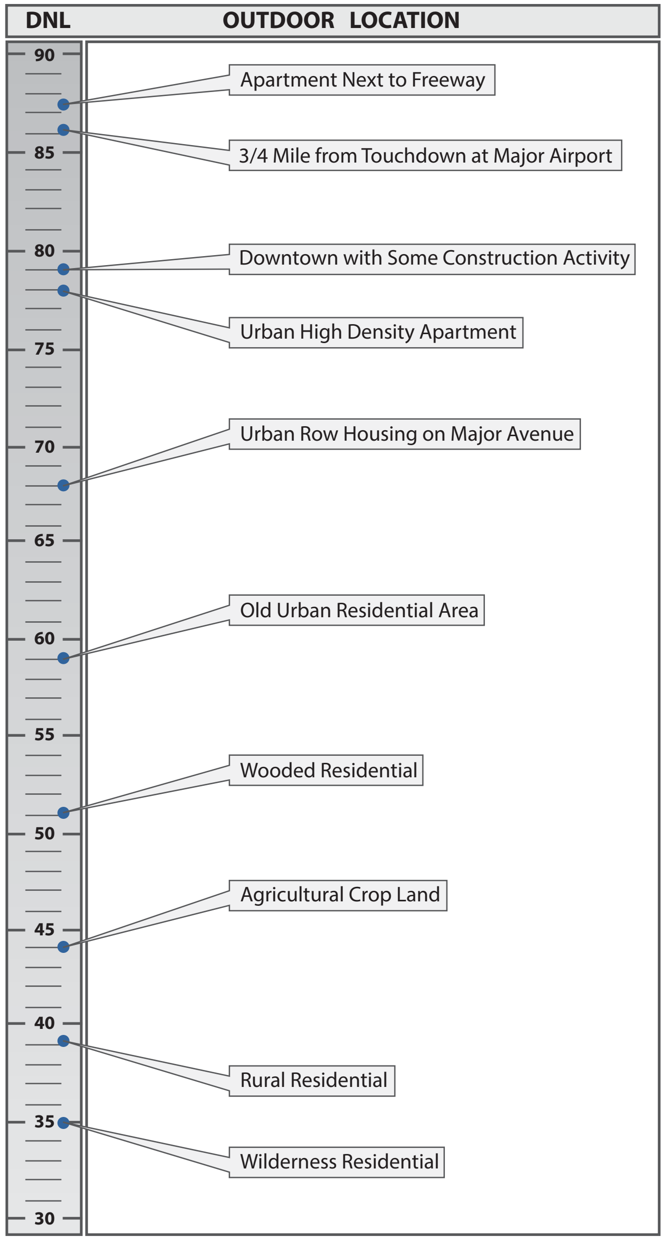


FIGURE C7
Examples of Lmax, SEL, LEQ, and DNL Noise Levels



SOURCE: EPA Levels Document, 1974.

FIGURE C8
Typical Outdoor Noise Environment in Terms of DNL

Noise/Land Use Compatibility Standards and Guidelines

Noise metrics describe noise exposure and help predict community response to various noise exposure levels. The public reaction to different noise levels has been estimated based upon extensive research on human responses to exposure of different levels of aircraft noise. Figure C9, *EXAMPLE OF COMMUNITY REACTION TO INTRUSIVE AIRCRAFT NOISE* relates DNL noise levels to community response. Based on human response, land use compatibility guidelines have been developed that are defined in terms of the DNL described earlier (a 24-hour average that includes a sound level weighting for noise at night). Using these metrics and surveys, agencies have developed guidelines for assessing the compatibility of various land uses with the noise environment.

Highlights of Land Use Compatibility Guidelines

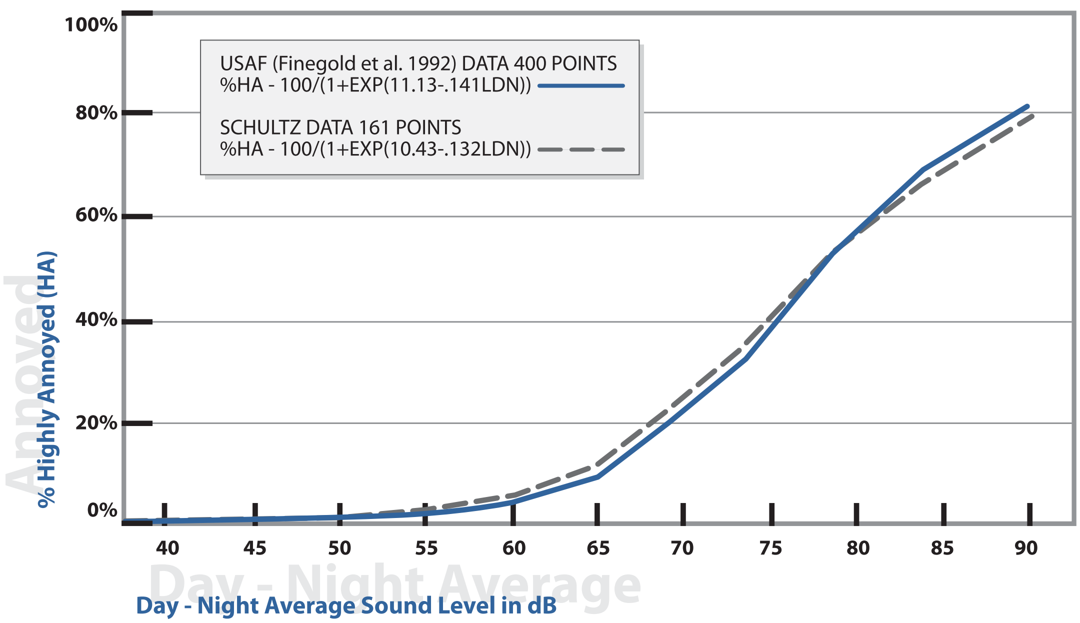
The FAA and other federal agencies have established land use compatibility guidelines based on the DNL that identify the acceptability of various types of land use with aircraft noise exposure.

- Residential uses are compatible with noise up to 65 DNL and up to 70 DNL with sound insulation;
- Schools are compatible with noise up to 65 DNL and up to 70 DNL with sound insulation;
- Commercial development is compatible with noise up to 75 DNL.

Numerous laws have been passed concerning aircraft noise.

- FAA required to use DNL;
- Phase-out of noisiest aircraft (Stage 2) >75,000 lbs. in the year 2000;
- ANCA prevents adoption of airport access restrictions (e.g., curfews, and caps).

Through the Aviation Safety and Noise Abatement Act (ASNA) of 1985, Congress required the FAA to select one metric for describing aircraft noise levels. The FAA selected the use of the DNL, which is required for use in Part 150 Noise Compatibility Planning, as well as environmental evaluations under the National Environmental Policy Act. Federal agencies have also selected the DNL for describing the compatibility of various land uses with aircraft noise exposure. That compatibility has been based on scientific research concerning public reaction to noise exposure. The Schultz curve, as shown in Figure C9, predicts approximately 14% of the exposed population would be highly annoyed with exposure to the 65 DNL. At 60 DNL, it decreases to approximately 8% of the population who would be highly annoyed. However, recent updates to the Schultz curve, done by the U.S. Air Force, indicate that even a higher percentage of residents may experience annoyance with 65 DNL.



USAF	0.40	0.831	1.66	3.31	6.48	12.29	22.1	36.47	53.74	70.16	82.64
SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81.00

CALCULATED % HIGHLY ANNOYED (HA) POINTS

FIGURE C9
Example of Community Reaction
to Aircraft Noise

A summary of pertinent noise regulations and guidelines is presented below:

- **Federal Aviation Regulation, Part 36, "Noise Standards: Aircraft Type and Airworthiness Certification"**
  Originally adopted in 1960, FAR Part 36 prescribes noise standards for issuance of new aircraft type certificates; it also limited noise levels for certification of new types of propeller-driven, small airplanes as well as for transport category, large airplanes. Subsequent amendments extended the standards to certain newly produced aircraft of older type designs. Other amendments extended the required compliance dates. Aircraft may be certificated as Stage 1, Stage 2, or Stage 3 (also called Chapter number outside the U.S.) aircraft based on their noise level, weight, number of engines and, in some cases, number of passengers. Stage 1 aircraft over 75,000 pounds are no longer permitted to operate in the U.S. Stage 2 aircraft over 75,000 pounds were phased-out of the U.S. fleet effective at the start of 2000, as discussed below by the Airport Noise and Capacity Act of 1990.

  Federal Aviation Regulation Part 36 has followed the regulatory requirements established by the International Civil Aviation Organization (ICAO) a world aviation industry standard setting organization. In June 2001, on the basis of recommendations made by the fifth meeting of the Committee on Aviation Environmental Protection (CAEP/5), ICAO adopted a new Chapter 4 (Stage 4 in the U.S.) noise standard, more stringent than that contained in Chapter 3. Effective January 1, 2006, all newly certificated aircraft/engines must meet this new standard.

- **Federal Aviation Regulation, Part 150, "Airport Noise Compatibility Planning"**
  As a means of implementing the Aviation Safety and Noise Abatement Act (ASNA), the FAA adopted Federal Aviation Regulation Part 150, Airport Noise Compatibility Planning Programs. FAR Part 150 established a uniform program for developing balanced and cost effective programs for reducing existing and future aircraft noise at individual airports. Included in FAR Part 150 was the FAA's adoption of noise and land use compatibility guidelines discussed earlier. An expanded version of these guidelines/chart appears in Aviation Circular 150/5020-1 (dated August 5, 1983) and is reproduced in Figure C10, *FAA FAR PART 150 LAND USE COMPATIBILITY MATRIX*. These guidelines offer recommendations for determining acceptability and compatibility of land uses. The guidelines specify the maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that would be considered acceptable or compatible to people in living and working areas.

LAND USE	BELOW 65	YEARLY DAY-NIGHT NOISE LEVEL (DNL) IN DECIBELS 65-70	70-75	75-80	80-85	OVER 85
RESIDENTIAL						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail-building materials, hardware and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade-general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Numbers in parentheses refer to NOTES.

The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

TABLE KEY

SLUCM	Standard Land Use Coding Manual.
Y(Yes)	Land Use and related structures compatible without restrictions.
N(No)	Land Use and related structures are not compatible and should be prohibited.
NLR	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30 or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 dB must be incorporated into design and construction of structure.

NOTES

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB to 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided that special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

SOURCE: FAR Part 150 Guidelines.

FIGURE C10
FAR Part 150 Land Use Compatibility Matrix

- **Federal Aviation Administration Order 5050.4B and Order FAA Order 1050.1E Environmental Impacts: Policies and Procedures**

  FAA, like many other federal agencies, issues guidance for compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1E *Considering Impacts: Policies and Procedures*, identified the procedures for complying with NEPA for all divisions of the FAA. FAA Order 5050.4B supplements 1050.1E and identified issues specific to the Airports Division of the FAA, which oversees airport development projects and the conduct of Part 150 Noise Compatibility Planning. These orders specify the processes for considering environmental factors when evaluating federal actions under NEPA, and include methodologies for assessing noise, as well as thresholds of significant project-related noise changes. This guidance requires the use of the FAA's Integrated Noise Model (INM), the preparation of noise contours showing 65, 70, and 75 DNL, and note that "A significant noise impact would occur if analysis shows that the proposed action will cause noise sensitive areas to experience an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure when compared to the no action alternative for the same time frame." Noise abatement alternatives that result in shifting of noise may trigger an environmental documentation process, subject to one of these orders, before they can be implemented.

- **Airport Noise and Capacity Act of 1990 (ANCA)**

  The Airport Noise and Capacity Act of 1990 (PL 101-508, 104 Stat. 1388), also known as ANCA or the Noise Act, established two broad directives for the FAA: (1) establish a method to review aircraft noise, and airport use or access restriction, imposed by airport proprietors, and (2) institute a program to phase-out Stage 2 aircraft over 75,000 pounds by December 31, 1999 [Stage 2 aircraft are older, noisier aircraft (B-737-200, B-727 and DC-9); Stage 3 aircraft are newer, quieter aircraft (B-737-300, B-757, MD-80/90)]. To implement ANCA, the FAA amended Part 91 to address the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. In addition, Part 91 states that all Stage 2 aircraft over 75,000 pounds were to be removed from the domestic fleet or modified to meet Stage 3 by December 31, 1999. There are a few exceptions, but only Stage 3 aircraft greater than 75,000 pounds are now in the domestic fleet.

  Furthermore, FAR Part 161 was adopted to institute a highly stringent review and approval process for implementing use or access restrictions by airport proprietors. Part 161 sets out the requirements and procedures for implementing new airport use and access restrictions by airport proprietors. They must use the DNL metric to measure noise effects, and the Part 150 land use guideline table, including 65 DNL as the threshold contour to determine compatibility.

The ANCA applies to all local noise restrictions that are proposed after October 1990, and to amendments to existing restrictions proposed after October 1990. The FAA has approved only one completed Part 161 Study to date (for restricting Stage 2 corporate jets). Recent litigation has upheld the validity and reasonableness of that Part 161 restriction. Congress amended ANCA in 2012 to require the phase out of all Stage 2 aircraft less than 75,000 pounds by December 31, 2015.

- **Federal Interagency Committee on Noise (FICON) Report of 1992 [8]**

  The use of the DNL metric criteria has been criticized by various interest groups concerning its usefulness in assessing aircraft noise impacts. As a result, at the direction of the EPA and the FAA, the Federal Interagency Committee on Noise (FICON) was formed to review specific elements of the assessment on airport noise impacts and to recommend procedures for potential improvements. FICON included representatives from the Departments of Transportation, Defense, Justice, Veterans Affairs, Housing and Urban Development, the Environmental Protection Agency, and the Council on Environmental Quality.

  The FICON review focused primarily on the manner in which noise impacts are determined, including whether aircraft noise impacts are fundamentally different from other transportation noise impacts; how noise impacts are described; and whether impacts outside of Community Equivalent Noise Level (DNL) 65 decibels (dB) should be reviewed in a National Environmental Policy Act (NEPA) document.

  The committee determined that there are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL cumulative noise exposure metric. FICON determined that the DNL method contains appropriate dose-response relationships (expected community reaction for a given noise level) to determine the noise impact is properly used to assess noise impacts at both civil and military airports. The report does support agency discretion in the use of supplemental noise analysis, recommends public understanding of the DNL and supplemental methodologies, as well as aircraft noise impacts. FICON did, however, recommend that if screening analysis shows a 1.5 dB increase within a 65 DNL (a significant project-related effect) then additional analysis is recommended to document if a 3.0 dB increase within a 60-65 DNL and/or a 5.0 DNL within the 45-60 DNL.

Introduction to Noise Assessment Methodology

> **Highlights of Noise Assessment Method**
>
> Two tools are used to evaluate aircraft noise:
>
> - Noise measurements or monitoring of aircraft and ambient/background noise;
> - Integrated Noise Model (INM) computer model.
>
> FAA Part 150 Studies are required to model aircraft noise with the FAA Integrated Noise Model (INM) computer model.
>
> Actual noise monitoring is not required for FAA Part 150 studies. It is used to supplement the computer model and as a tool to show citizens actual noise measurements.
>
> Actual measurements were conducted during Winter and Summer 2012. Tests were collected at 30 sites: 20 sites for short periods and 10 sites for longer periods.

Existing and future aircraft noise environments for airports are typically determined through a combination of computer modeling and on-site sound measurement data. Computer-generated noise contours of existing aircraft noise are developed and verified using the on-site measurements. The on-site measurements also help establish the ambient noise environment and identify noise levels at specific areas of interest. Once reliable computer-generated contours are developed for existing conditions, the computer input files are enhanced to reflect future conditions based on forecasts of future operations and/or proposed noise abatement aircraft operational measures.

New computer-generated data and contours are then developed to assess those future conditions. The following sections provide the details on this process. This section is divided into the following sub-sections:

- Noise Measurement Survey. Describes the noise monitoring sites in the vicinity of Ted Stevens Anchorage International Airport, and the methodology used in the noise measurement survey. The full noise monitoring report is included in the **Noise Measurement Appendix** of this Study.
- Computer Modeling. Describes the computer noise model and modeling techniques used in the Study.
- Measurement and Analysis Procedures. Describes the measurement and analysis procedures used to develop the various noise metrics of use in this Study.

Noise Measurement Survey

Purpose of Measurement Survey. Measuring noise directly using calibrated and reliable monitoring devices augments computer modeling and offers several advantages over relying solely on computer modeling. While not specifically required by FAR Part 150, such programs are often very helpful in showing actual noise levels and ensuring the accuracy of the computer-based modeling. The noise measurement survey is an integral part of this Study; it serves to:

- Identify noise levels for individual aircraft operations, both on the ground and in the air, specific to the local Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base environment and its unique conditions.
- Validate the computer model using actual noise measurement data from aircraft operating at the Airport.
- Identify the aircraft and ambient noise level at multiple locations around the Airport using a variety of noise metrics.
- Identify examples of Ground Run-up Noise in the area.
- Give confidence in the accuracy of the noise exposure contours.

The primary goal of the measurement program for the Part 150 Noise Compatibility Study was the identification of the single event noise levels that could then be correlated to a variety of different aircraft types flying the different paths and procedures unique to Ted Stevens Anchorage International Airport and the Lake Hood Seaplane Base. Based upon this single event data and the annual operational flight data, it was then possible to calculate various noise metrics of interest. These data were then compared to the predicted single event noise levels incorporated within the FAA Integrated Noise Model (INM). With the verified noise model, it was then possible to ensure that the contours reflect real measurements and to prepare supplemental noise metrics. When it is not possible for the contour to exactly match the measurements, the differences are small but have been identified. The noise monitoring program was conducted in accordance with FAR Part 150 guidelines, and the adjustments in the INM were performed in accordance with FAA agreement.

Types of Field Noise Measurements. The field noise measurement program conducted for this Part 150 Noise Compatibility Study included the use of long-term and short-term portable measurement sites and followed Part 150 guidelines. Long-term sites had equipment placed for one to two continuous weeks, whereas sound level measurement equipment (also called monitors) were placed at the short-term sites for up to eight continuous hours of measurements.

Regardless of the measurement duration, the noise monitors recorded the one-second noise levels on a continuous basis and were later analyzed to compute other noise metrics.

These noise metrics included DNL, hourly LEQ, single event (SEL, Lmax, and duration), and ambient descriptors (L1, L10, L50, L90, L99). The ambient sound level at each site was identified based on information from the noise survey. Ambient sound level is measured using the Percent Noise Levels (Ln). Measurement locations were selected through coordination with the Study Input Committee and local stakeholders. Table C2, *NOISE MEASUREMENT SITES, SEMI-PERMANENT AND SHORT-TERM* lists these sites where the noise measurement microphones were located. Semi-permanent sites were set up for about a week of noise measurements, whereas the short-term sites were set up for a few hours. The measurement program included the following numbers of measurement sites:

- 20 short-term measurement sites (approximately 8 hours).
- 10 semi-permanent measurement sites (1-2 weeks).

Site Selection Criteria. Noise monitoring sites included locations within the communities located along the primary flight paths (over-flight noise) within the Study area. Noise monitoring sites were selected based upon technical suitability, as well as locations of public interest. Information used in the selection of the noise monitoring sites includes land use pattern/proximity to neighborhoods, flight tracks, and distribution of the sites representatively around the Airport. Examples of the site selection criterion are listed below:

Criteria

- Exposure to a variety of different aircraft activity sources:
    - Departures and arrivals.
    - Commercial-type and general aviation aircraft.
    - Over-flight or sideline noise.

- Proximity of the site to the 65 DNL noise contour developed for previous Part 150 Study.
- Representation of the potential exposure to surrounding residents.
- Representation of the noise environment in the local area.
- Locations that are not in close proximity to other localized (non-aircraft) noise sources.
- Locations that are not exposed to high wind speeds.
- Locations that are not severely shielded from the aircraft activity.
- Locations of public interest.
- Security and ease of access to the noise monitoring equipment.
- Locations exposed to ground run-up noise.

Noise Measurement Locations. Noise measurements were conducted at selected locations within the airport environs. The portable noise monitoring sites, both short- and long-term are presented in Figure C11, *PART 150 STUDY NOISE MEASUREMENT SITES*. Table C2, *SEMI-PERMANENT NOISE MEASUREMENT SITES, and TABLE C3, SHORT TERM NOISE MEASUREMNET SITES* lists the addresses of those locations where noise equipment was placed for monitoring purposes. Sites included single family residences, parks, a hospital, and a school, chosen to supplement the existing network of permanent noise monitors for which there was historic data. The permanent noise monitors are listed in Table C4, *AIRPORT PERMANENT NOISE MONITOR LOCATIONS* and are illustrated in Figure C12, *AIRPORT PERMANENT NOISE MONITORS*. While these noise monitors are no longer in operation, historic data from when they were operational was used in this analysis.

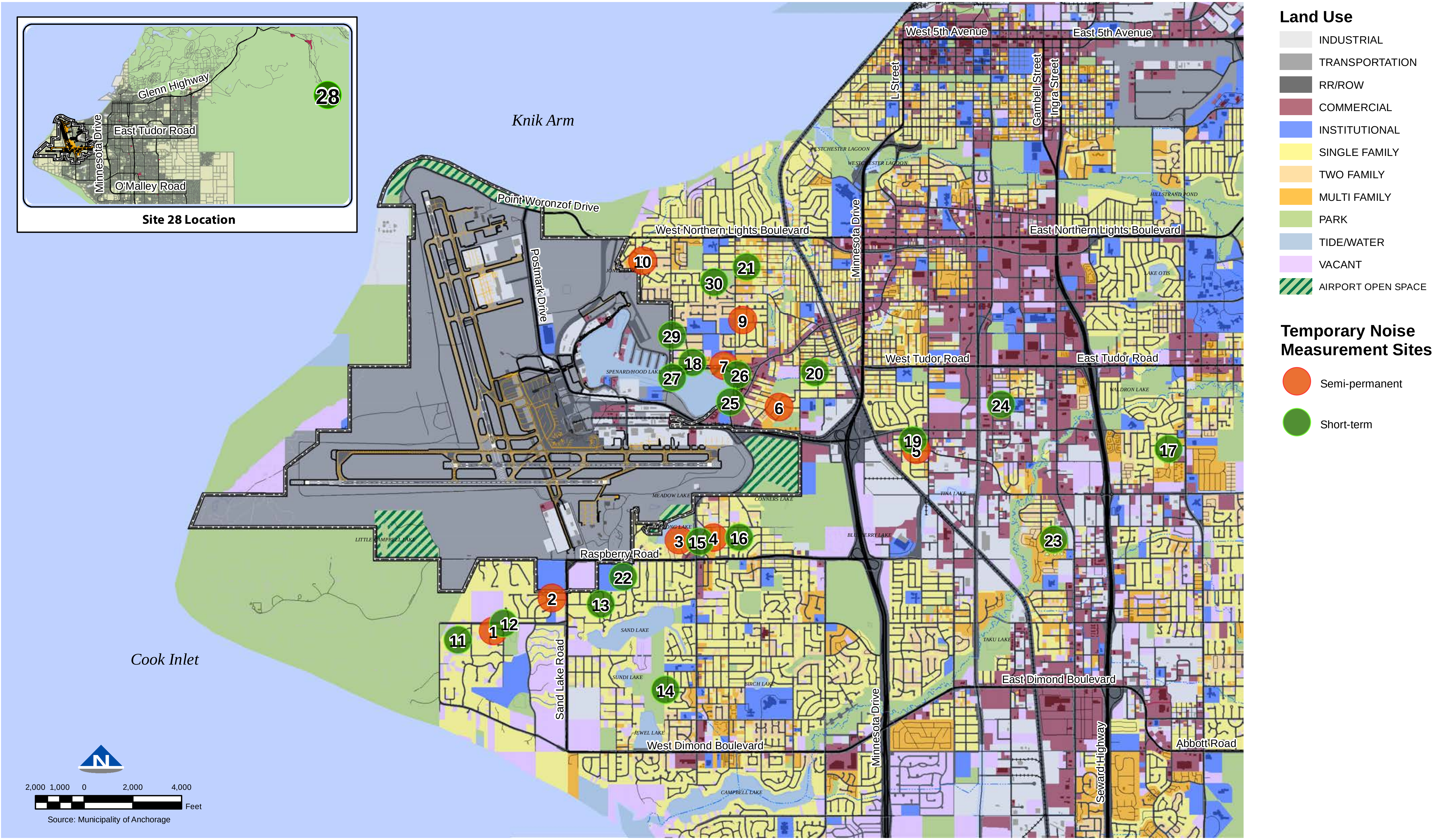


Figure C11 **Part 150 Study Noise Measurement Sites**

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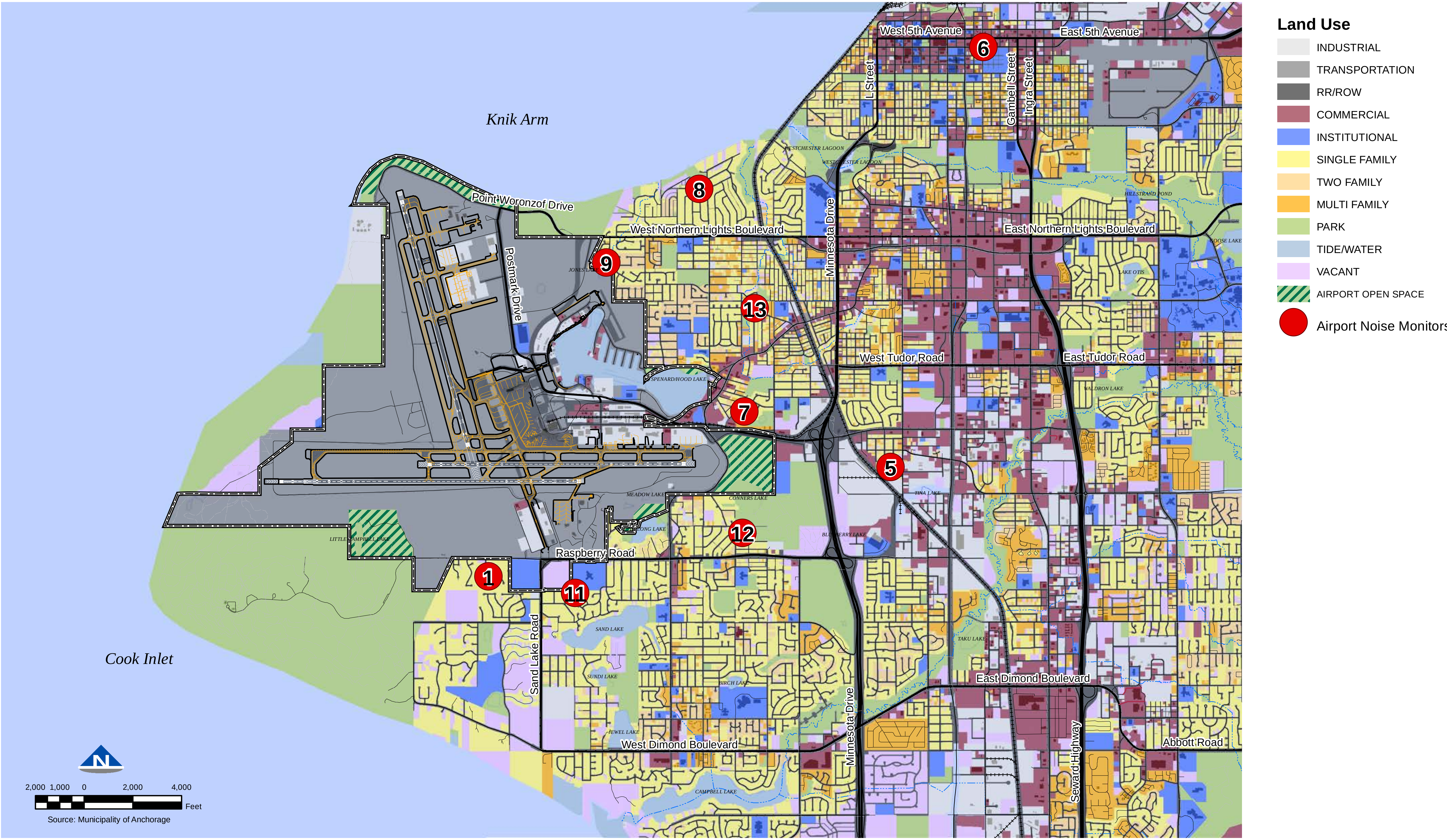

Figure C12 **Airport Permanent Noise Monitors**

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Table C2
SEMI-PERMANENT NOISE MEASUREMENT SITES

Site	Address/Location	City	Type	Latitude	Longitude
1	6341 Quiet Cir.	Anchorage	Semi-permanent	61.151103	-149.999122
2	5600 John Muir Cir.	Anchorage	Semi-permanent	61.154805	-149.985518
3	6535 McGill Way	Anchorage	Semi-permanent	61.161301	-149.955957
4	6521 Bridget Cir.	Anchorage	Semi-permanent	61.161584	-149.947927
5	901 W. 54th Ave.	Anchorage	Semi-permanent	61.171417	-149.900713
6	4707 Melvin Dr.	Anchorage	Semi-permanent	61.176257	-149.932678
7	3333 Lakeshore Dr. #4	Anchorage	Semi-permanent	61.180930	-149.945500
9	3031 Bennett Ave.	Anchorage	Semi-permanent	61.186011	-149.941139
10	3190 Bridle Ln	Anchorage	Semi-permanent	61.192720	-149.964379

Source: L&B, 2012.

Table C3
SHORT TERM NOISE MEASUREMENT SITES

Site	Address/Location	City	Type	Latitude	Longitude
11	6780 Lauden Cir	Anchorage	Short-term	61.150094	-150.007394
12	7200 Lucy St	Anchorage	Short-term	61.151970	-149.996752
13	7322 Cetter Drive	Anchorage	Short-term	61.154117	-149.974166
14	4301 West Lake Circle	Anchorage	Short-term	61.144484	-149.959169
15	3831 W. 67th Ave.	Anchorage	Short-term	61.161142	-149.951135
16	6530 Imlach Dr.	Anchorage	Short-term	61.161617	-149.941984
17	2141 Tudor Hills Ct	Anchorage	Short-term	61.171443	-149.842075
18	4315 Beechcraft Dr.	Anchorage	Short-term	61.181250	-149.952811
19	906 W. 53rd Ave.	Anchorage	Short-term	61.172490	-149.901570
20	2203 W. 45th Ave.	Anchorage	Short-term	61.180147	-149.924376
21	3003 W. 32nd Ave.	Anchorage	Short-term	61.191995	-149.940212
22	4900 Raspberry Road	Anchorage	Short-term	61.157182	-149.968976
23	6630 Hampstead Dr.	Anchorage	Short-term	61.161301	-149.868907
24	4800 Cordova St	Anchorage	Short-term	61.176486	-149.881034
25	Aviation Ave and Spenard Rd	Anchorage	Short-term	61.176813	-149.944028
26	Wisconsin St/Spenard	Anchorage	Short-term	61.179885	-149.942387
27	Lakeshore Dr.	Anchorage	Short-term	61.179575	-149.957521
28	445 Wolf Dr.	Eagle River	Short-term	61.224956	-149.438388
29	3800 W 40th Ave.	Anchorage	Short-term	61.184307	-149.957556
30	3360 Wisconsin St	Anchorage	Short-term	61.190275	-149.947755

Source: L&B, 2012.

Table C4
AIRPORT PERMANENT NOISE MONITOR LOCATIONS

Monitor	Address/Location	City	Latitude	Longitude
1	7023 Tanaina Dr.	Anchorage	61.15715	-149.994237
3	8312 Skyhills Dr.	Anchorage	61.11454	-150.007247
5	903 W. 57th Ave.	Anchorage	61.16941	-149.900719
6	310 E. 6th Ave.	Anchorage	61.21659	-149.87899
7	4722 Melvin	Anchorage	61.17568	-149.934765
8	3201 Illiamna Dr. (Lyn Ary Park)	Anchorage	61.20071	-149.945166
9	3003 Wendys Way.	Anchorage	61.19244	-149.9668
11	7200 Setter Dr.	Anchorage	61.15529	-149.974106
12	2709 W. 65th Ave.	Anchorage	61.16203	-149.935194
13	Woodland Park	Anchorage	61.18728	-149.93227

Source: L&B, 2012.
Note: Note that Site 8 was across the street from Site 10, so the noise monitor at site 10 was kept at the site for a longer period of time rather than duplicate monitoring at two sites so close. Therefore Site 8 was not used and is left off the tables.

Measurement Procedures. Noise measurements were conducted for this study for two periods of time, one during the winter of 2012 and one during the summer of 2012, and were conducted for a one to two week period at each of the semi-permanent noise monitoring sites. Short-term noise monitoring sites were set up to simultaneously collect continuous one-second noise levels during the entire time the noise monitor is at a given location (generally approximately 8 hours). The equipment was checked and calibrated on a regular basis throughout the measurement survey.

The noise measurements conducted in winter and summer of 2012 were not used as INM model inputs or to determine the base line fleet mix, but rather were used to verify the noise from individual overflights and run-up activity to accurately depict aircraft operations at the Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base. The time at each temporary site varied depending on the type of noise gathered.

Acoustic Data. The noise measurement survey used specialized monitoring instrumentation that allowed for the measurement of aircraft single event data and ambient noise levels.

The data determined at each noise measurement site is listed below:

- Continuous one-second noise levels.
- Single event data (SEL, Lmax and Duration) for individual aircraft.
- Hourly noise data (LEQ, Level Percent).
- Daily noise level (DNL).
- Correlation of noise data with aircraft identification (when available).
- Non-aircraft ambient sound level (Level Percent).

The survey used software that provides continuous measurement and storage of the one-second LEQ noise level. From this data, the above noise descriptors could be calculated. In addition, this data can be used to plot the time histories for noise events of interest. Time histories show by second, minute, or hour of a day how the sound level varies at a specific site.

Instrumentation. The measurements consisted of monitoring A-weighted decibels in accordance with procedures and equipment that comply with specific International Standards (IEC), and measurement standards established by the American National Standards Institute (ANSI) for Type 1 instrumentation, as specified in FAA guidance. State of the art equipment used in this program included the Bruel & Kajer model 2238 and the Larson Davis 824 sound level meters. These are Class I Precision Sound Level Meters (as defined by American National Standards Institute (ANSI) and International Electrotechnical Commission (IEC)). The equipment was calibrated in compliance with manufacturer's procedures. Microphones and recording equipment are the highest quality and are capable of recording and calculating the various noise metrics. Each meter logged noise levels every second in terms of the one-second equivalent noise level, Leq.

Computer Modeling. Computer modeling generates maps or tabular data of an airport's noise environment expressed in the various metrics described above such as SEL and DNL. Computer models are useful in developing contours that depict, like elevation contours on a topography map, areas of equal noise exposure. Accurate noise contours are largely dependent on the use of reliable, validated, and updated noise models, as well as the collection of accurate aircraft operational data.

The FAA's Integrated Noise Model (INM) models civilian and military aviation operations. The original INM was released in 1977. The latest version, INM Version 7.0c is the state-of-the-art in airport noise modeling.

The program includes standard aircraft noise and performance data for over 100 aircraft types that can be tailored to the characteristics of specific individual airports. Version 7.0c includes an updated database that includes some newer aircraft, the ability to include run-ups (maintenance test when the aircraft is on the ground), enhanced thrust reverser implementation, and topography in the computations, and a provision to vary aircraft profiles in an automated fashion. Version 7.0c improved its ability to model helicopters, including a more realistic depiction of how noise propagates from helicopters. It also includes more comprehensive and flexible contour plotting routines than earlier versions of the model.

The INM program requires the input of the physical and operational characteristics of an airport. Data needed to generate noise contours include:

- Runway locations and elevations.
- Airfield elevation.
- Runway use.
- Total operations.
- Aircraft type and engine type.
- Number of aircraft operations by aircraft type.
- Day (7 a.m.-10 p.m.) and night (10 p.m.-7 a.m.) time distribution by aircraft type.
- Flight tracks and track use by aircraft type.
- Flight ascent and descent profiles specific to aircraft and engine type.
- Average meteorological conditions.
- Location of ground run-up activity.

Noise Measurement Data and Analysis Procedures. The following section outlines the methodology used to measure and quantify noise levels from aircraft operations and from ambient noise level conditions. Measurement methodology and analysis techniques used in the study are also described.

Continuous Measurement of the Noise. The methodology employed in this Study used a data collection program that was designed to continuously measure and record the noise at each measurement location. Full information from the noise monitoring is presented in the **Noise Measurement Appendix**.

Since all of the noise data is collected during the measurements, it is possible to process the data and calculate different metrics of interest that may arise, including the aircraft single event noise event level, cumulative daily noise levels, time above levels, and the ambient levels. The process of calculating noise events from this data includes the use of floating threshold methodology, which allows for the measurement of lower noise level events. The parameters are adjustable and can be modified so that it is possible to recalculate noise events from raw data any time in the future.

Operational Data and Field Observations. Several types of data were also used to determine detailed aircraft fleet mix, aircraft type, flight number, type of operation, as well as destinations of aircraft flying to and from Ted Stevens Anchorage International Airport, and flight track data. Data from the airport noise system was used for the 2009 operations, and FAA radar data was used for the measurement periods with Aircraft Situational Display Information (ASDI) as a secondary source. The position information includes the X and Y coordinates that position each aircraft for the flight track every four seconds of the flight, as well as the altitude of the aircraft at each point.

- Date and time of flight.
- Base or airport of operation.
- Operator.
- Aircraft type.
- Airline and flight number.
- Type of operation (departure or arrival).

Results from the noise monitoring are summarized in the following chapter.

Chapter D - Existing and Future Noise Exposure

INTRODUCTION. This chapter presents the existing and future baseline noise conditions. These contours are referred to as the baseline, as they are the contours to which the benefits/impacts of various alternatives will be compared. The noise environment is presented in terms of noise contours supplemented with noise data from the noise measurement survey. DNL noise contours for the Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base Part 150 Study Update were prepared based upon existing and forecast operational conditions at the Airport. The noise data from the noise monitoring survey reflect actual noise measurement data from aircraft departing from and arriving at Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base.

For purposes of this Part 150 Study, Ted Stevens Anchorage International Airport (ANC) and Lake Hood Seaplane Base are included in one study, with one set of noise contours. All previous Part 150 Studies completed to date included both facilities. The reasons for this includes several factors. The ANC Airport Traffic Control Tower (ATCT) controls aircraft operations on the ground and within designated airspace at ANC, and it also controls air traffic at Lake Hood Seaplane Base. With this integrated airspace, departures and arrivals occur within such close proximity, that it functions as one airport. The community also perceives LHD and ANC as operating as one facility. Additionally, ANC and LHD are physically linked by connecting taxiways and share a boundary. The runways and sea lanes are as close in proximity to each other as many other airports operating with several runways.

Because of these factors, the noise contours could not be separated, as they act in many ways as one facility. Therefore, for the purposes of this Study, they are included together.

This chapter is divided into the following sections:

- **Noise Measurement Data and Supplemental Metrics.** The noise monitoring system data consists of: single event noise levels from aircraft and non-aircraft events, ambient noise, hourly LEQ noise, and daily DNL noise. A description of the measurement locations and the various noise metrics was presented in Chapter C, Background Information on Noise and its Measurement. This section presents noise measurement data derived from the permanent noise system for the base year 2009. The measurement data are described by:
  - Ambient or background sound levels
  - Hourly LEQ Noise
  - Flow DNL Analysis
  - Single event sound levels for aircraft and non-aircraft noise sources
  - Time Above Noise Contours
  - Number Above Noise Contours

- **Noise Contour Modeling Results.** The results of the computer modeling process that creates aircraft noise exposure contour maps are presented in this section. The assumptions used to develop the noise contours are also presented. These noise contours are developed in terms of DNL noise levels using the Federal Aviation Administration (FAA) Integrated Noise Model. A detailed description of the DNL noise metrics and the INM noise model was presented in Chapter C, Background Information on Noise and its Measurement.

Noise Measurement Data

The following paragraphs present noise measurement data from the temporary noise monitoring conducted over two periods during April 2012 and August 2012. Thirty noise monitoring sites were used. The consulting team created a noise monitoring program that placed portable noise monitoring equipment at locations surrounding the Airport. Locations of the noise monitors can be found in Chapter C. The noise monitoring followed all Part 150 guidance. The sites were chosen due to their location relative to the Airport and Lake Hood Seaplane Base as well as other noise sources. Noise meters were located at different residences, parks, a hospital, and a school to capture noise from aircraft operations. People volunteered locations at a public meeting in early 2012. The noise monitors needed to be situated in a location relative to flight patterns, proximity to existing permanent airport noise monitors, and in response to community suggestion. Each portable noise monitor was routinely calibrated by acoustic technicians to verify that the data being collected was accurate.

The weather was noted during the monitoring period but was generally clear, with minor precipitation. During the winter measurements, snow removal equipment was operated in the vicinity of some of the microphones and in the summer, lawn mowers and carpentry tools were operated in the vicinity of some of the microphones. All of ANC's runways were in operation, and normal air traffic conditions were observed during the measurement dates. At Lake Hood Seaplane Base, there were fewer operations during the winter than during the summer period. Table D1 shows the noise monitoring durations during the winter at each site, and Table D2 shows the noise monitoring durations during the summer at each site. Note that Site 8 was across the street from Site 10, so the noise monitor at site 10 was kept at the site for a longer period of time rather than duplicate monitoring at two sites so close together. Therefore, Site 8 was not used and is left off the tables.

Table D1
NOISE MONITORING DURATION WINTER

Site	Start Date	Start Time	End Date	End Time	Hours of monitoring
1	3/25/12	14:01:09	4/2/16	9:28:44	163.2
2	4/1/12	14:39:13	4/9/12	10:32:56	187.9
3	3/25/12	14:21:34	3/31/12	13:58:28	122.1
4	3/25/12	19:43:34	4/1/12	10:16:50	138.3
5	3/25/12	19:07:31	4/1/12	10:50:06	163.7
6	4/1/12	14:08:18	4/9/12	9:47:54	187.6
7	4/1/12	16:09:51	4/9/12	8:23:53	184.2
9	4/1/12	15:22:49	4/9/12	9:18:21	178.5
10	3/25/12	20:34:22	4/9/12	8:59:30	321.7
11	3/27/12	8:13:09	3/28/12	17:10:35	8.1
12	3/27/12	13:51:15	3/28/12	12:05:35	8.0
13	3/29/12	8:29:46	3/30/12	17:06:44	8.1
14	3/27/12	14:12:28	3/28/12	12:10:08	8.0
15	3/29/12	13:25:19	3/30/12	12:19:47	8.1
16	3/29/12	8:16:31	3/30/12	17:15:09	8.0
17	3/29/12	14:14:20	3/30/12	12:15:32	8.0
18	3/31/12	8:20:06	4/2/12	12:20:51	8.1
19	3/31/12	14:32:39	4/2/12	17:22:27	8.0
20	3/31/12	8:19:07	4/3/12	18:17:25	8.0
21	3/31/12	13:15:23	4/3/12	12:21:59	7.8
22	3/27/12	8:27:15	3/28/12	17:48:44	7.8
23	4/4/12	8:14:24	4/5/12	12:22:03	8.1
24	4/4/12	12:58:10	4/5/12	17:00:09	8.0
25	3/26/12	10:03:52	3/26/12	12:01:30	2.0
26	3/26/12	13:05:09	3/26/12	15:10:05	2.1
27	3/26/12	9:38:15	3/26/12	12:14:15	2.6
28	4/6/12	14:01:02	4/7/12	12:27:44	8.1
29	3/26/12	12:55:08	3/26/12	15:31:59	2.6
30	4/6/12	8:14:14	4/7/12	17:34:04	8.0

Source: L&B, 2012.

Table D2
NOISE MONITORING DURATION SUMMER

Site	Start Date	Start Time	End Date	End Time	Hours of monitoring
1	8/5/12	16:10:18	8/12/12	9:34:27	161.4
2	8/12/12	14:35:14	8/19/12	14:00:30	163.5
3	8/5/12	13:50:46	8/12/12	8:35:37	162.7
4	8/5/12	15:07:23	8/12/12	8:50:02	161.7
5	8/5/12	15:40:23	8/12/12	9:10:23	161.5
6	8/12/12	13:53:17	8/19/12	13:00:30	167.1
7	8/12/12	15:12:19	8/19/12	14:30:30	167.2
9	8/12/12	15:41:35	8/19/12	15:00:29	167.3
10	8/5/12	13:00:17	8/19/12	15:00:29	246.9
11	8/6/12	10:16:47	8/7/12	9:05:14	8.0
12	8/6/12	13:31:13	8/7/12	13:19:47	8.0
13	8/8/12	8:14:13	8/9/12	17:08:45	7.9
14	8/6/12	13:45:38	8/7/12	12:12:57	8.1
15	8/8/12	13:03:49	8/9/12	12:42:09	8.0
16	8/8/12	8:18:15	8/9/12	17:05:44	8.0
17	8/8/12	13:10:03	8/9/12	12:17:30	7.9
18	8/10/12	7:50:51	8/11/12	16:38:26	8.0
19	8/10/12	12:48:40	8/11/12	11:57:24	8.0
20	8/10/12	8:21:25	8/11/12	16:58:57	8.0
21	8/10/12	12:48:06	8/11/12	12:12:49	8.0
22	8/6/12	8:09:48	8/7/12	17:36:53	8.1
23	8/13/12	9:01:51	8/13/12	18:25:52	8.0
24	8/16/12	8:49:06	8/16/12	18:10:44	8.0
25	8/18/12	8:34:18	8/18/12	18:14:02	8.0
26	8/17/12	8:39:05	8/17/12	17:48:37	8.0
27	8/13/12	8:42:40	8/21/12	13:02:36	7.9
28	8/14/12	13:59:34	8/21/12	18:13:26	8.3
29	8/15/12	8:25:23	8/15/12	17:44:58	8.3
30	8/20/12	9:47:15	8/20/12	19:14:17	8.0

Source: L&B, 2012.

Ambient or Background Sound Levels

The ambient sound level at each site was identified based on information from the noise survey. Ambient sound level is measured using the Percent Noise Levels (Ln). Percent Noise Level is the noise level exceeded for specified percentages (n) of the time (e.g., L90 represents the sound level exceeded 90% of the time). The information helps identify the ambient noise environment and aids in assessing how intrusive aircraft noise is at a particular location. The sources of background sound include noise from cars on roadways, railroads, and commercial sources.

The results of the ambient noise measurement data at each measurement site are described in the following figures and tables. Table D3, *AMBIENT MEASUREMENT RESULTS (AIRCRAFT NOISE INCLUDED) WINTER* and Table D4, *AMBIENT MEASUREMENT RESULTS (AIRCRAFT NOISE INCLUDED) SUMMER* presents a summary of the ambient measurements for all of the sites in tabular format. The data collected during the measurements can be summarized as a noise environment in terms of the noise level exceeded 1%, 10%, 50%, and 90%, and 99% of the time and designated as L1, L10, L50, L90, L99, respectively. L1 is the noise level exceeded 1% of the time and L99 is the noise level exceeded 99% of the time. L10 is the noise level exceeded 10% of the time and represents the typical peak noise level. The L50 is the median noise level. L90 is the noise level exceeded 90% of the time. The L90 is a good approximation of the background noise level, i.e., the noise level that would occur in the absence of identifiable noise events.

Table D3
AMBIENT NOISE LEVELS BY MONITORING SITE – WINTER

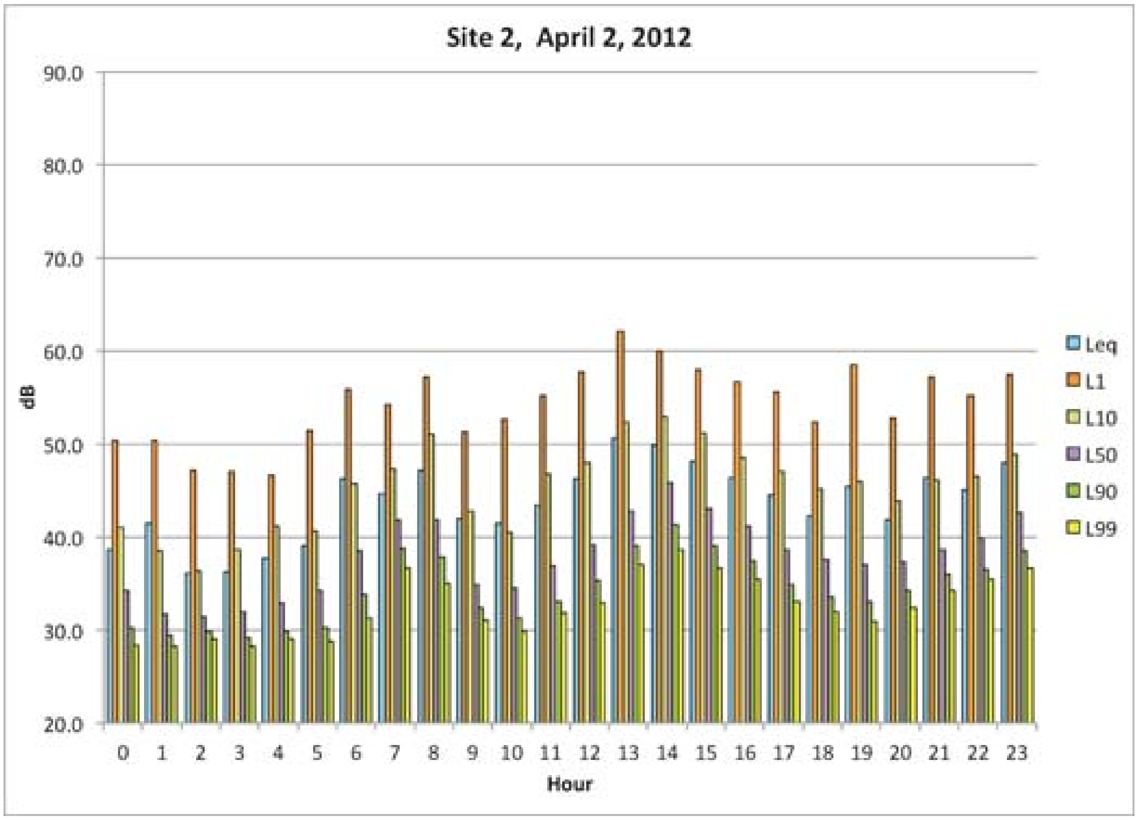
Site	Leq (dB)	L1 (dB)	L10 (dB)	L50 (dB)	L90 (dB)	L99 (dB)
1	55.6	62.4	52.7	44.7	37.0	28.5
2	53.5	59.9	48.3	39.7	32.7	29.4
3	52.1	62.9	52.8	45.7	39.9	36.2
4	51.9	61.9	50.0	43.5	37.0	32.3
5	51.6	61.7	52.6	47.5	43.3	39.8
6	51.6	62.1	53.1	44.2	37.7	33.1
7	55.1	65.1	52.7	46.9	41.1	37.1
9	54.2	63.7	52.4	44.4	39.2	36.3
10	59.3	65.0	53.6	43.2	34.8	29.1
11	51.7	61.6	53.8	48.5	42.9	39.4
12	55.3	66.0	56.3	48.4	43.6	40.6
13	54.4	63.3	54.0	44.5	37.0	34.6
14	52.5	63.7	52.2	44.8	40.5	38.3
15	54.9	66.6	56.4	50.7	45.9	42.1
16	54.9	65.4	54.9	45.6	39.1	37.2
17	50.2	59.5	53.2	43.2	38.4	36.8
18	55.4	63.5	52.0	45.0	41.2	38.7
19	59.7	68.1	55.8	51.1	49.0	46.3
20	56.9	69.0	60.2	45.9	39.7	37.4
21	56.6	67.5	55.1	44.4	37.4	34.0
22	55.7	66.2	56.5	49.4	42.6	39.9
23	60.5	60.9	56.5	52.6	44.2	42.4
24	52.9	60.0	54.8	51.5	49.1	33.5
25	54.2	64.8	53.5	48.9	47.0	45.6
26	57.2	64.4	56.5	52.4	48.1	45.1
27	63.2	68.3	57.2	44.7	39.8	38.5
28	50.0	57.8	41.6	24.5	20.4	20.0
29	59.1	64.5	49.7	40.4	36.7	34.9
30	54.4	64.6	56.1	50.9	45.1	39.5

Source: L&B, 2012.

Table D4
AMBIENT NOISE LEVELS BY MONITORING SITE – SUMMER

Site	Leq (dB)	L1 (dB)	L10 (dB)	L50 (dB)	L90 (dB)	L99 (dB)
1	61.0	65.0	54.6	46.0	32.9	26.0
2	60.8	66.1	50.5	42.4	34.5	29.0
3	54.6	64.7	53.6	45.2	40.3	38.5
4	55.8	64.3	52.7	45.4	37.7	31.2
5	65.7	65.5	56.2	50.3	45.5	42.2
6	56.0	65.7	55.2	47.0	41.2	38.5
7	59.5	71.8	57.2	50.2	45.5	41.7
9	56.5	67.7	55.0	46.4	40.1	33.8
10	64.9	68.9	55.9	44.3	36.3	30.0
11	71.3	79.6	54.9	47.1	39.7	36.2
12	59.6	67.4	60.5	50.7	42.8	39.1
13	52.7	59.8	49.6	43.0	36.2	32.9
14	61.5	65.5	49.8	41.1	36.8	34.4
15	58.7	67.4	62.7	54.2	49.2	45.5
16	52.4	63.7	54.2	47.8	38.9	35.6
17	51.7	63.1	51.2	47.6	40.5	38.5
18	67.6	80.5	65.9	53.3	46.3	41.1
19	54.8	66.5	53.3	46.9	43.0	40.7
20	61.4	71.1	62.3	49.0	41.6	38.3
21	57.6	69.2	57.2	44.8	38.5	34.4
22	61.9	71.1	55.5	49.4	41.2	38.1
23	60.6	59.2	50.1	45.3	41.1	39.1
24	62.2	68.4	57.1	52.9	50.7	49.6
25	70.6	82.7	63.6	53.2	49.0	47.0
26	63.0	75.5	63.9	55.4	50.5	46.6
27	78.2	88.6	68.0	53.3	46.5	43.2
28	44.2	55.0	44.2	40.1	36.8	34.4
29	65.5	72.3	60.6	50.0	42.0	38.7
30	63.0	66.2	58.3	53.9	47.3	42.1

Source: L&B, 2012.



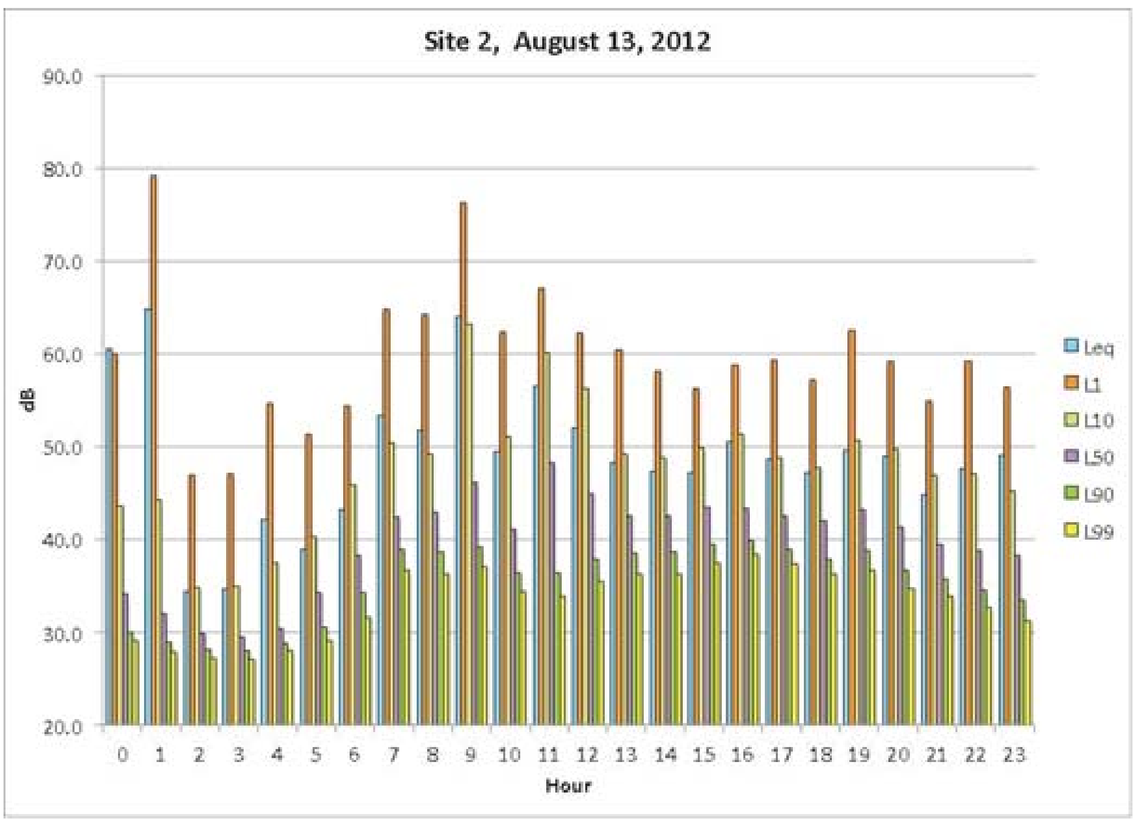


FIGURE D1
Example of Continous Noise Measurement

Supplemental Metrics

This Part 150 Study expanded the required noise analysis in two significant ways: conducting sample noise monitoring in locations around the Airport, and supplementing DNL contours with additional noise metrics, including the SEL noise metrics. Both of these tasks were initiated in response to community desire to view the noise data in different ways. Additionally, there was a very strong desire for noise information to be related to daily living activities, particularly speech and sleep.

Field noise measurement described previously allowed adjustment to be made to the INM model to more accurately reflect actual fleet and meteorological conditions in the environs of the Airport. Similarly, SEL contours are provided to describe the probable impact on sleep interference. Such additional measuring and metrics can aid in understanding the cost and benefits of various noise abatement alternatives. As a result, it is desired that discussion will not only be over simply the accuracy of the data, but also on the substance of the findings. The goal is to facilitate an understanding of the impacts and benefits of various alternatives.

Supplemental metrics can help to better illustrate the noise surrounding an airport. As stated in the previous chapter, although DNL is the metric used by the FAA in Part 150 Noise Studies, several supplemental metrics were used in this chapter to help illustrate aspects of the noise environment. However it is important to note that these supplemental metrics are for informational purposes and are not generally used by the FAA to determine impacts. The following sections highlight the results of the supplemental metrics, followed by the standard DNL contour analysis.

Flow DNL Analysis

On any given day, or for part of a day, the Airport will operate in a particular flow condition. The flow is determined by the wind direction, and if the wind speed is low, by the policies of Air Traffic Control (ATC). If winds are strong from the south then the aircraft flow will be to depart towards the south and arrive from the north (if the wind speed exceeds a threshold speed, then operations must occur into the wind as departing or landing with a tailwind would reduce safety). This is called South Flow. Similarly if winds are strong from the north the Airport would be in North Flow, for winds from the east the Airport would be in East Flow, and if the winds are strong from the west, West Flow.

On average the Airport operates in a kind of mixed flow, with departures primarily to the north and west and arrivals primarily from the north and west. As will be seen, this mixed flow reduces noise over developed areas substantially.

The following figures D2 through D5 show the DNL contours on a day where the winds are sufficiently strong to require north, south, east, or west flow. As is easily seen in these figures, when the winds dictate arrivals to or from the south or east, the noise contours extend well beyond the annual average DNL contours and impact many more people than shown for an average day. This dichotomy may be the cause of some residents' concern that the annual DNL is not representative of what happens when they hear aircraft operate in a flow that is not the average condition.

