Table of Contents

Page Revised 03-19-10

List of Figures

List of Tables

Glossary of Terms

A-weighted Sound Level (dBA): A measurement of loudness which accounts for the frequency sensitivity of the human ear. A-weighting accounts for frequency dependence by adjusting the very high and very low frequencies (below approximately 500 Hz and above approximately 10,000 Hz) to approximate the human ear's lower sensitivities to those frequencies. Sound in each one third octave band is A-weighted and summed.

Advisory Circular (AC): An FAA-issued document providing methods, procedures, and practices for compliance with regulations and grant requirements.

Air Traffic Control (ATC): The function of providing positive control and aircraft separation services to participating aircraft through safe, orderly, and expeditious traffic flow procedures and instructions.

Air Traffic Control Tower (ATCT): A facility that provides local air traffic control services to aircraft operating into and out of an airport. ATCT facilities are located on the airfield maintaining an unrestricted view of airside facilities (i.e., runway, taxiways). They are typically FAA-operated, but can also operate under contract.

Airport Noise and Capacity Act of 1990 (ANCA): The congressional act that established the first national noise policy. ANCA created a timeline for the phase out of Stage 2 aircraft and created a review and approval process governing the implementation of local airport use or access restrictions by airport proprietors.

Airport Sponsor: The recipient of AIP grant funding. In a Part 150 study, the airport operator is identified as the Airport Sponsor, but local jurisdictions can also assume 'airport sponsor' status when applying for AIP funding for noise mitigation programs.

Airspace: A three-dimensional portion of the atmosphere that is controlled by a jurisdictional entity, generally a nation. In aviation, airspace is either defined as regulatory or non-regulatory, with many subcategories.

Ambient Noise: Background noise levels not including aircraft activity. These levels can also be referred to as "community noise levels."

Arrival (or Approach): A flight operation in the terminal control area that encompasses the descent and landing of an aircraft on an airport runway or pad.

Aviation Safety and Noise Abatement Act of 1979: A congressional act authorizing the FAA to award grants under the AIP for noise mitigation projects. ASNA states that in order to access funding for noise mitigation projects, the project must be identified in an airport's Noise Compatibility Program (NCP) per 14 CFR Part 150.

Contour: see noise contour

Day-Night Average Sound Level (DNL): The 24-hour average sound level, in A-weighted decibels, with a 10-dB penalty for sound levels occurring between 10 p.m. and 7 a.m. local time.

Decibel (dB): A logarithmic unit used to describe the intensity of sound.

Distance Measuring Equipment: Equipment used to measure slant range distance in nautical miles from an aircraft to a navigational aid.

Engine Run-up Area: A designated area on an airfield used for prolonged aircraft engine testing.

Environmental Assessment (EA): An analysis prepared, pursuant to the National Environmental Policy Act (NEPA), to assess the potential environmental impacts of a proposed Federal action, which contains sufficient detail in order for a Federal determination of either a Finding of No Significant Impact (FONSI) or the need to pursue an Environmental Impact Statement (EIS).

Environmental Impact Statement (EIS): An analysis prepared pursuant to NEPA that discloses the significant impacts of a proposed Federal action and evaluates a series of alternatives. The process for completing an EIS is outlined in Order 5050.4B and Order 1050.1E.

Environmental Protection Agency (EPA): The federal agency responsible for natural resource protection and oversight of the release of toxins and other pollutants into the environment.

Equivalent Sound Level (L_{eq}): The average sound level of all noise occurring over a specified period of time. The L_{eq} metric can provide an accurate quantification of noise exposure for a specific period, particularly for daytime periods when the nighttime penalty under the DNL metric is inappropriate.

FAR Part 150 (also known as "Part 150" or "14 C.F.R Part 150"): Titled *Airport Noise Compatibility Planning*, establishes standards for the documentation of noise exposure in the airport environs, as well as procedures for obtaining FAA approval of programs to reduce or eliminate incompatibilities between aircraft noise and surrounding land uses. A Part 150 study is comprised of both a set of Noise Exposure Maps which depict existing and future five-year forecast conditions and a Noise Compatibility Program, which identifies strategies to reduce, mitigate, and prevent existing and future incompatible land uses in the vicinity of an airport. An approved NCP is required to access AIP funding for mitigation programs.

Federal Aviation Administration (FAA): The federal agency responsible for regulating aviation activity, certifying pilots, air carriers, air traffic controllers and aircraft, as well as operating the National Airspace System (NAS) in the United States.

Fleet mix: A representation of aircraft types operating at the airport over a given period of time.

Flight Track (or path): The three-dimensional flight trajectory traveled by aircraft from the start of the departure (takeoff-off roll) to the destination. Flight tracks for noise modeling usually are derived from radar data and are generalized for input into the INM.

Geographical Information Systems (GIS): A group of software applications used to analyze, interpret, and visualize spatial data such as land use, zoning, and demographic data.

Integrated Noise Model (INM): An integrated model used as the standard tool for the modeling of noise exposure resulting from aircraft operations at civilian airports in the U.S.

Maximum Sound Level (L_{max}): The highest A-weighted sound level measured during a single event in which the sound level changes value as time goes on (e.g., an aircraft over-flight).

National Airspace System (NAS): The sovereign airspace under the control of the United States as defined by international law and governed by access and use restrictions.

National Environmental Policy Act (NEPA): A congressional Act which established the national policy for disclosing the potential impacts of Federal actions. Compliance with NEPA requires the completion of an environmental document that outlines impacts that may significantly affect the quality of the human environment.

Navigation Aid: Typically, a ground-based facility designed to provide signal data to assist aircraft with navigation, approach and departure operations both within terminal airspace and in the enroute environment.

Noise: Typically defined as disagreeable or unwanted sound.

Noise Compatibility Program (NCP): A program that promulgates recommendations on the abatement and/or mitigation of existing impacts of aviation noise, and the prevention of future incompatibilities in areas identified as being significantly impacted by aircraft noise. An NCP is created or updated as part of the FAR Part 150 process, following the completion of existing and future Noise Exposure Maps.

Noise Contour: A line connecting a series of points of equal sound level values. Locations inside of a noise contour have greater sound levels, and locations outside of the contour have lesser sound levels. Noise exposure contours are computed using noise models such as INM or NoiseMap.

Noise Exposure Map (NEM): Noise exposure contours overlaid on a background map which identifies existing or future noise exposure conditions at an airport. An NEM is typically developed as part of the FAR Part 150 process.

Run-up: A maintenance operation conducted to test aircraft engines following routine or major maintenance or repair. Run-ups consist of engine tests at varying durations and power settings.

Sound: Minute vibrations that travel through air and can be sensed by the human ear. Sounds are measured by their intensity, frequency, and duration.

Sound Exposure Level (SEL): A logarithmic measure of the total acoustic energy transmitted to the listener during the event. SEL represents the sound level of the constant sound that would, in one second, generate the same acoustic energy as did the actual time-varying noise event. SEL is the building block for calculating DNL, which consists of the logarithmic sum of the aircraft SEL values for one day of operations, averaged over 24 hours, and with a 10 dB weighting applied to nighttime events.

1. Introduction

This section provides background information on the requirements set forth by Federal Aviation Regulation (FAR) Part 150 under which this document has been prepared, and the public coordination efforts undertaken to meet these requirements.

1.1. Background

Philadelphia International Airport (PHL) first completed a FAR Part 150 study in 2002, including both the identification of Noise Exposure Maps (NEM) and a Noise Compatibility Program (NCP). The Federal Aviation Administration (FAA) determined the previous NEMs to be in compliance on November 21, 2002. On May 19, 2003 the FAA approved PHL's NCP, which recommended strategies for reducing existing significant noise exposure and preventing future significant noise exposure around PHL. The FAA's Record of Approval (ROA) is included in **Appendix A**.

This Noise Exposure Map (NEM) Update has been prepared pursuant to the guidelines set forth in the United States Code of Federal Regulations (CFR) Title 14, Part 150 "Airport Noise Compatibility Planning" and additional guidance as provided by FAA Advisory Circular 150/5020-1 *Noise Control and Compatibility Planning for Airport*s. **Appendix B** provides additional information on airport noise and the Federal guidance developed to address this important issue. This document constitutes the NEM submittal portion of the PHL Part 150 Noise Compatibility Program Update. The NCP portion of the Update is concurrently under development and will be submitted at a later date.

The purpose of this study is to identify areas of significant noise exposure in the vicinity of the airport for current and forecast conditions. Therefore, the update to the existing NEMs reflects changes that have taken place at PHL and changes that are expected to occur at the airport within a five-year timeframe. The partial implementation of the FAA's New York/New Jersey/Philadelphia (NY/NJ/PHL) Airspace Redesign (ARD) project[1] and the extension of Runway 17/35 are examples of changes to airport operations that warrant an evaluation of noise exposure. The existing NEM reflects current airport operating conditions (based on operational data from 2008), and the five-year forecast NEM reflects anticipated operations and development at the airport in 2013.

It should be noted that, when this study was undertaken, the project was scoped to evaluate a 2007 Existing Baseline condition and a 2012 Future Baseline condition. However, soon after the Update was initiated, the FAA began implementation of the ARD which had been studied and planned since 1999. The purpose of the ARD is to increase the efficiency and reliability of the airspace structure and Air Traffic Control system while maintaining safety in the New York/New Jersey/Philadelphia Metropolitan Area airspace. The FAA evaluated several alternatives to achieve this purpose and need. An alternative was selected and the Record of Decision (ROD) on the project was executed in the fall of 2007. The ROD enabled the FAA to begin implementing their approved plan. One of the early action items was to implement two divergent departure flight tracks from Runways 27L and 27R. These tracks approximate a 268-degree heading and a 245-degree heading. For departures to the east from Runways 9L, 9R and 26, a 081-degree heading and a 096-degree heading were implemented in addition to the existing 085-degree heading. On December 19, 2007, the FAA Air Traffic Control Tower (ATCT) began utilizing these additional flight tracks, in addition to the existing departure tracks, as demand dictated.

[1] "Partial Implementation" refers to the fact that the proposed 230-degree departure heading from Runway 27L is not included in the 2008 existing baseline condition, but is included in the 2013 future baseline condition, as it is anticipated to be implemented sometime between 2009 and 2013.

Meanwhile, PHL had developed a 2007 Existing Baseline NEM and a 2013 Future Baseline NEM. However, to more accurately reflect the existing conditions, to take into account the feedback received from the public, and the coordination undertaken with the FAA, a contour review process was initiated.

This process led to a modification of the existing baseline year from a 2007 condition to a 2008 condition. There was no need to modify the future baseline year as the future changes associated with ARD were already taken into consideration.

1.2. Noise Exposure Maps Update Planning Process Overview

The NEM Update planning process is designed to facilitate airport user and community input at various stages of the study. The process typically begins with an introductory meeting concurrent with an inventory of airport facilities and operations. The existing NEM, representative of baseline conditions over a 12-month period, is developed and overlaid on a land use base map which identifies land use patterns, noise-sensitive development (such as residences, places of worship, libraries, and schools), major roadways, airport facilities, and other readily identifiable geographic references. The noise exposure contours are developed using the FAA's Integrated Noise Model (INM) computer model, which utilizes data including the runway orientation, airport facilities, weather, types of aircraft operations, flight trajectories used for the operations, and the time of day of operations. The noise model and modeling process are discussed in further detail in **Appendix B**.

A forecast of aircraft operations is used for identifying and projecting the five-year future condition. The forecast identifies projected changes at the airport in the number of operations, the fleet mix, and the time of day of each operation, as well as any other facility development that will be in place.

1.3. Consultation and Public Involvement

Per FAR Part 150 guidelines, the development of the NEMs must include consultation with appropriate interested parties, which may include tenants who utilize the airport, the ATCT, surrounding jurisdictions and the general public.

As the Updated NEMs were developed, the study team informed the communities around the airport about the study and gathered input regarding the findings. This was accomplished through the convening of a Study Advisory Committee (SAC), holding two rounds of Community Workshops, publishing and maintaining a website, and by publishing a study fact sheet and project newsletters.

1.3.1 Study Advisory Committee

The initial public participation action was to convene a Study Advisory Committee (SAC). An extensive list of elected officials, government agencies, civic organizations and airport-affiliated organizations was developed for consideration. Selections were made from this list to ensure representation from adjacent communities in Pennsylvania, New Jersey, and Delaware, while keeping the size of the committee appropriate to the interaction required to fulfill its role as advisor to the study. The meetings were designed and managed to encourage the exchange of information and creative ideas. In addition, SAC Members were asked to comment on each meeting and rank components of the meeting through evaluation/comment forms.

During the period the Noise Exposure Maps were developed, the SAC met four times.

- Meeting #1 – October 30, 2007
- Meeting #2 – March 13, 2008
- Meeting #3 - June 17, 2008
- Meeting #4 – November 20, 2008

Appendix C contains a listing of the SAC membership, meeting minutes, sign-in sheets, and copies of the presentations from each meeting.

1.3.2 Community Workshops

Two rounds of Community Workshops were held during the development of the NEMs. Each round consisted of five workshops: two in Pennsylvania; two in New Jersey; and, one in Delaware. These workshops were attended by interested citizens, civic leaders, elected officials or their representatives, and local media.

The first series of community workshops held in November 2007 focused on introducing the study and the study process. Philadelphia International Airport operations and characteristics were explained as were the basics of sound, sound measurement, and the methodology that will be used to identify current and future noise exposure.

The second series of community workshops was held in June 2008. At these workshops, the study team presented the Draft 2007 Noise Exposure Contour, the Draft 2013 Noise Exposure Contour as well as the supporting flight tracks and input data used in the development of these maps. The results of the Noise Measurement Program, undertaken in the fall of 2007, were also presented to attendees for their information. **Table 1-1** summarizes the dates and locations of the Community Workshops.

Appendix D includes the promotional materials, meeting materials, sign-in sheets, and photos from each round of workshops.

1.3.3 Publications

During the time the Noise Exposure Maps were developed, a project website (www.phlpart150update.com) was created to present key study findings, to advertise community meetings or publications and to provide a means for the public to leave comments, request information, and sign up to receive information. The study also produced a fact sheet at the inauguration of the project and two newsletters. Copies of each are in **Appendix D**.

A **Noise Exposure Map Summary Report** was also prepared and distributed to the SAC, elected officials, community workshop attendees and those on the project mailing list. The Summary Report was distributed to ensure that all interested parties had an opportunity to provide comment on the Draft NEMs. The impetus for this distribution was the reassessment of the existing baseline contour study year from 2007 to 2008.

A copy of the Summary Report and information pertaining to the distribution is included in **Appendix E**. A thirty day comment period from August 5, 2009 through September 4, 2009 was provided. During that time approximately ten people provided comments. All comments received during the public comment period are documented along with detailed responses, in **Appendix E.**

Table 1-1: Community Workshops	
Round 1 – November 2007	
Date	**Location**
Wednesday November 7, 2007	Crowne Plaza Hotel 2349 W. Marlton Pike Cherry Hill, NJ
Thursday November 8, 2007	Claymont Community Center 3301 Green Street Claymont, DE
Tuesday November 13, 2007	Tinicum School First & Seneca Streets Essington, PA
Wednesday November 14, 2007	Mercy Wellness Center 2821 Island Avenue Philadelphia, PA
Thursday November 15, 2007	Paulsboro High School 670 N. Delaware Street Paulsboro, NJ
Round 2 – June 2008	
Date	**Location**
Tuesday June 17, 2008	Paulsboro Volunteer Fire Association 1502 Swedesboro Ave. Paulsboro, NJ
Wednesday June 18, 2008	Tinicum School First & Seneca Streets Essington, PA
Thursday June 19, 2008	Claymont Community Center 3301 Green Street Claymont, DE
Tuesday June 24, 2008	Cherry Hill Public Library 1100 Kings Highway North Cherry Hill, NJ
Wednesday June 25, 2008	Mercy Wellness Center 2821 Island Avenue Philadelphia, PA

2. PHL and Surrounding Land Use

This section describes the Philadelphia International Airport's location, facilities, airspace, and surrounding land use. A summary of the noise measurement program is also included in this section.

2.1. Airport Location

Philadelphia International Airport (PHL) is located on 2,354 acres along the southwestern border of the City of Philadelphia in Philadelphia County and Tinicum Township, Delaware County. PHL is approximately seven miles from downtown Philadelphia and is at a field elevation of 36 feet above Mean Sea Level (MSL).

The Delaware River and Hog Island Road make up the southern boundary of the airport. Interstate 95 represents the northern boundary. Island Avenue, Enterprise Avenue, and Ft. Mifflin Road make up the eastern boundaries with the western boundary being Tinicum Island Road. Interstates 76, 95, and 476 provide regional access to the airport. The boroughs of Paulsboro and National Park lie across the Delaware River in New Jersey. While the State of Delaware lies within the flight patterns used by aircraft serving PHL, it does not lie within the detailed study area of this analysis. **Figure 2-1: Airport Location Map** shows the location of PHL in relationship to the surrounding area.

2.1.1 Surrounding Land Uses

Ascertaining and evaluating land uses around the Airport is necessary to identify residential and other noise-sensitive land uses that exist. The outdoor noise environment, in relation to airport noise compatibility is measured in terms of the yearly Day-Night Sound Level (DNL) metric. The FAA guidelines specify that DNL is the noise metric used in defining land-use compatibility. Both the US Department of Housing and Urban Development (HUD) and the FAA define a DNL value of 65 dB as the threshold of incompatibility with residential land uses. All land uses below the noise level measured as 65 DNL are generally considered compatible with airport operations. Consequently, the study area for this land use assessment was formed by assessing both the location of flight tracks and the general area where noise levels would drop below 65 DNL. It should be noted that areas outside the study area were not excluded from the Part 150 process. For purposes of this analysis, this broader area will be defined as the PHL Region and will include Philadelphia, Chester, Delaware, and Montgomery Counties in Pennsylvania, and Gloucester, Camden, and Salem Counties in New Jersey.

Existing land use data was primarily collected from the Delaware Valley Regional Planning Commission (DVRPC). The DVRPC region includes Bucks, Chester, Delaware, Montgomery, and Philadelphia counties in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer counties in New Jersey. Outside of the DVRPC's jurisdiction, land use for New Castle County in Delaware was collected through the Research Data Management Service at the University of Delaware, via the Internet. Land uses within the study area are classified into generalized categories, as shown on the accompanying figures and summarized in **Appendix F**.

A few residential communities are located in close proximity to the Airport as depicted in **Figure 2-2: Neighboring Municipalities.** In Philadelphia, north of Runway 17, is the residential neighborhood of Eastwick and the Eastwick Industrial Park. The Eastwick residential neighborhood is located north of Lindbergh Boulevard. The Eastwick Industrial Park is a designated City of Philadelphia Commerce Department, Keystone Opportunity Zone (KOZ). This industrial land consists of 131 acres located just off I-95 near the Airport. Eligible KOZ business and property owners are virtually exempt from state and local business taxes until December 31, 2010.

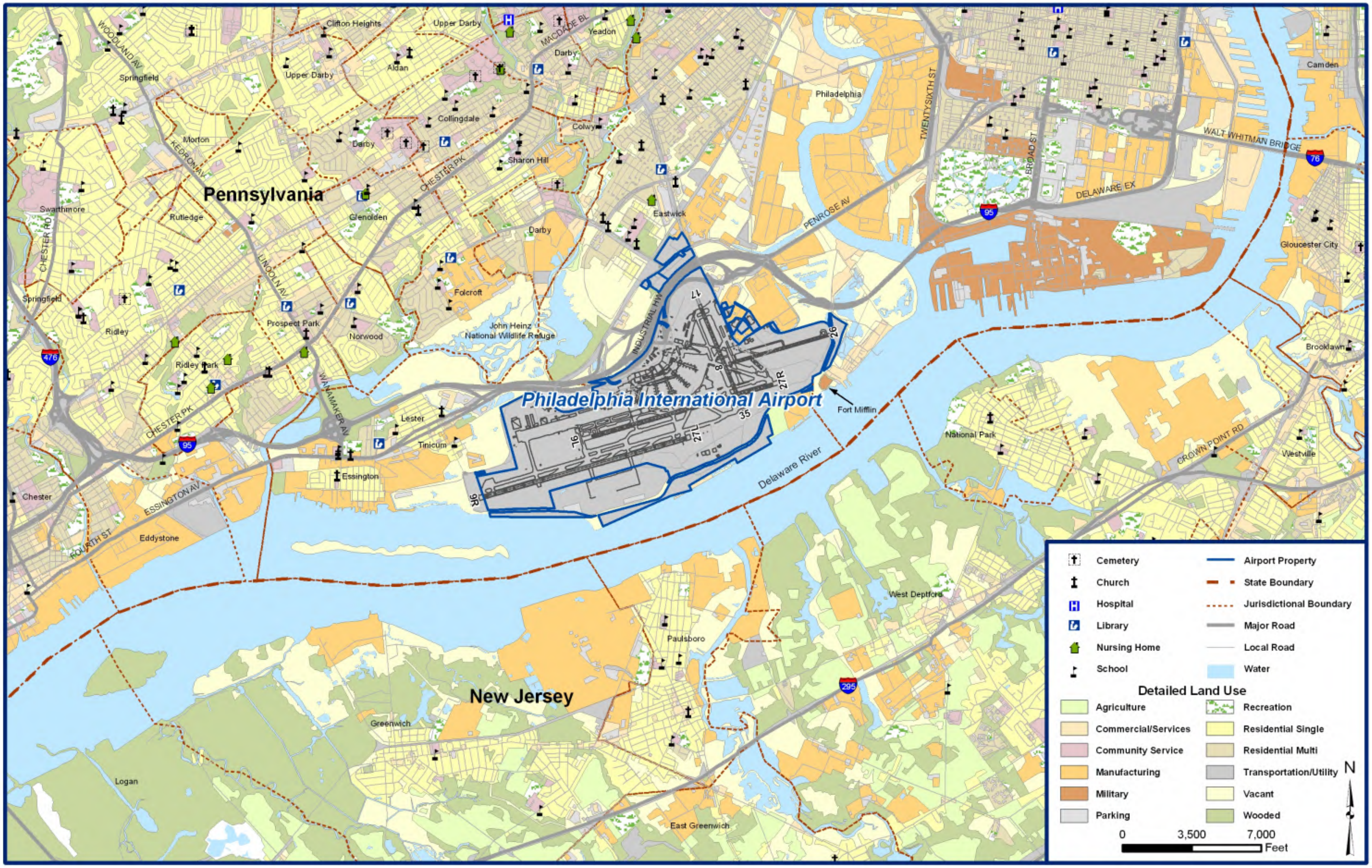

Figure 2-1: Airport Location Map

PHL PHILADELPHIA INTERNATIONAL AIRPORT

Noise Compatibility Program Update

DMJM AVIATION | AECOM

Figure2-1_Airport.mxd

10-07-09

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

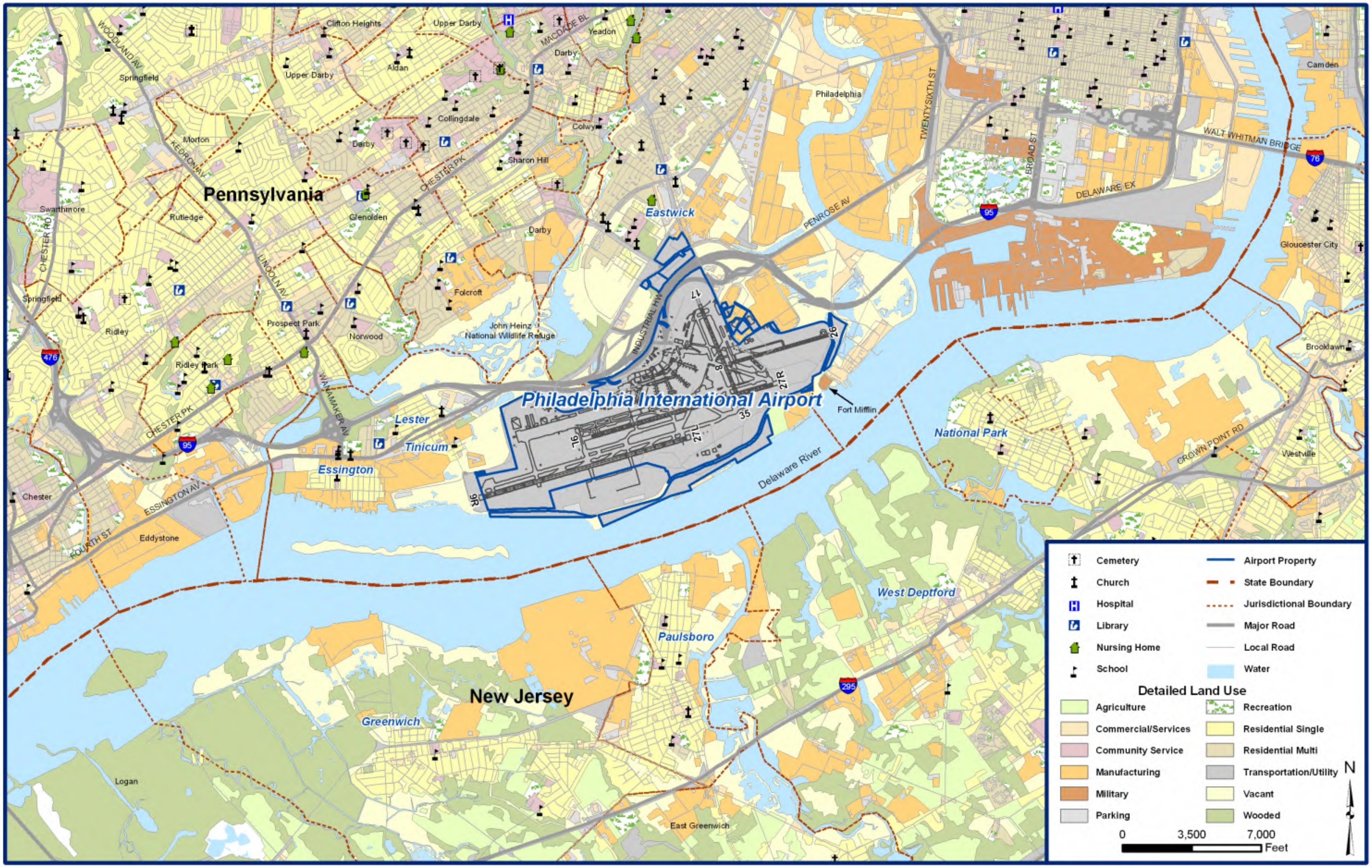

Figure 2-2: Neighboring Municipalities

Noise Compatibility Program Update

DMJM AVIATION | AECOM

10-08-09

Figure2-2_NeighboringMunicipalities.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

The goal of the KOZ program is to encourage business expansion within the City, attract new businesses to Philadelphia, and to encourage property owners to make capital improvements to their properties.

West of the Airport in Delaware County is Tinicum Township. This municipality contains residential neighborhoods (Essington and Lester) located directly under several existing PHL arrival and departure flight paths. Pockets of residential development are interspersed throughout larger tracts of commercial, and light and heavy industrial land uses.

South and southeast of the Airport on the opposite side of the Delaware River within Gloucester County, New Jersey are the municipalities of West Deptford Township, Logan Township, Greenwich Township, the City of Woodbury and the Boroughs of National Park, Westville and Paulsboro. As seen in **Figure 2-2**, mixed land use types are present throughout these various jurisdictions.

Land use on and in the immediate vicinity of the Airport is mostly compatible with airport operations as defined by the FAA in Table 1 of Part 150. Land use at PHL can be divided into two broad categories: on-airport land use and off-airport land use. Off-airport land use is then further divided into sub-categories, such as adjacent land uses and neighboring municipalities.

Existing land uses within the Airport's boundaries are categorized according to function and are summarized below; see **Figure 2-3: On-Airport Land Uses**.

Passenger Terminal Area
The 240-acre passenger terminal area lies at the northern portion of the Airport. The passenger terminal facilities, rental car properties, Southeastern Pennsylvania Transportation Authority (SEPTA) R-1 Line, parking garages, and economy parking lots are also located in this area.

Cargo City
Cargo City is located on 106 acres in the northwestern corner of the Airport. All on-airport cargo, packages and mail handled by the airlines and cargo carriers is channeled through this area.

South Side General Aviation/Airport Support Area
South Side General Aviation/Airport Support Area is an 80-acre site located south of the approach end of Runway 27L and north of Hog Island Road. This area includes the FAA's Air Traffic Control Tower (ATCT), the Airport's Aircraft Rescue and Fire Fighting (ARFF) facility, the Airport fuel farm and four corporate hangars.

East Side Aviation Facilities
The East Side Aviation Facilities are located on 52 acres east of Runway 17/35. The area includes the general aviation Fixed Base Operator (FBO) Atlantic Aviation, remote aircraft parking aprons and miscellaneous airport maintenance facilities.

The off-airport areas summarized below are located immediately adjacent to the Airport's property line. PHL is located within a heavily urbanized area, and land uses in the immediate vicinity of the Airport are mainly industrial or commercial, as discussed below and shown on **Figure 2-4: Adjacent Land Uses**.

Airport Business Complex
Situated to the west of Cargo City, in Tinicum Township, Delaware County, is the Airport Business Complex, which is currently zoned as commercial and contains miscellaneous businesses and a hotel facility.

Eastside Businesses
The Eastside Area encompasses more than 100 acres along the eastern boundary of the Airport bounded by Island Avenue and Enterprise Avenue. Most of the properties within this area are private businesses.

International Plaza
International Plaza is a commercially zoned parcel located west of the Passenger Terminal Area and north of Cargo City in Tinicum Township, Delaware County. The site contains two commercial office buildings, automobile parking, and an off-airport parking facility for Airport passengers.

Parks and Recreational Areas
Parks, recreational areas, and historical sites can be found at various locations around the Airport.

Immediately north of the Airport is the John Heinz National Wildlife Refuge (JNHWR) administered by the U.S. Fish and Wildlife Service. The refuge was established by public law in 1972 to protect 83 acres of tidal marsh in Pennsylvania.

Fort Mifflin, located east of the Airport along the extended centerline of Runway 27R, is zoned as a park. The Fort is a National Historic Landmark and provides educational programming and hands-on learning to more than 12,000 students annually through guided tours and staged re-enactments.

Red Bank Battlefield Park, located south of the airport in National Park Borough, Gloucester County, New Jersey, is a National Register Site. The 44 plus acre park provides a passive recreational area, riverside walking paths, playground equipment and picnic pavilions.

Philadelphia Water Department Southwest Water Pollution Control Plant
The Southwest Water Pollution Control Plant is located to the north of Airport property limits near Runway 8-26. The facility occupies approximately 79 acres of land located on both sides of Enterprise Avenue.

Sunoco Logistics
Sunoco Logistics' owns and operates two facilities located along the Delaware River on the south side of the Airport, the Fort Mifflin Terminal Complex (75-acres) and the Hog Island Wharf Facility (15 acres).

United Parcel Service (UPS)
UPS's regional terminal and distribution facility is located on 212 acres along the Airport's south side.

US Army Corps of Engineers
The U.S. Army Corps of Engineers (USACE) owns and operates the Fort Mifflin Confined Disposal Facility (CDF) located adjacent to PHL at the confluence of the Schuylkill and Delaware Rivers. The Fort Mifflin Facility and disposal areas cover approximately 348 acres of land.