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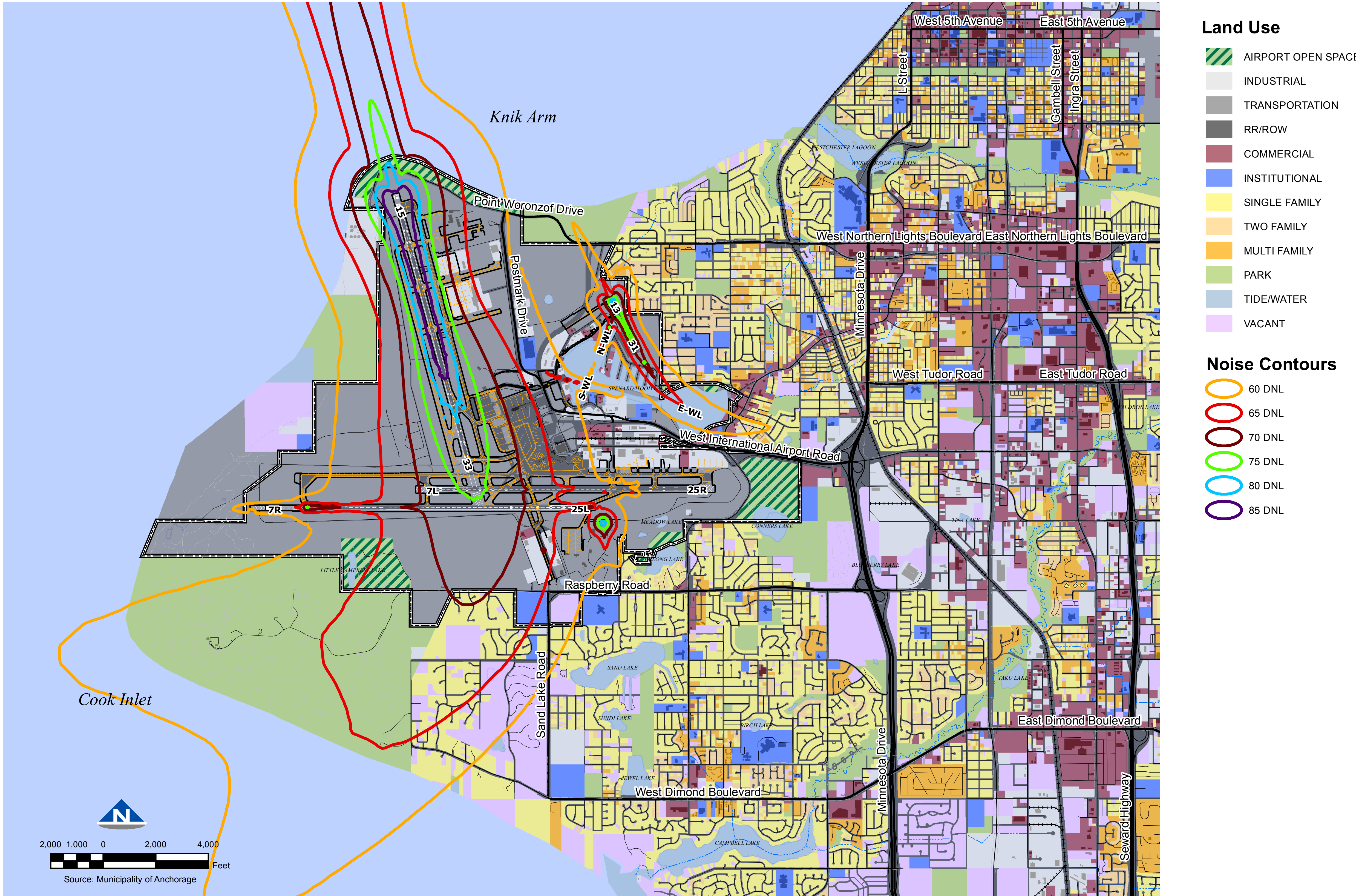

Figure D2 **DNL South Flow**

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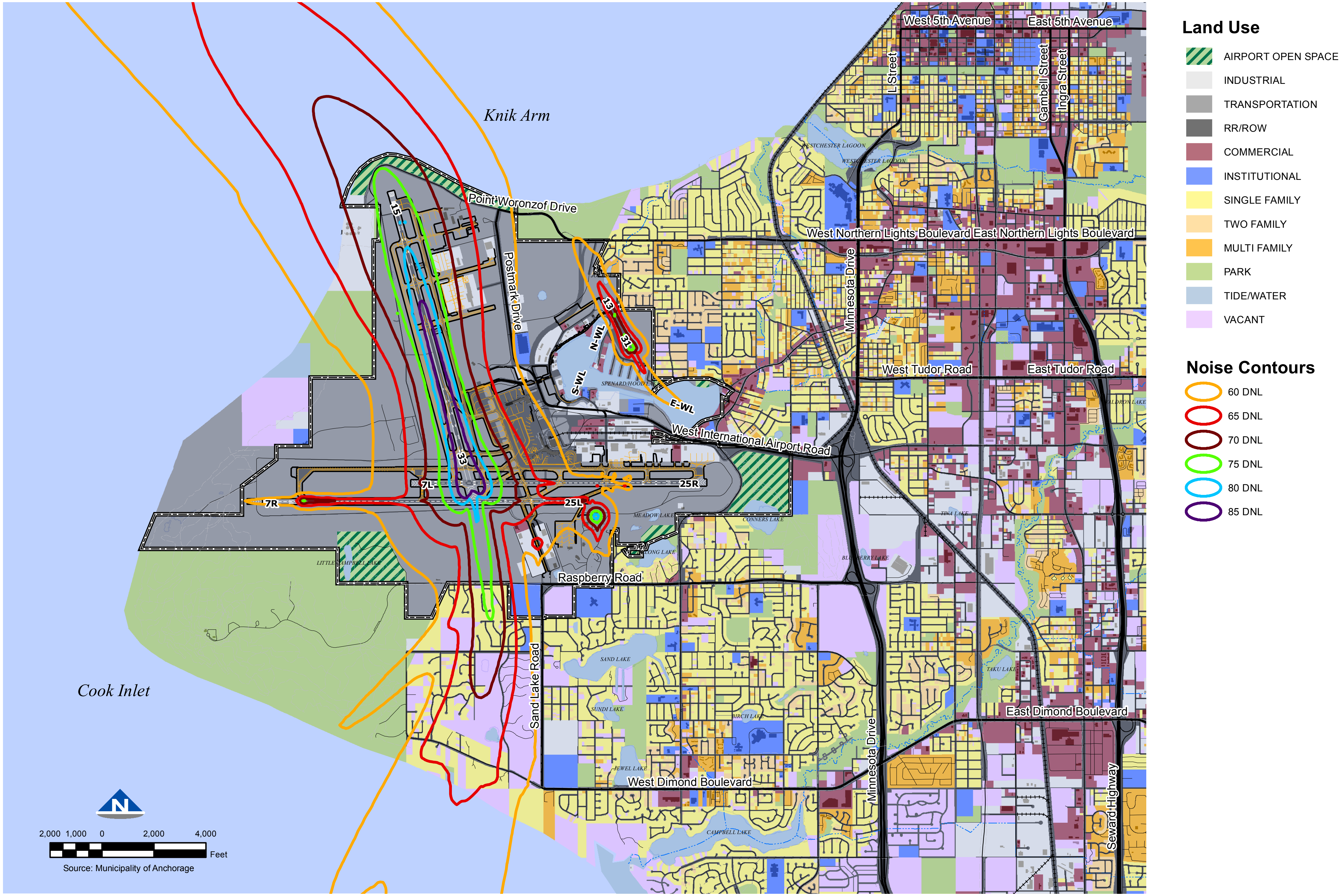

Figure D3 **DNL North Flow**

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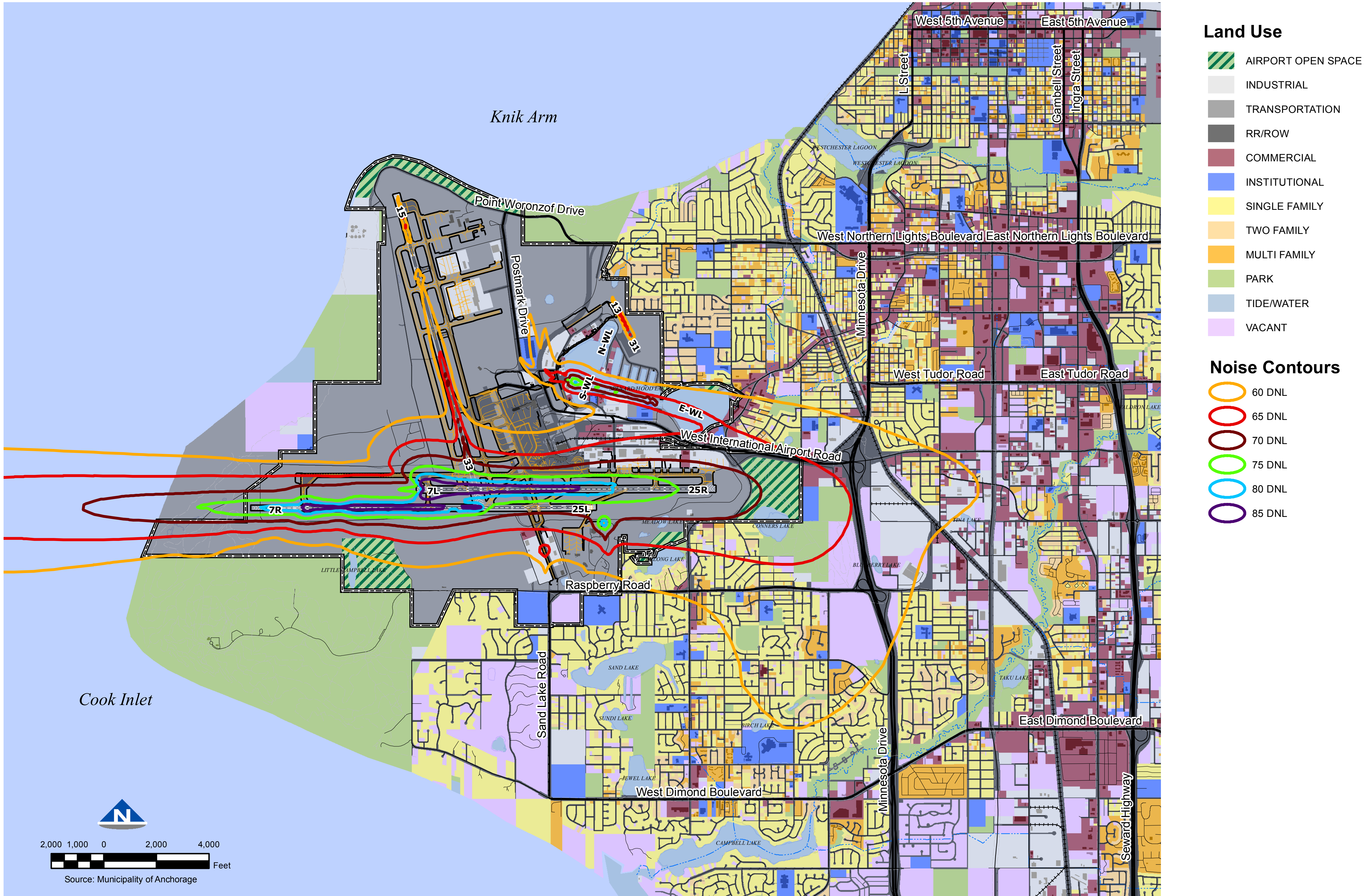

Figure D4 **DNL East Flow**

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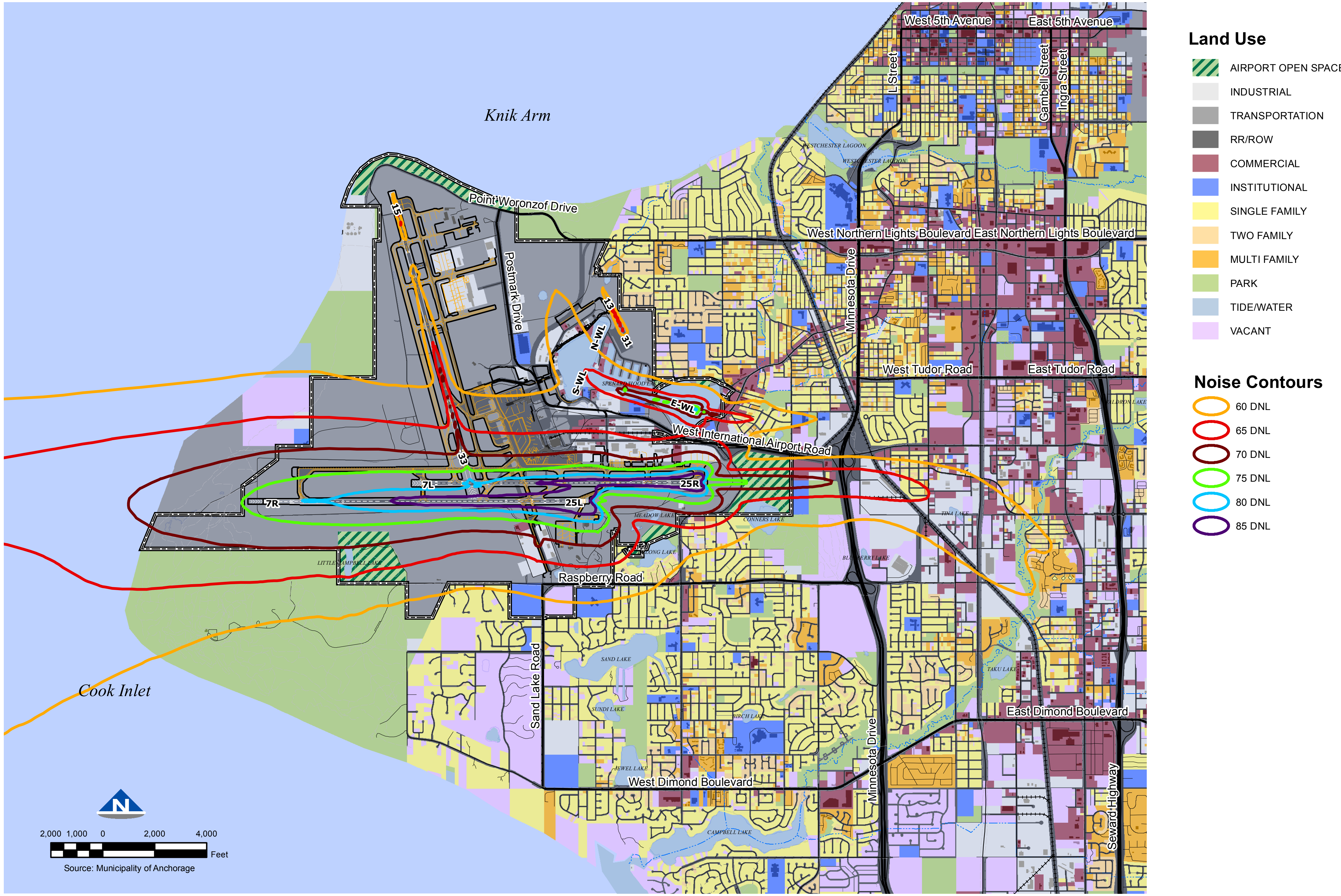

Figure D5 DNL West Flow

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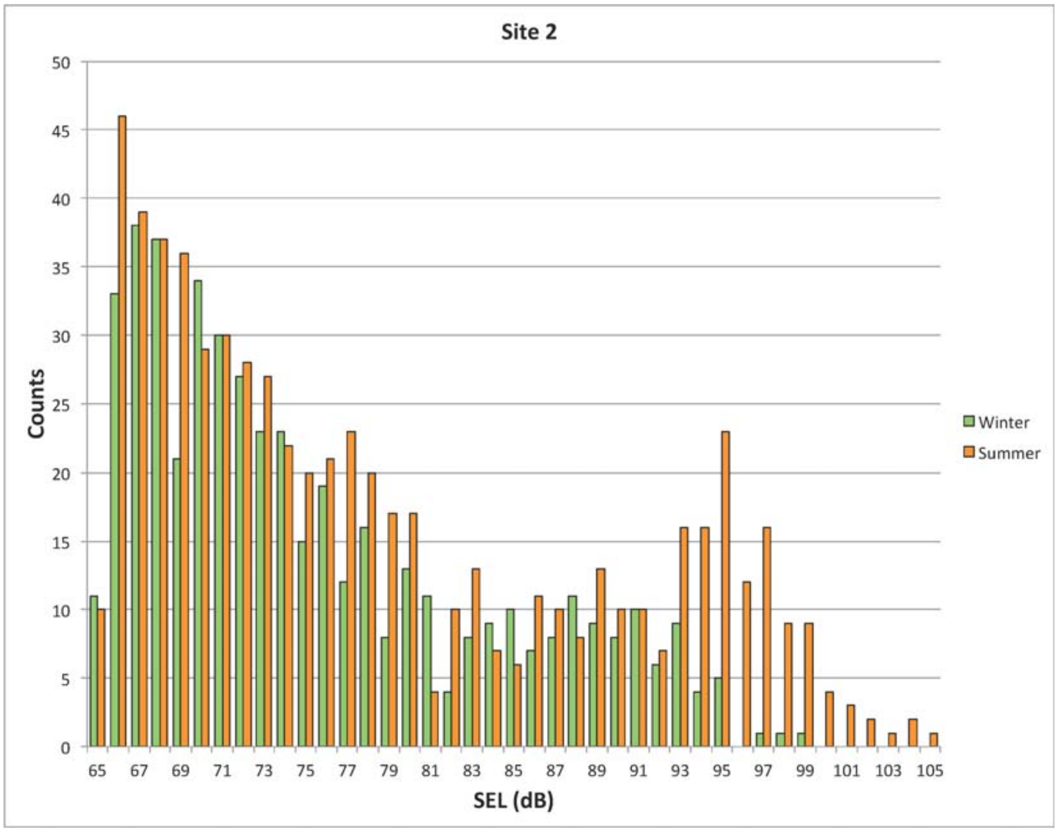
Single Event Noise Exposure Levels from Aircraft

Aircraft and non-aircraft single event noise levels were measured at each location. The acoustic data included the maximum noise level (Lmax), Single Event Noise Level (SEL), and the time duration of aircraft events. The single events measured during the survey were correlated with flight operations information. Using single event noise data, it was possible to separately identify the single event sound levels from the different aircraft types operating at Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base. The FAA noise compatibility policy is based on an annual cumulative noise contour. This section describes the noise events at noise monitoring sites, as well individual noise impacts of four representative aircraft that operate at the Airport in terms of SEL. Noise exposure in terms of SEL contours may be used to compare noise disturbance criteria for the purpose of assessing potential sleep disturbance.

Currently, there is conflicting research on how, why, and how often people awaken during the night. One predictor of awakening is the “meaning of sound” to the individual, such as a child crying, an alarm clock, or birds chirping. The Federal Interagency Committee on Aviation Noise (FICAN) sleep disturbance curve is based on interior rather than exterior noise levels. The difference between exterior and residential interior noise levels may vary due to the Noise Level Reduction (NLR) characteristics of building structural design (i.e. windows, doors, vents, walls). Typically, the NLR for a residence with acoustical treatment with closed windows will be about 30 dB, with closed standard windows and doors will be about 20 to 25 dB, and with windows open will be about 12 to 15 dB. To associate exterior noise levels and different residential structural characteristics to sleep disturbance, the FICAN recommended sleep disturbance curve can be used to calculate the percentage of awakenings at different noise levels relative to sound exposure of 85 dB SEL. The single event levels are summarized in the following paragraphs and graphics.

The number of noise events measured at Site 2 and Site 7 are presented graphically in Figure D6, *NOISE EVENTS AT SITE 2 and SITE 7*. Site 2 is located in the area south of the Airport, and Site 7 is located near Lake Hood Seaplane Base. All other site information is included in the **Noise Measurement Appendix**. The histogram shows the number of measured aircraft and non-aircraft events on the vertical column and the measured SEL on the horizontal column. Site 2 is representative of a location closer to the Airport, while Site 7 is representative of a location close to Lake Hood Seaplane Base. These results show the wide range in events that occur at each site, as well as the number of noise events.



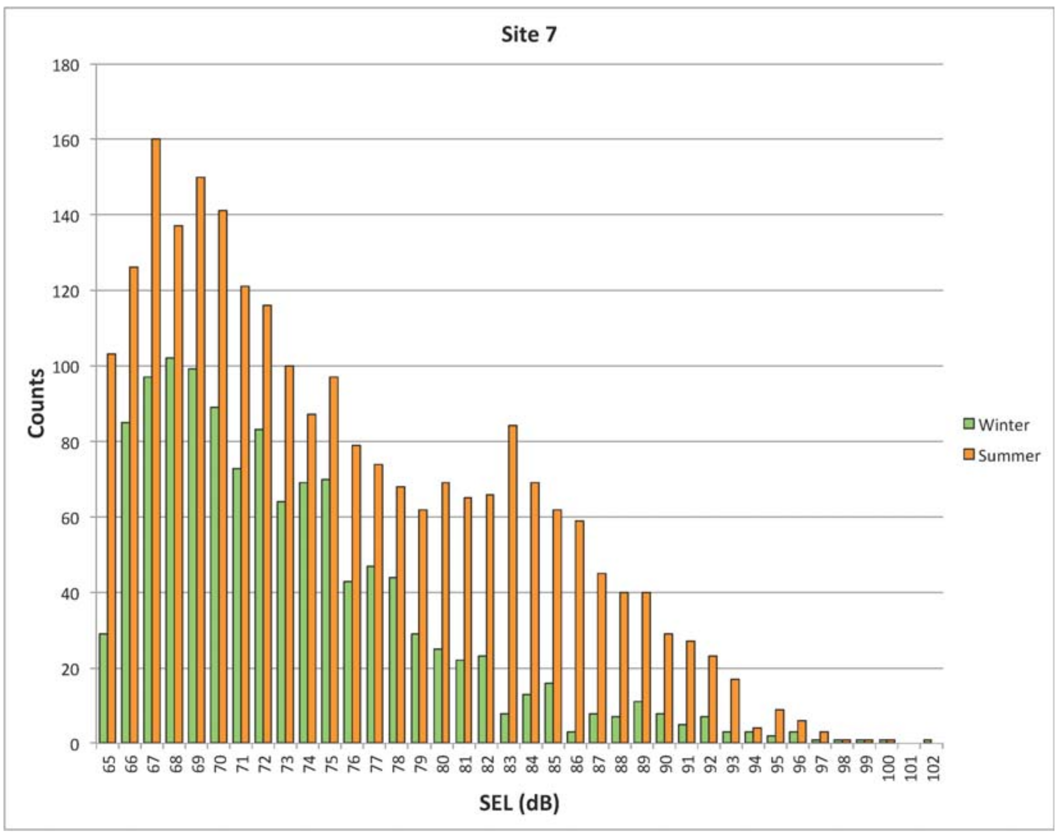


FIGURE D6

Noise Events at Site 2 and Site 7

Table D5 below lists the maximum percentage of awakenings expected per exterior noise levels and residential characteristics. For example, for standard home construction and an outdoor SEL of 85 dB, you can expect 3.8% of the population to awaken due to that noise event. It is interesting to note that the American National Standards Institute (ANSI) adopted a standard method of estimating sleep disturbance and the data shown in the table below is for a population that is newly exposed to noise and not habituated. A habituated population awakens at a lower rate.

Table D5
MAXIMUM PERCENTAGE OF AWAKENINGS PER EXTERIOR SEL

Residential Characteristic	NLR (dB)	EXTERIOR SEL OF 85 dB
Acoustical Treatment	30	2.8%
Standard Construction	25	3.8%
Windows Open	15	6.4%

Source: FICAN (1997), MGA/L&B (2013), Port of Oakland SEIR (2003).
ANSI 12.9-2008/Part 6, Methods for Estimation of Awakenings Associates with Outdoor Noise Events Heard in Homes.

The SEL contours of four aircraft that typically operate at the Airport were modeled using INM 7.0c. Two jet aircraft were used on the main runways. A typical narrow body twin engine jet represented by the B737-800 (the most common jet used at ANC) and the B747-400, the loudest heavy air cargo jet was used to represent the heavy cargo carriers. On Lake Hood, the two propeller aircraft modeled were the Cessna 208 and the Beaver. The C208 was used on the hard surfaced, gravel runway, and the Beaver was modeled on the Lake. The Beaver is a slow moving aircraft with a loud radial engine. Note that the arrival and departure of that aircraft are shown in the same contour and the direction of flow is indicated by an arrow in the following figures, D7 through D19. Again, the type of aircraft and direction of flow has a significant effect on who is flown over.

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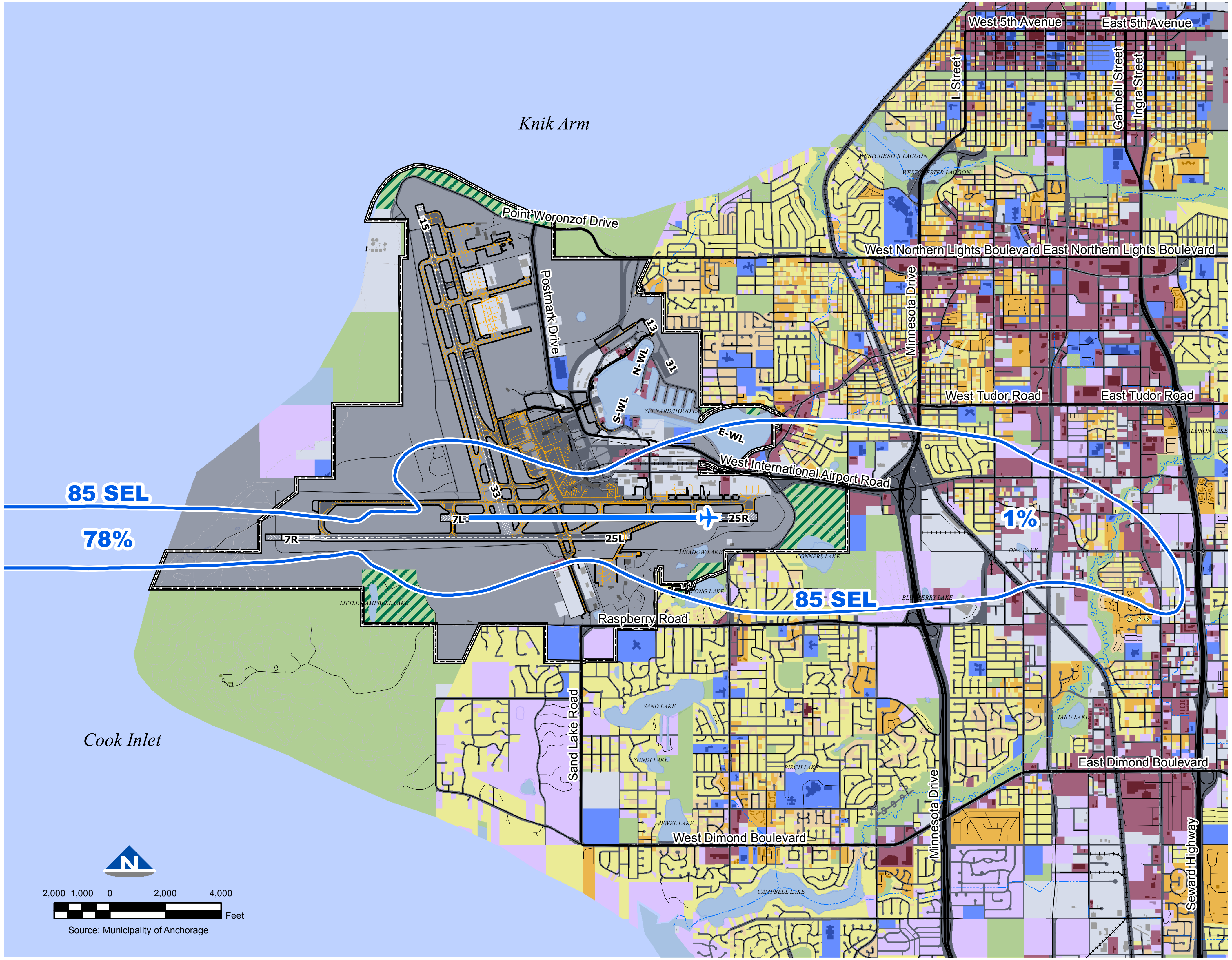

Land Use

- AIRPORT OPEN SPACE
- INDUSTRIAL
- TRANSPORTATION
- RR/ROW
- COMMERCIAL
- INSTITUTIONAL
- SINGLE FAMILY
- TWO FAMILY
- MULTI FAMILY
- PARK
- TIDE/WATER
- VACANT

737 EAST Noise Contours

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D7 SEL 737 East

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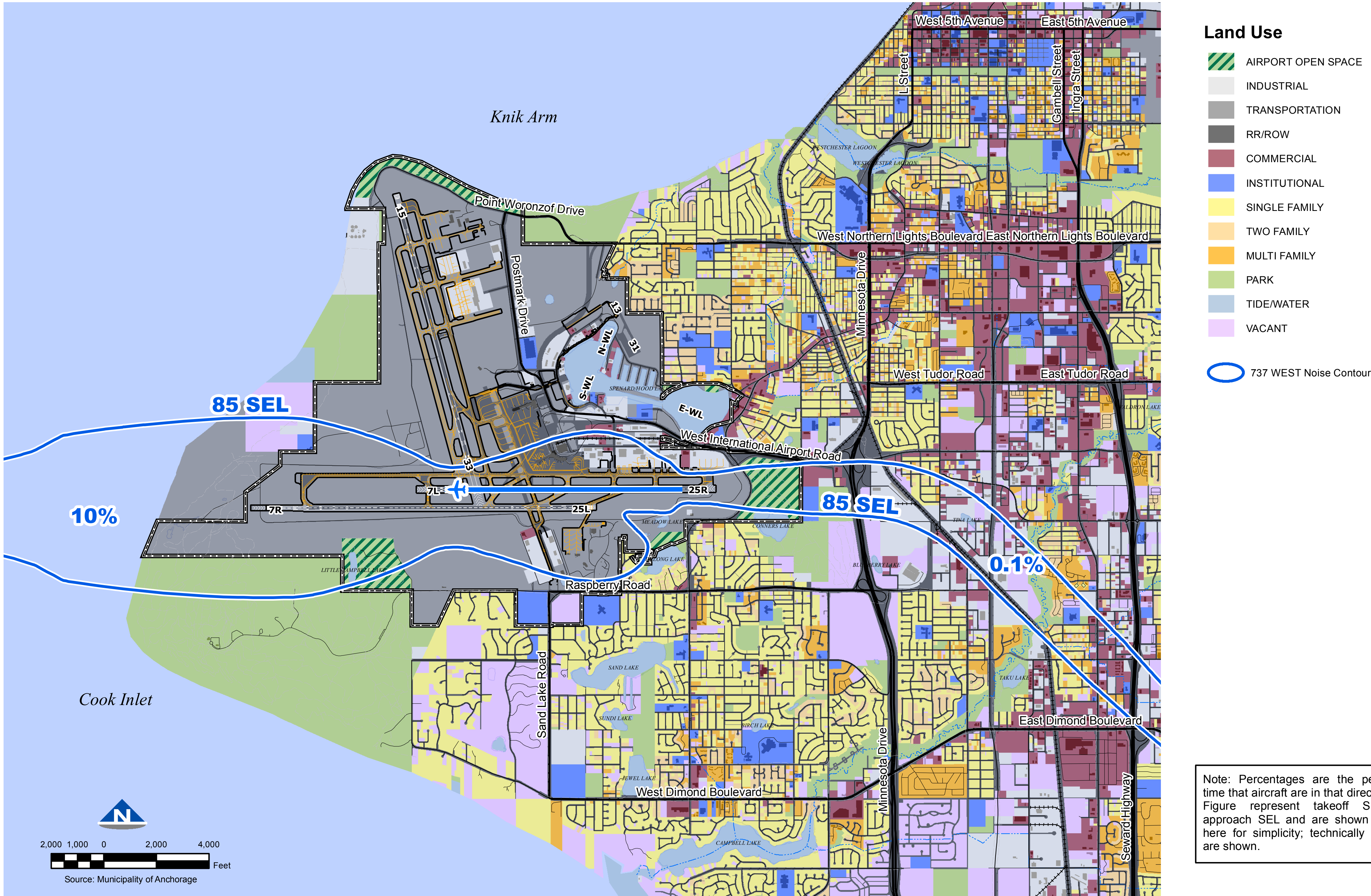

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D8 SEL 737 West

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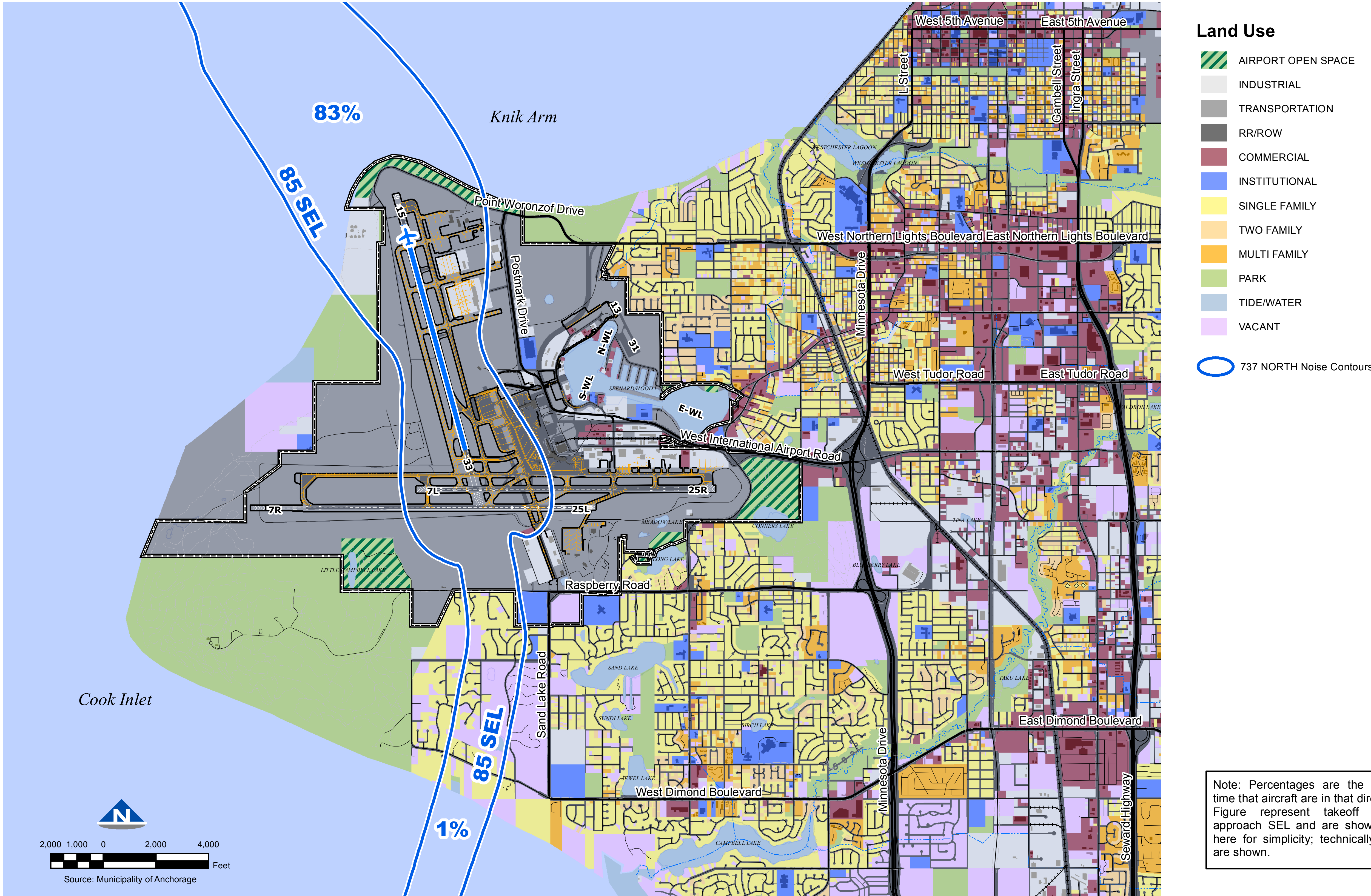

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D9 SEL 737 North

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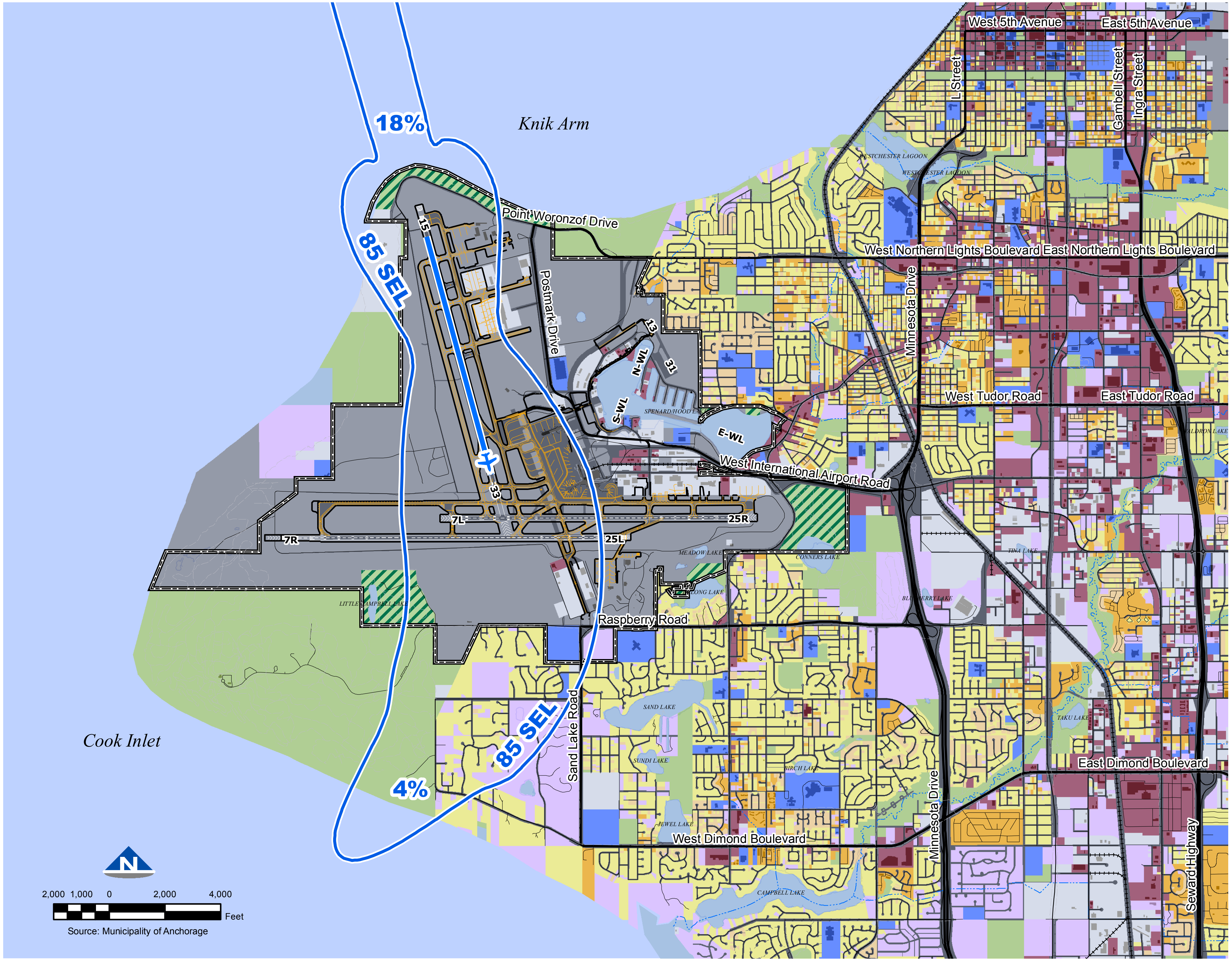

Land Use

- AIRPORT OPEN SPACE
- INDUSTRIAL
- TRANSPORTATION
- RR/ROW
- COMMERCIAL
- INSTITUTIONAL
- SINGLE FAMILY
- TWO FAMILY
- MULTI FAMILY
- PARK
- TIDE/WATER
- VACANT
- 737 SOUTH Noise Contours

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D10 SEL 737 South

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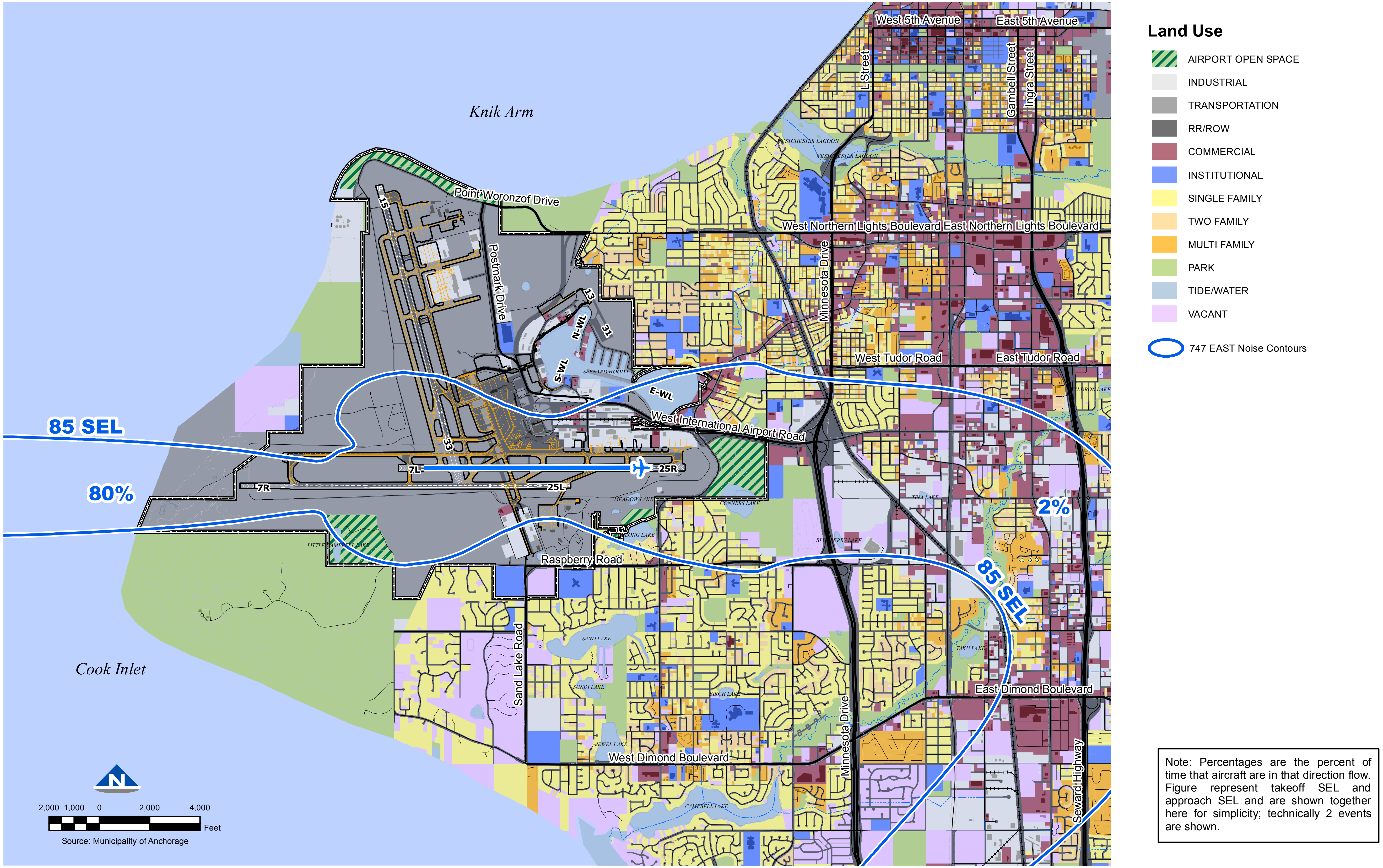

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D11 SEL 747 East

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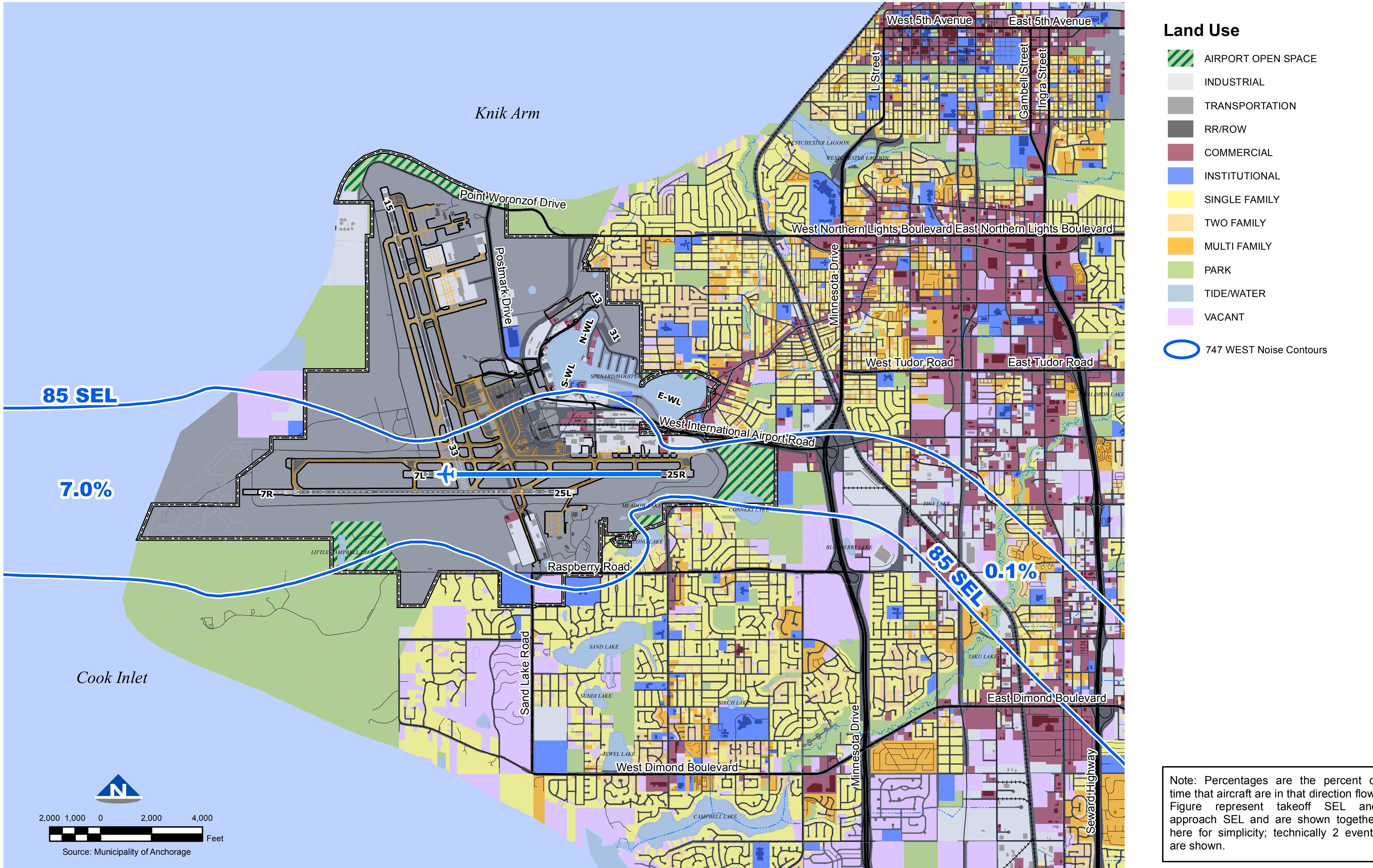

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D12 SEL 747 West

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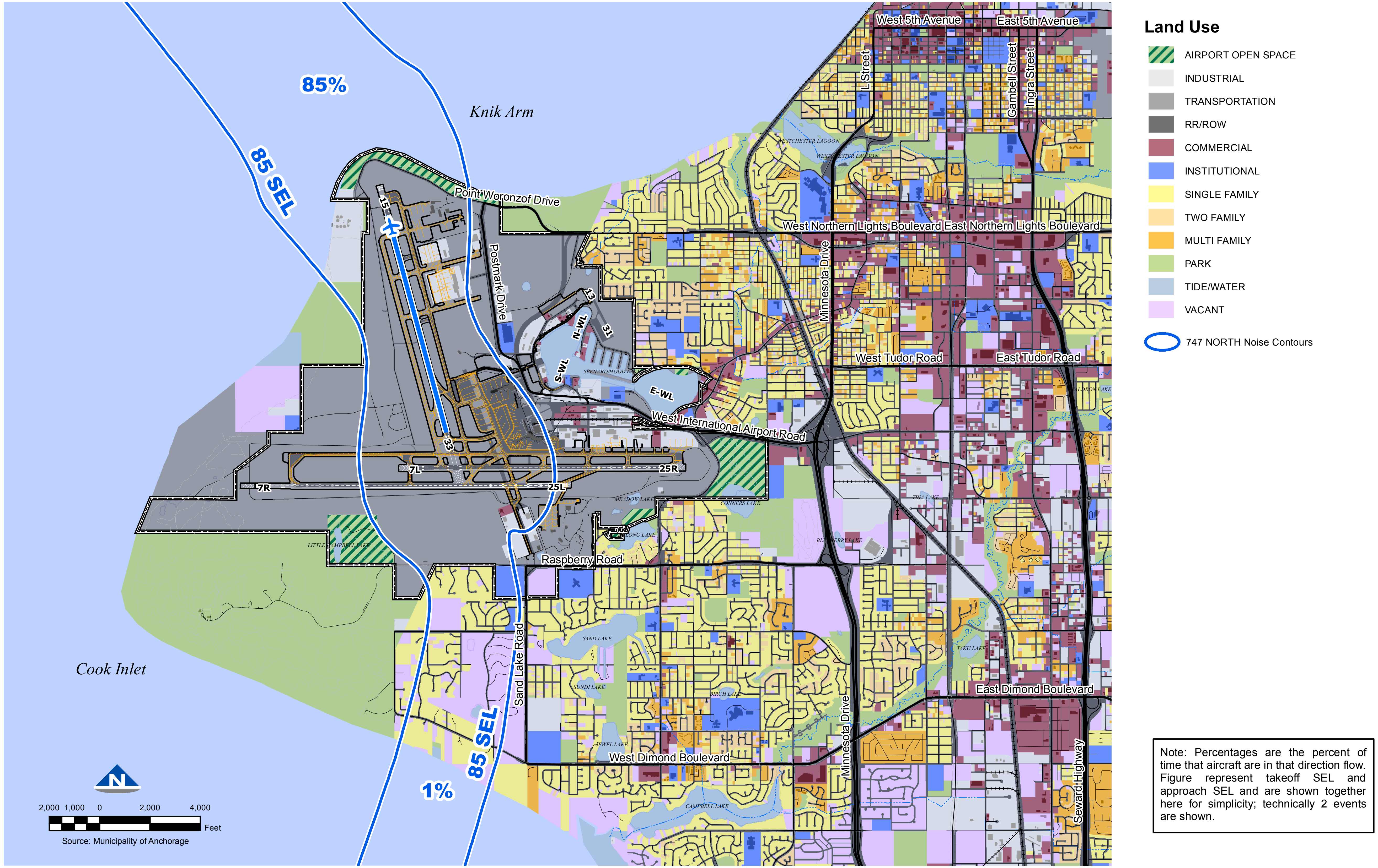

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D13 SEL 747 North

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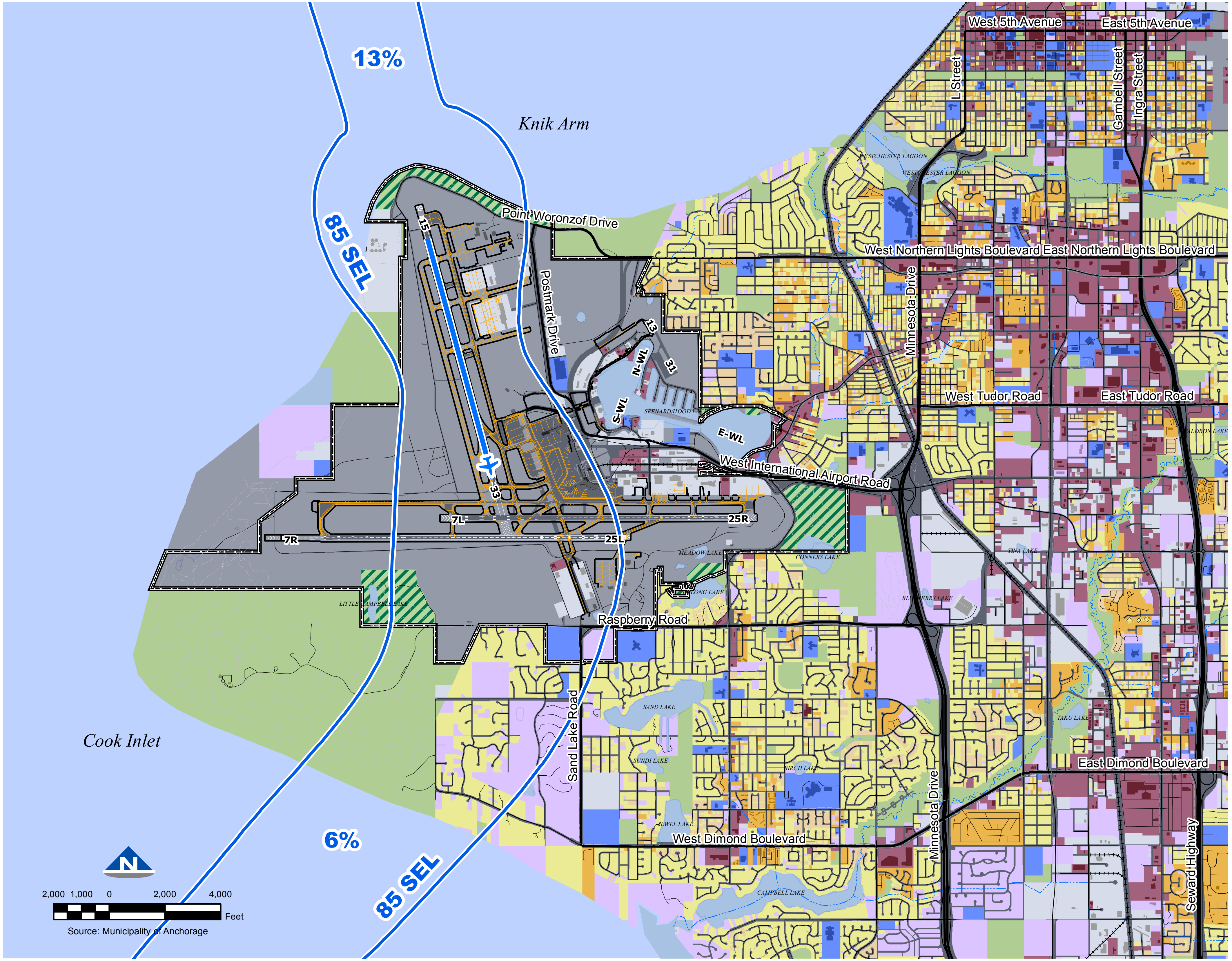

Land Use

- AIRPORT OPEN SPACE
- INDUSTRIAL
- TRANSPORTATION
- RR/ROW
- COMMERCIAL
- INSTITUTIONAL
- SINGLE FAMILY
- TWO FAMILY
- MULTI FAMILY
- PARK
- TIDE/WATER
- VACANT
- 747 SOUTH Noise Contours

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D14 **SEL 747 South**

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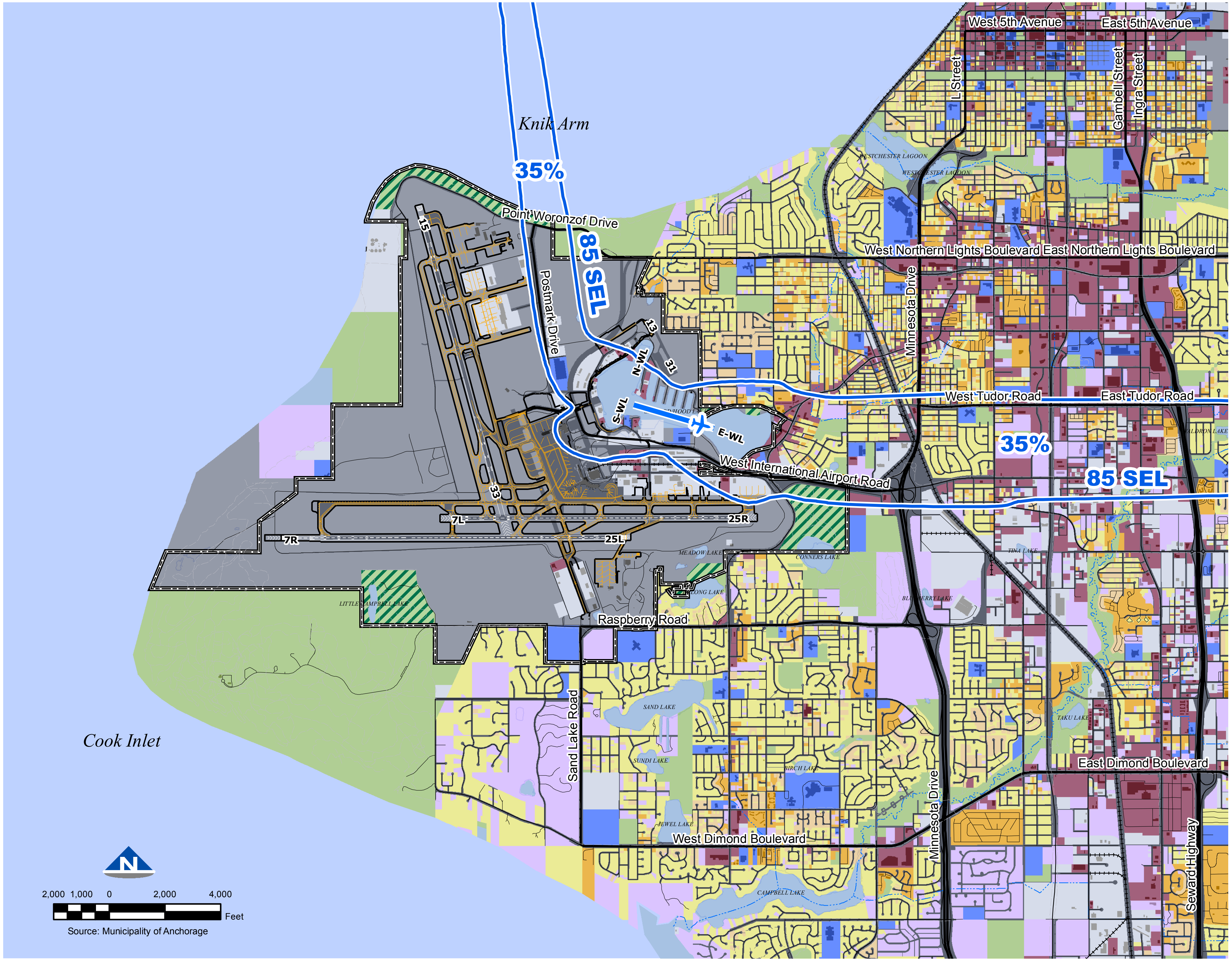

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D15 SEL Beaver East

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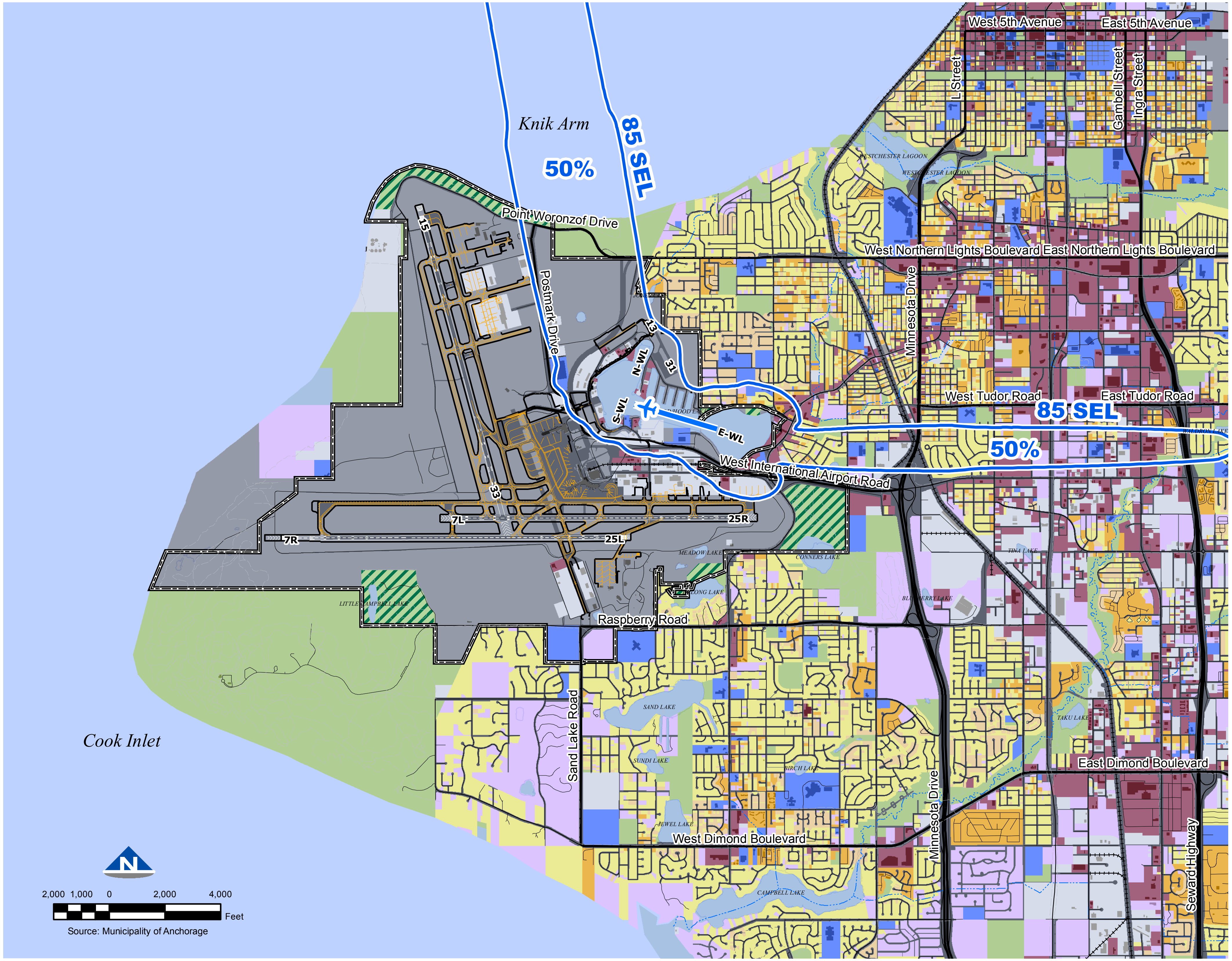

Land Use

- AIRPORT OPEN SPACE
- INDUSTRIAL
- TRANSPORTATION
- RR/ROW
- COMMERCIAL
- INSTITUTIONAL
- SINGLE FAMILY
- TWO FAMILY
- MULTI FAMILY
- PARK
- TIDE/WATER
- VACANT
- DHC WEST Noise Contours