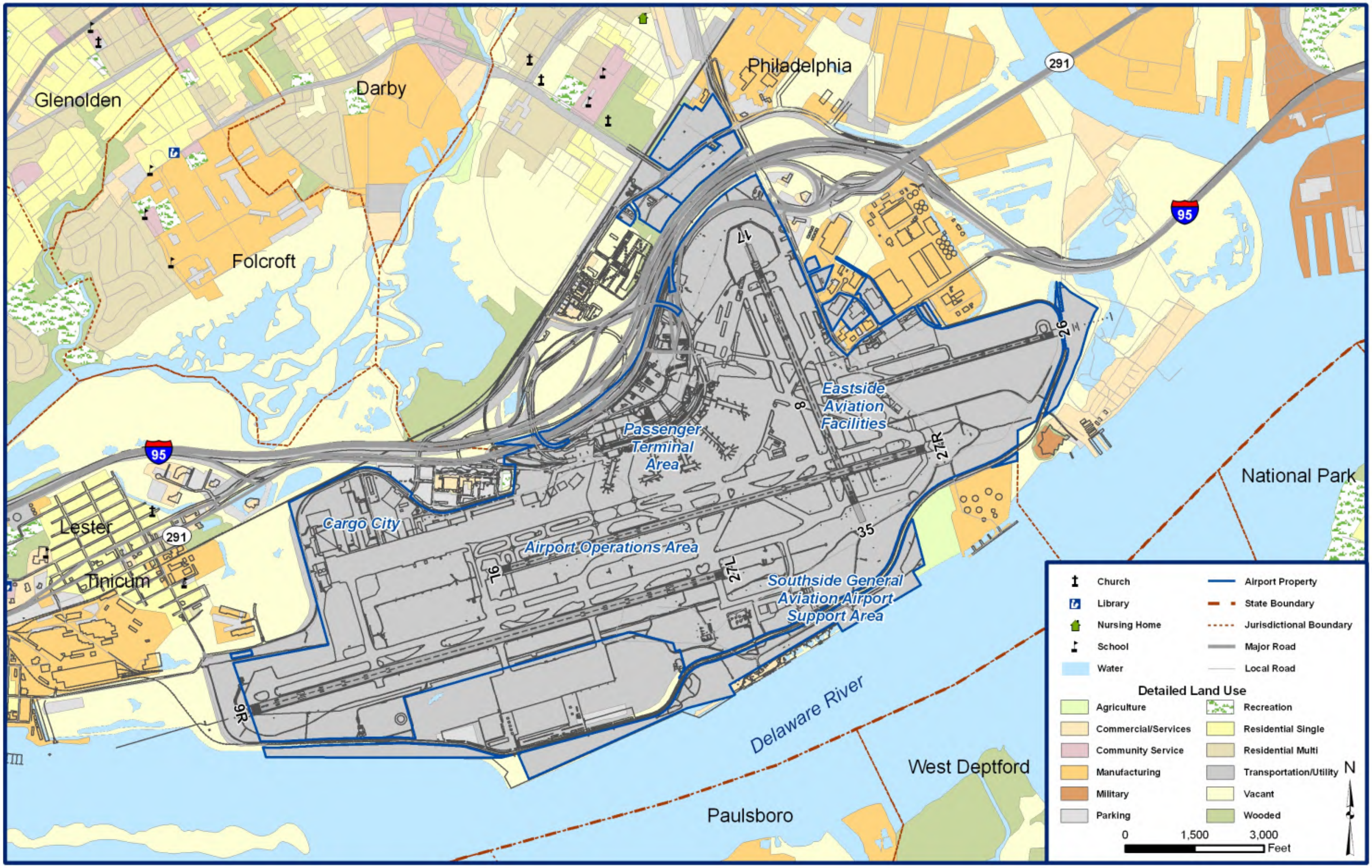

Figure 2-3: On Airport Land Uses

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Noise Compatibility Program Update

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Figure2-3_AirportLandUse.mxd

10-08-09

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

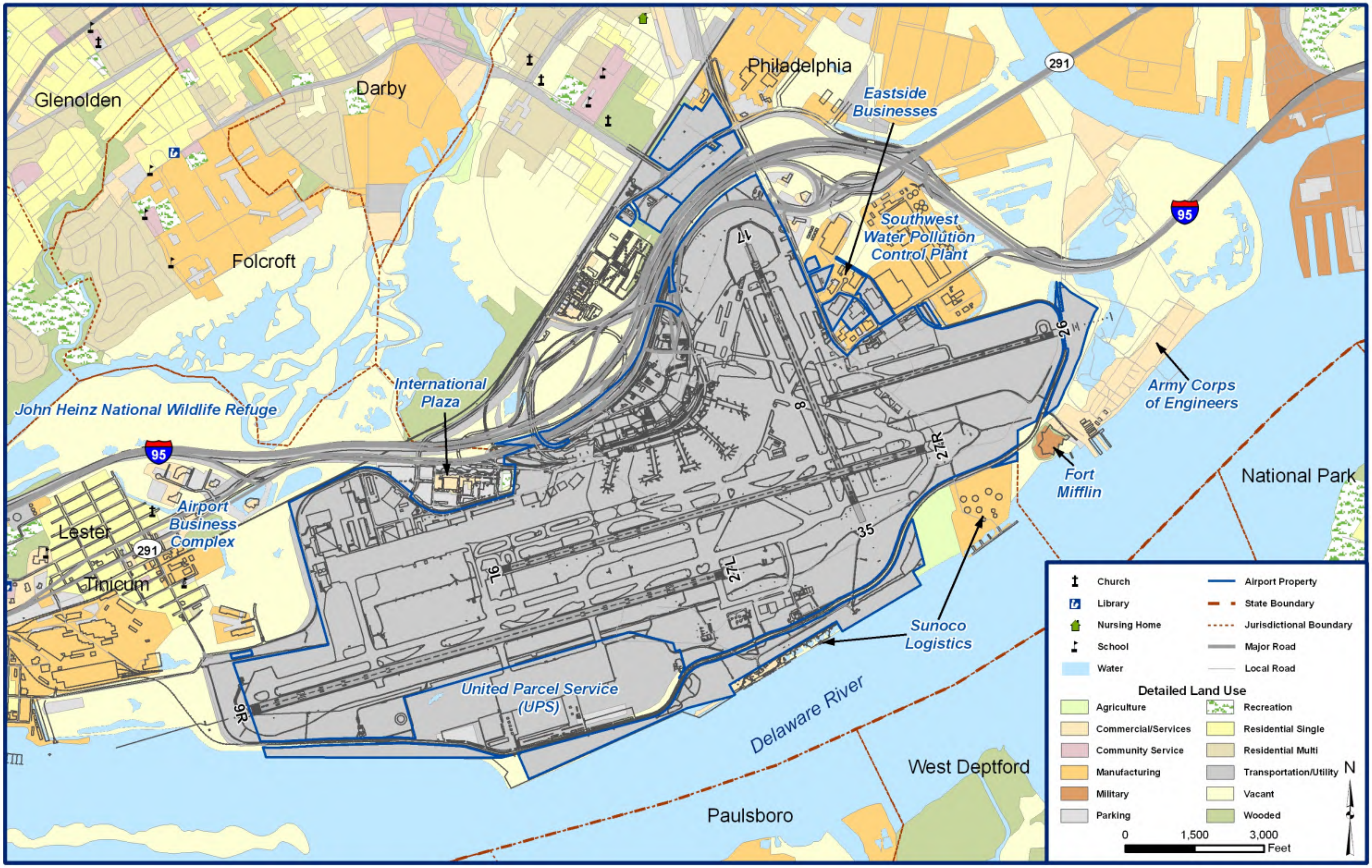

Figure 2-4: Adjacent Land Uses

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Noise Compatibility Program Update

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Figure2-4_AdjacentLandUse_.mxd

06-30-09

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

2.1.2 Noise-sensitive Public Facilities

Noise-sensitive public facilities include schools, churches, nursing homes, libraries, hospitals and cemeteries. As summarized in **Table 2-1: Noise-sensitive Public Facilities** and depicted on the NEMs in Section 5, there are 139 schools, 27 churches, 13 libraries, 11 nursing homes, 3 hospitals and 9 cemeteries in the PHL Region, as defined in Section 2.1.1.

Appendix F further documents how the noise-sensitive facilities were identified.

Table 2-1 Noise-sensitive Public Facilities
Schools
Academy Park High School
Amosland Elementary School
Ashland Middle School
Aldan Elementary School
Archbishop Ryan School
Archbishop Diamano School
Glenolden School
Bartram High School
Blessed Virgin Mary School
Bregy Elementary School
Colwyn Elementary School
Chester High School
Chester Charter School
George Crothers Memorial School
Columbus Elementary School
Darby Township Elementary School
Delaware County Area Vocational-Technical School-Folcroft
Delcroft Elementary School
Kinder Care Learning Center 222
Eddystone Elementary School
Edgewood Elementary School
Grace Park Elementary School
Fell Elementary School
Harris Elementary School
Early Learners Fundamental School
Ted Di Renzo Montessori School
Holy Spirit School (Philadelphia)
Holy Spirit School (Sharon Hill)
Interboro High School
Lake View Elementary School
Leedom Elementary School
Norwood Elementary School
Our Lady of Fatima School
Our Lady of Peace School
Our Lady of Perpetual Help School
Park Lane Elementary School
Patterson Elementary School
Penn Wood West Middle School
Prospect Park Elementary School / Kindergarten Center
Ridley Middle School

Table 2-1 Noise-sensitive Public Facilities
Ridley High School
Woodlyn Elementary School
Lakeview Elementary School
Saint Clements-Irenaeus School
Saint Gabriel’s School
Saint George’s School
Saint Monica Junior School
Philadelphia Performing Arts Charter School
Motivation High School
Saint Joseph’s School
Trinity Christian School
Vare Middle School
Girard Elementary School
Girard Academy Music Program (GAMP) High School
South Philadelphia High School
Furness High School
Bok Technical School
Southwark Elementary School
Epiphany of Our Lord School
Key Elementary School
Vare Elementary School
Sharswood Elementary School
Our Lady of Mount Carmel School
Taggart Elementary School
Fell Elementary School
Thomas Middle School
Stella Maris School
AS Jenks Elementary School
Saint Madeline-St. Rose School
Saint Margaret Mary’s School
Saint Matthew’s Regional School
Morton Elementary School
Saint Barnabas School
Tilden Middle School
Sacred Heart Preschool
Sharon Hill Elementary School
Sabold Elementary School
Swarthmore-Rutledge Elementary School
Swarthmore Friends Pre School
National Park Elementary School
Taggert Elementary School
Thomas Junior High School
Walnut Street Elementary School
Communications Technology High School
Billingsport Elementary School
Loudenslager Elementary School
Red Bank Elementary School Number 11
Oakview Elementary School
Parkview Elementary School
Shady Lane Elementary School
Bellmawr Park Elementary School

Table 2-1 Noise-sensitive Public Facilities
Archbishop Diamano Special Education School
Most Holy Redeemer School
Larc School
Bonsall Elementary School
Sumner Elementary School
Sacred Heart School (Camden)
RT Cream Elementary School
HB Wilson Elementary School
Morgan Village Middle School
Mary E. Costello Elementary School
Alice Costello Elementary School
Gloucester City Adult High School
Gloucester Catholic High School
St. Mary’s School (Gloucester)
Cold Spring School
Springfield High School
ET Richardson Middle School
Saint Kevin’s School
Blesses Katherine Drexel School
Primos Elementary School
Saint Eugene’s School
Saint John Chrysostom School (Wallingford)
Notre Dame DeLourdes School
Ancona Montessori School
Saint Francis of Assisi School
Saint Margaret’s School
Saint Michael’s School
Saint Patrick’s School
Saint Richard’s School
Calvary Temple Christian Academy
Verga School
Summit School
Nether Providence Elementary School
Broadstreet Elementary school
Wallingford Elementary School
Strath Haven Middle School
Strath Haven High School
Wetherill Elementary School
Paulsboro High School
Saint John’s School (Paulsboro)
Nehaunsey Middle School
West Deptford Middle School
West Deptford High School
Woodbury Junior/Senior High School
Tinicum Elementary School
All State Career Truck School
George Pepper Middle School
Penrose Elementary School
Churches
Victoria Church
Grace Church

Table 2-1 Noise-sensitive Public Facilities
Temple Ohev Sholom
Holy Trinity Church
Leiper Church
Blue Church
Princeton Church
Karmel Church
New Life Community Bible Church
Prospect Hill Church
Saint Pauls Church (Paulsboro)
Berkley Church
Zion Church
Saint John Chrysostom Church (Wallingford)
Eastwick United Methodist Church
St. John's Evangelist Church
St. Marks Church
Ridley Park Presbyterian Church
Kingdom Hall
St. Margaret Mary Church
St. Mary Church (Gloucester)
Tinicum Lutheran Church
St. George Church
Union Church
American Methodist Episcopal Church
St. Eugene's Church
Eastwick Worship Center (United Methodist Church)
Libraries
Free Library of Philadelphia (Island Avenue)
Free Library of Philadelphia (South Broad Street)
Free Library of Philadelphia (Shunk Street)
Free Library of Philadelphia (Snyder Avenue)
Darby Free Library
Folcroft Public Library
Collingdale Public Library
Tinicum Memorial Public Library
Glenolden Library
Norwood Public Library
Prospect Park Free Library Assoc.
Ridley Park Public Library
Ridley Township Public Library
Nursing Homes
Little Flower Manor
Older Adults Senior Citizens (Glenolden)
Connor Williams Nursing Home
Older Adults Senior Citizens (Ridley Park)
Ross Manor Nursing Home
Prospect Park Health and Rehab Residence
Belvedere Nursing Home
Cobbs Creek Nursing Center
St. Francis Country Manor
Holy Family Home
Inglis Home

Table 2-1 Noise-sensitive Public Facilities
Hospitals
Mercy Fitzgerald Hospital
Methodist Hospital
Crozer Medical Center
Cemeteries
Eastlawn Cemetery
Eden Memorial Cemetery
Har Zion Cemetery
Holy Cross Cemetery
Mount Jacob Cemetery
Mount Lawn Cemetery
Mount Lebenon Cemetery
Mount Zion Cemetery
Chester Rural Cemetery

Source: Wyle, AECOM: 2009

2.1.3 Historic Properties

As part of the land use analysis, research was conducted on historic properties located in proximity to the Airport. A historic property is a building, structure, district, object, or site that is listed in or has been determined eligible for listing in the National Register of Historic Places. A national historic landmark is a historic property that the Secretary of the Interior has designated a National Historic Landmark.

The National Register of Historic Places is the official list of the Nation's cultural resources worthy of preservation. The Register was authorized under the National Historic Preservation Act of 1966, and is administered by the National Park Service under the Secretary of the Interior.

Given that some historic properties are composed of resources for which solitude, quiet, or contemplation contribute to, or define, the reason for their significance, it is important to inventory and document the location of listed or eligible historic properties in any noise assessment.

The findings of this research indicate that ten historic resources exist as shown on **Figure 2-5: Historic Properties** and summarized in **Table 2-2: Historic Properties Inventory**. More detailed information on these properties is presented in **Appendix F**.

Table 2-2
Historic Properties Inventory

Property	National Register Status
Fort Mifflin	National Historic Landmark
The Printzhof Site	National Historic Landmark
The Lazaretto	National Register Listed
The Corinthian Yacht Club	National Register Eligible
Westinghouse Village	National Register Eligible
Westinghouse Electric and Manufacturing Company's South Philadelphia Works	National Register Eligible
Philadelphia Naval Shipyard Historic District	National Register Listed
Philadelphia Naval Shipyard Marine Barracks	National Register Listed
Red Bank Battlefield Park	National Register Listed
Soupy Island Sanitarium Playground	National Register Eligible

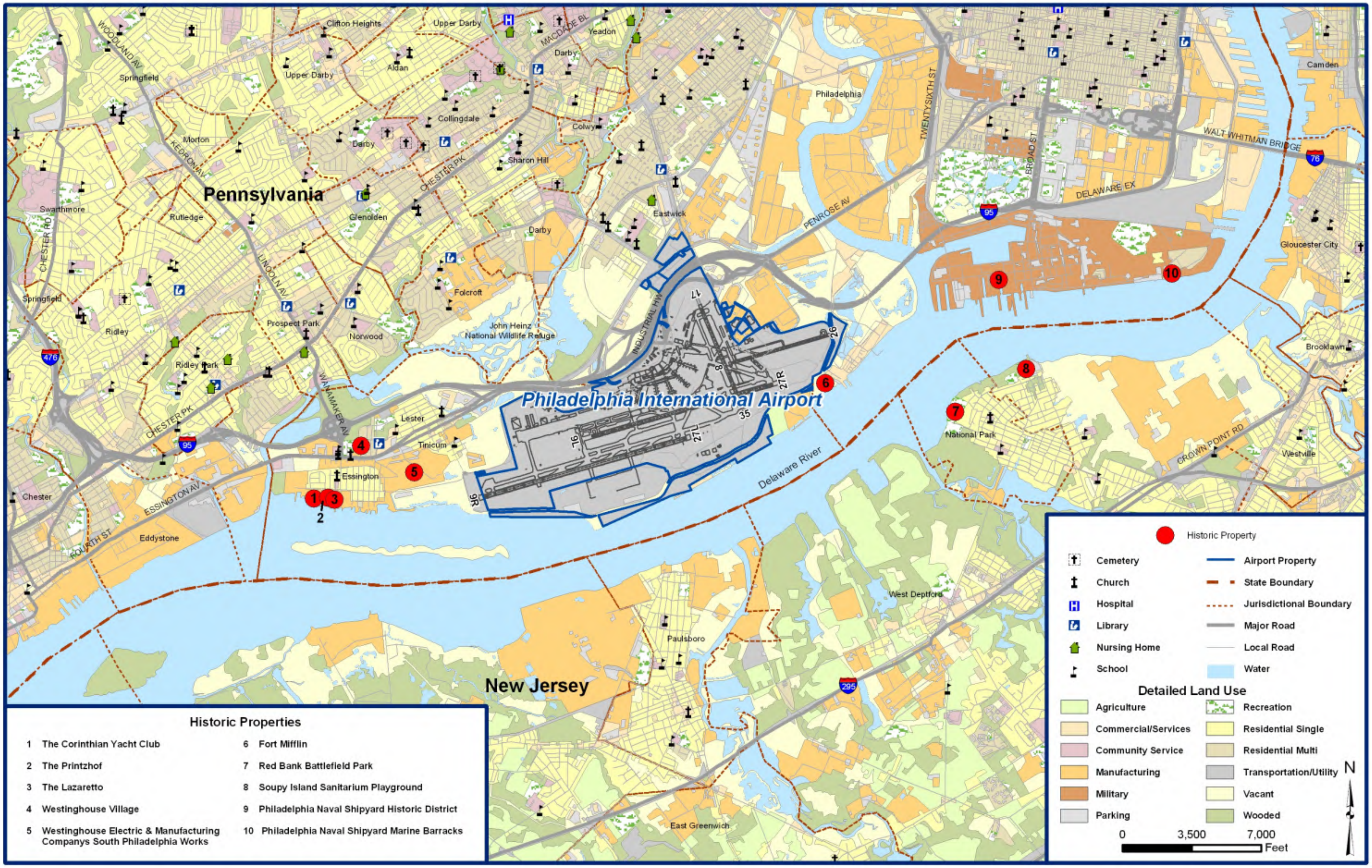


Figure 2-5: Historic Properties

Noise Compatibility Program Update

PHL PHILADELPHIA INTERNATIONAL AIRPORT

DMJM AVIATION | AECOM

Figure2-5_HistoricProperties.mxd

06-30-09

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

2.2. Noise Monitoring

A te mporary noise monitoring program was completed to measure community sound levels as part of the NEM/NCP Update. The program was designed to meet the following objectives:

- Sample and document overall outdoor sound levels in the communities surrounding the Airport, and
- Sample and document the sound levels of aircraft, and determine the contribution of aircraft noise to the overall sound levels

As seen in **Figure 2-6 Noise Measurement Program Locations and in Figures 7A and 7B** (in Section 5), twenty-eight portable noise monitors were placed in locations surrounding PHL between November 7th and November 16th, 2007 to identify characteristics of noise exposure as a result of aircraft overflights in the context of a Part 150 study. It is important to note that the noise monitoring values are for supplemental purposes and are the result of the environmental factors of a 10-day sample; whereas modeled noise levels represent average daily conditions for an entire calendar year (365 days) using the FAA's INM.

The measurement period is a representative "slice-in-time" that allows the characterization of the daily fluctuations in airport traffic throughout a typical week. Since the 10-day measurement period occurred under a variety of weather conditions, specifically shifting wind patterns, the program also demonstrates changes in the noise environment as the operational flow at the Airport varies.

Appendix G provides more detailed information on the methodology and findings of the noise monitoring program.

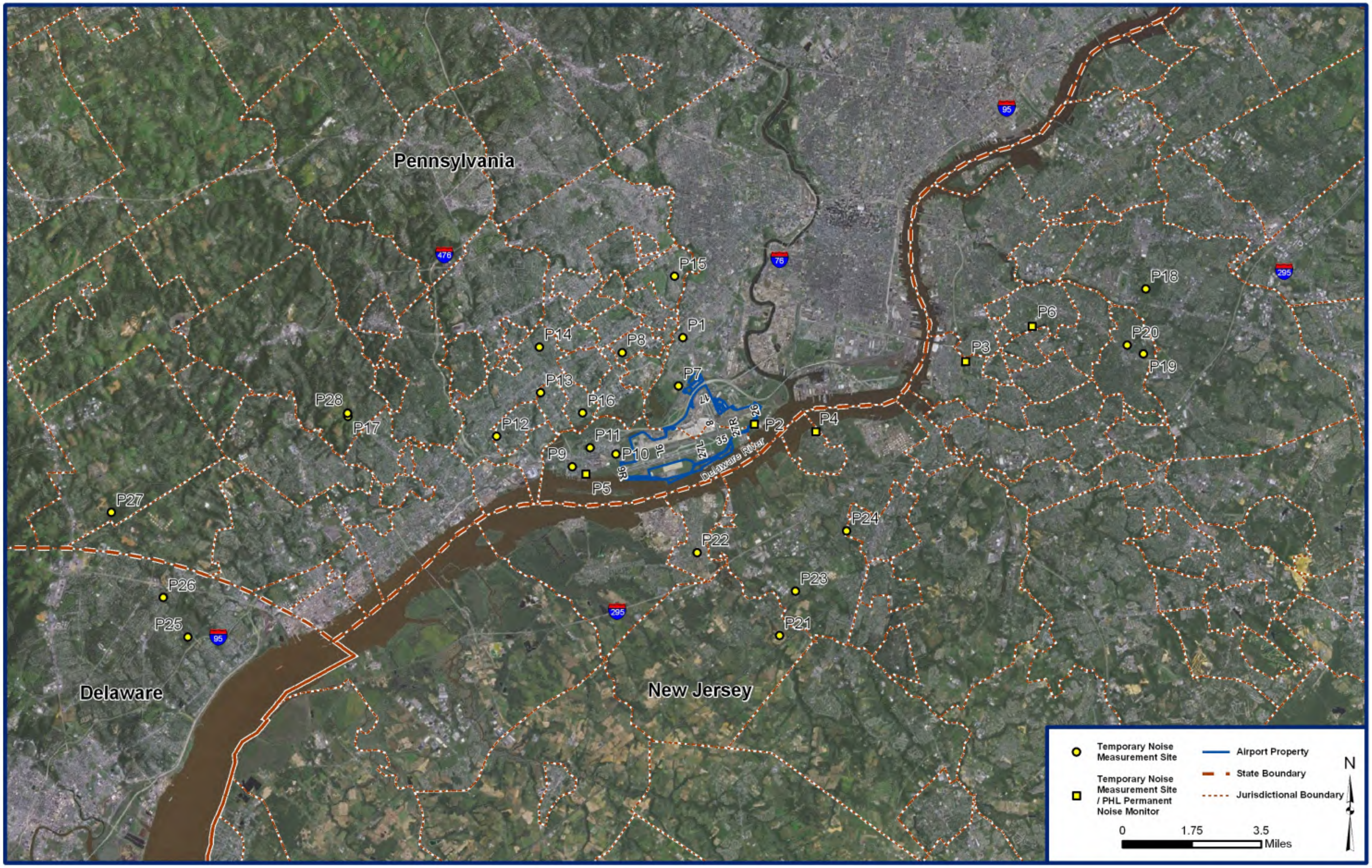


Figure 2-6: Noise Measurement Locations

PHL PHILADELPHIA INTERNATIONAL AIRPORT

Noise Compatibility Program Update

DMJM AVIATION | AECOM

10-08-09

Figure2-6_NoiseMeasurementLocations.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

2.3. Land Use Planning and Zoning

Land use planning around airports is a function of local governments and the bodies established to carry out the policies and practices enacted.

Zoning is the classification of land into separately regulated areas which specify permitted land uses, density, design, and placement of structures within a boundary, and is a key element of land use control used by municipalities. Zoning serves many functions, one of which is the segregation of activities which may be disruptive to residents.

Regionally, land use is guided by the DVRPC. The DVRPC was created by the Pennsylvania and New Jersey Legislatures in 1965 as the federally designated Metropolitan Planning Organization (MPO) for the Philadelphia-Camden-Trenton Metropolitan Area. Counties served by the DVRPC that are located within the PHL study area include Delaware and Philadelphia in Pennsylvania; and Burlington, Camden, and Gloucester in New Jersey. DVRPC is an interstate, inter-county, and intercity agency. As such, it is advisory in nature for planning issues such as regional policy and capital funding concerning transportation, economic development, the environment, and land use. The largest part of the DVRPC's work concerns the efficient transportation of people and goods. The DVRPC is governed by an 18-member board made up of elected officials and three representatives from each state. The state representatives include Pennsylvania Department of Transportation (PennDOT), New Jersey Department of Transportation (NJDOT), Pennsylvania Governor's Policy Office, New Jersey Department of Community Affairs, and appointees of both governors. The Commission has approximately 80 professional and support staff to provide technical assistance to the Board.

In the area located nearest to the airport (southwest Philadelphia and Tinicum Township), land use planning is undertaken by the Philadelphia City Planning Commission, the Delaware County Planning Department, and the Tinicum Township Board of Commissioners.

2.3.1 Philadelphia City Planning Commission

A nine member Philadelphia City Planning Commission (PCPC) is responsible for guiding the orderly growth and development of the City of Philadelphia. The powers and duties of the Commission include proposing zoning ordinances and amendments, administering the regulations concerning the subdivision of land, preparing a Comprehensive Plan, and maintaining the capital program and budget.

Zoning and planning falls under Title 14 of the Philadelphia City Code and Home Rule Charter. Specifically, the airport is contained in Title 14-1601. In May 2007, city voters overwhelmingly approved the creation of a Zoning Code Commission to reform and modernize Philadelphia's outdated and complex zoning code. The Commission is charged with developing a new zoning code that:

- is easy to understand
- improves the City's planning process
- promotes positive development
- preserves the character of Philadelphia's neighborhoods

The Zoning Code Commission consists of 31 members comprised as follows:

- the City Planning Commission Director, who serves as the Chair
- the Commissioner of Licenses & Inspections
- the Chairman of the Zoning Board of Adjustment
- 10 community leaders, one appointed by each of the 10 District Council members
- 3 City Council members
- 5 members appointed by the Mayor, and 5 members appointed by the Council President
- One representative from the Greater Philadelphia Chamber of Commerce, Greater Northeast Chamber, African-American Chamber, Hispanic Chamber and Asian-American Chamber.

2.3.2 Tinicum Township and the Delaware County Planning Department

Tinicum Township Officials in conjunction with the Delaware County Planning Department (DCPC) are responsible for zoning and land use development within Tinicum Township. The mission of the DCPC is to promote sound development and redevelopment of the County through the application of contemporary planning principles and growth management concepts. It is organized into seven sections: Community Assistance, Information Services, Subdivision and Land Development, Environmental Planning, Policy Planning, Preservation Planning and Transportation Planning.

Tinicum Township is responsible for implementing and adhering to their zoning, but any changes to the zoning ordinance must be approved by the DCPC and made available for public comment.

2.4. Local Land Use Planning Initiatives

Land in close proximity to the Airport has little to no risk of development in incompatible use. There are few vacant land parcels west of the airport in Tinicum Township; research indicates that four parcels are available totaling approximately 84 acres. Two of the parcels are available on a build-to-suit basis, including 49 acres of land at the former Westinghouse complex (also known as the Airport Business Complex). This tract could support another 780,000 SF of building area mixed between office and industrial uses. A second parcel was 12 acres at Mack-Cali Class A office park at the Airport Business Complex. This parcel could support another 130,000 SF of office space.

Much of the adjacent land east of PHL is owned by the City of Philadelphia and is planned to be compatible with PHL aircraft noise levels. Further east, across the Schuylkill River is League Island, the location of the former Philadelphia Naval Base and Shipyard. This site, now referred to as “The Navy Yard” is 1,200 acres along 7 miles of historic waterfront at the confluence of the Schuylkill and Delaware Rivers. Currently the land uses at this site are all compatible with aircraft noise levels associated with the Airport. The site is actively marketed to accommodate up to 12 million square feet of capacity for historic renovations and build-to-suit opportunities for office, research and development, light and heavy industrial, distribution, marina and recreational uses. Interest in the Navy Yard continues to expand and attract tenants. Current tenants include PennShip Services L.L.C., a ship-repair yard and Aker Philadelphia Shipyard. Tasty Baking Company has committed to move its corporate headquarters to a 350,000 square foot, state of the art baking facility in the Navy Yard. This new facility will be ready for occupancy in 2010.

The area directly north of the end of Runway 17 is also primarily compatible with airport operations and is expected to continue to be used for commercial/industrial purposes and remain zoned accordingly for future development. The vacant parcel between I-95 and Bartram Avenue is the Eastwick Industrial Park. The Philadelphia Industrial Development Corporation (PIDC) is marketing parcels in the Eastwick Industrial Park for industrial and commercial use.

Figure 2-7: Navy Yard Master Plan

2.5. Airport Facilities

2.5.1 Runways, Taxiways, Instrumentation, Lighting, Navigational Aids

There are four runways at PHL, three of which are oriented in the east-west direction. Runway 9L/27R (inboard) measures 9,500 feet by 150 feet, Runway 9R/27L measures 10,506 feet by 200 feet, and unidirectional Runway 8/26 measures 5,000 feet by 150 feet, which is used exclusively for west-flow arrivals and east-flow departures. Crosswind Runway 17/35, oriented in the north-south direction, has been recently extended and measures 6,501 feet by 150 feet. **Table 2-3: Runway Data Summary** provides PHL's runway information.

A variety of navigational and lighting aids are available for use at PHL. Used primarily for identification or navigation to and from the Airport, they provide visual and electronic guidance to pilots and air traffic controllers. PHL navigational aids are described in **Appendix H**.

Table 2-3 Runway Data Summary								
	Runway		Runway		Runway		Runway	
	9L	27R	9R	27L	17	35	8	26
Length [1]	9,500'	9,500'	10,506'	10,506'	6,501'	6,501'	5,000'	5,000'
Displaced Threshold	0'	0'	0'	0'	0'	0'	0'	0'
Landing Length [1]	9,500'	9,500'	10,506'	10,506'	6,501'	6,501'	N/A	5,000'
Effective Gradient [1]	0.05%	0.05%	0.11%	0.11%	0.03%	0.03%	0.53% up E	0.53% dn W
Pavement Strength [1]	Single Wheel – 200K Lbs. Dual Wheel – 210K Lbs. Dual Tandem – 350K Lbs.		Single Wheel – 200K Lbs. Dual Wheel – 210K Lbs. Dual Tandem – 350K Lbs.		Single Wheel – 100K Lbs. Dual Wheel – 170K Lbs. Dual Tandem – 300K Lbs.		Dual Tandem – 60K Lbs.	
Approach Surfaces [3]	50:1	50:1	50:1	50:1	50:1	20:1	N/A	50:1
Runway Pavement Markings	Precision Instrument						Basic	Precision Instrument
Landing Aides [1,2]	PAPI MALSR ILS HIRL RCL REIL	PAPI MALSR ILS HIRL RCL	ALSF2 ILS DME HIRL RCL TDZ	PAPI MALSR ILS PRM HIRL RCL	PAPI MALSR ILS HIRL	VASI LOC HIRL REIL	HIRL RCL	PAPI MALSR ILS PRM HIRL RCL

Abbreviations:
ALSF2 – High Intensity Approach Lighting System with Sequenced Flashing Lights, Category 2
DME – Distance Measuring Equipment
HIRL – High Intensity Runway Lights
ILS – Instrument Landing System
LOC – Localizer
MALSR – Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights
PAPI – Precision Approach Path Indicator
PRM – Precision Runway Monitor
RCL – Runway Centerline Lights
REIL – Runway End Identifier Lights
TDZ – Touchdown Zone Lighting
VASI – Visual Approach Slope Indicator

Sources: PHL Master Plan, November 2007

Notes: (1) Runway 9R also has CATII and CATIII capability. CATII refers to providing for precision approach to a height above touchdown of not less than 100 feet with runway visual range of not less than 1,200 feet. CATIII has three separate categories (IIIA, IIIB, and IIIC) which allow for precision approach with no minimum decision height and visual ranges of 700 feet for CATIIIA, 150 feet for CATIIIB, and less than minimum visual range for CATIIIC.

2.5.2 Airspace and Air Traffic Control

Airspace within control of the United States is classified as either uncontrolled (Class G) or controlled (Classes A-E), each having specific restrictions and guidelines. PHL is located within what is known as Class B airspace. Geography and other considerations determine the exact architecture of each Class B airspace. Typically Class B airspace has a radius of 20 nautical miles and extends up to 10,000 feet above ground level.

The Airport operates in one of two modes: east flow or west flow, with wind and weather conditions primarily dictating which mode is used. Historically, the Airport is in a west flow operation approximately 70 percent of the year. As shown in **Figure 2-8: West Flow Runway Use,** during west flow operations, aircraft depart from Runways 27L, 27R, and 35 and arrive to Runways 27L, 27R, 26, and 35. As shown in **Figure 2-9: East Flow Runway Use,** during east flow operations aircraft depart from Runways 09L, 09R, 08, and 17, and arrive to Runways 09L, 09R, and 17.