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D16 **SEL Beaver West**

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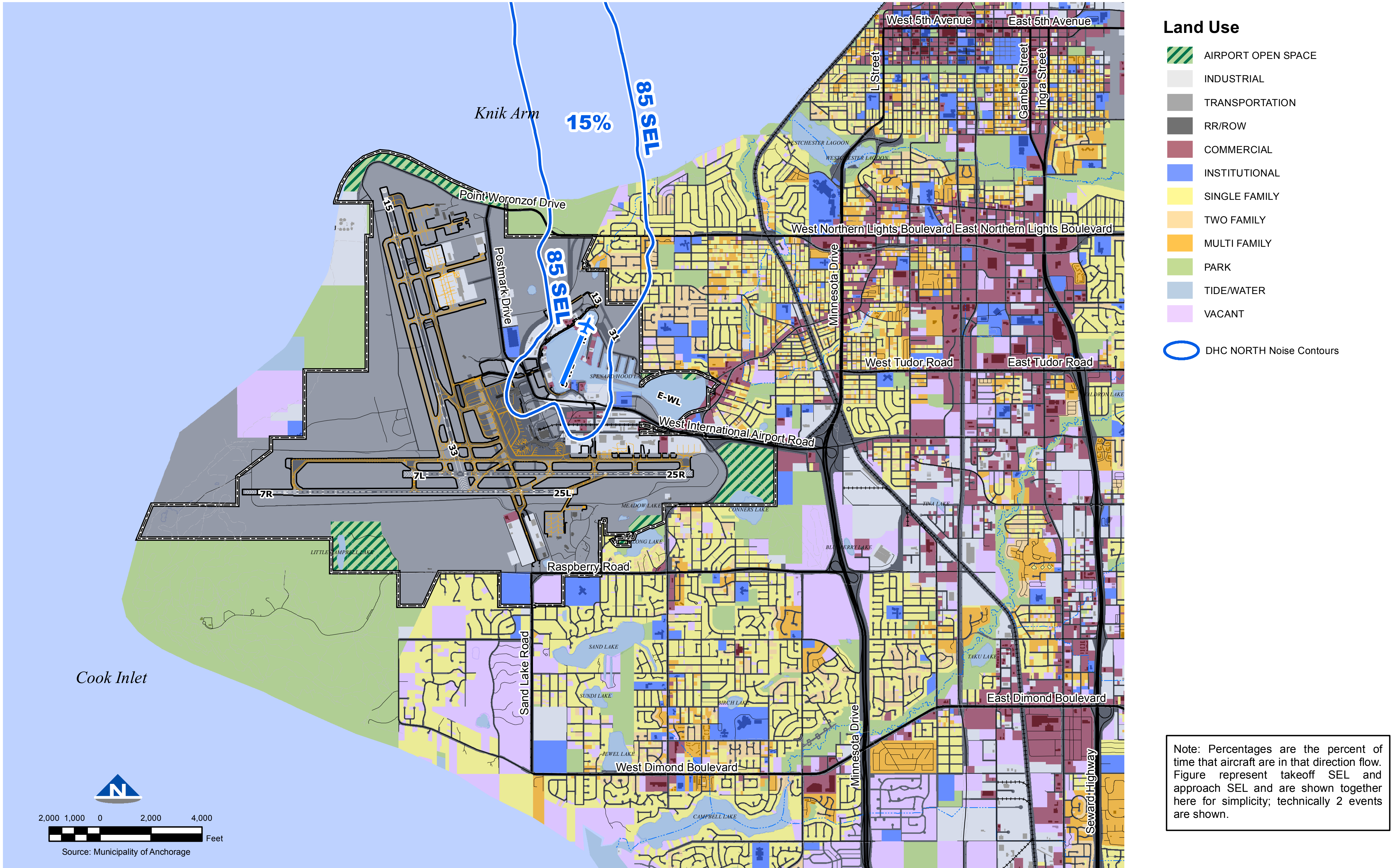

Figure D17 SEL Beaver North

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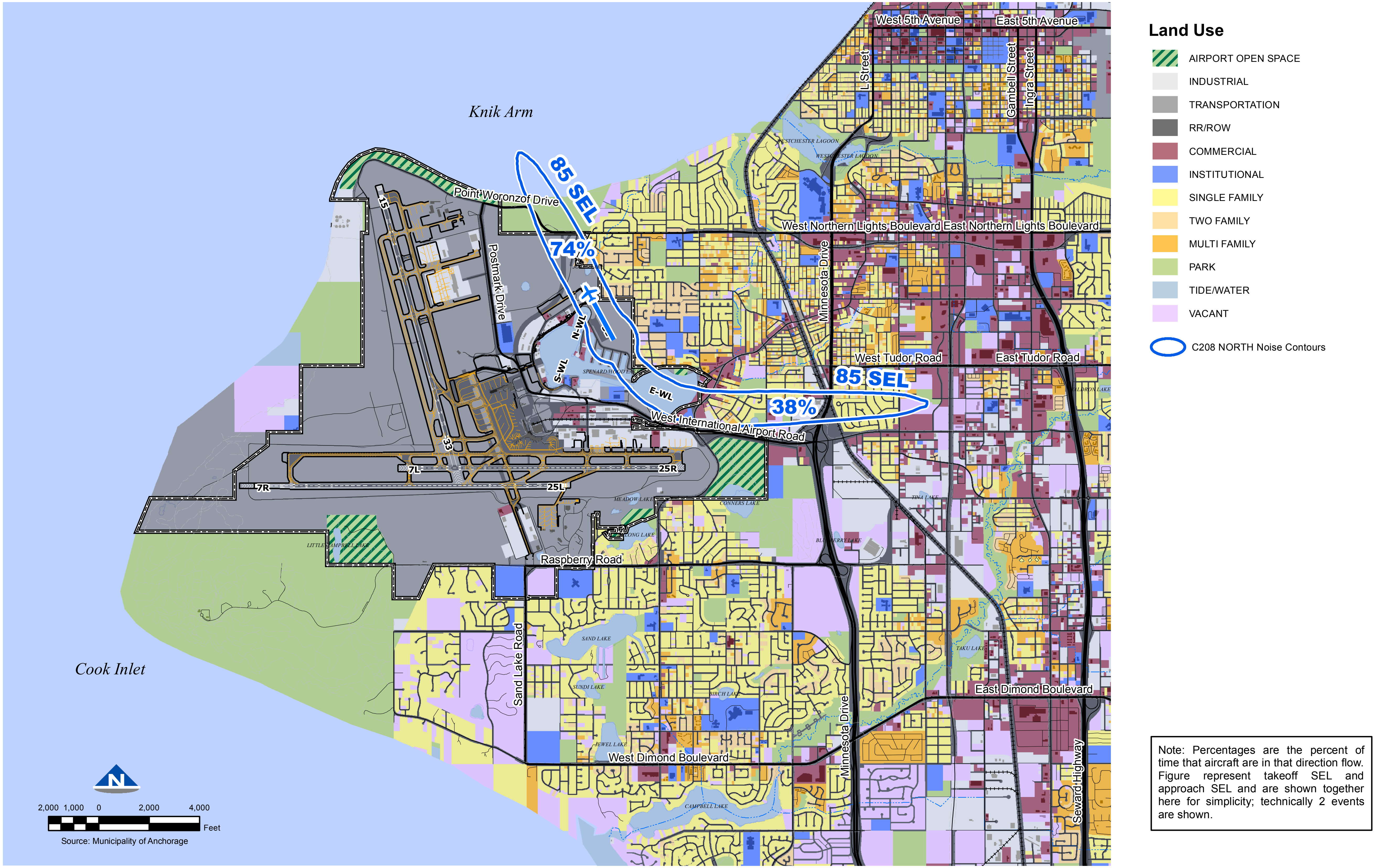

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D18 **SEL C208 North**

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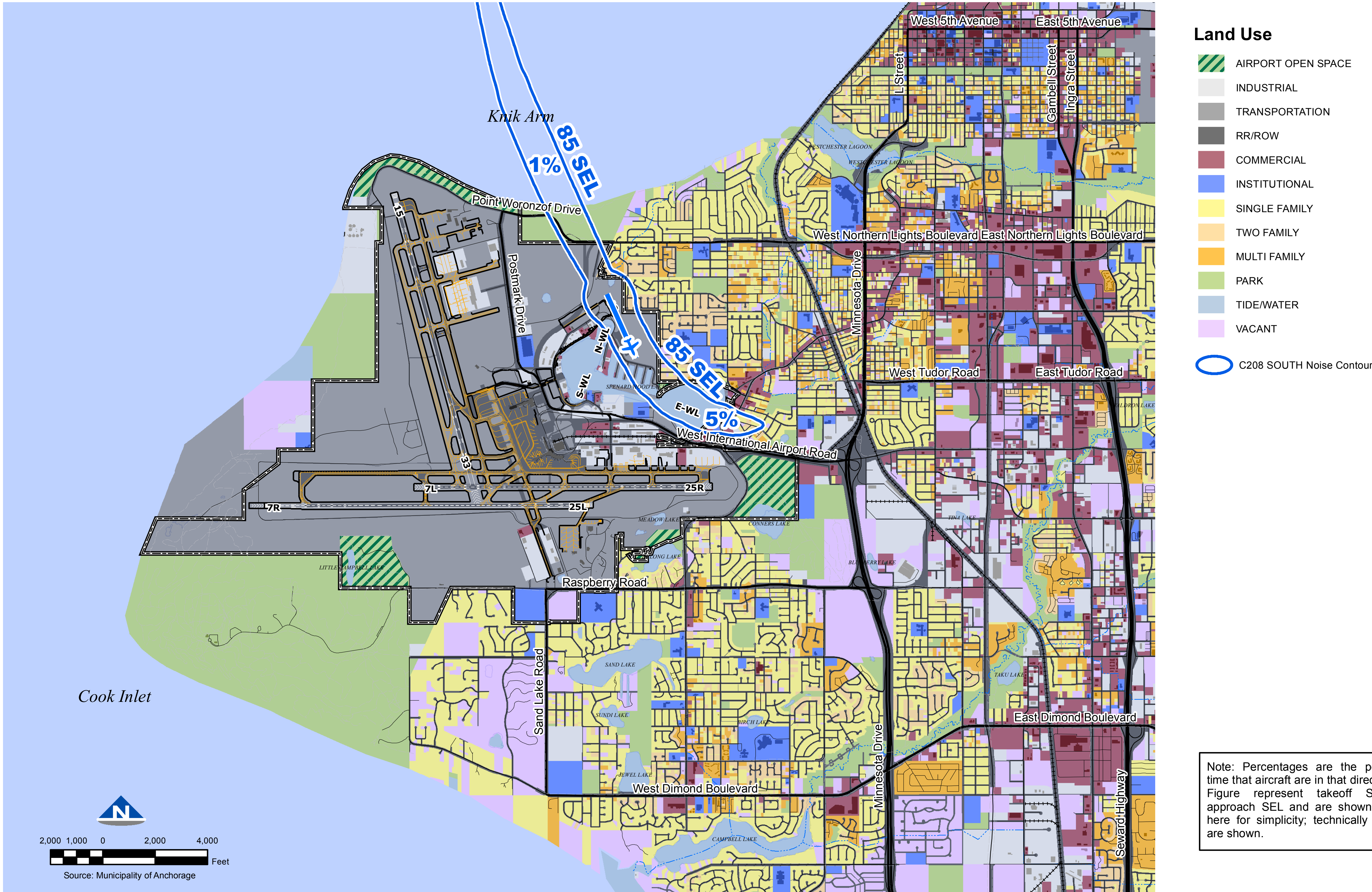

Note: Percentages are the percent of time that aircraft are in that direction flow. Figure represent takeoff SEL and approach SEL and are shown together here for simplicity; technically 2 events are shown.

Figure D19 SEL C208 South

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Time Above Noise Contours

The single event contours shown in the previous section show noise level contours, i.e., the noise level on the ground at those contour locations. An alternative method of describing noise is in terms of time above a specific noise level. In this case, the contours plotted are in terms of three thresholds, 65 dBA, 75 dBA, and 85 dBA. These thresholds are the in terms of actual noise levels. For example, the time above 65 dBA shows the number of minutes per day that the sound level due to aircraft exceeds 65 dBA. The contours are in minutes. Plotting time as a geographic location can be a bit abstract, but what this means is that at the contour labeled '10,' the aircraft sound will exceed 65 dBA 10 minutes per day.

The thresholds 65, 75, and 85 dBA, illustrated in Figures D20, D21, and D22, were selected to illustrate when noise levels exceeds the typical speech level, a level that is perceived as twice as loud as typical speech, and 85 dBA would be twice as loud again. Typical face to face conversation is about 65 dBA, although a quiet talker may be more like 60 dBA. 75 dBA will seem twice as loud and typical of a raised voice level. The following figures show the Time Above contours.

While the time above metric is of some use, it may be difficult to interpret time above metrics. The time above data do not tell you whether this noise occurred from a few loud aircraft or many quieter aircraft. An example situation in which the time above metric may have utility is for examining the amount of time that a school may experience speech interference levels.

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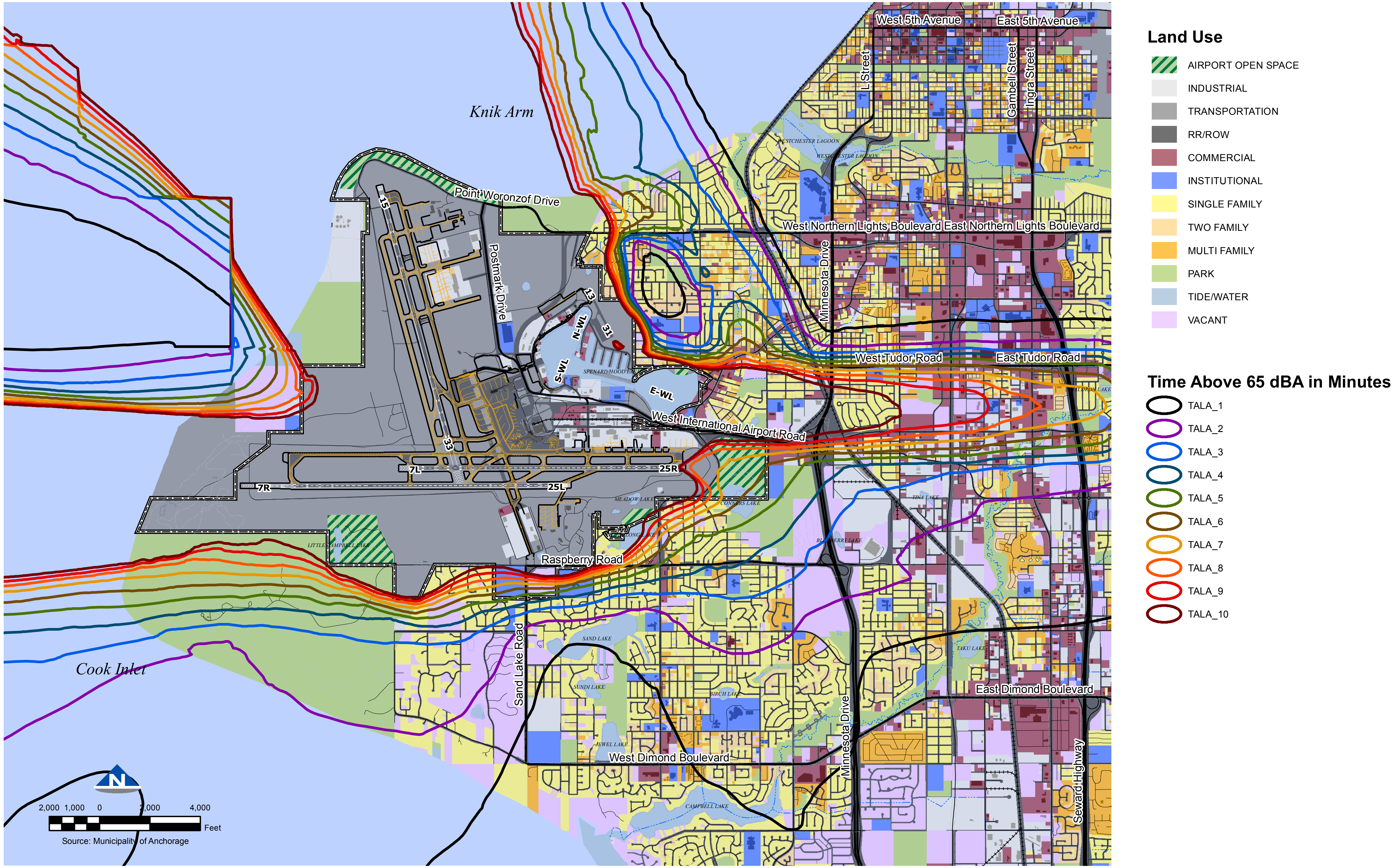

Figure D20 **Minutes Above 65 dBA Per Day, Year 2009**

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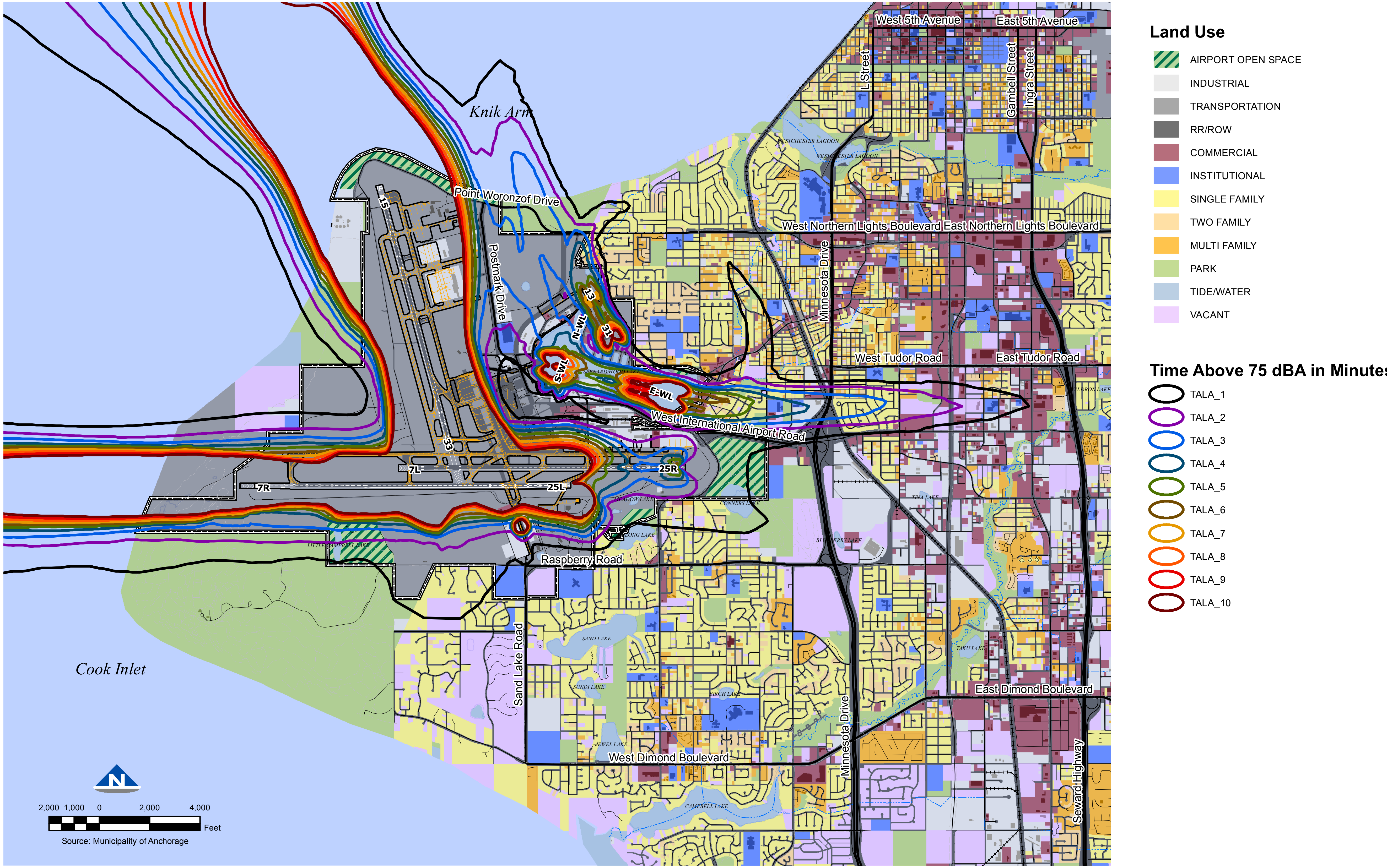

Figure D21 **Minutes Above 75 dBA Per Day, Year 2009**

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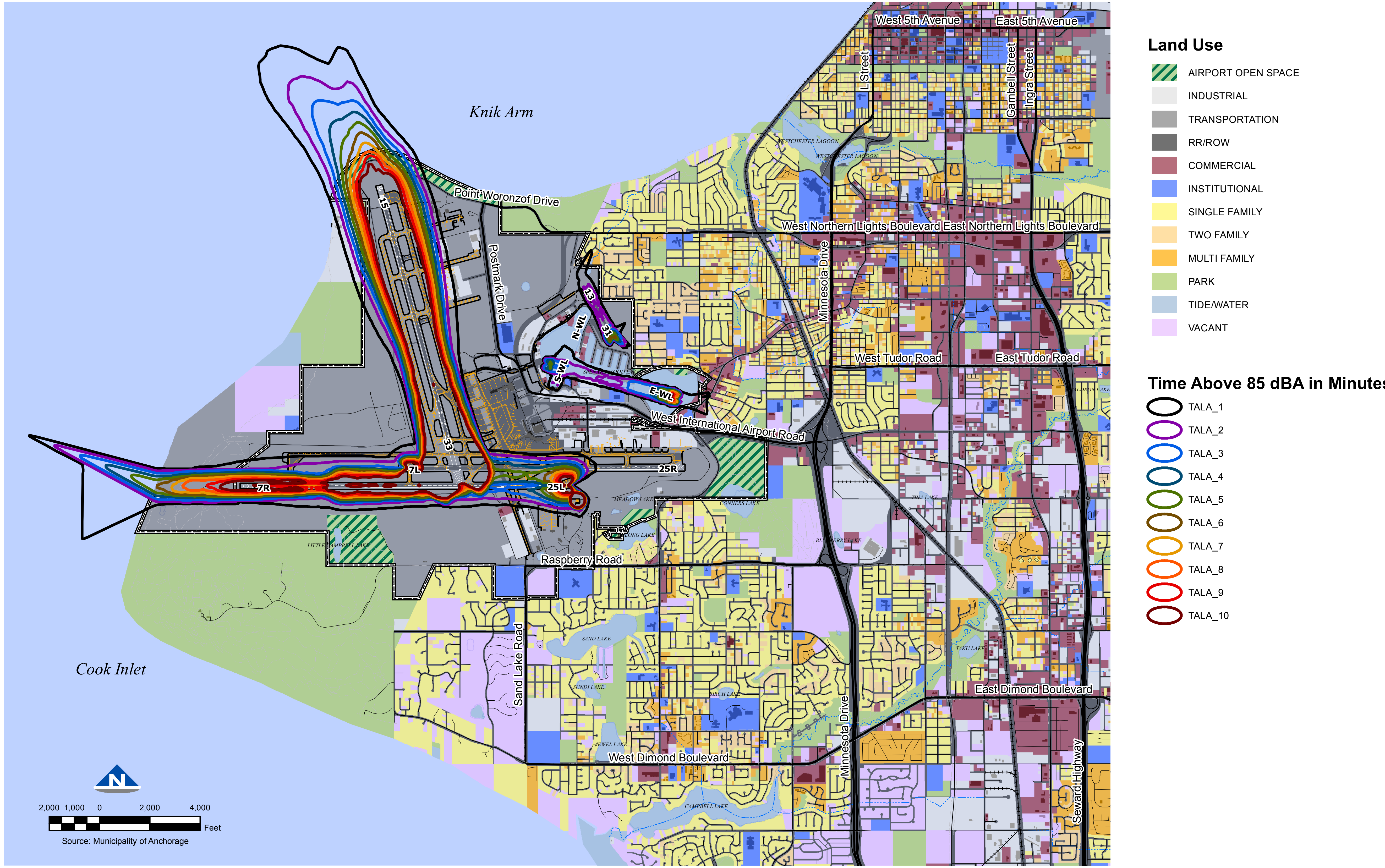

Figure D22 Minutes Above 85 dBA Per Day, Year 2009

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AeroNexus®

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Number Above Noise Contours

A relatively new metric for describing aircraft noise is the Number Above, or NA, metric. The metric could be used for any threshold, but is most commonly used with a 70 dBA metric. It counts the number of times that a resident would experience a flyover with a maximum noise level equal to or exceeding 70 dBA. This is 5 dBA above the level of typical face to face speech. This metric was developed in Australia and is popular there. The number of events above is a very simple and easy to explain way of saying how many aircraft noise events occur at a given location. While DNL includes the number of events in its computation, it is based on the logarithm of the number of events, so the DNL metric is not as sensitive to number of events as the NA metric.

NA provides the resident with a "number of flights" type of number, requires no understanding of decibels and is less abstract than the time above metric. A point on the ground that is under the contour labeled '10' means that at that location on average 10 flyovers will occur per day that exceed 70 dBA. However it is important to note that when comparing alternatives, the NA70 may mask other effects. For example if a change in aircraft fleet were to increase the noise level of aircraft that were already above 70 dBA, the new fleet may have exactly the same NA even though the noise level of each flyover has increased. For that reason, NA by itself must be regarded carefully. The NA70 contours are illustrated in Figure D23.

Finally, it is important to note that the Time Above and Number Above metrics are linear metrics that are highly sensitive to small changes in noise level. As such the INM predictions of TA and NA numbers have a higher level of uncertainty than do the INM prediction of noise levels in decibels.

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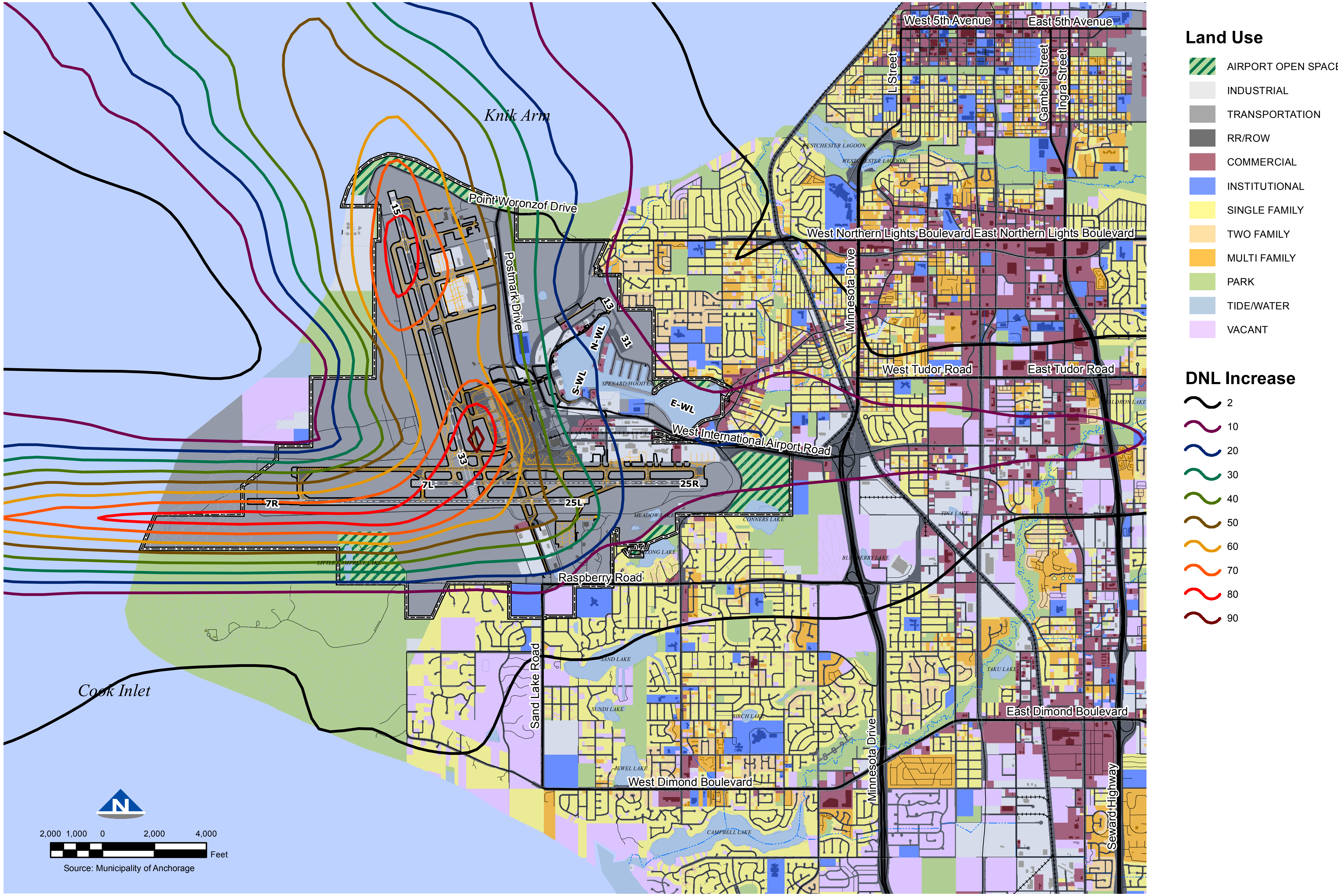

Figure D23 **Number Above 70 dBA for ANC, Year 2009**

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Ground Run Up Noise

Aircraft operators perform engine maintenance and testing on ANC airfield, normally at designated locations including Taxiway Q and J, which are near the Runway 15 end and Runway 7R end, respectively. In general, aircraft are parked heading towards the wind and with the exhaust pointing away from terminal buildings and residential areas. According to ANC records, there were approximately 150 full-power run ups in 2009 by various aircraft including the Boeing 747-400, Boeing 737-800, Saab 340, and the Beech 1900. Figure D24 shows the modeled Lmax noise levels of two 747-400 run ups, one of which is at Taxiway Q and the other at Taxiway J. The colored noise contours represent Lmax 60 to 85.

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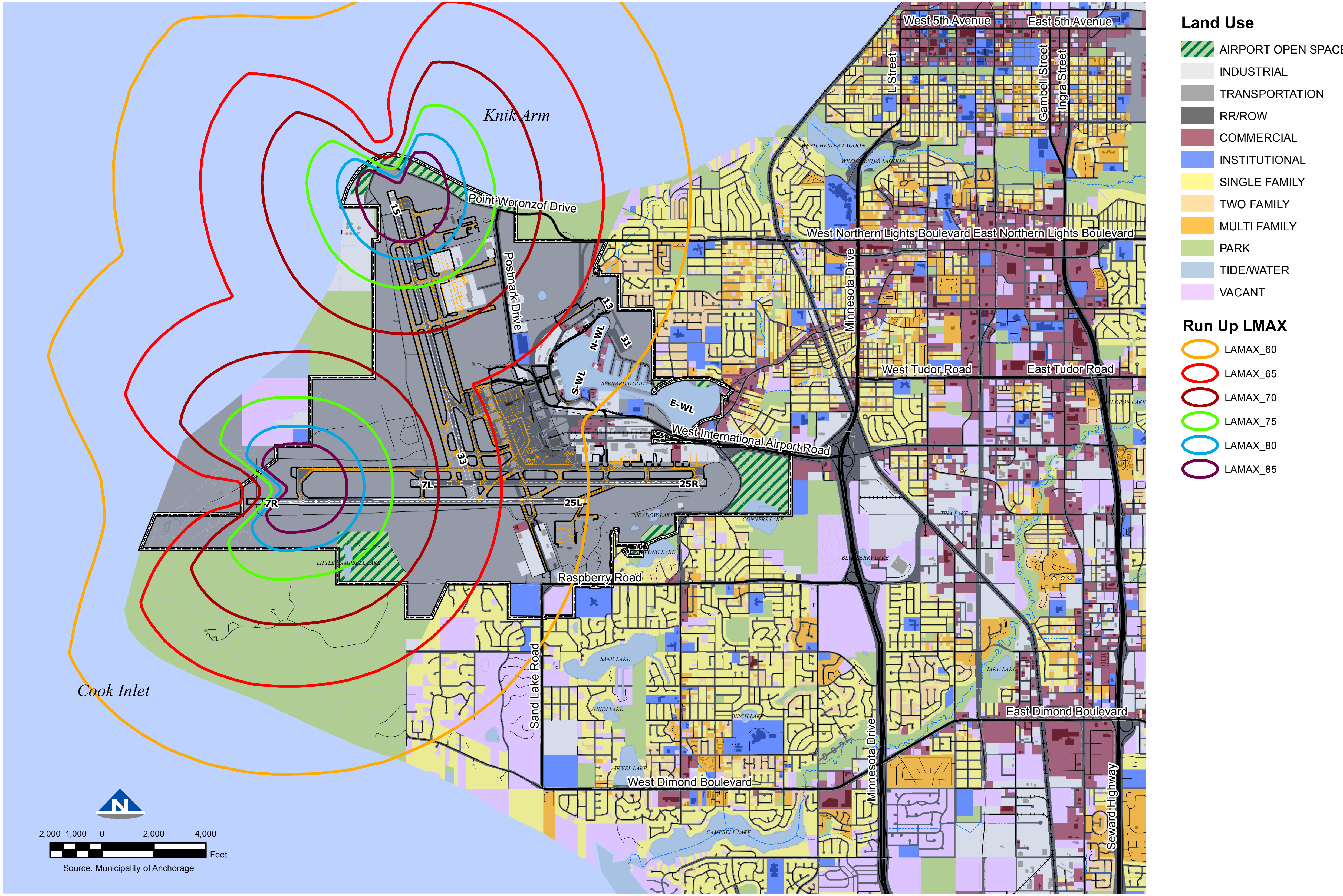

Figure D24 **Boeing 737-800 Ground Run-ups Lmax**

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Supplemental Metrics Summary

As stated at the beginning of the chapter, noise measurements were made at various locations around the Airport and Lake Hood as part of this Part 150 update. These temporary sites were monitored from hours at a time to days at a time. The measurement results were reported in the **Noise Measurement Appendix**. These same noise measurement locations were used to model the noise levels at these sites using the supplemental metrics described above. Chapter C includes a map with the noise monitoring locations. Table D6 below lists these same locations, 1 through 30 with the supplemental metrics.

The table below shows the same trend that appears in the supplemental metrics contours presented earlier. During specific flow conditions, there are locations on the ground that experience more noise than shown when average conditions are reported. For example at Site 1, the annual average DNL is 56 dB, but during south flow is about 11 dB louder (about twice as loud), while during east flow it is about 4 dB quieter than for average conditions. At Site 1 the typical single event noise level during a flyover has a Sound Exposure Level (SEL) of about 72 dBA (which would represent a flyover with a maximum noise level of about 62 dBA). Site 1 experiences about 3 minutes per day above 65 dBA, 1 minute per day above 75 dBA, and about 6 seconds per day above 85 dBA. On average there are about 3 flights per day that have a maximum noise level that exceeds 70 dBA.

The site with the loudest single event noise is Site 25 (typical SEL of 87 dBA), and the site with the highest number of minutes above 65 dBA, at 25 minutes per day, is Site 27. The site with the most number of flights with a maximum noise level above 70 dBA is site 27 with 36 per day. Site 25 and 27 are adjacent to Lake Hood.

The supplemental metrics study reinforces the fact that the current preferential runway system in use at ANC is effective. This maximizes the departures to and from the north and to and from the west reducing overflights over the adjacent communities. The supplemental metrics also show that adjacent to Lake Hood there are frequent noisy events.

Table D6
REPRESENTATIVE RECEPTIVE NOISE LEVELS – SUPPLEMENTAL METRICS AND DNL

Site Number	Annual DNL (dB)	South Flow DNL (daily DNL , dB)	North Flow DNL (daily DNL , dB)	East Flow DNL (daily DNL , dB)	West Flow DNL (daily DNL , dB)	Typical SEL* (dBA)	Time Above 65 dBA (minutes/day)	Time Above 75 dBA (minutes/day)	Time Above 85 dBA (minutes/day)	Number Events Above 70 dBA Lmax (n)
1	56.2	67.2	68.4	51.8	54.3	72	3.1	0.9	0.1	3
2	54.4	64.3	61.3	53.4	57.3	71	4.2	0.4	0	3
3	54.2	53	47.5	54.3	49.7	70	7	0.1	0	5
4	54.3	52.5	51.9	63.2	59.3	72	5.4	0.7	0	3
5	50.8	51.1	45.4	61.2	61.7	70	5.8	0.5	0	4
6	61.5	59.7	55.2	63.2	63.2	81	13.7	5.2	1	26
7	54.3	55.6	52.4	58.3	57.6	73	10.2	0.5	0	7
9	50.4	50.5	49.9	52.8	53.2	68	2.7	0	0	1
10	56.7	59.9	54.2	49.9	53	75	10.7	1	0.2	14
11	56	67.5	60.7	51.5	53.9	72	2.8	0.8	0.1	3
12	56.5	67.1	70.7	52.2	54.9	73	3.4	0.9	0.1	3
13	52.2	58.1	52	54.4	57.2	69	2.6	0	0	1
14	47.6	49.5	46.3	57.3	50.5	66	0.7	0.1	0	0
15	54.5	52.9	52.2	62.4	59.8	72	6	0.6	0	3

Source: L&B, 2012.

Table D6
REPRESENTATIVE RECEPTIVE NOISE LEVELS – SUPPLEMENTAL METRICS AND DNL (CONTINUED)

Site Number	Annual DNL (dB)	South Flow DNL	North Flow DNL	East Flow DNL	West Flow DNL	Typical SEL* (dBA)	Time Above 65 dBA	Time Above 75 dBA	Time Above 85 dBA	Number Events Above 70 dBA Lmax (n)
		(daily DNL , dB)					(minutes/day)			
16	53.7	51.4	50.9	64.1	58.3	72	4.9	0.8	0	3
17	46.9	48.3	42.4	52	46.7	66	3.3	0	0	3
18	55.4	59.2	53.6	58.2	58.1	74	14	0.7	0	9
19	51.7	52	46.4	60.9	58.7	71	7.6	0.7	0	9
20	52.9	53.7	49	57.4	54.4	72	9.8	0.7	0	12
21	51.9	48.6	51.2	48.8	53.2	70	3.2	0.8	0	6
22	54.6	56.8	53	56.6	60	71	5.5	0	0	4
23	48.5	48.1	46.9	57.2	59.6	67	1.5	0.3	0	1
24	53.4	52.8	48.3	56.6	54.3	72	9.3	1.9	0	16
25	67.6	62	57.7	64.9	69.9	87	13	5.1	1.5	29
26	55.5	56.4	54.2	59.6	58.2	74	15.3	1.1	0	11
27	63.4	64.9	62.2	63	64.3	82	25.4	8.7	1	36
28	22.8	16.4	23.3	17.6	17.7	40	0	0	0	0
29	56.3	58.2	56.6	54.3	55.7	74	15.8	0.3	0	15
30	49.9	49.9	49.4	49.8	51.9	67	1.1	0	0	0

Source: L&B, 2012.
* Note that SEL is approximately 10 dB greater than the Lmax.
Also note, time above and number of events above 70 dBA have a high level of uncertainty.

Day Night Noise Level (DNL) Noise Levels

Aircraft-related DNL levels were identified for each of the noise monitoring sites. Table D7, *DNL NOISE MEASUREMENT RESULTS FOR SEMI-PERMANENT SITES (WINTER AND SUMMER)*, presents the results of the DNL noise measurements at the noise-monitoring locations in the two monitoring periods. This table lists the average DNL due to aircraft and community noise events for the two noise measurement periods (one in April 2012 and one in August 2012). These measurements include all aircraft activity on the ground and in the air. While these totals include noise from aircraft ground run-up activity, DNL is not as sensitive to this type of noise as single event noise metrics. The table also shows the ambient, or background DNL, as well as the total DNL.

Table D7
DNL NOISE MEASUREMENT RESULTS FOR SEMI-PERMANENT SITES (WINTER AND SUMMER 2012)

Site	Total DNL	Event DNL	Non-Event DNL
Winter			
1	64.5	64.1	53.7
2	60.3	59.9	50.3
3	58.4	56.3	54.2
4	56.4	53.4	53.5
5	55.8	49.4	54.7
6	55.2	50.2	53.5
7	57.9	55.0	54.7
9	57.0	53.8	54.1
10	61.6	60.4	55.6
Summer			
1	67.1	66.8	54.2
2	67.0	66.9	50.7
3	58.2	56.5	53.1
4	58.9	57.4	53.7
5	61.6	59.9	56.7
6	58.7	55.9	55.4
7	61.4	59.7	56.6
9	58.7	57.0	53.9
10	66.6	66.4	54.2

Source: L&B, 2012.

Noise Contour Modeling Results

Existing Aircraft Operations

A Part 150 Study requires that the existing noise exposure contour maps reflect annual conditions using a recent continuous 12-month period. The existing aircraft noise environment around Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base was evaluated based upon the level of aircraft operations in 2009 and the associated airport operational characteristics. The development of the baseline conditions used data from a variety of sources. The sources of data for this study are listed below:

- FAA Airport Traffic Control Tower (ATCT) counts.
- Aircraft Situational Display Information (ASDI) data for Instrument Flight Rule (IFR) aircraft.
- Field observations and noise monitoring results from the noise measurement survey.
- Data from permanent noise monitors.
- Discussions with Airport, FAA ATCT, and FBO staff.
- Discussions with aircraft maintenance operators.

As noted earlier, aircraft noise exposure maps were generated using the FAA's Integrated Noise Model (INM) Version 7.0c. The INM computer model requires a variety of operational data to evaluate the noise environment around an airport. These data include the following information, which are discussed in detail in the following paragraphs:

- Total Aircraft Activity Levels.
- Aircraft Fleet Mix Categories.
- Detailed Fleet Mix.
- Time of Day.
- Runway Use.
- Departure and Arrival Procedures.
- Flight Paths.
- Flight Path Utilization.
- Ground Run-Up.

Total Aircraft Activity Levels. The total aircraft operational levels were derived directly from the FAA's ATCT activity data, called tower counts. The tower count data and nighttime activity logs showed that, for 2009, there were a total of 256,632 operations, or an average of 703 operations per day (an operation is one takeoff or one landing).

Table D8 summarizes the tower count data for 2009. Air taxi operations are essentially non-scheduled passenger operations generally using general aviation type aircraft.

Table D8
AIRPORT TOWER COUNTS FOR BASELINE PERIOD - 2009

Category	Annual Operations	Average Daily Operations
Air Carrier/Air Taxi	170,677	468
General Aviation	81,570	223
Military	4,385	12
Total	**256,632**	**703**

Source: Landrum & Brown, Calendar Year 2009.

Aircraft Fleet Mix Categories. The distribution of the operations (i.e., both arrivals and departures) among the many types of aircraft available within the INM database is another important component of the INM input data. The aircraft type information provided in the noise monitoring system data sample described above was used in conjunction with airline and flight ID data to categorize each of the sample flights into the operational categories provided in the Air Traffic Activity Data System (ATADS) and ANC forecast. Once categorized, the flights were tallied by aircraft type, and individual proportions were computed from within each operational category. The resulting fleet mix was used directly for the 2009 baseline fleet. Table D9, *OPERATIONS BY AIRCRAFT CATEGORY – 2009, 2020, 2030* presents operations for the different categories of aircraft. The INM aircraft types are identified along with the typical actual aircraft at ANC that are represented by the model aircraft.

The expected future fleet mix in 2020 is largely similar to the current fleet. Generally, it is expected that some of the older aircraft types currently serving ANC will gradually decline in frequency into the future. These include aircraft such as the Boeing 737-200's, which will be replaced by the Boeing 737-800. However, for noise modeling purposes, the proportion of each aircraft type remained constant relative to the Aircraft Category type and only changed according to the forecast.

Table D9
OPERATIONS BY AIRCRAFT CATEGORY – 2009, 2020, 2030

Typical Aircraft	Annual Operations		
	2009	2020	2030
Air Carrier Jet			
DC1010	457	593	0
MD11GE	12,549	16,260	0
737400	15,698	0	0
737700	2,188	2,835	10,216
737800	13,297	37,568	41,985
747200	4,537	0	0
747400	27,321	41,273	46,125
757300	959	1,243	1,389
767300	2,929	3,795	4,241
777300	455	589	19,493
737N17	4,867	6,307	0
757PW	2,630	3,407	3,808
A319-131	1,197	1,551	1,733
Business Jet			
CL600	121	157	176
ECLIPSE500	295	383	428
GII	619	403	0
GV	1,880	2,836	3,620
LEAR35	5,372	6,961	7,779
MU3001	776	1,005	1,124
Helicopter			
B206L	533	691	772
R22	1,971	2,553	2,854
Military			
C130E	2,150	512	0
E3A	52	27	27
F15E20	16	8	8
S70	2,167	1,120	1,120
Propeller			
1900D	29,025	37,607	42,029
BEC58P	12,390	10,087	17,394
CNA182FLT	25,547	28,126	33,897
CNA206	4,302	4,823	5,772
CNA208	19,733	22,120	26,475
CNA441	10,784	8,779	15,140
DC3	761	985	0
DHC-2FLT	665	746	892
DHC6	11,458	14,846	16,592
DHC8	9,988	13,536	16,676
EMB120	1,184	1,534	1,714
GASEPF	7,630	9,148	10,710
GASEPV	518	503	602
SF340	17,611	22,818	25,501
Total Operations	**256,632**	**307,735**	**360,293**

Source: Landrum & Brown, 2012.

Time of Day. The time of day that operations (i.e. both arrivals and departures) occur is also a key component of the INM input. It is important to the computation of the cumulative average noise level because a penalty of 10 decibels is assigned to each operation that occurs at night (between the hours of 10:00 p.m. and 7:00 a.m.). The distribution between day and night was developed for each individual aircraft type and operation type based on a 12-month sample data from ANC's Airport Noise and Operations Monitoring System (ANOMS: a computer system that collects aircraft operational data and noise events from noise monitoring terminals around the Airport) that was provided through the Airport's noise management office. This dataset included, among other items, flight tracks, aircraft types, and flight times for the ANC traffic occurring in the months of January through December of 2009. The dataset provided information on over 145,000 flights to and from ANC and LHD during the sample period.

On an average day in 2009, approximately 17% of aviation traffic operating at ANC and takes place during the nighttime hours (10:00 p.m. to 7:00 a.m.). The Day-Night splits developed from the data sample were used for the existing 2009 as well as the future 2020 and 2030 noise exposure contours. Table D10 presents a summary of the Day-Night percentages used for noise modeling for each operational category at ANC.

Table D10

SUMMARY OF NIGHTTIME OPERATIONS BY CATEGORY

INM Aircraft	Arrivals		Departures	
	Day	Night	Day	Night
Air Carrier Jet				
DC1010	66%	34%	80%	20%
MD11GE	79%	21%	83%	17%
737400	76%	24%	74%	26%
737700	93%	7%	95%	5%
737800	67%	33%	66%	34%
747200	62%	38%	82%	18%
747400	75%	25%	76%	24%
757300	42%	58%	31%	69%
767300	56%	44%	85%	15%
777300	20%	80%	22%	78%
737N17	79%	21%	87%	13%
757PW	69%	31%	64%	36%
A319-131	30%	70%	13%	87%
Business Jet				
CL600	85%	15%	86%	14%
ECLIPSE500	92%	8%	99%	1%
GII	98%	2%	97%	3%
GV	78%	22%	80%	20%
LEAR35	72%	28%	73%	27%
MU3001	97%	3%	97%	3%
Helicopter				
B206L	97%	3%	93%	7%
R22	87%	13%	97%	3%
Military				
C130E	89%	11%	77%	23%
E3A	100%	0%	100%	0%
F15E20	100%	0%	100%	0%
S70	78%	22%	95%	5%
Propeller				
1900D	82%	18%	76%	24%
BEC58P	97%	3%	91%	9%
CNA182FLT	95%	5%	96%	4%
CNA206	98%	2%	98%	2%
CNA208	92%	8%	83%	17%
CNA441	95%	5%	97%	3%
DC3	99%	1%	100%	0%
DHC-2FLT	100%	0%	100%	0%
DHC6	84%	16%	70%	30%
DHC8	91%	9%	92%	8%
EMB120	99%	1%	41%	59%
GASEPV	99%	1%	97%	3%
GASEPF	85%	15%	85%	15%
SF340	91%	9%	95%	5%

Source: Landrum & Brown, 2012.

Runway Use. The usage of the runways and helipads at the Airport is another principal element in the definition of the noise exposure pattern. The more frequently jet aircraft use a runway, particularly at night, the greater the noise exposure energy associated with that runway. Generally, the primary factor determining runway use at an airport is the weather and prevailing wind conditions at the time of a flight. Additionally, several key secondary factors also have a strong influence on runway selection. These factors include runway safety issues (taxiing aircraft crossing active runways or Land and Hold Short rules), the current make-up of the traffic (many arrivals or many departures), and even the location of a flight's gate relative to the runway layout.

The INM uses runway utilization to distribute fixed-wing aircraft onto the correct runway end by type of operation (arrival or departure). Additionally, there are two helipad areas at ANC that helicopters use to take off and land. Both helipads are located near the Runway 25L runway end. These distributions were developed based on information provided in the 12-month noise monitoring system data sample described above in a previous section. The runway use percentages prepared for the noise modeling were developed at a level of detail based on individual aircraft types and operational type as well as time-of-day. The runway use percentages developed from the analysis of the radar data are summarized in the following for ANC arrivals, ANC departures, and LHD operations. Tables D11, D12, and D13 present the runway use in terms of the various categories of aircraft types, the operational type, and day and night periods. These percentages were used for both the current and future noise modeling.

Table D11
PERCENTAGE RUNWAY UTILIZATION (ARRIVALS) – TED STEVENS ANCHORAGE INTERNATIONAL AIRPORT

ARRIVALS	Daytime						Nighttime					
	Runway											
INM Aircraft Type	15	33	7L	7R	25L	25R	15	33	7L	7R	25L	25R
737400	14.1%	0.7%	11.9%	73.1%	0.1%	0.1%	31.3%	0.5%	8.1%	60.1%		
737700	18.0%	0.8%	17.7%	63.5%			15.5%		8.6%	75.9%		
737800	15.1%	0.6%	9.5%	74.7%		0.1%	24.5%	0.4%	5.6%	69.5%		
747200	11.1%	1.1%	6.5%	81.3%			15.6%	0.6%	5.7%	78.1%		
747400	12.5%	0.9%	6.1%	80.4%		0.1%	16.4%	0.7%	5.8%	77.1%		
757300	27.4%		1.8%	70.7%			27.8%	0.4%	4.3%	67.4%		
767300	10.5%	0.8%	6.8%	81.7%		0.2%	17.8%	1.0%	6.3%	74.9%		
777300	12.1%	3.0%	3.0%	81.8%			16.2%		8.8%	75.0%		
1900D	13.6%	0.6%	7.7%	77.6%	0.2%	0.3%	15.3%		7.8%	76.7%	0.3%	
737N17	12.4%	0.8%	59.4%	26.7%	0.3%	0.4%	23.0%		69.6%	7.4%		
757PW	19.1%	0.3%	6.2%	74.5%			21.8%	1.0%	6.5%	70.6%		
A319-131	17.5%		6.6%	75.9%			26.9%	0.3%	5.2%	67.6%		
BEC58P	13.6%	0.6%	7.7%	77.6%	0.2%	0.3%	15.3%		7.8%	76.7%	0.3%	
CL600	13.0%		21.7%	65.2%						100.0%		
CNA441	13.6%	0.6%	7.7%	77.6%	0.2%	0.3%	15.3%		7.8%	76.7%	0.3%	
DC1010	8.7%	0.9%	4.3%	86.1%			16.7%	1.7%	3.3%	78.3%		
DC3	8.4%	0.6%	46.1%	44.2%	0.6%		50.0%		50.0%			
C130E	15.4%	2.5%	11.0%	70.8%	0.4%		32.4%	0.9%	2.8%	63.9%		
DHC6	13.6%	0.6%	7.7%	77.6%	0.2%	0.3%	15.3%		7.8%	76.7%	0.3%	
DHC8	9.4%	1.1%	50.9%	33.3%	3.1%	2.1%	8.7%	0.3%	53.7%	31.1%	3.4%	2.8%
E3A	25.0%			75.0%								
ECLIPSE500	34.5%	1.7%	10.3%	53.4%					40.0%	60.0%		
EMB120	10.0%	10.8%	19.0%	59.9%	0.4%		50.0%		50.0%			
F15E20	50.0%		25.0%	25.0%								
GII	29.5%	0.8%	7.0%	62.8%						100%		
GV	12.8%	1.4%	12.8%	72.2%		0.9%	17.3%		15.3%	67.3%		
LEAR35	13.6%	0.6%	7.7%	77.6%	0.2%	0.3%	15.3%		7.8%	76.7%	0.3%	
MD11GE	11.4%	0.8%	5.6%	82.2%		0.0%	11.8%	0.2%	5.6%	82.4%		
MU3001	10.4%		9.2%	78.6%	1.7%		20.0%			80.0%		
SF340	12.1%	1.1%	25.0%	59.0%	1.1%	1.7%	38.2%	3.7%	12.2%	39.7%	4.8%	1.4%

Source: ANC ANOMS (2009).

Table D12
PERCENTAGE RUNWAY UTILIZATION (DEPARTURES) – TED STEVENS ANCHORAGE INTERNATIONAL AIRPORT

DEPARTURES	Daytime						Nighttime					
	Runway											
INM Aircraft Type	15	33	7L	7R	25L	25R	15	33	7L	7R	25L	25R
737400	2.1%	87.0%	2.3%	0.1%	8.0%	0.5%	4.1%	81.6%	0.3%		11.9%	2.1%
737700	2.1%	87.1%	2.1%	0.3%	7.9%	0.5%		90.2%			9.8%	
737800	2.9%	86.1%	2.1%	0.1%	7.4%	1.4%	6.1%	77.4%	0.2%		14.0%	2.3%
747200	7.4%	84.7%	2.6%	0.4%	4.9%		5.0%	87.3%	0.4%		6.4%	0.9%
747400	5.5%	84.8	2.5%	0.2%	6.6%	0.4%	5.8%	82.9%	0.4%	0.4	9.7%	0.8%
757300	5.1%	82.8	2.0%	2.0%	7.1%	1.0%	9.5%	63.5%		0.9	25.7%	0.5%
767300	5.9%	85.3%	3.5%	0.3%	4.4%	0.6%	3.1%	87.7%	1.2%		6.7%	1.3%
777300	2.6%	89.5	5.3%		2.6%		1.5%	89.4%	0.8%		6.8%	1.5%
1900D	1.1%	74.2%	8.1%	0.3%	13.2%	2.9%	1.6%	56.7%	0.9%		29.9%	10.9%
737N17	1.2%	85.8%	2.5%	0.1%	9.6%	0.8%	2.1%	80.6%			11.0%	6.3%
757PW	4.9%	76.5%	3.2%	0.3%	14.5%	0.6%	7.4%	76.8%	0.5%		14.5%	0.8%
A319-131	1.8%	78.2%	3.6%		9.1%	7.3%	8.6%	75.4%	0.5%		9.6%	5.9%
BEC58P	1.1%	74.2%	8.1%	0.3%	13.2%	2.9%	1.6%	56.7%	0.9%		29.9%	10.9%
CL600		66.7%	12.5%		16.7%	4.2%		100%				
CNA441	1.1%	74.2%	8.1%	0.3%	13.2%	2.9%	1.6%	56.7%	0.9%		29.9%	10.9%
DC1010	6.7%	86.6	1.5%	0.7%	3.7%	0.7%	3.0%	94.0%	3.0%			
DC3	1.6%	42.6	38.9%	8.4%	5.3%	3.2%						
C130E	5.5%	87.1%	1.8%	0.1%	4.9%	0.6%	13.3%	78.6%			5.7%	2.4%
DHC6	1.1%	74.2%	8.1%	0.3%	13.2%	2.9%	1.6%	56.7%	0.9%		29.9%	10.9%
DHC8	1.0%	32.0%	55.3%	0.7%	10.5%	0.4%	2.7%	66.4%	9.2%		18.2%	3.4%
E3A		20.0	20.0	40.0	20.0							
ECLIPSE500		45.7%	10.0%	1.4%	41.4%	1.4%		100.0				
EMB120	4.6%	41.7%	45.4%	0.9%	7.4%		8.2%	86.7%	0.6%		3.2%	1.3%
F15E20		100%										
GII		84.0	5.6%		10.4%			80.0%			20.0%	
GV	2.5%	85.0%	4.3%	0.3%	6.1%		4.8%	83.3%	1.2%		9.5%	1.2%
LEAR35	1.1%	74.2%	8.1%	0.3%	13.2%		1.6%	56.7%	0.9%		29.9%	10.9%
MD11GE	6.4%	85.3%	2.8%	0.3%	4.9%		5.2%	81.7%	0.4%		11.9%	0.8%
MU3001		75.7%	5.9%		17.8%			60.0%			20.0%	20.0%
SF340	0.9%	21.2%	66.5 %	1.4%	9.5%	0.5%	6.3%	72.4%	4.2%		15.6%	1.6%

Source: ANC ANOMS (2009).

Table D13
PERCENTAGE RUNWAY UTILIZATION – LAKE HOOD SEAPLANE BASE

	Daytime						Nighttime					
	Runway											
INM Aircraft Type	**2**	**11**	**13**	**20**	**29**	**31**	**2**	**11**	**13**	**20**	**29**	**31**
Arrivals												
CNA206		23.1%			76.9%			7.7%			92.3%	
CNA208		0.2%	0.7%		61.4%	37.7%			3.6%		58.4%	38.1%
DHC-2FLT		35.0%		15.0%	50.0%			35.0%		15.0%	50.0%	
CNA182FLT		35.0%			50.0%			35.0%		15.0%	50.0%	
GASEPV			30.0%			70.0%			30.0%			70.0%
Departures												
CNA206		28.1%			71.9%			26.7%			73.3%	
CNA208	0.1%	0.1%	3.2%		21.7%	74.9%			15.0%		13.4%	71.6%
DHC-2FLT	15.0%	35.0%			50.0%		15.0%	35.0%			50.0%	
CNA182FLT	15.0%	35.0%		15.0%	50.0%		15.0%	35.0%			50.0%	
GASEPV			30.0%			70.0%			30.0%			70.0%
GASEPF						100%*						100%*

Source: ANC ANOMS (2009)
Note: Nighttime refers to 10 p.m.-7a.m.; daytime refers to 7a.m.-10 p.m.
* Due to internal rounding, the total is rounded to the nearest tenth.

Aircraft Weight and Trip Length. Aircraft weight during departure is a factor in the dispersion of noise, because it impacts the rate at which an aircraft is able to climb. Generally, the heavier the aircraft is, the slower the rate of climb and the distribution of noise along its route of flight tends to be larger. Where specific aircraft weights are unknown, the INM uses the distance flown to the first stop as a surrogate for the weight, by assuming that the weight has a direct relationship with the fuel load necessary to reach the first destination. The INM groups trip lengths into nine stage length categories, and assigns various aircraft weights associated with up to all nine categories. These categories are shown below:

Category	Stage Length
1	0-500 nautical miles
2	500-1000 nautical miles
3	1000-1500 nautical miles
4	1500-2500 nautical miles
5	2500-3500 nautical miles
6	3500-4500 nautical miles
7	4500-5500 nautical miles
8	5500-6500 nautical miles
9	6500+ nautical miles

The trip lengths flown from ANC for the current 2009 and future 2020 and 2030 conditions are based on the destination field provided in the radar data sample. Table D14 presents the proportion of the operations that are assumed to fall within each of the trip length categories used for both existing future operation levels.

Table D14
STAGE LENGTH

	Stage Length					
Aircraft Type	1	2	3	4	5	6
Air Carrier Jet						
737400	78.40%	5.60%	16.00%	-	-	-
737700	22.00%	1.20%	60.20%	16.60%	-	-
737800	11.60%	-	70.80%	17.60%	-	-
747200	-	-	-	33.50%	43.80%	22.70%
747400	-	-	-	22.80%	58.80%	18.40%
757300	-	-	57.50%	42.50%	-	-
767300	-	-	-	18.20%	75.50%	6.30%
777300	-	-	-	-	49.14%	50.86%
737N17	84.30%	15.70%	-	-	-	-
757PW	-	-	2.90%	73.30%	23.80%	
A319-131	-	-	11.68%	88.32%	-	-
DC1010	-	-	1.20%	83.20%	15.60%	-
MD11GE	-	-	-	11%	70%	19%
Business Jet						
CL600	100%	-	-	-	-	-
ECLIPSE500	100%	-	-	-	-	-
GII	100%	-	-	-	-	-
GV	100%	-	-	-	-	-
LEAR35	100%	-	-	-	-	-
MU3001	100%	-	-	-	-	-
Helicopter						
B206L	100%	-	-	-	-	-
R22	100%	-	-	-	-	-
Military						
C130E	99%	1%	-	-	-	-
E3A	100%	-	-	-	-	-
F15E20	100%	-	-	-	-	-
S70	100%	-	-	-	-	-
Propeller						
1900D	97%	3%	-	-	-	-
BEC58P	100%	-	-	-	-	-
CNA182FLT	100%	-	-	-	-	-
CNA206	100%	-	-	-	-	-
CNA208	100%	-	-	-	-	-
CNA441	100%	-	-	-	-	-
DC3	100%	-	-	-	-	-
DHC-2FLT	100%	-	-	-	-	-
DHC6	100%	-	-	-	-	-
DHC8	100%	-	-	-	-	-
EMB120	100%	-	-	-	-	-
GASEPF	100%	-	-	-	-	-
GASEPV	100%	-	-	-	-	-
SF340	100%	-	-	-	-	-

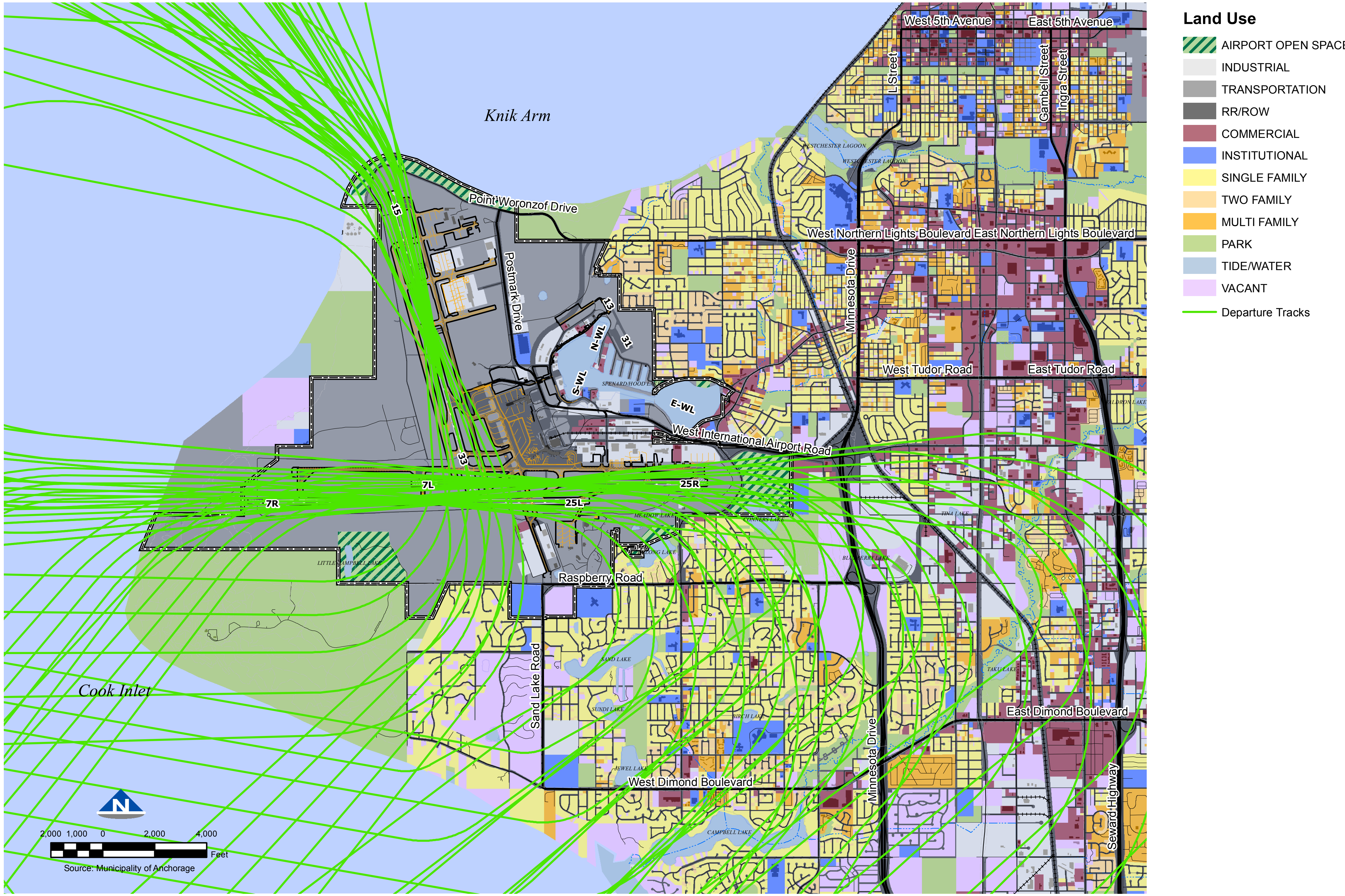
Flight Paths/Tracks and Flight Path Use. To determine projected noise levels on the ground, it is necessary to determine not only how many aircraft are present, but also the route along which they fly. Therefore, flight route information is a key element of the INM input data. In order to ensure that the INM modeling accurately reflects local conditions in the Anchorage area it is necessary to develop noise modeling tracks from a sample of detailed radar data. As previously noted, a four-week sample of radar flight track data was acquired and analyzed for traffic into and out of ANC. The sample provided some four weeks of data, including approximately 10,000 arrival and departure tracks, and is distributed throughout the year to cover any seasonal differences in weather or flight conditions. This detailed information allowed for the development of an exhaustive and rigorous database of flight tracks for the noise modeling effort.

ESRI's ArcView Geographic Information System software was utilized for the detailed analysis of the radar data for the development of noise modeling tracks. The data was separated first by operation type (i.e., arrival, departure) and then by aircraft category (i.e., jet, propeller) and runway.

Once the radar tracks were separated, INM primary tracks were developed to simulate the location of actual aircraft flight paths. The INM sub-tracks were developed by creating two dispersed tracks to either side of a primary track. The result of the process was a series of INM model tracks that closely match the current radar data at ANC.

Figures D25 and D26 depicts the location of the consolidated INM flight tracks representative of departures from all runways at ANC overlaid on the GIS base map. Figures D27 and D28 present the departures and arrivals on Lake Hood waterways and airstrip, respectively. Figure D29 illustrates the departure and arrival helicopter flight tracks for ANC, and Figure D30 illustrates the Touch and Go flight track for the LHD airstrip.

The level of operations assigned to each INM flight track were based on the distribution of the radar data for each aircraft type and operator category. Modeled operations for each INM aircraft type were assigned to the INM tracks based on the distribution of radar data specific to that aircraft type. This ensures that the operational distribution of flights in the modeling closely matches that seen in the actual radar data from ANC. The modeled flight tracks and operational distributions were used to model both the current conditions as well as the forecast years included in this NEM.



These represent the existing and future flight tracks, as the flight tracks are not expected to change substantially in the future year. Potential future changes in the allocations of number of aircraft to each flight track were taken into account in the modeling, but the flight tracks here are representative of both existing and future flight tracks.

Figure D25 ANC INM Fixed-wing Departure Flight Tracks

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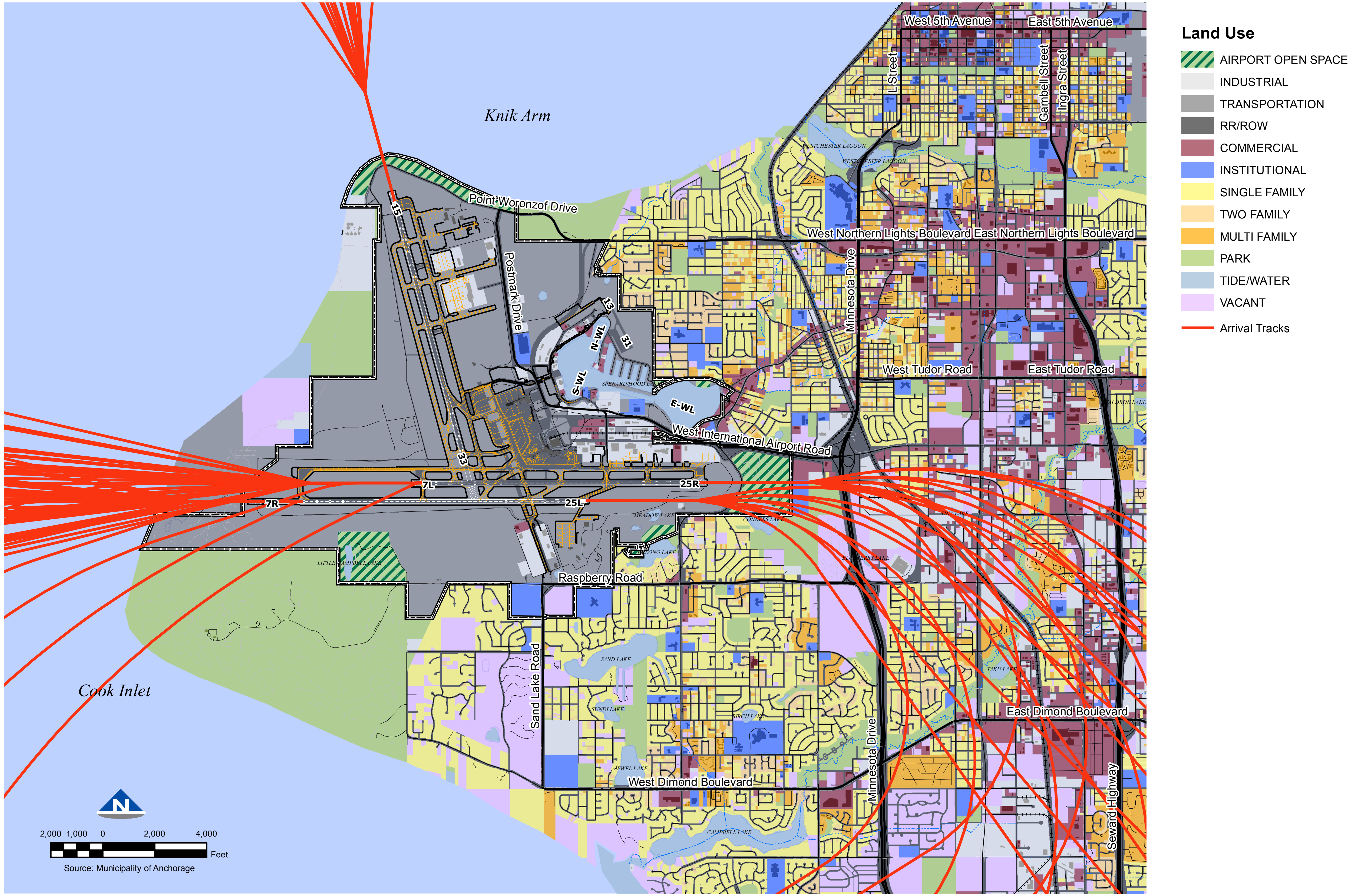

These represent the existing and future flight tracks, as the flight tracks are not expected to change substantially in the future year. Potential future changes in the allocations of number of aircraft to each flight track were taken into account in the modeling, but the flight tracks here are representative of both existing and future flight tracks.

Figure D26 ANC INM Fixed-wing Arrival Flight Tracks

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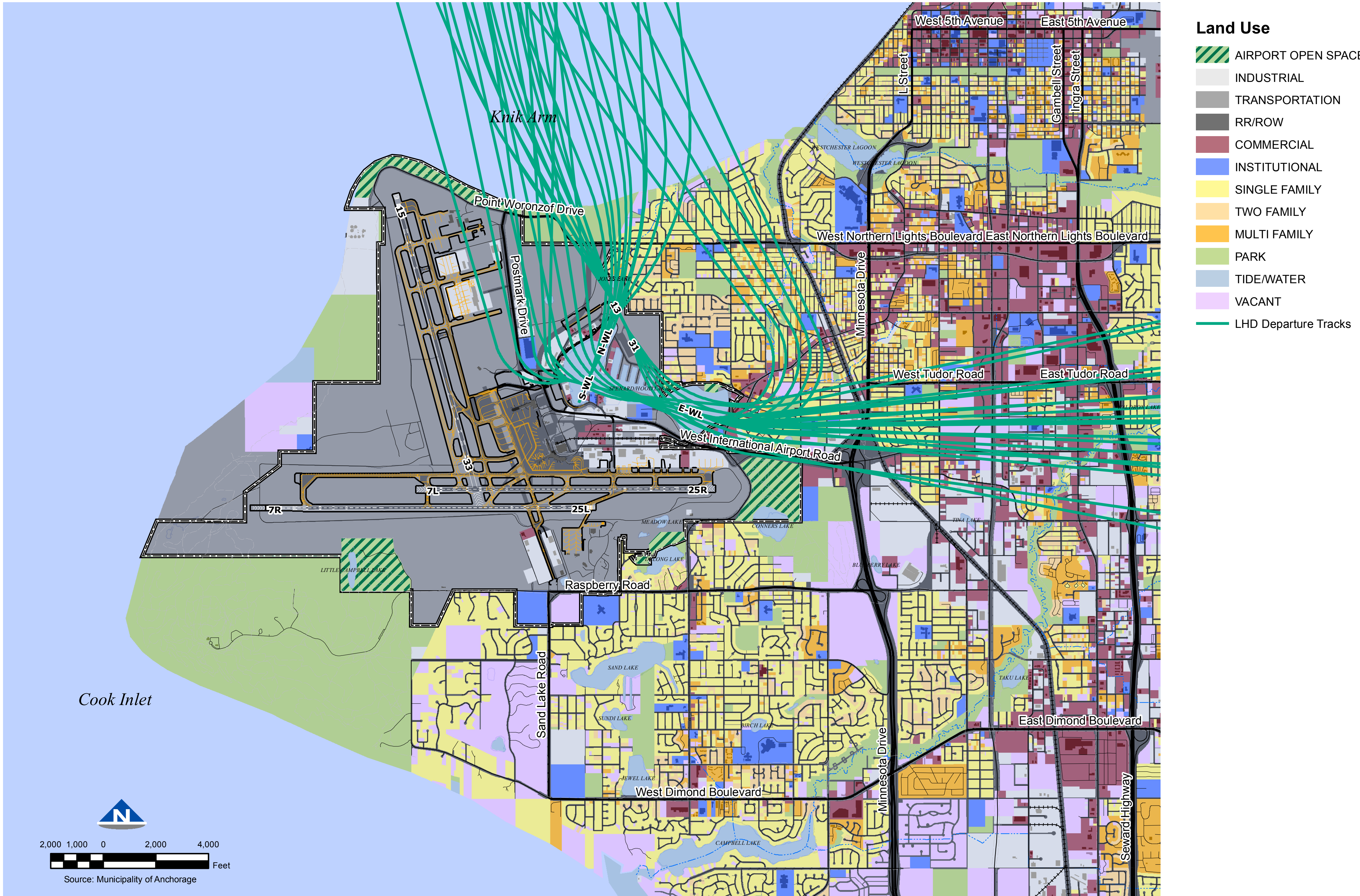

These represent the existing and future flight tracks, as the flight tracks are not expected to change substantially in the future year. Potential future changes in the allocations of number of aircraft to each flight track were taken into account in the modeling, but the flight tracks here are representative of both existing and future flight tracks.

Figure D27 LHD INM Fixed-wing Departure Flight Tracks

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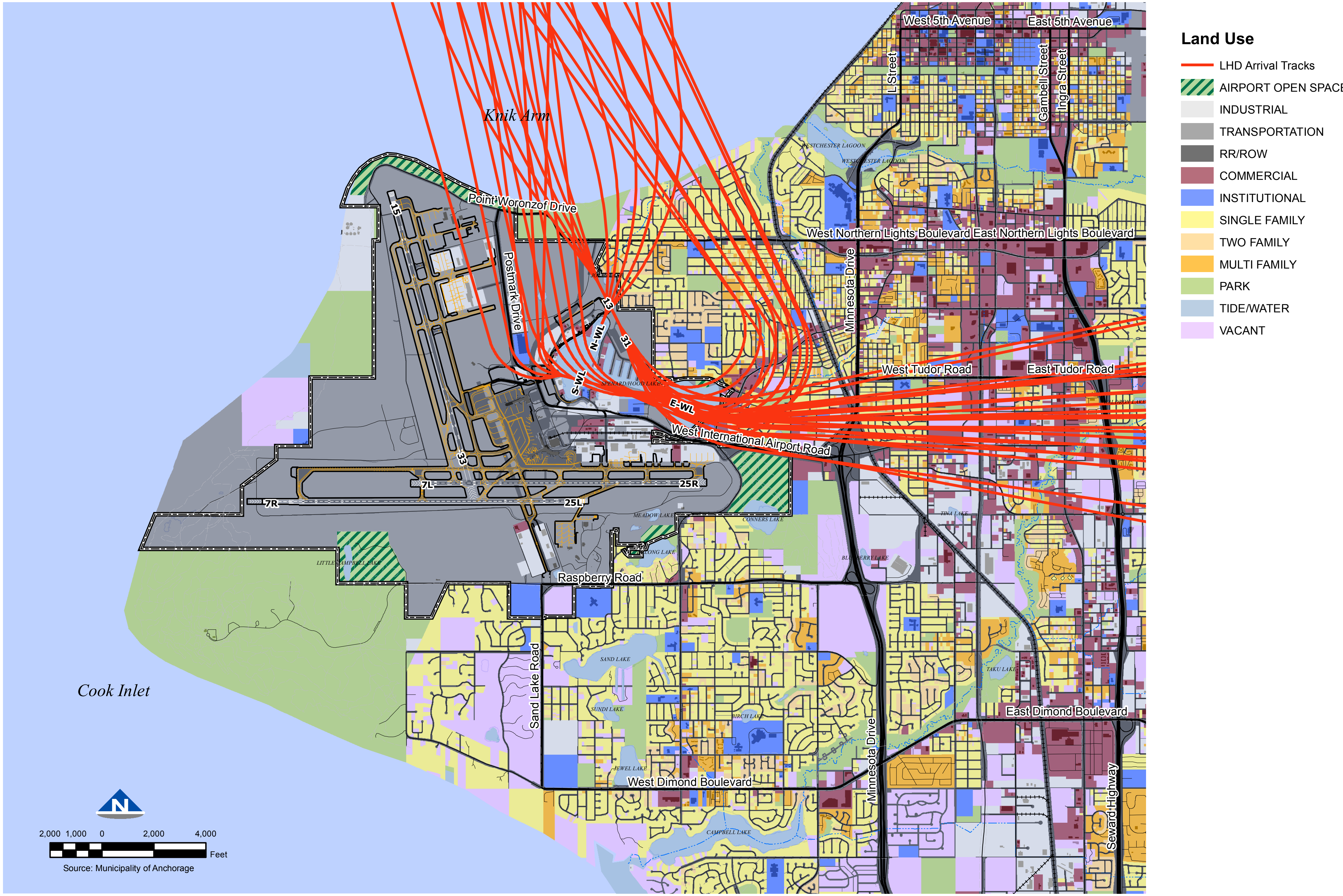

These represent the existing and future flight tracks, as the flight tracks are not expected to change substantially in the future year. Potential future changes in the allocations of number of aircraft to each flight track were taken into account in the modeling, but the flight tracks here are representative of both existing and future flight tracks.

Figure D28 **LHD INM Fixed-wing Arrival Flight Tracks**

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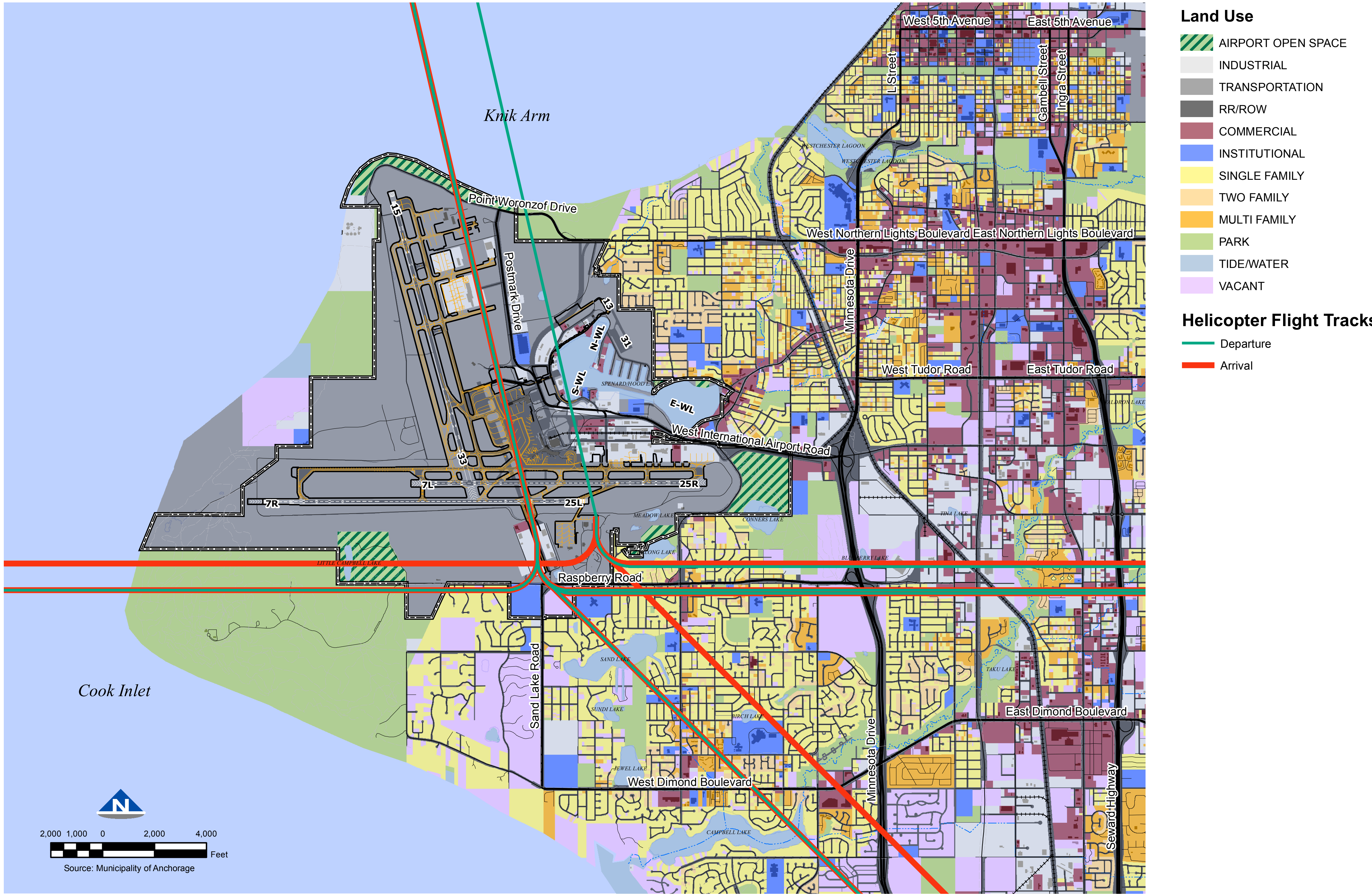

These represent the existing and future flight tracks, as the flight tracks are not expected to change substantially in the future year. Potential future changes in the allocations of number of aircraft to each flight track were taken into account in the modeling, but the flight tracks here are representative of both existing and future flight tracks.

Figure D29 **ANC INM Helicopter Flight Tracks**

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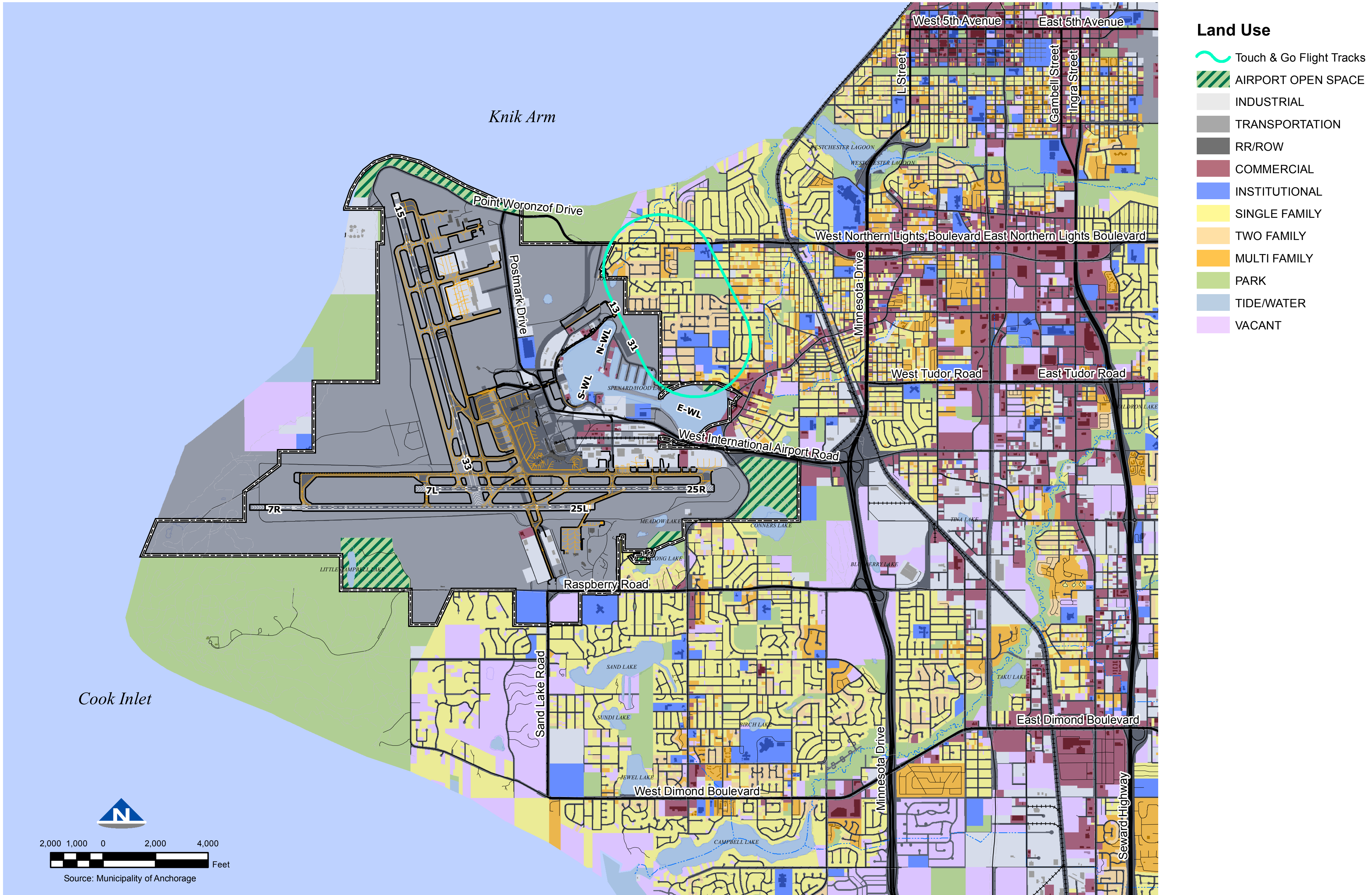

These represent the existing and future flight tracks, as the flight tracks are not expected to change substantially in the future year. Potential future changes in the allocations of number of aircraft to each flight track were taken into account in the modeling, but the flight tracks here are representative of both existing and future flight tracks.

Figure D30 LHD INM Touch and Go Flight Tracks

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Noise Exposure Maps

The compiled data as described in the preceding sections is used as input to the FAA's Integrated Noise Model (INM) 7.0c computer model for the calculation of noise in the Airport environs. Contours are presented at levels of 60, 65, 70, and 75 decibels of DNL. Levels of 65 DNL and above are considered by 14 CFR Part 150 to be significant for noise-sensitive land uses such as residences, churches, and schools.

The noise contours do not represent the noise levels present on any specific day, but, rather, represent the daily energy-average of all 365 days of operation during the year. The noise contour pattern extends from the Airport from each runway end, reflective of the flight tracks used by all aircraft. The relative distance of the contours from the Airport along each route is a function of the frequency of use of each runway for total arrivals and departures, as well as its use at night, and the type of aircraft assigned to it.

Existing Baseline Noise Contours

Based upon the operational conditions presented previously and the INM noise model, noise contours were developed. As required by the FAA, the primary noise criterion to describe the existing noise environment is DNL. The existing (2009) DNL noise exposure contours for Ted Stevens Anchorage International Airport are presented in Figure D31, *EXISTING NOISE EXPOSURE MAP - 2009*. This figure shows the 65 DNL, 70 DNL, and 75 DNL noise exposure contours. This figure depicts the average-annual day noise exposure pattern present at the Airport for the existing condition (2009), reflective of typical operating conditions at ANC. The exhibit illustrates the current land uses around the Airport in relation to the noise exposure pattern. The overall shape of the noise contours is primarily a function of the combination of runway use, flight tracks, and time of operations at ANC. The shape of the noise contours to the north and west of the Airport reflects the predominant use of the primary runways, Runway 15/33 and Runways 7R/L and 25R/L.

Ground Run-Up Operations. As stated previously, aircraft operators perform engine maintenance and testing on ANC airfield, normally at designated locations including Taxiway Q and J, which are near the Runway 15 end and Runway 7R end, respectively. In general, aircraft are parked heading towards the wind and with the exhaust pointing away from terminal buildings and residential areas. According to ANC records, there were approximately 150 full-power run ups in 2009 by various aircraft including the Boeing 747-400, Boeing 737-800, Saab 340, and the Beech 1900. The ground run ups are included in the INM and the contours below.

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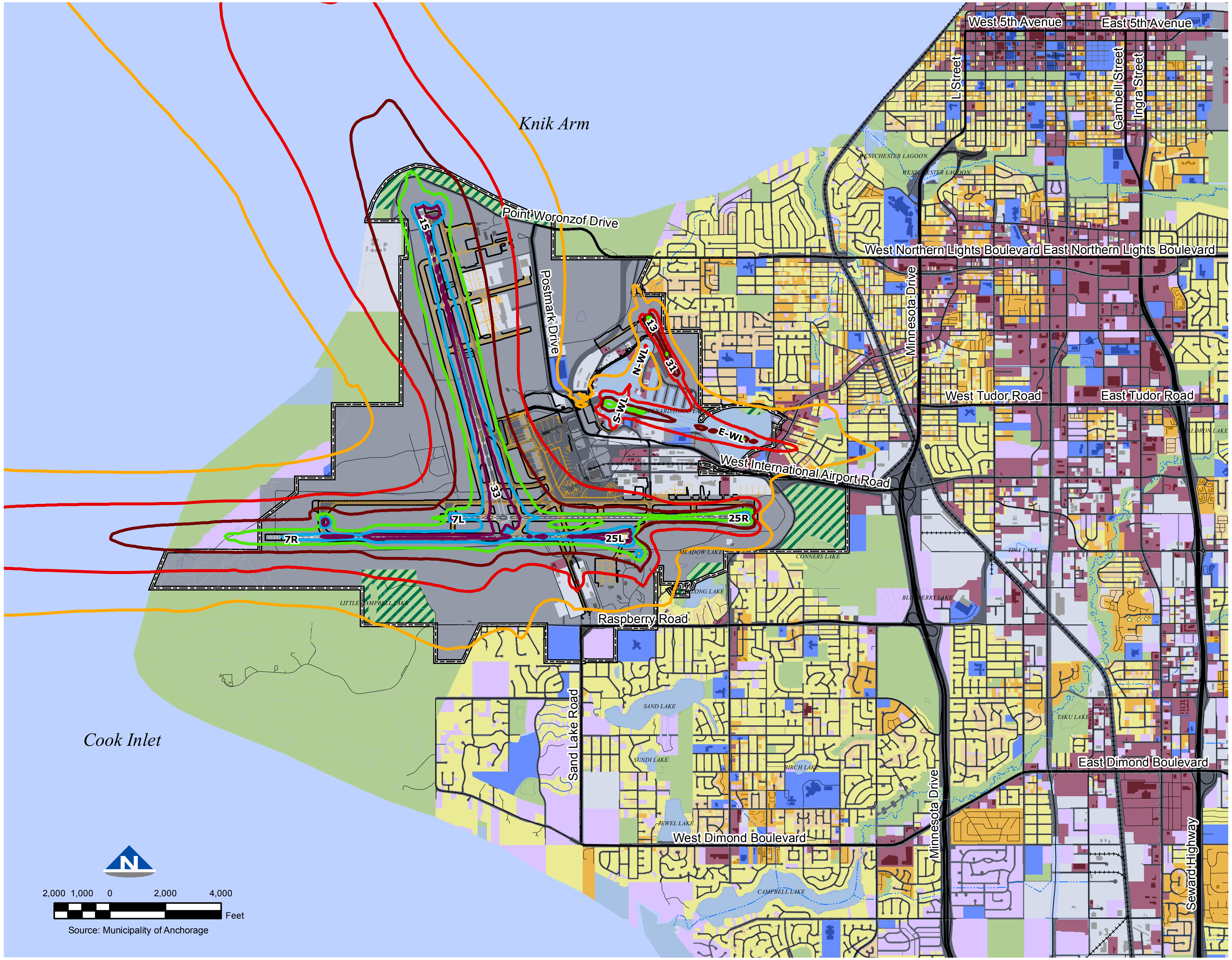

Land Use

- AIRPORT OPEN SPACE
- INDUSTRIAL
- TRANSPORTATION
- RR/ROW
- COMMERCIAL
- INSTITUTIONAL
- SINGLE FAMILY
- TWO FAMILY
- MULTI FAMILY
- PARK
- TIDE/WATER
- VACANT

Noise Contours

- 60 DNL
- 65 DNL
- 70 DNL
- 75 DNL
- 80 DNL
- 85 DNL

The 65 DNL contour contains approximately 4126 acres, 20 residential structures and 55 people.

The 70 DNL contour contains approximately 1674 acres, no residential structures and no people.

The 75 DNL contour contains approximately 760 acres, no residential structures and no people.

Planning jurisdictions are shown on the map.

Noise measurement sites and flight tracks are depicted on the Noise Measurement Sites and Flight Tracks Maps.

Residential land use, as defined by FAR Part 150, is an incompatible use without proper sound attenuation within the 65 DNL or greater contour.

The Noise Exposure Maps and accompanying documentation for the Noise Exposure Map for Anchorage International Airport, submitted in accordance with FAR Part 150 with the best available information, are hereby certified as true and complete to the best of my knowledge and belief.

In addition, it is hereby certified that the public was afforded the opportunity to review and comment on the document and its contents.

Signed______________________________Date____________

Figure D31 Existing Noise Exposure Map - 2009

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Future Noise Contours (2020)

As noted in earlier sections, FAR Part 150 requires the development of existing and future aircraft noise exposure contours. FAR Part 150 requires that the future contour reflect conditions five (5) years or longer from study completion. As a result, conditions in 2020 were evaluated. Figure D32 depicts the average-annual day noise exposure pattern expected at the Airport for the future 2020 condition. This figure presents the 65 DNL, 70 DNL, and 75 DNL noise contours. Again, this contour pattern is reflective of typical operating conditions at ANC combined with the expected future operational levels, fleet mix, and flight tracks as described previously. There were no changes made to the consolidated INM flight tracks for the future 2020 NEM.

The overall shape of the noise contours is generally similar to that of the 2009 contours. As evidenced in the comparison of contour areas above, the 2020 noise pattern is slightly larger than that of the 2009 condition. This is expected due to the forecast of an increase in air carrier operations by 2020 as compared to 2009.

Ground Run-Up Operations. The total number of ground run-ups in the future year shows an increase in activity extrapolated out with the same growth rate as the operations. For the future year DNL noise contour, the location of the run-ups do not change, and percentage of run-ups at the two locations also remains the same. The ground run ups are included in the INM and the contours below.

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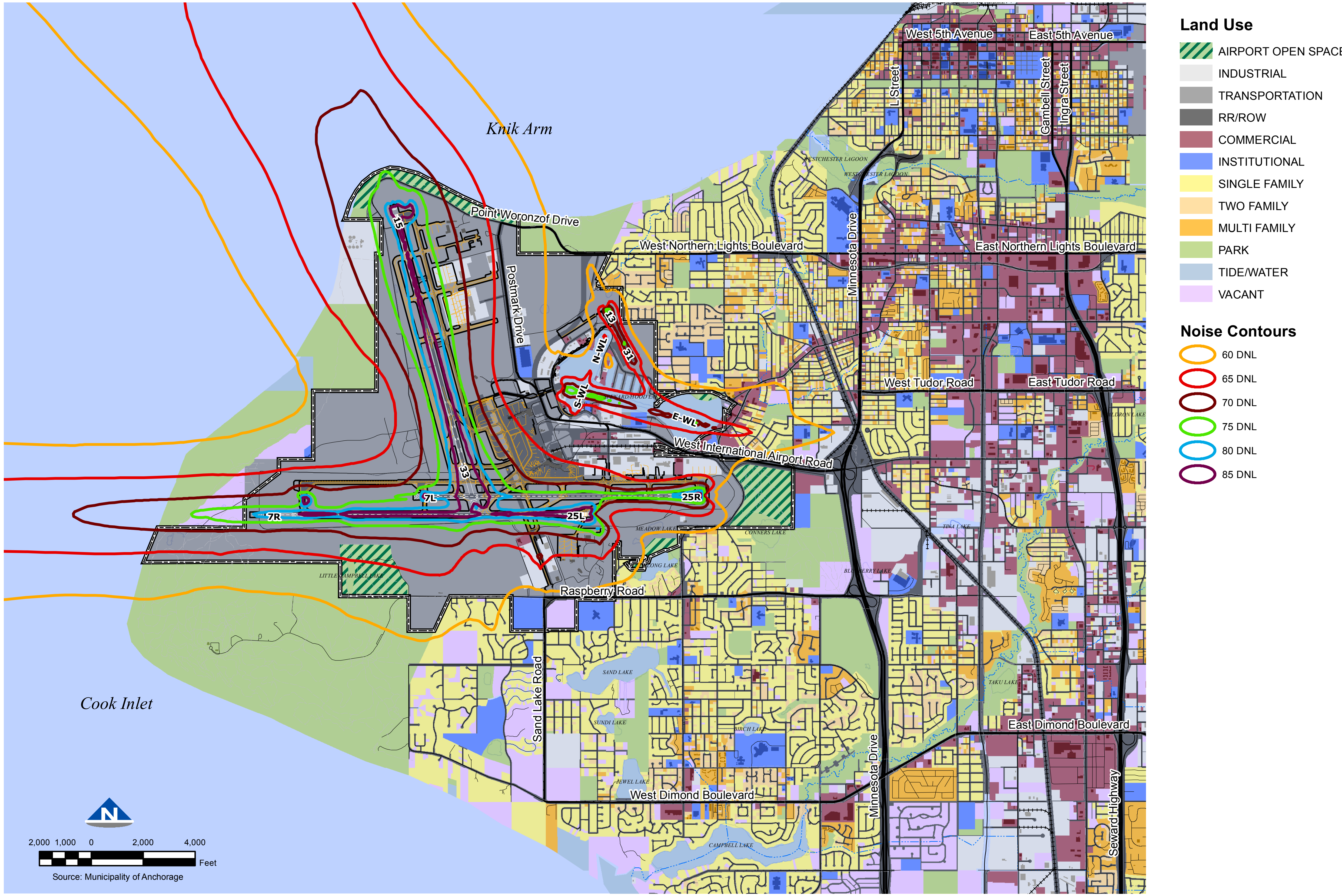

Figure D32 **Future (2020) Noise Contours**

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Future 2030 Noise Contours – For Informational Purposes

In order to provide a longer term understanding of expected noise trends, the noise contours for the future 2030 conditions (for informational purposes only) were prepared. Figure D33 depicts the average-annual day noise exposure pattern expected at the Airport for the long-term 2030 condition. This figure presents the 65 DNL, 70 DNL, and 75 DNL noise contours. Again, this contour pattern is reflective of typical operating conditions at ANC combined with the expected future operational levels and fleet mix as described previously.

Future 2030 noise contours were developed using the previously described data. These contours were developed for informational uses only, to allow for future planning around the Airport looking at long term land use around the Airport. The 2020 contour will be used as the official future noise contours for the purposes of the Study.

Ground Run-Up Operations. The total number of ground run-ups in the future year shows an increase in activity extrapolated out with the same growth rate as the operations. For the future year DNL noise contour, the location of the run-ups do not change, and percentage of run-ups at the two locations also remains the same. The ground run ups are included in the INM and the contours below.

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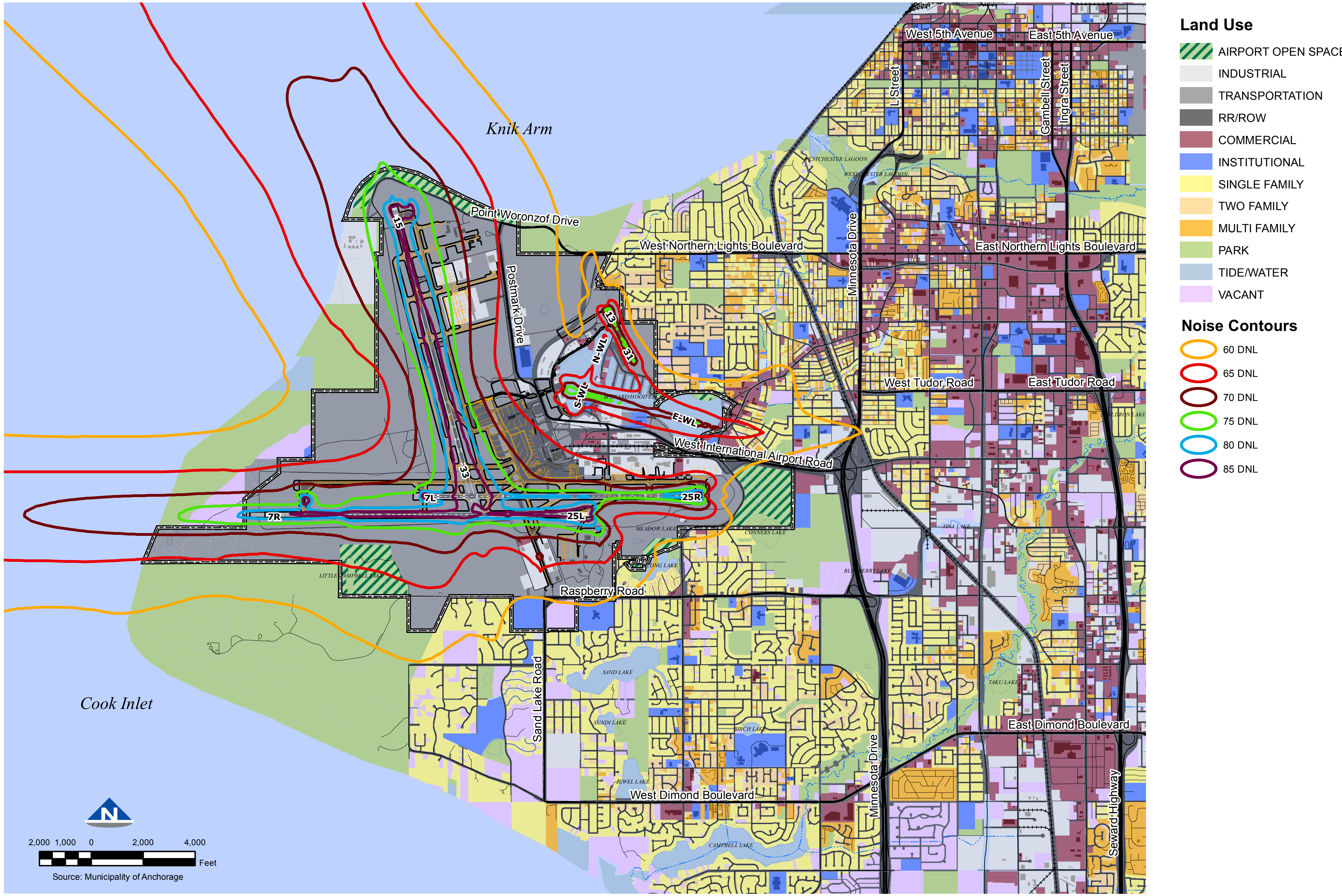

Figure D33 **Future (2030) Noise Contours**

Chapter E - Land Use Analysis

INTRODUCTION. This chapter summarizes the compatibility of various land uses with the existing (2009) and future (2020) "Base Case" noise exposure contours. Additionally, it summarizes the 2030 contour, which will be used for future planning purposes only. The 2020 contour is the Base Case for determining alternatives in the Noise Compatibility Program. One of the first steps in evaluating land use compatibility is to identify the existing and future noise exposure associated with the operation of Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base. Noise abatement alternatives and land use compatibility actions described in the following chapters are compared with the information presented in this chapter to gauge the potential success of various alternatives.

Methodology

The land use and population analysis for both the existing and future "Base Case" noise contours were derived from a variety of sources. The existing land use maps provided in the Inventory Chapter were used to determine the number of acres of different land use types in the area surrounding the Airport. The noise contours (for 2009, 2020, and 2030) were overlaid on these maps and a Geographical Information System (GIS) computer program was used to determine the number of acres for each land use type located within each noise contour. A 2030 contour was developed for informational uses and can be used for local land use planning and zoning purposes. Housing units and population numbers were determined from the 2010 Census (and most recent updates) using the same GIS program. The information was determined using the Census block level data for each contour and are rounded to the nearest five.

Existing Land Use Analysis/Existing Noise Contours, 2009 Base Case

This section discusses the housing units and population found within the existing noise exposure contours generated by aircraft using the Ted Stevens Anchorage International Airport. The existing noise exposure is represented by contour bands, including the 60 DNL, 65 DNL, 70 DNL, and 75 DNL contours.

A Part 150 Study and the Noise Exposure Maps use the 65 DNL contour as the threshold of significance for land use analysis, based on the FAA's land use compatibility guidelines. The FAR Part 150 Land Use Guidelines (as presented in Chapter C, Background Information on Noise and its Measurement) state that residential uses, as well as other noise sensitive uses, are not compatible within the 65 or greater DNL noise contours. However, noise sensitive uses can be made compatible within the 65 DNL noise contour through sound attenuation programs, such as sound insulation, noise easements, or land acquisition.

The existing 2009 65 DNL and greater contour[1] contains approximately 4,126 acres, most of which is contained on airport property or extends offshore into Cook Inlet. There are 20 housing units representing approximately 55 people (Census Bureau 2010 block data was used to estimate population) within the 65 DNL and greater contour. These residences are located off the east end of Lake Hood, and were not previously eligible for sound attenuation. Table E1, *EXISTING LAND USE WITHIN EXISTING 2009 NOISE CONTOURS, BASE CASE*, summarizes the population and housing units within the existing 2009 noise contours. There are no schools or religious facilities within the 65 DNL noise contour. There are several areas of park/open space within the 65 DNL and greater noise contour used for recreation including Point Woronzof Park, Point Woronzof Overlook, Kincaid Park/Point Campbell, as well as portions of the Coastal Trail. Several of these areas are on airport property but used on a temporary basis as a park. There are no historical sites listed on the National Register of Historic Places within the 65 DNL and greater contour. The 70 DNL and greater noise contour contains approximately 1,674 acres, with no housing units or any other incompatible land uses. The 2009 noise contour map will serve as the Existing Noise Exposure Map.

Existing Land Use Incompatibilities

The FAA has developed generalized guidelines for land use compatibility to assist with land use planning. These guidelines were presented in the chapter entitled Background Information on Noise and Its Measurement. Within FAR Part 150 regulations, these land use compatibility guidelines are to be used unless the local communities have adopted local guidelines. These locally adopted guidelines must be uniformly applied to all types of noise exposure (all sources of noise, not just aircraft) in order for the FAA to accept the local guidelines. In the case of the communities near Ted Stevens Anchorage International Airport, no aircraft noise specific land use guidelines have been adopted. Therefore, for purposes of this study, FAA guidelines are used.

[1] The impact analysis presented in this chapter notes the impacts between the 65 DNL and 70 DNL noise contour (referred to as 65-70 DNL), and impacts between the 70 DNL greater noise contour. The total impact within the 65 DNL noise contour includes these incremental contours.

This is an update to the Airport's previous Part 150 Noise Compatibility Study undertaken. To date, over 700 residences in the vicinity of the Airport have been sound attenuated. The 60 DNL is presented for informational purposes only and to be consistent with the previous Part 150 Study.

Based on FAA guidelines, residential land uses within the existing 65 DNL or greater noise contours are not compatible with the aircraft noise exposure unless the residence has sound attenuation features that reduce interior noise to requisite levels. Without such attenuation, the property would be considered incompatible with the noise exposure. There are 20 homes with about 55 people within the existing 65 DNL and greater contour that would be considered incompatible with the level of noise produced from the Airport in this area without sound attenuation.

Table E1
EXISTING LAND USE WITHIN EXISTING 2009 NOISE CONTOURS

Land Use	60 DNL*	65 DNL	70 DNL	75 DNL
Residential Acres	**79.9**	**1.9**	**0**	**0**
Persons	1,225	55	0	0
Housing Units	550	20	0	0
Schools	1	0	0	0
Religious Facilities	0	0	0	0
Historic Properties	0	0	0	0
Vacant	34.0	0.4	0	0
Commercial	65.9	8.3	0	0
Industrial	367.6	179.9	81.8	0
Institutional	40.9	4.0	0	0
Open Space/Park (Total)	484.0	105.0	43.8	1.9
On Airport	*176.7*	*70.6*	*37.7*	*1.4*
Off Airport	*307.2*	*34.4*	*6.2*	*0.5*
Transportation	2,963.6	1,871.0	1,124.7	582.1
Other/ROW	7,751.5	1,955.7	423.1	176.0
Total Land Use Acres	***11787.3***	***4,126.2***	***1,673.5***	***760.0***

Sources: Existing Land Use 2010 Census Block Data and Aerial Photography, Mead & Hunt Analysis.
Notes: Acres rounded to the nearest tenth; housing rounded to the nearest 5
*Presented for informational purposes only

Existing Population Analysis/Future (Base Case 2020) Noise Contours

A review was conducted of the existing population and the housing units that could be affected by Airport noise five years into the future. The previous chapter, Existing and Future Base Case Noise Conditions, discusses the noise exposure contour prepared for the year 2020. This "Base Case" assumes that no operational or facility modifications would occur at the Airport and is reflective of the forecast operations and aircraft types explained previously.

The future Base Case noise contours are larger than the existing noise contours as a result of an increase in aircraft operations forecast to be operating in the year 2020.

The future 65 DNL and greater contour is expected to increase in size from approximately 4,126 acres to 5,253 acres by 2020.

Approximately 35 residential units with approximately 95 people would be within the 65 DNL and greater noise contour in 2020. Approximately 25 of these residences, which are located off the east end of Lake Hood, were not previously eligible for sound attenuation under the previous Residential Sound Insulation Program. There are no schools, religious facilities, or known historic sites, within the future 65 DNL and greater noise contour. There are several areas of park/open space within the 65 DNL and greater noise contour used for recreation including Point Woronzof Park, Point Woronzof Overlook, Kincaid Park/Point Campbell, as well as portions of the Coastal Trail. Several of these areas are on airport property but used on a temporary basis as a park. The 70 DNL and greater noise contour contains approximately 2,034 acres and no housing units. Table E2, *EXISTING LAND USE WITHIN 2020 NOISE CONTOURS, BASE CASE*, lists the various housing units and the population that would be expected to be within the 2020 Base Case noise contours. [2]

[2] *Analysis in this chapter shows that some number of homes (approximately 25) were in the Future 2020 Noise Contours that were not previously insulated or eligible for insulation with the previous RSIP. Since that analysis, two operational procedure changes were determined to be reasonably foreseeable (the Master Plan Phase 2, Modification of Preferential Runway Use System to Meet Future Demand and the Required Navigation Performance (RNP) Procedure to Runway 33). These two changes were modeled and provide the base for the official Future Noise Exposure Map, as shown in Chapter I. The Future NEM is a slightly larger version of the Future 2020 Noise Contours, due to the addition of these two operational procedures. Therefore, the analysis of the number of homes within the 65 DNL was updated based on this Future Noise Exposure Map for the final Recommendations in Chapter I. Within the updated 65 DNL noise contour of the Future Noise Exposure Map, there are approximately 45 homes that may be eligible for insulation within the proposed eligibility boundary that have not previously been offered insulation, because under the previous NEMs, these homes were not located within the 1997 65 DNL contour. The proposed eligibility boundary is illustrated in Chapter I.*

Future Base Case (2020) Land Use Incompatibilities

There are approximately 35 homes with about 95 people within the future Base Case 65 DNL and greater contour that would be considered incompatible with the level of noise produced from aircraft operations at the Airport in this area without sound attenuation. Approximately 25 of these homes were not previously sound attenuated under the previous program. Table E2, *EXISTING LAND USE WITHIN 2020 NOISE CONTOURS, BASE CASE*, illustrates that these residential homes are the only noise sensitive land uses that are located in the future 65 DNL and greater noise contour.

Table E2
EXISTING LAND USE WITHIN 2020 NOISE CONTOURS, BASE CASE

Land Use	60 DNL*	65 DNL	70 DNL	75 DNL
Residential Acres	**139.6**	**3.9**	**0**	**0**
Persons	1,880	95	0	0
Housing Units	870	35	0	0
Schools	1	0	0	0
Religious Facilities	0	0	0	0
Historic Properties	0	0	0	0
Vacant	91.0	0.5	0	0
Commercial	76.2	9.7	0	0
Industrial	408.6	200.6	118.7	9.6
Institutional	52.1	5.2	0	0
Open Space/Park (Total)	719.7	155.5	51.0	7.4
On Airport	*182.1*	*94.2*	*42.5*	*3.8*
Off Airport	*537.6*	*61.4*	*8.5*	*3.6*
Transportation	3,178.4	2,134.7	1,280.1	702.0
Other/ROW	10,292.3	2,742.4	584.3	191.9
Total Land Use Acres	***14,957.9***	***5,252.6***	***2,034.1***	***911.0***

Sources: Existing Land Use; 2010 Census Block Data and Aerial Photography, Mead & Hunt Analysis.
Notes: Acres rounded to the nearest tenth; housing rounded to the nearest 5.
*Presented for informational purposes only

Existing Population Analysis/2030 Informational Noise Contours

A review was conducted of the existing population and the housing units that could be affected by airport noise in 2030 for additional information and long-term planning considerations. The previous chapter, Existing and Future Noise Exposure, discusses the noise exposure contour prepared for the year 2030. This "Base Case" assumes that no operational or facility modifications would occur at the Airport and is reflective of the forecast operations and aircraft types explained previously.

The 2030 noise contours are larger than the existing noise contours as a result of an increase in aircraft operations forecast to be operating in the year 2030. The future 65 DNL and greater contour is expected to increase in size from approximately 5,253 acres in 2020 to 6,593 acres by 2030.

Approximately 80 residential units with approximately 200 people would be within the 65 DNL and greater noise contour in 2030. There are no schools, religious facilities, known historic sites, or other noise sensitive land uses within the future 65 DNL and greater noise contour.

There are several areas of park/open space within the 65 DNL and greater noise contour used for recreation including Point Woronzof Park, Point Woronzof Overlook, Kincaid Park/Point Campbell, as well as portions of the Coastal Trail. Several of these areas are on airport property but used as a temporary basis as a park.

The 70 DNL and greater noise contour contains approximately 2,455 acres and no housing units. Table E3, *EXISTING LAND USE WITHIN 2030 NOISE CONTOURS*, lists the various housing units and the population that would be expected to be within the 2030 Base Case noise contour. Again, the 60 DNL contour is presented for informational purposes only.

Informational 2030 Land Use Incompatibilities

There are approximately 80 homes with about 200 people within the 2030 65 DNL and greater contour that would be considered incompatible with the level of noise produced from aircraft operations at the Airport in this area without sound attenuation. Table E3, *EXISTING LAND USE WITHIN 2030 NOISE CONTOURS*, illustrates that these residential homes are the only noise sensitive land uses that are located in the future 65 DNL and greater noise contour.

Table E3
EXISTING LAND USE WITHIN 2030 NOISE CONTOURS

Land Use	60 DNL*	65 DNL	70 DNL	75 DNL
Residential Acres	**226.6**	**9.1**	**0**	**0**
Persons	3,110	200	0	0
Housing Units	1,440	80	0	0
Schools	1	0	0	0
Religious Facilities	1	0	0	0
Historic Properties	0	0	0	0
Vacant	145.2	0.5	0	0
Commercial	93.8	14.4	1.2	0
Industrial	436.2	222.9	134.8	25.5
Institutional	60.6	7.6	0	0
Open Space/Park	885.8	186.0	57.0	18.1
On Airport	*193.4*	*112.6*	*45.5*	*13.8*
Off Airport	*692.5*	*73.4*	*11.6*	*4.3*
Transportation	3,289.0	2,333.1	1,412.6	815.7
Other/ROW	13,352.6	3,818.9	849.3	210.7
Total Land Use Acres	***18,489.8***	***6,592.7***	***2,455.0***	***1,070.0***

Sources: Existing Land Use, 2010 Census Block Data and Aerial Photography, Mead & Hunt Analysis.
Notes: Acres rounded to the nearest tenth; housing and persons rounded to the nearest 5.
*Presented for informational purposes only

Chapter F - Potential Noise Abatement Measures

INTRODUCTION. This chapter provides a general overview of the potential noise abatement and noise reduction measures that were considered during the Study process. It contains an explanation of the roles and responsibilities of various parties in noise abatement planning and the implementation of various noise abatement measures. It also identifies 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 information served to guide discussions on the options that were evaluated for the Noise Compatibility Program.

This chapter describes how each noise reduction measure might affect noise exposure conditions. 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 (such as regulatory limitations etc.). This chapter provides a basis for understanding of the range of alternative measures available for consideration in the Part 150 Study. With that understanding, Study Input Committee members provided input to the Airport management and consultants to help identify additional noise abatement measures that could target specific local issues. This chapter identifies the following:

- **Background to Part 150 Study Requirements.**
  - Required program standards for Part 150 Study Alternatives.
  - Required Alternatives to be examined within the Part 150 Study.
  - The roles and responsibilities of the parties responsible for noise abatement planning.
  - Regulatory limitations on noise measures.

- **Types of Potential Noise Abatement Measures.**

Part 150 regulation lists the criteria that every alternative must meet in order to be considered for inclusion in the Noise Compatibility Program.

The regulation states that, "the airport operator shall evaluate the several alternative noise control actions and develop a noise compatibility program which:

a) Reduces existing non-compatible uses and prevents or reduces the probability of the establishment of additional non-compatible uses;

b) Does not impose undue burden on interstate and foreign commerce;

c) Provides for revision in accordance with the regulation.

d) Is not unjustly discriminatory.

e) Does not derogate safety or adversely affect the safe and efficient use of airspace.

f) To the extent practicable, meets both local needs and needs of the national air transportation system, considering tradeoffs between economic benefits derived from the airport and the noise impact.

g) Can be implemented in a manner consistent with all of the powers and duties of the Administrator of FAA."

In addition to the program standards that each alternative must meet, Part 150 identifies a number of specific alternatives that must be considered in developing a Part 150 Noise Compatibility Program. These required alternatives are:

1) Acquisition of land and interests therein, including, but not limited to air rights, easements, and development rights, to ensure the use of property for purposes which are compatible with airport operations.

2) The construction of barriers and acoustical shielding, including the soundproofing of public buildings.

3) The implementation of a preferential runway system.

4) The use of flight procedures (including the modifications of flight tracks) to control the operation of aircraft to reduce exposure of individuals (or specific noise sensitive areas) to noise in the area around the airport.

5) The implementation of any restriction on the use of airport by any type or class of aircraft based on the noise characteristics of those aircraft. Such restrictions may include, but are not limited to:
    a. Denial of use of the airport to aircraft types or classes which do not meet Federal noise standards;
    b. Capacity limitations based on the relative noisiness of different types of aircraft;
    c. Requirement that aircraft using the airport must use noise abatement takeoff or approach procedures previously approved as safe by the FAA;
    d. Landing fees based on FAA certificated or estimated noise emission levels or on time of arrival; and
    e. Partial or complete curfews.

6) Other actions or combinations of actions which would have a beneficial noise control or abatement impact on the public.

7) Other actions recommended for analysis by the FAA for the specific airport.

Every alternative above was reviewed to determine whether it is applicable to the Airport and whether the implementation of each alternative meets the criteria requirements for alternatives set out in Part 150. This can be confusing when examining alternatives within the regulatory context and criteria requirements. Although this Study follows Part 150, it is important to note that there are several other regulations that regulate how/when alternatives may be implemented, which can limit an alternative's viability in a Part 150 Study.

A good example of this is the Part 161 regulation, which was created after Part 150 regulation. The background and implications of Part 161 will be described in more detail below, but in short, Part 161 makes it more difficult for the Airport or any others to implement use or access restrictions. This means that even though examining the implementation of a restriction on use at an airport is a required alternative under Part 150, it is one that is limited in terms of implementation based on the requirements in Part 161 (i.e., a Part 161 Study would be needed before an alternative could be implemented).

So while this chapter discusses Part 161 under several of the alternatives, it is important to note that this discussion is presented within the context of whether an alternative can be implemented. This Study follows Part 150 regulations and will not model alternatives that require a Part 161 study, because all non-regulatory alternatives must be considered first. In the detailed descriptions of the alternatives below, it notes where alternatives have these types of regulatory or other limitations so it is clear as to what can be feasibly implemented to help lead the discussion toward practicable alternatives.

Roles and Responsibilities

Before considering the specific aircraft noise and land use incompatibilities measures outlined above in more detail, 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."
>
> **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.
>
> 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 again, 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 ANC and LHD) 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.

Regulatory Context - National Noise Reduction Efforts

The history of noise regulations is important to understanding the regulatory context for potential alternatives that can be included in a Part 150 Study. 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 1979, Congress passed the Aviation Safety and Noise Abatement Act (ASNA) which directed FAA to do several things:

- **Establish a single system of measuring noise,**
- **Establish a single system for determining noise exposure, and**
- **Identify land use compatibility.**

It also directed FAA to set forth procedures for developing noise exposure maps and land use compatibility programs. The Act also set aside funding for noise mitigation and planning, the first time ever in Federal legislation.

As a result, FAA promulgated Part 150, which is the regulatory context for developing aircraft Noise Exposure Maps and Noise Compatibility Programs to determine among other things eligibility for funding to be used for noise abatement and noise mitigation. The regulation also establishes procedures, standards and methodologies for developing such maps and programs, and defined the thresholds for determining land use compatibility.

The regulation set the standards so that each Part 150 Study done throughout the United States was prepared and evaluated to the same set of standards and criteria, providing uniformity for all airports.

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 required 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 Part 91 and issued a new Part 161 in 1991. Part 91 addresses the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. 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. A Part 161 plan must be done in order to approve use or access restrictions. 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. Therefore, while Part 150 studies examine use restrictions as potential alternatives, a Part 161 Study would need to occur prior to any use restrictions being implemented, and only after all non-regulatory alternatives have been examined.

As stated above, there are several exemptions to Part 91. Alaska and Hawaii are exempt from the 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; 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 hush kits, 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 Part 161, and it must not regulate military aircraft.

The outcome of a Part 150 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 Part 150 noise compatibility planning process. The objective is to explore a wide range of feasible measures of land use measures, noise control actions and noise exposure measures, seeking optimum accommodation of both airport users and airport neighbors within acceptable safety, economic, and environmental parameters.

These feasible measures must be meet all the program standards set out in Part 150, as well as meet the regulations illustrated above. The applicability of these regulations is described for the alternatives in the following sections.