Figure 2-8. West Flow Runway Use

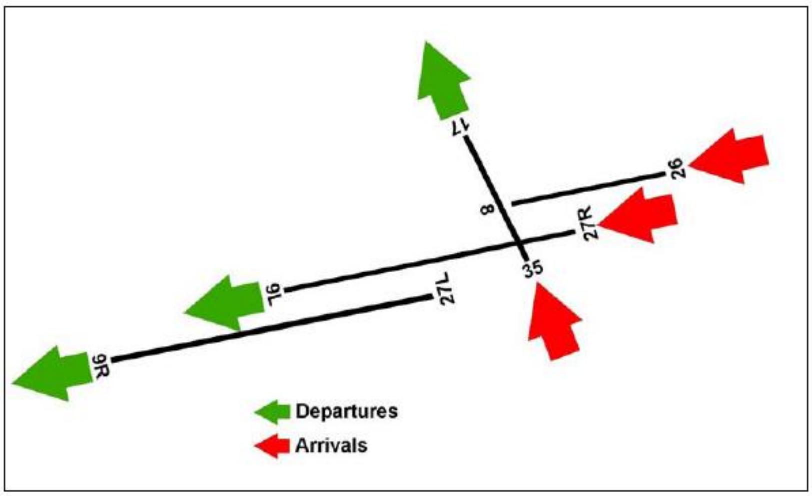
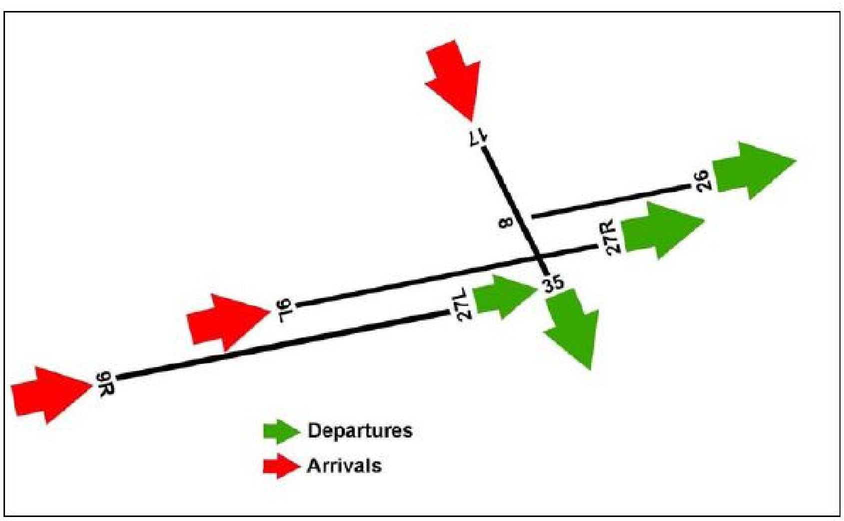


Figure 2-9. East Flow Runway Use



The current NCP, approved by the FAA in 2003, documented the Airport's voluntary noise abatement procedures that have been in use for many years. The Runway 27L and 27R noise abatement procedure, as identified in the PHL NCP, directs jet aircraft to turn towards a 255° heading after takeoff, which generally places them over the center of the Delaware River. Once reaching an altitude of 3,000 feet, the aircraft turn and fly to departure checkpoints that surround the region. It should be noted that when jet aircraft do use the ARD dispersal headings, they are still directed to fly to 3,000 feet before turning, which keeps aircraft close to the Delaware River and reduces the number of residential areas overflown at a low altitude. Permanent signage on the airfield reminds pilots to use the noise abatement procedures when permitted by ATCT. Since the implementation of the ARD dispersal headings, the 255° heading is still used during the overnight hours and continues to be part of our noise reduction strategy, although the Airport cannot dictate when it can or cannot be used.

PHL also has a nighttime preferential runway use procedure. Between the hours of 11:00 p.m. to 6:00 a.m. local conditions permitting, aircraft should:

During west operations –	Depart Runway 27L and Land Runways 27L/27R/26 Depart Runway 17 and Land Runway 35
During east operations –	Depart Runways 09L/09R/08 and Land Runway 9R Depart Runway 17 and Land Runway 35

3. 2008 Noise Exposure

This section describes the input data, resulting noise exposure, and estimated land use incompatibilities for the 2008 Existing Baseline Noise Exposure Map. The existing baseline noise exposure contours were initially developed based on actual operational data at PHL (operating levels, fleet mix, runway layout, and flight tracks) for the full calendar year 2007. At the time, this was the most recent data available for modeling existing conditions. On December 19th, 2007, the FAA implemented portions of the Airspace Redesign project at PHL by utilizing two new departure headings from Runways 27L and 27R to the west and Runways 09L and 09R to the east. This meant that the 2007 Noise Exposure Contour as modeled included only two weeks of operations utilizing the new departure headings. Given that there was significant public interest with the Airspace Redesign Project, the City of Philadelphia Division of Aviation and project team coordinated with various FAA lines of business to discuss the changing conditions at PHL and whether or not they would affect the existing baseline noise contour. FAA Headquarters suggested that the first six months of operations data including ARD activity should be examined to determine whether there were any significant changes over the 2007 existing conditions. Following a review of the radar data and cognizant of the feedback received at the community workshops held in June 2008, a determination was made to develop the existing baseline contour for the year 2008.

Subsequent to the development of the 2008 noise exposure contour, overall operations at PHL have decreased by approximately five percent. This decrease in operations is generally consistent with trends seen throughout the aviation industry as a result of the economic downturn. Also, subsequent to the 2008 contour development, work on Runway 17/35, subject of an FAA Environmental Impact Statement, was completed and the runway was extended by 1,040 feet. The Airport has been tracking activity on the extended Runway 17/35 since its commissioning in February 2009. During the first six months of 2008, which coincides with half of the operational data used to develop the 2008 Existing Baseline Contour, approximately 1.5% of Runway 17/35 activity was by narrowbody aircraft. In the six months following the opening of Runway 17/35, narrowbody jet activity accounted for nearly 4% of Runway 17/35 activity. Although both the number of narrowbody aircraft and the percentage of total utilization on that runway have increased, overall aircraft activity on Runway 17/35 has decreased slightly, consistent with a decrease in overall operations at the airport. When paired with the overall decrease in operations at PHL, the modeled assumptions are considered to represent the actual levels of operations on that runway. There are no other changes that have occurred that would be expected to notably alter the noise contour, especially over noise-sensitive land uses. For these reasons, the resulting noise exposure contour described as the 2008 Existing Baseline Noise Exposure Map accurately represents the year of submission.

3.1. Airport Facilities

The development of noise contours using the Integrated Noise Model (INM) takes into account a number of variables that affect noise exposure patterns, including the location of runways, the number and types of aircraft that use the airport, the runway utilization patterns, the flight track locations and utilization, and other variables such as trip distance, weather, and maintenance run ups. This information is generalized to represent an average annual day (AAD). Each of the following subsections describes this input data. Since operating levels, runway use, flight track use, and other variables fluctuate on a daily basis at an airport, some variations on average noise model data input can be expected. Runways are crucial components for determining noise exposure, as the length of a runway is directly related to the types of aircraft which can utilize it. PHL operates three parallel runways (09R/27L, 09L/27R, and 08/26) and one crosswind runway (17/35). Section 2.5 and Table 2-3 provide more detailed information on PHL runway data.

The noise model includes a database of airport specific information, including airport elevation data, displaced thresholds, and runway end location and elevation. Runway end locations, elevations, and displaced thresholds were cross-referenced with additional data sources for consistency. For the 2008 condition, runway lengths as provided in INM were utilized. Additionally, no displaced thresholds were identified or modeled. When evaluating noise exposure for an annual condition, one factor to consider is modifications to airport facilities which may include facility development such as the installation of new navigation equipment, extended runway closures, or new facility development. None of the Airport's runways remained closed for a period of time that would have notably affected the average runway utilization at PHL, however, in February 2009, Runway 17/35 became fully operational with a total usable length of 6,501 feet.

3.2. 2008 Activity Level and Fleet Mix

An analysis of the Airport's flight tracking data (TAMIS) was undertaken to evaluate the distribution of operations by aircraft category and the specific aircraft types using the airport. For noise modeling purposes, aircraft types were grouped based on the aircraft's size and in some cases, engine characteristics. Each of the groups referenced throughout this report are described in further detail below:

- Widebody aircraft: Generally the heaviest aircraft in operation at PHL, including both widebody passenger and cargo aircraft, such as the Boeing 747 series, 767 series, and 777 series, Airbus A300, A330, and A340, and McDonnell Douglas DC-10 and MD-11 aircraft.
- Narrowbody aircraft: Narrowbody passenger and cargo aircraft, including the Boeing 717, 737, and 757 series aircraft, Airbus 319 and 320 aircraft, and McDonnell Douglas MD-80 series aircraft.
- Regional jet aircraft: Regional and corporate or business jets, which are smaller than narrowbody aircraft, generally carrying less than 100 passengers. This category includes both commercial service operators and general aviation jet activity, and includes Embraer 145, Canadair Regional Jets, and Gulfstream business jets, among others.
- Propeller: Single- and multi-engine propeller aircraft, including turbine-powered propeller aircraft (turboprops), and military aircraft. This category includes Dash-8 commuter aircraft, smaller single-engine aircraft such as the Beechcraft Baron 58P, and military aircraft such as the C-130.

The type of users may be further categorized, as appropriate, during the development of the average annual day operations. Individual aircraft types identified in the TAMIS data were matched to INM aircraft types. Additional analysis was performed to match generic TAMIS aircraft codes, such as B757, to the specific aircraft type in the INM database, based on the series model, individual airlines' fleet, and engine type. Because the model database does not contain noise data for every individual aircraft type and engine configuration, the fleet mix is generalized to group aircraft with similar performance and noise characteristics. This analysis groups aircraft based on the size, type, or weight of the aircraft.

Part 150 regulations require the use of an average annual day (AAD) condition, meaning the operations, temporal distribution, runway utilization, and flight track utilization occurring over a 365-day period are averaged. The AAD condition takes into account all aircraft that operate at the airport in a 365-day period, the runways and flight paths utilized, the profiles flown by the aircraft, and the time of day of operations to create a 'typical' average daily noise exposure. An analysis of TAMIS data was first completed for 2007 (January through December) and indicated that, during the 12-month period, a total of 489,516 operations were recorded. The FAA maintains an official record of air traffic activity at a facility by use of the Air Traffic Activity Data System (ATADS). An analysis of 2007 operations via the ATADS system indicated that a total of 499,683 operations were recording during 2007, while an analysis of data from July 2007 to June 2008 reported 499,310 operations, which equates to approximately 1,368 operations on an AAD. Following the assignment of INM aircraft and activity levels according to the TAMIS analysis, operations were scaled to match the AAD number identified in the FAA ATADS statistics.

For the 12-month period of analysis at PHL, regional jet aircraft and narrowbody aircraft represented the majority of aircraft operations. Overall, the aircraft fleet mix at PHL is comprised of 40% narrowbody, 43% regional jet, 12% propeller aircraft, and 5% widebody aircraft. The fleet mix is comprised most heavily of regional jet aircraft and narrowbody jets such as aircraft in the Boeing 737 and 757 families as well as the Airbus A319 and A320 aircraft families. Another common aircraft at PHL is the De Havilland Dash-8 aircraft, a commuter propeller aircraft used for short haul connections. **Table 3-1: 2008 Existing Baseline Annual Average Day Operations** presents the 2008 Existing Baseline Annual Average Day (AAD) operations.

Table 3-1: 2008 Existing Baseline Annual Average Day Operations							
		Arrivals		Departures		Total AAD	
INM Type	Description	Day	Night	Day	Night	Day	Night
Widebody Aircraft							
74710Q	Boeing 747-100 Series	0.3	0.1	0.4	0.1	0.7	0.2
74720A	Boeing 747-200 Series	-	-	-	-	-	-
74720B	Boeing 747-200 Series	0.5	0.2	0.6	0.1	1.1	0.3
747400	Boeing 747-400 Series	-	-	-	-	-	-
767300	Boeing 767-300	0.8	0.2	0.8	0.1	1.6	0.4
767400	Boeing 767-400 ER	-	-	-	-	-	-
767CF6	Boeing 767-200 Series	11.3	3.4	12.5	2.2	23.8	5.6
767JT9	Boeing 767-200 Series	0.1	-	0.1	-	0.2	-
777200	Boeing 777-200 Series	0.9	0.3	1.0	0.2	1.9	0.4
777300	Boeing 777-300 Series	-	-	-	-	-	-
A300-622R	Airbus A300-622R	1.9	0.6	2.1	0.4	4.0	0.9
A300B4-203	Airbus A300B4-200/CF6-50C2	1.1	0.3	1.2	0.2	2.2	0.5
A310-304	Airbus A310-304	0.1	-	0.1	-	0.1	-
A330-301	Airbus A330-301	0.2	0.1	0.3	-	0.5	0.1
A330-343	Airbus A330-343	4.8	1.4	5.3	0.9	10.2	2.4
A340-211	Airbus A340-211	1.2	0.4	1.4	0.2	2.6	0.6
DC1010	DC10-10	1.0	0.3	1.1	0.2	2.0	0.5
DC1030	DC10-30	0.3	0.1	0.4	0.1	0.7	0.2
DC93LW	DC9-30 with Hushkit	1.3	0.4	1.5	0.3	2.8	0.7
DC95HW	DC9-50 with Hushkit	1.9	0.6	2.1	0.4	4.1	1.0
MD11GE	MD-11	0.4	0.1	0.4	0.1	0.8	0.2
MD11PW	MD-11	0.6	0.2	0.6	0.1	1.2	0.3
Total		**28.7**	**8.5**	**31.7**	**5.5**	**60.4**	**14.1**
Narrowbody Aircraft							
717200	Boeing 717-200	7.1	1.4	7.1	1.4	14.2	2.8
727EM1	Boeing 727-100 Series	-	-	-	-	-	-
727EM2	Boeing 727-200 Series	1.7	0.3	1.7	0.3	3.4	0.7
727QF	Boeing 727-100 Series	-	-	-	-	-	-
737300	Boeing 737-300 Series	33.6	6.7	33.8	6.4	67.4	13.2
737400	Boeing 737-400 Series	20.9	4.2	21.1	4.0	42.0	8.2
737500	Boeing 737-500 Series	5.1	1.0	5.1	1.0	10.2	2.0
737700	Boeing 737-700 Series	40.0	8.0	40.3	7.7	80.4	15.7
737800	Boeing 737-800 Series	6.8	1.4	6.8	1.3	13.6	2.7
737N17	Boeing 737-200 with Hushkit	0.0	-	0.0	-	0.1	-
757300	Boeing 757-300	0.0	-	0.0	-	0.1	-
757PW	Boeing 757-200	13.2	2.7	13.4	2.5	26.6	5.2
757RR	Boeing 757-200	22.9	4.6	23.1	4.4	46.0	9.0
A319-131	Airbus A319-131	39.5	7.9	39.9	7.6	79.4	15.5
A320-211	Airbus A320-211	22.8	4.6	23.0	4.4	45.8	8.9

INM Type	Description	Arrivals		Departures		Total AAD	
		Day	Night	Day	Night	Day	Night
Table 3-1: 2008 Existing Baseline Annual Average Day Operations							
A320-232	Airbus A320-232	2.4	0.5	2.4	0.5	4.8	0.9
A321-232	Airbus A321-232	1.9	0.4	1.9	0.4	3.8	0.7
DC870	DC8-70	3.2	0.6	3.2	0.6	6.4	1.2
F10065	F100	-	-	-	-	-	-
MD81	MD-81	0.1	-	0.1	-	0.1	-
MD82	MD-82	7.0	1.4	7.0	1.3	14.0	2.7
MD83	MD-83	3.5	0.7	3.6	0.7	7.1	1.4
Total		**231.6**	**46.4**	**233.5**	**44.4**	**465.1**	**90.8**
Regional Jet Aircraft							
CIT3	Cessna Citation	0.7	0.1	0.7	0.1	1.4	0.2
CL600	Challenger	3.1	0.4	3.0	0.5	6.1	0.9
CL601	Canadair Regional Jet	143.8	19.7	140.9	22.7	284.7	42.4
CNA500	CIT 2	0.6	0.1	0.6	0.1	1.3	0.2
CNA750	Citation X	1.3	0.2	1.3	0.2	2.6	0.4
EMB145	Embraer 145 ER	9.4	1.3	9.2	1.5	18.6	2.8
EMB14L	Embraer 145 LR	5.9	0.8	5.8	0.9	11.6	1.7
FAL20	Falcon 20	2.3	0.3	2.3	0.4	4.6	0.7
GII	Gulfstream GII	0.4	0.1	0.4	0.1	0.8	0.1
GIV	Gulfstream GIV	2.1	0.3	2.1	0.3	4.2	0.6
GV	Gulfstream GV	68.7	9.4	67.3	10.8	135.9	20.2
HS748A	HS748	-	-	-	-	-	-
IA1125	ASTRA 1125	0.9	0.1	0.9	0.1	1.8	0.3
LEAR25	LEAR 25	0.3	0.0	0.3	0.0	0.6	0.1
LEAR35	LEAR 36	8.4	1.1	8.2	1.3	16.5	2.5
MU3001	MU300-10	6.6	0.9	6.4	1.0	13.0	1.9
Total		**254.5**	**34.9**	**249.3**	**40.1**	**503.8**	**75.0**
Propeller Aircraft							
BEC58P	BARON 58P	2.0	0.4	2.0	0.3	4.0	0.7
C130AD	C-130	-	-	-	-	-	-
C-130E	C-130	-	-	-	-	-	-
C131B	C-131	-	-	-	-	-	-
CNA172	Cessna 172	0.1	-	0.1	-	0.3	-
CNA206	Cessna 206	0.2	0.0	0.2	0.0	0.4	0.1
CNA441	Conquest II	0.6	0.1	0.6	0.1	1.2	0.2
CVR580	Convair 580	-	-	-	-	-	-
DHC6	Dash 6	3.7	0.7	3.7	0.6	7.4	1.4
DHC8	DASH 8-100	47.4	9.4	48.5	8.3	95.9	17.6
DHC830	DASH 8-300	9.8	1.9	10.1	1.7	19.9	3.7
GASEPF	Single Engine GA Fixed Prop	1.2	0.2	1.2	0.2	2.3	0.4
GASEPV	Single Engine GA Variable Prop	1.0	0.2	1.0	0.2	1.9	0.4
PA30	Piper Twin Comanche	-	-	-	-	-	-

Table 3-1: 2008 Existing Baseline Annual Average Day Operations							
INM Type	Description	Arrivals		Departures		Total AAD	
		Day	Night	Day	Night	Day	Night
PA31	Piper Navajo/Chiefton	0.5	0.1	0.5	0.1	1.0	0.2
SD330	Shorts 330	-	-	-	-	-	-
Total		**66.5**	**13.1**	**68.0**	**11.6**	**134.5**	**24.7**
Grand Total		581.3	102.9	582.5	101.7	1163.8	204.6

Note: Operations are rounded. Omitted entries may include operations less than 0.01.
Source: TAMIS 2007-2009, Wyle 2009

An analysis of the temporal distribution of operations was also undertaken. The TAMIS data also provided statistics on the number of operations occurring during daytime and nighttime hours. The DNL metric penalizes operations occurring during nighttime hours (defined as between 10:00 p.m. and 7:00 a.m.) to account for the perceived added intrusion during these hours. For the 2008 Existing Baseline condition, approximately 85% of operations occur during the day, while the remaining 15% occur during nighttime hours, as shown in **Table 3-2: 2008 Existing Baseline Temporal Distribution**.

Table 3-2: 2008 Existing Baseline Temporal Distribution				
Aircraft Category	Arrivals		Departures	
	Day	Night	Day	Night
Widebody	77.0%	23.0%	84.9%	15.1%
Narrowbody	83.3%	16.7%	84.0%	16.0%
Regional Jet	83.5%	16.5%	85.5%	14.5%
Propeller	88.0%	12.0%	86.1%	13.9%
Overall Temporal Distribution	**85.0%**	**15.0%**	**85.1%**	**14.9%**

Source: PHL TAMIS, Wyle 2009

3.3. 2008 Runway Utilization

PHL typically operates in one of two operating configurations, based on the predominate direction of winds at the time. The primary operating configuration is described as west flow, with arrivals approaching the airport with a western heading, and departures departing the airport on westbound headings. West flow consists of aircraft departures from Runways 27L, 27R, and 35 and aircraft arrivals to Runways 27L, 27R, 26, and 35 (refer to **Figure 2-8**). East flow consists of aircraft departures from Runways 09L, 09R, 08, and 17, and arrivals to Runways 09L, 09R, and 17 (refer to **Figure 2-9**). For the period of analysis, the ATCT determines the operating configuration at the airport to maximize the safety and efficiency of the runway system, based on actual and anticipated weather conditions. In some cases, the airport may remain in west flow for a majority of the time, then switch to east flow to account for a specific weather change. During 2008, the airport operated in west flow 81% of the time, and in east flow the remaining 19% of the time, which is a notable change from historic average weather patterns that kept the airport in west flow approximately 70% of the time and east flow for the remaining 30%. For example, for January 2009 through September 10th 2009, PHL operated in 75% west flow, 23% east flow, with a 2% margin of error.

The selection of a runway for an arrival or departure by a pilot or Air Traffic Control is based on wind and weather conditions, aircraft operating requirements (i.e. length), and, in some cases, the level of activity associated with the runway. Runway use was determined through an evaluation of the TAMIS database for the 2008 Existing Baseline condition. Overall, Runways 27L and 27R were the busiest runways at the airport in 2008, accounting for nearly 65% of all operations at PHL. Runway 35 accounted for approximately 11% of operations, followed by Runways 09R, 09L, and 26. Both Runways 08 and 17 accounted for less than 3% of total operations.

Due to the lengths of each runway at PHL, the majority of aircraft in the widebody and narrowbody category use Runways 09R/27L and 09L/27R for both arrivals and departures. During the daytime hours (7:00 a.m. to 10:00 p.m.), aircraft in the widebody, narrowbody, and regional jet categories used Runway 27L for a majority of departures. On the other hand, propeller aircraft, which do not require as long as runway, and generally fly slower than jet aircraft, used Runway 35 nearly as often as Runway 27L. Runway 27R is the primary arrival runway at PHL for jet aircraft, while propeller aircraft more often utilized Runway 26, which is generally of insufficient length for use by most jet aircraft, and is also located near the general aviation area on the airfield.

During nighttime hours, the airport maintains a voluntary runway use program designed to reduce, to the extent practical, overflights over populated areas. The voluntary program, in effect between 11:00 p.m. and 6:00 a.m. indicates that during west flow, aircraft should depart from Runways 27L and 17, and arrive first to Runways 27L/27R/26, then Runway 35. When the airport operates in east flow, aircraft should depart from Runways 09L/09R/08 then 17, and arrive to Runway 09R followed by Runway 35. It is important to note that the program is voluntary, meaning that aircraft will follow instructions as indicated by the ATCT, and deviations do occur for various reasons. **Table 3-3: 2008 Existing Baseline Runway Utilization** depicts runway utilization for the 2008 Existing Baseline condition.

Table 3-3: 2008 Existing Baseline Runway Utilization (by percent of total operations)									
Daytime (7:00 A.M. - 10:00 P.M.) Arrivals									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Widebody	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	1.7%	2.1%
Narrowbody	0.0%	0.0%	0.0%	3.2%	0.0%	0.2%	0.2%	13.3%	16.9%
Propeller	0.0%	1.4%	0.0%	0.2%	0.5%	2.7%	0.0%	0.0%	4.9%
Regional Jet	0.0%	3.0%	0.0%	2.7%	0.6%	5.0%	0.2%	7.2%	18.6%
Total	**0.0%**	**4.4%**	**0.1%**	**6.5%**	**1.0%**	**7.9%**	**0.4%**	**22.2%**	**42.5%**
Nighttime (10:00 P.M. - 7:00 A.M.) Arrivals									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Widebody	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.4%	0.6%
Narrowbody	0.0%	0.0%	0.0%	0.7%	0.0%	0.0%	0.4%	2.3%	3.4%
Propeller	0.0%	0.6%	0.0%	0.1%	0.1%	0.2%	0.0%	0.0%	1.0%
Regional Jet	0.0%	0.7%	0.0%	0.5%	0.1%	0.4%	0.0%	0.9%	2.5%
Total	**0.0%**	**1.2%**	**0.1%**	**1.4%**	**0.1%**	**0.6%**	**0.5%**	**3.6%**	**7.5%**
Daytime (7:00 A.M. - 10:00 P.M.) Departures									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Widebody	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	1.5%	0.4%	2.3%
Narrowbody	0.0%	0.0%	3.2%	0.1%	0.0%	0.0%	12.4%	1.4%	17.1%
Propeller	0.4%	0.0%	0.6%	0.1%	<0.1%	1.5%	2.0%	0.4%	5.0%
Regional Jet	0.8%	0.0%	2.5%	0.1%	<0.1%	0.2%	13.2%	1.4%	18.2%
Total	**1.3%**	**0.0%**	**6.6%**	**0.3%**	**<0.1%**	**1.7%**	**29.1%**	**3.5%**	**42.6%**
Nighttime (10:00 P.M. - 7:00 A.M.) Departures									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Widebody	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.3%	0.0%	0.4%
Narrowbody	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	2.1%	0.3%	3.2%
Propeller	0.2%	0.0%	0.1%	0.0%	<0.1%	0.1%	0.3%	0.2%	0.8%
Regional Jet	0.2%	0.0%	0.4%	0.0%	<0.1%	0.0%	2.0%	0.2%	2.9%
Total	**0.4%**	**0.0%**	**1.4%**	**0.1%**	**<0.1%**	**0.1%**	**4.7%**	**0.7%**	**7.4%**
Overall Runway Utilization	**1.6%**	**5.6%**	**8.2%**	**8.3%**	**1.2%**	**10.3%**	**34.7%**	**30.1%**	**100.0%**

Source: PHL TAMIS, Wyle 2009

Note: Percentages are rounded to the nearest 0.1%. Totals are subject to rounding errors.

3.4. 2008 Flight Track Development and Utilization

Flight tracks refer to the flight paths (also referred to as ground tracks) that aircraft fly when arriving to or departing from (or when conducting touch and go operations) an airport. In addition to runway utilization, they are a critical component for determining noise exposure. Aircraft typically depart from an airport and follow instructions issued by the ATCT and, once at specified altitudes, turn towards their destination or departure fix. Wind, pilot procedures, and other variables often affect the path flown by the aircraft. The INM is designed such that the many variations to flight paths must be 'generalized' to create representative flight tracks.

The TAMIS data provides an actual three-dimensional representation of each aircraft as it travels to and from PHL, and was utilized to develop representative flight tracks for modeling in INM. Five weeks of TAMIS data (approximately 35 days) was analyzed in detail for the initial 2007 analysis, and six weeks of additional data was analyzed in detail to incorporate the changes as a result of the partial implementation of the ARD at PHL. Actual radar flight tracks were grouped according to the operation type, aircraft category, runway, day/night classification, and departure or arrival fix, to create a "bundle." Each bundle of radar flight tracks was assigned to one or many INM flight tracks, depending on the size and spatial distribution of the bundle. Previously developed INM flight tracks (from the Runway 17/35 Final Environmental Impact Statement) were verified and used in the analysis, and new flight tracks were developed where appropriate. The noise model allows for the distribution of each flight track to multiple subtracks to account for the dispersion of operations due to wind, pilot procedures, or other factors.

The analysis includes the changes resulting from the implementation of the ARD on the location of departure flight tracks in use at PHL. On December 19th, 2007, the FAA partially implemented new departure headings from Runways 27L and 27R to the west and Runways 09L and 09R to the east. Prior to the partial implementation of the ARD, aircraft typically departed Runway 27L or Runway 27R and turned to a 255-degree heading before reaching approximately 3,000 feet above ground level (AGL), then proceeded to turn towards the navigation fix. This placed a majority of aircraft departures to the west over the Delaware River corridor. Two of the three planned west dispersed departure headings were implemented, which approximate a 268-degree heading and a 245-degree heading (see **Figure 3-1: Existing and Future West Flow Departure Headings)**. For departures to the east, revised departure headings in addition to the existing 085-degree heading were identified: 081-degree and 096-degree headings (see **Figure 3-2: Existing and Future East Flow Departure Headings)**.

The TAMIS data was categorized by aircraft user category and segregated by departure fix. During selected hours, the PHL ATCT utilizes the divergent headings to accommodate air traffic to assist in reducing delay and to accommodate future airspace changes. During the times the divergent headings are in use, the traditional 255-degree heading in west flow (Delaware River corridor) and 081-heading during east flow are not used.

Figures 3-3 and 3-4 depict the modeled arrival and departure flight tracks (including subtracks) for the 2008 Existing Baseline condition. **Table 3-4** depicts the 2008 flight track utilization, which corresponds to the flight track labels in **Figure 3A, Figure 3B, Figure 4A and Figure 4B** (in Section 5).