Discussion of Measures Available

As stated above, there are a number of measures that are required to be examined under Part 150 Studies. This section contains a generalized description of potential noise abatement and mitigation measures or actions that may be considered for ANC and LHD. A general evaluation of each is made on the basis of the regulatory criteria outlined in the introduction of this section that dictate what an alternative must follow in order to be considered for inclusion in the Noise Compatibility Program. To summarize these criteria, an alternative must: 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.

Based on Part 150 requirements, the noise alternatives must be presented according to the following categories:

a) Noise abatement alternatives for which the airport operator has adequate implementation authority;

b) Noise abatement alternatives for which the requisite implementation authority is vested in a local agency or political subdivision governing body or a state agency or political subdivision governing body; and,

c) Noise abatement options for which requisite authority is vested in the FAA or other Federal agency.

However, it is important to note that these categories refer to the generalized implementation authority (identifying who is most likely to implement), and there is some overlap within measures on who can implement a measure or who plays a part in implementation. While implementation may lie with the Airport, in certain cases, there might be federal regulations that regulate how an alternative is implemented and the steps required to take to implement an action. For instance, many noise actions that lie under the implementation authority for the Airport are also regulated under Part 161. Therefore, these alternatives cannot be implemented without the Airport completing the steps required in Part 161 and having it approved by the FAA. As described above, this study will not include modeling alternatives that would require a Part 161 study, because all non-regulatory alternatives must be examined first. Additionally, under Part 150, the FAA must review the Noise Compatibility Program alternatives with respect to the program standards outlined in Section B150.5 of the Part 150 regulation and approve those measures in a Record of Approval in order for them to be eligible for federal funding.

Each measure is assigned below 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. The Study Input Committee assisted the Airport and consultant in identifying more specific measures to evaluate for noise abatement or mitigation. Specific measures that were further examined for this Study are described in Chapter G, Analysis of Noise Abatement Options and Additional Studies and Chapter H, Potential Land Use, Administrative and Facility Options. Study recommendations are contained in Chapter I, Issues/Actions and Recommendations.

Tables F1 and F2 list a few noise abatement and land use compatibility measures that were discussed, as well as specific noise issues these measures are designed to address. This table is listed by types of alternatives (airspace, facilities, etc.), to help facilitate understanding the types of alternatives available in a condensed format. However, based on Part 150 regulation, the detailed descriptions of these alternatives later in the chapter need to be organized by who generally has implementation authority to meet the requirements in Part 150. As stated previously, it is noted that there is some overlap between jurisdictions in some of these alternatives. The organization of these alternatives is based on who most likely implements or has authority to implement, but there are several cases where several groups could be involved. In addition, the alternatives may undergo an FAA review taking into account operational, safety, and airspace considerations. All of the alternatives described below 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.

[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.

Table F1

OPERATIONAL AND FACILITY MEASURES

Measures For Consideration		Type of Noise Measure is Designed to Address: Aircraft Ground	Departure flight	Approach Flight	Landing Roll	Maint. Activity	Ground Equip.	Sample Implementation Measure
Airport Infrastructure or Airport Facilities	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/ Modify Approach procedures.
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		Aircraft Ground noise	Departure flight	Approach Flight	Landing Roll	Training Flights	Maint. Activity	Ground Equip.	Sample Implementation Measure
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	◆	◆	◆	◆	◆	◆	◆	

Measures with Airport Proprietor Implementation Authority

Airport and Airspace Use – Use Restrictions

Denial of Use of Airport to Aircraft Not Meeting 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 to certain Part 36, noise level requirements such as the restriction to Stage 3 at Naples, Florida). Most turboprops and other large aircraft manufactured after 1964 were required to meet those 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, such as a business jet like the Gulfstream II 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 weighing less than 75,000 lbs. are now required to be Stage 3 by the end of 2015. As stated previously, Alaska and Hawaii are exempt from the Stage 3 requirement. However, if an operator of a non-stage 3 aircraft changes ownership, then the exemption disappears. The old B737-200 that are now operated by other cargo airlines are included in the 2009 (4,867 operations) and 2020 (6,307 operations) model but were replaced in the 2030 case because the aircraft will be at the end of its usable life at that point.

Thus, this measure could require aircraft weighting less than 75,000 lbs. to meet Stage 3 or better levels or require aircraft weighting more than 75,000 lbs. to meet Stage 4 levels. In order to require this, it must meet the program standards of Part 150 alternatives outlined in the introduction of this chapter. This means that 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 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 may be feasible where the majority of the aircraft fall within the parameters of Part 36. However, to restrict Stage 3 or Stage 2 aircraft less than 75,000 lbs., 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).

Capacity Limits Based on Defined Noise Levels.

The following capacity limit measures are required to be addressed by Part 150. However, they all would require a 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 proposed non-restrictive measures evaluated during this Part 150 update, 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," where 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." Measures like this generally don’t meet the Part 150 Study program standards because as a public use airport, the Airport has to follow their grant assurances, including that they accommodate all types and classes of aircraft. Additionally, it would likely not meet the Part 150 Study program standards of being nondiscriminatory.

Restrictions Based on Certificated Single-Event Noise Levels. Most aircraft today have been certificated by the FAA, as part of the 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. This kind of restriction generally does not meet Part 150 program standards because by restricting certain kinds of aircraft, it would put the Airport in noncompliance with their grant assurances, as well as have the potential for economic impact on state and interstate commerce.

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. 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.

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] 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 and so could not be approved under by the FAA under Part 150. 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.

[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]

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.

Airport Infrastructure or Airport Facilities

Noise Barriers (Shielding, including earth berms and walls). Noise generated from ground-level sources on an airport can result from engine run-up[4] 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; however berms/barriers are generally most effective either very close to the source, or very close to the affected area. 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.

[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.

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 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 aircraft noise for those areas close to an airport. The Airport is preparing a Master Plan in which infrastructure or operational changes are proposed and may be implemented, dependent upon operational needs, within the time-frame of the Future Noise Exposure Map (2020). Noise impacts expected from these changes have been evaluated as alternatives in this Study and are discussed in detail in Chapter G, Analysis of Noise Abatement Options and Additional Analysis, and Chapter I, Issues/Actions and Recommendations.

[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.

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.

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.

Land Use Measures

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 ANC and LHD, 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.

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. Since 2001, insulation modifications have been completed for over 880 eligible dwellings at a cost of approximately $50,000 per single family house. An avigation easement was granted for those homes that were insulated.

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 Program Management

Although the requirements in Part 150 dictate that the alternatives reduce or prevent non-compatible land uses, some measures, such as a noise monitoring program, are allowed because while they don't directly reduce non-compatible land uses; they can help identify noise issues and increase communications with stakeholders. These types of programs can help identify potential problem spots, potentially leading to solutions, such as through development of a voluntary Fly Quiet Program.

Noise Monitoring Program. Noise monitoring or sound level measurement programs can be used to measure effectiveness of a program and identify potential single events that are problematic (due to an unusual flight track or otherwise). Airports use continuous sound level measurement devices (called noise monitoring systems) and flight track systems to demonstrate changes in aircraft noise exposure and to identify noise levels associated with specific aircraft events. This can help identify problematic single events that could be addressed in the voluntary programs such as a Fly Quiet Program. 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. It is important to note that this is a method to measure noise, but does not replace the federally required use of the Integrated Noise Model for developing noise contours under a Part 150 Study that dictates where residences are eligible for federal funding for sound attenuation.

In addition, many airport operators (such as the Airport) provide staff to receive and respond to citizen complaints of aircraft noise. A comprehensive noise complaint tracking system allows for 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 via various media (web, phone, email, etc.), and public relations.

Measures with State or Local Government Implementation Authority

Many airport operators do not have land use control over the land use development around an airport; such is the case of the ANC and LHD. 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 Measures - Preventative Measures

Land Use Controls. Federal guidelines contained in 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 plans (CIPs), 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 usually 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. 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 Improvement Plan (CIP). 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 improvement plan (CIP), can reduce or avoid land use incompatibilities in the future.

Measures with FAA or Federal Agency Implementation Authority

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 restrict Stage 3 aircraft must be approved by the FAA under Part 161. That discussion is not repeated, and thus readers are referred to the earlier discussion.

Aircraft Operations

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 from a noise perspective for aircraft to climb faster and turn earlier than to fly over noise-sensitive areas at lower power. 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 take-off 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.**

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 where the FAA will implement arrival tracks. As this Part 150 Study was initiated in 2012, the FAA began a process of considering two arrival tracks using RNP. Airport staff and the Part 150 Study consultants monitored the FAA's RNP process and coordinated the noise abatement needs with the opportunity of that RNP development. The final RNP procedure is included in the Future Noise Exposure Map since its use is reasonably foreseeable.

Airport and Airspace Use

Preferential Runway Use System. A preferential runway use system typically identifies the runway end(s) that for arrivals and 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 of 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 and those actions that would have regulatory or other limitations. The Study Input Committee assisted the Airport and consultants in identifying more specific measures to evaluate for noise abatement or mitigation using the guidelines and information provided. These alternatives are described in the following chapters.

Chapter G - Analysis of Noise Abatement Options and Additional Studies

INTRODUCTION. This chapter summarizes the noise abatement options identified with the Study Input Committee and considered in this Part 150 Noise Compatibility Study. The options examined are:

NOISE ABATEMENT OPTIONS

- **DEPARTURE CLIMB PROCEDURES.**
  - Option 1 – **Distant Departure**.
  - Option 2 – **Close-In Departure**.

- **AIRFIELD/AIRPORT CHANGES.**
  - Option 3 – **Noise Barrier**.
  - Option 4 – **Ground Run-up Enclosure (hush house)**.
  - Option 5 – **Voluntary Reduced Use of Reverse Thrust**.

ADDITIONAL STUDIES

- **NOISE CONSIDERATIONS RELATED TO OTHER STUDIES.**
  - **Master Plan Update Modified Preferential Runway Use System to Meet Future Demand**.
  - **Required Navigation Performance (RNP) Procedure**.

It should be noted that the analyses documented in this Part 150 include the 60 DNL contour. This contour, as well as the supplemental metrics (such as the single event sound exposure contours), are included as supplemental information for the sole purposes of identifying areas that may receive increased or decreased sound levels. The 60 DNL contours are generally less accurate than the higher intensity contours, but when comparing one noise abatement option to another, show the locations that could experience an increase or decrease in noise exposure. The 65 DNL contour is the threshold contour for determining land use compatibility per the Part 150 land use guidelines.

The options listed were analyzed for this chapter and are documented herein. In addition to the alternatives identified for noise abatement, Table G1 summarizes the effects of the options that have been analyzed to date by comparing their anticipated noise impacts to the future base case noise contours (Day-Night Level noise contours for the year 2020 based on forecast operations).

The analysis contained within this chapter was used to develop the recommendations that are included in the final submitted Noise Compatibility Program. For the purposes of Part 150 Studies, options involving arrival or departure procedures or facility modifications, are included under this chapter. Land use alternatives, such as Residential Sound Insulation, are evaluated in the Potential Land Use, Administrative and Facility Options chapter.

Additionally, several concurrent studies, including the Master Plan and a Study on Required Navigation Performance (RNP) Procedures, contain elements that have the potential to change noise exposure through modifications in operations at the Airport. These potential operational changes to the noise exposure are important to examine within the Part 150 Study even though their goals are not related to reducing noise; therefore, the analysis of the potential impacts of these changes is analyzed in this chapter. As those planning processes proceeded, it was determined that those operational procedures were reasonably foreseeable. Therefore, those operational changes are included within the future Noise Exposure Map, as described further in Chapter I.

It is important to note that each category of options is intended to stand alone – and thus, information is often repeated.

Table G1
SUMMARY OF NOISE ABATEMENT OPTIONS COMPARED TO BASE CASE 2020 NOISE CONTOURS

Option	65 DNL & Greater Impact/Change (Net Change in affected Population)		60 DNL & Greater Impact/Change (Net Change in affected Population)		Operational Issues/Comments
	Population	Housing Units	Population	Housing Units	
NOISE ABATEMENT OPTIONS					
Option 1 – Distant Departure	0	0	+175	+70	No substantial change in 65 DNL; increase in 60 DNL
Option 2 – Close-In Departure	0	0	+80	+45	No substantial change in 65 DNL; increase in 60 DNL
Option 3 – Noise Barrier	NA	NA	NA	NA	Benefits qualitatively discussed in text; could result in a reduction in noise but would not show up substantially in DNL.
Option 4 – Ground Run-Up Enclosure	100% reduction in population and housing units affected by the 60 dBA Lmax at all four potential run-up locations				Increased taxi time; needs to be sited according the Part 77.
Option 5 – Voluntary Reduced Use of Reverse Thrust	NA	NA	NA	NA	Benefits qualitatively discussed in text; voluntary measure could result in a reduction in noise but would not show up substantially in DNL.
ADDITIONAL STUDIES					
Master Plan Update Modified Preferential Runway Use System to Meet Future Capacity	+130	+65 (approx. +25 non insulated over base case)	+5,510	+2,220	Would help meet future capacity, would increase noise; Change in homes is mostly over a previously insulated area, so only around 25 additional uninsulated homes are within the contour resulting from this alternative.
RNP Procedure	0	0	+10	+5	Could increase safety for aircraft. No substantial change in 65 DNL and a small increase in the 60 DNL to the south

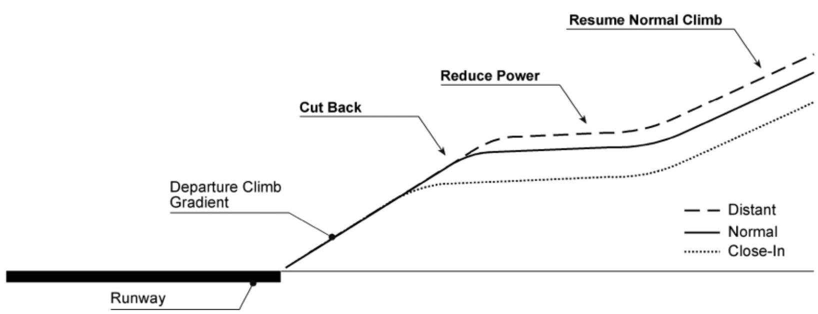
Source: L&B and Mead & Hunt, 2013; Census 2013.
With location, the (60) indicates farther from the Airport (i.e. 60 DNL contour), and (65) indicates closer to the Airport (i.e., 65 DNL contour).
All housing units and population data are estimated using Census data.
Base Case includes the noise contours based on 2020 forecasts for the Airport; Lmax is the Maximum Noise Level, or the highest noise level reached during a single event
NA – Not evaluated, as option would not be expected to have noise reduction benefits that would show in the DNL contours. Alternative addressed qualitatively. The 60 DNL contour, as well as the supplemental metrics (such as the single event sound exposure contours), are included as supplemental information for the sole purposes of identifying areas that may receive increased or decreased sound levels. The 60 DNL contours are generally less accurate than the higher intensity contours, but when comparing one noise abatement option to another, show the locations that could experience an increase or decrease in noise exposure. The 60 DNL contour is just used for planning level analysis. Only the 65 DNL contour changes are used in comparison of alternatives under Part 150.

Option 1: Departure Climb Procedures - Distant Departure Climb Procedure

DESCRIPTION OF THE OPTION: In response to communities desiring to consider noise reductions close to the Airport, and locations wishing to consider reductions farther away, the FAA adopted a new Advisory Circular (AC-91-53A, *Noise Abatement Departure Procedures*) in 1993 allowing for two new options: 1) a close-in procedure, and 2) a farther away distant procedure. These departure profiles have the potential to minimize noise in specific areas by modifying distance and altitude for application of full take-off power, engine thrust cutback, flap retraction, and application of normal climb thrust.

The close-in departure typically reduces noise closer to an airport, but may increase noise farther from an airport (8 to 10 miles away). Conversely, the distant procedure concentrates noise closer to an airport (within 3 to 6 miles), but reduces noise farther away. This alternative analyzes the effects of a distant departure procedure.

DISCUSSION: Changes in departure climb procedure (the location relative to the ground where power is applied), can alter aircraft noise exposure, and can increase noise exposure in some areas and decrease it in others. Aircraft that climb quickly deliver a greater noise impact to these areas nearer an airport, while a more gradual climb may increase noise levels farther from an airport. It is important to note that noise abatement departure procedures do not reduce noise overall but actually redistribute noise in such a way as to benefit either communities close-in or distant to an airport, but not both.



NOISE ABATEMENT PROCEDURE GOAL: The goal of this option would be to reduce noise levels from jet departures over residential land uses by using the power (thrust) cutback that would result in the lowest noise levels in the community. This alternative focuses on a Distant Departure Procedure.

COMPARABLE EXISTING PROCEDURE(S): On a normal departure procedure, aircraft typically reduce thrust and begin to retract flaps at about 1,000 to 1,200 feet above field elevation (AFE), but it will vary by airline and aircraft type. The current departure climb procedure is applicable to most jet aircraft. Take-off power is applied until reaching the cutback altitude above airfield elevation (AFE), at which point the power is cut back to a reduced climb power prior to flap retraction. Regular climb power is applied when reaching an altitude of 3,000 feet AFE.

MODELING ASSUMPTIONS/NEW PROCEDURE: Distant Departure Procedure: The "distant" departure procedure is a variant of the current Airport departure - the difference being that flaps begin retraction while maintaining take-off power after which flap are retracted on schedule. Similar to a normal procedure, full climb power would again resume at an altitude of 3,000 feet above ground. Of note, in the base case contours, Alaska Airlines already operates using a distant departure procedure, so this alternative assumes that all other operators would change to using distant departure procedures and that Alaska Airlines would continue to use the distant departure procedure.

ANALYSIS OF OPTION: The analysis of this option considered both the noise exposure impacts of the option, as well as the possible operational effects.

NOISE ANALYSIS: As required by Part 150, the study relied upon the use of the average annual DNL noise contours to consider possible noise exposure consequences of the option.

IMPACT ON ANNUAL DNL CONTOUR: When looking at the changes in the DNL contours, this alternative slightly increased the area within the 65 DNL contour, but the change in area was so slight, there was no change to the number of housing units within the contour. This alternative would increase both the area and number of housing units within the 60 DNL contour, as seen in Figure G1.

With the distant procedure, a noise reduction would occur in the areas more distant from the Airport (about 5 miles) which would not be shown in this study area. However, since farther from the Airport most commonly corresponds to areas over water, this alternative would not have a substantial benefit to non-compatible land uses. As stated above, the area close-in to the Airport (60 DNL) would experience an increase in the number of people affected by noise.

Within the 65 DNL contour, there would be a slight increase in area, but this increase would be small and not result in any change in the number of people within the 65 DNL contour. This alternative would not provide a benefit to the residential communities nearby. The population analysis associated with the distant departure procedure is shown in Table G2.

Close-in and the distant noise abatement departure procedures are more effective at reducing departure noise when the fleet mix is homogenous, i.e., all wide bodies or all narrow body twins in the fleet. ANC's fleet is not homogenous and includes wide body and narrow body aircraft that apply power and flap setting at different points along the flight track. This causes a louder noise exposure on areas within 2-3 miles of the Airport when compared to the standard departure procedure.

Table G2
DISTANT DEPARTURE PROCEDURE IMPACTS

	Baseline (2020)/No Action		Distant Departure Procedure	
	Population	**Housing**	**Population**	**Housing**
75 DNL	0	0	0	0
65 DNL & Greater	95	35*	95	35*
60 DNL & Greater*	1,880	870	2,055	940

Source: 2010 US Census Numbers rounded
Note: no residential uses are located in the 75 DNL and greater contours.
* Of these homes, approximately 11 were sound insulated under the previous Residential Sound Insulation Program, and approximately 25 have not been previously insulated. Residential sound insulation will be examined as a potential alternative under the subsequent land use alternatives chapter.

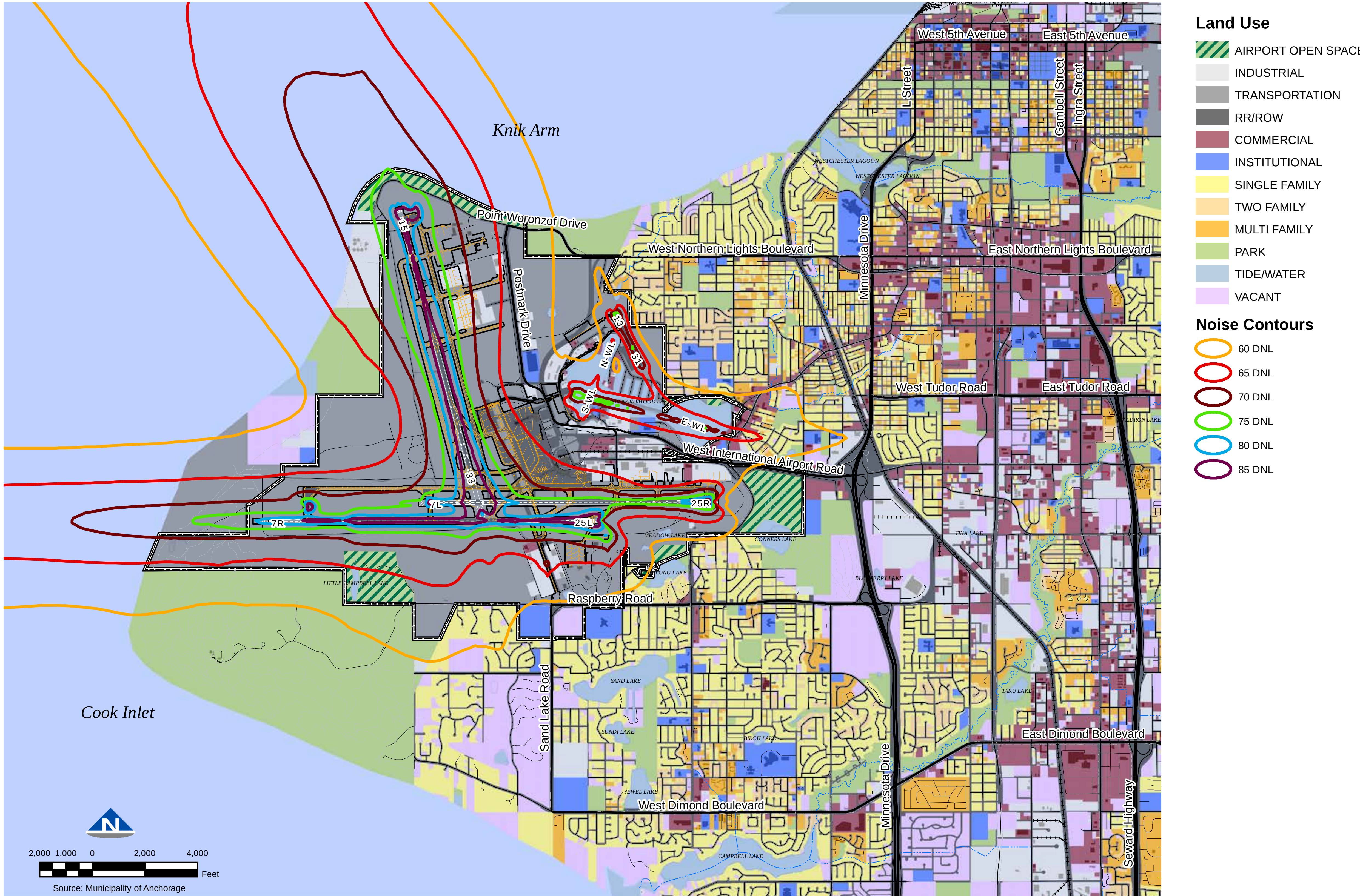


Figure G1 **Distant Departure 2020**

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IMPACTS OF IMPLEMENTATION: The following issues could arise from implementation of the option. Also identified are the agencies that would have a role in assisting in the implementation of Option 1.

AIRPORT AND ATC OPERATIONAL CONSIDERATIONS (SAFETY AND EFFICIENCY ISSUES): FAA has ultimate responsibility for the control of aircraft flight, whereas, the airlines/pilot control the flight procedures, such as departure climb. This option would not be expected to materially change FAA ATC workload.

OTHER ENVIRONMENTAL ISSUES (NEPA, ETC.): Implementation of noise abatement procedures requires compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, outlines the documentation required based on the types of federal action. Significance under NEPA is based on a 1.5 DNL change in noise exposure within the 65 DNL and greater noise contour. Since there would likely be no increase in the number of homes within the 65 DNL, a Categorical Exclusion could be needed to implement this action. The FAA is the responsible agency, and the action taken by the FAA to approve a noise abatement departure procedure is the modification and approval of an airline's Operations Specification (Ops Spec) for operations at a specific airport. The Ops Specs for a specific airline are reviewed and approved by the FAA office nearest the headquarters of an airline.

LEGAL ISSUES: The option does not appear to have legal issues associated with its implementation.

CONCLUSIONS OF CONSULTANT TEAM: The Consultant Team does not recommend implementation of this option, because it increases the number of people affected in the 60 DNL noise contour and would not result in any decrease in the number of people affected by noise in the 65 DNL noise contours. Because of the preferential runway use, the distant procedure would produce the most benefit for areas farther away from the Airport (generally over water based on the use of the preferential runway use system currently in place).

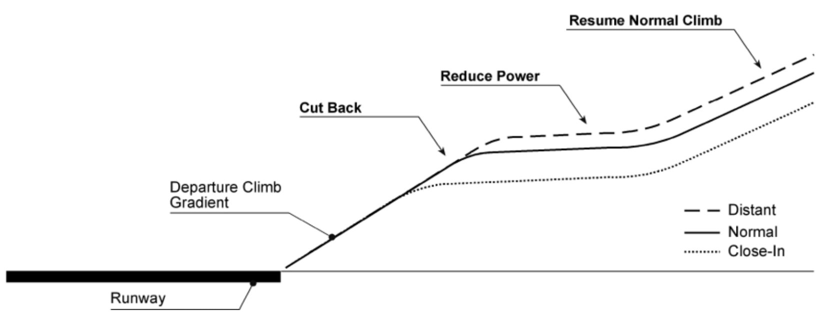
Because no substantial noise reduction would occur for noise sensitive uses, this alternative is not recommended.

Option 2: Departure Climb Procedures – Close-In Departure

DESCRIPTION OF THE OPTION: In response to communities desiring to consider noise reductions close to the Airport, and locations wishing to consider reductions farther away, the FAA adopted a new Advisory Circular (AC-91-53A, *Noise Abatement Departure Procedures*) in 1993 allowing for two new options: 1) a close-in procedure, and 2) a farther away procedure. These departure profiles have the potential to minimize noise in specific areas by modifying distance and altitude for application of full take-off power, engine thrust cutback, and re-application of normal climb thrust. This alternative looks at a close-in departure.

The close-in departure typically reduces noise closer to an airport, but may increase noise farther from an airport (8 to 10 miles away). Conversely, the distant procedure concentrates noise closer to an airport (within 3 to 6 miles), but reduces noise farther away.

DISCUSSION: Changes in departure climb procedure (the location relative to the ground where power is applied), can alter aircraft noise exposure, and can increase noise exposure in some areas and decrease it in others. Aircraft that climb quickly deliver a greater noise impact to these areas nearer an airport, while a more gradual climb may increase noise levels farther from an airport.



NOISE ABATEMENT PROCEDURE GOAL: The goal of this option would be to reduce noise levels from jet departures over residential land uses by using the power (thrust) cutback that would result in the lowest noise levels in the community. This alternative focuses on a Close-In Departure.

COMPARABLE EXISTING PROCEDURE(S): On a normal departure procedure, aircraft typically reduce thrust and begin to retract flaps at about 1,000 to 1,200 feet above field elevation (AFE). The current departure climb procedure is applicable to most jet aircraft. Take-off power (full power) is applied until reaching about 1,000 feet above airfield elevation (AFE), at which point the power is cut back to a reduced climb power. Regular climb power is applied when reaching an altitude of 3,000 feet AFE.

MODELING ASSUMPTIONS/NEW PROCEDURE: Close-In Departure Procedure: Using this procedure, aircraft would apply full take-off power until reaching cutback altitude, when they cut back and apply regular climb power and begin to retract flaps at 3,000 feet above ground. With this procedure, noise would be decreased for areas closest to the Airport, but would increase for areas at a distance, when the power is re-applied. This alternative assumes that all operators (including Alaska Airlines) will use a close-in departure. A simplified way of describing the difference between a close-in and a distant procedure is that for a close-in procedure the initial power cutback occurs before flap retraction, and for a distant procedure the flap retraction occurs before the initial power cutback.

ANALYSIS OF OPTION: The analysis of this option considered both the noise exposure impacts of the option, as well as the possible operational effects.

NOISE ANALYSIS: As required by Part 150, the study relied upon the use of the average annual DNL noise contours to consider possible noise exposure consequences of the option.

IMPACT ON ANNUAL DNL CONTOUR: As seen in Table G3 and Figure G2, looking at the DNL contours, there was no change from this alternative in the 65 DNL and greater contour for housing units or population. However, there was an increase in the area and the number of housing units and number of people affected within the 60 DNL contour.

With the close-in procedure, a noise level reduction would be expected in the areas closer to the Airport (within 2 miles), but it might be so slight that it did not show up in the DNL. Those areas more distant from the Airport would experience an increase in noise. In this case, there would also be an increase in the area of the 60 DNL noise contour, as well as the number of homes and number of people within this contour. While 60 DNL is still considered fairly close to the Airport, the reason this increase occurs is because close-in and the distant noise abatement departure procedures are more effective at reducing departure noise when the fleet mix is homogenous, i.e., all wide bodies or all narrow body twins in the fleet. The Airport's fleet is not homogenous and includes wide body and narrow body aircraft that apply power and flap setting at different points along the flight track. This causes a louder noise exposure on areas within 2-3 miles from of the Airport (as shown in the increase in the 60 DNL contour) when compared to the standard departure procedure.

Table G3
CLOSE-IN DEPARTURE PROCEDURE IMPACTS

	Baseline (2020)/No Action		Close-In Departure Procedure	
	Population	**Housing**	**Population**	**Housing**
75 DNL	0	0	0	0
65 DNL & Greater	95	35*	95	35*
60 DNL & Greater*	1,880	870	1,960	915

Source: 2010 US Census Numbers rounded.
Note: No residential uses are located in the 75 DNL and greater contours.
* Of these homes, approximately 11 were sound insulated under the previous Residential Sound Insulation Program, and approximately 25 have not been previously insulated.

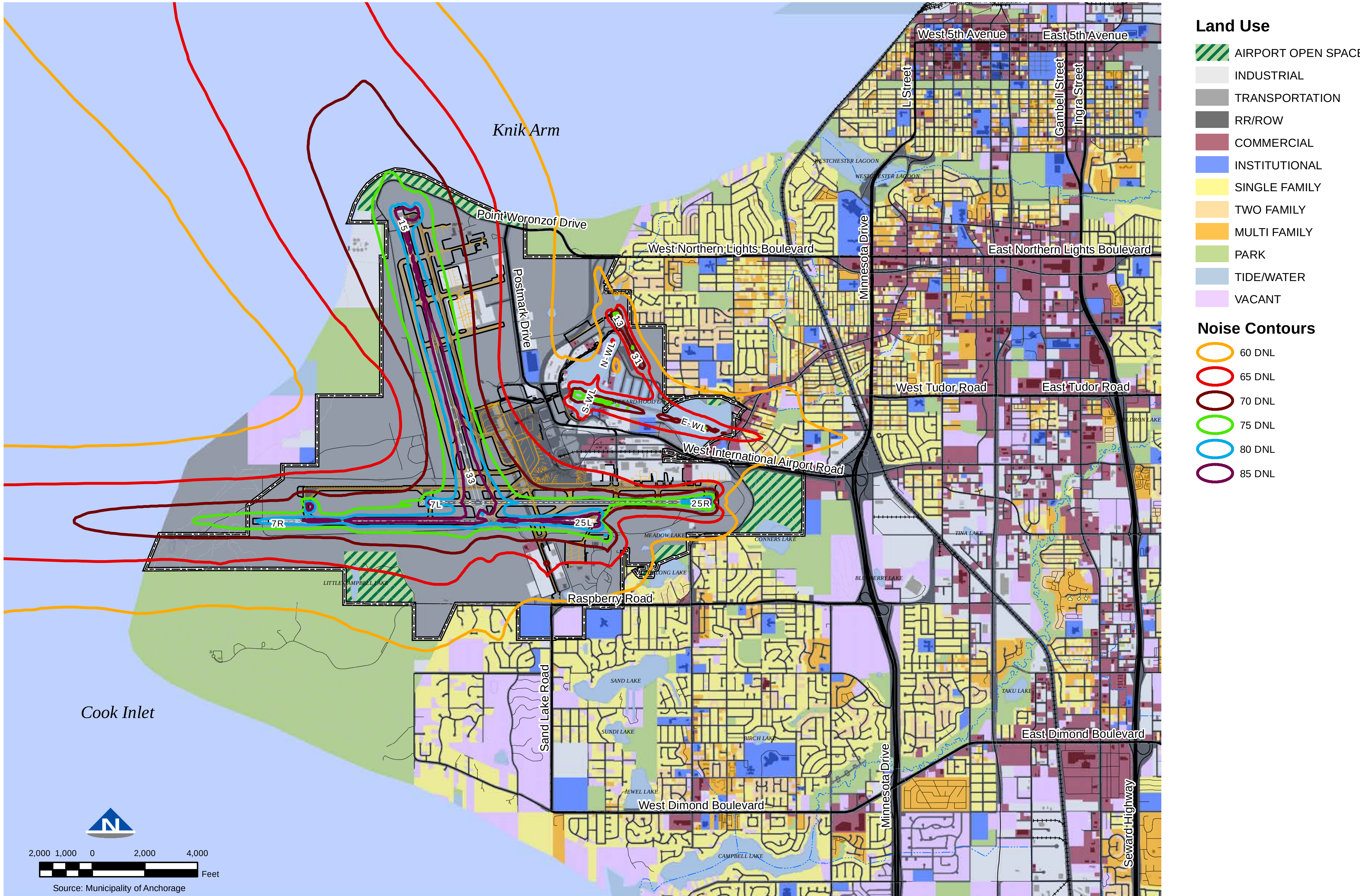


Figure G2 **Close-in Departure 2020**

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IMPACTS OF IMPLEMENTATION: The following issues could arise from implementation of the option. Also identified are the agencies that would have a role in assisting in the implementation of this option.

AIRPORT AND ATC OPERATIONAL CONSIDERATIONS (SAFETY AND EFFICIENCY ISSUES): FAA has ultimate responsibility for the control of aircraft flight, whereas, the airlines/pilot control the flight procedures, such as departure climb. This option would not be expected to materially change FAA ATC workload. However, with the close-in procedure, aircraft would not climb as fast as they currently do and thus, there could be airspace issues to ensure proper separation of aircraft.

OTHER ENVIRONMENTAL ISSUES (NEPA, ETC.): Implementation of noise abatement procedures requires compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, outlines the documentation required based on the types of federal action. Significance for NEPA is based on a 1.5 DNL change in noise exposure within the 65 DNL and greater noise contour. Since there would likely be no increase in the number of homes within the 65 DNL, a Categorical Exclusion could be needed to implement this action. The FAA is the responsible agency, and the action taken by the FAA to approve a noise abatement departure procedure is the modification and approval of an airline's Operations Specification (Ops Spec) for operations at a specific airport. The Ops Specs for a specific airline are reviewed and approved by the FAA office nearest the headquarters of an airline.

LEGAL ISSUES: The option does not appear to have legal issues associated with its implementation.

CONCLUSIONS OF CONSULTANT TEAM: The Consultant Team does not recommend implementation of this option, because it increases the number of people affected in the 60 DNL noise contour and would not result in any decrease in the 65 DNL noise contours. Because no substantial noise reduction would occur to noise sensitive uses, this alternative is not recommended.

Option 3: Noise Barrier

DESCRIPTION OF THE OPTION: Noise barriers are obstructions to the path of the sound that reduces noise for observers behind the barrier. Barriers can include noise walls, berms (earth mounds), or Ground Run-Up Enclosures (a specific type of barrier for aircraft that is considered as a separate alternative later in this chapter). The analysis here assumes the barrier is a noise wall because it would likely provide the greatest benefit in a constrained area (i.e. a larger area would be required to create an earthen berm with similar noise benefits). To be effective in reducing noise, a barrier must either be close to the noise source or noise receiver. Aircraft ground noise was cited as a concern during the Study Input Committee meetings and public meetings. Given the layout of the Airport, existing berms, and the surrounding community, three sites for barriers were identified, North Air Park, South Air Park, and an area close to the LHD gravel strip. Barriers at these locations were considered in this alternative relative to sample cross-sections of the topography in the area and are detailed below.

DISCUSSION: A noise barrier is an obstruction to the path of the sound that reduces noise for observers that are "behind" the barrier relative to the noise source. Noise barriers reduce noise levels by interrupting, or blocking, the direct path between a noise source and a receiver. The direct path is often referred to as the line-of-sight. When a noise barrier blocks line-of-sight between a noise source and receiver, the sound must bend around (diffract) the noise barrier to reach the receiver. The more the sound has to bend around the top of the barrier, the greater the noise reduction provided by the barrier. Noise barriers have no impact on noise generated from sources at elevations above the barrier, such as airborne aircraft.

Figure G3 illustrates how noise barriers work in a simplified two-dimensional world. Point S shows the location of a noise source and Point R shows the location of a receiver. The line between Point S and Point R, Line SR, is the direct-line of sight (LOS). Point B is the location of the top of the noise barrier that is being constructed to reduce the noise exposure to Point R. With the barrier, sound must travel from the source, Point S, to the top of the noise barrier, Point B, and then to the receiver, Point R. The greater the angle that the sound has to bend over the top of the barrier, the outside angle between Line SB and Line BR, the greater the noise reduction provided by the barrier. This angle is directly related to the difference in path length. The path length difference is the difference between the length of the LOS path, Line SR, and the length of the travel path over the barrier, Line SB plus Line BR or Path SBR. The greater path length difference, the greater the noise reduction provided by the noise barrier.

A noise barrier that does not break the LOS does not result in any path length difference and provides no noise reduction. A barrier that just breaks the LOS and lengthens the path the sound must travel just slightly, generally provides approximately 5 dB of noise reduction.

As the height of the barrier is increased, the path length difference increases along with the noise reduction provided by the barrier. However, as discussed above, the amount of noise reduction is not proportional to the height of the barrier, or the distance that it breaks the line of sight. The noise reduction is proportional to the angle the sound must bend or, equivalently, the path length difference. This results in a decrease to the amount of additional noise reduction provided by the barrier for each incremental increase in height of the barrier. That is, increasing the height of the barrier that just breaks LOS by one foot may provide 1 dB of additional noise reduction while adding one foot to a barrier that already provides considerable reduction will only increase the noise reduction by a fraction of 1 dB. This is often referred to as a "diminishing returns" situation. The maximum noise reduction that is generally provided by a noise barrier is approximately 20 to 25 dB, but is dependent upon many complex variables.

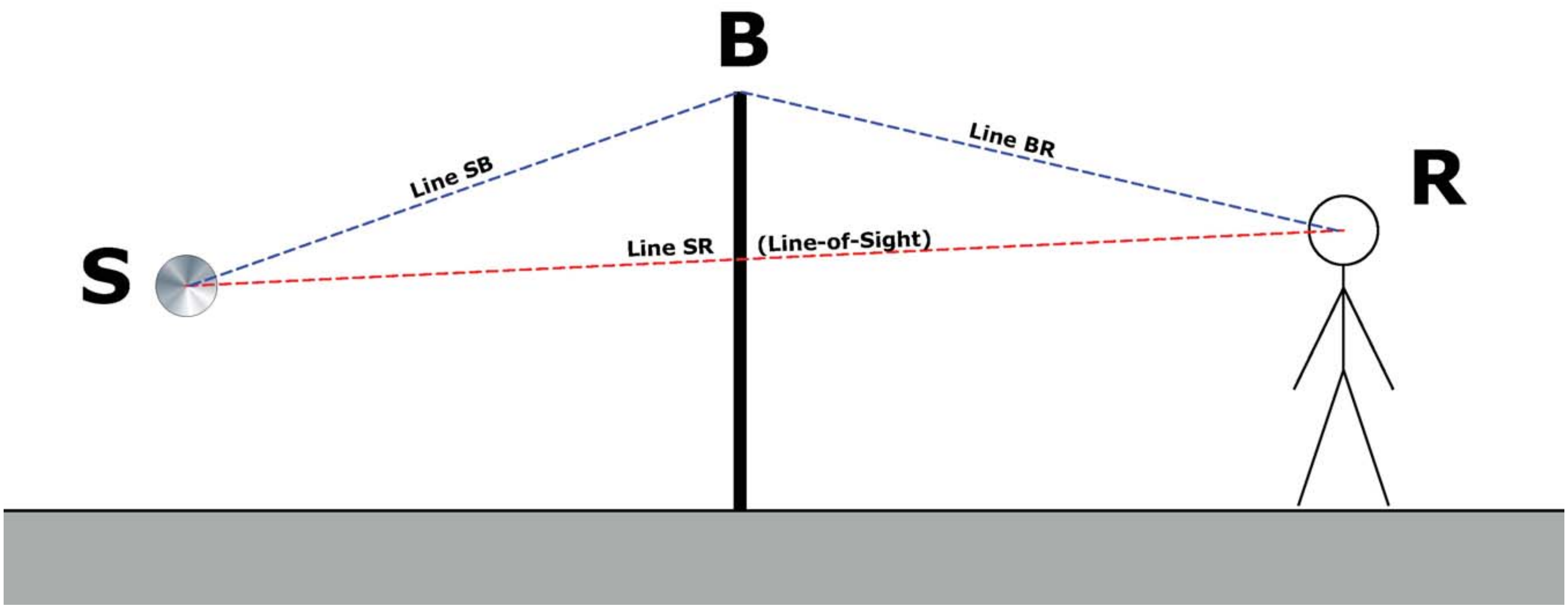

FIGURE G3
Noise Barrier Diagram

The amount of noise reduction provided by a noise barrier is affected by the tonal characteristics of the source noise. Barriers are much more effective at reducing high frequency sounds than they are at reducing low frequency sounds. Most noise sources, including aircraft, are considered broadband because their noise is comprised of a wide range of frequencies. This results in the barrier not only reducing the overall noise level, but it also affects the tonal characteristics of the noise behind the barrier. As humans are less sensitive to low frequency noise than high frequency noise, this increases the perceived effectiveness of the barrier.

For a noise barrier to be effective, the amount of sound that is transmitted through the barrier must be at least 10 dB lower than the sound diffracted over the top of the noise barrier. In general, as long as the noise barrier has a surface density of 3.5 pounds per square foot or greater, then this condition will be satisfied. Masonry concrete blocks are most often used for noise barriers, but any other material can be used as long as it meets the surface density requirement. It is possible to achieve the required transmission loss with barriers with lower surface densities. However, these barriers must be specially designed and should be tested to demonstrate their transmission loss characteristics. Natural vegetation such as trees do not do much to reduce noise exposure; however, due to the reduction in being able to "see" a source, natural vegetation sometimes provides a perceived benefit.

Over long distances, 300 feet or more, weather conditions can significantly affect the performance of a noise barrier. Wind conditions and/or atmospheric inversions can cause the sound that would otherwise travel harmlessly up and out into the atmosphere to bend back down towards the ground short circuiting the performance of the barrier and decreasing the amount of noise reduction provided, in some cases to zero. This can result in some people perceiving that a new noise barrier results in an increase in noise levels during these conditions.

The placement of barriers is dictated by airport design guidelines and regulations, one of which is Federal Aviation Regulation (FAR) Part 77, which defines certain height restrictions at specified distances from runways. To ensure the safe operation of aircraft at the Airport, these restrictions would be followed, thereby making earthen berm type barriers unfeasible in specific locations. Generally, the closer a barrier is to the noise source or to the receiver, the more effective the barrier.

Noise barriers are most often used to mitigate traffic noise. When used for an airport, the barriers only reduce noise from aircraft ground operations. Once an aircraft becomes airborne and can be seen above a barrier, the barrier has no further effect. Often, the reduction in aircraft ground activity noise provided by a barrier is overwhelmed by the noise levels from airborne aircraft resulting in negligible decreases in overall long-term average noise levels.

COMPARABLE EXISTING PROCEDURE(S): Currently the Airport considers the location of buildings for potential noise reduction benefits, but there are no other noise barriers currently in place.

MODELING ASSUMPTIONS/NEW PROCEDURE: No changes to standard airport operations were assumed when assessing the feasibility of noise barriers. The feasibility of the barriers is being assessed qualitatively by estimating the minimum noise barrier height required to provide a discernable reduction in noise. As discussed above, this occurs when the barrier just breaks LOS between the noise source and observer. Increasing the height of the barrier above this minimum would increase the amount of noise reduction provided. However, as discussed above, increasing the height of the barrier provides diminishing returns in that each incremental increase in barrier height will provide a smaller incremental increase in the noise reduction provided by the barrier. Because the reduction in noise would not substantially change the DNL, a qualitative discussion of several locations on the Airport is included below.

ANALYSIS OF OPTION: The analysis of this option considered both the noise exposure impacts of the option, as well as the possible operational effects.

NOISE ANALYSIS: Figure G4 presents an aerial photograph of the Airport along with five lines drawn between the Airport and the residential uses adjacent to the Airport, chosen to be representative cross sections of the topographical features in the area. Two lines are drawn from the South Airpark to the residences to the south of the Airport, two lines are drawn from the LHD gravel airstrip to the residences to the east of the Airport, and one line is drawn from the North Airpark to the residences east of the Airport. Ground elevation profiles for each of these lines were obtained from Google Earth and are presented in Figures G5 through G8. The LOS from a representative aircraft to the residential areas is shown on each of these figures and will be used to discuss the feasibility and effectiveness of a noise barrier, which is discussed below. Note that this analysis generally involves benefits to houses outside the 65 DNL noise contour.

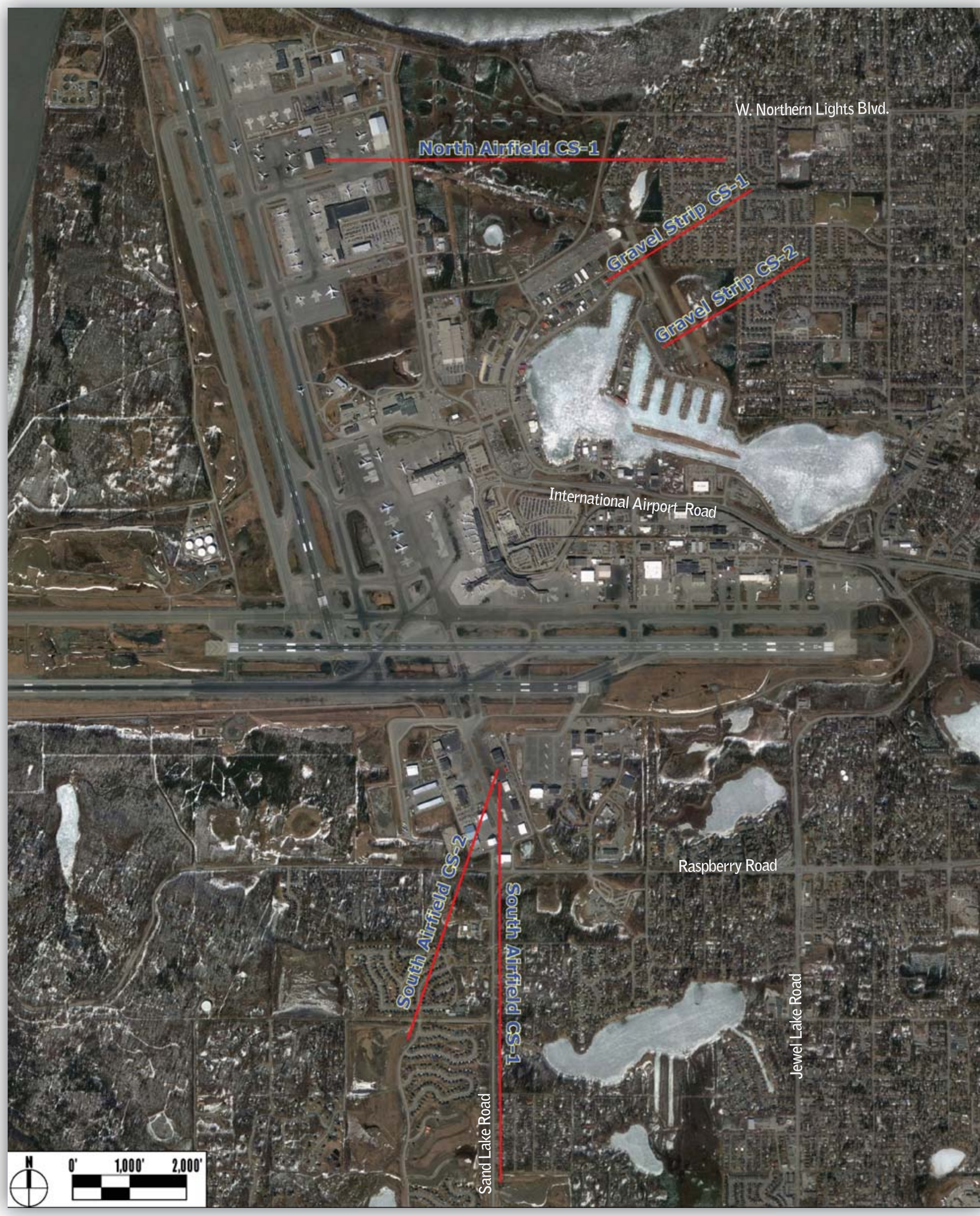

FIGURE G4
Elevation Profile Locations

SOUTH AIRPARK: Figures G5 and G6 present the two elevation profiles for the South Airpark. The vertical lines on the left side of the profile show the distance from the ground to the top of a 737-800 engine, 9 feet above the ground. The dashed lines show the line of sight between this point and the residential areas to the south. The LOS for both ground level and second floor observers are shown. Both figures show that the existing topography between the South Airpark and the nearest homes break the LOS and act as noise barriers.

Profile 1 (Figure G5) shows that farther from the South Airpark the homes that are elevated have a direct LOS. The figure shows a 15 foot high wall at the south edge of the airport property would be required to break the LOS to the most elevated homes for an aircraft located at the easternmost point shown. This barrier would not reduce noise levels from an aircraft farther to the east unless its height was increased to more than 27 feet. The barrier would also need to have openings for the roadways along the edge of the airfield, which would limit its effectiveness.

This wall would also reduce noise levels at the nearest homes. However, because these homes already receive reduced noise levels due to the topographic berm, the amount of additional noise reduction provided for these homes would be limited.

Profile 2 (Figure G6) shows that all homes in this direction from South Airpark are located behind topography that breaks LOS and acts as a noise barrier. A sound wall would need to be located on the top of the topography to discernibly further reduce noise levels.

A noise barrier for the South Airpark is not practical for the following reasons:

- **Existing topography south of the Airport (Profile 1 and Profile 2) acts as a noise barrier for many of the closest homes, limiting the amount of additional noise reduction provided by a noise barrier.**
- **Limited benefits to a small number of homes and a barrier with a height in excess of 15 feet would be required to provide perceptible noise reduction for the homes not affected by this topography for aircraft operation on the southern-most portion of the South Airpark. The wall would need to be in excess of 27 feet to reduce noise from aircraft located 500 feet farther to the north.**
- **The effectiveness of a barrier would be reduced by openings required for roadway connections.**
- **The distance between the airfield and the nearest homes, approximately 2,000 feet, would result in the barrier being ineffective during certain weather conditions.**

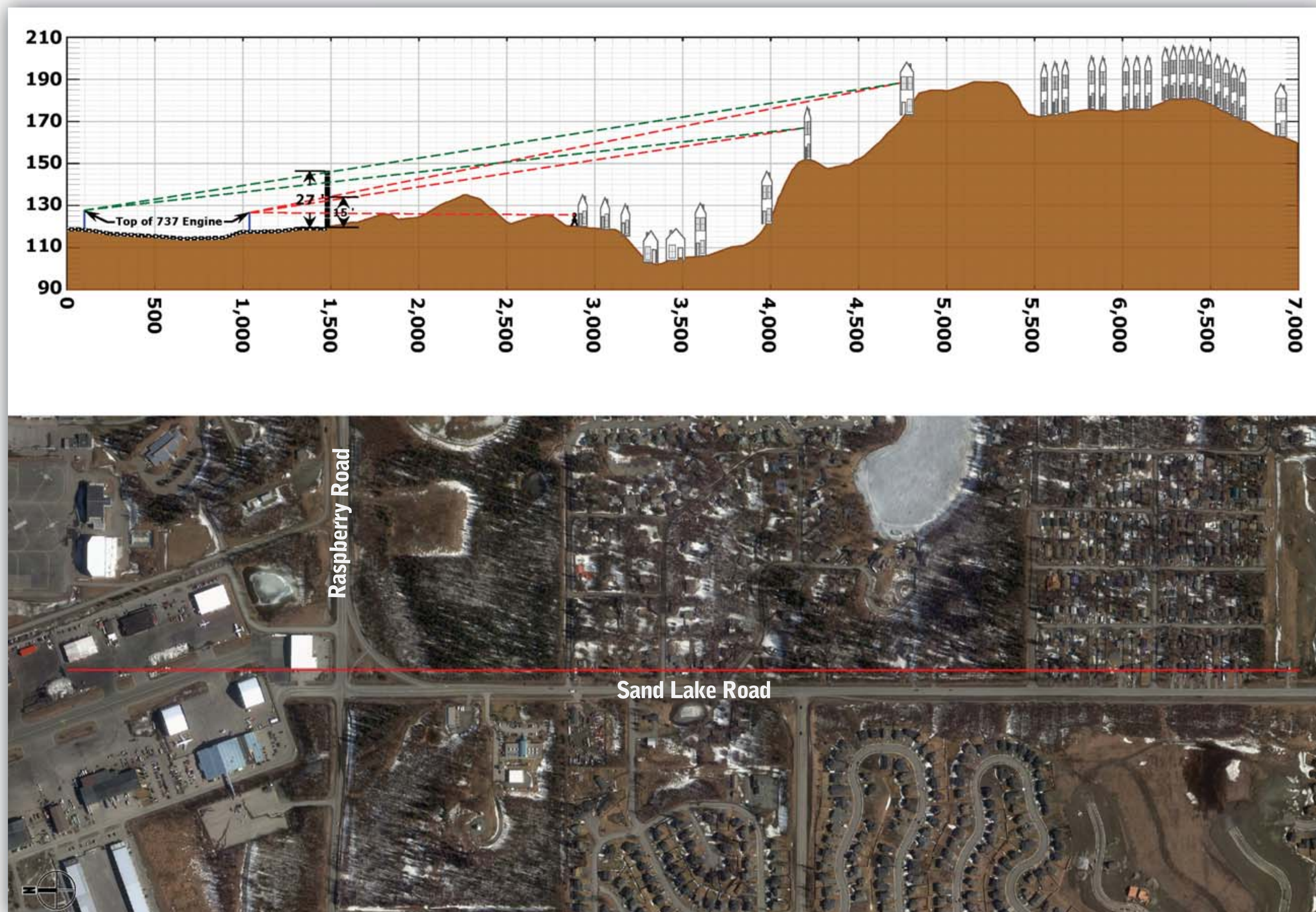

FIGURE G5
South Airpark Elevation Profile 1

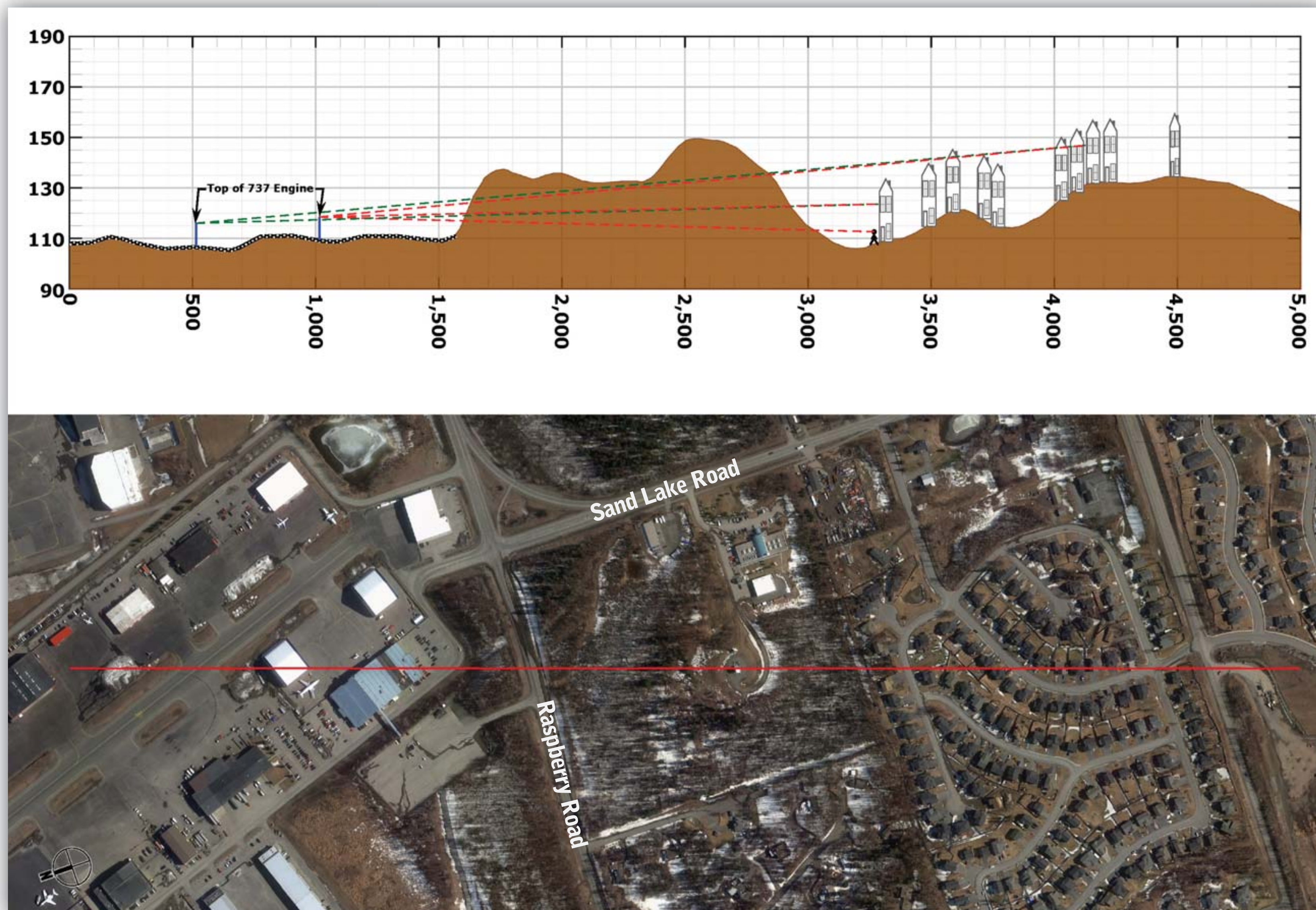

FIGURE G6
South Airpark Elevation Profile 2

GRAVEL AIRSTRIP: Figures G7 and G8 show the two elevation profiles along the gravel airstrip. These figures show that this area is relatively level. The vertical lines on the left side of the profile represent the top of a Cessna 185 propeller. Figure G7 shows that the north end of the gravel airstrip is elevated above the nearest homes by approximately 5 feet and Figure G8 shows at the south end the elevation of the airstrip is about even with the homes. A wall located on the eastern edge of airport property (just west of the residential area) with an approximate height of 16 feet would just break LOS to the second floor of the closest home in both cross sections. This means that a wall 16 feet high would provide benefit to both one and two story residences in the area. The benefit is greatest for the homes closest to the barrier, generally with diminishing noise reduction benefits the further away a house is from the barrier.

Barriers with these heights along the gravel airstrip would only break the LOS for aircraft on the ground. As aircraft take off they would quickly rise above the barrier where direct LOS to the homes would be reestablished and the barrier would be ineffective. This could actually result in the aircraft noise being perceived as more annoying due to this rapid change in noise level as the aircraft elevates above the barrier, compared to the gradual increase in noise that occurs without the barrier. However, overall cumulative noise levels at the homes would be reduced.

The homes nearest the end of the airstrip, where take-offs begin, would receive the most benefit from the noise barrier, and the homes adjacent to the other end of the airstrip would receive no benefit from the noise barrier. Homes near the middle of the airstrip would experience lower noise levels before the aircraft takes off, but the levels would quickly rise to the same levels as without a barrier as the aircraft rises above the wall. As discussed above, this can be perceived by some as being louder than the no-barrier condition due to the reduced noise level at the start of take-off with the barrier.

The figures show that the taxi and parking areas on the west side of the airstrip are at the same or lower elevation than the gravel airstrip. Therefore, the noise barrier would also reduce noise levels from aircraft ground operations in these areas.

It appears that a noise barrier located along the eastern edge of the gravel strip would also be feasible and effective at reducing noise levels at the homes to the east. This wall would need to have a minimum height of 15 to 20 feet, with 25 feet nearing the optimal height. Increasing the wall beyond approximately 30 feet in height would provide little additional noise reduction. Note that these wall heights are approximate and if this option were included as a recommendation in the Study, detailed engineering studies and siting studies would need to be done to specify the exact height and length of wall needed to meet Part 77 surfaces and other requirements.

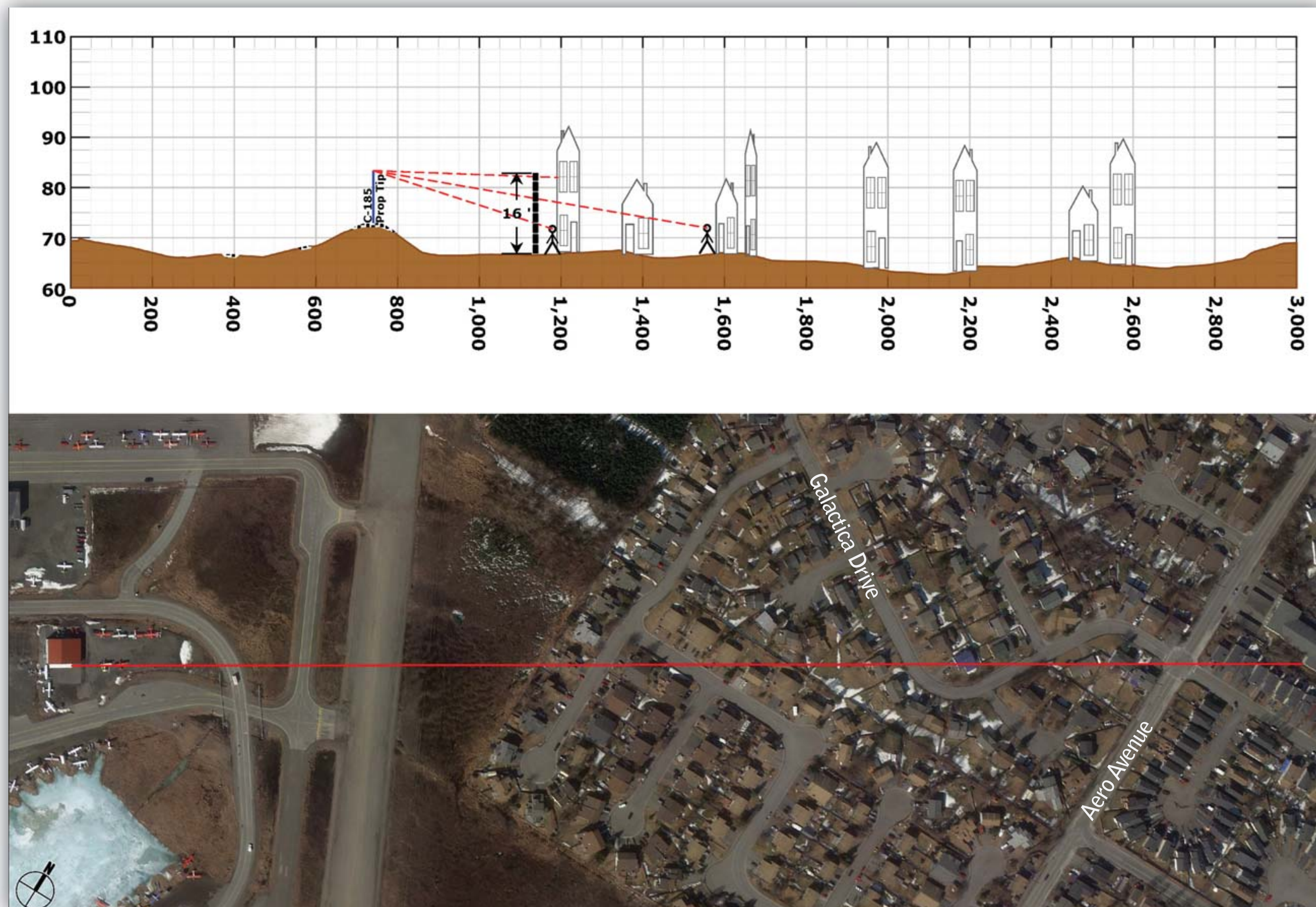

FIGURE G7
Gravel Airstrip Elevation Profile 1

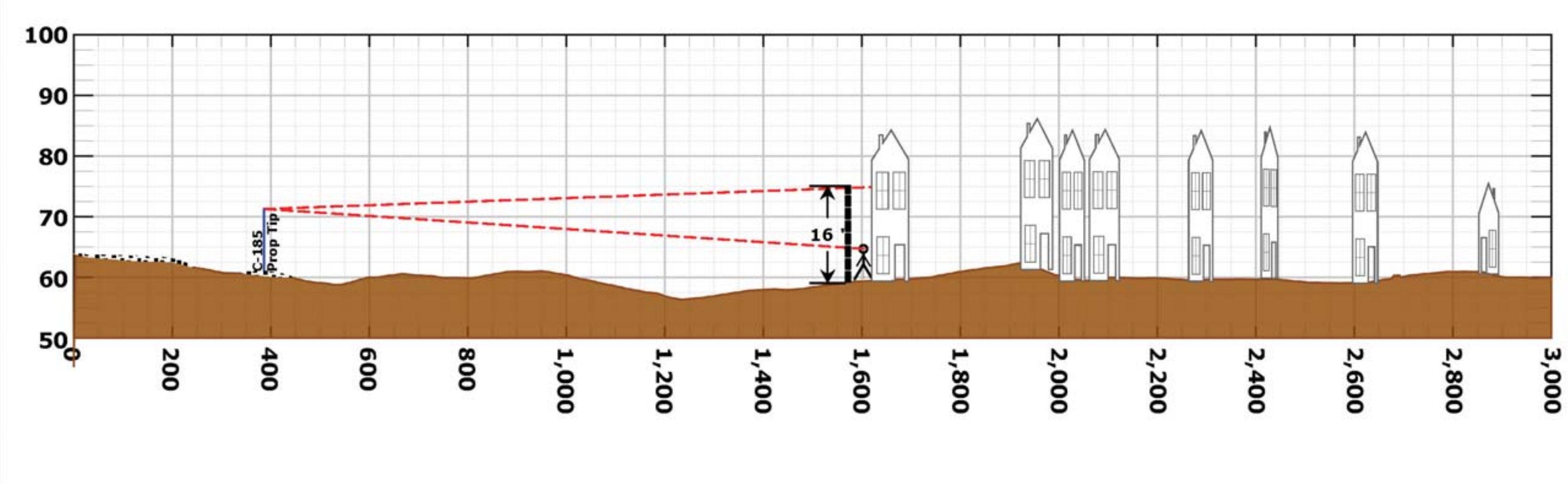

FIGURE G8
Gravel Airstrip Elevation Profile 2

NORTH AIRPARK: Figure G9 shows that the North Airpark is elevated approximately 30 feet above the residential areas to the east. The vertical line on the left side of the profile represents the height to the top of a 747 engine, 16 feet above the ground. The LOS shows that a barrier located along the eastern boundary of Postmark Drive would need to be approximately 35 feet high to break the LOS for the houses closest to the Airport. The benefit is greatest for the homes closest to the barrier, generally with diminishing noise reduction benefits the further away a house is from the barrier.

Alternatively a barrier could be located along the edge of the residential use. In this case the wall would need to have a height of approximately 16 feet to provide noise reduction to the second floor of the adjacent home. As with the other proposed location, the benefit is greatest for the homes closest to the barrier, generally with diminishing noise reduction benefits the further away a house is from the barrier.

In cases where the noise source is elevated above the receptors, it is typically most efficient to place the noise barrier next to the noise source. In this case, the top of the noise barrier needs to be at least slightly above the height of the noise source to be effective. Increasing the height of the barrier from this level not only increases the effectiveness of the barrier, but also reduces the amount of "short-circuiting" of the barrier during adverse weather conditions described previously.

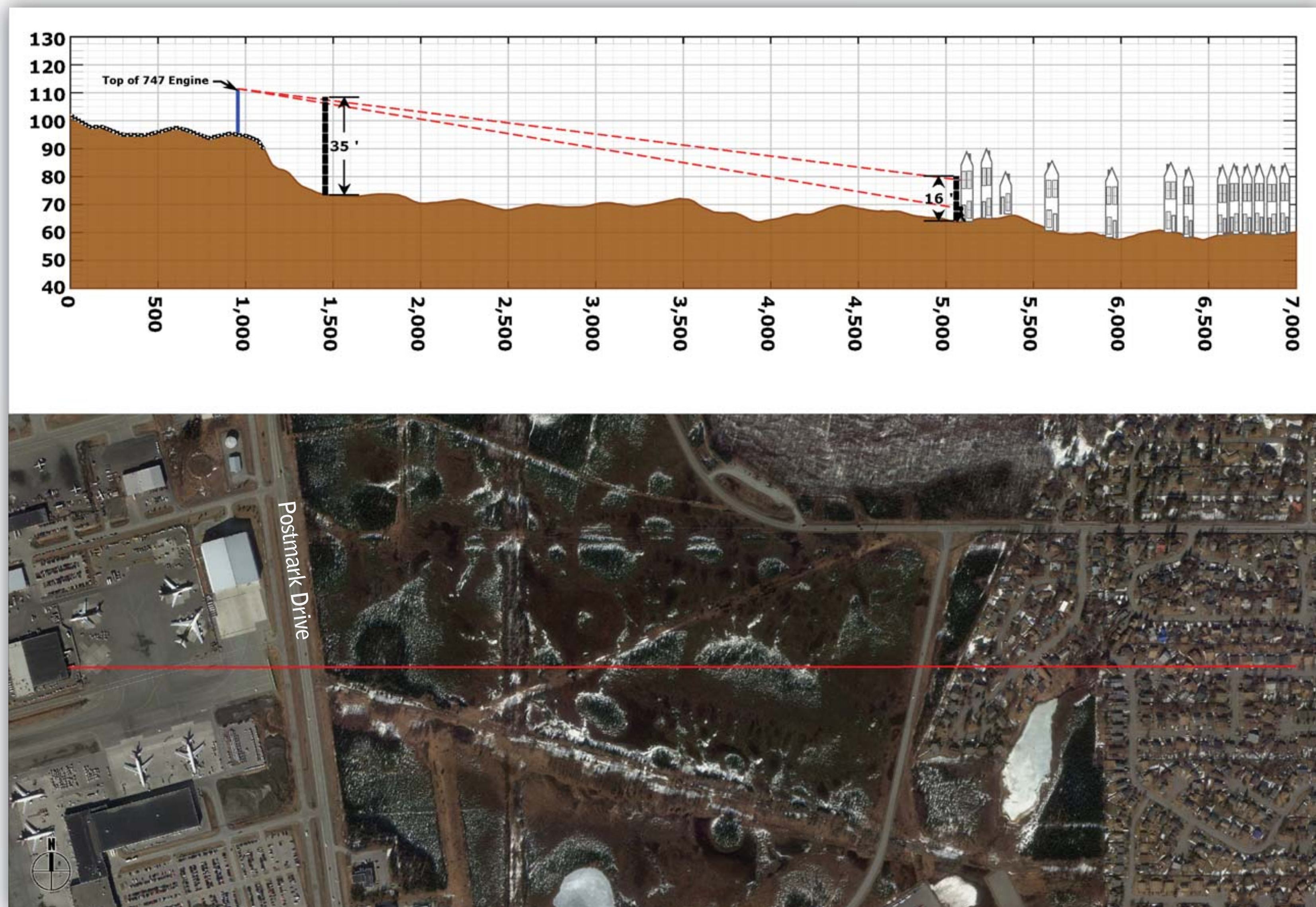

FIGURE G9
North Airpark Elevation Profile

IMPACTS OF IMPLEMENTATION: This option does not have any aircraft operational impacts. However, it is important to note that location of barriers could have an impact on the Airport itself, and its ability to provide facilities if the barriers are located within areas for future development. Therefore, any barrier locations would have to take future development into account before being implemented so as to not adversely constrain the Airport.

AIRPORT AND ATC OPERATIONAL CONSIDERATIONS (SAFETY AND EFFICIENCY ISSUES): Any barriers would have to be developed to meet Part 77.

OTHER ENVIRONMENTAL ISSUES (NEPA, ETC.): Implementation of noise abatement options requires compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, outlines the documentation required based on the types of federal action.

LEGAL ISSUES: The option does not appear to have legal issues associated with its implementation.

CONCLUSIONS OF CONSULTANT TEAM: The relative topography of the residential areas near the South Airpark precludes the effective implementation of noise barriers in this area. The same is true for the North Airpark. However, the relative topography of the North Airpark with the residential areas to the east will increase the effectiveness of the GRE discussed in Option 4 compared to a situation where the homes are level with or elevated above the airfield.

A noise barrier located along the eastern boundary of the Airport, just adjacent to the homes located east of the gravel airstrip, with a height of at least 16 feet above the residential land elevations would considerably reduce noise from aircraft ground operations. However, a ground run-up enclosure (GRE) is also being considered as another alternative in this chapter and may be more effective than a noise barrier in this area.

Option 4: Ground Run-up Enclosure (GRE)/Hush House

DESCRIPTION OF THE OPTION: Aircraft ground run-ups are routine aircraft engine maintenance tests, which require the operation of an engine at high power for extended periods of time generating continuous elevated noise levels. GREs provide a location for such operations that minimizes engine noise to the surrounding community. A GRE could be sited in one of a number of locations adjacent to existing taxiways to enable aircraft to perform run-ups in a manner that minimizes aircraft noise for the surrounding populated areas.

DISCUSSION: Airlines must regularly conduct maintenance and 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. A substantial amount of noise can be created when run-up testing occurs. As a result, airports often establish locations on the airfield for run-ups to minimize the impacts on nearby residences. An engine run-up enclosure (sometimes called a GRE or a Hush House) is a structure designed to deflect upward the noise from the run-up, thus reducing noise levels impacting areas surrounding the Airport.

Chicago O'Hare International Airport was the first large commercial service airport in the U.S. to develop a GRE. Pontiac/Oakland County Airport in Waterford, Michigan has also built a GRE. The O'Hare GRE cost $3 million (in 1999 dollars) and accommodates B-747 aircraft, whereas the smaller Oakland County GRE cost $3.5 million (2004 dollars) and accommodates general aviation aircraft, including business jets. One of the other variables in the cost of the GRE is if new pavement and access is needed to build the GRE facility. If a new pad is needed, then the total costs can double.

A GRE is a three-sided enclosure with no roof where aircraft taxi to for the purpose of conducting an engine run-up. The size of the facility is dependent upon the type of aircraft that would use the facility. An example of the cost vs. size of the facility is presented in Table G4.

Table G4
COMPARISON OF ESTIMATED COST AND SIZE OF GRE'S

Aircraft	Cost (millions)	Land Site (Sq. ft.)
B-747-400	$5.0	100,000
B-757	$4.5	60,000
B-737/MD80	$4.0-	50,000

Note: Cost is approximate. Taxiways to the GRE can be an additional cost and can greatly affect this number.

The Lmax (Maximum Noise Level, or the highest noise level reached during a single noise event) noise footprint for a 747-400 aircraft run-up with and without a GRE at the existing ground run-up locations and two other potential GRE locations is shown in Figure G10. The GRE would reduce noise levels by roughly 15 dBA. The 747-400 aircraft is representative of the worst case aircraft in terms of run-up noise at the Airport.

No locations exist at ANC that would eliminate all run-up noise from every area adjacent to the Airport. However, several locations could be examined to minimize effects. A full site selection study would occur prior to this alternative being implemented to make sure that the best possible site is selected based on noise, as well as operational issues, such as taxi time, Part 77, and wind direction. A GRE cannot be used in all wind conditions. GRE facilities are aligned with the prevailing winds, with the opening facing into the wind. In this case for the locations on Taxiway Q or the two Postmark Drive locations, the GRE would be oriented with the open end facing generally to the north/northwest in the same general heading as the Runway 15/33. For the alternative location on Taxiway J, it would be oriented with the open end to the west (along the same general heading of Runway 7/25. Assuming a north/northwest orientation of the GRE, the facility could be used almost 100% of the time. However, it is possible that the wind speed and direction could render the GRE momentarily non-operational.

NOISE ABATEMENT PROCEDURE GOAL: The goal of this option would be to reduce single event noise levels from aircraft maintenance engine run-up testing.

COMPARABLE EXISTING PROCEDURE(S): Currently ANC does not have a GRE; rather two locations on the airfield are designated (Taxiway J and Taxiway Q) where run-ups can be performed, and the Airport has existing procedures in place that require aircraft run-ups to orient to direct noise out toward the water to minimize noise exposure to the surrounding community.

MODELING ASSUMPTIONS/NEW PROCEDURE: Four areas were identified for possible location of a GRE (the two existing run-up locations at Taxiway J and Taxiway Q, as well as two locations near Postmark Drive).

The assumptions used in this analysis include the unrestricted use of the GRE. All ground run-up activity would occur in the enclosure, unless wind conditions precluded the use of the GRE. The existing locations would no longer be available for maintenance activities, and only be used as backup if winds precluded use of the GRE.

Lmax is the highest noise level reached during a noise event and it is this metric to which people generally respond when a ground run-up occurs, so Lmax was used to analyze the potential benefits of a GRE.

ANALYSIS OF OPTION: The analysis of this option considered both the noise exposure impacts of the option, as well as the possible operational effects.

NOISE ANALYSIS: Because of the unique way that ground run-up noise affects the community, the Lmax noise metric was used to examine the potential benefits of a Ground Run-Up Enclosure.

IMPACT ON ANNUAL DNL CONTOUR: DNL noise contours were not used to evaluate the noise impacts associated with a ground run-up enclosure, because it would likely not show a measurable change in those contours; rather the Lmax metric was used because of the unique nature of aircraft ground run-up noise and its impact on communities. Noise from aircraft engine run-ups have varying characteristics depending upon the type of run-up procedure, the power level, the engine type, and the orientation of the aircraft. Full power run-ups present the greatest potential for noise impacts. The characteristics of engine run-up noise are summarized below:

- ✓ Varying duration noise events that can last many minutes
- ✓ Quick onset and drop-off of the noise
- ✓ Dominant low-frequency characteristics
- ✓ Magnitude of the noise is similar to aircraft departure ground roll
- ✓ Some run-ups include a number of cycles at full power
- ✓ Greatest potential for impact is for those homes close to the Airport

RUN-UP NOISE CONTOURS. Run-up noise single event contours were generated for a 747-400 aircraft, which represents the loudest aircraft that is prevalent in the fleet operating at the Airport. However, it is important to note, that this represents the loudest run-up, and most of the aircraft that would use the GRE are quieter than the 747-400.

Figure G10 presents the 70 dBA Lmax and 60 dBA Lmax contour for a 747-400 aircraft run-up at full power without a proposed GRE at the two existing run-up locations (Taxiway J and Taxiway Q), and Figure G11 shows a 747-400 run-up at full power in the proposed four alternative GRE locations. The results show significant reductions in noise as a result of the use of a GRE and the centralization of all run-up activity.

Table G5 presents a summary of the total population within all of the run-up locations combined for the existing procedure and for the GRE alternative. The existing procedure table is a composite for the worst case run-up at each of the run-up locations. While no homes were included in the 70 dBA Lmax without the GRE, the results show for the GRE alternative up to a 100% reduction in the potential population exposed to run-up noise greater than 60 dBA Lmax at any of the four proposed locations.

Table G5
GROUND RUN-UP ENCLOSURE (GRE)

Noise Exposure	60 dBA Lmax		70 dBA Lmax	
	Population	Housing Units	Population	Housing Units
Existing - NO GRE				
Taxiway J	1,480	470	0	0
Taxiway Q	3,140	1,230	0	0
With GRE				
Taxiway J Location	0	0	0	0
Taxiway Q Location	0	0	0	0
Postmark Drive Location #1	0	0	0	0
Postmark Drive Location #2	0	0	0	0

Source: L& B and Mead & Hunt, Inc., 2013. 2010 US Census Numbers; all numbers are estimates.

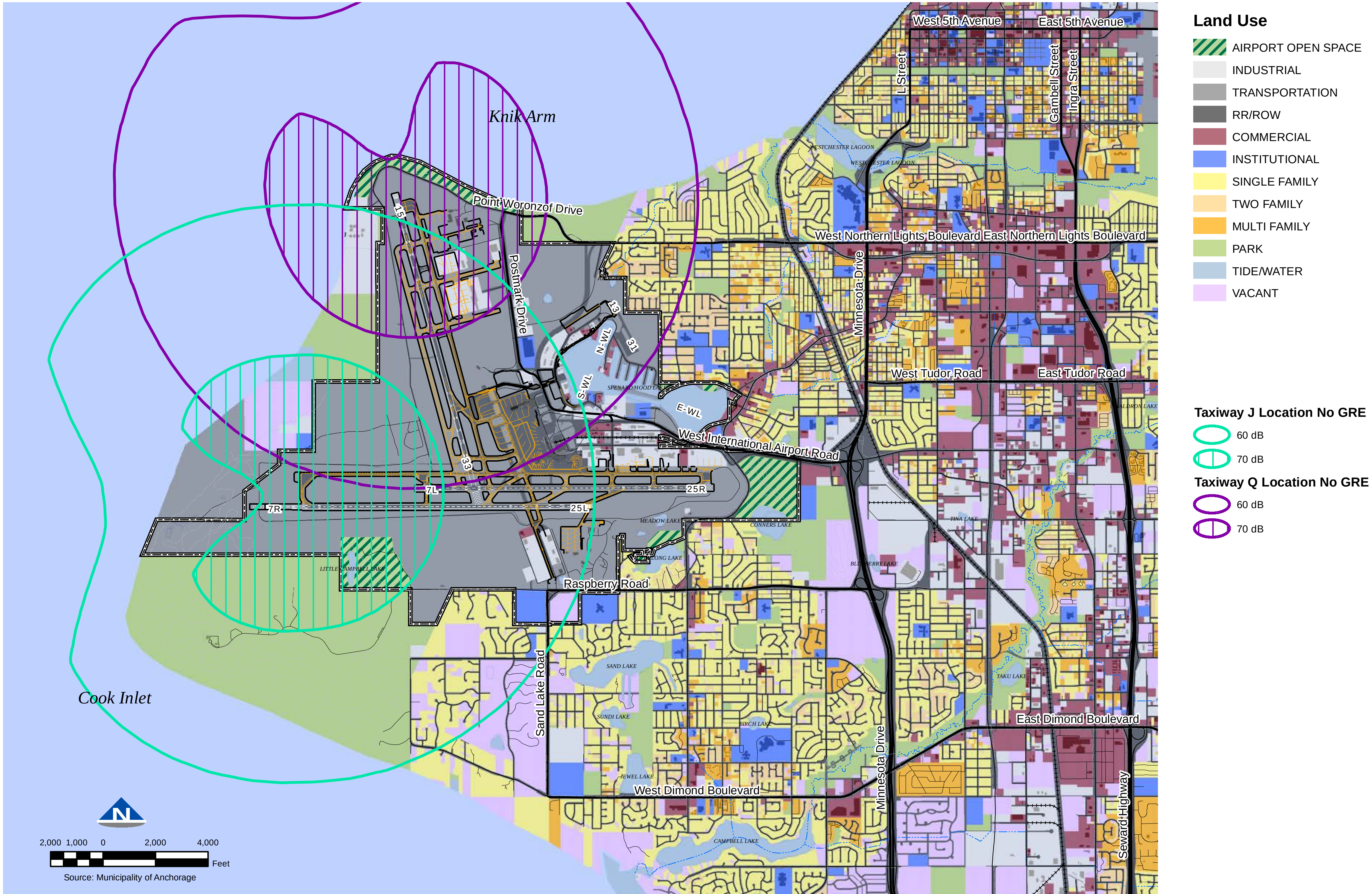

Figure G10 Lmax without GRE

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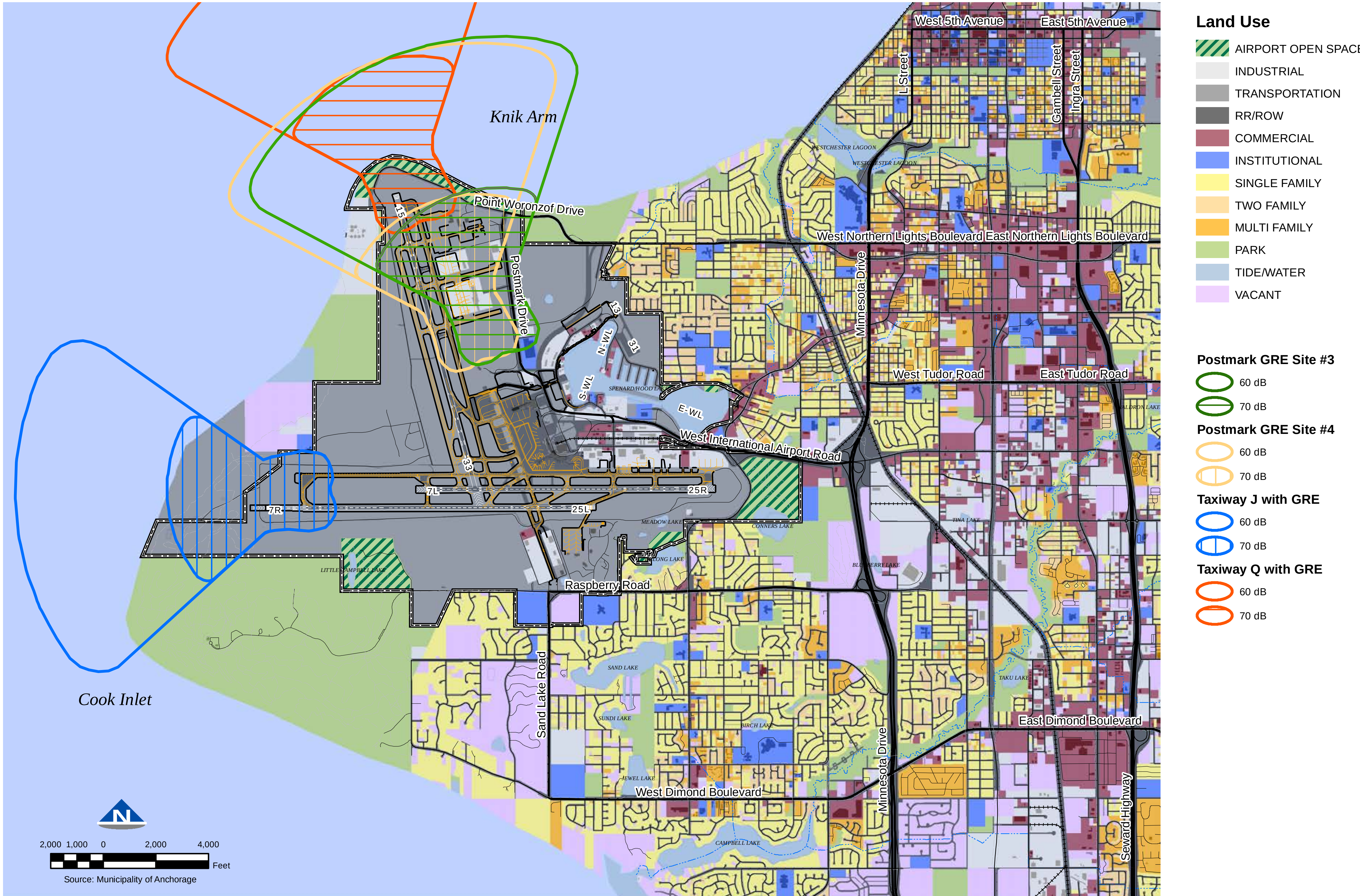

Figure G11 Lmax with GRE

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IMPACTS OF IMPLEMENTATION: Outside of the use of the ground run-up enclosure for all maintenance activities, there are no significant operational impacts resulting from development of a centralized ground run-up enclosure. A GRE would require all run-ups to be conducted in a central location. Relative to current procedures, an increase in taxiing would be expected for aircraft to use the GRE, depending upon the location of the maintenance base with respect to the aircraft.

AIRPORT AND ATC OPERATIONAL CONSIDERATIONS (SAFETY AND EFFICIENCY ISSUES): The GRE would have to be developed to meet Part 77.

OTHER ENVIRONMENTAL ISSUES (NEPA, ETC.): Implementation of noise abatement procedures requires compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures,* outlines the documentation required based on the types of federal action. The development of a GRE may be categorically excluded under NEPA, meaning that if extraordinary circumstances do not arise, an Environmental Assessment or an Environmental Impact Statement would not be required. No extraordinary circumstances are currently known, although it is suggested that a review of airport environmental conditions would be necessary to ascertain such conditions.

LEGAL ISSUES: The option does not appear to have legal issues associated with its implementation.

CONCLUSIONS OF CONSULTANT TEAM: Recommended upon the identification of funding priorities.

Option 5: Voluntary Reduced Use of Reverse Thrust

DESCRIPTION OF THE OPTION: When runway conditions allow for a dry, uncontaminated surface, and low congestion activity, it is sometimes possible for the pilot to reduce the use of reverse thrust upon landing and still exit the runway at the desired location. This option is entirely up to the discretion of the pilot in command and would only be implemented when conditions allow. This option cannot be monitored or enforced.

DISCUSSION: The ability to reduce the use of reverse thrust depends on the runway length required by the landing aircraft, as well as the location of the taxiways. In general, larger/heavier aircraft require longer landing distances. The reduced use of reverse thrust is greatly dependent on landing conditions as well as taxiway location, and can only be a recommended measure, not required, as the use of reverse thrust is up to the pilot based on conditions and safety.

NOISE ABATEMENT PROCEDURE GOAL: The goal of this option would be to reduce noise levels from landing jets, where pilots typically deploy reverse thrust to slow the aircraft. The optional use of taxiways farther down the runway would reduce the need for reverse thrust.

COMPARABLE EXISTING PROCEDURE(S): None.

MODELING ASSUMPTIONS/NEW PROCEDURE: As it is difficult to determine when or how often such a procedure could safely be used, no modeling was performed. This would be a possible reduction in aircraft ground noise only.

ANALYSIS OF OPTION: The analysis of this option considered both the noise exposure impacts of the option, as well as the possible operational effects.

NOISE ANALYSIS: This alternative was analyzed qualitatively, because it is voluntary and it is impossible to quantify when this procedure could be safely implemented. This option would reduce the use of reverse thrust on an "as able" basis and would therefore reduce noise when pilots are able to reduce the use of reverse thrust. This option is entirely up to the discretion of the pilot in command and would only be implemented when conditions allow, and therefore, while there would be a reduction in noise when implemented, this reduction cannot be accurately quantified.

IMPACT ON ANNUAL DNL CONTOUR: DNL noise contours were not used to evaluate the noise impacts associated with a use of reverse thrust, because it would be a voluntary procedure and the reduction of effects could not be calculated because the use would be entirely up to the pilot and not associated with any conditions that could be modeled. However, any reduction in the use of reverse thrust could be qualitatively considered a noise benefit for the surrounding communities.

Therefore, even though this measure is voluntary and not quantifiable via the DNL metric, it could provide a noise reduction benefit to surrounding communities. It is important to note that the future taxiway configuration could result in changes in the amount of time pilots would use reverse thrust.

IMPACTS OF IMPLEMENTATION: Because this options would be voluntary, it would be entirely up to the pilot to decide when to implement it. It would be implemented when feasible and safe.

AIRPORT AND ATC OPERATIONAL CONSIDERATIONS (SAFETY AND EFFICIENCY ISSUES): Relative to current procedures, a decrease in use of reverse thrust could increase the taxi time, resulting in additional fuel costs. Aircraft would potentially need to use taxiways farther down the runway, as it would take them longer to stop without the use of reverse thrust.

LEGAL ISSUES: The option does not appear to have any legal issues associated with its implementation. However, it would be a voluntary procedure, as the use of reverse thrust is entirely up to the pilot and dependent on multiple factors such as weather, airfield conditions, safety, etc.

OTHER ENVIRONMENTAL ISSUES (NEPA, ETC.): Because it is a voluntary procedure, no NEPA documentation would need to be conducted, because no federal action is being implemented.

CONCLUSIONS OF CONSULTANT TEAM: Recommended as a voluntary measure.

ADDITIONAL STUDIES ANALYSIS

Potential operational changes relative to two separate studies (the Master Plan Update and the RNP Procedure Study) have the potential to change noise around the Airport. These potential changes are examined in the Part 150 Study below with respect to their potential to affect the noise. Since the initial examination of these elements, they were both found to be reasonably foreseeable; therefore, these changes will be included as a future condition in the official Noise Exposure Map in this Study.

Master Plan Update Modified Preferential Runway Use System to Meet Future Capacity

DESCRIPTION OF THE OPTION: In response to the Master Plan's analysis of projected future operations at the Airport, there may be an issue meeting the projected operations demand under the existing preferential runway use system without causing delay. Currently, the Airport operates with a preferential runway use system that, when winds allow, directs arrivals and departures over the water instead of over the non-compatible land uses around the Airport. This system was put into place after the previous Part 150 Study and has been very successful. This runway use change examines the modification in the preferential runway use system during times of peak demand in 2020 to reduce operational delay. These changes would likely occur for only a portion of the day. This would result in an increase in use of Runway 07L for departures and a corresponding decrease in the number of jets departing Runway 33 during certain times of the day, generally noon to 5:00 p.m. No changes would occur during the nighttime hours (10 p.m. to 7 a.m.).

DISCUSSION: Changes in the percentage of time a runway is used can alter the noise exposure based on where the aircraft are directed (over compatible or non-compatible land uses). Runways that have arrivals or departures over compatible land uses can greatly decrease the noise exposure for non-compatible land uses such as residential areas, and runways that have arrivals and departures over non-compatible land uses can greatly increase the noise exposure.

MASTER PLAN STUDY GOAL: This is not a noise abatement procedure. The goal of this option in the Master Plan Update would be to meet the future capacity of the Airport by changing the existing preferential runway use system during times of peak operations.

COMPARABLE EXISTING PROCEDURE(S): As stated above, the Airport currently operates under a preferential runway use system that directs a large portion of operations over the water rather than to the east and south of the Airport, where there is a larger concentration of non-compatible land uses. This procedure was put into place after the previous Part 150 Study and has since reduced the contours significantly from the contours shown in the previous Part 150 Study.

MODELING ASSUMPTIONS/NEW PROCEDURE: Table G6 lists the runway utilization proposed in the Master Plan. This change assumed an increase in use of Runway 07L for departures and a corresponding decrease in the number of jets departing Runway 33 during certain times of the day. No changes would occur during the nighttime hours (10 p.m. to 7 a.m.) and no changes were made to the runway utilization at Lake Hood Seaplane Base (LHD).

Table G6
RUNWAY USE PERCENTAGES FOR THE AIRPORT MASTER PLAN UPDATE MODIFIED PREFERENTIAL RUNWAY USE

Runway	Arrivals	Departures
33	0.00%	39.72%
15	27.97%	3.01%
7L	12.11%	35.20%
7R	58.81%	0.04%
25R	1.10%	0.92%
25L	0.00%	21.10%

Source: ATAC, 2013 Numbers may not add due to rounding.

ANALYSIS: The analysis of this additional study consideration examined both the noise exposure impacts of the option, as well as the possible operational effects.

NOISE ANALYSIS: As required by Part 150, the examination of this operational change relied upon the use of the average annual DNL noise contours to consider possible noise exposure consequences of the option.

IMPACT ON ANNUAL DNL CONTOUR 2020: When looking at the changes in the DNL contours, this operational change increased the area within the 65 DNL contour, from about 35 homes/95 people to about 100 homes/225 people. A large portion of these homes have already been sound insulated under the Airport's Residential Sound Insulation Program that was implemented as a recommendation from the previous Part 150 Study. Of the homes within the 65 DNL, approximately 50 of these homes have not previously been insulated. This operational change would also increase both the area and housing units within the 60 DNL contour. The contours are illustrated in Figure G12.

This modification in the preferential runway use system and its change on land use is summarized in Table G7 for 2020.

Table G7
COMPARISON OF EFFECTS OF MASTER PLAN PHASE 2– 2020 (MODIFICATION OF PREFERENTIAL RUNWAY USE SYSTEM)

	Baseline (2020)/No Action			Master Plan Alt 3 – 2020		
	Population	Housing Units	Non-Insulated Housing Units	Population	Housing Units	Non-Insulated Housing Units
75 DNL	0	0	0	0	0	0
65 DNL & Greater	95	35	25*	225	100	50*
60 DNL & Greater*	1,880	870	NA	7,390	3,090	NA

Source: 2010 US Census Numbers rounded.
*This number was calculated using land use parcel data
Note: All numbers are estimates; no residential uses are located in the 75 DNL and greater contours.
NA – Not applicable. Residences within the 60 DNL noise contour are not eligible for insulation.

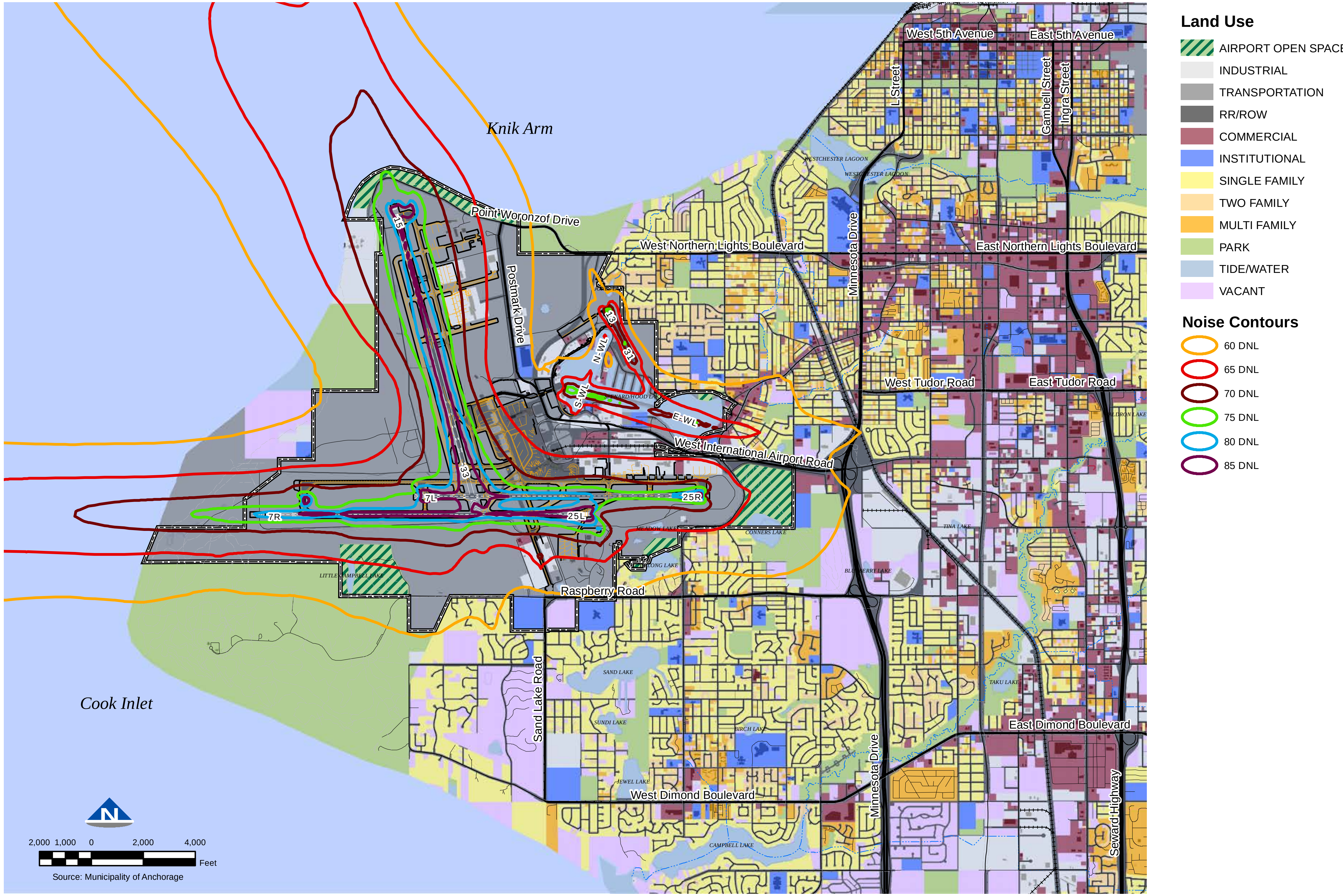

Figure G12 **MP Revised Preferential Runway Use Contours**

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IMPACTS OF IMPLEMENTATION: The following issues could arise from implementation of the operational change. Also identified are the agencies that would have a role assisting in this option's implementation.

AIRPORT AND ATC OPERATIONAL CONSIDERATIONS (SAFETY AND EFFICIENCY ISSUES): This option would not be expected to materially change FAA ATC workload. The current Airport Master Plan Update is examining these elements.

OTHER ENVIRONMENTAL ISSUES (NEPA, ETC.): Implementation of noise abatement procedures requires compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, outlines the documentation required based on the types of federal action and would need to be examined to determine if a NEPA document would need to be completed in order to proceed with this operational change. The current Airport Master Plan Update is examining these elements.

LEGAL ISSUES: The option does not appear to have legal issues associated with its implementation. The current Airport Master Plan Update is examining these elements.

CONCLUSIONS OF CONSULTANT TEAM: This operational change is not a noise abatement alternative and does not meet the goal of the Part 150 Noise Compatibility Study, because it increases the number of people affected by noise. Although it would not reduce noise, the Master Plan indicates that the Airport may have other operational reasons to implement this operational change outside the process of the Part 150 Study for capacity reasons. Therefore, it was further examined as a future existing condition in the official future Noise Exposure Map in Chapter I.

Required Navigation Performance (RNP) Procedure

DESCRIPTION OF THE OPTION: In response to a Study from the FAA relating to navigational aid known as NextGen, this study modeled a RNP procedure that is being developed as part of an FAA funded NextGen study. The main purpose of the RNP procedure from the FAA study was to increase safety. The RNP approach is being developed by General Electric (GE) for the FAA and because of its potential to change the noise exposure near the Airport, it is being examined in the Part 150 Study.

DISCUSSION: The implementation of a Required Navigation Performance (RNP) Procedure is being examined under an FAA Study, separate from the scope of this Part 150 Study and is not initiated by the Airport. However, the potential noise impacts from this proposed procedure are examined within this study to determine if there would be any substantial noise impacts relative to the base case (2020) contours. A RNP procedure is a satellite based procedure that allows an aircraft to fly a specific path between two 3-dimensional points in space. The procedure is meant to benefit safety of arriving aircraft on to ANC's Runway 33 (arriving from the south) during poor weather conditions. To perform this procedure, aircraft need to be RNP-capable. The forecast shows a slight increase in the number of RNP-capable aircraft that could use Runway 33.

RNP STUDY GOAL: This is not a noise abatement procedure, but rather a potential change in the way aircraft may operate if the RNP Procedure is implemented as a result of the FAA RNP Study. The goal of implementing this procedure would be to increase safety while minimizing noise impact.

COMPARABLE EXISTING PROCEDURE(S): None.

MODELING ASSUMPTIONS/NEW PROCEDURE: Given that the forecast shows an increase in aircraft that could perform an RNP arrival on Runway 33, the noise impact of these arrivals will increase to the south of Runway 33, primarily during adverse weather conditions.

ANALYSIS OF OPTION: The analysis of this option considered both the noise exposure impacts of the option, as well as the possible operational effects.

NOISE ANALYSIS: As required by Part 150, the study relied upon the use of the average annual DNL noise contours to consider possible noise exposure consequences of the option.

IMPACT ON ANNUAL DNL CONTOUR: When looking at the changes in the DNL contours (Figure G13), this potential change in arrival procedure does not change the number of housing units within the 65 DNL contour.

It slightly increases the number of homes and population within the 60 DNL contour. By increasing the arrivals on Runway 33, the noise contours expand underneath the arrival path. The 65 DNL expands slightly, but not enough to reach additional housing units. However, the 60 DNL expands south and reaches additional housing units.

The population analysis associated with the RNP Procedure is shown in Table G8.

Table G8
COMPARISON OF DNL EFFECTS OF RNP PROCEDURE

	Baseline (2020)/No Action		RNP Procedure	
	Population	**Housing**	**Population**	**Housing**
75 DNL	0	0	0	0
65 DNL & Greater	95	35	95	35
60 DNL & Greater*	1,880	870	1,890	875

Source: 2010 US Census Numbers rounded.
Note: no residential uses are located in the 75 DNL and greater contours.
* includes the 65 DNL & Greater

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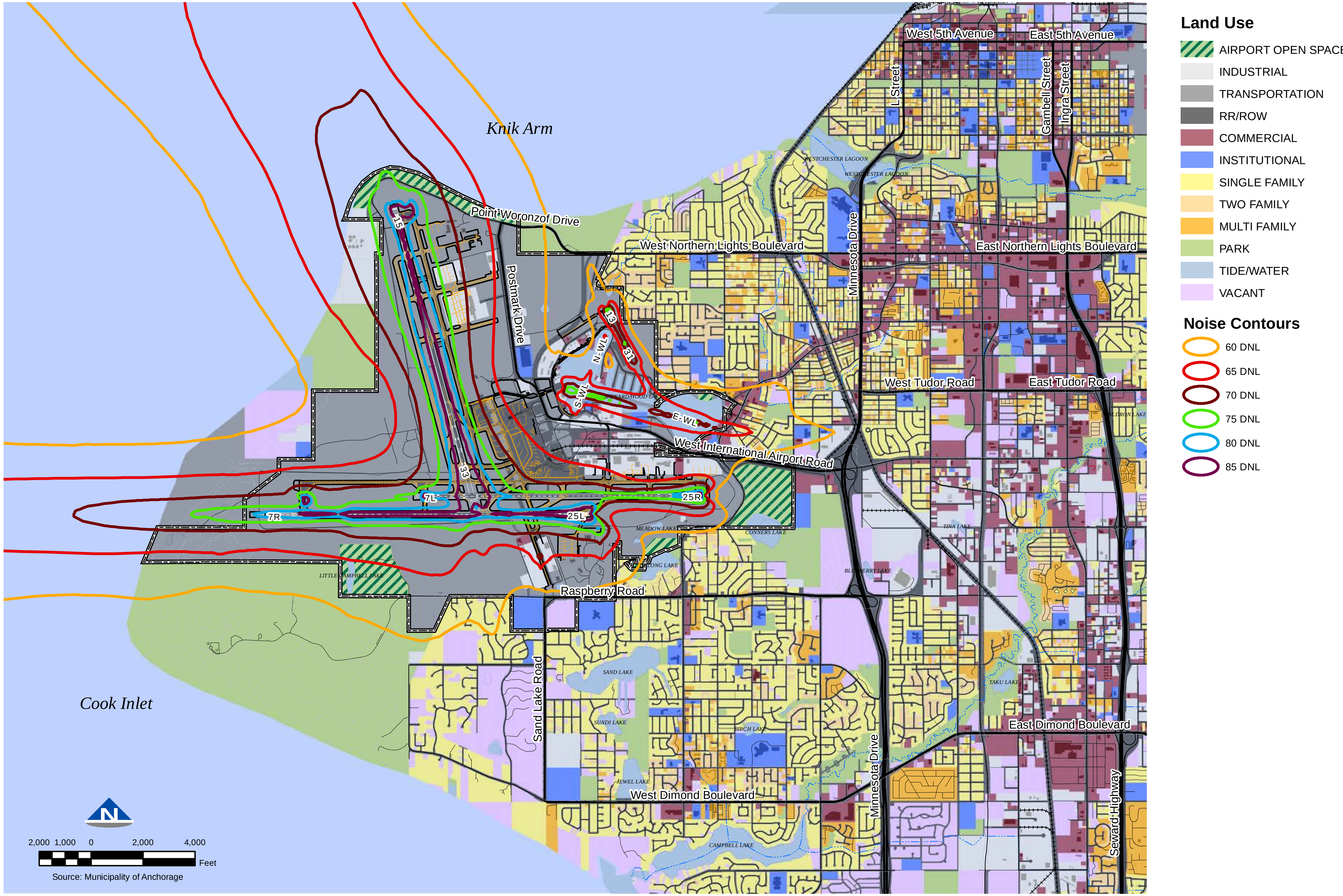

Figure G13 **RNP Procedure Contours**

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IMPACTS OF IMPLEMENTATION: The following issues could arise from implementation of the procedure. Also identified are the agencies that would have a role in assisting in the implementation of this procedure.

AIRPORT AND ATC OPERATIONAL CONSIDERATIONS (SAFETY AND EFFICIENCY ISSUES): FAA has ultimate responsibility for the control of aircraft flight, whereas, the airlines/pilot control the flight procedures, such as departure climb. This procedure would not be expected to materially change FAA ATC workload. The current RNP Study is examining these elements.

OTHER ENVIRONMENTAL ISSUES (NEPA, ETC.): Implementation of noise abatement procedures requires compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, outlines the documentation required based on the types of federal action. This option would likely require preparation of a Categorical Exclusion to determine if the impacts would be significant; significance is based on a 1.5 DNL change in noise exposure within the 65 DNL and greater noise contour. Because there would not be an increase in the number of homes within the 65 DNL, a Categorical Exclusion would likely be needed to implement this action. The current RNP Study is examining these elements.

LEGAL ISSUES: The option does not appear to have legal issues associated with its implementation. The current RNP Study is examining these elements.

CONCLUSIONS OF CONSULTANT TEAM: This potential operational change is not a noise abatement measure and therefore, this operational change does not meet the goal of the Part 150 Noise Compatibility Study, because it increases the number of people affected by noise. Although it would not reduce noise, the Airport may have other operational reasons to implement this operational change outside the process of the Part 150 Study for safety reasons. Therefore, it was included as a future existing condition when running the official Future Noise Exposure Map in Chapter I.

Chapter H - Potential Land Use, Administrative and Facility Options

INTRODUCTION. The previous chapters presented the evaluation and analysis of airport operational noise abatement procedures. Included in those documents were the evaluation of approach and departure procedures, runway use alternatives/other operational procedures, and facility modifications. Those chapters addressed measures that could reduce the number of people affected by noise by changing the operational characteristics of aircraft flying into and out of Ted Stevens Anchorage International Airport (ANC) and Lake Hood Seaplane Base (LHD). This chapter presents the evaluation, analysis, and recommendations of land use measures, as well as administrative and facility measures.

- **Land use measures represent mechanisms that local land use officials can undertake to improve the compatibility of areas exposed to various noise levels.**
- **Administrative measures are those that the Airport can implement that are solely within their discretion. These measures will not result in noise reduction (as can be expected from the implementation of the operational noise abatement procedures), but will enable the Airport to monitor the success of the program and to provide enhanced community response to issues of concern.**
- **Facility measures include changes to the direct Airport facilities that could reduce noise. These measures will not result in noise reduction that would be visible in the DNL, so they have not been modeled. However, their implementation could potentially reduce single event noise intrusion. These measures, if recommended could be eligible for federal funding, pending availability.**

The analysis includes several measures that arose as a result of the public outreach process and discussions that have taken place at the Study Input Committee (SIC) and public meetings, as well as those measures that were included in the previous Noise Compatibility Program (NCP), approved by the FAA. The continued or revised measures from the NCP are noted under the title heading, along with the previous NCP measure number. The following table summarizes the land use, administrative, and facility options that are examined in this chapter.

Table H1
SUMMARY OF LAND USE, ADMINISTRATIVE AND FACILITY OPTIONS

Options	Responsible Party	Relationship to Previous Part 150 Study
Land Use Options		
Voluntary Sound Insulation	Airport	Continued Measure – *3.3.11 Soundproofing for Existing Development*
Voluntary Acquisition of Non-Compatible Land Uses or Undeveloped Land Zoned for Residential Use	Airport	Continued Measure – *3.3.10 Land Banking*
Voluntary Acquisition of Avigation or Noise Easements	Airport	Revisited Measure
Voluntary Sales Assistance (Assurance Program)	Airport	Revisited Measure
Disclosure Statements/ Buyer Notification	Local Jurisdiction	Continued Measures – *3.3.4 Noise Levels on Plats* and *3.3.9 Fair Disclosure Policy*
Building Code Requirements – Sound Attenuation Required for New Development	Local Jurisdiction	Continued Measure – *3.3.3 Soundproofing Requirement for New Development*
Comprehensive Plan Amendments	Local Jurisdiction	Continued Measure – *3.3.5 Comprehensive Planning*
Zoning Code Changes/Noise Overlay Zone	Local Jurisdiction	Continued Measures – *3.3.1 Compatible Land Use Zoning*, *3.3.2 Mobile Home Camper Park Restrictions*, *3.3.8 Noise Overlay Zone*, *3.3.6 Planning Commission Review* and *3.3.7 Public Land Development Criteria*
Administrative Options		
Continuation of Study Input Committee	Airport	Continued Measure – *3.4.1 Noise Advisory Committee*
Development of Fly Quiet Report Card and Pilot Awareness Program	Airport	Continued Measures – *3.4.4 Regulations and Agreements*, *3.4.8 Airfield Signs*, *3.4.10 Pilot Manual Insert* and *3.5.2 GA Program*
Continuation of Public Information Program and Noise Information on the Website	Airport	Continued Measures – *3.4.7 Noise Information Page* and *3.4.9 Public Information Program*
Public Comment Submittal Form	Airport	Continued Measure – *3.4.3 Complaint Response*
Addressing of Noise Comments	Airport	Revised Measure – *3.4.6 Noise Program Manager*
Noise Monitoring/Flight Tracking	Airport	Revised Measure – *3.4.2 Noise Monitoring*
Review and Update Part 150 Study	Airport	Continued Measure – *3.4.5 NEM and NCP Review and Revision*
Facility Options		
Install Electrification and Preconditioned Air at All Jet Bridges and Cargo Areas	Airport	None – New Measure

Source: Part 150 Study ROA, 2000; Mead & Hunt 2014.

LAND USE OPTIONS

This analysis focuses on the evaluation of land use measures designed to reduce incompatible land use within specific noise exposure contours. Federal guidelines contained in Part 150 indicate that residential development, along with other noise sensitive uses such as schools, religious facilities, hospitals, nursing homes, etc. should be discouraged from developing within areas exposed to 65 DNL and greater sound levels. These guidelines are recognized by the FAA and 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 compatibility actions can be placed in two groups:

- **Preventive:** Prohibiting certain land uses from developing within the aircraft noise exposure contours. Preventive actions do not affect existing land uses, but are targeted at preventing future noise sensitive uses and generally have to be implemented by the land use authority (in this case the Municipality of Anchorage (MOA)). Preventive actions include zoning, building codes/subdivision regulation provisions, granting of avigation easements, sound attenuation requirements for new construction, buyer disclosure statements and comprehensive plan amendments.
- **Remedial or Corrective:** Remedial or corrective actions are directed at correcting existing land use incompatibilities. Remedial actions may include sound insulation of single family structures, multi-family structures, sleeping portions of fire stations, hospitals, assisted living facilities, religious facilities, schools and libraries; purchase of non-compatible land uses within high noise contours; purchase of avigation easements; and sales assistance programs.

Preventative measures are within the authority of the local jurisdiction and usually of lesser concern to citizens living near the Airport, because they apply only to new construction. Remedial measures are within the authority of the FAA to fund for existing non-compatible land uses inside the 65 DNL noise contour. Both types of land use measures were evaluated.

The Airport has been in the process of implementing remedial land use measures for the past several years, since the completion of the last Part 150 Study and the issuance of the Record of Approval in 2000. Since 2001, the Airport has sound attenuated 880 homes at a cost of approximately $45 million. As was described in prior chapters, the following noise exposure impacts have been identified by this Part 150 Study.

Table H2
SUMMARY OF FUTURE BASELINE NOISE EXPOSURE IMPACTS (2020)

Noise Contours	Baseline (2020)/No Action		
	Population	Housing Units	Non-Insulated Housing Units
75 DNL	0	0	0
65 DNL & Greater	95	35	25*
60 DNL & Greater*	1,880	870	NA

Source: 2010 US Census and Aerial Photography   Numbers rounded to the nearest 5.
* Point count with parcel data/aerial used to determine this number.
Note: No residential uses are located in the 75 DNL and greater contours. No other noise sensitive uses are located in the 70 DNL and greater contour. No schools, religious facilities or historic properties are included in the 65 DNL and greater noise contour.

Some of the homes within the 65 DNL have been insulated under the previous Residential Sound Insulation Program. However, since there are additional houses within the updated contours that are not insulated within the 65 DNL contour (that were not offered insulation or eligible for insulation (due to code or other issues) in the previous Residential Sound Insulation Program), this chapter will focus on both the remedial land use measures (such as insulation), as well as on the preventative land use measures that can be implemented by the various jurisdictions surrounding the Airport with land use control authority. Each of these measures is described in greater detail in the following pages. Land use measures recommended and approved in the previous FAR Part 150 Study, but not yet adopted or implemented by the entities having jurisdiction, remain as recommendations.

Evaluation Method

The future base case noise contour (2020) will be used to quantify the number of structures and people eligible for participation for each of the land use measures. If any of the operational changes, such as the RNP Procedure or Master Plan Runway Use changes are determined to be reasonably foreseeable, these eligibility numbers will change and be based upon that scenario at that time.[1]

[1] All alternatives within this chapter were analyzed based on the Future 2020 Noise Contours; Since that time, the Master Plan Update Modified Preferential Runway Use System to Meet Future Capacity and the RNP Procedure have been deemed reasonably foreseeable, so in the Recommendations Chapter (Chapter I), these numbers reflect that change for those Recommendations brought forward for inclusion in the Noise Compatibility Program (NCP).

For remedial land use measures (those eligible for Federal funding), the 65 DNL and greater contours will be used for evaluation. It is important to note that Federal policy precludes homes constructed after October 1998 within known noise contours from being eligible for Federal remedial land use funding associated with the recommendations. As previously noted, residential land use is considered compatible up to the 65 DNL contour and sometimes in higher contours, such as 70 DNL, if specific measures are taken such as additional sound insulation. This means that generally, residential structures are non-compatible with aircraft noise if located in the 65 DNL or greater noise contour. A summary of the options are included in Table H1.

Land Use Option 1: Voluntary Sound Insulation of Noise Sensitive Structures within the 65 DNL Noise Contour such as: Single Family Homes, Multi-Family Homes, Assisted-Care Facilities, and Schools and Religious Facilities

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.3.11 SOUNDPROOFING FOR EXISTING DEVELOPMENT

GOAL: To reduce the noise levels experienced inside noise sensitive uses. This would reduce aircraft-generated noise intrusion for sleeping, studying, and religious activities.

DESCRIPTION: Land uses, such as residential structures are considered to be non-compatible with aircraft noise if located within the 65 DNL or greater contour. Within this contour and with a measured interior noise levels of above 45 dB, homes can be considered as eligible for federal funding for noise reduction measures such as sound attenuation. The only non-compatible land uses within the 2020 65 DNL and greater contours are residential uses. This measure was a recommendation from the previous Part 150 Study. It could include insulation of eligible existing residential structures within the 65 DNL or greater noise levels of the 2020 contour created for this Study Update. The Airport recently completed a Residential Sound Insulation Program (RSIP) for insulation of existing structures within the previous 65 DNL noise contour that was recommended in the previous Part 150 Study. All eligible homes within the 1997 noise contour (and have accepted the terms of the insulation) have been sound insulated under previous phases of the program. However, the updated contours indicate that airport-related noise above 65 DNL occurs in areas where it previously did not, primarily in the area east of Lake Hood Seaplane Base; therefore, there are structures that could be eligible for insulation in those areas that have not received insulation.

The measure proposes to voluntarily sound attenuate the habitable rooms in eligible structures with a minimum 5 dB reduction. The eligible structures include existing private homes and public uses such as schools and religious facilities. No schools or religious facilities are located within the 65 DNL contour. An avigation easement is generally obtained in return for the attenuation, which grants the Airport the right to fly over a particular piece of property and create noise or vibration. The sound attenuation costs would be borne by the FAA (93.75%) with the Airport matching funds (6.25%) and would generally be an extension of the existing program.

To be eligible, the habitable rooms in existing structures must have been constructed prior to October 1, 1998 and had to be located within the approved 65 DNL or greater noise boundary. Under clarified guidance, homes must also show interior noise levels of 45 dB or higher in order to be eligible for sound insulation.

The soundproofing of eligible new structures and new construction/remodeling was an approved recommendation of the previous Part 150 Study Update. Sound attenuation work associated with the previous sound insulation program resulting from the previous Part 150 Study at ANC and LHD had an approximate total cost of $45 million for about 880 residences.

Based on the 2020 Future Base Case noise contours, of the 35 homes within the 65 DNL contour, there are approximately 25 housing units within the 65 DNL and greater noise contour that could be eligible for insulation.[2] These homes were not in the 65 DNL noise contour created for the 2000 Part 150 Study and were therefore not previously sound insulated or offered insulation under the previous sound insulation program. There are no schools, hospitals, or known religious facilities within the 65 DNL and greater noise contour. If sound insulation is determined to be a recommendation, then the feasible boundaries of such insulation must be identified. These boundaries are not necessarily required to follow the 65 DNL contour exactly, but can be determined by the closest reasonable physical boundary (major street, railroad track, highway, stream, etc.) beyond the contour so that neighborhoods are not separated, to the extent possible. This could slightly expand the number of housing units. These homes would then also need to meet the interior noise requirement of 45 dB, as well as be up to municipal, state and federal code.

[2] This alternative was analyzed based on the Future 2020 Noise Contours; since that time, the Master Plan Update Modified Preferential Runway Use System to Meet Future Capacity and the RNP Procedure have been deemed reasonably foreseeable. In the Recommendations Chapter (Chapter I), the numbers reflect that change for those Recommendations brought forward for inclusion in the Noise Compatibility Program (NCP). The number of potentially eligible homes are higher in the Recommendation chapter than listed here due to an increase in the contour size due to the two additional operational changes.

DISCUSSION: Sound insulation of specified units is eligible for Federal funding. However, the structure must be "brought up to code" prior to initiating sound insulation. Additionally, any contamination discovered or encountered by the homeowner while conducting upgrades is the responsibility of the homeowner and not reimbursable by the State or federal government. Any structural changes or improvements required to bring the structure into compliance with existing codes is not eligible for Federal funding and must be borne by the homeowner, or the local jurisdiction must waive the code requirements.

As noted earlier, the Airport has sound insulated approximately 880 dwellings under their previous RSIP (32 additional parcels were either not eligible or withdrew) at a cost of approximately $50,000 per single family house.

A review of the homes in the 2020 65 DNL contour indicates that approximately 25 homes could be eligible under this updated contour. These homes have not been insulated or offered insulation under the previous Residential Sound Insulation Program (i.e. these houses were not within the previous eligibility boundary). Homes that were either offered insulation in the past, and opted out, or were not eligible due to code or other issues would not be eligible in this measure. At an approximate $50,000 per house for insulation, this option could cost about $1.25 million (although cost per unit will vary depending on size of house in question, number of doors, window, and type of HVAC system). The exact eligibility boundary would be determined with FAA if this option becomes a recommendation.