Page Revised 03-19-10

Table 3-4: 2008 Flight Track Utilization							
Runway	Flight Track Name	Day Percentage	Night Percentage	Runway	Flight Track Name	Day Percentage	Night Percentage
Arrivals				Departures			
09L	A09LAN1	0.02%	0.00%	08	D08PN1	0.15%	0.00%
	A09LASE2	0.01%	0.10%		D08PNE1	0.08%	0.74%
	A09LASE3	0.03%	0.23%		D08PNE2	0.03%	0.00%
	A09LASW1	0.01%	0.00%		D08PNW1	0.21%	0.22%
	A09LASW3	0.02%	0.33%		D08PNW2	0.21%	0.22%
	A09LAW1	0.02%	0.00%		D08PSE1	0.04%	0.00%
	A09LAW2	0.01%	0.00%		D08PSE2	0.04%	0.15%
	A09LPN1	0.00%	0.00%		D08PSW1	0.11%	0.74%
	A09LPSE1	0.00%	0.00%		D08PSW2	0.07%	0.00%
	A09LPSW1	0.01%	0.00%		D08PW1	0.10%	0.15%
	A09LPW1	0.00%	0.10%		D08RN1	0.06%	0.16%
	A09LPW2	0.00%	0.10%		D08RNE1	0.09%	0.00%
09R	A09RAN1	1.10%	0.75%		D08RNW1	0.46%	0.81%
	A09RAN2	1.10%	0.75%		D08RSE1	0.40%	0.32%
	A09RASE1	1.19%	1.10%		D08RSW1	0.14%	0.65%
	A09RASE2	1.67%	1.10%		D08RSW2	0.14%	0.00%
	A09RASE3	1.91%	1.47%		D08RW1	0.13%	0.00%
	A09RASW1	0.47%	1.79%		D08RW2	0.17%	0.49%
	A09RASW2	0.70%	1.79%		D08RW3	0.17%	0.49%
	A09RASW3	1.82%	0.90%		D08RW4	0.17%	0.00%
	A09RASW4	0.98%	0.90%	09L	D9L_AE1	0.71%	0.00%
	A09RAW1	1.08%	0.65%		D9L_AE2	0.11%	0.00%
	A09RAW2	0.75%	0.67%		D9L_AE3	0.03%	0.00%
	A09RAW3	0.32%	0.65%		D9L_AE4	0.41%	0.00%
	A09RAW4	0.72%	2.49%		D9L_ANW1	0.40%	0.00%
	A09RAW5	0.88%	2.04%		D9L_ANW2	0.30%	0.00%
	A09RPN1	0.18%	0.43%		D9L_ANW3	0.34%	0.00%
	A09RPSE1	0.05%	0.11%		D9L_ANW4	0.02%	0.00%
	A09RPSE2	0.05%	0.11%		D9L_AS1	0.23%	0.00%
	A09RPSW1	0.17%	0.65%		D9L_AS2	0.40%	0.00%
	A09RPW1	0.12%	0.00%		D9L_AS3	0.23%	0.00%
17	A17PN1	0.51%	0.30%		D9L_AS4	0.22%	0.00%
	A17PNW1	0.10%	0.00%		D9L_AS5	0.21%	0.00%
	A17PNW2	0.10%	0.15%		D9L_AW1	0.79%	0.00%
	A17PSE1	0.20%	0.08%		D9L_AW2	0.85%	0.00%
	A17PSW1	0.17%	0.23%		D9L_AW3	0.22%	0.00%
	A17PSW2	0.04%	0.00%		D9L_AW4	0.45%	0.00%
	A17RN1	0.39%	0.42%		D9L_AW5	0.03%	0.00%
	A17RN2	0.10%	0.00%		D9L_AW6	0.11%	0.00%
	A17RNW1	0.22%	0.00%		D9LAE1	1.47%	3.63%
	A17RNW2	0.22%	0.42%		D9LAE2	0.16%	0.00%
	A17RSE1	0.16%	0.00%		D9LAE3	0.03%	0.12%
	A17RSW1	0.12%	0.00%		D9LANW1	0.54%	1.30%

Table 3-4: 2008 Flight Track Utilization

Runway	Flight Track Name	Day Percentage	Night Percentage	Runway	Flight Track Name	Day Percentage	Night Percentage
Arrivals				Departures			
	A17RSW2	0.12%	0.00%		D9LANW2	0.56%	1.28%
26	A26PNE1	0.02%	0.90%		D9LANW3	0.54%	1.24%
	A26PNW1	0.47%	0.63%		D9LAS1	0.96%	1.15%
	A26PNW2	0.47%	0.63%		D9LAS2	0.52%	0.80%
	A26PNW3	0.47%	0.63%		D9LAS3	0.24%	1.15%
	A26PNW4	0.47%	0.63%		D9LAW1	0.69%	1.89%
	A26PS1	0.06%	0.12%		D9LAW2	1.36%	1.47%
	A26PS2	0.06%	0.12%		D9LAW3	0.63%	2.00%
	A26PS3	0.06%	0.12%		D9LAW4	0.25%	0.94%
	A26PS4	0.06%	0.12%		D9LAW5	0.05%	0.22%
	A26PSE1	0.05%	0.00%		D9LAW6	0.12%	0.46%
	A26PSE2	0.05%	0.22%		D9LPE1	0.03%	0.12%
	A26PSE3	0.05%	0.00%		D9LPE2	0.07%	0.12%
	A26PSE4	0.05%	0.22%		D9LPE3	0.04%	0.00%
	A26PSW1	0.02%	0.51%		D9LPN1	0.17%	0.00%
	A26PSW2	0.02%	0.51%		D9LPNW1	0.42%	0.35%
	A26PSW3	0.02%	0.53%		D9LPNW2	0.42%	0.35%
	A26PW1	0.17%	0.31%		D9LPSW1	0.07%	0.15%
	A26PW2	0.17%	0.31%		D9LPSW2	0.01%	0.00%
	A26PW3	0.17%	0.31%		D9LPW1	0.17%	0.15%
	A26PW4	0.17%	0.31%	09R	D9R_AE1	0.05%	0.00%
	A26PW5	0.17%	0.31%		D9R_AE2	0.01%	0.00%
	A26RNE1	0.01%	0.15%		D9R_AE4	0.02%	0.00%
	A26RNE2	0.01%	0.15%		D9R_ANW1	0.04%	0.00%
	A26RNE3	0.01%	0.15%		D9R_ANW2	0.03%	0.00%
	A26RNW1	0.45%	0.65%		D9R_ANW3	0.05%	0.00%
	A26RNW2	0.45%	0.65%		D9R_ANW4	0.00%	0.00%
	A26RNW3	0.45%	0.65%		D9R_AS1	0.01%	0.00%
	A26RNW4	0.45%	0.65%		D9R_AS2	0.00%	0.00%
	A26RNW5	0.23%	0.32%		D9R_AS3	0.01%	0.00%
	A26RNW6	0.23%	0.32%		D9R_AS4	0.01%	0.00%
	A26RSE1	0.07%	0.00%		D9R_AS5	0.01%	0.00%
	A26RSE2	0.13%	0.18%		D9R_AW1	0.05%	0.00%
	A26RSE3	0.13%	0.18%		D9R_AW2	0.05%	0.00%
	A26RSE4	0.13%	0.18%		D9R_AW3	0.01%	0.00%
	A26RSE5	0.20%	0.18%		D9R_AW4	0.02%	0.00%
	A26RSW1	0.11%	0.41%		D9R_AW6	0.01%	0.00%
	A26RSW2	0.11%	0.00%		D9RAE4	0.02%	0.04%
	A26RSW3	0.11%	0.41%		D9RAE5	0.02%	0.04%
	A26RSW4	0.11%	0.41%		D9RAE6	0.01%	0.04%
	A26RSW5	0.11%	0.41%		D9RANW1	0.07%	0.13%
	A26RW1	0.53%	0.43%		D9RASE1	0.02%	0.13%
	A26RW2	0.53%	0.43%		D9RAW1	0.07%	0.33%
	A26RW3	0.53%	0.43%		D9RAW2	0.05%	0.33%

Table 3-4: 2008 Flight Track Utilization							
Runway	Flight Track Name	Day Percentage	Night Percentage	Runway	Flight Track Name	Day Percentage	Night Percentage
Arrivals				Departures			
	A26RW4	0.53%	0.43%		D9RPE1	0.00%	0.00%
	A26RW5	0.53%	0.43%		D9RPE2	0.00%	0.10%
	A26RW6	0.53%	0.43%		D9RPNW1	0.13%	0.00%
	A26RW7	0.35%	0.29%		D9RPNW2	0.03%	0.00%
	A7LAN1	0.04%	0.19%		D9RPSW2	0.00%	0.10%
	A7LAN2	0.04%	0.18%		D9RPW1	0.01%	0.00%
	A7LAN3	0.04%	0.18%		D17PE1	0.01%	0.00%
	A7LASE1	0.04%	0.58%		D17PE2	0.01%	0.00%
	A7LASE2	0.08%	0.11%		D17PNE1	0.01%	0.26%
	A7LASE3	0.04%	0.42%		D17PNW1	0.01%	0.00%
	A7LASE4	0.04%	0.42%	17	D17PNW2	0.01%	0.00%
	A7LASE5	0.06%	0.09%		D17PSW1	0.01%	0.00%
	A7LASE6	0.01%	0.00%		D17PSW2	0.01%	0.00%
	A7LASE7	0.02%	0.01%		D17RS1	0.03%	0.07%
27L	A7LASW1	0.11%	0.70%		D17RS2	0.01%	0.02%
	A7LASW2	0.09%	0.70%		D17RSW1	0.01%	0.10%
	A7LASW3	0.05%	0.14%		D27LAE1	0.44%	5.64%
	A7LASW4	0.07%	0.14%		D27LAE2	6.23%	5.64%
	A7LAW1	0.10%	0.10%		D27LAN1	0.11%	0.00%
	A7LAW2	0.08%	0.82%		D27LAN2	0.03%	0.00%
	A7LAW3	0.04%	0.82%		D27LANE1	0.33%	2.54%
	A7LAW4	0.05%	0.53%		D27LANE2	0.00%	0.09%
	A7LPN1	0.01%	0.02%		D27LANW1	1.96%	1.79%
	A7LPS1	0.01%	0.01%		D27LANW2	1.13%	6.78%
	A7LPS2	0.01%	0.01%		D27LANW3	2.29%	6.65%
	A7RAN1	0.75%	0.21%		D27LANW4	1.13%	1.66%
	A7RAN2	1.77%	1.40%		D27LAS1	6.16%	7.31%
	A7RAN3	1.67%	1.19%		D27LAW1	0.49%	3.66%
	A7RAN4	1.38%	0.65%		D27LAW2	4.64%	4.33%
	A7RAN5	0.25%	0.00%	27L	D27LAW3	2.86%	2.36%
	A7RASE1	2.27%	4.01%		D27LAW4	3.26%	2.26%
	A7RASE2	1.08%	0.18%		D27LAW5	0.59%	2.20%
	A7RASE3	3.35%	2.89%		D27LAW6	0.71%	1.43%
	A7RASE4	0.94%	0.10%		D27LAW7	0.09%	1.28%
27R	A7RASE5	3.21%	1.67%		D27LAW8	0.20%	3.60%
	A7RASE6	0.94%	0.10%		D27LPE1	0.65%	0.04%
	A7RASE7	2.75%	0.63%		D27LPE2	0.40%	0.42%
	A7RASE8	2.75%	2.89%		D27LPN1	0.10%	0.29%
	A7RASW1	1.33%	0.00%		D27LPNE1	0.00%	0.25%
	A7RASW2	2.54%	3.88%		D27LPNW1	0.38%	0.36%
	A7RASW3	1.33%	1.31%		D27LPNW2	0.57%	0.36%
	A7RASW4	3.53%	3.88%		D27LPS1	0.69%	0.32%
	A7RASW5	3.09%	4.53%		D27LPS2	0.69%	0.33%
	A7RASW6	3.64%	4.53%		D27LPS3	0.46%	0.32%

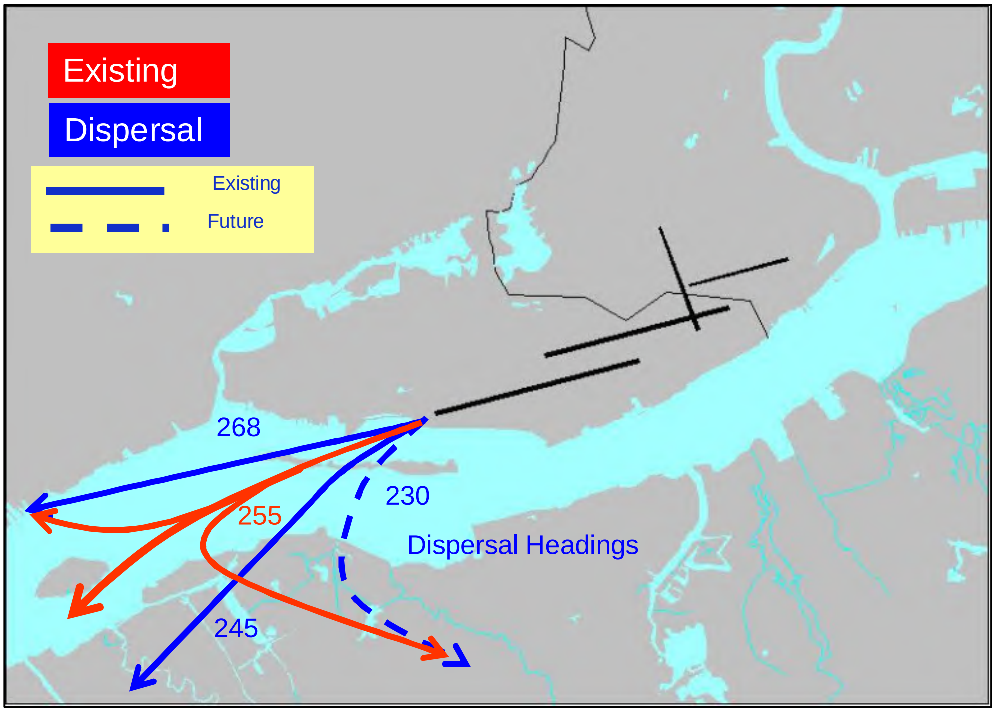
Table 3-4: 2008 Flight Track Utilization							
Runway	Flight Track Name	Day Percentage	Night Percentage	Runway	Flight Track Name	Day Percentage	Night Percentage
Arrivals				Departures			
	A7RAW1	4.54%	8.71%		D27LPSW1	0.40%	0.34%
	A7RAW2	4.54%	5.43%		D27LPW1	0.15%	0.34%
	A7RAW3	2.04%	0.00%		D27LPW2	0.22%	0.34%
	A7RAW4	2.58%	0.00%		D7L_AE1	1.96%	0.00%
	A7RPN1	0.01%	0.02%		D7L_AE2	3.64%	0.00%
	A7RPN2	0.01%	0.02%		D7L_AN1	0.07%	0.00%
	A7RPSE1	0.01%	0.03%		D7L_AN2	0.04%	0.00%
	A7RPSE2	0.01%	0.03%		D7L_ANE1	0.13%	0.00%
	A7RPSE3	0.01%	0.03%		D7L_ANW1	1.84%	0.00%
	A7RPSW1	0.05%	0.16%		D7L_ANW2	1.06%	0.00%
	A7RPW1	0.01%	0.03%		D7L_ANW3	3.05%	0.00%
	A35PN1	1.95%	0.15%		D7L_ANW4	1.28%	0.00%
	A35PN2	0.65%	0.44%		D7L_AS1	5.29%	0.00%
	A35PNW1	0.56%	0.35%		D7L_AW1	0.64%	0.00%
	A35PNW2	0.37%	0.00%		D7L_AW2	4.36%	0.00%
	A35PSE1	1.37%	0.47%		D7L_AW3	3.04%	0.00%
	A35PSW1	1.18%	0.96%		D7L_AW4	3.24%	0.00%
	A35PSW2	0.29%	0.32%		D7L_AW5	0.61%	0.00%
35	A35RNE1	0.73%	0.34%		D7L_AW6	0.53%	0.00%
	A35RNE2	0.73%	0.34%		D7L_AW7	0.06%	0.00%
	A35RNW1	0.50%	0.00%		D7L_AW8	0.22%	0.00%
	A35RNW2	2.67%	0.17%		D27RAE1	0.90%	0.91%
	A35RNW3	0.17%	0.00%		D27RAN1	0.88%	1.26%
	A35RSE1	2.42%	1.86%		D27RANE1	0.03%	0.18%
	A35RSE2	0.81%	0.00%		D27RAS1	0.55%	0.19%
	A35RSW1	2.05%	1.35%		D27RAS2	0.31%	1.07%
	A35RSW2	2.05%	1.35%		D27RAW1	1.02%	1.13%
					D27RAW2	1.06%	2.45%
					D27RAW3	0.05%	0.13%
					D27RPE2	0.06%	0.22%
					D27RPN1	0.03%	0.16%
					D27RPNE1	0.00%	0.50%
				27R	D27RPNW1	0.31%	0.25%
					D27RPS1	0.10%	0.02%
					D27RPS2	0.23%	0.02%
					D27RPSW1	0.05%	0.18%
					D27RPSW2	0.00%	0.22%
					D27RPW1	0.03%	0.33%
					D27RPW2	0.09%	0.33%
					D7R_AE1	0.40%	0.00%
					D7R_AE2	0.55%	0.00%
					D7R_AN1	0.21%	0.00%
					D7R_ANE1	0.01%	0.00%
					D7R_AS1	0.56%	0.00%

Table 3-4: 2008 Flight Track Utilization

Runway	Flight Track Name	Day Percentage	Night Percentage	Runway	Flight Track Name	Day Percentage	Night Percentage
Arrivals				Departures			
					D7R_AS2	0.35%	0.00%
					D7R_AW1	0.20%	0.00%
					D7R_AW2	0.22%	0.00%
					D7R_AW3	0.06%	0.00%
				35	D35PE1	0.02%	0.00%
					D35PN1	1.12%	0.07%
					D35PNE1	0.30%	0.00%
					D35PNE2	0.10%	0.54%
					D35PNW1	0.52%	0.00%
					D35PNW2	0.65%	0.54%
					D35PNW3	0.13%	0.00%
					D35PS1	0.07%	0.00%
					D35PW1	0.21%	0.00%
					D35PW2	0.21%	0.00%
					D35PW3	0.10%	0.41%
					D35RN1	0.18%	0.16%
					D35RNE1	0.18%	0.00%
					D35RNE2	0.04%	0.00%
					D35RNW1	0.03%	0.03%
					D35RNW2	0.03%	0.00%
					D35RW1	0.03%	0.00%
					D35RW2	0.03%	0.05%

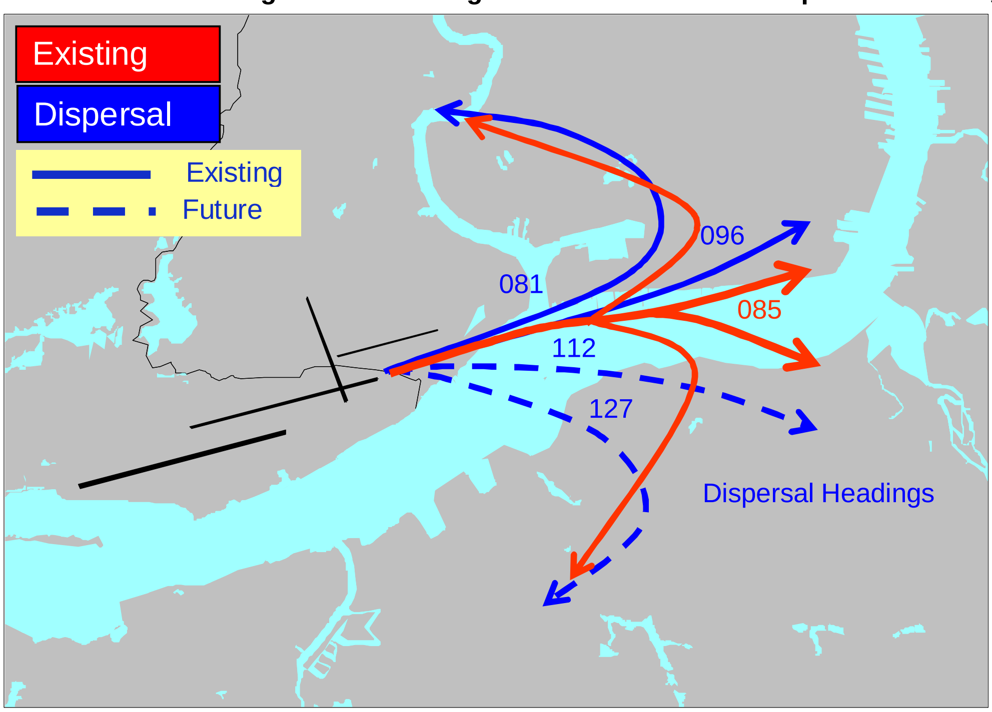
Note:Operations are rounded. Omitted entries may include operations less than 0.01.
Source:Wyle, 2009

Figure 3-1. Existing and Future West Flow Departure Headings



Source: http://www.faa.gov/airports_airtraffic/air_traffic/nas_redesign/regional_guidance/eastern_reg/nynjphl_redesign/

Figure 3-2. Existing and Future East Flow Departure Headings



Source: http://www.faa.gov/airports_airtraffic/air_traffic/nas_redesign/regional_guidance/eastern_reg/nynjphl_redesign/

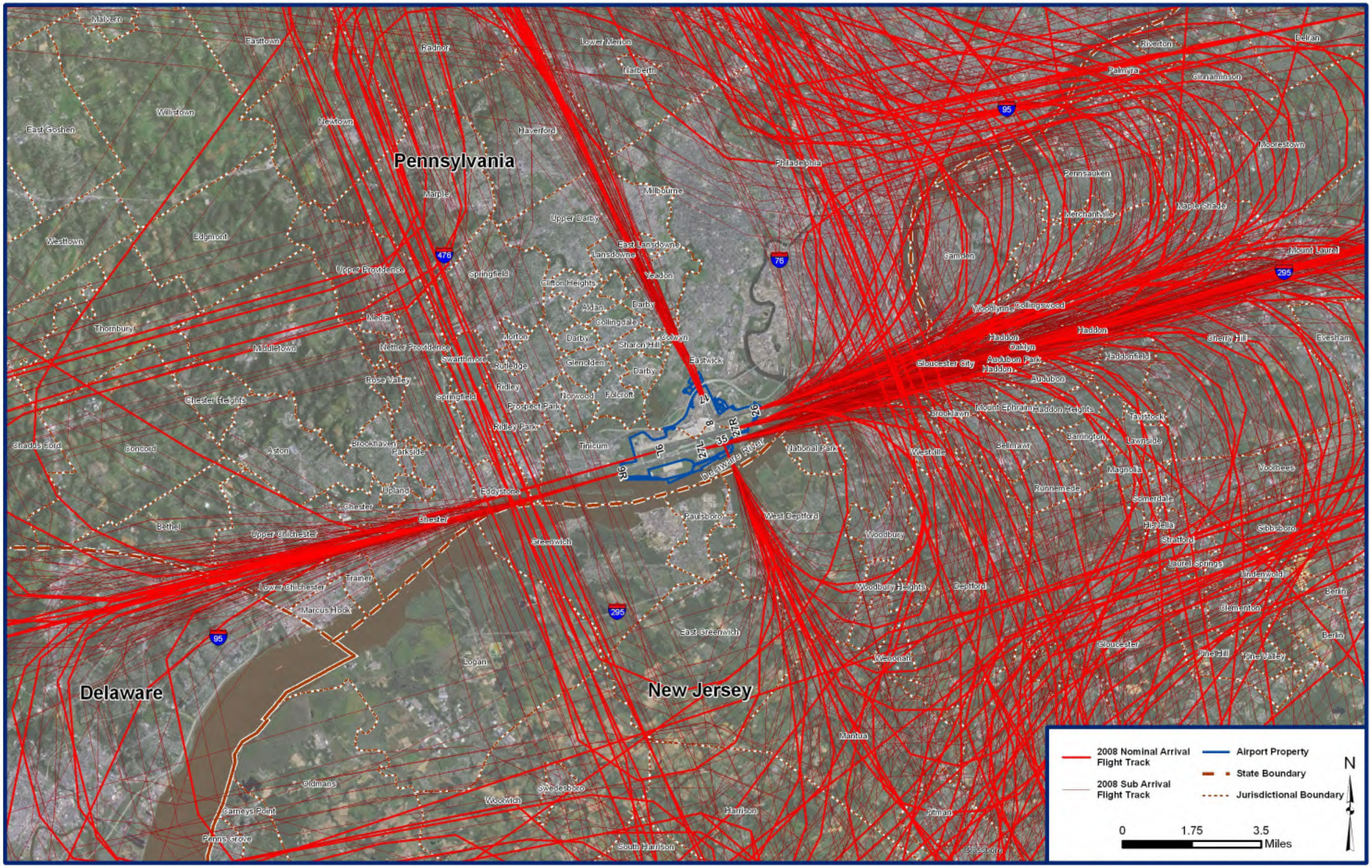


Figure 3-3: 2008 Existing Baseline Arrival Flight Tracks

PHL Philadelphia International Airport

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10-08-09

Figure3-3_2008ExistingBaselineArrivals.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

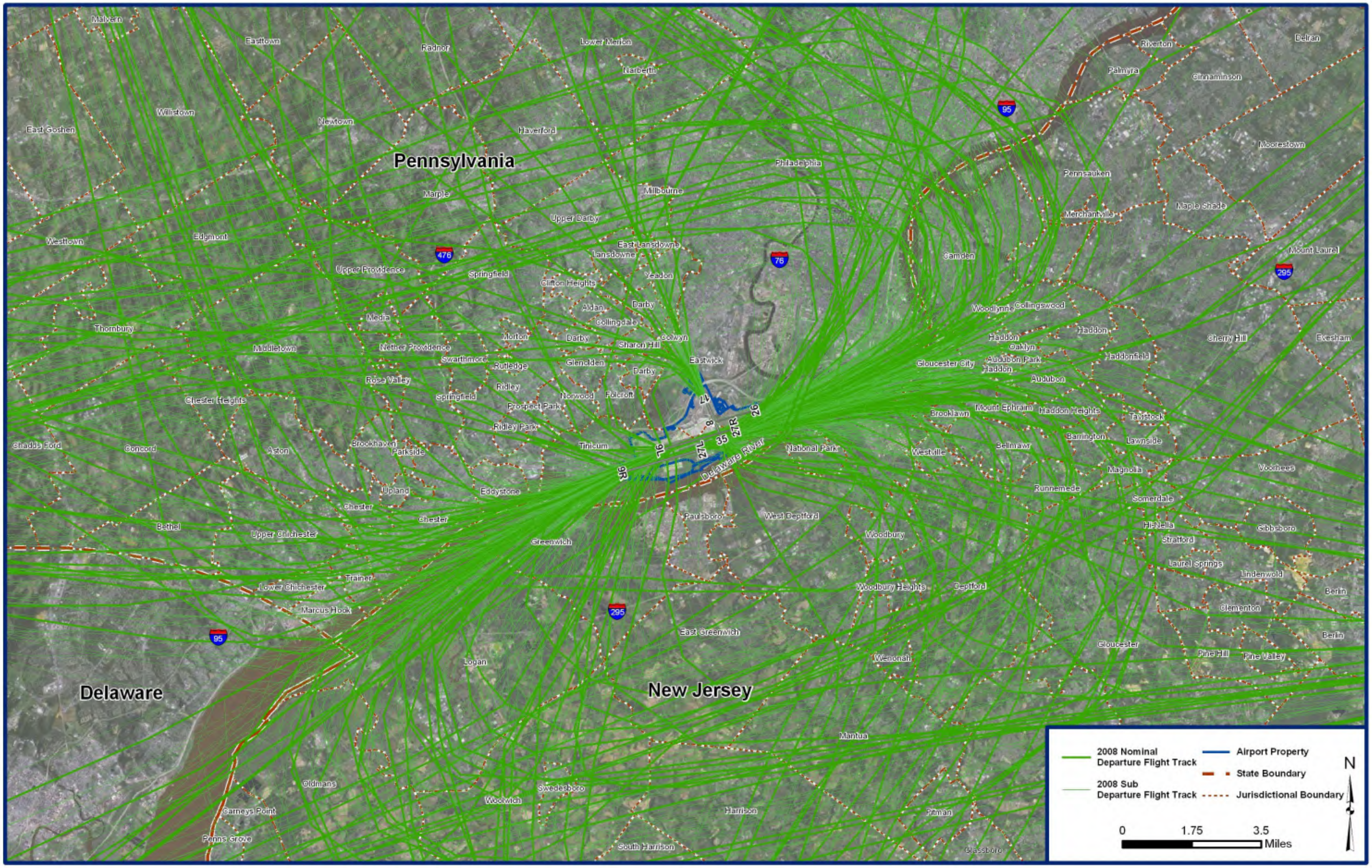

Figure 3-4: 2008 Existing Baseline Departure Flight Tracks

Noise Compatibility Program Update

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10-08-09

Figure3-4_2008ExistingBaselineDepartures.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

3.5. 2008 Stage Length Assignment

Where a flight track indicates the horizontal location of an aircraft in relation to the airport and surrounding land uses, a flight profile indicates its vertical location and power settings. Profiles vary by aircraft type, operational procedures, and weight. INM includes a set of standard profiles which have been developed by the FAA to ensure representative three-dimensional flight trajectories that correlate with average speeds and thrust settings for each aircraft. These profile settings, unless specific procedures are in use at an airport, are generally used in noise modeling without modification. The standard INM profiles were used to model the 2008 condition at PHL.

The heavier the aircraft, in general terms, the slower it will be able to climb. The weight of an aircraft is dependent on the amount of fuel, cargo, or passengers on board. The INM includes variations to standard profiles to account for aircraft which may climb at a slower rate by using the distance of the aircraft's trip. In other words, the longer the trip distance, the heavier the average takeoff weight is likely to be for the same aircraft type due to increased fuel requirements. Based on the distance of the trip, a stage length is assigned to the operation. For this analysis, published schedule data was utilized in order to determine the distances each specific aircraft type traveled from PHL to the destination airport. **Table 3-5: 2008 Existing Baseline Stage Length Assignment** depicts the stage length assignments for aircraft departures for the 2008 Existing Baseline condition.

Table 3-5: 2008 Existing Baseline Stage Length Assignment

Category	Stage Length (Nautical Miles)							Total
	1 (0-500)	2 (500-1,000)	3 (1,000-1,500)	4 (1,500-2,500)	5 (2,500-3,500)	6 (3,500-4,500)	7 (4,500+)	
Widebody	23%	24%	3%	11%	7%	32%	1%	100%
Narrowbody	37%	35%	11%	15%	3%	-	-	100%
Regional Jet	98%	1%	0%	-	-	-	-	100%
Propeller	100%	-	-	-	-	-	-	100%

Source: TAMIS, Wyle 2009

3.6. 2008 Engine Maintenance Operations

Aircraft noise and its effect on the surrounding environment is not limited to flight operations. At many large airports, such as PHL, aircraft perform extended engine maintenance testing on the airfield, sometimes during nighttime hours. This maintenance activity, or 'run-up', varies in duration and in the aircraft power settings, and can often be a source of noise exposure in the community due to their duration. The INM allows for the modeling of engine run-up activity at an airport. The PHL ATCT records engine run ups performed by aircraft operators, including the location, duration, aircraft type, and orientation into the wind, and this data was collected and input into the INM. Generally, aircraft run-ups at PHL occur at two locations on the airfield, depicted in **Figure 3-5**.

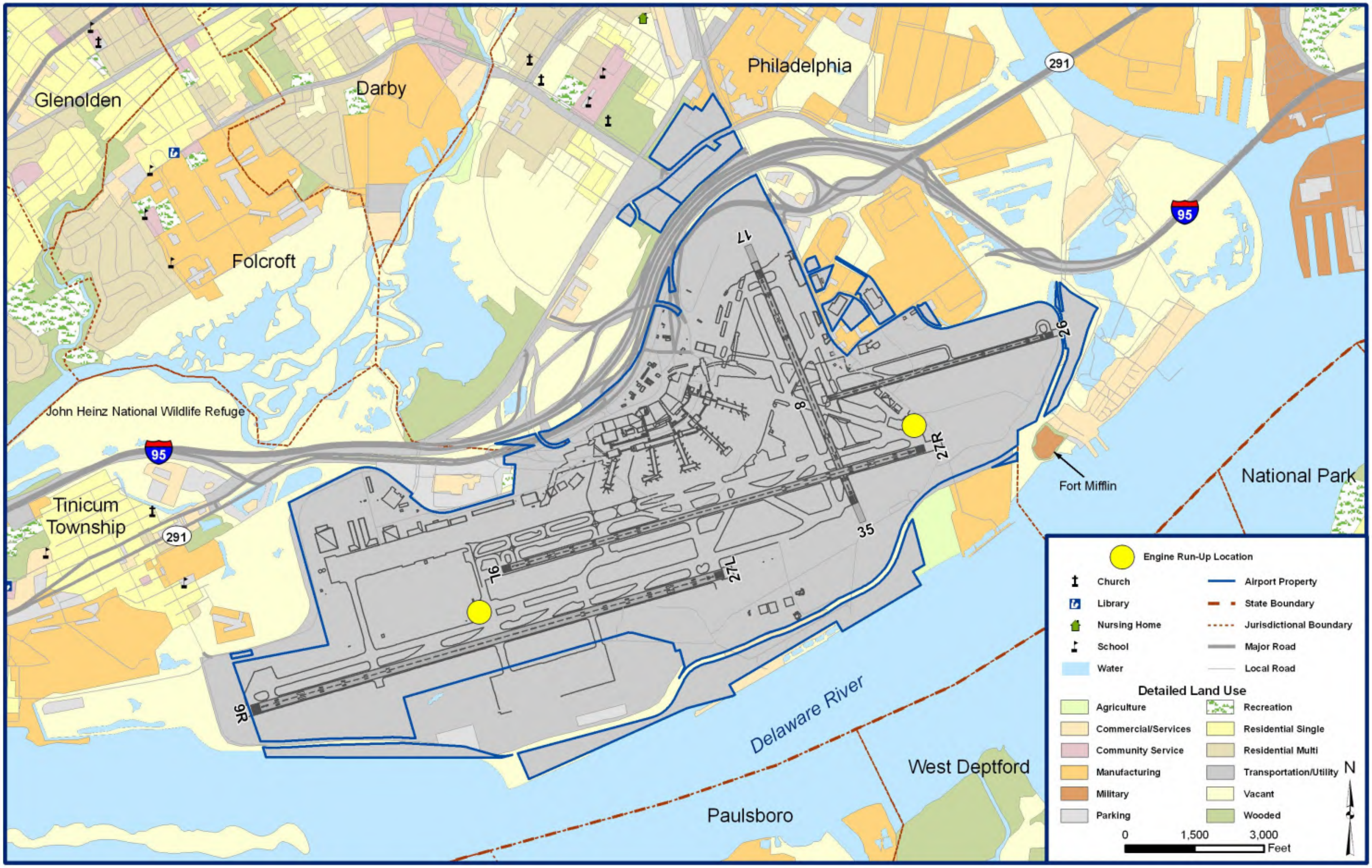

Figure 3-5: Engine Run-Up Locations

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Figure3-5_EngineRunUps.mxd

10-08-09

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

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3.7. 2008 Existing Baseline Noise Exposure

Noise exposure for the 2008 Existing Baseline Condition was calculated from the input data identified in the preceding sections using the INM. The resulting noise exposure contour is shown in **Figure 3-6: 2008 Existing Baseline Noise Exposure Contour Map** and on **Figure 1** in **Section 5**. The size of the noise contour is approximately 6.9 square miles, most of which occurs to the west along the extended departure corridor over the Delaware River, and to the east along the extended approach route to Runway 27R. Overall, a majority of the DNL 65 dB noise contour is either over airport property or over the Delaware River (99%), while less than one percent of the underlying land uses are considered incompatible.

The shape of the contour reflects primarily the predominant west flow operations at PHL and the use of Runways 9L/27R and 9R/27L. As shown on **Figure 3-6**, to the west, the DNL 65 dB noise contour extends over the Delaware River, driven by aircraft departures from Runways 27L and 27R. To the east, the contour also extends over the Delaware River reflecting mainly the majority of aircraft arrivals to Runway 27R. North of the Airport, the contour remains on airport property due to the use of Runway 17/35 by regional jet and propeller aircraft which are comparatively quieter than larger narrow and widebody aircraft. Aircraft departures from Runway 17 and arrivals to Runway 35 contribute to the noise contour extending past the airport property line to the south of the Airport, however, the contour remains over the Delaware River.