SUMMARY: This option was a Recommendation from the Record of Approval approved by FAA in the 2000 Part 150 Noise Compatibility Program for the Airport (Measure 3.3.11). The updated noise contours encompass fewer homes than the noise contours generated by the last Part 150 due to the continued introduction of quieter aircraft and use of the preferential runway use system. Although all eligible homes within the RSIP boundary of the previous Part 150 study have been insulated (or chose not to have the insulation), there are approximately 25 homes within the updated 2020 65 DNL contour that may be eligible for insulation and have not been offered insulation in the past. When finalized, the eligibility boundary developed as part of this Part 150 Study could slightly expand the number of housing units, and then these homes would also need to meet the interior noise requirement of 45 dB, as well as be up to municipal, state and federal code.

Land Use Option 2: Acquisition of Non-Compatible Land Uses or Undeveloped Land Zoned for Residential Use

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.3.10 LAND BANKING

GOAL: To reduce the existence or potential of non-compatible land uses within the 65 DNL and greater noise contours.

DESCRIPTION: This measure would result in the voluntary (i.e. eligible homeowners may opt out if they wish), fee-simple purchase of privately-owned, vacant, non-compatible land uses within the 65 DNL contour, including the purchase of undeveloped property that is zoned for residential development. This would be a continuation of the existing program at the Airport (Land Banking – Measure 3.3.10 from the previous Part 150 Study Record of Approval), amended to include any areas within the new noise contours. In 2001 and 2002, approximately 6 acres of land were acquired under the NCP in the DeLong Lake Area, east of Kulis and South of Runway 25R. Based on the new contours, there is only a small amount of vacant, residentially-zoned property within the 65 and greater DNL contours. So with the combination of the previous NCP implementation and the shrinking contours, there is a much smaller potential for increasing non-compatible land uses within this contour.

DISCUSSION: With the new contours, there is a very small amount of vacant residentially zoned property that is within the 2020 65-70 DNL contour that could be developed into non-compatible land uses (less than half an acre). Unless local jurisdictions put in place land use controls, land zoned for residential uses could eventually be developed for homes.

SUMMARY: There is a very small amount of vacant land within the 65 DNL noise contour that is residentially zoned and could be acquired to prevent future non-compatible land uses.

Land Use Option 3: Voluntary Acquisition of Avigation or Noise Easements Over Non-Compatible Land Uses

PREVIOUS PART 150 STUDY REVISITED MEASURE

GOAL: To reduce the number of non-compatible land uses for residents wishing to remain in their homes but not participate in sound attenuation.

DESCRIPTION: his measures proposes to voluntarily purchase an avigation easement (right to fly over a property and make noise) from those owners of noise sensitive uses that do not desire to participate in the sound attenuation process.

DISCUSSION: The easement does not reduce or mitigate noise levels, but does grant to the Airport the right of aircraft to fly over a particular piece of property and create noise or vibration. The purchase of an easement could be one of the options offered to the owner of a noise sensitive use in lieu of sound attenuation. The easement would be attached to the deed and “run with the land,” meaning that it would be attached to the property title if the owner sells the property in the future. Some people do not feel comfortable with sound insulation, which places construction contractors inside their homes, replacing doors, replacing windows, etc. Sometimes, these residents prefer selling an easement to the Airport. The cost of the easement is usually in the range of $2,000 to $4,000 and is determined based on fair market value as ascertained by the rules of appraisal. This measure was examined under the very first Part 150 Study (1988); however, it was not brought forward in the last Part 150 Study Update (2000) because insulation was deemed to be preferable to this option.

As mentioned above, structures that were insulated through the Airport’s Residential Sound Insulation Program were required to sign an avigation easement in order to receive the insulation. For those homeowners who do not want to receive sound insulation, the purchase of a separate avigation easement would be a separate option. Approximately 25 residences that have not been previously insulated are located within the 65 DNL noise contour. These houses were not within the previous eligibility boundary. Homes that were either offered insulation in the past, and opted out, or were not eligible due to code or other issues would not be eligible in this measure.

At up to $4,000 per easement, the full cost to acquire individual easements from all 25 homeowners could be as high as $100,000; but generally, this option is not considered as beneficial as the sound attenuation for most homeowners.

SUMMARY: Generally, sound insulation is a more effective measure to addressing noise in the 65 DNL contour, however, sometimes homeowners prefer separate avigation easements to sound insulation.

Land Use Option 4: Voluntary Sales Assistance (Assurance Program)

PREVIOUS PART 150 STUDY REVISITED MEASURE

GOAL: To reduce the number of non-compatible land uses and to provide a means for homeowners to sell their homes for fair market value without the Airport taking ownership.

DESCRIPTION: This voluntary measure would initiate a Sales Assistance Program as one option for owners of residential uses to participate in if they are eligible for sound insulation. This measure was examined under the very first Part 150 Study; however, it was not brought forward in the last Part 150 Study Update because insulation was deemed to be preferable to this option. Many times homeowners desire to sell their homes and feel that they cannot receive fair market value for a home due to its proximity to the Airport. This option helps alleviate that situation, but it does not require the Airport to actually purchase or insulate the home. As a result, if fair market could not be obtained during a sale, the Airport would compensate the current owner for a sale that is verified to be less than the current fair market or appraised value. This action would include purchase assistance in exchange for an avigation easement, for areas inside the 65 DNL contour.

DISCUSSION: Under the Sales Assurance Program, the homeowner is guaranteed fair market value for the property. In this type of program, the airport operator does not take title to the property, but rather compensates the property owner for the difference between fair market, and the value offered by a verified purchaser. Should the property sell for less than the appraised value, the Airport operator would compensate the selling owner for the shortfall. Property is appraised at its current fair market value of the homeowners' interest "as is" subject to airport noise. The property is listed and sold, subject to the Airport's avigation easement that is conveyed to the Airport at sale of the property.

Simply stated, the home is placed on the market for fair market value. If the home does not sell within the average time that it takes a home to sell in the area, then the price is reduced. This continues until the home sells. At the time of the sale, the Airport would pay the homeowner the difference between the selling price and the appraised value, with an avigation (noise) easement granted to the Airport at the time of sale.

This option is most successful with single family, as opposed to multi-family structures, because the sales price of most multi-family structures are not sensitive to aircraft noise levels. Further, in most cases, the difference between the appraised value and the verified offer typically must exceed 10 percent for a property to be eligible for participation in a sales assistance program.

As noted earlier, sound insulation was offered to all of the owners of homes in the existing 65 DNL contour during the 2001-2012 period. Those participating in the program granted the Airport an avigation easement for the insulated properties.

Therefore, this program would only be available to the homeowners that who are now located within the updated 65 DNL noise contour who previously did not receive sound insulation - an estimated 25 homes within the new contours. Assuming a median house value of $277,000[3] and a 15% purchase assurance value, the cost of this program would be approximately $1,038,750 at $41,550 per home. The original Part 150 Study examined this option, but it was not included in the subsequent 2000 Study Update Record of Approval, because acquisition and insulation were the primary priorities. Therefore, it is listed as a revisited measure.

SUMMARY: This measure is costly and generally sound insulation is a more effective option to addressing noise in the 65 DNL contour; however, this could be implemented in conjunction with an airport overlay zone to reduce non-compatible land uses. As a condition precedent to implementing a sales assistance program, an airport overlay zone (Land Use Options 5 and 8) would be adopted by the Municipality of Anchorage.

[3] U.S. Census data; http://quickfacts.census.gov/qfd/states/02/0203000.html. Accessed December 2013.

Land Use Option 5: Disclosure Statements/Buyer Notification

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.3.4 NOISE LEVELS ON PLATS AND 3.3.9 FAIR DISCLOSURE POLICY

GOAL: To reduce the annoyance of aircraft noise intrusion to prospective residents by providing direct notice of the possibility of such intrusion prior to home purchase.

DESCRIPTION: This measure is continued from the previous Part 150 Study (Measure 3.3.4 and 3.3.9 from the previous NCP) and is intended to inform potential homeowners/renters that they are purchasing a home in an area where they might experience aircraft noise levels that could cause varying levels of annoyance. Notification of this type would allow the buyer/renter to make a conscious decision prior to purchasing/renting a home and reduce the resultant complaints of aircraft over flights.

DISCUSSION: There are generally two methods of providing buyer notification: 1) through the title search/analysis process and 2) at the disclosure/closing time of purchase. The title search method is effective with new home construction/subdivisions. As a condition to subdivision approval or the issuance of a building permit, such notice is placed on the subdivision plat or deed for each individual lot. Such notice is recorded on the deed and is identified in a title opinion or title insurance report, as are other similar notices.

When using the disclosure method, the seller is required to disclose, on a standard disclosure form, if certain conditions exist. Conditions can include, 1) if the seller has ever been annoyed by aircraft noise, and 2) if the property is within a certain distance from an airport or within identified noise contours that have been officially adopted by the local jurisdiction. It is up to the local jurisdiction, which may require state enabling legislation, to require such buyer disclosure prior to closing a sale.

SUMMARY: Implementation of these two actions requires adoption at the local or state level, depending upon which method is implemented. The local jurisdictions have the authority to require notice to be placed on plats or deeds for new subdivisions or as a condition of building permit approval. This would be most effective for such approvals within the 60 DNL noise contour. This is similar to the types of notice required for other public health, safety, and welfare issues such as severe terrain, underground conditions, historic districts, and tax assessment districts. Seller disclosure statements generally require the passing of state enabling legislation and place the burden on the seller of the property. This is usually very difficult to implement.

This action was recommended during the 2000 Part 150 Study Update NCP, but has not yet been implemented. It is also recommended in the *West Anchorage District Plan*, which was adopted by the Municipality of Anchorage in July 2012, to disclose the Airport's presence to future residents purchasing a home within the proposed Airport Influence Overlay.

Land Use Option 6: Building Code Requirements – Sound Attenuation Required for New Development

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.3.3 SOUNDPROOFING REQUIRMENT FOR NEW DEVELOPMENT

GOAL: To reduce the number of future non-compatible land uses through mandatory sound attenuation requirements for new construction of noise sensitive uses.

DESCRIPTION: This measure is the first of the preventive land use controls and is a continued measure from the previous Part 150 Study. It would amend building code requirements to include sound attenuation standards for any new construction of noise sensitive uses within certain prescribed boundaries, such as the 60 DNL contour. This is not a remedial remedy, but a preventive remedy in that it requires noise reduction or sound attenuation for new construction. Prior to building permit or plat approval, noise sensitive uses would be required, through construction techniques, to achieve a pre-determined reduction in the amount of noise between outside noise levels and inside noise levels.

DISCUSSION: When modifying the building codes, the code would not specify the means to achieve this reduction only that such reduction is necessary, and the builder is given the option of how to achieve such reduction. Normally, the plat or building plans are certified to provide for the necessary noise reduction. This certification by an engineer or architect licensed to practice in the State is typically required by the building official of a local jurisdiction prior to the issuance of a building permit. In most parts of the country, regular energy codes and modern construction techniques result in approximately 20 to 25 dB noise reduction. FAA guidelines suggest a 25 dB reduction within the 65 DNL, a 30 dB reduction within the 70 DNL, and a 35 dB reduction within the 75 DNL. However, aircraft noise annoyances are experienced at lower noise levels (beyond the 65 DNL), and it may be advisable to achieve higher levels of noise reduction than are suggested by Part 150 guidelines.

Experience has shown that it may be desirable to achieve a 30 dB reduction within the 65 DNL and a 35 dB reduction within the 70 DNL contours. Noise sensitive land uses within the 75 DNL or greater contours should be prohibited as adequate internal sound attenuation is not possible.

Once enacted, building code requirements would result in a slight increase in the cost of construction, as homes are built with the appropriate insulation. At other airport sites, contractors have found that the cost of such insulation, performed at the time of construction is less than $10,000 in comparison to the cost of retrofitting an already built home (estimated at $50,000).

Building code requirements are implemented by the local jurisdiction having land use control authority. Such requirements do not change the outside noise levels but do require the inside noise levels of new noise sensitive structures to be reduced to a maximum of 45 dB, the same as remedial sound attenuation requirements for existing structures. The requirements are based on some definable boundary, usually the DNL noise contours, and apply only to new construction within those contours. Such measures have been successful for many communities near airports in helping achieve compatibility where housing is at a premium. In addition, FAA policy is that any new noise sensitive use constructed after October 1998 within a published noise contour is not eligible for remedial sound attenuation. Therefore, if sound attenuation is to be achieved, it must be part of the initial construction process.

The *West Anchorage District Plan*, adopted by the Municipality of Anchorage in July 2012, recommends adopting an Airport Influence Overlay as part of the Municipal zoning code that requires enhanced sound insulation for new or remodeled residences. It would also prohibit the construction of new modular or mobile homes within the overlay because they cannot be sound insulated.

SUMMARY: As part of the 2000 Part 150 Noise Compatibility Program Record of Approval, the Airport recommended that new residences within the 1997 60 dB contour be required to incorporate sound insulation in order to achieve interior noise levels of 45 dB or lower. The measure has not yet been implemented.

Land Use Option 7: Comprehensive Plan Amendments

PREVIOUS PART 150 STUDY CONTINUED MEASURE 3.3.5 COMPREHENSIVE PLANNING

GOAL: To prevent the introduction of new non-compatible land uses through the land use planning and development policy process.

DESCRIPTION: Comprehensive plans are prepared by local jurisdictions to 1) identify current conditions in a community, 2) identify community goals and policies, and 3) identify plans for that community to achieve the goals. This measure proposes to amend existing adopted *Anchorage 2020* Comprehensive Plans and *West Anchorage District Plan* to achieve long-term land use compatibility of the jurisdictions lands with aircraft noise exposure at ANC and LHD.

Community comprehensive plans are policy guides for the future development of a particular jurisdiction. Plans provide guidance for future land use development and land use changes. These plans are particularly important in the area around the Airport that may experience noise levels that could impact certain types of residential structures or public buildings. It is desirable that each community develop its plans and policies to be compatible with existing and future aircraft noise levels. This approach will help ensure that compatible development occurs in the future, as it is much easier to avoid the creation of land use incompatibilities than it is to remedy incompatibilities in the future.

DISCUSSION: The Airport is located entirely within the Municipality of Anchorage, which is considered a consolidated city-borough under state law. Jurisdictions in the State of Alaska, including boroughs, unorganized boroughs, and cities, have the authority, through Alaska Statutes Title 29, to provide for planning, platting, and land use regulation.

The Municipality of Anchorage is the jurisdiction having land use control around the Airport. The MOA Assembly adopted *Anchorage 2020: Anchorage Bowl Comprehensive Plan*, in 2001 to serve as a guide for future development within the Anchorage Bowl.

The plan recognizes the importance of the Airport as an economic resource, as well as a transportation resource. The plan also recognizes the potential for airport expansion, primarily within the existing airport boundaries. West Anchorage is the portion of Anchorage including and surrounding the Airport. *Anchorage 2020* designates a West Anchorage Planning Area to serve as a mechanism to identify, address, and resolve land use conflicts within and near the Airport.

The *West Anchorage District Plan* was adopted in July 2012 in order to "develop mechanisms and recommendations to address long-standing land use conflicts between the community and the Ted Stevens Anchorage International Airport" and to "establish a framework for making future development decisions that align with long-range land use recommendations in Anchorage 2020." The WADP makes a number of recommendations for furthering improved cooperation between the needs of the Airport, the MOA, and Anchorage residents living near the Airport.

SUMMARY: As stated earlier, a comprehensive plan by itself does not reduce aircraft noise levels nor does it control the use of land, as it is just a policy statement of the intended future use of land. However, comprehensive plans do influence the development or change in use of any particular piece of property. They also serve as a guide for future development. One of the most influential uses of the comprehensive plan can be to officially adopt and present aircraft generated noise contours, and use those noise contours to help guide compatible development.

As part of the 2000 Part 150 Noise Compatibility Program Record of Approval, the FAA approved several preventive land use control and comprehensive planning measures. The consultant team encourages that this measure be retained and that the local jurisdiction continue to work collaboratively with other agencies and the community to implement comprehensive land use planning measures that will discourage new non-compatible land uses in areas affected by airport noise.

Land Use Option 8: Zoning Code Changes/Noise Overlay Zone

PREVIOUS PART 150 STUDY CONTINUED MEASURES – 3.3.1 COMPATIBLE LAND USE ZONING, 3.3.2 MOBILE HOME CAMPER PARK RESTRICTIONS, AND 3.3.8 NOISE OVERLAY ZONE, 3.3.6 PLANNING COMMISSION REVIEW, AND 3.3.7 PUBLIC LAND DEVELOPMENT CRITERIA

GOAL: To protect the health, safety, and welfare of the public through the prevention of new non-compatible land uses within the vicinity of the Airport.

DESCRIPTION: This measure involves changes to the Municipality of Anchorage Title 21 Land Use Code to guide compatible development. A zoning code has more regulatory authority than a comprehensive plan. The zoning code prescribes development standards that new development must meet.

Standards can include sound attenuation, granting of an avigation (noise) easement, disclosure notification and other related standards. This is a continued measure from the previous Part 150 Study Update (Measure 3.3.1 Compatible Land Use Zoning, Measure 3.3.8 Noise Overlay Zone, Measure 3.3.6 Planning Commission Review, and Measure 3.3.7 Public Land Development Criteria).

DISCUSSION: As experience has shown, and made clear in this study, noise complaints and concerns are common in those areas outside the 65 DNL noise contour. Thus, consideration should be given to restricting residential and other noise sensitive uses between the 55 DNL and 65 DNL contours.

A rewrite of the Title 21, Land Use Planning, of the Anchorage Municipal Code of Ordinances, became effective on January 1, 2014. Under Title 21.04.060, Other Districts, the code states that an airport zoning district will be adopted separately through the preparation of updated land use regulations specific to airport lands and development, as indicated in the *West Anchorage District Plan*. Until the airport district is implemented and airport lands are rezoned, all areas within the TSAIA boundary are subject to the Title 21 land use regulations that existed prior to the Title 21 rewrite and were current as of December 31, 2013.

SUMMARY: Zoning can be a very effective means of controlling land use development and is the most widely used land use control. However, since it is the result of a political process, it can be changed or amended. Zoning codes and accompanying zoning district maps are accepted means to guide and control development within the vicinity of an airport.

The local jurisdiction must determine what uses within which contours are considered to be non-compatible and can then pass reasonable measures to restrict such land uses within those contours. The consultant team encourages that this measure be retained. TSAIA and the MOA should continue to work together to identify ways to enact appropriate zoning code amendments.

ADMINISTRATIVE OPTIONS

Administrative measures are those that the Airport can implement, with or without FAA funding, that are solely within their discretion. These measures will not result in noise reduction (as can be expected from the implementation of the operational noise abatement procedures), but will enable the Airport to monitor the success of the program and to provide enhanced community response to issues of concern. They are not dependent upon other measures to be implemented prior to their implementation.

Administrative Option 1: Continuation of Study Input Committee

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.4.1 NOISE ADVISORY COMMITTEE

GOAL: To assist in implementation of the Part 150 Study Noise Compatibility Program and identify and address noise issues with an ongoing method.

DESCRIPTION: This measure involves the continuation of the Study Input Committee established for this Study. It is recommended that noise concerns are addressed either through a continuation of a similar committee or via an addition of these discussions to existing planning meetings.

DISCUSSION: Noise metrics and mitigation is a complex subject and the committee members and Airport have invested a significant amount of time in the development of this Study, particularly in the "learning curve" effort and building of relationships. The continuation of the committee in one format or another could assist the on-going implementation efforts once the Noise Compatibility Program is approved by the FAA. The balance of interested parties is very important for the successful implementation of the noise compatibility program. This was recommended as part of the last NCP, and noise meetings have continued alongside other planning meetings to address noise concerns.

SUMMARY: Continuation of the committee in some format can ensure that the "body of knowledge" gained during the Study process is not lost and will continue to foster relationships between the stakeholders and the program gets implemented.

Administrative Option 2: Development of Fly Quiet Report Card and Pilot Awareness Program

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.4.4 REGULATIONS AND AGREEMENTS, 3.4.8 AIRFIELD SIGNS, 3.4.10 PILOT MANUAL INSERT AND 3.5.2 GA PROGRAM

GOAL: To reduce the effect of single event noise levels, and to increase awareness of noise sensitive uses and noise reducing procedures for pilots operating at ANC and LHD.

DESCRIPTION: This measure involves the creation/update of a Fly Quiet Program for ANC and for LHD. A Fly Quiet Program can be tailored to the Airport to address noise issues and promote fly quiet procedures for pilots. This would include participation of the affected communities, as well as users to develop and initiate a program.

DISCUSSION: Pilot education is very important with regards to single event levels. A Fly Quiet Program distributed to pilots can help education them on "good neighbor" procedures, that reduce the effect of fly-overs on noise sensitive uses. Although specific noise abatement measures for LHD were not recommended in the previous Noise Compatibility Program (NCP), the ADOT&PF committed to pursuing a pilot awareness and education program for GA users though Measure 3.5.2, GA Program. This Measure, while not formally approved in the NCP, was identified as an additional measure that the Airport was going to examine outside the FAA NCP approval.

Additionally, the previously recommended NCP Measure 3.4.4, Regulations and Agreements, comprised several measures to increase pilot awareness of the noise abatement program at the ANC. Comments received during this Study have indicated that a Fly Quiet Program at LHD would be highly valued. There is currently an unofficial Fly Quiet Program at LHD, and this would be updated with help from stakeholders and initiate and implement in a way to provide education through reports, meetings, etc. The Fly Quiet Program could also address operations at ANC, but LHD appears to be the primary area of focus for this measure.

SUMMARY: A Fly Quiet Program is focused on education, and experience with these programs across the nation have indicated that education can be an important tool for reducing single event noise near airports, particularly related to general aviation operations.

Administrative Option 3: Continuation of Public Information Program and Noise Information Page on the Website

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.4.7 NOISE INFORMATION PAGE AND 3.4.9 PUBLIC INFORMATION PROGRAM

GOAL: To increase availability of noise related information for the public to access and provide feedback.

DESCRIPTION: This measure involves keeping the noise section of the Airport's website active with information about the existing noise reduction measures, current Noise Exposure Maps, information on submitting comments and any other noise related information for access by stakeholders. Additionally, this involves pursuing a public information program (which could include the continuation of existing periodic meetings with user groups and community councils). This is a continued measure from the last Part 150 Study NCP (Measure 3.4.7, Noise Information Page on the AIA Website and Measure 3.4.9 Public Information Program), and the Airport implemented this on their current website and through periodic meetings with stakeholders.

DISCUSSION: Stakeholder updates can be very important for the relationship between the Airport and the surrounding communities. The area of the website with this information can answer many commonly asked questions and misconceptions about what an airport can and cannot do with regards to noise. The current website can be found at:

http://www.dot.state.ak.us/anc/business/noise/index.shtml

SUMMARY: Information is important to help answer stakeholder questions and keep the public informed about noise related issues at the Airport. This can help build relationships and trust with the Airport and be beneficial to the public with noise concerns.

Administrative Option 4: Public Comment Submittal Form

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.4.3 COMPLAINT RESPONSE

GOAL: To collect and examine aircraft noise comments and increase ability to respond to public concerns based on comments received.

DESCRIPTION: This measure involves keeping the noise comment submittal form on the website so that members of the public can submit noise comments easily. The current noise comment submittal is located at:
http://www.dot.state.ak.us/anc/business/noise/index.shtml

DISCUSSION: Stakeholder comments can be very important for the relationship between the Airport and the surrounding communities. The comment submittal form allows the Airport to track where and when comments are received, so they can better understand what types of operations cause single event concerns. The comments are reviewed Monday through Friday by airport staff and responses are provided when requested. As stated in the Administrative Measure 5, this is a change from the previous measure where a designated staff member reviewed comments.

SUMMARY: Tracking noise comments or complaints can help the Airport better understand the location and type of noise impacts the surrounding neighborhoods.

Administrative Option 5: Addressing of Noise Comments

PREVIOUS PART 150 STUDY REVISED MEASURE – 3.4.6 NOISE PROGRAM MANAGER

GOAL: Ensure airport staff monitors noise comments and provides a liaison with the community.

DESCRIPTION: This measure involves providing staff support responsible for tracking noise complaints and acting as a staff/community liaison for noise related issues.

DISCUSSION: Under the previous NCP, establishing a dedicated Noise Program Manager was identified as a measure to be implemented. The Airport created this position for several years, but recently, due to reorganization of the staff, the responsibilities of this Noise Program Manager position were reallocated to several other staff members to better balance work load. This measure includes keeping staff to cover the responsibilities of a Noise Program Manager, but incorporates the flexibility of balancing work load within the Airport staff to accommodate these tasks across several positions to be more efficient. This option is dependent upon Airport budget constraints and operational priorities.

SUMMARY: This revised measure allows Airport to cover the tasks of noise tracking and community liaison more flexibly within existing staff members.

Administrative Option 6: Flight Tracking

PREVIOUS PART 150 STUDY REVISED MEASURE - 3.4.2 NOISE MONITORING

GOAL: To track single noise events around the Airport.

DESCRIPTION: This measure would involve the update of the existing noise monitoring system to make it operable for flight tracking.

DISCUSSION: Under the previous FAA approved Noise Compatibility Program, the NCP recommended the implementation of a noise monitoring system around the Airport. This system was purchased and operated until the end of 2009. To date, the Airport has not decided whether to continue using the noise monitoring system, because it does not actively do anything to mitigate noise. In the past, the flight tracking portion of the noise monitoring/tracking system was found to be the most beneficial in answering questions from the public. Therefore it may be helpful to use a system that focuses on flight tracking rather than full monitoring. Additionally, the Airport tracks numbers and types of operations on a regular basis, and a 15% change in operations (or a significant change in flight tracks etc.) would trigger the update of the Part 150 Study (See Administrative Option 7). Therefore, the goals, benefits, and costs need to be discussed by the Airport and Study Input Committee before making a decision on whether re-implementing the noise monitoring system or a flight tracking system makes sense at this time. It is important to note that this measure is not associated with noise reduction.

SUMMARY: This measure was previously implemented after the last NCP was approved by the FAA. The noise monitoring system was operable until the end of 2009. This measure would be very costly in terms of staff and operational costs, and would not actually do anything to mitigate noise. The goals of noise monitoring were discussed and it was determined that this measure should be recommended, with a focus on flight tracking.

Administrative Option 7: Review and Update Part 150 Study As Needed

PREVIOUS PART 150 STUDY CONTINUED MEASURE – 3.4.5 NEM AND NCP REVIEW AND REVISION

GOAL: To update the Part 150 Study when appropriate to ensure the Noise Exposure Maps and Noise Compatibility Program are adjusted as conditions change over time.

DESCRIPTION: This measure would involve the update of the Noise Exposure Maps or the Part 150 Study, when needed.

DISCUSSION: A Part 150 Study is intended to be a "living document," to be used as a tool to monitor and guide program development, and evaluate aircraft types and operations. The Study should be reviewed and updated as appropriate. The general guideline is whenever the actual operations are approximately 15% different from the forecast operations, the Noise Exposure Maps (NEMs) should be reviewed. In addition, anytime there are significant new non-compatible land uses within the 65 DNL or greater contours or if there are airport facility changes which may affect the contours, consideration should be given to reviewing the maps. At the end of the five-year study period (after date of Noise Compatibility Program [NCP] approval), the operations and mix should be re-evaluated to determine the extent to which they have changed and updated as appropriate.

SUMMARY: This measure will ensure that the Noise Compatibility Program is adjusted as conditions in the environs of the Airport change over time (such as an increase in number/type of traffic or operational changes).

FACILITY OPTIONS

Facility options include changes to the direct Airport facilities that could reduce noise. These measures will generally not result in noise reduction that would be visible in the DNL, so they have not been modeled. However, their implementation could potentially reduce single event noise complaints. They are not dependent upon other measures to be implemented prior to their implementation. Note that noise barriers and Ground Run Up Enclosures are included in the Analysis of Noise Abatement Options and Additional Studies chapter due to being dependent upon additional operational considerations.

Facility Option 1: Install Electrification and Preconditioned Air at All Jet Bridges and Cargo Areas

NEW MEASURE

GOAL: The goal of this measure would be to reduce aircraft engine noise while on the ground.

DESCRIPTION: This measure would involve installing gate electrification and preconditioned air at all gates and cargo areas that do not currently have these features.

DISCUSSION: Aircraft generally use their auxiliary power units (APU) for power, heat and air conditioning while on the ground, which causes some ground noise. With gate electrification and preconditioned air hook-ups, the aircraft can hook into this power at a gate and not use their APU, thus reducing noise. While this measure was not previously examined in the past Part 150 Noise Compatibility Programs, the Airport has added gate electrification at most of their gates as part of separate projects. Therefore, this measure would include adding electrification and pre-conditioned air hook-ups at any feasible areas that do not already have this feature.

SUMMARY: This measure could reduce ground noise of aircraft, but it is already implemented at many locations on the Airport. The cargo area hook-ups would need to be examined further to determine if it is feasible at the locations that do not already have it.

Chapter I – Issues, Actions and Recommendations

INTRODUCTION. This chapter contains the recommendations of this Part 150 Noise Compatibility Program – herein referred to as the Noise Compatibility Program (NCP). This is an update to the NCP approved in 2000. The time period for this NCP is through the year 2020, which is the future year serving as the basis for the Future Noise Exposure Map. The Future Noise Exposure Map (NEM) is presented here along with the affected population associated with it. This is the NEM that is used as the basis for this NCP. In addition, the individual recommendations of the NCP are identified, which are comprised of noise abatement or operational recommendations, land use compatibility recommendations, administrative recommendations, and facility recommendations.

Future Noise Exposure Map

Part 150 requires the evaluation of future noise conditions and the identification of a Future Noise Exposure Map (NEM). This study developed a future baseline noise exposure contour map that served as the basis for considering the effectiveness of each noise abatement option. The Future NEM (2020) reflects the future aircraft operations forecast (as modeled in the previously Future 2020 Noise Contours), but is updated with two new potential future operational changes. The Future NEM is illustrated in Figure I1, *FUTURE NOISE EXPOSURE MAP – 2020* and the comparison of the existing (2009) and future NEM are shown in Figure I2. The land use types and population within the Future NEM are illustrated in Table I1, *EXISTING LAND USE WITHIN FUTURE NOISE EXPOSURE MAP CONTOURS, 2020*.

The Future NEM reflects the 2020 forecast of aviation activity. Additionally, while no noise abatement operational alternatives were found to reduce noise beyond the preferential runway use system already in place, it reflects an update of the Future 2020 Noise Contours seen in Chapter D because it assumes the implementation of the following two (2) operational considerations related to the currently ongoing Master Plan Update and the FAA-sponsored Required Navigation Performance (RNP) Study.

These two operational considerations are included in the Future NEM because they are under consideration as part of other additional ongoing studies for the Airport. While they have not yet been officially approved or implemented, these operational considerations are reasonably foreseeable and therefore are added into the official Future NEM as future baseline conditions. The two operational considerations are discussed in the previous chapter, Analysis of Noise Abatement Options and Additional Studies. These two operational considerations are:

- **Master Plan Phase 2, Modification of Preferential Runway Use System to Meet Future Demand.**
- **Required Navigation Performance (RNP) Procedure to Runway 33.**

The Future NEM can be considered effectively the same as the Future Combined Recommendation contour, because none of the noise abatement recommendations would affect the DNL noise contours once implemented. In addition to the two operational considerations, several noise abatement recommendations are recommended for implementation that would not alter the size or location of the DNL noise exposure contours, but may reduce single event noise or help prevent additional noise issues in the future. The noise abatement recommendations include: a noise barrier, a ground run-up enclosure, and reduced use of reverse thrust; as well as land use, administrative, and facility recommendations. These noise abatement recommendations are summarized in the sections below.

TABLE I1
EXISTING LAND USE WITHIN FUTURE NOISE EXPOSURE MAP CONTOURS, 2020

Land Use	60 DNL*	65 DNL	70 DNL	75 DNL
Residential Acres	**246.1**	**8.4**	**0**	**0**
Persons	3,444	226	0	0
Housing Units (Total)	1,555	100	0	0
Insulated	*N/A*	*55*	*0*	*0*
Non-Insulated (May Be Eligible)	*N/A*	*45***	*0*	*0*
Schools	1	0	0	0
Religious Facilities	0	0	0	0
Historic Properties	0	0	0	0
Vacant	120.8	0.5	0	0
Commercial	106.1	17.6	0	0
Industrial	425.8	259.0	94.6	2.6
Institutional	73.2	6.4	0	0
Open Space/Park (Total)	937.7	134.5	45.9	4.1
On Airport	*288.3*	*90.8*	*37.3*	*1.5*
Off Airport	*649.4*	*43.7*	*8.6*	*2.6*
Transportation	3,170.4	2,215.5	1,305.6	692.8
Other/ROW	9,514.7	2,480.5	523.7	194.6
Total Land Use Acres	***14,594.8***	***5,122.3***	***1,969.8***	***894.1***

Sources: Existing Land Use; 2010 Census Block Data and Aerial Photography, Mead & Hunt Analysis.
Notes: Acres rounded to the nearest tenth; housing rounded to the nearest 5.
*Presented for informational purposes only
**Housing unit counts are preliminary and are based on aerial photography

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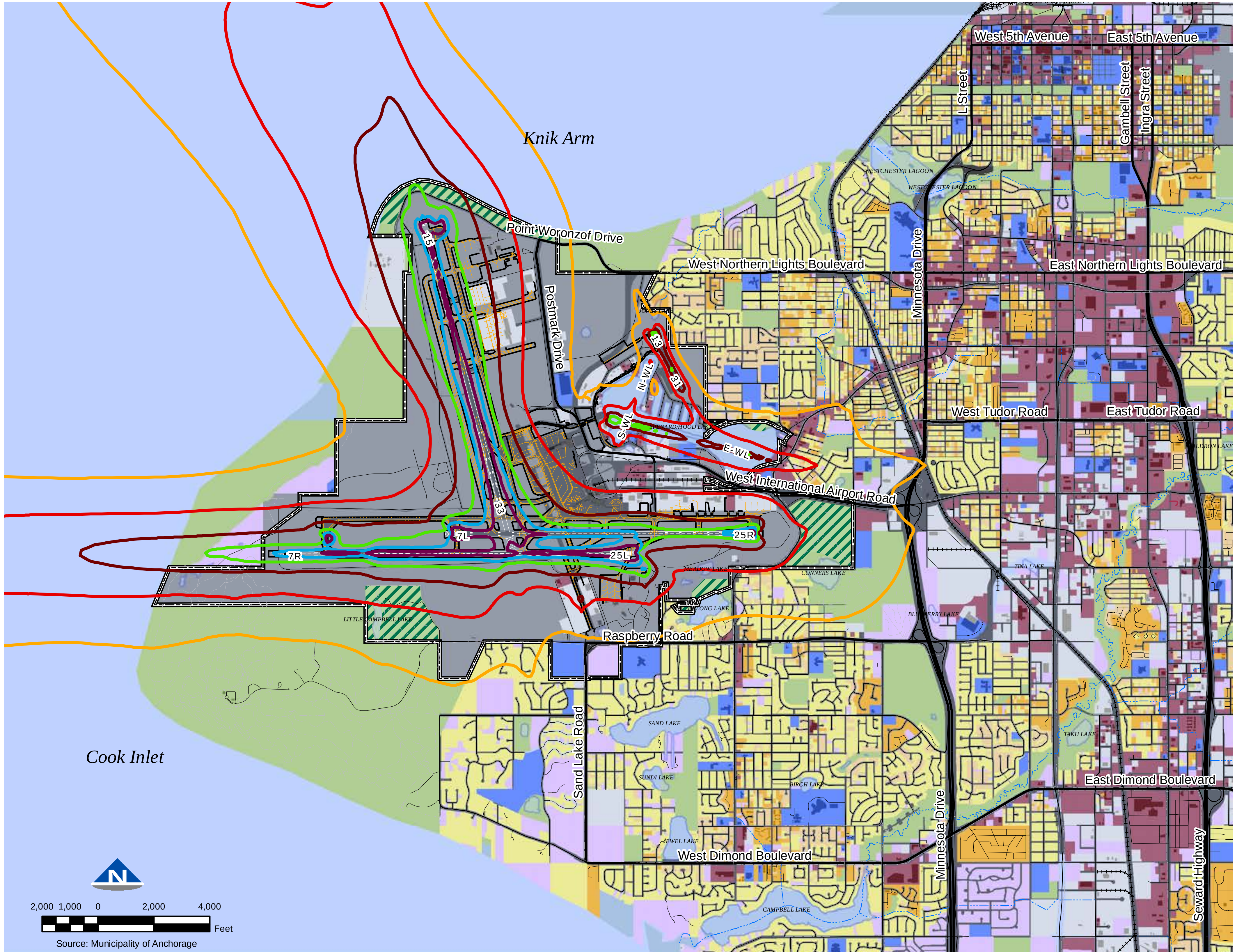

Land Use

- AIRPORT OPEN SPACE
- INDUSTRIAL
- TRANSPORTATION
- RR/ROW
- COMMERCIAL
- INSTITUTIONAL
- SINGLE FAMILY
- TWO FAMILY
- MULTI FAMILY
- PARK
- TIDE/WATER
- VACANT

Future 2020 Noise Contours

- 60 DNL
- 65 DNL
- 70 DNL
- 75 DNL
- 80 DNL
- 85 DNL

The 65 DNL contour contains approximately 5122 acres, 101 residential structures and 226 people.

The 70 DNL contour contains approximately 1970 acres, no residential structures and no people.

The 75 DNL contour contains approximately 894 acres, no residential structures and no people.

Planning jurisdictions are shown on the map.

Noise measurement sites and flight tracks are depicted on the Noise Measurement Sites and Flight Tracks Maps.

Residential land use, as defined by FAR Part 150, is an incompatible use without proper sound attenuation within the 65 DNL or greater contour.

The Noise Exposure Maps and accompanying documentation for the Noise Exposure Map for Anchorage International Airport, submitted in accordance with FAR Part 150 with the best available information, are hereby certified as true and complete to the best of my knowledge and belief.

In addition, it is hereby certified that the public was afforded the opportunity to review and comment on the document and its contents.

Signed__________________________Date___________

Figure I1 **Future Noise Exposure Map - 2020**

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Legend

Anchorage International Airport

2009 NEM Noise Contours

65 DNL

2020 NEM Noise Contours

65 DNL

2,000 1,000 0 2,000 Feet

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure I2 65 DNL Comparison of 2020 NEM and 2009 NEM

Ted Stevens Anchorage International Airport AeroNexus®

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Recommendations

The individual recommendations of the NCP identified in this section are comprised of noise abatement or operational recommendations, land use compatibility recommendations, administrative recommendations, and facility recommendations. For each recommendation of the Program, this section identifies: the issue that the recommendation is intended to address; comments concerning the recommendation; the estimated cost of implementation of the recommendations; the parties responsible for the implementation; the role of the Airport; and the estimated implementation timeframe. Note that the remainder of this chapter no longer uses the same numbering system that was used to differentiate among the options in other chapters (i.e., Option 1 or Option 6). Instead, this chapter uses recommendation numbers, which are a sequential listing of NCP recommendations within each category (noise abatement, land use management, administrative, and facility). The original option numbers from the previous chapter are listed in parentheses. The recommendations are **not** listed in any order for priority of implementation. Priorities and conditions are subject to change over time and based on availability of funding, and should be set yearly along with the Airport's Capital Improvement Plan.

Noise Abatement Recommendations

Recommendation 1: Noise Barrier (Option 3)
Recommendation 2: Ground Run-Up Enclosure (Hush House) (Option 4)
Recommendation 3: Voluntary Reduced Use of Reverse Thrust (Option 5)

Land Use Management Recommendations

Recommendation 1: Voluntary Sound Insulation of Noise Sensitive Structures Within the 65 DNL Noise Contour (Option 1)
Recommendation 2: Disclosure Statements/Buyer Notification (Option 5)
Recommendation 3: Building Code Requirements – Sound Attenuation Required for New Development (Option 6)
Recommendation 4: Comprehensive Plan Amendments (Option 7)
Recommendation 5: Zoning Code Changes/Noise Overlay Zone (Option 8)

Administrative Recommendations

Recommendation 1: Development of Fly Quiet Report Card and Pilot Awareness Program (Option 2)
Recommendation 2: Continuation of Public Information Program and Noise Information Page on the Website (Option 3)
Recommendation 3: Public Comment Submittal Form (Option 4)
Recommendation 4: Addressing of Noise Comments (Option 5)
Recommendation 5: Flight Tracking (Option 6)
Recommendation 6: Review and Update Part 150 Study As Needed (Option 7)

Facility Recommendations

Recommendation 1: Install Electrification and Preconditioned Air at All Jet Bridges and Cargo Areas (Option 1)

It is the intent of the Airport to implement the proposed Noise Compatibility Program. ***However, it is important to note that implementation of the recommendations is not required and is highly dependent upon availability of funding and resources. Inclusion in this is subject to eligibility, allowability and justification requirement in place at the time the project is proposed for the Airport's capital improvement plan (CIP).***

Existing Actions – Previous Part 150 Study NCP

The Airport completed the previous Part 150 Study in 1999, and the FAA issued its Record of Approval for that Study in 2000. The FAA approved, and the Airport has implemented several noise abatement/mitigation measures contained in that document. The previous Record of Approval is in **Appendix B** of this Study. Many of the recommendations of this Study are continued from the previous NCP (such as the insulation program) or revised/updated based on additional considerations and new conditions. Although some of the recommendations, particularly those addressing land use, have been revised or combined to reflect current conditions, these continued or revised measures are included in the recommendations of this report and are explained in the next section. All remedial and preventative land use measures were approved by the FAA in 2000, but not all were implemented.

In addition to those measures that are continued or revised, there are several measures that were completed as part of the previous NCP and are therefore not recommendations in this updated Study. These measures include:

- **Use of Noise Abatement Departure Profiles on Runways 6R, 6L, and 14 (now 7L/7R and 15)– a Close-In departure (approved as voluntary): This previous recommendation was examined based on new conditions, and this type of departure showed no noise benefit with future conditions, so it is not included as a recommendation.**
- **Conduct detailed NADP Study: This previous recommendation was completed under the previous NCP.**
- **Conduct detailed ground noise study: This recommendation was completed under the previous NCP.**

Several other measures were disapproved by the FAA under the previous Part 150 Study including:

- **Investigation of sound barriers/buffers. This recommendation was disapproved by the FAA pending the ground noise study. This Part 150 Study update examined this as a measure for this Study Update.**
- **Noise Abatement Departure Track for Commuter Aircraft Departing to the Southwest. This recommendation from the previous Part 150 NCP was disapproved by the FAA because it was not operationally efficient. Therefore, it was also not considered in this Study Update.**
- **Enhanced Nighttime Runway Use Program. This recommendation was disapproved by the FAA because the contours indicated that it would decrease noise in one area and increase noise in another area; therefore, it was also not considered for this Study Update.**

The following pages describe the recommendations for the updated NCP.

Noise Abatement Recommendations

Noise Abatement Recommendation 1: Noise Barrier

ISSUE. Reduce aircraft ground noise impacts to neighborhoods surrounding the Airport.

CONTINUED ACTION. This recommendation would involve the design and construction of a noise barrier/wall generally along the eastern boundary of Lake Hood Seaplane Base (LHD) east of the gravel strip. Examining noise barriers through a noise barrier study was a product of the last Part 150, but no noise barriers were constructed based on limited benefits shown in the study at that time. However, ground noise was identified as still being a concern early in the Part 150 Study Update process through public and committee comments; therefore it was re-analyzed. The potential benefits of a barrier east of the Lake Hood Seaplane Base gravel strip are described below.

COMMENTS. Noise barriers are obstructions to the path of the sound that reduce noise for observers behind the barrier. Barriers can include noise walls, berms (earth mounds), or Ground Run-Up Enclosures (a specific type of barrier for aircraft that is considered as a separate recommendation later in this chapter). The analysis in this Study assumes the barrier is a noise wall, because it would likely provide the greatest benefit in a constrained area (i.e. a larger area would be required to create an earthen berm with similar noise benefits).

Noise barriers reduce noise levels by interrupting, or blocking, the direct path between a noise source and a receiver. The direct path is often referred to as the line-of-sight. When a noise barrier blocks line-of-sight between a noise source and receiver, the sound must bend around (diffract) the noise barrier to reach the receiver. The more the sound has to bend around the top of the barrier, the greater the noise reduction provided by the barrier. Noise barriers have no impact on noise generated from sources at elevations above the barrier, such as airborne aircraft.

To be effective in reducing noise, a barrier must either be close to the noise source or noise receiver. Given the layout of the Airport, existing berms, and the surrounding community, only one area was found to be effective for a barrier, an area close to the Lake Hood Seaplane Base gravel strip. As discussed in the previous chapter (Chapter G), Analysis of Noise Abatement Options and Additional Studies, the relative topography of the residential areas near the South Airpark precludes the effective implementation of noise barriers in this area. The same is true for the North Airpark.

Figure I3 shows the location of the five lines of sight (LOS) drawn between the Airport and the residential uses adjacent to the Airport, chosen to be representative cross sections of the topographical features in the area, and discussed in the previous chapter, Analysis of Noise Abatement Options and Additional Studies. Figures I4 and I5 show the two elevation profiles along the gravel airstrip. These figures show that this area is relatively level. The vertical lines on the left side of the profile represent the top of a Cessna 185 propeller. Figure I4 shows that the north end of the gravel airstrip is elevated above the nearest homes by approximately 5 feet and Figure I5 shows at the south end the elevation of the airstrip is about even with the homes. A wall located on the eastern edge of airport property (just west of the residential area) with an approximate height of 16 feet would just break LOS to the second floor of the closest home in both cross sections, this means that a wall 16 feet high would provide benefit to both one and two story residences in the area. The benefit is greatest for the homes closest to the barrier, generally with diminishing noise reduction benefits the further away a house is from the barrier.

Barriers with these heights along the gravel airstrip would only break the LOS for aircraft on the ground. As aircraft take off they would quickly rise above the barrier where direct LOS to the homes would be reestablished and the barrier would be ineffective. This could actually result in the aircraft noise being perceived as more annoying due to this rapid change in noise level as the aircraft elevates above the barrier compared to the gradual increase in noise that occurs without the barrier. However, overall cumulative noise levels at the homes would be reduced.

The homes nearest the end of the airstrip where take-offs begin would receive the most benefit from the noise barrier and the homes adjacent to the other end of the airstrip would receive no benefit from the noise barrier. Homes near the middle of the airstrip would experience lower noise levels before the aircraft takes off but the levels would quickly rise to the same levels as without a barrier as the aircraft rises above the wall. This can be perceived by some as being louder than the no-barrier condition due to the reduced noise level at the start of take-off with the barrier.

The figures show that the taxi and parking areas on the west side of the airstrip are at the same or lower elevation than the gravel airstrip. Therefore, the noise barrier would also reduce noise levels from aircraft ground operations in these areas.

It appears that a noise barrier located along the eastern edge of the gravel strip would also be feasible and effective at reducing noise levels at the homes to the east. This wall would need to have a minimum height of 15 to 20 feet, with 25 feet nearing the optimal height.

Increasing the wall beyond approximately 30 feet in height would provide little additional noise reduction. Note that these wall heights are approximate and detailed engineering studies and siting studies would need to be done to specify the exact height and length of wall needed to meet Part 77 surfaces and other requirements.

A noise barrier located along the eastern boundary of Lake Hood Seaplane Base just adjacent to the homes located east of the gravel airstrip with a height of at least 16 feet above the residential land elevations would considerably reduce noise from aircraft ground operations for those homes immediately adjacent to the wall. The exact height and location would be determined prior to construction.

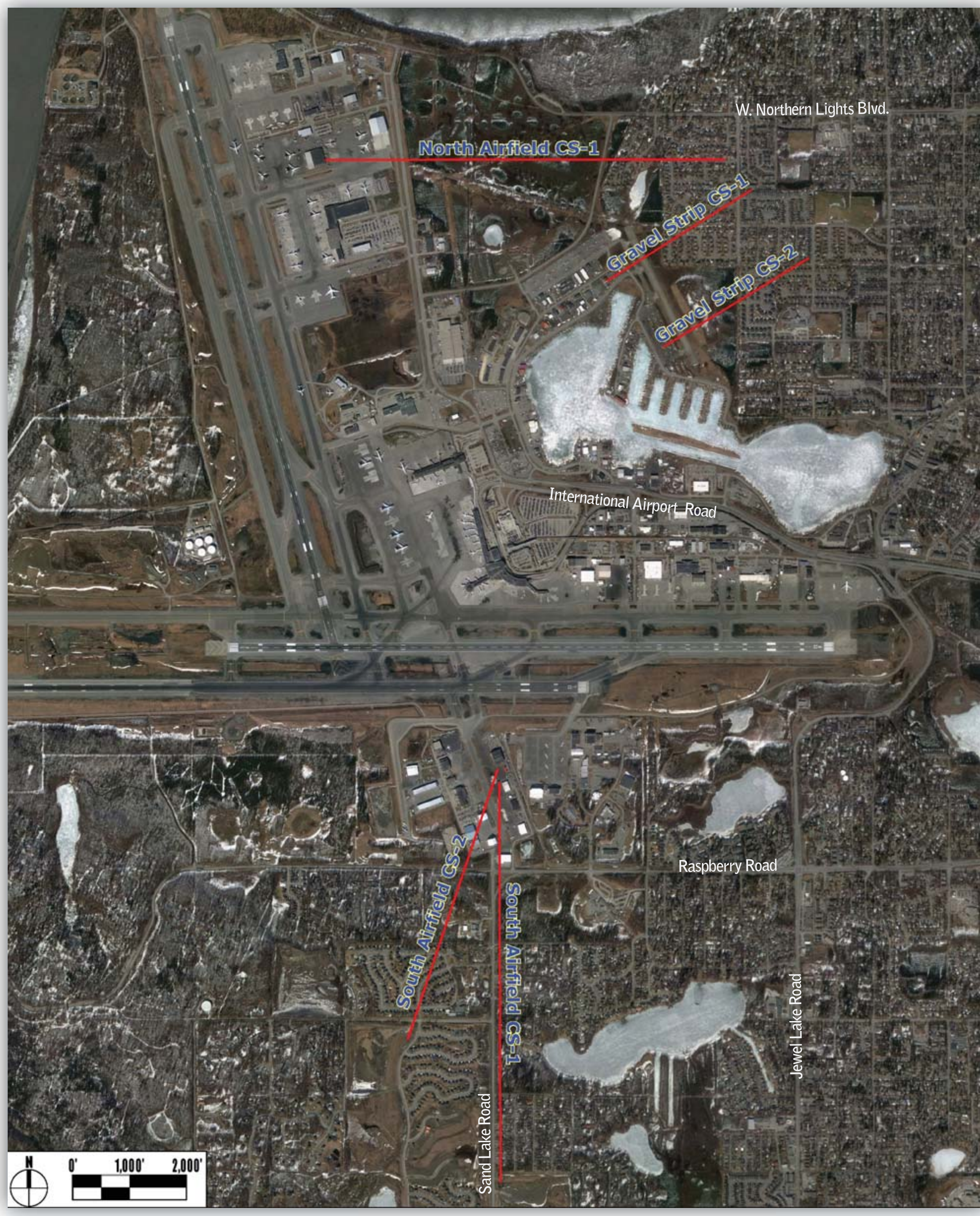

FIGURE I3
Elevation Profile Locations

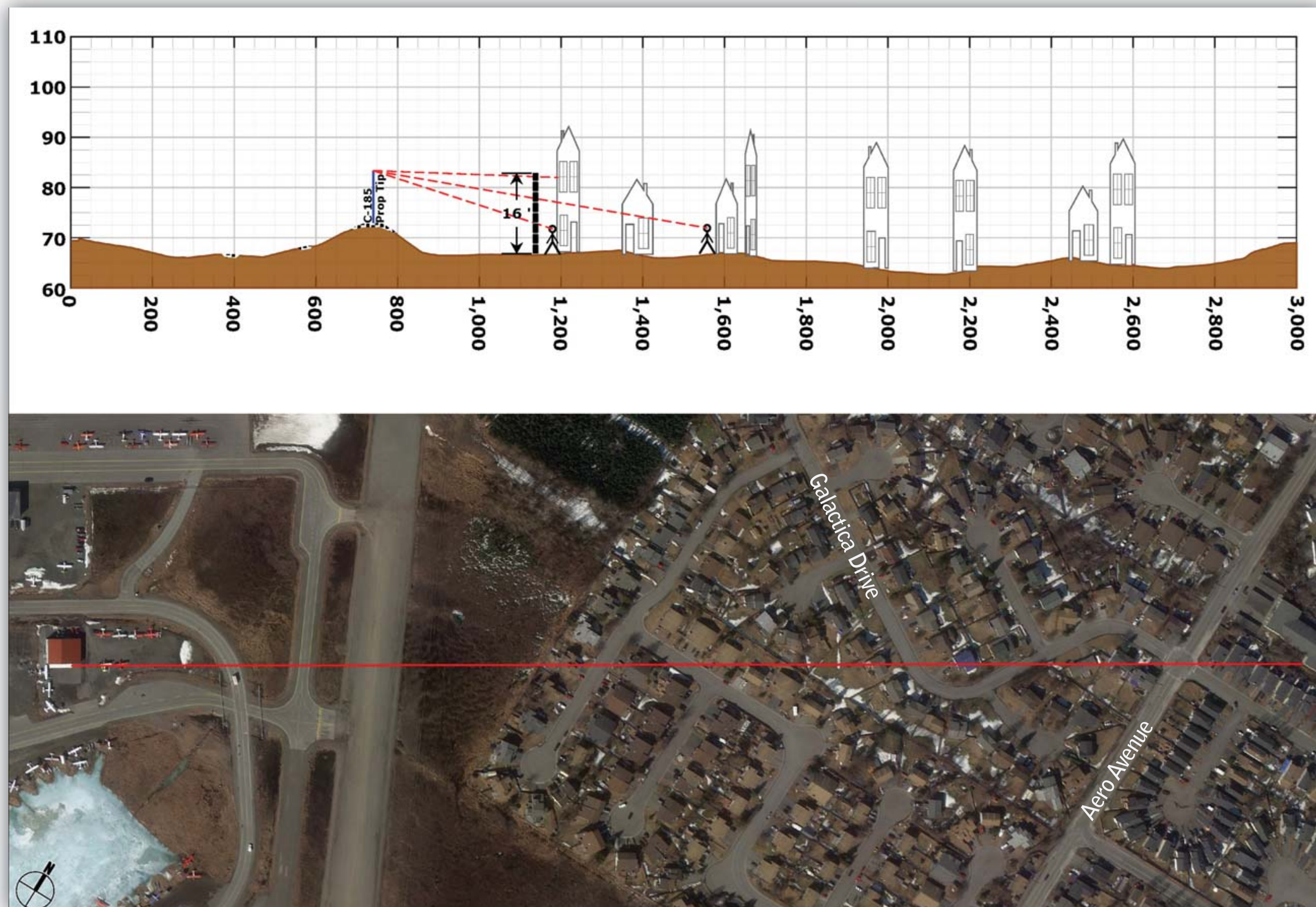

FIGURE I4
Gravel Airstrip Elevation Profile 1

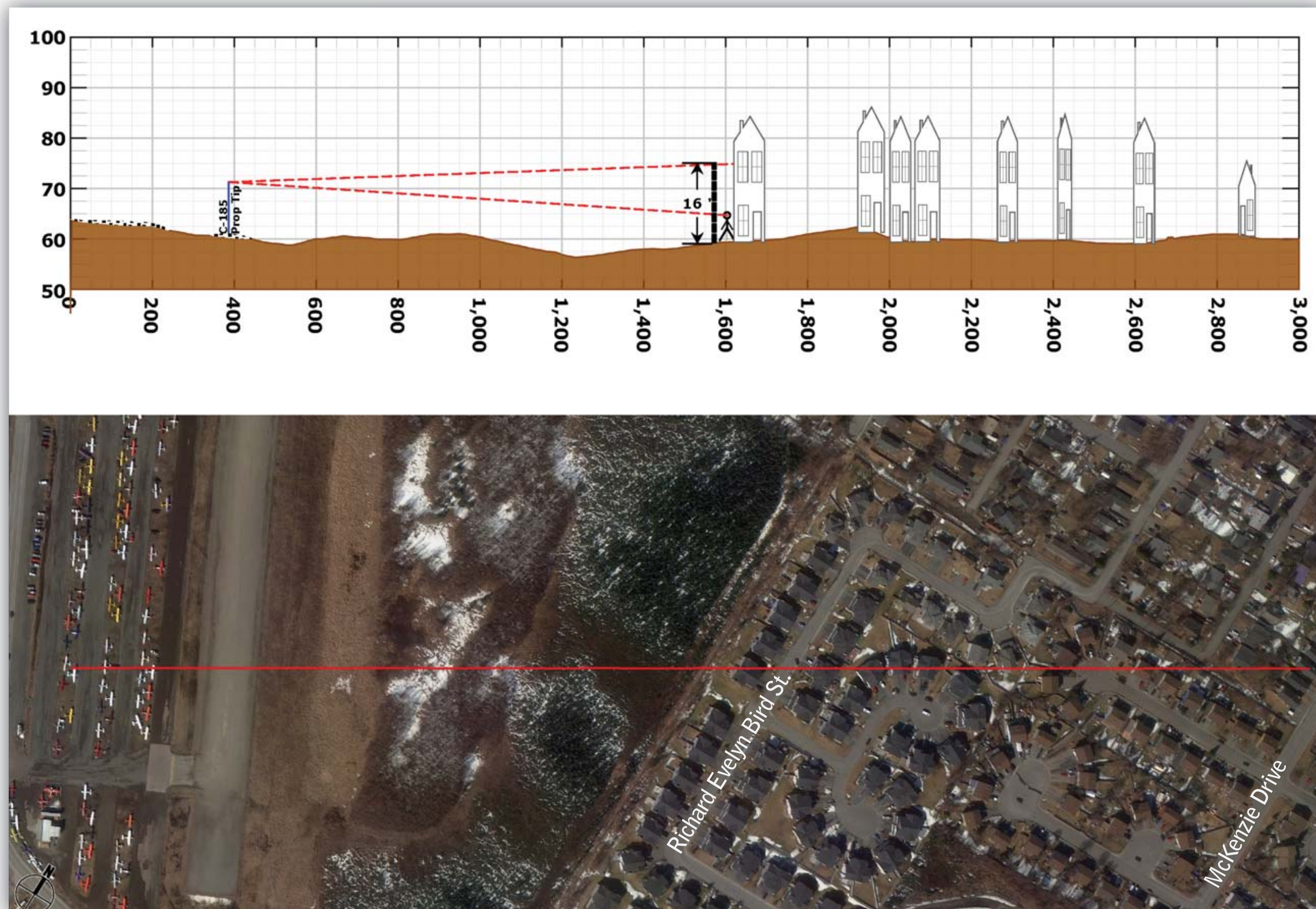

FIGURE I5
Gravel Airstrip Elevation Profile 2

COST. The cost to plan for and construct a noise barrier would be approximately $100,000-$1,000,000, but would be highly dependent on the size and design, with any impacts to wetlands significantly increasing the costs.

RESPONSIBLE PARTIES. The Airport would be responsible for hiring a consultant to conduct a site selection study to determine the best location for the noise barrier and to design the barrier, and hire contractors to construct the barrier. The Airport would also be responsible for applying for FAA funding for the recommendation. Subject to eligibility, allowability and justification requirements in place at the time the project is proposed for the Airport's capital improvement plan (CIP), FAA will be responsible to provide funding for this recommendation. The public would be encouraged to provide input.

AIRPORT ACTION. The Airport would apply for funding, initiate a site study, hire a consultant to conduct a site study and design the barrier, and hire contractors.

TIME FRAME. This recommendation could be initiated immediately upon approval of this Part 150 Study. It would take approximately 2 to 3 years to plan and construct a noise barrier, depending on location and availability of funding.

Noise Abatement Recommendation 2: Ground Run-Up Enclosure (Hush House)

ISSUE. Reduce engine run-up noise to neighborhoods close to the Airport.

NEW ACTION. This recommendation would construct a Ground Run-Up Enclosure (GRE) in which maintenance ground run-operations can be conducted.

COMMENTS. Airlines 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. A substantial amount of noise can be created when run-up testing occurs.

A GRE could be sited in one of a number of sites adjacent to an existing taxiway to enable aircraft to perform run-ups in a manner that reduces these single event noise impacts to nearby residents. The exact location of the GRE would be determined through a separate site selection study.

It is important to note that a GRE cannot be used under all wind conditions. The facility is aligned with the prevailing winds. Assuming a north orientation, the direction of the prevailing winds, the GRE could be used nearly 100% of the time. However, if wind conditions were to shift unexpectedly, the GRE could not be used during that time. Use of the GRE may also require a slight increase or decrease of taxiing time for aircraft, depending on final siting.

As mentioned in the previous chapter, Analysis of Noise Abatement Options and Additional Studies, aircraft ground noise was cited as a concern during the Study Input Committee meetings and public meetings. The future abated single event noise levels (SEL) for four potential ground run-up enclosure (GRE) sites are illustrated in Figure I6, *LMAX WITH GRE*. As shown in Figure I6, results calculated for the GRE recommendation noise contours for a 747 aircraft show up to a 100% reduction in the potential population exposed to run-up noise greater than the 60 Lmax at all four potential locations. The sizing of the GRE would be determined during a siting study.

COST. The cost of the GRE would be dependent upon its size, as well as whether new pavement is needed to provide access to the GRE. A larger GRE could accommodate larger aircraft.

Depending on the specific GRE needs determined for the Airport, the cost of constructing a GRE would be approximately $4 million to $5 million for a 747 aircraft. A closer look at the majority of aircraft doing run-ups would be examined during the siting study to determine the final sizing of the GRE. If the majority of the aircraft currently and proposed to do run-ups at the Airport are shown to be smaller than the 747, a smaller GRE may be constructed, which would cost more in the range of $3 to $4 million.

RESPONSIBLE PARTIES. The Airport is responsible for identifying a location for the GRE in accordance with Part 77 regulations through conducting a site selection study, writing the request for a proposal for design and construction, and notifying operators of the procedures after construction is complete.