Estimated population and housing units information was calculated based on data from the 2000 US Census, and is shown in **Table 3-6: 2008 Existing Baseline Noise Contour Estimated Impacts**. The population exposure was computed by proportion, which means that the population in each block was proportionally included in the count based on the percentage of each block's area that fell within the noise contour. This approach assumes that the population within each block is evenly distributed over the entire census block area, which is not necessarily indicative of the actual population distribution of the census block. According to this methodology, the DNL 65 dB noise exposure contour includes an estimated population of approximately 240 people and 132 housing units, with one housing unit and an estimated population of three people residing within the DNL 70+ dB noise contour, representing the caretaker residence at Fort Mifflin. The calculation method utilized for estimated population utilizes a percentage of each census block identified with DNL levels of 65 dB or greater. While this method is effective for large-scale analysis around airports, further field verification is often required in specific areas. According to field verification, the noise exposure contour in Tinicum Township does include residential land uses in Essington and Lester, although it is notably less than indicated by the Census analysis; approximately 30 homes are located within the DNL 65 dB noise exposure contour in Tinicum Township. **Figure 3-7** depicts the location of the 2008 Existing Baseline noise contours over Tinicum Township while **Figures 3-8 and 3-9** depict noise exposure beyond the DNL 65 dB noise contour. Noise exposure beyond the DNL 65 dB is presented for the purposes of supplementing the impact information disclosed by the DNL metric. It is not intended to replace the DNL metric in determining "levels of significance" as defined by NEPA and FAR Part 150. More detailed information on utilization of supplemental noise metrics for this study is presented in **Appendix I.**

Table 3-6: 2008 Existing Baseline Noise Contour Estimated Impacts				
2008 Existing Baseline Noise Exposure Estimated Impacts				
	65-70 DNL	70-75 DNL	75+ DNL	65+ DNL
Estimated Population and Housing Units*				
Estimated Population	237	3	0	**240**
Housing Units	131	1	0	**132**
Area (Square Miles)				
2008 Existing Baseline	4.1	1.6	1.2	**6.9**
Land Use Impacts (Square Miles)				
Agriculture	0.03	0.00	0.00	**0.03**
Airport Property	0.71	0.73	1.11	**2.55**
Commercial Services	0.05	0.06	0.00	**0.11**
Community Service	0.00	0.00	0.00	**0.00**
Manufacturing	0.16	0.00	0.00	**0.16**
Military	0.12	0.01	0.00	**0.13**
Parking	0.05	0.00	0.00	**0.05**
Recreation	0.00	0.00	0.00	**0.00**
Residential (Multi-Family)	0.00	0.00	0.00	**0.00**
Residential (Single-Family)	0.01	0.00	0.00	**0.01**
Transportation	0.15	0.19	0.03	**0.37**
Vacant	0.45	0.11	0.01	**0.58**
Water	2.39	0.51	0.00	**2.90**
Wooded	0.00	0.00	0.00	**0.00**
Total	**4.1**	**1.6**	**1.2**	**6.9**

Note: Values less than 0.01 were omitted in the calculation of land use impacts.
* Estimates based on 2000 US Census block data
Source: Wyle 2009

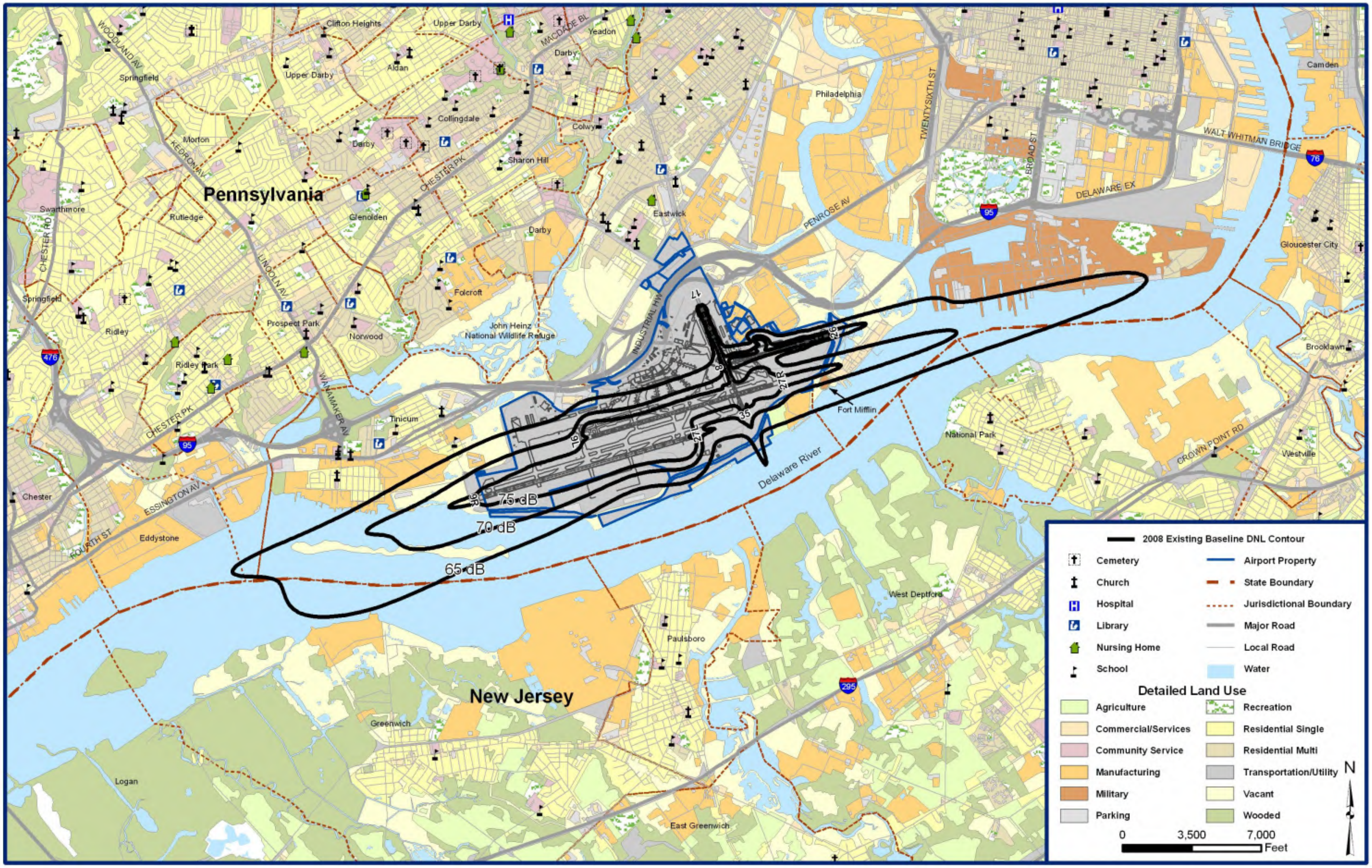

Figure 3-6: 2008 Existing Baseline DNL Noise Exposure Contour

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Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

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Figure3-6_2008ExistingBaseline.mxd

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Ridley
Wanamaker Ave
95
Industrial Hwy
Chippewa St
Mohican St
4th Ave
3rd Ave
2nd Ave
St John Tinicum
Lutheran Church
291
Tinicum School
Seneca St
Powhattan St
All State Career
Truck School
Seminole St
Iroquois St
St. Margaret Mary
RC School
St Margaret Mary
RC Church
Manor Field
Recreation
Area
Saude Ave
Jansen Ave
Tinicum Memorial
Public Library
New Life Community
Bible Church
Lester
St. John
Evangelist Church
Essington
9L

4. 2013 Noise Exposure

FAR Part 150 guidelines require the evaluation of a five-year future forecast condition in the analysis of noise exposure at an airport. This section documents the expected future operating conditions and noise exposure patterns at PHL for the five-year future baseline condition (2013). This five-year forecast condition takes into account anticipated changes to factors which may influence the patterns of noise exposure around an airport, such as expected increases in the levels of operations or the opening of capacity-enhancing projects, such as a runway extension.

4.1. 2013 Airport Facilities

The 2013 Future Baseline condition includes the incorporation of all anticipated changes to the airfield at PHL which are expected to be operational by 2013. Runway 17/35 has been extended to a total length of 6,501 feet, by adding 640 feet to the north and 400 feet to the south and is included in this evaluation. Though the Capacity Enhancement Program (CEP) is planned to provide additional capacity at PHL, there are no CEP construction activities that would affect runways or taxiways or alter aircraft operations before or during 2013. Therefore, beyond the extension of Runway 17/35, no further changes to runways, elevation, or other facilities were modeled.

4.2. 2013 Airport Operating Conditions

The PHL Master Plan was updated in November 2007 and included the identification of the forecasted fleet mix and operating levels at the Airport. The number of operations and anticipated fleet mix prepared for the Master Plan were incorporated into the input data for the 2013 Future Baseline condition. The Master Plan forecasts were prepared through the following methodology:

- Analysis of historical growth trends, in particular historical growth in relation to key factors such as economic activity and airline service developments. Statistical analysis was conducted to examine the historical growth trends and provide input to assumptions regarding future growth trends.
- Assumptions regarding future annual growth rates using professional judgment based on analyses of historical trends and reference to independent forecasts such as the Federal Aviation Administration (FAA) forecasts for the nation as a whole.
- Assumptions regarding the likely future trend in key ratios, such as average aircraft size and boarding load factors, based on analyses of recent actual activity, information on airline fleet developments, and reference to independent forecasts such as the FAA forecasts for the nation as a whole.

Where specific INM types were not identified in the master planning process, INM aircraft types corresponding to the identified aircraft family utilized in the 2008 Existing Baseline condition were supplemented. Operations in 2013 are expected to reach 1,628 on an average annual day, an increase of approximately 19% from 2008 levels.

The Master Plan also identified the distribution of operations between daytime and nighttime hours. In the 2013 Future Baseline condition, approximately 89 percent of average annual day operations occur during daytime (7:00 a.m. to 10:00 p.m.) hours. Nighttime operations account for a smaller percentage of overall operations in 2013 as compared to 2008. 2013 annual average day operations, including the fleet mix, number of operations, and temporal distribution are presented in **Table 4-1: 2013 Future Baseline Annual Average Day Operations.**

Page Revised 03-19-10

Table 4-1: 2013 Future Baseline Annual Average Day Operations							
INM Type	Description	Arrivals		Departures		Total AAD	
		Day	Night	Day	Night	Day	Night
Widebody Aircraft							
74710Q	Boeing 747-100 Series	1.4	0.2	1.3	0.2	2.7	0.4
74720A	Boeing 747-200 Series	0.0	0.0	0.0	0.0	0.1	0.0
74720B	Boeing 747-200 Series	2.1	0.3	2.1	0.3	4.2	0.6
747400	Boeing 747-400 Series	0.0	0.0	0.0	0.0	0.1	0.0
767300	Boeing 767-300	1.2	0.2	1.2	0.2	2.4	0.3
767CF6	Boeing 767-200 Series	18.4	2.3	18.1	2.6	36.6	5.0
777200	Boeing 777-200 Series	1.8	0.2	1.8	0.3	3.5	0.5
A300-622R	Airbus A300-622R	4.7	0.6	4.7	0.7	9.4	1.3
A300B4-203	Airbus A300B4-200/CF6-50C2	2.4	0.3	2.4	0.3	4.8	0.6
A330-301	Airbus A330-301	0.4	0.0	0.4	0.1	0.8	0.1
A330-343	Airbus A330-343	7.5	1.0	7.4	1.1	14.9	2.0
A340-211	Airbus A340-211	1.9	0.2	1.9	0.3	3.8	0.5
DC1010	DC10-10	0.2	0.0	0.2	0.0	0.4	0.1
DC1030	DC10-30	0.1	0.0	0.1	0.0	0.1	0.0
MD11GE	MD-11	0.1	0.0	0.1	0.0	0.1	0.0
MD11PW	MD-11	0.1	0.0	0.1	0.0	0.2	0.0
Total		42.4	5.4	41.8	6.0	84.2	11.4
Narrowbody Aircraft							
717200	Boeing 717-200	12.5	1.6	12.3	1.8	24.8	3.4
737300	Boeing 737-300 Series	48.2	6.1	47.5	6.9	95.7	13.0
737400	Boeing 737-400 Series	37.7	4.8	37.2	5.4	74.9	10.1
737500	Boeing 737-500 Series	3.3	0.4	3.3	0.5	6.6	0.9
737700	Boeing 737-700 Series	30.7	3.9	30.2	4.4	61.0	8.3
737800	Boeing 737-800 Series	36.3	4.6	35.7	5.2	72.0	9.7
757300	Boeing 757-300	0.1	0.0	0.1	0.0	0.2	0.0
757PW	Boeing 757-200	4.1	0.5	4.0	0.6	8.1	1.1
757RR	Boeing 757-200	6.5	0.8	6.4	0.9	13.0	1.8
A319-131	Airbus A319-131	64.8	8.2	63.8	9.2	128.6	17.4
A320-211	Airbus A320-211	33.9	4.3	33.4	4.8	67.2	9.1
A320-232	Airbus A320-232	6.7	0.8	6.6	0.9	13.2	1.8
A321-232	Airbus A321-232	30.4	3.8	29.9	4.3	60.3	8.2
DC870	DC8-70	2.2	0.3	2.2	0.3	4.4	0.6
F10065	F100	6.3	0.8	6.2	0.9	12.4	1.7
MD81	MD-81	0.2	0.0	0.2	0.0	0.3	0.0
MD82	MD-82	19.9	2.5	19.6	2.8	39.4	5.3
MD83	MD-83	8.5	1.1	8.4	1.2	16.9	2.3
Total		352.3	44.6	346.9	50.0	699.2	94.7

Table 4-1: 2013 Future Baseline Annual Average Day Operations							
INM Type	Description	Arrivals		Departures		Total AAD	
		Day	Night	Day	Night	Day	Night
Regional Jet Aircraft							
CIT3	Cessna Citation	0.5	0.1	0.5	0.1	1.0	0.1
CL600	Challenger	2.3	0.3	2.3	0.3	4.6	0.6
CL601	Canadair Regional Jet	103.1	13.1	101.5	14.6	204.5	27.7
CNA500	CIT 2	0.4	0.1	0.4	0.1	0.9	0.1
CNA750	Citation X	0.9	0.1	0.9	0.1	1.8	0.2
EMB145	Embraer 145 ER	119.4	15.1	117.6	17.0	236.9	32.1
EMB14L	Embraer 145 LR	16.4	2.1	16.1	2.3	32.5	4.4
FAL20	Falcon 20	1.6	0.2	1.5	0.2	3.1	0.4
GII	Gulfstream GII	0.3	0.0	0.3	0.0	0.6	0.1
GIV	Gulfstream GIV	1.4	0.2	1.4	0.2	2.9	0.4
GV	Gulfstream GV	38.2	4.8	37.7	5.4	75.9	10.3
HS748A	HS748	0.0	0.0	0.0	0.0	0.0	0.0
IA1125	ASTRA 1125	0.6	0.1	0.6	0.1	1.2	0.2
LEAR25	LEAR 25	0.2	0.0	0.2	0.0	0.4	0.1
LEAR35	LEAR 36	6.5	0.8	6.4	0.9	12.9	1.7
MU3001	MU300-10	4.7	0.6	4.6	0.7	9.3	1.3
Total		296.5	37.6	291.9	42.1	588.4	79.7
Propeller Aircraft							
BEC58P	BARON 58P	1.8	0.2	1.8	0.3	3.6	0.5
CNA172	Cessna 172	0.1	0.0	0.1	0.0	0.2	0.0
CNA206	Cessna 206	0.1	0.0	0.1	0.0	0.3	0.0
CNA441	Conquest II	0.3	0.0	0.3	0.0	0.5	0.1
CVR580	Convair 580	0.0	0.0	0.0	0.0	0.0	0.0
DHC6	Dash 6	1.7	0.2	1.7	0.2	3.4	0.5
DHC8	DASH 8-100	19.6	2.5	19.3	2.8	38.8	5.3
DHC830	DASH 8-300	4.4	0.6	4.3	0.6	8.7	1.2
GASEPF	Single Engine GA Fixed Prop	0.9	0.1	0.9	0.1	1.8	0.2
GASEPV	Single Engine GA Variable Prop	0.6	0.1	0.6	0.1	1.2	0.2
PA30	Piper Twin Comanche	0.0	0.0	0.0	0.0	0.0	0.0
PA31	Piper Navajo/Chiefton	1.8	0.2	1.7	0.3	3.5	0.5
SD330	Shorts 330	0.0	0.0	0.0	0.0	0.0	0.0
Total		31.3	4.0	30.8	4.4	62.0	8.4
Grand Total		*722.4*	*91.6*	*711.4*	*102.6*	*1433.8*	*194.2*

Note: Operations are rounded. Omitted entries may include operations less than 0.1.
Source: PHL Master Plan November 2007, Wyle 2009,

4.3. 2013 Runway Utilization

Runway utilization for the 2013 Future Baseline condition was determined through coordination with the PHL Capacity Enhancement Program (CEP) and the NY/NJ/PHL Airspace Redesign Project. The distribution of operations between east and west flow for the 2013 Future Baseline condition is approximately 70 percent west flow operations and 30 percent east flow operations, which represents a projected return to historical average weather conditions. **Table 4-2: Future Baseline Runway Utilization** depicts runway utilization for the 2013 Future Baseline noise contour.

Table 4-2: 2013 Future Baseline Runway Utilization (by percent of total operations)									
Daytime (7:00 A.M. - 10:00 P.M.) Arrivals									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Widebody	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%	0.2%	1.5%	2.6%
Narrowbody	0.0%	0.0%	0.1%	6.4%	0.6%	1.3%	1.6%	11.7%	21.6%
Propeller	0.0%	0.5%	0.0%	0.3%	0.0%	1.2%	0.0%	0.0%	1.9%
Regional Jet	0.0%	1.0%	0.1%	4.6%	0.8%	10.4%	0.2%	1.2%	18.2%
Total	**0.0%**	**1.5%**	**0.2%**	**12.1%**	**1.4%**	**12.8%**	**2.0%**	**14.4%**	**44.4%**
Nighttime (10:00 P.M. - 7:00 A.M.) Arrivals									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Widebody	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.2%	0.3%
Narrowbody	0.0%	0.0%	0.0%	1.0%	0.1%	0.2%	0.4%	1.1%	2.7%
Propeller	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%
Regional Jet	0.0%	0.3%	0.0%	0.9%	0.1%	0.9%	0.0%	0.1%	2.3%
Total	**0.0%**	**0.4%**	**0.1%**	**2.0%**	**0.1%**	**1.2%**	**0.4%**	**1.4%**	**5.6%**
Daytime (7:00 A.M. - 10:00 P.M.) Departures									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Widebody	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	1.6%	0.1%	2.6%
Narrowbody	0.0%	0.0%	6.6%	0.3%	<0.1%	1.4%	12.0%	1.0%	21.3%
Propeller	0.3%	0.0%	0.3%	0.0%	<0.1%	1.1%	0.2%	0.0%	1.9%
Regional Jet	0.6%	0.0%	4.1%	0.2%	<0.1%	10.0%	2.8%	0.2%	17.9%
Total	**0.8%**	**0.0%**	**11.8%**	**0.5%**	**<0.1%**	**12.6%**	**16.6%**	**1.4%**	**43.7%**
Nighttime (10:00 P.M. - 7:00 A.M.) Departures									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Widebody	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.2%	0.0%	0.4%
Narrowbody	0.0%	0.0%	1.0%	0.1%	<0.1%	0.2%	1.6%	0.2%	3.1%
Propeller	0.1%	0.0%	0.0%	0.0%	<0.1%	0.1%	0.0%	0.0%	0.3%
Regional Jet	0.1%	0.0%	0.7%	0.1%	<0.1%	1.2%	0.4%	0.1%	2.6%
Total	**0.1%**	**0.0%**	**1.9%**	**0.2%**	**<0.1%**	**1.5%**	**2.3%**	**0.3%**	**6.3%**
Overall Runway Utilization	**1.0%**	**1.8%**	**14.0%**	**14.8%**	**1.5%**	**28.1%**	**21.3%**	**17.5%**	**100%**

Source: Wyle 2009, PHL CEP DEIS October 2008, FAA Airspace Redesign EIS 2006

Note: Percentages are rounded to the nearest 0.1%. Totals are subject to rounding errors.

Table 4-3: 2008 and 2013 Baseline Runway Utilization Comparison depicts changes in runway utilization between the 2008 and the 2013. As shown in the table, the increase in overall operations forecasted to occur at PHL contributes to an increased utilization of Runway 17/35, particularly Runway 35 departures. This is due, in part, to Runway 17/35 realizing activity that is shifted from the primary runways (9R-27L and 9L-27R) during peak periods, resulting in a use of Runway 17/35 that is disproportional in comparison to the historic runway utilization split.

Table 4-3: 2008 and 2013 Baseline Runway Utilization Comparison									
Daytime Arrivals									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Heavy	-	-	0.5%	13.7%	-	-	7.5%	-21.6%	0%
Narrow	-	-	0.3%	10.7%	2.7%	5.1%	5.9%	-24.7%	0%
Propeller	-	-4.8%	0.2%	8.9%	-7.5%	4.2%	-0.2%	-0.9%	0%
Regional Jet	-	-10.6%	0.4%	11.1%	1.3%	29.9%	-	-32.1%	0%
Nighttime Arrivals									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Heavy	-	-	0.3%	15.7%	-	-	4.5%	-20.5%	0%
Narrow	-	-	0.8%	14.2%	1.9%	7.2%	1.72%	-25.7%	0%
Propeller	-	-14.7%	-0.8%	3.22%	0.8%	14.3%	-0.3%	-2.5%	0%
Regional Jet	-	-15.2%	1.5%	20.7%	-	22.9%	0.9%	-30.8%	0%
Daytime Departures									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Heavy	-	-	15.4%	-0.1%	-	-	-4.9%	-10.5%	0%
Narrow	-	-	12.4%	0.5%	-	6.8%	-16.3%	-3.5%	0%
Propeller	6.2%	-	2.2%	-1.0%	-0.4%	28.6%	-28.9%	-6.7%	0%
Regional Jet	-1.4%	-	9.3%	0.5%	-	54.8%	-57.1%	-6.2%	0%
Nighttime Departures									
Runway	**08**	**26**	**09L**	**09R**	**17**	**35**	**27L**	**27R**	**Total**
Heavy	-	-	10.9%	0.5%	-	-	-10.0%	-1.4%	0%
Narrow	-	-	9.3%	1.4%	-	5.2%	-13.6%	-2.3%	0%
Propeller	6.0%	-	-2.6%	-1.1%	-2.3%	36.1%	-18.6%	-17.5%	0%
Regional Jet	-5.4%	-	14.0	1.8%	-0.4%	46.6%	-51.8%	-4.7%	0%

Source: Wyle 2009

4.4. 2013 Flight Track Development and Utilization

Flight tracks utilized for the modeling of the 2013 Future Baseline noise contour were derived from the NY/NJ/PHL Airspace Redesign project. The modeled flight tracks include the use of multiple departure headings in both east and west flow, as well as the anticipated mitigation components of the project. The 2013 Future Baseline flight tracks also include the adjustment of flight track locations originating and terminating on Runway 17/35 to account for the extension. **Figures 4-1: 2013 Future Baseline Arrival Flight Tracks** and **4-2: 2013 Future Baseline Departure Flight Tracks** depict modeled flight tracks (including both nominal and sub tracks) for the 2013 Future Baseline condition. **Table 4-4** provides the flight track utilization percentages, which correspond to **Figure 5A, 5B, 6A,** and **6B** in **Section 5**.

Page Revised 03-19-10

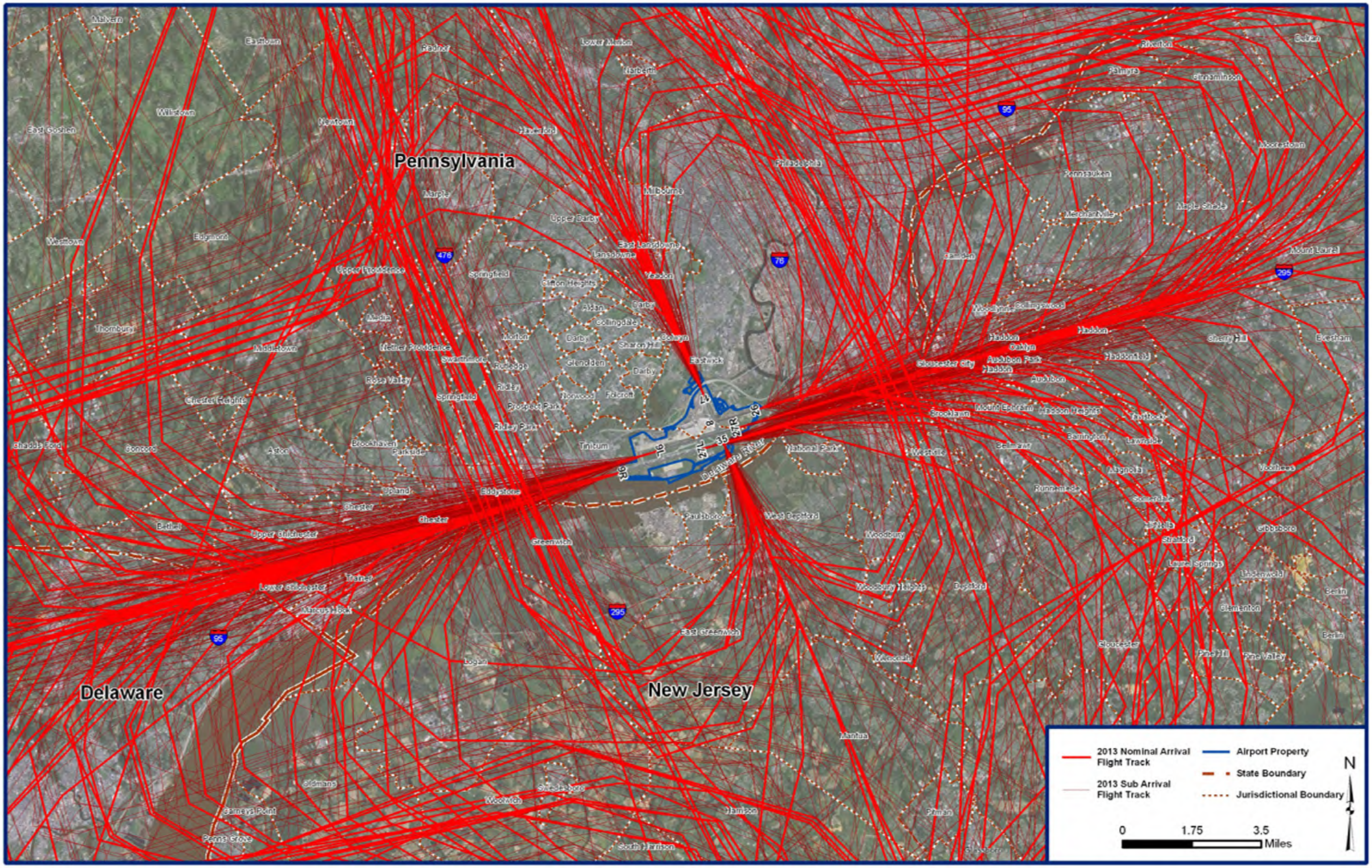

Figure 4-1: 2013 Future Baseline Arrival Flight Tracks

PHL PHILADELPHIA INTERNATIONAL AIRPORT

Noise Compatibility Program Update

DMJM AVIATION | AECOM

10-08-09

Figure4-1_2013FutureBaselineArrivals.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

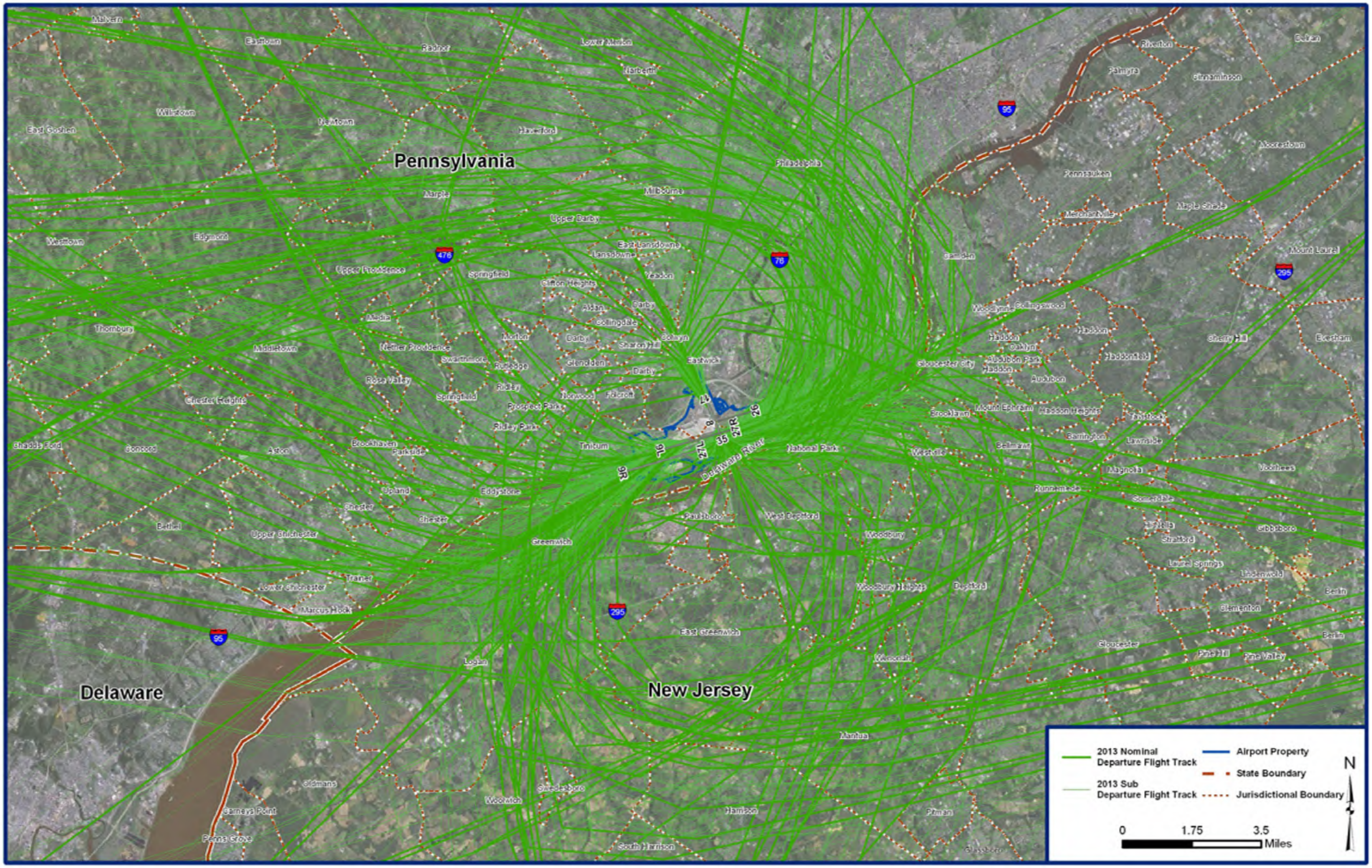

Figure 4-2: 2013 Future Baseline Departure Flight Tracks

Noise Compatibility Program Update

DMJM AVIATION | AECOM

10-08-09

Figure4-2_2013FutureBaselineDepartures.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

Table 4-4. 2013 Flight Track Utilization							
Runway	Flight Track Name	Day Percentage	Night Percentage	Runway	Flight Track Name	Day Percentage	Night Percentage
Arrivals				Departures			
09L	CDA_N_M	0.00%	0.11%	08	J_MAZ	0.21%	0.04%
	CDA_NW_M	0.00%	0.08%		J_MXA	0.37%	0.50%
	CDA_S_M	0.00%	0.10%		J_MXB	0.02%	0.00%
	J_BUN_1	0.04%	0.20%		J_MXC	0.29%	0.08%
	J_BUN_2	0.04%	0.20%		J_PTW	0.11%	0.00%
	J_PTW	0.00%	0.00%		J_RBV	0.28%	0.22%
	J_SPU1	0.05%	0.19%		P_MAZ	0.11%	0.58%
	J_SPU2	0.05%	0.19%		P_MXE	0.05%	0.00%
	J_TER_1	0.07%	0.20%		P_PTW	0.15%	0.00%
	J_TER_2	0.07%	0.20%		P_RBV	0.33%	0.53%
	J_VCN1	0.08%	0.12%	09L	J_CYN	5.79%	3.70%
	J_VCN2	0.08%	0.10%		J_CYN_M	0.00%	5.03%
	P_ACY1	0.00%	0.00%		J_DQO	0.16%	0.10%
	P_ACY2	0.00%	0.00%		J_MAZ	0.21%	0.00%
	P_BUN_1	0.00%	0.01%		J_MXA_M	0.00%	1.65%
	P_BUN_2	0.00%	0.01%		J_MXA1	3.46%	1.39%
	P_PTW	0.00%	0.00%		J_MXA2	1.15%	0.46%
	P_SPU1	0.00%	0.00%		J_MXB	0.26%	0.00%
	P_SPU2	0.00%	0.00%		J_MXC_M	0.00%	1.83%
	P_TER_1	0.00%	0.01%		J_MXC1	2.63%	2.21%
	P_TER_2	0.00%	0.01%		J_MXC2	0.88%	0.74%
	P_VCN1	0.00%	0.00%		J_OOD	6.33%	2.27%
	P_VCN2	0.00%	0.00%		J_OOD_M	0.00%	2.28%
09R	CDA_N_M	0.10%	2.38%		J_PTW	5.09%	3.06%
	CDA_NW_M	0.04%	1.67%		J_PTW_M	0.00%	4.49%
	CDA_S_M	0.02%	2.08%		J_RBV	0.45%	1.01%
	J_BUN_1	3.13%	4.85%		P_CYN	0.11%	0.00%
	J_BUN_2	1.67%	3.52%		P_CYN_M	0.00%	0.27%
	J_PTW	0.11%	0.00%		P_DQO	0.11%	0.00%
	J_SPU1	3.55%	4.36%		P_MXE	0.11%	0.00%
	J_SPU2	1.79%	3.40%		P_OOD	0.11%	0.00%
	J_TER_1	4.62%	4.79%		P_PTW	0.07%	0.00%
	J_TER_2	2.62%	3.03%		P_RBV	0.11%	0.09%
	J_VCN1	5.06%	2.83%	09R	J_CYN	0.25%	0.32%
	J_VCN2	3.39%	1.69%		J_CYN_M	0.00%	0.43%
	P_ACY1	0.05%	0.00%		J_DQO	0.01%	0.01%
	P_ACY2	0.05%	0.00%		J_MAZ	0.01%	0.00%
	P_BUN_1	0.02%	0.09%		J_MXA_M	0.00%	0.14%
	P_BUN_2	0.02%	0.09%		J_MXA1	0.15%	0.12%
	P_PTW	0.03%	0.00%		J_MXA2	0.05%	0.04%
	P_SPU1	0.05%	0.03%		J_MXB	0.01%	0.00%
	P_SPU2	0.05%	0.03%		J_MXC_M	0.00%	0.16%

Table 4-4. 2013 Flight Track Utilization

Runway	Flight Track Name	Day Percentage	Night Percentage	Runway	Flight Track Name	Day Percentage	Night Percentage
Arrivals				**Departures**			
	P_TER_1	0.11%	0.13%		J_MXC1	0.11%	0.19%
	P_TER_2	0.11%	0.13%		J_MXC2	0.04%	0.06%
	P_VCN1	0.06%	0.03%		J_OOD	0.27%	0.19%
	P_VCN2	0.06%	0.03%		J_OOD_M	0.00%	0.20%
	RNV_S_M	0.29%	0.14%		J_PTW	0.22%	0.26%
	RNV_SW_M	0.35%	0.31%		J_PTW_M	0.00%	0.38%
17	J_BUN	1.54%	1.12%		J_RBV	0.02%	0.09%
	J_PTW	0.07%	0.00%		P_CYN	0.00%	0.00%
	J_SPU	1.45%	0.80%		P_CYN_M	0.00%	0.02%
	P_BUN	0.03%	0.15%		P_DQO	0.00%	0.00%
	P_PTW	0.07%	0.00%		P_MXE	0.00%	0.00%
	P_SPU	0.00%	0.15%		P_OOD	0.00%	0.00%
26	J_BUN	0.68%	0.96%		P_PTW	0.00%	0.00%
	J_PTW	0.02%	0.00%		P_RBV	0.00%	0.01%
	J_SPU	1.24%	2.21%	27L	J_CYN_M	0.00%	5.88%
	J_TER	0.20%	1.01%		J_CYN1	5.29%	4.07%
	J_VCN	0.12%	0.37%		J_CYN2	1.32%	1.02%
	P_ACY_1	0.00%	0.00%		J_DQO	0.23%	0.05%
	P_ACY_2	0.01%	0.00%		J_MAZ	0.27%	0.02%
	P_BUN	0.37%	0.93%		J_MXA_M	0.00%	2.06%
	P_PTW	0.39%	0.00%		J_MXA1	6.67%	2.39%
	P_SPU	0.19%	0.86%		J_MXA2	0.74%	0.27%
	P_TER	0.03%	0.07%		J_MXB	0.40%	0.00%
	P_VCN	0.02%	0.04%		J_MXB_M	0.00%	0.59%
27L	CDA_N_M	0.00%	0.54%		J_MXC	7.12%	3.52%
	CDA_NW_M	0.01%	0.31%		J_MXC_M	0.00%	3.72%
	CDA_S_M	0.00%	0.78%		J_OOD	9.83%	2.35%
	J_BUN_1	0.41%	1.36%		J_OOD_M	0.00%	2.07%
	J_BUN_2	0.20%	0.67%		J_PTW	5.47%	6.10%
	J_SPU1	0.59%	1.17%		J_RBV	0.12%	1.28%
	J_SPU2	0.29%	0.58%		P_CYN_M	0.00%	0.02%
	J_TER_1	0.21%	0.19%		P_CYN1	0.01%	0.00%
	J_TER_2	0.86%	0.75%		P_CYN2	0.00%	0.00%
	J_VCN	1.85%	1.47%		P_DQO	0.01%	0.00%
27R	CDA_N_M	0.00%	1.75%		P_MAZ	0.01%	0.04%
	CDA_NW_M	0.09%	0.99%		P_MXE1	0.02%	0.00%
	CDA_S_M	0.00%	2.50%		P_MXE2	0.01%	0.00%
	J_BUN_1	3.03%	4.38%		P_OOD	0.20%	0.00%
	J_BUN_2	1.49%	2.16%		P_PTW	0.02%	0.00%
	J_SPU1	4.32%	3.78%		P_RBV	0.22%	0.54%
	J_SPU2	2.13%	1.86%	27R	J_CYN_M	0.00%	0.79%
	J_TER_1	1.57%	0.60%		J_CYN1	0.43%	0.54%
	J_TER_2	6.28%	2.41%		J_CYN2	0.11%	0.14%

Table 4-4. 2013 Flight Track Utilization

Runway	Flight Track Name	Day Percentage	Night Percentage	Runway	Flight Track Name	Day Percentage	Night Percentage
Arrivals				Departures			
	J_VCN	13.55%	4.73%		J_DQO	0.02%	0.01%
35	J_BUN_1	2.27%	1.60%		J_MAZ	0.02%	0.00%
	J_BUN_2	3.03%	2.14%		J_MXA_M	0.00%	0.28%
	J_BUN_3	2.27%	1.60%		J_MXA1	0.55%	0.32%
	J_PTW_1	0.19%	0.00%		J_MXA2	0.06%	0.04%
	J_PTW_2	0.19%	0.00%		J_MXB	0.03%	0.00%
	J_SPU_1	2.69%	3.76%		J_MXB_M	0.00%	0.08%
	J_SPU_2	2.69%	3.76%		J_MXC	0.59%	0.47%
	J_TER	7.04%	4.58%		J_MXC_M	0.00%	0.50%
	J_VCN	5.90%	2.04%		J_OOD	0.81%	0.32%
	P_ACY	0.48%	0.00%		J_OOD_M	0.00%	0.28%
	P_BUN_1	0.03%	0.07%		J_PTW	0.45%	0.82%
	P_BUN_2	0.04%	0.09%		J_RBV	0.01%	0.17%
	P_BUN_3	0.03%	0.07%		P_CYN_M	0.00%	0.00%
	P_PTW_1	0.05%	0.00%		P_CYN1	0.00%	0.00%
	P_PTW_2	0.05%	0.00%		P_CYN2	0.00%	0.00%
	P_SPU_1	0.00%	0.12%		P_DQO	0.00%	0.00%
	P_SPU_2	0.00%	0.12%		P_MAZ	0.00%	0.00%
	P_TER	1.19%	1.06%		P_MXE1	0.00%	0.00%
	P_VCN	0.72%	0.00%		P_MXE2	0.00%	0.00%
		100.00%	**100.00%**		P_OOD	0.02%	0.03%
					P_PTW	0.00%	0.00%
					P_RBV	0.02%	0.04%
				35	J_CYN1	3.64%	3.32%
					J_CYN2	1.21%	1.11%
					J_DQO	0.08%	0.00%
					J_MAZ	0.55%	0.00%
					J_MXA	7.14%	3.30%
					J_MXB	0.53%	0.00%
					J_MXC	4.53%	3.00%
					J_OOD1	1.85%	1.85%
					J_OOD2	0.62%	0.62%
					J_PTW	4.77%	7.74%
					J_RBV	1.35%	0.98%
					P_CYN1	0.16%	0.40%
					P_CYN2	0.05%	0.13%
					P_DQO	0.21%	0.00%
					P_MAZ	0.21%	1.08%
					P_MXE	0.81%	0.00%
					P_PTW	0.42%	0.00%
					P_RBV	0.63%	0.54%
						100.00%	**100.00%**

Note: Operations are rounded. Omitted entries may include operations less than 0.01.
Source: Wyle, 2009

4.5. 2013 Stage Length Assignment

Trip distance, as utilized by INM to account for variations in aircraft weight, is shown in **Table 4-5: 2013 Future Baseline Stage Length Assignment.** The distribution of stage length assignments remain generally consistent with assumptions utilized in the 2008 Existing Baseline condition (refer to Section 3.6).

Table 4-5: 2013 Future Baseline Stage Length Assignment

Category	Stage Length (Nautical Miles)							Total
	1 (0-500)	2 (500-1,000)	3 (1,000-1,500)	4 (1,500-2,500)	5 (2,500-3,500)	6 (3,500-4,500)	7 (4,500+)	
Widebody	19%	22%	3%	13%	9%	32%	1%	100%
Narrowbody	40%	31%	12%	15%	3%	0%	0%	100%
Regional Jet	88%	9%	3%	-	-	-	-	100%
Propeller	100%	0%	-	-	-	-	-	100%

Source: Wyle 2009

4.6. 2013 Engine Maintenance Operations

Ground noise exposure remained consistent with assumptions modeled in the analysis for the 2008 Existing Baseline condition, adjusted to account for the increase in overall operations.

4.7. 2013 Future Baseline Noise Exposure

Results of the INM noise modeling for the 2013 Future Baseline noise exposure contour, based on the input data in described in the preceding sections are depicted in **Figure 4-3: 2013 Future Baseline DNL Noise Exposure Contour**. A comparison between the 2008 Existing and 2013 Future Baseline contours is shown on **Figure 4-4: 2008 Existing versus 2013 Future Baseline DNL Noise Exposure Contour Comparison.** Overall, the area exposed to DNL levels of 65 dB or greater is expected to increase to 7.7 square miles in 2013. As discussed in **Section 4.2,** airport operations are forecasted to increase by approximately 19% to an average annual day total of 1,628 operations, which is expected to increase the area of noise exposure. However, more notable changes in noise exposure exist due to the implementation of the ARD project and the Runway 17/35 extension. This is most evident to the west of PHL, where the implementation of dispersed headings from Runways 27L and 27R departures results in additional areas of overflight. As compared to the 2008 Existing Baseline condition, the use of the 230-degree heading to the south produces a noticeable change in the shape of the contour. To the east of the Airport, along the Runway 09R/27L and 09L/27R extended centerlines, the noise contour has receded by approximately 3,500 feet, likely caused by the reduced use of Runways 27L and 27R during the east flow operations. North of Runway 17/35, an area of increased noise exposure is evident, resulting from the increase in operations associated with additional traffic (regional jets and narrowbody aircraft) departing from Runway 35. This area, located in Eastwick section of Philadelphia, includes some incompatible land uses within the DNL 65 dB noise contour. **Figures 4-5: 2008 Existing versus 2013 Future Baseline DNL Noise Exposure Contour Comparison-Tinicum** and **4-6: 2008 Existing versus 2013 Future Baseline DNL Noise Exposure Contour Comparison- Eastwick** depict noise contours over these areas. **Figures 4-7, 4-8, and 4-9** depict noise exposure beyond the DNL 65 dB noise contour.

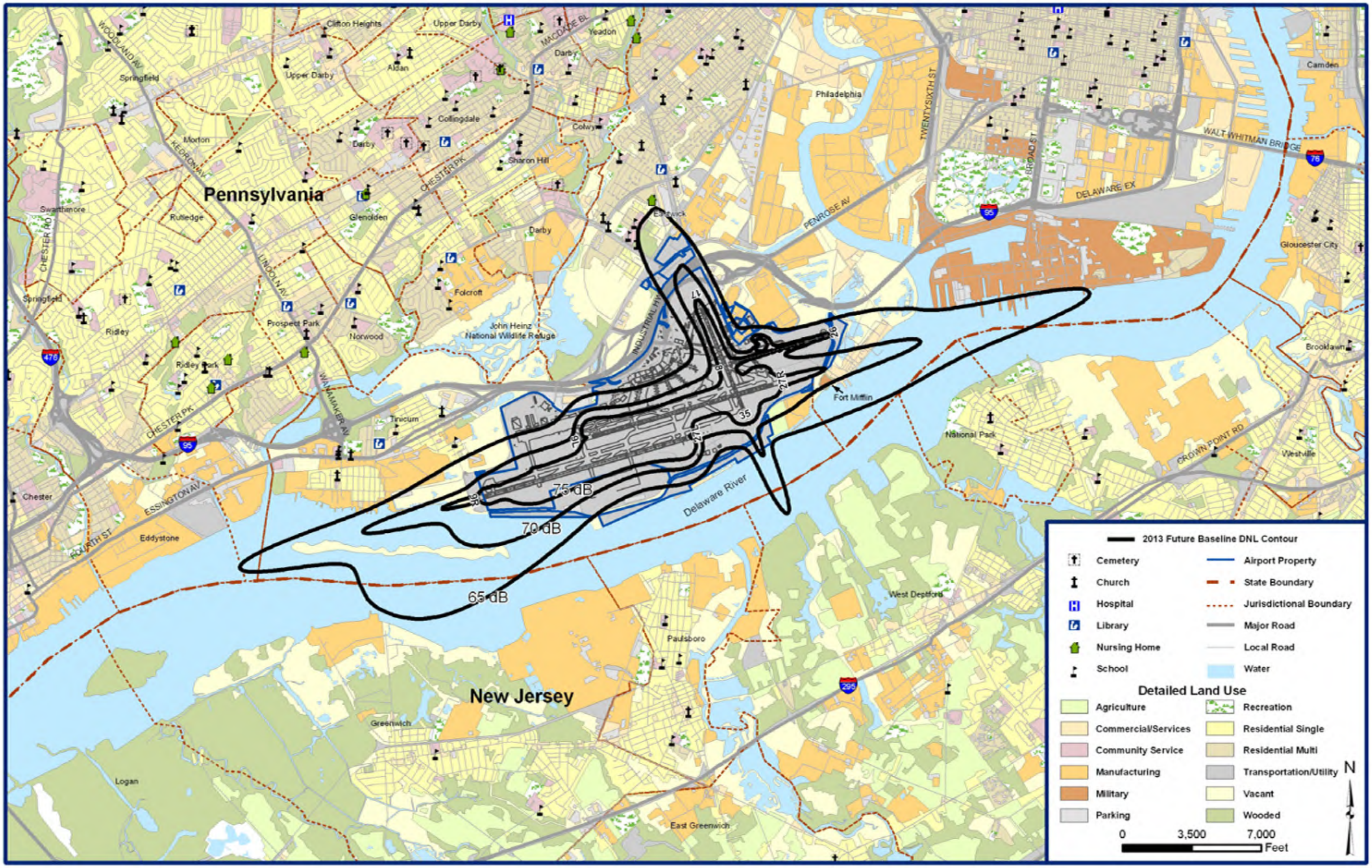

Figure 4-3: 2013 Future Baseline DNL Noise Exposure Contour

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Figure4-3_2013FutureBaseline.mxd

10-08-09

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

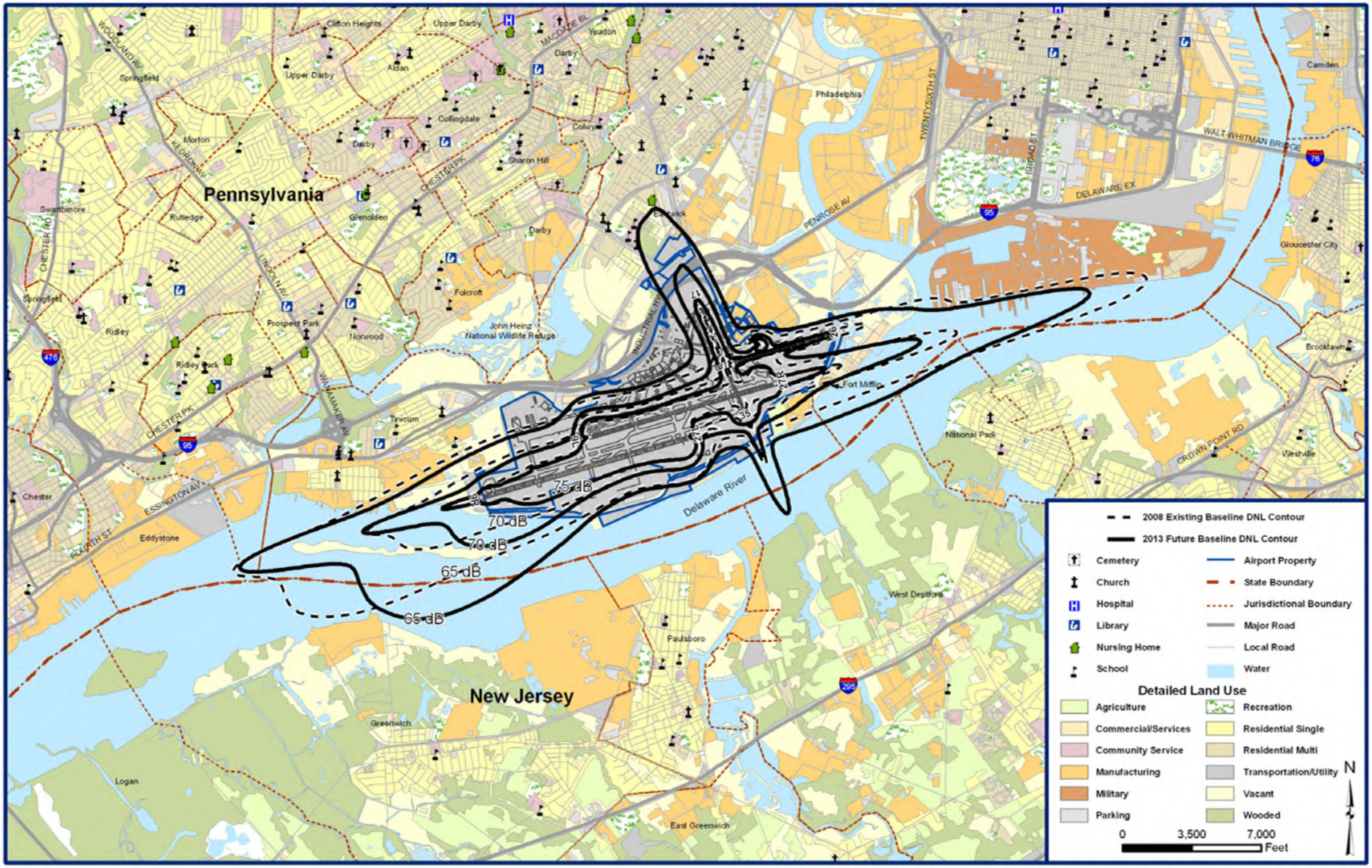

Figure 4-4: 2008 Existing versus 2013 Future Baseline DNL Noise Exposure Contour Comparison

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Noise Compatibility Program Update

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10-08-09

Figure4-4_2008Existingvs2013FutureBaseline.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

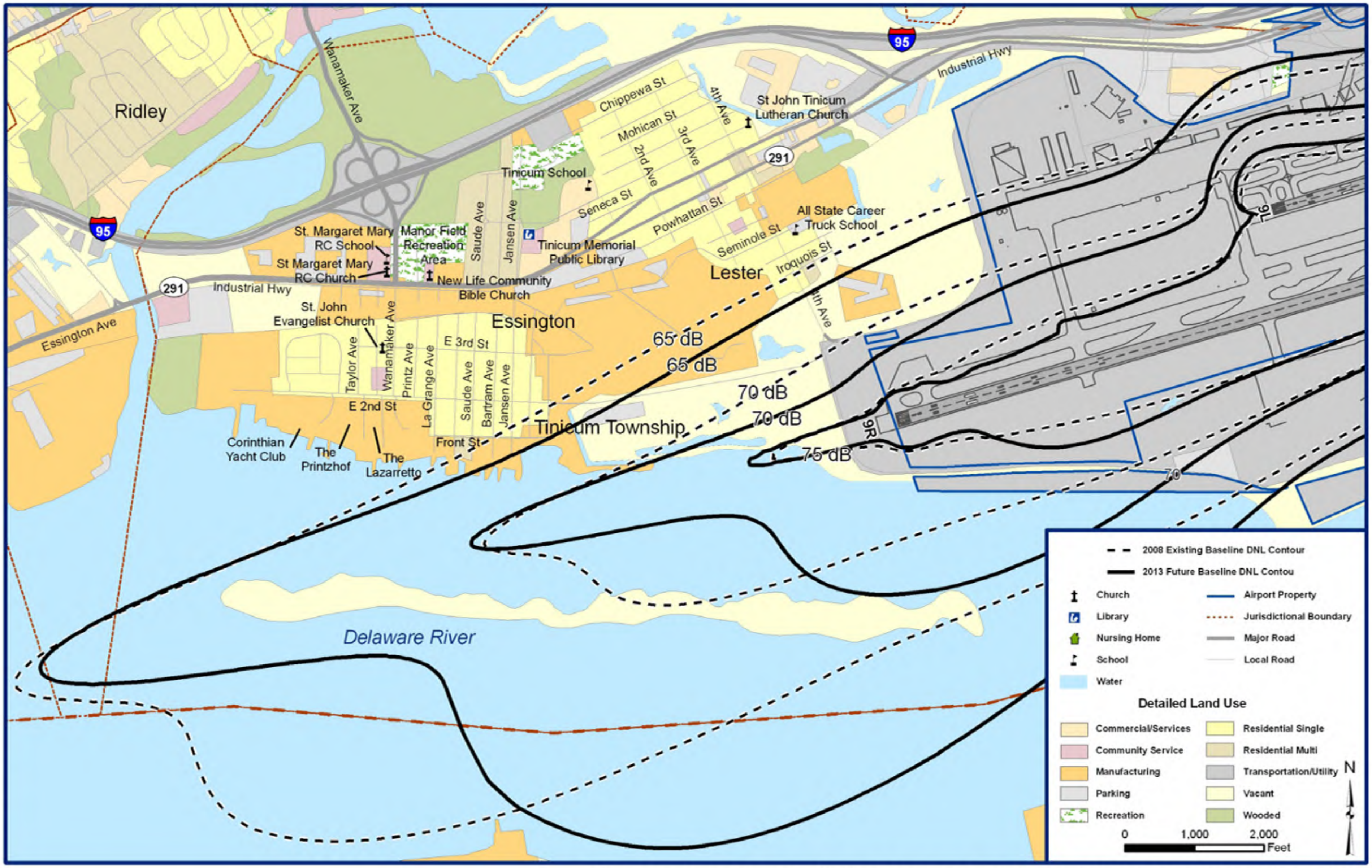

Figure 4-5: 2008 Existing versus 2013 Future Baseline DNL Noise Exposure Contour Comparison - Tinicum Township

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10-08-09

Figure4-5_2008Existingvs2013FutureBaseline_Tinicum.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

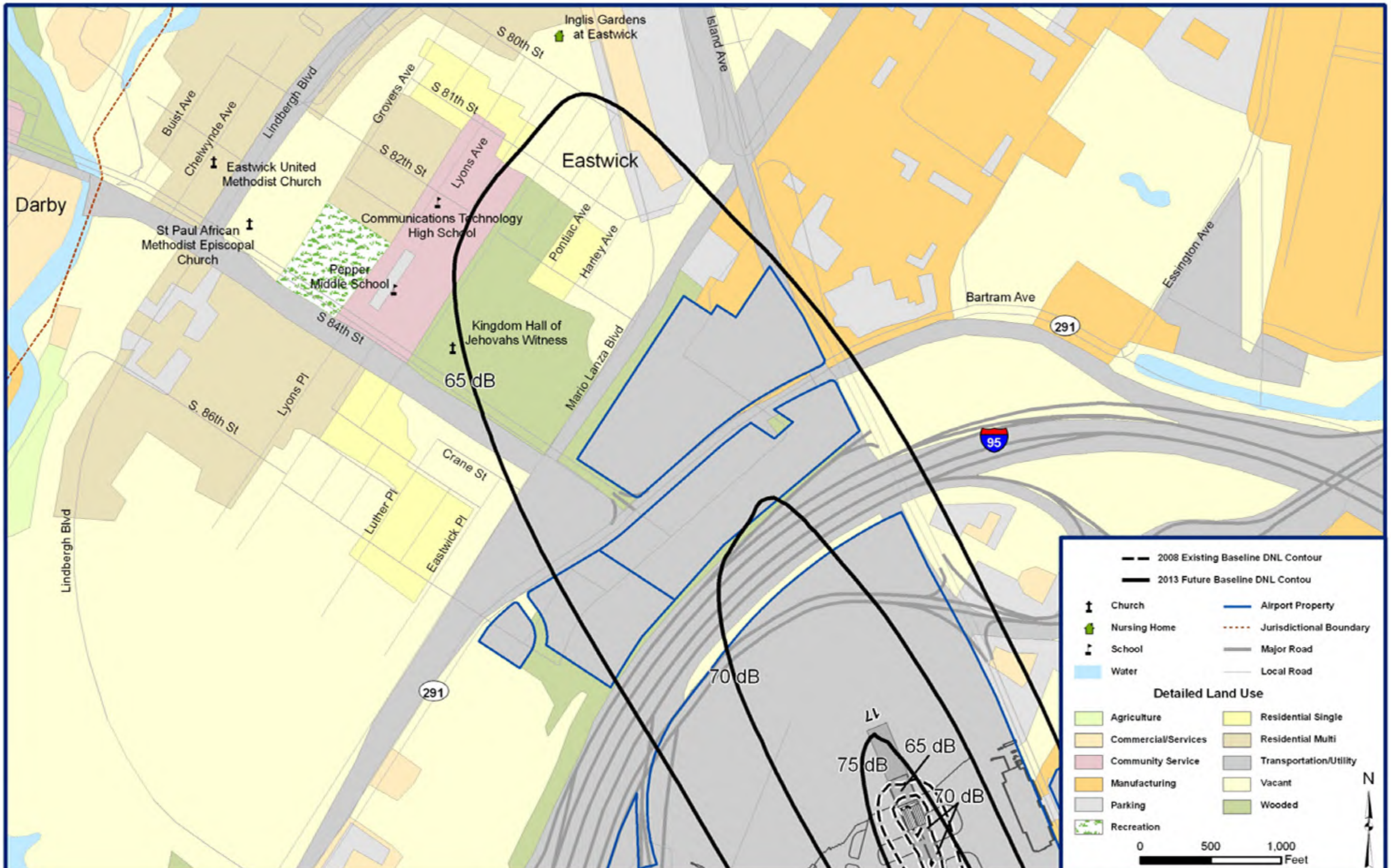

Figure 4-6: 2008 Existing versus 2013 Future Baseline DNL Noise Exposure Contour Comparison - Eastwick

Figure28_2008Existingvs2013FutureBaseline_Eastwick.mxd

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10-08-09

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

Table 4-6: 2013 Future Baseline Noise Exposure Estimated Impacts depicts the land use and estimated population impacts associated with the 2013 Future Baseline Noise Contour (see also **Figure 2** in **Section 5**). The DNL 65 dB noise exposure contour includes an estimated population of approximately 319 people and 168 housing units, with no housing units and an estimated population of two people residing within the DNL 70+ dB noise contour. As was the case with the 2008 Existing Baseline impact analysis, estimated population and housing units were proportionally distributed among each census block. Since the 2013 condition includes incompatible land uses, further land use assessments within the DNL 65 dB noise contour were undertaken. **Figure 4-5** and **Figure 4-6** compare the 2008 and 2013 noise contours over Tinicum and Eastwick. Although in the previous Noise Compatibility Study, significant impacts were anticipated to occur in Tinicum Township, the noise contour has receded in this area due to changes in the aircraft fleet mix and the implementation of the dispersed departure headings from Runways 27L and 27R. As a result, no incompatible land uses in Tinicum Township remain in the DNL 65 dB noise exposure contour under the 2013 Future Baseline NEM. However, in Eastwick, due to the extension of Runway 17/35 and the forecasted increase in operations on this runway, the noise contour does include incompatible land uses consisting of approximately 35 homes, two schools, and one church. Impacts within the DNL 70 dB noise contour are attributed to the caretaker residence located at Fort Mifflin. Reducing the incompatibility of these land uses is the goal of the updated Noise Compatibility Program.