The FAA is responsible for directing taxiing aircraft to the GRE, and the aircraft operators are responsible for using it. FAA is also responsible for compliance of the GRE with NEPA, but since it would likely be a Categorical Exclusion or an Environmental Assessment, the document would be completed by the Airport (or airport consultants) and then submitted to the FAA for review and approval. Subject to eligibility, allowability and justification requirements in place at the time the project is proposed for the Airport's capital improvement plan (CIP), FAA will be responsible to provide funding for this recommendation.

AIRPORT ACTION. The Airport would identify an acceptable GRE location using a site selection study, apply for federal funding and hire a consultant to design the facility, write specifications and the Request for Bid for contractors, and hire the contractor to construct the facility.

TIME FRAME. This recommendation could be initiated immediately upon approval of this Part 150 Study Update, but not prior to an air space review of the location to ensure compliance with Part 77 regulations, compliance with NEPA regulations, and receipt of funding.

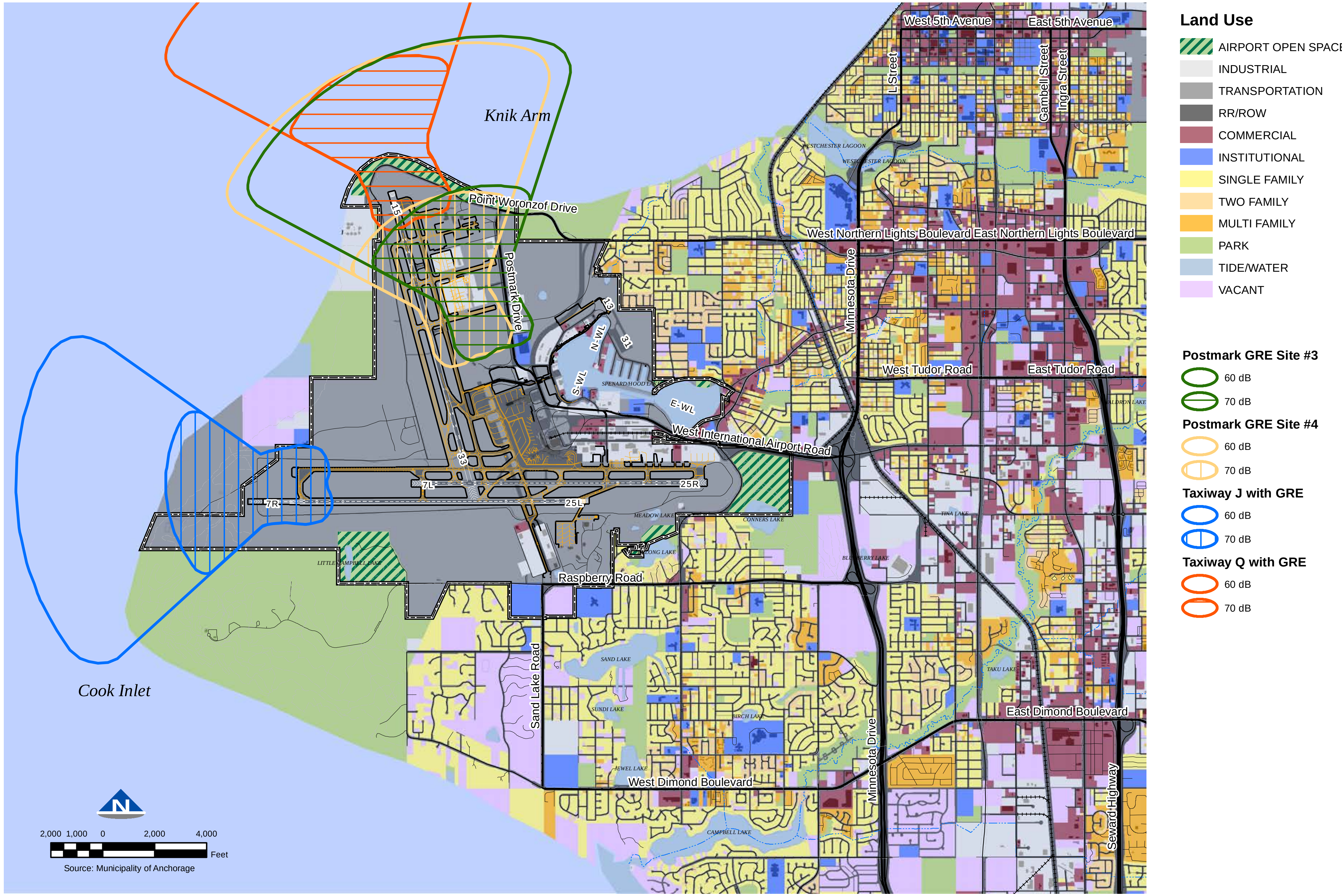

Figure I6 Lmax with GRE

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Noise Abatement Recommendation 3: Voluntary Reduced Use of Reverse Thrust

ISSUE. Reduce noise levels from the use of reverse thrust to slow jets during landing.

NEW ACTION. This recommendation is a ***voluntary*** measure, involving reduced use of reverse thrust during landing, and it is dependent upon weather and safety considerations.

COMMENTS. The ability to reduce the use of reverse thrust is dependent upon the runway length required by landing aircraft, the location of the taxiways, and landing conditions. Larger/heavier aircraft generally require longer landing distances.

The recommendation could result in an increase in taxiing time for aircraft because aircraft may need to use taxiways that are farther down the runway as it would take them longer to stop without the use of reverse thrust, resulting in additional fuel costs. It is not possible to quantify the potential benefits of reduced use of reverse thrust using DNL noise modeling, because the recommendation would be voluntary in nature. However, a qualitative aircraft ground noise reduction benefit would occur for residents near the Airport.

COST. There would be no associated cost with this recommendation because it is a voluntary landing procedure.

RESPONSIBLE PARTIES. The airlines would be responsible for implementing this recommendation when conditions are favorable. The Airport Traffic Control Tower (ATCT) would be responsible for directing aircraft to the proper exit taxiways. The Airport would be responsible for requesting that airlines use limited reverse thrust when conditions allow. No NEPA documentation would be necessary because the measure is voluntary and would not involve federal action.

AIRPORT ACTION. The Airport would be responsible for coordinating the specific procedures for reduced use of reverse thrust with the ATCT, and notifying pilots about the voluntary reduction in the use of reverse thrust. However, because the recommendation is voluntary the Airport has no control over when or by whom this procedure is used. This recommendation cannot be monitored or enforced.

TIME FRAME. This recommendation could be initiated immediately upon approval of this Part 150 Study Update, coordination with the ATCT, and through notification of operators about the voluntary recommendation.

Land Use Management Recommendations

Land Use Management Recommendation 1: Voluntary Sound Insulation of Noise Sensitive Structures Within the 65 DNL Noise Contour

ISSUE. Reduce noise levels experienced inside noise sensitive uses.

CONTINUED ACTION. This recommendation would sound attenuate eligible noise sensitive land uses.

COMMENTS. Contingent upon FAA funding becoming available, the habitable rooms in eligible structures within the 65 DNL and greater noise contour would be sound insulated with a minimum 5dB noise reduction for owners that are eligible and volunteer for the program. To be eligible for sound insulation, the structure must be a noise-sensitive land use located within the approved 65 DNL and greater noise eligibility boundary (see Figures I7 and I8), experience measured interior noise levels of 45 dB or higher, meet code, and must have been constructed prior to October 1, 1998. Noise-sensitive uses include residences, schools, and religious facilities.

The Airport recently completed a Residential Sound Insulation Program (RSIP) for insulation of existing structures within the previous 65 DNL noise contour that was recommended in the previous Part 150 Study. This measure would be a continuation of the previous recommendation, to include any additional areas within the new noise contours. All eligible homes within the previous 1997 contour that accepted the terms of the insulation have been sound insulated. Analysis in the previous chapter showed that some number of homes (approximately 25) were in the Future 2020 Noise Contours that were not previously insulated or eligible for insulation with the previous RSIP. Since that analysis, two operational procedure changes were determined to be reasonably foreseeable (the Master Plan Phase 2, Modification of Preferential Runway Use System to Meet Future Demand and the Required Navigation Performance (RNP) Procedure to Runway 33). These two changes were modeled and provide the base for the official Future Noise Exposure Map. The Future NEM is a slightly larger version of the Future 2020 Noise Contours, due to the addition of these two operational procedures.

Therefore, for this chapter, the analysis of the number of homes within the 65 DNL was updated based on this Future Noise Exposure Map. Within the updated 65 DNL noise contour of the Future Noise Exposure Map, there are approximately 45 homes[1] that may be eligible for insulation within the proposed eligibility boundary that have not previously been offered insulation, because under the previous NEMs, these homes were not located within the 1997 65 DNL contour. The proposed eligibility boundary is illustrated in Figure I7, *ELIGIBILITY BOUNDARY*, and Figure I8, *ELIGIBILITY BOUNDARY CLOSE UP*.

COST. The cost of insulating about 45 additional homes within the contour at approximately $50,000 per single family home would be about $2.25 million. The FAA would bear the majority of the cost, assuming funding availability, and the Airport would provide the required local match.

RESPONSIBLE PARTIES. The Airport is responsible for identifying the properties eligible for sound insulation, contacting the owners, applying for FAA funding, and hiring contactors to perform the sound interior noise monitoring and insulation. Citizens with qualifying homes are responsible for notifying the Airport that they would like to take part in the sound insulation program and signing a participation agreement. Subject to eligibility, allowability and justification requirements in place at the time the project is proposed for the Airport's capital improvement plan (CIP), FAA will be responsible to provide funding for this recommendation.

AIRPORT ACTION. The Airport would apply for federal funding, identify eligible properties, contact the owners of those properties, apply for funding, and hire contractors.

TIME FRAME. Full implementation of this recommendation is dependent upon several steps: the approval of this Part 150 Study Update, the securing of funding and discussion with eligible homeowners, in-house monitoring to make sure residences meet the 45 dB interior noise requirement, hiring of contractors, and general initiation and organization of the next phase of the RSIP. Full completion of this recommendation could take several years to a decade.

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[1] Note that this represents an increase in number of potentially eligible homes from the analysis shown in Chapter H; the Future NEM is slightly larger than the 2020 Future Noise Contours due to the addition of the two operational procedure changes. The number of potentially eligible homes listed here represents the official recommendation for the NCP.

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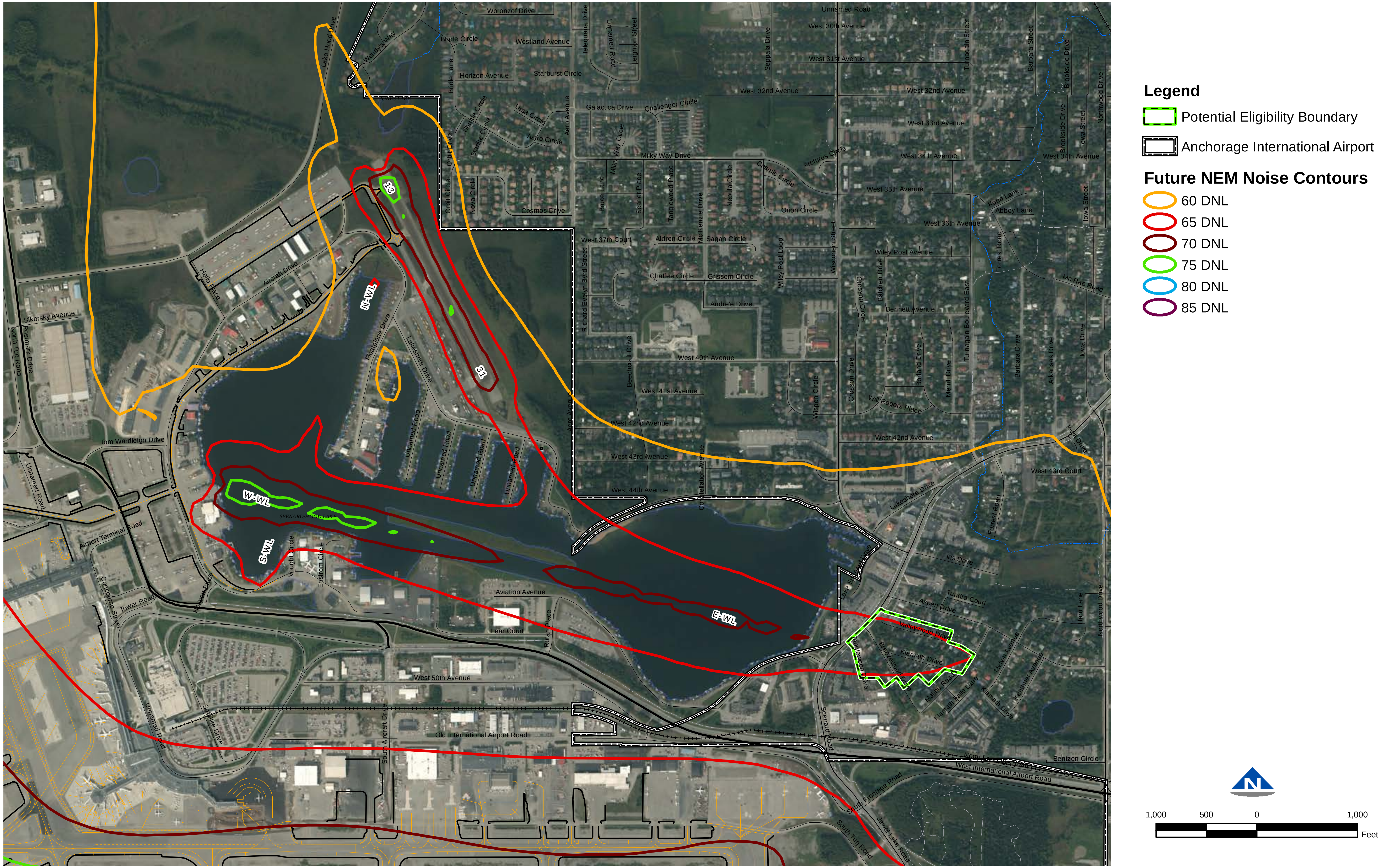

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure I7 **Potential Eligibility Boundary**

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure I8 **Potential Eligibility Boundary Close Up**

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Land Use Management Recommendation 2: Disclosure Statements/Buyer Notification

ISSUE. Reduce the annoyance of aircraft noise intrusion for prospective residents.

CONTINUED ACTION. This recommendation would inform potential homeowners/renters that they are purchasing a home in an area where they might experience aircraft noise levels that could cause annoyance.

COMMENTS. Notification of this type allows the buyer/renter to make a conscious decision prior to purchasing/renting a home and reduce the resultant complaints of aircraft over flights, as some new home buyers are not aware of the proximity of the Airport to the home they are considering.

There are generally two methods of providing buyer notification: 1) through the title search/analysis process, and 2) at the disclosure/closing time of the purchase. The title search method is effective with new home construction/subdivisions. As a condition to subdivision approval or the issuance of a building permit, such notice is placed on the subdivision plat or deed for each individual lot. Such notice is recorded on the deed and is identified in a title opinion or title insurance report, as are other similar notices. When using the disclosure method, the seller is required to disclose, on a standard disclosure form, if certain conditions exist. Conditions can include, 1) if the seller has ever been annoyed by aircraft noise, and 2) if the property is within a certain distance from an airport or within identified noise contours that have been officially adopted by the local jurisdiction.

This recommendation is a continued measure from the previous Part 150 Study. Of the two types of buyer notification, one is in place and the other is not. Currently, the State of Alaska has a disclosure form that requires that the seller disclose noise related issues. The notice tied to specific plats (within the 60 DNL noise contour) has not been implemented.

The *West Anchorage District Plan*, adopted by the Municipality of Anchorage in July 2012, recommends pursuing new notification provisions as part of an Airport Influence Overlay that would advise future residents about the Airport's presence before buying a home in the area. The possible notification requirements would apply only to new subdivisions and future discretionary approvals within the Airport's 60 or 65 DNL noise contour.

Implementation of this measure would be up to the local jurisdiction, which would have the authority to require such disclosure/notification. The Airport does not have the authority to implement this recommendation.

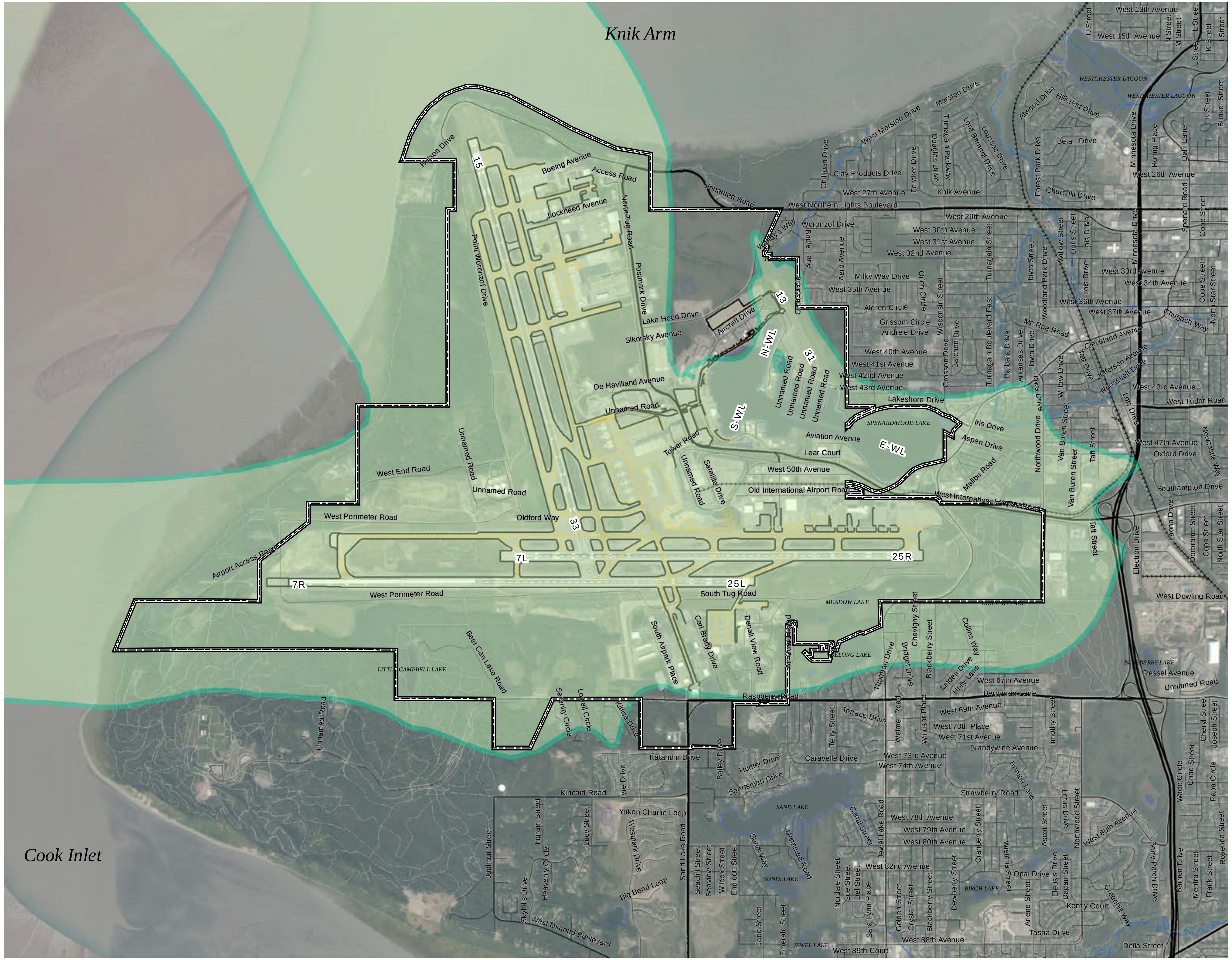
The local jurisdiction has the authority to require noise notifications on plats or deeds, or as a condition of permit approval. Noise notification requirements would be most effective if linked to the 60 DNL noise contour.

COST. There would be no associated direct cost for this recommendation.

RESPONSIBLE PARTIES. The local jurisdiction would be responsible for adopting measures requiring disclosure statements or buyer notification tied to the plats. The Airport would be responsible for identifying the relevant 60 DNL or other noise contour used as the basis for a potential buyer notification requirement and coordinating with the local jurisdiction to ensure that they have the proper maps.

AIRPORT ACTION. The Airport would identify the 60 DNL (see Figure I9) or other noise contour and coordinate with the local jurisdiction on the proper maps to be used.

TIME FRAME. This recommendation is typically difficult to implement. Due to political issues and processes at the local and state levels related to implementation of disclosure statements/buyer notification requirements, implementation of this measure is not definite, and could take a number of years, and may not be not achieved at all during the time frame of this Part 150 Study Update.



Legend

Anchorage International Airport

Notification Area

Future 60 DNL Contour

3,000 1,500 0 3,000 Feet

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure I9 **Future 60 DNL Notification Area**

Ted Stevens Anchorage International Airport AeroNexus®

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Land Use Management Recommendation 3: Building Code Requirements – Sound Attenuation Required for New Development

ISSUE. Reduce the number of non-compatible land uses in the future.

CONTINUED ACTION. This recommendation would implement mandatory sound attenuation requirements for new construction of noise sensitive uses.

COMMENTS. This measure would amend building code requirements to include sound attenuation standards for any new construction of noise sensitive uses within certain prescribed boundaries, such as the 60 DNL contour. Prior to building permit or plat approval, noise sensitive uses would be required through construction techniques to achieve a pre-determined reduction in the amount of noise between outside and inside noise levels. As part of the 2000 Part 150 Noise Compatibility Program Record of Approval, the Airport recommended that new residences within the 1997 60 dB contour be required to incorporate sound insulation in order to achieve interior noise levels of 45 dB or lower.

Building code requirements are implemented by the local jurisdiction having land use control authority. Such requirements do not change the outside noise levels but do require the inside noise levels of new noise sensitive structures to be reduced to a maximum of 45 dB, the same as remedial sound attenuation requirements for existing structures. The requirements are based on some definable boundary, usually the DNL noise contours, and apply only to new construction within those contours. Such measures have been successful for many communities near airports in helping achieve compatibility where housing is at a premium. In addition, FAA policy is that any new noise sensitive use constructed after October 1998 within a published noise contour is not eligible for remedial sound attenuation. Therefore, if sound attenuation is to be achieved, it must be part of the initial construction process.

When modifying the building codes, the code would not specify the means to achieve this reduction only that such reduction is necessary, and the builder is given the option of how to achieve such reduction. Normally, the plat or building plans are certified to provide for the necessary noise reduction. Experience has shown that it may be desirable to achieve a 30 dB reduction within the 65 DNL and a 35 dB reduction within the 70 DNL contours. Noise sensitive land uses within the 75 DNL or greater contours should be prohibited as adequate internal sound attenuation is not possible.

The *West Anchorage District Plan*, adopted by the Municipality of Anchorage in July 2012, recommends adopting an Airport Influence Overlay as part of the Municipal zoning code that requires enhanced sound insulation for new or remodeled residences. It would also prohibit the construction of new modular or mobile homes within the overlay because they cannot be sound insulated.

COST. There would be no cost to the Airport associated with this recommendation, because it is a policy measure dependent upon adoption by the local jurisdiction. The cost to administer the building code requirements would be part of the normal review and approval process. The cost to amend the building codes would be borne by the municipality. Once enacted, building code requirements would result in a slight increase in the cost of construction, as homes are built with the appropriate insulation. At other airport sites, contractors have found that the cost of such insulation, performed at the time of construction is less than $10,000 in comparison to the cost of retrofitting an already built home (estimated at $50,000). The additional construction costs for new noise sensitive uses within the specified area would be borne by the developer.

RESPONSIBLE PARTIES. The local jurisdiction would be responsible for implementing this policy measure by adopting changes or additions to the building code, and/or the zoning ordinance if the measure were adopted in conjunction with an airport overlay zone. The Airport would be responsible for assisting the local jurisdiction with identifying the noise level basis for the boundaries and supplying them with the proper maps.

AIRPORT ACTION. The Airport would assist the local jurisdiction with proper identification of the prescribed boundaries for the additional building code requirements.

TIME FRAME. Due to political issues and processes at the local level related to implementation of building code requirements, implementation of this measure is not definite, and could take a number of years, and may not be not achieved at all during the time frame of this Part 150 Study Update.

Land Use Management Recommendation 4: Comprehensive Plan Amendments

ISSUE. Prevent the introduction of new non-compatible land uses.

CONTINUED ACTION. This recommendation would utilize land use planning and development policy processes to achieve long-term land use compatibility of the jurisdictions with aircraft noise exposure from the Airport.

COMMENTS. Comprehensive plans are prepared by local jurisdictions to 1) identify current conditions in a community, 2) identify community goals and policies, and 3) identify plans for that community to achieve the goals. This measure proposes to amend existing adopted comprehensive plans, the *Anchorage 2020 Comprehensive Plan* and the *West Anchorage District Plan*, to achieve long-term land use compatibility in the Airport environs. The FAA previously approved several preventive land use control and comprehensive planning measures in the Record of Approval for the previous Part 150 Study.

Community comprehensive plans are policy guides for the future development of a particular jurisdiction. Plans provide guidance for future land use development and land use changes. These plans are particularly important in the area around the Airport that may experience noise levels that could impact certain types of noise sensitive uses such as residential structures or public buildings. It is desirable that each community develop its plans and policies to be compatible with existing and future aircraft noise levels.

A comprehensive plan alone does not reduce aircraft noise levels nor does it control the use of land, as it is just a policy statement of the intended future use of land. However, comprehensive plans do influence the development or change in use of any particular piece of property. They also serve as a guide for future development. One of the most influential uses of the comprehensive plan can be to officially adopt and present aircraft generated noise contours, and use those noise contours to help guide compatible development.

COST. There would be no cost to the Airport associated with this recommendation, because it is a policy measure dependent upon adoption by the local jurisdiction. There would not be significant cost for implementation to the local jurisdiction, because airport compatibility issues would be taken into consideration as part of the normal comprehensive plan updating process.

RESPONSIBLE PARTIES. The local jurisdiction having land use authority over the area around the Airport would be responsible for implementation of this recommendation. The Airport would provide technical assistance and the proper noise exposure maps as needed.

AIRPORT ACTION. The Airport would assist the local jurisdiction with providing proper identification of the prescribed boundaries or other technical Airport-related information needed to properly inform the comprehensive planning process.

TIME FRAME. Due to political issues and processes at the local level related to implementation of comprehensive planning, implementation of this measure is not definite, and could take a number of years, and may not be not achieved at all during the time frame of this Part 150 Study Update.

Land Use Management Recommendation 5: Zoning Code Changes/Noise Overlay Zone

ISSUE. Protect the health, safety, and welfare of the public and prevent new non-compatible land uses within the vicinity of the Airport and.

CONTINUED ACTION. This recommendation involves changes to the Municipality of Anchorage Title 21 Land Use Code to guide compatible development near the Airport.

COMMENTS. A zoning code has more regulatory authority than a comprehensive plan. The zoning code prescribes development standards that new development must meet. Standards can include sound attenuation, granting of an avigation (noise) easement, disclosure notification, and other related standards. Noise complaints and concerns are common in those areas outside the 65 DNL noise contour. Thus, consideration should be given to restricting residential and other noise sensitive uses between the 55 DNL and 65 DNL contours.

The *West Anchorage District Plan* recommends adopting an Airport Influence Overlay as part of the Municipal zoning code that would apply several special requirements and restrictions to minimize the effects of airport noise in the vicinity of the Airport.

Zoning can be a very effective means of controlling land use development and is the most widely used land use control. The local jurisdiction must determine what uses within which contours are considered to be non-compatible and can then pass reasonable measures to restrict such land uses within those contours.

COST. There would be no cost to the Airport associated with this recommendation, because it is a policy measure dependent upon adoption by the local jurisdiction. There would not be significant cost for implementation to the local jurisdiction, because airport compatibility issues would be taken into consideration as part of the zoning update process. The additional construction costs for new noise sensitive uses within the specified area would be borne by the developer.

RESPONSIBLE PARTIES. The local jurisdiction having land use authority over the area around the Airport, would be responsible for implementation of this recommendation. The Airport would provide technical assistance and the proper noise boundary maps as needed.

AIRPORT ACTION. The Airport would assist the local jurisdiction by providing proper identification of the prescribed boundaries (generally dictated by a noise contour such as the 55 DNL or 60 DNL) or other technical Airport-related information needed to properly inform the zoning ordinance amendment process.

TIME FRAME. Due to political issues and processes at the local level related to making changes to the zoning ordinance, implementation of this measure is not definite, and could take a number of years, and may not be not achieved at all during the time frame of this Part 150 Study Update.

Administrative Recommendations

Administrative Recommendation 1: Development of Fly Quiet Report Card and Pilot Awareness Program

ISSUE. Reduce effect of single event noise levels, and increase awareness of noise sensitive uses and noise reducing procedures for pilots operating at Lake Hood Seaplane Base (LHD).

CONTINUED ACTION. This recommendation would create/update a Fly Quiet Program for LHD. While fly quiet programs have been completed as part of the previous Part 150 Study for ANC, this would build upon what was completed previously and focus on creating an official Fly Quiet program for LHD.

COMMENTS. A Fly Quiet Program is focused on education, which can be an important tool for reducing single event noise near airports, particularly related to general aviation operations. A Fly Quiet Program can be tailored to the Airport to address noise issues and promote fly quiet procedures for pilots. Pilot education is very important with regards to single event levels. A Fly Quiet Program distributed to pilots can help educate them on "good neighbor" procedures that reduce the effect of fly-overs on noise sensitive uses.

Several measures to increase pilot awareness of the noise abatement program at ANC were recommended and completed as part of the previous Part 150 Study. Specific noise abatement measures for LHD were not recommended in the previous Study, but a pilot awareness and education program for general aviation users was pursued by the ADOT&PF outside the FAA Noise Compatibility Program approval. Comments received during this Study have indicated that a Fly Quiet Program at LHD would be highly valued. There is currently an unofficial Fly Quiet Program at LHD, and this would be updated to provide education through reports, meetings, etc. The Fly Quiet Program would focus primarily on LHD for this measure.

COST. Funding sources could be borne by the Airport along with Federal funding assistance, if available. The cost to prepare and print the Fly Quiet Brochure for LHD would be approximately $40,000. If additional help was needed to update, raise awareness or track success of the Fly Quiet Program in the future, the cost for this recommendation would be approximately $35,000 to 40,000 per year.

RESPONSIBLE PARTIES. The Airport would be responsible for applying for FAA funding for the recommendation, planning for the programs and implementing them. If the Fly Quiet/Pilot Awareness programs were to be carried out by a consultant, the Airport would be responsible for hiring the consultant and managing the project; this management could require about five hours of a staff member's time for about 8-12 months during development. Subject to eligibility, allowability and justification requirements in place at the time the project is proposed for the Airport's capital improvement plan (CIP), FAA will be responsible to provide funding for this recommendation. Aircraft operators, the ATCT, and the public would be responsible for providing input and participating in the program development.

AIRPORT ACTION. The Airport would plan and implement the programs, or hire and manage a consultant to do so.

TIME FRAME. The recommendation could be initiated immediately upon approval of this study, but would likely take time to implement because the formation of Fly Quiet/Pilot Awareness programs is a complex process involving many stakeholders. The full implementation timeframe would be approximately 1-2 years.

Administrative Recommendation 2: Continuation of Public Information Program and Noise Information Page on the Website

ISSUE. Increase the availability of noise related information for the public to access and provide feedback.

CONTINUED ACTION. This recommendation would keep the noise section of the Airport's website active with information about existing noise reduction measures, current Noise Exposure Maps, information on submitting comments, and any other noise related information for access by stakeholders. The recommendation also includes pursuing a public information program that could include the continuation of existing airport noise briefings during existing meetings of the surrounding community councils, the Municipality of Anchorage, etc.

COMMENTS. Stakeholder updates can be very important for the relationship between the Airport and the surrounding communities. The area of the website with this information can answer many commonly asked questions and misconceptions about what an airport can and cannot do with regards to noise. This is a continued measure from the previous Part 150 Study. The Airport has implemented this measure on their website and through periodic meetings with user groups and community councils.

COST. There would be no expected additional cost for this recommendation, as the cost would be within existing airport staff functions and budgets.

RESPONSIBLE PARTIES. The Airport would be responsible for continuing to update noise information on its website as necessary, and for continuing its public information program briefings.

AIRPORT ACTION. The Airport would update its website noise information and provide briefings.

TIME FRAME. This recommendation is currently ongoing.

Administrative Recommendation 3: Public Comment Submittal Form

ISSUE. Increase the ability of the Airport to respond to public concerns based on comments received.

CONTINUED ACTION. This recommendation involves collecting and examining aircraft noise comments by keeping the comment submittal form on the website, so members of the public can submit noise comments easily.

COMMENTS. Tracking noise comments or complaints can help the Airport better understand the location and type of noise affecting the surrounding neighborhoods, and comments are crucial to the relationship between the Airport and the surrounding communities. The current comment submittal form allows the Airport to track where and when comments are received, so they can better understand what types of operations cause single event concerns. Comments are reviewed by airport staff and responses are provided when requested. This recommendation is a continuing action from the previous Part 150 Study, but differs from the previous measure that stated that a designated staff member reviewed comments.

COST. There would be no expected additional cost for this recommendation, as the cost would be within existing airport staff functions and budgets.

RESPONSIBLE PARTIES. The Airport would be responsible for regularly reviewing comments or complaints and responding when requested. The public and other airport stakeholders would be responsible for using the form to submit comments in order to provide input to the Airport.

AIRPORT ACTION. The Airport would review and respond to noise comments.

TIME FRAME. This recommendation is currently ongoing.

Administrative Recommendation 4: Addressing of Noise Comments

ISSUE. Ensure that airport staff monitors noise comments and provides a liaison with the community.

REVISED ACTION. This recommendation provides staff support responsible for tracking noise complaints and comments and acting as a staff/community liaison for noise issues.

COMMENTS. This revised measure allows the Airport to cover the tasks of noise tracking and community liaison more flexibly within existing staff members. The previous Part 150 Study identified a measure to establish a dedicated Noise Program Manager.

The Airport created this position for several years, but the responsibilities of this Noise Program Manager position were recently reallocated to several other staff members to better balance work load. This measure includes keeping staff to cover the responsibilities of a Noise Program Manager, but incorporates the flexibility of balancing work load within the airport staff to accommodate these tasks across several positions to be more efficient.

COST. There would be no expected additional cost for this recommendation, as the cost would be within existing airport staff functions and budgets.

RESPONSIBLE PARTIES. The Airport would be responsible for distributing responsibilities for review and response to comments amongst staff members as necessary. The Airport would be responsible for regularly reviewing comments or complaints and responding when requested.

AIRPORT ACTION. The Airport would monitor noise comments and respond to them when requested.

TIME FRAME. This recommendation is currently ongoing.

Administrative Recommendation 5: Flight Tracking

ISSUE. Track single noise events around the Airport.

REVISED ACTION. This recommendation would involve the acquisition of a flight tracking system.

COMMENTS. This measure was approved under the previous Part 150 Study Update, and a noise monitoring/flight tracking system was installed around the Airport. The system was operated until the end of 2009. In the past, the flight tracking portion of this system was found to be the most beneficial in answering questions from the public. Therefore, it may be helpful to use a system that focuses on flight tracking rather than full monitoring, as stated in this recommendation. Additionally, the Airport tracks numbers and types of operations on a regular basis, and a 15% change in operations (or a significant change in flight tracks, etc.) would trigger the update of the Part 150 Study (See Administrative Recommendation 6). This recommendation is not associated with noise reduction.

COST. The estimated cost of modifying the existing flight tracking system would be costly. The cost for updating the flight tracking system to make it operable for flight tracking would be approximately $24,000 and would cost approximately $24,000 per year to operate.

If a new flight tracking office system is also needed, the office system would cost approximately $34,000 and would cost approximately $50,000 per year to operate, in addition to the previous costs to make the flight tracking system operable. If the Airport's existing noise monitoring terminals (NMTs) should need to be replaced as well, the cost could increase substantially to as high as $1 Million to get new terminals and set up the office system, and would also cost approximately $97,000 to $131,000 per year to operate.

RESPONSIBLE PARTIES. The Airport would be responsible for developing the specifications of the updated system, budgeting for equipment and services needed, and apply for FAA funding. The Airport would also be responsible for hiring a consultant to perform the necessary work involved. The Airport would also be responsible for ensuring that data received from the systems is properly downloaded and stored and for making the data available and usable by airport staff and potentially the public as well. Subject to eligibility, allowability and justification requirements in place at the time the project is proposed for the Airport's capital improvement plan (CIP), FAA will be responsible to provide funding for this recommendation.

AIRPORT ACTION. The Airport would budget for flight tracking, apply for funding, hire a consultant to update the system, properly store and manage data received, and utilize the data when responding to noise comments, where applicable.

TIME FRAME. This recommendation could be implemented immediately upon approval of this Part 150 Study Update. Completion of this recommendation would take approximately 1-2 years.

Administrative Recommendation 6: Review and Update Part 150 Study As Needed

ISSUE. Ensure that the Noise Exposure Maps and Noise Compatibility Program are updated as conditions change.

CONTINUED ACTION. This recommendation involves updating the Noise Exposure Maps or the Part 150 Study at the end of the five-year period or when there is a significant change in aircraft types, numbers of operations, or new facilities.

COMMENTS. This recommendation will ensure that the Noise Compatibility Program is adjusted as conditions in the environs of the Airport change over time (such as an increase in number/type of traffic or operational changes). This recommendation is a continued measure from the previous Part 150 Study, as a Part 150 Study is intended to be a "living document," to be used as a tool to monitor and guide program development, and evaluate aircraft types and operations. The Study should be reviewed and updated as appropriate.

The general guideline for when to update the Study is that whenever the actual operations are approximately 15% different from the forecast operations, the Noise Exposure Maps (NEMs) should be reviewed. The forecasts used for the future NEMs (2020) in this report were 307,735, so if operations are above approximately 354,000 annual operations, the contours may need to be updated. In addition, whenever there are significant new non-compatible land uses within the 65 DNL or greater contours or if there are airport facility changes which may affect the contours, consideration should be given to reviewing the maps. At the end of the five-year study period (after date of Noise Compatibility Program approval), the operations and fleet mix should be re-evaluated to determine the extent to which they have changed, and updated as appropriate. If necessary, new noise mitigation measures would be evaluated as part of the Study Update.

COST. The cost to monitor operational and aircraft type information would be within existing airport staffing and budgeting constraints. The cost to hire a consultant to update independent elements, such as just running some test noise contours, would be approximately $30,000. The cost to update the entire Part 150 Study would be approximately $1-$1.5 million, and approximately half that to just update the NEMs.

RESPONSIBLE PARTIES. The Airport would be responsible for applying for FAA funding for the Part 150 Study Update and for initiating and managing the Study. Subject to eligibility, allowability and justification requirements in place at the time the project is proposed for the Airport's capital improvement plan (CIP), FAA will be responsible to provide funding for this recommendation.

AIRPORT ACTION. Using the monitoring systems discussed above in Administrative Recommendation 5, the Airport would reevaluate the program when there is a significant change in operations, aircraft types, or at the end of the five-year timeframe. If an update to the Part 150 Study is justified, the Airport would initiate and carry out the Study Update.

TIME FRAME. The Airport would continue its ongoing monitoring of operational and aircraft type information. Based on that information, the Airport would consider a Part 150 Study Update as necessary according to FAR Part 150 regulations, or at the end of the 5-year period after the date of submittal of this Part 150 Study Update.

Facility Recommendations

Facility Recommendation 1: Install Electrification and Preconditioned Air at All Jet Bridges and Cargo Areas

ISSUE. Reduce aircraft engine noise while on the ground.

NEW ACTION. This recommendation involves installing electrification and preconditioned air at all jet bridges and cargo areas that do not currently have these features.

COMMENTS. Aircraft generally use their auxiliary power units (APUs) for power (both cargo and passenger aircraft), heat and air conditioning while on the ground (primarily passenger aircraft), which causes some ground noise. With gate/jet bridge electrification and preconditioned air hook-ups, the aircraft can hook into this power at a jet bridge and not use their APUs, thus reducing noise. While this measure was not previously examined in the past Part 150 Studies, the Airport has added electrification at most of their jet bridges as part of separate projects. Therefore, this measure would include adding electrification and pre-conditioned air hook-ups at any feasible areas that do not already have this feature. When able, Alaska Airlines uses the jet bridge electrification on all C gates due to their company policy. The other jet bridges likely use jet bridge electrification when able, but the addition of pre-conditioned air would decrease the amount of time that aircraft would use the APU. Most of the cargo areas already have electric hook-ups and would likely not need additional air hook-ups, because without passengers, have less need for heating/cooling, and most of the jet bridges already have electric hook ups. So this recommendation would focus primarily on adding preconditioned air hook-ups on the jet bridges to reduce the use of APUs by the commercial service aircraft.

COST. An engineering study of the existing electrical systems would be required to identify the specific costs to add preconditioned air at the jet bridge that already have electrification at the Airport. This study would likely cost around $50,000. However, based on costs pulled from other jet bridge electrification/preconditioned air hook-up projects at other airports around the country, these projects tend to cost approximately $300,000-$600,000 per jet bridge/area. For the 37 jet bridges at the Airport, this could cost approximately $11.1 Million to $22.2 Million total. While this represents a very high cost, because Anchorage is located within a non-attainment area for the National Ambient Air Quality Standards, this project could be eligible for a Voluntary Airport Low Emissions (VALE) Program grant. If completed under noise funding, jet bridges within exclusive use areas may not be eligible for funding, which could limit the total number of jet bridges that would be eligible.

This recommendation is being recommended from a noise perspective, but it also has air quality benefits and could be eligible for separate grant money under the VALE program.

RESPONSIBLE PARTIES. The Airport would be responsible for identifying the feasible jet bridges/areas where this recommendation could be implemented in cooperation with the aircraft operators and airlines. The Airport would apply for FAA funding for the recommendation, and would also hire a consultant to design and implement the new hook-ups. Subject to eligibility, allowability and justification requirements in place at the time the project is proposed for the Airport's capital improvement plan (CIP), FAA would be responsible to provide funding for this recommendation. The airlines would be responsible for cooperating with the Airport on the installation and granting the installation technicians access to the jet bridges and cargo areas.

AIRPORT ACTION. The Airport would identify the feasible locations for implementing this recommendation in cooperation with the airlines, apply for funding, and hire a consultant to install the new electrification/preconditioned air hook-ups.

TIME FRAME. This recommendation could be initiated as soon as funding sources are identified.

Chapter J – Consultation

INTRODUCTION. The Ted Stevens Anchorage International Airport FAR Part 150 Noise Study Update involved an extensive public participation process, in accordance with the requirements of the regulation. The Airport set an inclusive tone by requesting that the community and users be actively involved throughout the process. Many opportunities were presented to solicit public and key stakeholder input during the study process. The kick-off meeting for the Study was held on February 29, 2012.

Study Input Committee

A Study Input Committee was developed to provide input during the Study process. The Committee met nine times during the course of the Study, on February 29, 2012; May 10, 2012; November 7, 2012; February 12, 2013; June 4, 2013; August 20, 2013; November 19, 2013; March 6, 2013; and July 9, 2014. The Committee was composed of airport users, aviation representatives, community council representatives, members of the public, Municipality of Anchorage representatives, FAA representatives, and State of Alaska representatives, and other interested parties. Presentations, meeting notes, and sign-in sheets from the Committee meetings as well as a membership list are contained in the **Consultation Appendix**. At each meeting, a working paper was presented and discussed. The Committee meetings were open to the public, and members of the public attended several meetings. Upcoming Committee meetings were announced on the project website.

In addition to the Committee meetings, five public workshops were held to present information to the public and receive comments from the public, on February 29, 2012; November 7, 2012; November 19, 2013; April 24, 2014; and September 30, 2014. Prior to the first public workshop, an informational card was sent by mail to a list of addresses created from noise comments/complaints submitted to the Airport, informing them about the Study and the initial kick-off meeting. Prior to each workshop, an advertisement informing the public of the date, location, and content of the workshop was placed in the Anchorage Daily News. The public workshops were also announced on the project website, the State of Alaska Online Public Notices website, and the Alaska Department of Transportation website.

In addition, announcements for the public workshops were sent via e-mail to those members of the public who had requested to be placed on the e-mail list for receiving project updates and announcements as well as to Study Input Committee members. Several written comments were received during the public workshops, as well as many verbal comments. Comments received at the public workshops and through the Study website were addressed and taken into account during the Study process and during development of the Study. The kick-off meeting mailing card, workshop presentations, sign-in sheets, proofs of publication, and submitted comments for the public workshops are contained in the **Consultation Appendix**.

Public Hearing

A Public Hearing on the Recommendations was held on November 12, 2014. Approximately 61 people attended. Both verbal and written comments were received. The verbal comments were given before a Court Reporter, and the written comments were accepted both at the Hearing and until November 24th, subsequent to the Hearing. The Public Hearing presented the forecasts of airport operations, the Existing and Future Noise Exposure Maps with affected population, the Recommendations, and a map of the proposed eligibility boundary area for voluntary residential sound insulation. The Hearing date and location was announced twice prior to the Hearing in the Anchorage Daily News, on the project website, the State of Alaska Online Public Notices website, and the Alaska Department of Transportation website. In addition, prior to the hearing, an informational card was sent by mail to four zip codes within the vicinity of the Airport, informing them about the hearing. A public hearing announcement was also sent via e-mail to those members of the public who had requested to be placed on the e-mail list for receiving project updates and announcements as well as to the Study Input Committee members. There was an official comment period during which official comments could be submitted, beginning with the Hearing and extending two weeks after the hearing, from October 10, 2014 to November 24, 2014. In the Response to Comments section of the **Public Hearing-Comment Period Appendix**, the Study Team formally responded to each comment submitted at the Hearing and during the official comment period. The Hearing mailing card, proof of publication, presentation, transcripts, sign-in sheets, and a copy of all submitted comments at the Hearing and during the comment period are also contained in the **Public Hearing-Comment Period Appendix**.

Department of Transportation & Public Facilities Acceptance

The Alaska Department of Transportation and Public Facilities has approved and accepted the Draft Part 150 Study. The Letter of Approval/Acceptance of the Recommendations, Noise Exposure Maps, and Part 150 Study by Ted Stevens Anchorage International Airport is contained in the **Approval Appendix**.

FAA Noise Exposure Map Acceptance and Record of Approval

The Federal Aviation Administration accepted the Noise Exposure Maps on July 27, 2015 and approved the Noise Compatibility Program on November 18, 2015 by issuing their Record of Approval. The Record of Approval contains those approved elements that would be eligible to receive federal funding to implement aircraft noise mitigation. A copy of the 2015 Record of Approval is included at the beginning of this document.

Part 150 Noise Compatibility Program Checklist

I. IDENTIFICATION AND SUBMISSION OF PROGRAM:	Page Number
A. Submission is properly identified:	
1. 14 C.F.R Part 150 NCP?	Yes, Cover, Fly Sheet, Cover Letter
2. NEM and NCP together?	Yes
3. Program revision?	Yes, full NCP/NEM Part 150 Study Update
B. Airport and Airport Operator's name identified?	Yes, Cover, Flysheet
C. NCP transmitted by airport operator cover letter?	Yes

II. CONSULTATION:

A. Documentation includes narrative of public participation and consultation process?	Yes, J.1-J.2, Appendix
B. Identification of consulted parties:	
1. All parties in 150.23(c) consulted?	Yes, J.1, Appendix
2. Public and planning agencies identified?	Yes, J.1, Appendix
3. Agencies in 2., above, correspond to those affected by the NEM noise contours?	Yes, J.1, Appendix
C. Satisfies 150.23(d) requirements:	
1. Documentation shows active and direct participation of parties in B, above?	Yes, J.1, Appendix
2. Active and direct participation of general public?	Yes, J.1-J.2, Appendix
3. Participation was prior to and during development of NCP and prior to submittal to FAA?	Yes, J.1-J.2, Appendix
4. Indicates adequate opportunity afforded to submit views, data, etc.?	Yes, J.1-J.2, Appendix

D. Evidence included of notice and opportunity for a public hearing on NCP? — Yes, Appendix

E. Documentation of comments:
   1. Includes summary of public hearing comments, if hearing was held? — Yes, J.2, Appendix
   2. Includes copy of all written material submitted to operator? — Yes, Appendix
   3. Includes operator's responses/disposition of written and verbal comments? — Yes, Appendix

F. Informal agreement received from FAA on flight procedures? — N/A

III. NOISE EXPOSURE MAPS: [150.23, B150.3, B150.35 (f)]

(This section of the checklist is not a substitute for the Noise Exposure Map checklist. It deals with maps in the context of the Noise Compatibility Program submission.)

A. Inclusion of NEMs and supporting documentation:
   1. Map documentation either included or incorporated by reference? — Yes, D.95-D.97, I.1-I.5
   2. Maps previously found in compliance by FAA? — Yes
   3. Compliance determination still valid? — Yes
   4. Does 180-day period have to wait for map compliance finding? — Yes

B. Revised NEMs submitted with program:

   (Review using NEM checklist if map revisions included in NCP submittal)

   1. Revised NEMs included with program? — Yes, D.97, I.5
   2. Has airport operator requested FAA to make a determination on the NEM(s) when NCP approval is made? — Yes

C. If program analysis used noise modeling:
   1. INM or HNM, or FAA-approved equivalent? — Yes, C.38-39
   2. Monitoring in accordance with A150.5? — Yes, C.27-C.40

D. Existing condition and 5-year maps clearly identified as the official NEMs?
   Yes, D.97, I.5, and Large-Scale Maps Submitted Separately

IV. CONSIDERATION OF ALTERNATIVES: [B150.7, 150.23 (e)]

A. At a minimum, are the alternatives below considered?
   1. Land acquisition and interest therein, including air rights, easements, and development rights? Yes, H.9-H.11
   2. Barriers, acoustical shielding, public building sound proofing Yes, G.16, G.31, H.6
   3. Preferential runway system Yes, F.24, G.42
   4. Voluntary Flight procedures Yes, G.4, G.10, G.40, G.48
   5. Restrictions on type/class of aircraft (as least one restriction below must be considered) taking into account applicable legislation (49 U.S.C 47521 et. seq.), powers and duties of the Administrator, and grant assurances.
      a. deny use based on Federal standards Yes, F.11
      b. capacity limits based on noisiness Yes, F.12
      c. mandatory noise abatement takeoff/approach procedures Yes, F.24
      d. landing fees based on noise or time of day Yes, F.13
      e. nighttime restrictions Yes, F.14
   6. Other actions with beneficial impact not listed herein Yes, H.9-H.26
   7. Other FAA recommendations (see D, below) N/A

B. Responsible implementing authority identified for each considered alternative? Yes

C. Analysis of alternative measures:
   1. Measure clearly described? Yes, G.1-G.53, H.1-H.26
   2. Measures adequately analyzed? Yes, G.1-G.53, H.1-H.26
   3. Adequate reasoning for rejecting alternatives? Yes, G.1-G.53, H.1-H.26

D. Other actions recommended by the FAA:
   Should other actions be added? N/A
   (List separately, or on back, actions and discussions with airport operator to have them included prior to the start of the 180-day cycle. New measures adopted by the airport sponsor must be subject to consultation before they can be submitted to the FAA for action. (See E., below)

V. ALTERNATIVES RECOMMENDED FOR IMPLEMENTATION:
[150.23 (e),B150.7, B150.35 (b), B150.5]

A. Document clearly indicates:
   1. Alternatives recommended for implementation? — Yes, 1.1-1.51
   2. Final recommendations are airport operator's, not those of consultant or third party? — Yes, Cover Letter

B. Do all program recommendations:
   1. Relate directly or indirectly to reduction of noise and non-compatible land uses? — Yes, 1.1-1.51
      (Note: All program recommendations, regardless of Whether previously approved by the FAA in an earlier Part 150 study, must demonstrate a noise benefit if the airport sponsor wants FAA to consider the measure for approval in a program update. See E., below)
   2. Contain description of contribution to overall effectiveness of program? — Yes, 1.1-1.51
   3. Noise/land use benefits quantified to extent possible? — Yes, 1.1-1.51
   4. Include actual/anticipated effect on reducing noise exposure within noncompatible area shown on NEM? — Yes, 1.24-1.29
   5. Effects based on relevant and reasonable expressed assumptions? — Yes, 1.1-1.51
   6. Have adequate supporting data to support its contribution to noise/land use compatibility? — Yes, 1.1-1.51

C. Analysis appears to support program standards set forth in 150.35 (b) and B150.5? — Yes, 1.1-1.51

D. When use restrictions are recommended:
   1. Does (or could) the restriction affect Stage 2 or Stage 3 aircraft operations (regardless of whether they presently operate at the airport)? (If restriction affects Stage 2 helicopters, Part 161 also applies.) — N/A

      If the answer to 1. is yes, has the airport operator completed the Part 161 process and received FAA Part 161 approval for a restriction affecting Stage 3 aircraft? For restrictions affecting only Stage 2 analysis and consultation process required by Part 161? — N/A

   3. Are non-restrictive alternatives with potentially significant noise/compatible land use benefits thoroughly analyzed so that appropriate comparisons and conclusions can be made? — N/A

4. Did the FAA regional or ADO reviewer coordinate the use restriction with APP-600 prior to making determination on start of 180-days?	N/A
E. Do the following also meet Part 150 analytical standards:	
1. Formal recommendations which continue existing practices?	Yes, 1.9-1.51
2. New recommendations or changes proposed at end of Part 150 process?	Yes, 1.9-1.51
F. Documentation indicates how recommendations may change previously adopted plans?	Yes, 1.9-1.51
G. Documentation also:	
1. Identifies agencies which are responsible for implementing each recommendation	Yes, 1.9-1.51
2. Indicates whether those agencies have agreed to implement?	N/A
3. Indicates essential government actions necessary to implement recommendations?	Yes, 1.9-1.51
H. Time Frame:	
1. Includes agreed-upon schedule to implement alternatives?	Yes, 1.9-1.51
2. Indicates period covered by the program?	Yes, Cover Letter, 1.1-1.5
I. Funding/Costs:	
1. Includes costs to implement alternatives?	Yes, 1.9-1.51
2. Includes anticipated funding source?	Yes, 1.9-1.51

VI. PROGRAM REVISION: [150.23 (e) (9)]

Supporting documentation includes provision for revision?	Yes, 1.48

Part 150 Noise Exposure Map Checklist

I. IDENTIFICATION AND SUBMISSION OF MAP DOCUMENT: **Page Number**

A. Is this submittal appropriately identified as one of the following, submitted under 14 CFR Part 150: — Cover, Cover Letter
   1. A NEM only — N/A
   2. A NEM and NCP — Yes
   3. A revision to NEMs which have previously been determined by FAA to be in compliance with Part 150? — Yes

B. Is the airport name and the qualified airport operator identified? — Yes, Cover, Cover Letter

C. Is there a dated cover letter from the airport operator which indicates the documents are submitted under Part 150 for appropriate FAA determination? — Yes

II. CONSULTATION: [150.21 (b), A150.(a)]

A. Is there a narrative description of the consultation accomplished, including opportunities for public review and comment during map development? — Yes, J.1-J.2, Appendix

B. Identification:
   1. Are the consulted parties identified? — Yes, J.1-J.2, Appendix
   2. Do they include all those required by 150.21 (b) and A150.105 (a)? — Yes, J.1-J.2, Appendix

C. Does the documentation include the airport operator's certification, and evidence to support it, that interested persons have been afforded adequate opportunity to submit their view, data, and comments during map development and in accordance with 150.21 (b)? — Yes, Cover Letter, Large-scale Maps, Fly Sheet, Appendix

D. Does the document indicate whether written comments were received during consultation and, if there were comments, that they are on file with the FAA region? — Yes, J.1-J.2, Appendix

III. GENERAL REQUIREMENTS: [150.21]

A. Are there two maps, each clearly labeled on the face with year (existing condition year and 5-year)?
Yes, D.97, 1.5, Large-scale maps submitted separately

B. Map currency:
1. Does the existing condition map year match the year on the airport operator's submittal letter? No[1], D.95/D.97
2. Is the 5-year map based on reasonable forecasts and other planning assumptions and is it for the fifth calendar year after the year of submission? Yes, 1.5
3. If the answer to 1 and 2 above is no, has the airport operator verified in writing that data in the documentation are representative of existing condition and 5-year forecast conditions as of the date of submission? Yes, Cover Letter

C. If the NEM and NCP are submitted together:
1. Has the airport operator indicated whether the 5-year map is based on 5-year contours without the program vs. contours if the program is implemented? Yes, 1.1-1.2
2. If the 5-year map is based on program implementation:
    a. are the specific program measures which are reflected on the map identified? Yes, 1.2
    b. does the documentation specifically describe how these measures affect land use compatibilities depicted on the map? Yes, 1.24
3. If the 5-year NEM does not incorporate program implementation, has the airport operator included an additional NEM for FAA determination after the program is approved which show program implementation conditions and which is intended to replace the 5-year NEM as the new official 5-year map? N/A

[1] *Note: The base case year (2009) was used rather than 2014 (submittal date) because it was the last full year of operations under existing conditions (without construction closures). Therefore, it was considered to be the best year for the base case NEM.*

IV. MAP SCALE, GRAPHICS, AND DATA REQUIREMENTS:
[A150.101, A150.105, 150.21 (a)]

A. Are the maps of sufficient scale to be clear and readable (they must not be less than 1" to 2,000') and is the scale indicated on the maps?
Yes, Large-scale maps submitted separately

B. Is the quality of the graphics such that required information is clear and readable?
Yes, Large-scale maps submitted separately

C. Depiction of the airport and its environs.
1. Is the following graphically depicted to scale on both the existing condition and 5-year maps:
   a. Airport boundaries
   Yes, Large-scale maps submitted separately
   b. Runway configurations with runway end numbers
   Yes, Large-scale maps submitted separately
2. Does the depiction of the off-airport data include:
   a. A land use base map depicting streets and other identifiable geographic features — Yes
   b. The area within the 65 Ldn (or beyond, at local discretion) — Yes
   c. Clear delineation of geographic boundaries and the names of all jurisdictions with the 65 Ldn (or beyond, at local discretion) — Yes

D.
1. Continuous contours for at least the Ldn 65, 70, and 75? — Yes, Large-scale maps submitted separately
2. Based on current airport and operational data for the existing condition year NEM, and forecast data for the 5-year NEM? — Yes, Large-scale maps submitted separately

E. Flight tracks for the existing condition and 5-year forecast time frames (these may be on supplemental graphics which must use the same land use base map as the existing conditioned and 5-year NEM, which are numbered to correspond to accompanying narrative?
Yes, D.83-D.93, same existing and future, Appendix

F. Locations of any noise monitoring sites (these may be on supplemental graphics which must use the same land use base map as the official NEMs) Yes, C.31, C.33, Appendix

G. Noncompatible land use identification:
1. Are noncompatible land uses within at least the 65 Ldn depicted on the maps?
Yes, I.5, I.27-I.29, Large-scale maps submitted separately
2. Are noise sensitive public buildings identified? N/A
3. Are the noncompatible uses and noise sensitive public buildings readily identifiable and explained on the map legend?
Yes, I.5, I.27-I.29, Large-scale maps submitted separately
4. Are compatible land uses, which would normally be considered noncompatible, explained in the accompanying narrative?
Yes, previous Residential Sound Insulation Program, I.25

V. NARRATIVE SUPPORT OF MAP DATA:

[150.21 (a), A150.1, A150.103]

A.1. Are the technical data, including data sources, on which the NEMs are based adequately described in the narrative? Yes, B.1-B.2, D.1-D.105, Appendix
2. Are the underlying technical data and planning assumptions reasonable? Yes, B.1-B.2, D.1-D.105, Appendix

B. Calculation of Noise Contours:
1. Is the methodology indicated? Yes, Cover Letter, D.1-D.105, Appendix
   a. Is it FAA approved? Yes, C.38-C.40
   b. Was the same model used for both maps? Yes
   c. Has AEE approval been obtained for use of a model other than those which have previous blanket FAA approval? N/A
2. Correct use of noise models:

a. Does the documentation indicate the airport operator has adjusted or calibrated FAA-approved noise models or substituted one aircraft type for another? — No
b. If so, does this have written approval from AEE? — N/A

3. If noise monitoring was used, does the narrative indicate that Part 150 guidelines were followed? — Yes, C.27-C.40, D.2
4. For noise contours below 65 Ldn, does the supporting documentation include explanation of local reasons? (Narrative explanation is highly desirable but not required by the Rule.) — Yes, E.1, informational purposes

C. Noncompatible Land Use Information:

1. Does the narrative give estimates of the number of people residing in each of the contours (Ldn 65, 70 and 75, at a minimum) for both the existing condition and 5-year maps? — Yes, E.1-E.5, I.3
2. Does the documentation indicate whether Table 1 of Part 150 was used by the airport operator? — C.23-C.24, E.2
   a. If a local variation to Table 1 was used:
      (1) does the narrative clearly indicate which adjustments were made and the local reasons for doing so? — N/A
      (2) does the narrative include the airport operator's complete substitution for Table 1? — N/A
3. Does the narrative include information of self-generated or ambient noise where compatible/ noncompatible land use identifications consider non-airport/aircraft sources? — N/A
4. Where normally noncompatible land uses are not depicted as such on the NEMs, does the narrative satisfactorily explain why, with reference to the specific geographic areas? — N/A
5. Does the narrative describe how forecasts will affect land use compatibility? — E.1-E.7, I.1-I.3, I.24-I.29

VI. MAP CERTIFICATIONS: [150.21 (b), 150.21 (e)]

A. Has the operator certified in writing that interested persons have been afforded adequate opportunity to submit views, data, and comments concerning the correctness and adequacy of the draft maps and forecasts? Yes, Cover Letter, J.1-J.2, Appendix

B. Has the operator certified in writing that each map and description of consultation and opportunity for public comment are true and complete? Yes, Cover Letter, Large-scale maps submitted separately