Table 4-6: 2013 Future Baseline Noise Exposure Estimated Impacts

2013 Future Baseline Noise Exposure Estimated Impacts				
	65-70 DNL	70-75 DNL	75+ DNL	65+ DNL
Estimated Population and Housing Units*				
Estimated Population	317	2	-	**319**
Housing Units	168	-	-	**168**
Area (Square Miles)				
2013 Future Baseline	4.7	1.7	1.3	**7.7**
Land Use Impacts (Square Miles)				
Agriculture	0.03	0.02	-	**0.05**
Airport Property	0.92	0.90	1.25	**3.08**
Commercial Services	0.06	0.06	-	**0.11**
Community Service	-	-	-	**-**
Manufacturing	0.12	0.02	-	**0.15**
Military	0.02	0.01	-	**0.03**
Parking	0.06	-	-	**0.06**
Recreation	-	-	-	**-**
Residential (Multi-Family)	-	-	-	**-**
Residential (Single-Family)	0.01	-	-	**0.01**
Transportation	0.25	0.19	0.03	**0.47**
Vacant	0.53	0.08	0.01	**0.62**
Water	2.63	0.43	0.01	**3.07**
Wooded	0.05	-	-	**0.05**
Total	**4.67**	**1.71**	**1.30**	**7.7**

Note: Values less than 0.00 were omitted in the calculation of land use impacts.
* Estimates based on 2000 US Census block data
Source: Wyle, 2009

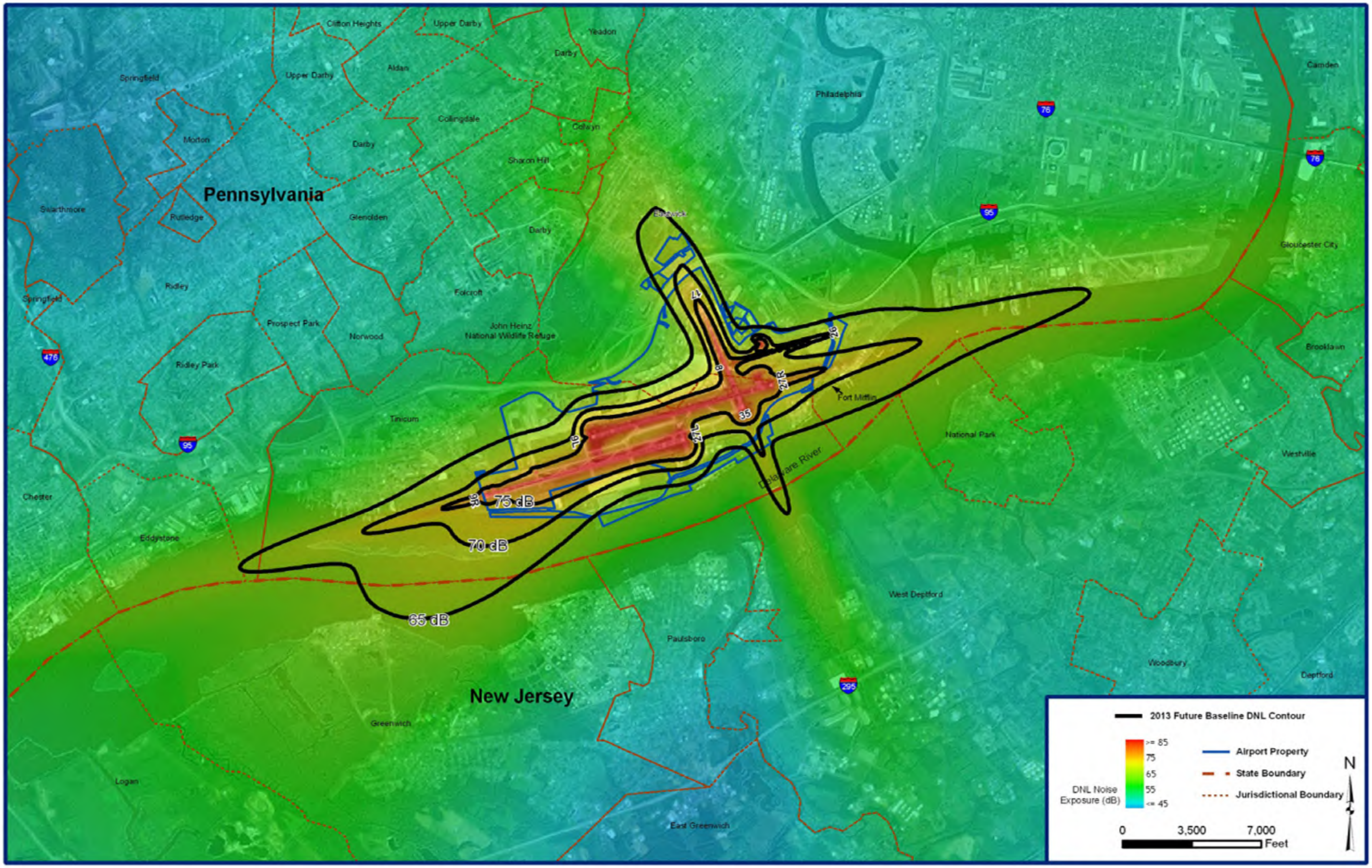

Figure 4-7: 2013 Future Baseline DNL Noise Exposure

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Figure4-7_2013FutureBaselineGradientCloseIn.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

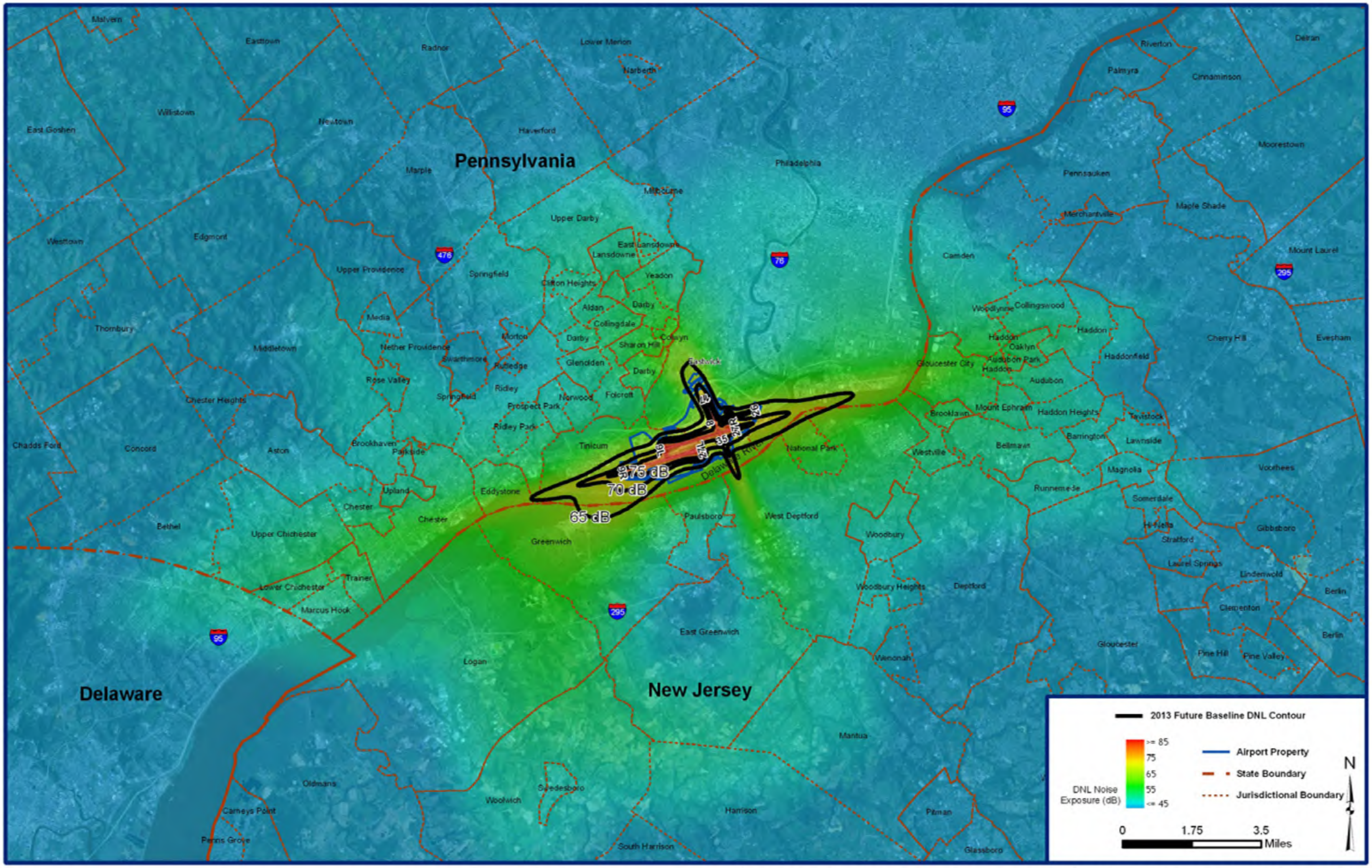

Figure 4-8: 2013 Future Baseline DNL Noise Exposure Regional View

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Figure4-8_2013FutureBaselineGradient.mxd

10-08-09

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

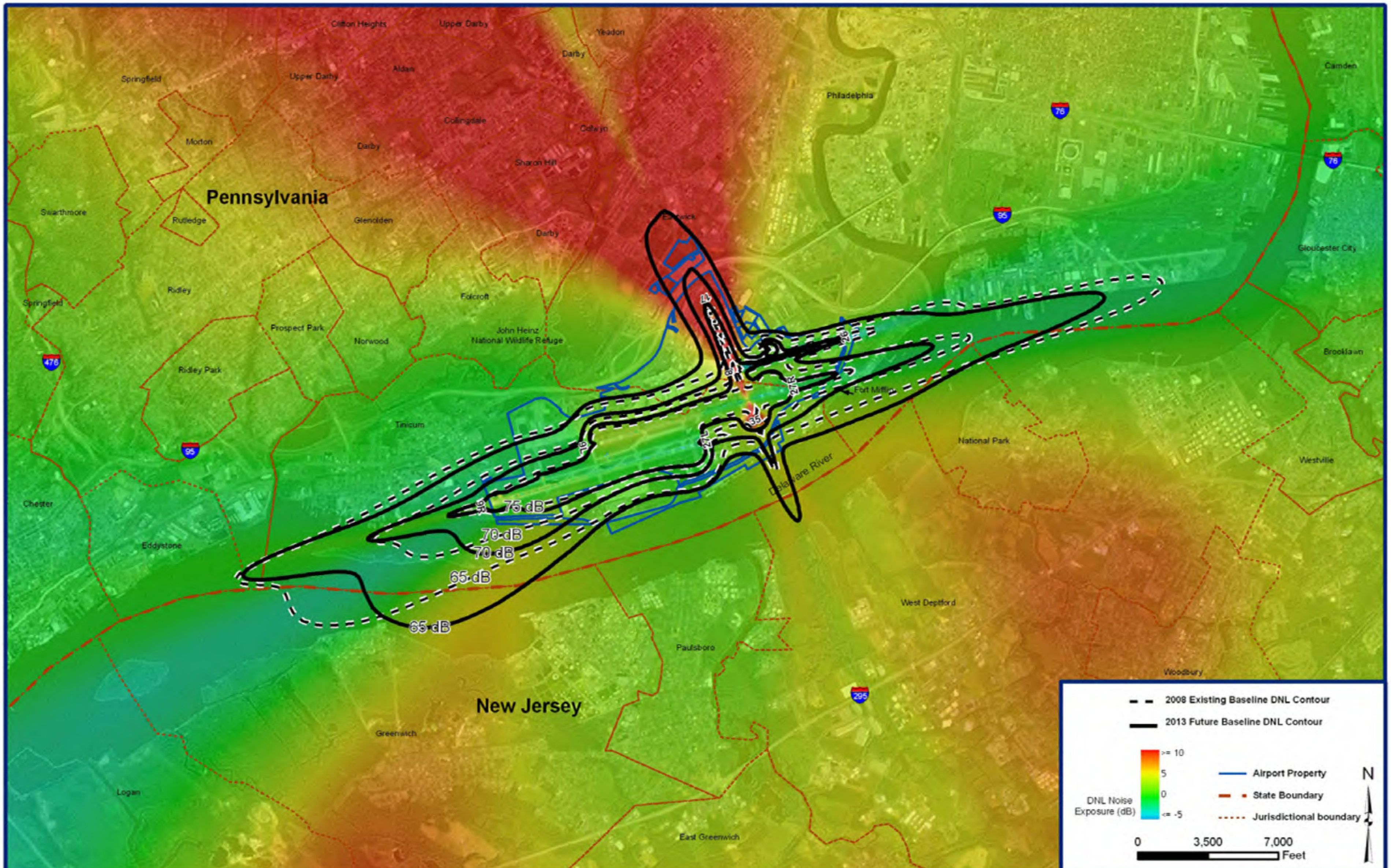

Figure 4-9: 2008 Existing versus 2013 Future DNL Noise Exposure Contour Comparison

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10-08-09

Figure4-9_2013-2008GradientCloseIn.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

Part 150: Records of Approval

The Philadelphia International Airport, Philadelphia Pennsylvania

Approved on 5/19/03

The Philadelphia International Airport, Philadelphia Pennsylvania, Noise compatibility Program (NCP) describes the current and future noncompatible land uses based upon the parameters established in Federal Aviation Regulation (FAR) part 150, *Airport Noise Compatibility Planning.* The program recommends a total of eighteen measures to prevent the introduction of additional noncompatible land uses and to reduce existing noncompatible land uses. The recommendations include seven noise abatement measures, five land use measures, and six program management measures. The recommended program measures are summarized on Pages 4-2 through 4-32, Exhibits 4-1 through 4-5, and Tables 4-1 through 4-3 of the NCP. The measures are summarized in Table 4-1 on pages 4-2 through 4-6.

The approvals listed herein include approvals of actions that the airport recommends be taken by the Federal Aviation Administration. It should be noted that these approvals indicate only that the actions would, if implemented, be consistent with the purposes of Part 150. These approvals do not constitute decisions to implement the actions. Later decisions concerning possible implementation of these actions may be subject to applicable environmental or other procedures or requirements.

The noise compatibility program recommendations below summarize as closely as possible the airport operator's recommendations in the noise compatibility program and are cross-referenced to the program. The statements contained within the summarized noise compatibility program recommendations and before the indicated FAA approval, disapproval, or other determination do not represent the opinions or decisions of the FAA.

NOISE ABATEMENT

NA 1: Aircraft weighing 12,500 pounds or more departing Runways 9L/9R/17/35/8 fly runway heading until reaching 2,000' Above Ground Level.

Description: This measure is a part of the existing condition. On departure to the east, north, or south, aircraft weighing more than 12,500 pounds normally fly along the runway heading until reaching altitudes 2000 feet above the ground. Turns are typically initiated over the Delaware River after the aircraft has reached the procedural altitude. Under conditions of adverse weather, or for reasons of safety and/or operating efficiency, deviations from this procedure may occur. Modifications are not justified by Part 150 findings, and hence are not suggested at this time. The concurrent New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project (the Project), in general, may be considering modifications to noise abatement measures at some of the Project airports in its five-state study area. However, at this time, no specific modification to noise abatement measures are planned in the Project for PHL. (See Page 4-7 and Exhibit 4-1 as well as page E-2 and Exhibit E-1)

FAA Action: Approved as voluntary and as an existing condition. This measure results in the maintenance of a departure course from Runways 8,9R, and 9L over areas of compatible land use and maintains a predictable departure corridor from Runways 17 and 35 over areas of scattered land use beyond the extent of the 65 DNL contour. This procedure may be subject to refinement based on findings of the FAA's New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project in the future.

NA 2: Aircraft weighing 12,500 pounds or more departing Runway 27L turn left to a 255 degree heading until reaching 3,000' Above Ground Level.

Description: This measure is a part of the existing condition. On departure to the west from Runway 27L, aircraft weighing more than 12,500 pounds turn left to a heading of 255 degrees and fly along the that heading until reaching altitudes 3000 feet above the ground. Turns from the 255 heading are typically initiated over the Delaware River after the aircraft has reached the procedural altitude. Under conditions of adverse weather, or for reasons of safety and/or operating efficiency, deviations from this procedure may occur. Modifications are not justified by Part 150 findings, and hence are not suggested at this time. The concurrent New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project (the Project), in general, may be considering modifications to noise abatement measures at some of the Project airports in its five-state study area. However, at this time, no specific modification to noise abatement measures are planned in the Project for PHL. (See page 4-8 and Exhibit 4-1 as well as page E-3 and Exhibit E-1)

FAA Action: Approved as voluntary and as an existing condition. The measure results in the maintenance of a compatible departure course from Runway 27L over the Delaware River until the aircraft has passed beyond the extent of the 65 DNL contour. This procedure may be subject to refinement based on findings of the FAA's New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project in the future.

NA 3: Aircraft weighing 12,500 pounds or more departing Runway 27R turn left to a 240 degree heading until reaching 3 DME, thence turn right to a 255 degree heading until reaching 3,000' Above Ground Level.

Description: This measure is a part of the existing condition. On departure to the west from Runway 27R, aircraft weighing more than 12,500 pounds turn to a heading of 240 degrees and fly that heading until reaching a position 3 nautical miles from the Instrument Landing System (ILS). The aircraft then turn right to a heading of 255 degrees and fly that heading until reaching altitudes 3000 feet above the ground. Turns from the 255-degree heading are typically initiated over the Delaware River after the aircraft has reached the procedural altitude. Under conditions of adverse weather, or for reasons of safety and/or operating efficiency, deviations from this procedure may occur. Modifications are not justified by Part 150 findings, and hence are not suggested at this time. The concurrent New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project (the Project), in general, may be considering modifications to noise abatement measures at some of the Project airports in its five-state study area. However, at this time, no specific modification to noise abatement measures are planned in the Project for PHL. (See page 4-9 and Exhibit 4-1 as well as page E-4 and Exhibits C-6 and E-1)

FAA Action: Approved as voluntary and as an existing condition. The measure results in the frequent use of a compatible departure course from Runway 27R over the Delaware River until the aircraft has passed beyond the extent of the 65 DNL contour. This procedure may be subject to refinement based on findings of the FAA's New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project in the future.

NA 4: Continue existing nighttime runway use program from midnight to 6:00 a.m.

Description: This measure is a part of the existing condition. When winds and operating conditions permit, the following preference is in effect: between midnight and 6:00 a.m., in east traffic flow, takeoffs are made from Runways 9R and 9L, landings are made on Runway 9R. During west flow, takeoffs are made on Runway 27L and landings are made on Runways 27R and 27L. When the crosswind runway is used, landings are made on Runway 35 and takeoffs are made on Runway 17. This preference is not applied when winds are from the east or when one or more of the runways is closed. (See Page 4-4 and Exhibit 4-2 as well as page E-7 and exhibit E-2)

FAA ACTION: Approved as voluntary and as an existing condition. This measure would result in the maintenance of compatible departure and approach courses over the Delaware River or over areas of generally compatible land use south of the airport within the extents of the 65 DNL contour.

NA 5: Continue existing run-up procedures providing for location and orientation preferences with requirements for pre-approval and limitation to 20 minutes or less.

Description: This measure is a part of the existing condition. Engine run-ups are currently restricted to two locations on the airport – at the intersection of Taxiway K with Taxiway H (preferred location) with the aircraft facing east, and at the intersection of Taxiway P with Taxiway W, with the aircraft facing west. Engine run-ups require prior approval by Airport Operations and are limited to twenty (20) minutes duration. Between 11:00 p.m. and 6:00 a.m., run-ups are restricted unless failure to conduct the run-up will delay the departure of a scheduled flight. In addition, these run-ups are to be conducted at the preferred east location. (See page 4-13 and Exhibit 4-3 as well as page E-11 and Exhibit E-3)

FAA Action: Approved as voluntary and as an existing condition. The run-up areas provide centrally located sites that would minimize the noise impact of run-ups as much as possible without building a barrier or berm.

NA-6: Support creation of Area Navigation (RNAV) overlay procedures for selected existing and future flight procedures.

Description: The New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project is examining the possibility of creating RNAV overlays for selected instrument approach procedures in the region. RNAV procedures utilize ground based (DGPS), satellite based (GPS), and on-board (FMS/GPS) equipment to assist the pilot in navigating from point to point. These procedures normally provide for greater accuracy and tighter flight corridors than traditional flights using controller-assigned or procedural headings (vectors). Some older aircraft are not equipped with the technology to use RNAV procedures and would continue to use traditional techniques. It is the FAA's intent that the airspace environment in the region ultimately become entirely RNAV, so aircraft will continue to be modified to use the technology and new aircraft will be so equipped. This measure does not require specific implementing action by the Airport, but rather the Airport should support the development of such procedures by the FAA for the regional airspace system. (See page 4-15 and E-45)

FAA Action: No action required. The airport sponsor is supporting development of RNAV overlay procedures, which is being considered as part of the FAA's New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project.

NA 7: Encourage noise attenuating standards in airport development.

Description: As the development envisioned by the Master Plan is accomplished, the Airport should consider the benefits associated with the placement of structures relative to the surrounding land uses. Where practicable, the design of such facilities should be made to place unbroken lineal blocks between sources of ground noise and noise-sensitive uses in surrounding neighborhoods. Such blocks may take the form of walls or barriers, of building footprints that are staggered with adjacent footprints, landscaping, roadway design, etc., all of which can be interruptions to the flow of aircraft ground noise between its source and receiver sites nearby. The development of facilities that use appropriate design standards that block the flow of ground noise may result in reductions of 8 to 10 decibels between the source and receiver depending upon design and location. (See page 4- 16 and E-53)

FAA Action: Approved for purposes of part 150. Final placement of structures is subject to Airport Layout Plan Approval and part 77 analysis. The measure is intended to reduce intrusive ground noise events from aircraft that are on the ramp, taxiing, in ground roll before or after flight, or while being run up or otherwise being serviced. Plans for airport development should be evaluated for their potential to reduce ground noise throughout the planning process to assure design standards are maintained.

LAND USE

LU 1: Develop and implement a residential sound insulation program.

Description:

- Offer sound insulation to all single-family owner occupied residential homes located within or immediately adjacent to the 65 DNL and higher levels of the 2006 Noise Compatibility Plan (NCP) noise contour. Sound insulation should be accomplished on a most impacted basis, where homes in the highest noise levels are insulated first. To accomplish this, two Options have been identified that would provide sound insulation to homes located in Tinicum Township as described below.

- **Option LU-1A** as displayed in Exhibit 4-4, defines the boundaries for the initial sound insulation program. This option would be defined by "squaring off" of neighborhood blocks that are included within, adjacent to or intersected by the 2006 NCP 65 DNL noise contour, thereby maintaining block continuity. The area identified in Lester has the railroad track as a natural boundary and includes 101 homes. The area in Essington does not have such a clear "natural" boundary; therefore 180 homes located 1) south of 3rd St., on Putcon, Erickson, Jansen, Bartram, Saude and on the east side of Carre; and 2) south of 2nd St., on La Grange Ave., would be included.

- Should additional federal funding be made available, **Option LU-1B** as displayed in Exhibit 4-4, would include an additional 164 homes and is the preferred program boundary. All homes south of the railroad tracks and east of Wannamaker Avenue would be included under this scenario. Extending the area of eligibility from the 65 DNL contour to this natural boundary would ensure continuity throughout the community.

- Avigation easements will be attached to the property deed as a requirement to participate in this program.

(See page 4-17, 18 and Exhibit 4-4 also see page F-2, 3 and Exhibit C-6 and C-7)

FAA Action: Approved. Conditions of Chapter 8 of 5100.38B Airport Improvement Handbook (or subsequent versions thereof) must be met, including those governing Noise Compatibility Projects and Interior Noise Level Reduction (NLR), section 812.b.

LU-2: Develop and implement a purchase and resale program as a supplement to the residential sound insulation program (LU-1).

<u>Description:</u>

- A purchase and resale program would be offered to supplement Measure LU-1, Residential Sound Insulation Program, for those eligible homes that do not qualify for the sound insulation program. For example, if a home did not meet local building codes required to qualify for sound insulation, the homeowner would have the option to sell the property to the Airport.

- Under this program the Airport would purchase an eligible home at fair market value and attempt to resell the home to a new owner. The home may be sound insulated and/or upgraded prior to resale and would have an avigation easement attached to the property deed.

- Provides an option for eligible residents who may not qualify for the sound insulation program.

- Properties would have an avigation easement attached, which would guarantee the right of flight over them.

<u>FAA Action:</u> Approved. Conditions of Chapter 8 of 5100.38B Airport Improvement Handbook (or subsequent versions thereof) must be met to be eligible for Federal financial assistance.

<u>LU-3:</u> Develop and implement a land use controls program.

<u>Description:</u> Encourage local municipalities, such as Tinicum Township and the City of Philadelphia, to implement various Land Use Controls, such as re-zoning, and disclosure, for areas within and adjacent to the 2006 NCP/NEM DNL 65 dB noise contour. Although it is not expected that re-zoning will be required, it was still considered for the land use mitigation program as a method to prevent future incompatibilities. This re-zoning measure will be implemented when necessary to maintain land-use compatibility in the Tinicum Township area. It is not expected that the City of Philadelphia would need to exercise the re-zoning measure. The main focus of this measure is intended to be a mandatory disclosure to buyers and developers that a property is located within a noise impact zone. The requirement for new development to consider the noise zones and to build in sound attenuating features as a means to prevent incompatibilities is another important focus. Both of these measures are discussed further under Implementation Steps, Costs and Phasing. (See page 4-21 and 22 and Appendix F)

<u>FAA Action:</u> Approved. Tinicum Township enacted zoning ordinance Nos. 2000-738 and 2001-747 to address this measure. The City of Philadelphia also has certain land use compatibility commitments outlined in its grant agreements with the Federal government to "…take appropriate action, to the extent reasonable, including the adoption of zoning laws, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations…."

LU-4: Develop and implement a land use development controls program.

<u>Description:</u> Encourage local municipalities, such as Tinicum Township and the City of Philadelphia, to amend their building codes to require any new construction and major alteration/addition within or adjacent to the DNL 65 dB NCP noise contour to meet an interior Noise Reduction Level (NRL) standard of 45 dB.

- Prevents new incompatible development.

- Ensures that any new construction or alteration will utilize materials that will minimize noise exposure on the interior of a structure. (See page 4-23 and Appendix F)

FAA Action: Disapproved for purposes of Part 150. New construction within the DNL 65 dB noise contour is considered incompatible with normal airport operations and is inconsistent with the purposes of Part 150 to reduce or prevent incompatible land uses. The FAA recognizes that inclusion of sound attenuation in newly constructed or altered noise-sensitive structures will provide interior compatibility. This is a local land use decision. However, the FAA will not participate in remedial mitigation measures for new noise-sensitive development that occurs after October 1, 1998.

LU-5: Prepare a Study to Determine Feasibility of Implementing Noise Mitigation Measures at Historic Fort Mifflin

Description:

- Historic Fort Mifflin, a National Historic Landmark, is located within the limits of the City of Philadelphia, just East of Philadelphia International Airport. It is further located within the 70 DNL level of the 2006 Noise Compatibility Plan (NCP) noise contour, with some portions falling within the 75 DNL. According to Appendix A of FAR Part 150, (Part B Sec. A150.101, (e) (6)) the location of properties on or eligible for inclusion in the National Register of Historic Places must be identified on the Noise Exposure Maps. In addition, Sec A150.101 (c) indicates that if there are other uses with greater sensitivity to noise permitted by local government at a site, a determination of compatibility must be based on that use that is most adversely affected by noise.

- Fort Mifflin is frequently used for educational purposes; however, due to the close proximity and orientation to the runways at the Airport, educational programs are frequently interrupted by extremely low and loud aircraft operations. School groups visit the Fort year round to take part in a variety of educational programs, and from April through November the general public is welcomed to visit the Fort.

- The Fort is authorized to provide housing for a year round on-site caretaker, in order to maintain and provide security for the facility when it is closed and especially during the nighttime. Unfortunately, due to the extreme noise levels experienced at the Fort, the administration has not been able to take advantage of this option.

- The intent of this measure is to authorize and fund a detailed study to determine if potential noise mitigation measures, such as sound insulation, could be effective in reducing the interior noise levels at that location. Key to the effort will be identifying suitable and effective mitigation measures that would not alter the character of this historic resource. Areas of concentration should include those facilities at Fort Mifflin that are commonly used for educational purposes, daily business activities, and the caretaker's quarters.

- Land uses at Fort Mifflin such as a caretaker residence, business offices and public educational facilities would be considered sensitive uses. Therefore, only those specific areas of use at Fort Mifflin could be eligible for noise mitigation, and could be partially funded by the FAA.

- Effective mitigation could reduce the interior noise levels of the areas within Fort Mifflin used for caretaker housing as well as the portion of the visitor's center that is used for educational purposes and staff business offices. (See pages 2-5, 4-24 and 25)

FAA Action: Approved for study. Any recommendations to implement the results of the study would need to be included in an amendment to the Noise Compatibility Program.

PROGRAM MANAGEMENT

PM – 1: Establish a Noise Abatement Advisory Committee

Description: Using the Part 150 Study Advisory Committee as a basis of membership, request additional volunteers or appointments from local municipalities within the area affected by operations at the airport to serve on a continued Noise Abatement Advisory Committee. The purpose of this committee would be to maintain regular communication and exchange of ideas between the Airport and surrounding communities, to enhance community understanding of the constraints on airport users and operators, and to serve as a vehicle for disseminating information to the community. The committee would be advisory in nature and chaired by the Director of Aviation or his designee. The Airport Noise Office unit of the Airport's Marketing and Public Affairs department would handle administrative duties. The committee would meet quarterly, or as necessary at its convenience. The committee is intended to communicate the nature of land use compatibility to the community and to assist in describing the Airports Noise Compatibility Program. (See page 4-26 and Appendix G)

FAA Action: Approved

PM-2: Enhance the Airport's Noise Monitoring System

Description: The existing Airport Noise Monitoring System (ANMS) is aging and would benefit from an upgrade of computer hardware to increase the reliability of the system and the efficiency of the Noise Office staff. Upgrades should include increasing processor speed, increasing data storage capabilities, and enhancing noise monitoring and mapping software. Improvement of the system will better enable the Airport's Marketing and Public Affairs Noise Office staff to be responsive to community inquiries. (See page 4-27, Exhibit B-1 Appendix G,page G-4)

FAA Action: Approved. Criteria in FAA Order 5100.38B (or subsequent versions) Chapter 8 Noise Compatibility Projects, paragraph 813 Noise Monitoring Equipment/Systems, must be satisfied to be eligible for Federal financial assistance. For reasons of aviation safety, this approval does not extend to use of the monitoring equipment for enforcement purposes by in situ measurement of any present noise thresholds.

PM-3: Install additional noise monitors.

Discussion: Evaluate the locations and number of noise monitors existing at the airport to determine whether or not relocated or additional monitors would be beneficial to the airport and the community. Most likely, one additional monitor could be installed in Tinicum Township and another could be installed in the Brandywine Hundred section of Northern Wilmington, DE. Other locations will be determined as any modifications to flight locations resulting from the New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project become resolved. That project may suggest additional locations to both the east and west of the airport. Additionally, the results of the Airport's Master Planning effort may suggest the installation of monitors in other locations to better measure noise from future airport modifications that may be recommended. To accomplish this evaluation, the Airport may wish to employ outside services to assess existing locations, recommend future sites, and specify equipment and its placement. Alternately, the Airport's Marketing and Public Affairs department may assign this effort to its Noise Office staff as part of its regular duties, with support from a specialized consultant. Additional noise monitors would allow the Airport to have more and better data related to aircraft noise and flight paths that could be incorporated into planning studies. Additionally, long-term actual noise levels can then be shared with the communities that are affected by aircraft noise through the production of standard periodic reports. (See page 4-28, Exhibit B-1 and Appendix G)

FAA Action: Approved. Criteria in FAA Order 5100.38B (or subsequent versions) Chapter 8 Noise Compatibility Projects, paragraph 813 Noise Monitoring Equipment/Systems, must be satisfied to be eligible for Federal financial assistance. For reasons of aviation safety, this approval does not extend to use of the monitoring equipment for enforcement purposes by in situ measurement of any present noise thresholds.

PM-4 Establish full time Noise Office with staff.

Description: The role of the Noise Office, which is a sub unit of the Airport's Marketing and Public Affairs department, will likely increase when the Part 150 Noise Compatibility Program is approved. The other Program Management measures, which are intended to increase the lines of communication between the airport and its surrounding communities, as well as to improve the quality and efficiency of the Noise Office, may necessitate greater staffing. To meet the demands anticipated for this office, both by the Program Management measures and in the expected increase in responsibilities associated with the residential sound insulation program (LU-1) and the purchase/resale program (LU-2), a full time commitment will be required. Staffing, which could be adjusted as conditions warrant, should include both technical and public relations expertise. Clerical assistance may be dedicated to the office or shared with other administrative functions of the Airport.

The responsibilities of the Noise Office should include management of the Airport Noise Monitoring System (ANMS), management and oversight of the residential sound insulation program, coordination of the noise complaint function and coordination of the Noise Abatement Advisory Committee. The Office should also maintain communication with Air Traffic Control to assure understanding of modifications to the airspace utilization as a result of the New York/New Jersey/Philadelphia Metropolitan Airspace Redesign Project and other such efforts that may evolve from that Project. The Office should also participate in the review of development designs to comment upon the application of noise abatement standards in plans for physical development on the Airport (NA-7). The Noise Office is intended to provide a single point of contact for community involvement with Airport staff on noise related issues and to relieve senior Airport management of daily coordination functions related to aircraft noise. (See page 4-29 and Appendix G)

FAA Action: Approved

PM-5: Establish a pilot/community awareness program

Description: A pilot and community awareness program would be designed to deliver information prepared by the Noise Office to both users and neighbors of the Airport. Communications to the community would carry messages of anticipated changes in the nature or character of noise in the environs, based on construction or other actions that may produce noticeable differences between normal and abnormal conditions. These messages could be distributed through a developing mailing list of interested neighbors, beginning with the membership of the NAAC and attendees at Public Workshops held during the Part 150 Study, through press releases, and through other means of direct communication.

Communications with controllers, pilots and air carriers would be intended to inform them of the noise-sensitivity of various areas around the airport and to request their consideration in using quiet flying techniques over those areas. Additionally, printed materials may be produced for posting or distribution in crew lounges, at fixed base operator (FBO) flight planning centers, or potentially as insertable plates for the Jeppeson charts used by all commercial pilots. The specific form of such materials would become a responsibility of the Airport Noise Office. Improved communications between the airport and the neighboring communities would reduce the unexpected nature of changes and would explain the expected length of time changes might be in effect. (See page 4-30 and Appendix G)

FAA Action: Approved in concept. FAA will approve specific language prior to publication or distribution.

PM-6: Update the Noise Exposure Maps and Noise Compatibility Program

Description: The Noise Exposure Maps (NEMs) are likely to become outdated and will need to be brought current periodically. Given the concurrent Master Plan Study, it is expected that new Noise Exposure Maps will need to be produced in two to three years, upon completion of the planning process and prior to the implementation of any newly anticipated facilities. Following the initial update, the NEMs should continue to be updated at least every three years to consider changes in traffic and traffic flows, as well as updates of the noise modeling software.

The Noise Compatibility Program should be updated as necessary to reflect larger changes in the nature of aircraft noise surrounding the Airport. Should the Master Plan make recommendations that would enlarge the area of incompatible use exposed to aircraft noise above 65 DNL, or should major changes such as runway realignments or significant modifications to ground facilities be planned, the NCP should be updated prior to the implementation of those improvements. A full update may not be required, but rather, a targeted assessment of the changes occasioned by specific development projects may suffice to bring the NCP to currency and to qualify additional areas for NCP programs, if appropriate. After five years, if such changes occur, or if the number and character of operations changes significantly, the NCP should then be updated.

Periodically evaluate the need for an NEM or NCP update. If appropriate, retain a qualified planning consultant to conduct the updates, separately or together. Complete and publish the results, modifying or expanding NCP programmatic boundaries as appropriate at the time of update.

The measure provides for continuing planning and care in assuring the greatest compatibility between the airport and its environs. (See page 4-31 and Appendix G)

FAA Action: Approved.

APPENDIX B

NOISE CONTROL POLICIES AND GUIDANCE

There have been a number of laws, regulations, and guidance issued in the United States to assist the public in addressing health concerns, including noise. The Environmental Protection Agency (EPA) first issued guidance for the protection of public health and welfare against hearing loss, annoyance, and activity interference in 1974 (EPA, 1974). Commonly known as the "Levels Document," it identified thresholds for protection of public health with an adequate margin of safety for noise levels averaged over various time periods. Passage of the National Environmental Policy Act (NEPA) in 1970 led to the establishment of criteria for the evaluation of Federally-funded projects and their impact on the environment. The FAA has since issued two Orders to assist in implementing NEPA: FAA Order 1050.1E *Environmental Impacts: Policies and Procedures*, and FAA Order 5050.4B *National Environmental Policy Act (NEPA): Implementing Instructions for Airport Actions*. These Orders provide direction and guidance for evaluating noise impacts at airports, including the use of specific metrics and thresholds of significance for Federal actions.

Noise planning at airports has evolved from a series of legislative acts over the last 30 years. The Aviation Safety and Noise Abatement Act of 1979, or ASNA, was a landmark legislation that provided assistance to airport operators in the development and implementation of noise compatibility programs. ASNA further mandated that the FAA establish the use of an appropriate noise metric and also required that airports would have to develop a procedure to follow to receive noise compatibility program funding. ASNA directly led to the establishment of FAR Part 150. The Airport and Airway Improvement Act of 1982 established Federal funding standards for airports through the development of the Airport Improvement Program (AIP), which funds many airport noise mitigation and abatement programs today. The Act also addressed compatible land uses in the vicinity of airports, including zoning, to ensure the continued safe operation of flights. The Airport Noise and Capacity Act of 1990 (ANCA) was the key legislation that led to the eventual phase out of most Stage 2 (louder) aircraft, as certified under FAR Part 36, and which established review procedures for airport and access restrictions. The FAA has issued a number regulations designed to address noise. FAR Part 36, *Noise Standards: Aircraft Type and Airworthiness Certification*, released in 1974, certifies aircraft based on measured noise levels, initially into one of three categories, or Stages. FAR Part 91 established a phase out schedule of Stage 1 and, eventually, Stage 2 aircraft weighing more than 75,000 pounds. Stage 1 aircraft were eliminated from service completely in 1985, and Stage 2 aircraft under 75,000 pounds were phased out of the United States on December 31, 1999, following the passage of ANCA. Many of these aircraft were re-engined, meaning the aircraft engines were replaced or modified to meet the more stringent Stage 3 standards, and some remain in aircraft fleets today. At this point, no phase out schedules for Stage 1 and 2 aircraft less than 75,000 pounds, nor Stage 3 aircraft, have been identified.

FAR Part 150, Airport Noise Compatibility Planning, provides the regulatory guidance used to develop NEMs and an NCP. Part 150 describes methodologies to measure noise in the vicinity of airports that provides a "highly reliable relationship between projected noise exposure and surveyed reaction of people to noise" and determines individual noise exposure as a result of those aircraft operations. Importantly, Part 150 outlines the types of land uses that are typically considered compatible or incompatible with specific levels of aircraft noise. This guideline serves as a measurement of the effectiveness of an airport's plan (NCP) for mitigation purposes. FAR Part 161, established in 1990, formalized the procedure for airports to impose mandatory access restrictions, which are sometimes considered in a sponsor's Part 150 program to address flights by loud aircraft or flights at noise-sensitive times, such as overnight hours.

NOISE MODELLING

Day-Night Average Sound Level (DNL) Metric

ASNA directed the FAA to establish, by regulation, a single system for measuring noise exposure at airports and surrounding areas which would provide a highly reliable relationship between projected noise exposure and surveyed reactions of people to noise. The FAA adopted the Day-Night Average Sound Level (DNL) metric, the same metric prescribed in the EPA's *Guidelines for Noise Impact Analysis,* as the primary measure of general audible noise. All Federal agencies have now adopted DNL as the metric for airport noise analysis in NEPA documents. The DNL is the energy-average of the sound levels at a location over a 24-hour period, with a 10-decibel penalty added to nighttime events (between 10:00 p.m. and 7:00 a.m.). DNL represents average sound exposure during a 24-hour day, rather than the sound level heard at any particular time, and it accounts for both the duration and frequency of aircraft events.

The goal of the FAA's noise compatibility guidelines is to provide guidance that encourages appropriate land uses around all U.S. airports. The FAA guidelines specify that DNL is the noise metric used in defining land-use compatibility, and based on this guidance, FAR Part 150 studies, EAs, and Environmental Impact Statements (EIS) use the DNL 65 dB contour to identify the boundary between compatible and non-compatible land uses. Land uses subjected to levels less than DNL 65 dB are considered compatible with airport operations. **Table B-1** depicts the FAA's suggested land use compatibility and corresponding DNL sound levels.

The FAA and the Federal Interagency Committee on Aviation Noise (FICAN) recognize that local communities often want and need an alternative to DNL for addressing noise exposure and impact analysis. In an effort to provide additional tools for communicating with the community, this analysis includes supplemental noise metrics to assist in the identification of noise exposure in the study area. The FAA acknowledges the effectiveness of such analyses, but must be presented as supplements to the DNL noise contours required for the official Noise Exposure Maps (NEMs).

TABLE B-1: Land Use Compatibility with Yearly Day-Night Average Sound Levels (DNL)

Land Use	Day-Night Average Sound Level (DNL) in decibels					
	Below 65	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 lodging	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 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.

<u>KEY TO TABLE B.1</u> 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.

<u>NOTES FOR TABLE B.1</u>

(1) Where the community determines that residential or school uses must be allowed, measure to achieve outdoor to indoor Noise Level Reduction (NRL) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide an NRL 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 NRL criteria will not eliminate outdoor noise problems.
(2) Measures to achieve NRL 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 NRL 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 NRL 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 special sound reinforcement systems are installed.
(6) Residential buildings require an NRL of 25.
(7) Residential buildings require an NRL of 30.
(8) Residential buildings not permitted.

Noise Modeling Methodology

The required model used in evaluating noise exposure around an airport is the FAA's Integrated Noise Model (INM). The INM is a computer model designed to estimate long term noise exposure using the annual average number of operations of each aircraft type, using a given runway, and flying in a given direction. The model accepts fractions of operations, and models the directional distribution of operations based on the proportion of aircraft flying in different directions throughout the year. This is the standard approach to all aircraft noise modeling projects of this type, including those completed under NEPA and FAA Part 150. The INM version 7.0, which was the most recent version available at the time the study was initiated, was used to model noise exposure at PHL. All aircraft operations and input data used to derive the noise exposure contours were modeled in accordance with FAA standards established in Orders 1050.1E and 5050.4B.

The INM has many analytical uses, such as assessing changes in noise exposure resulting from new or extended runways or runway configurations, assessing new traffic demand and fleet mix, as well as evaluating operational procedures. Part 150 regulations require the use of an average annual day (AAD) condition, meaning that the analysis input has to take into account all aircraft that operate at the airport in a 365-day period, the runways and flight paths utilized, the profiles flown, and the time of day of the operations to create a 'typical' average daily noise exposure. As input, the INM uses information about the airfield configuration, average temperature and humidity, flight track locations, aircraft fleet mix, aircraft climb and descent profiles, runway utilization, and number of daily operations (day/night). The model includes flight characteristics for a wide variety of aircraft in both the commercial and military fleets, and works by computing the noise from each flight at a large number of grid points on the ground. Once all operations have been modeled and the sound levels summed for the grid points, noise contours are generated by connecting grid points with equal levels of noise exposure.

INM can also be used to predict noise levels from single events. Single flight predictions are generally accurate to within 3 to 5 dB when compared with field measurements, depending on such factors as weather, ground characteristics, pilot practice and the unique characteristics of individual aircraft. According to Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 4721, Part 1, *Monitoring of Aircraft Noise in the Vicinity of Airports*:

> Analytical models often have a 95% confidence interval of ±3 dB to ±5 dB. Therefore a difference of 3 dB between an estimate from measurements and one from an analytical model may not be significant. Neither estimate can be presumed to be the absolute: each has errors in the estimate it represents (SAE, 2003, p. 49).

Part 150 regulations require the use of an average annual day (AAD) condition, meaning that the analysis input has to take into account all aircraft that operate at the airport in a 365-day period, the runways and flight paths utilized, the profiles flown, and the time of day of the operations to create a 'typical' average daily noise exposure.

AIRPORT NOISE and ITS EFFECT on the ENVIRONMENT

Noise represents one of the most contentious environmental issues associated with aircraft operations. Although many other sources of noise are present in typical communities, because of its uniqueness, aircraft noise is readily identifiable and tends to stand out as an annoyance for many people. An assessment of aircraft noise requires a general understanding of how sound affects people and the natural environment and how it is measured.

1.0 Basics of Sound

Noise is unwanted sound. Sound is all around us; sound becomes noise when it interferes with normal activities, such as sleep or conversation.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Whether that sound is interpreted as pleasant (e.g., music) or unpleasant (e.g., jackhammers) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound.

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration. First, intensity is a measure of the acoustic energy of the sound vibrations and is expressed in terms of sound pressure. The greater the sound pressure, the more energy carried by the sound and the louder the perception of that sound. The second important physical characteristic of sound is frequency, which is the number of times per second the air vibrates or oscillates. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches. The third important characteristic of sound is duration or the length of time the sound can be detected.

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. Because of this vast range, using a linear scale to represent the intensity of sound becomes very unwieldy. As a result, a logarithmic unit known as the decibel (abbreviated dB) is used to represent the intensity of a sound. Such a representation is called a sound level. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB; sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 to 140 dB are felt as pain (Berglund and Lindvall 1995).

Because of the logarithmic nature of the decibel unit, sound levels cannot be arithmetically added or subtracted and are somewhat cumbersome to handle mathematically. However, some simple rules are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. For example:

60 dB + 60dB = 63 dB, and
80 dB + 80dB = 83 dB.

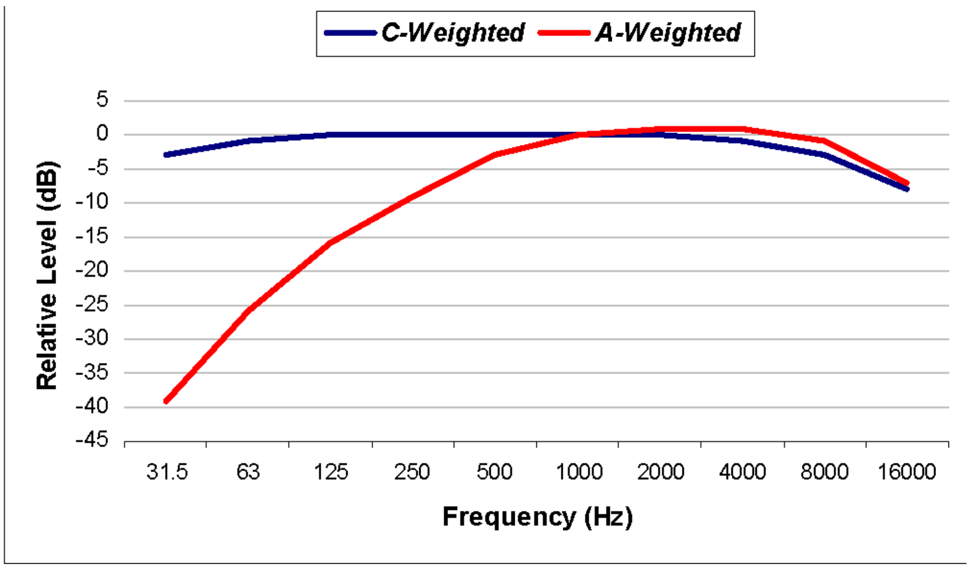
Second, the total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

Because the addition of sound levels is different than that of ordinary numbers, such addition is often referred to as "decibel addition" or "energy addition." The latter term arises from the fact that what we are really doing when we add decibel values is first converting each decibel value to its corresponding acoustic energy, then adding the energies using the normal rules of addition, and finally converting the total energy back to its decibel equivalent.

The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. On average, a person perceives a change in sound level of about 10 dB as a doubling (or halving) of the sound's loudness, and this relation holds true for loud and quiet sounds. A decrease in sound level of 10 dB actually represents a 90% decrease in sound intensity but only a 50% decrease in perceived loudness because of the nonlinear response of the human ear (similar to most human senses).

Sound frequency is measured in terms of cycles per second (cps), or hertz (Hz), which is the standard unit for cps. The normal human ear can detect sounds that range in frequency from about 20 Hz to about 15,000 Hz. All sounds in this wide range of frequencies, however, are not heard equally by the human ear, which is most sensitive to frequencies in the 1,000 to 4,000 Hz range. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most common weightings. A-weighting accounts for frequency dependence by adjusting the very high and very low frequencies (below approximately 500 Hz and above approximately 10,000 Hz) to approximate the human ear's lower sensitivities to those frequencies. C-weighting is nearly flat throughout the range of audible frequencies, hardly de-emphasizing the low frequency sound while approximating the human ear's sensitivity to higher intensity sounds. The two curves shown in Figure B-1 are also the most adequate to quantify environmental noises.



Source: ANSI S1.4 -1983 "Specification of Sound Level Meters"

Figure B-1. Frequency Response Characteristics of A and C Weighting Networks

1.1 A-weighted Sound Level

Sound levels that are measured using A-weighting, called A-weighted sound levels, are often denoted by the unit dBA or dB(A) rather than dB. When the use of A-weighting is understood, the adjective "A-weighted" is often omitted and the measurements are expressed as dB. In this report (as in most environmental impact documents), dB units refer to A-weighted sound levels.

Noise potentially becomes an issue when its intensity exceeds the ambient or background sound pressures. Ambient background noise in metropolitan, urbanized areas typically varies from 60 to 70 B and can be as high as 80 dB or greater; quiet suburban neighborhoods experience ambient noise levels of approximately 45-50 dB (U.S. Environmental Protection Agency 1978).

Figure B-2 is a chart of A-weighted sound levels from typical sounds. Some noise sources (air conditioner, vacuum cleaner) are continuous sounds which levels are constant for some time. Some (automobile, heavy truck) are the maximum sound during a vehicle pass-by. Some (urban daytime, urban nighttime) are averages over extended periods. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

Aircraft noise consists of two major types of sound events: aircraft takeoffs and landings, and engine maintenance operations. The former can be described as intermittent sounds and the latter as continuous. Noise levels from flight operations exceeding background noise typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contribution drops to lower levels, often becoming indistinguishable from the background.

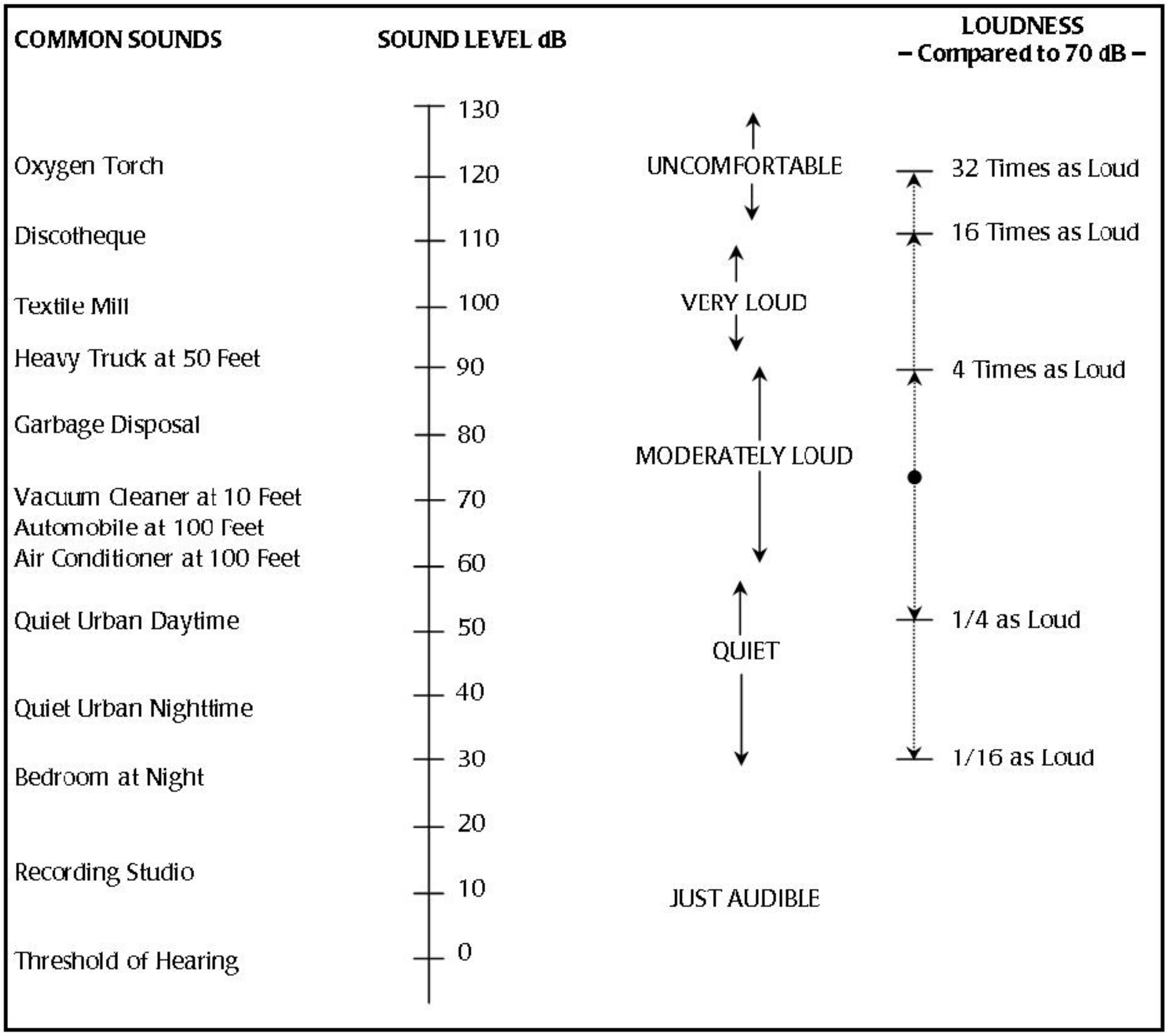
C-weighted Sound Level
Sound levels measured using a C-weighting are most appropriately called C-weighted sound levels (and denoted dBC). C-weighting is nearly flat throughout the audible frequency range, hardly de-mphasizing the low frequency. This weighting scale is generally used to describe impulsive sounds. Sounds that are characterized as impulsive generally contain low frequencies. Impulsive sounds may induce secondary effects, such as shaking of a structure, rattling of windows, inducing vibrations. These secondary effects can cause additional annoyance and complaints.

The following definitions in the American National Standard Institute (ANSI) Report S12.9, Part 4 provide general concepts helpful in understanding impulsive sounds (American National Standards Institute 1996).

Impulsive Sound: Sound characterized by brief excursions of sound pressure (acoustic impulses) that significantly exceeds the ambient environmental sound pressure. The duration of a single impulsive sound is usually less than one second (American National Standards Institute 1996).

Highly Impulsive Sound: Sound from one of the following enumerated categories of sound sources: small-arms gunfire, metal hammering, wood hammering, drop hammering, pile driving, drop forging, pneumatic hammering, pavement breaking, metal impacts during rail-yard shunting operation, and riveting.

High-energy Impulsive Sound: Sound from one of the following enumerated categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, military ordnance (e.g., armor, artillery and mortar fire, and bombs), explosive ignition of rockets and missiles, explosive industrial circuit breakers, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams.



Source: *Handbook of Noise Control*, C.M. Harris, Editor, McGraw-Hill Book Co., 1979, and FICAN 1992.

Figure B-2. Typical A-weighted Sound Levels of Common Sounds

1.2 Noise Metrics

As used in environmental noise analyses, a metric refers to the unit or quantity that quantitatively measures the effect of noise on the environment. To quantify these effects, the Department of Defense and the Federal Aviation Administration use three noise-measuring techniques, or metrics: first, a measure of the highest sound level occurring during an individual aircraft overflight (single event); second, a combination of the maximum level of that single event with its duration; and third, a description of the noise environment based on the cumulative flight and engine maintenance activity. Single noise events can be described with Sound Exposure Level or Maximum Sound Level. Another measure of instantaneous level is the Peak Sound Pressure Level. The cumulative energy noise metric used is the Day/Night Average Sound Level. Metrics related to DNL include the Onset-Rate Adjusted Day/Night Average Sound Level, and the Equivalent Sound Level. In the state of California, it is mandated that average noise be described in terms of Community Noise Equivalent Level (State of California 1990). CNEL represents the Day/Evening/Night average noise exposure, calculated over a 24-hour period. Metrics and their uses are described below.

1.2.1 Maximum Sound Level (Lmax)

The highest A-weighted integrated sound level measured during a single event in which the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or maximum sound level.

During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. The maximum sound level indicates the maximum sound level occurring for a fraction of a second. For aircraft noise, the “fraction of a second” over which the maximum level is defined is generally 1/8 second, and is denoted as “fast” response (American National Standards Institute 1988). Slowly varying or steady sounds are generally measured over a period of one second, denoted “slow” response. The maximum sound level is important in judging the interference caused by a noise event with conversation, TV or radio listening, sleep, or other common activities. Although it provides some measure of the intrusiveness of the event, it does not completely describe the total event, because it does not include the period of time that the sound is heard.

1.2.2 Peak Sound Pressure Level (Lpk)

The peak sound pressure level, is the highest instantaneous level obtained by a sound level measurement device. The peak sound pressure level is typically measured using a 20 microseconds or faster sampling rate, and is typically based on unweighted or linear response of the meter.

1.2.3 Sound Exposure Level (SEL)

Sound exposure level is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of the net impact of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL would include both the maximum noise level and the lower noise levels produced during onset and recess periods of the overflight.

SEL is a logarithmic measure of the total acoustic energy transmitted to the listener during the event. Mathematically, it represents the sound level of a constant sound that would, in one second, generate the same acoustic energy as the actual time-varying noise event. For sound from aircraft overflights, which typically lasts more than one second, the SEL is usually greater than the Lmax because an individual overflight takes seconds and the maximum sound level (Lmax) occurs instantaneously. SEL represents the best metric to compare noise levels from overflights.

1.2.4 Day-Night Average Sound Level (DNL) and Community Noise Equivalent Level (CNEL)

Day-Night Average Sound Level and Community Noise Equivalent Level are composite metrics that account for SEL of all noise events in a 24-hour period. In order to account for increased human sensitivity to noise at night, a 10 dB penalty is applied to nighttime events (10:00 p.m. to 7:00 a.m. time period). A variant of the DNL, the CNEL level includes a 5-decibel penalty on noise during the 7:00 p.m. to 10:00 p.m. time period, and a 10-decibel penalty on noise during the 10:00 p.m. to 7:00 a.m. time period.

The above-described metrics are average quantities, mathematically representing the continuous A-weighted or C-weighted sound level that would be present if all of the variations in sound level that occur over a 24-hour period were smoothed out so as to contain the same total sound energy. These composite metrics account for the maximum noise levels, the duration of the events (sorties or operations), and the number of events that occur over a 24-hour period. Like SEL, neither DNL nor CNEL represent the sound level heard at any particular time, but quantifies the total sound energy received. While it is normalized as an average, it represents all of the sound energy, and is therefore a cumulative measure.

The penalties added to both the DNL and CNEL metrics account for the added intrusiveness of sounds that occur during normal sleeping hours, both because of the increased sensitivity to noise during those hours and because ambient sound levels during nighttime are typically about 10 dB lower than during daytime hours.

The inclusion of daytime and nighttime periods in the computation of the DNL and CNEL reflects their basic 24-hour definition. It can, however, be applied over periods of multiple days. For application to civil airports, where operations are consistent from day to day, DNL and CNEL are usually applied as an annual average. For some military airbases, where operations are not necessarily consistent from day to day, a common practice is to compute a 24-hour DNL or CNEL based on an average busy day, so that the calculated noise is not diluted by periods of low activity.

Although DNL and CNEL provide a single measure of overall noise impact, they do not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. For example, a daily average sound level of 65 dB could result from a very few noisy events or a large number of quieter events.

Daily average sound levels are typically used for the evaluation of community noise effects (i.e., long-term annoyance), and particularly aircraft noise effects. In general, scientific studies and social surveys have found a high correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL (U.S. Environmental Protection Agency 1978 and Schultz 1978). The correlation from Schultz's original 1978 study is shown in Figure B-3. It represents the results of a large number of social surveys relating community responses to various types of noises, measured in day-night average sound level.

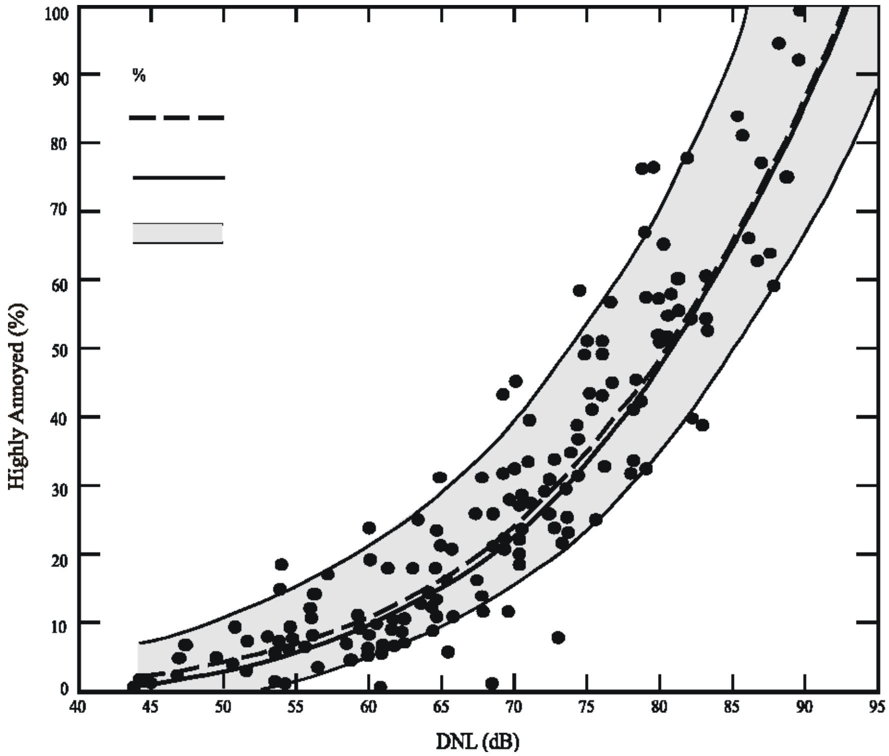


Figure B-3. Community Surveys of Noise Annoyance

A more recent study has reaffirmed this relationship (Fidell, et al. 1991). Figure B-4 (Federal Interagency Committee On Noise 1992) shows an updated form of the curve fit (Finegold, et al. 1994) in comparison with the original. The updated fit, which does not differ substantially from the original, is the current preferred form. In general, correlation coefficients of 0.85 to 0.95 are found between the percentages of groups of people highly annoyed and the level of average noise exposure. The correlation coefficients for the annoyance of individuals are relatively low, however, on the order of 0.5 or less. This is not surprising, considering the varying personal factors that influence the manner in which individuals react to noise. However, for the evaluation of community noise impacts, the scientific community has endorsed the use of DNL (American National Standards Institute 1980; American National Standards Institute 1988; U.S. Environmental Protection Agency 1974; Federal Interagency Committee On Urban Noise 1980 and Federal Interagency Committee On Noise 1992).

The use of DNL (CNEL in California) has been criticized as not accurately representing community annoyance and land-use compatibility with aircraft noise. Much of that criticism stems from a lack of understanding of the basis for the measurement or calculation of DNL. One frequent criticism is based on the inherent feeling that people react more to single noise events and not as much to “meaningless” time-average sound levels.

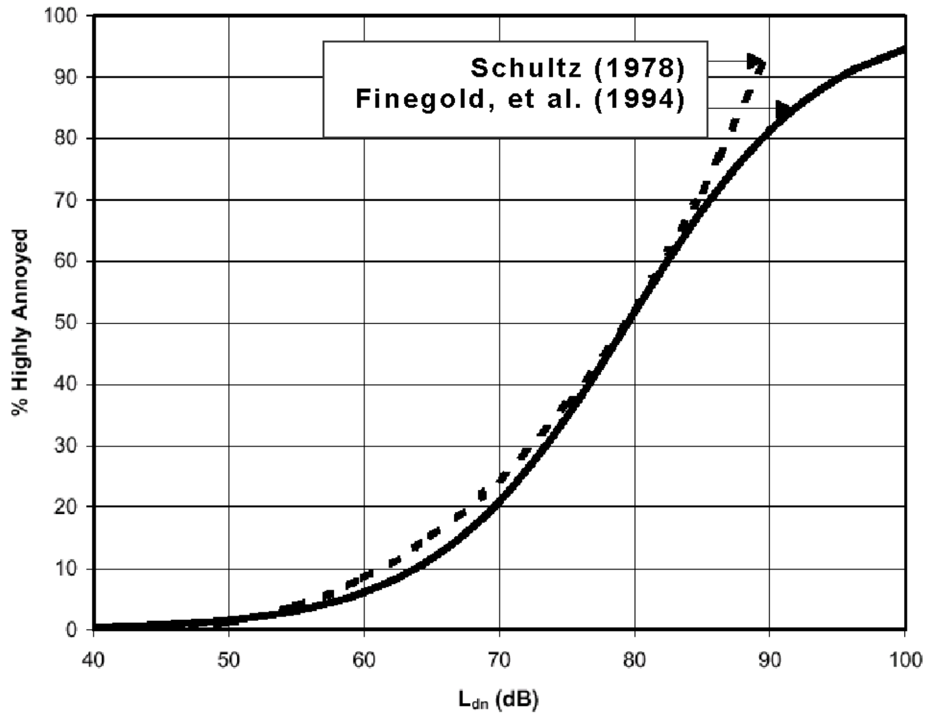


Figure B-4. Response of Communities to Noise; Comparison of Original (Schultz, 1978) and Current (Finegold, et al. 1994) Curve Fits

In fact, a time-average noise metric, such as DNL and CNEL, takes into account both the noise levels of all individual events that occur during a 24-hour period and the number of times those events occur. The logarithmic nature of the decibel unit causes the noise levels of the loudest events to control the 24-hour average.

As a simple example of this characteristic, consider a case in which only one aircraft overflight occurs during the daytime over a 24-hour period, creating a sound level of 100 dB for 30 seconds. During the remaining 23 hours, 59 minutes, and 30 seconds of the day, the ambient sound level is 50 dB. The day-night average sound level for this 24-hour period is 65.9 dB. Assume, as a second example, that 10 such 30-second overflights occur during daytime hours during the next 24-hour period, with the same ambient sound level of 50 dB during the remaining 23 hours and 55 minutes of the day. The day-night average sound level for this 24-hour period is 75.5 dB. Clearly, the averaging of noise over a 24-hour period does not ignore the louder single events and tends to emphasize both the sound levels and number of those events.

1. 2.5 Equivalent Sound Level (Leq)

Another cumulative noise metric that is useful in describing noise is the equivalent sound level. Leq is calculated to determine the steady-state noise level over a specified time period. The Leq metric can provide a more accurate quantification of noise exposure for a specific period, particularly for daytime periods when the nighttime penalty under the DNL metric is inappropriate.

Just as SEL has proven to be a good measure of the noise impact of a single event, Leq has been established to be a good measure of the impact of a series of events during a given time period. Also, while Leq is defined as an average, it is effectively a sum over that time period and is, thus, a measure of the cumulative impact of noise. For example, the sum of all noise-generating events during the period of 7 a.m. to 4 p.m. could provide the relative impact of noise generating events for a school day.

1.2.6 Rate Adjusted Day-Night Average Sound Level (Ldnr)

Military aircraft flying on Military Training Routes (MTRs) and in Restricted Areas/Ranges generate a noise environment that is somewhat different from that associated with airfield operations. As opposed to patterned or continuous noise environments associated with airfields, overflights along MTRs are highly sporadic, ranging from 10 per hour to less than one per week. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-airspeed flyover can have a rather sudden onset, exhibiting a rate of increase in sound level (onset rate) of up to 150 dB per second.

To represent these differences, the conventional SEL metric is adjusted to account for the “surprise” effect of the sudden onset of aircraft noise events on humans with an adjustment ranging up to 11 dB above the normal Sound Exposure Level (Stusnick, et al. 1992). Onset rates between 15 to 150 dB per second require an adjustment of 0 to 11 dB, while onset rates below 15 dB per second require no adjustment. The adjusted SEL is designated as the onset-rate adjusted sound exposure level (SELr).

Because of the sporadic, often seasonal, occurrences of aircraft overflights along MTRs and in Restricted Areas/Ranges, the number of daily operations is determined from the number of flying days in the calendar month with the highest number of operations in the affected airspace or MTR. This avoids dilution of the exposure from periods of low activity, much the way that the average busy day is used around military airbases. The cumulative exposure to noise in these areas is computed by DNL over the busy month, but using SELr instead of SEL. This monthly average is denoted Ldnmr. If onset rate adjusted DNL is computed over a period other than a month, it would be designated Ldnr and the period must be specified. In the state of California, a variant of the Ldnmr includes a penalty for evening operations (7 p.m. to 10 p.m) and is denoted CNELmr.

1.3 Noise Effects

1.3.1 Annoyance

The primary effect of aircraft noise on exposed communities is one of long-term annoyance. Noise annoyance is defined by the EPA as any negative subjective reaction on the part of an individual or group (U.S. Environmental Protection Agency 1974). As noted in the discussion of DNL above, community annoyance is best measured by that metric.

The results of attitudinal surveys, conducted to find percentages of people who express various degrees of annoyance when exposed to different levels of DNL, are very consistent. The most useful metric for assessing people’s responses to noise impacts is the percentage of the exposed population expected to be “highly annoyed.” A wide variety of responses have been used to determine intrusiveness of noise and disturbances of speech, sleep, television or radio listening, and outdoor living. The concept of “percent highly annoyed” has provided the most consistent response of a community to a particular noise environment. The response is remarkably complex, and when considered on an individual basis, widely varies for any given noise level (Federal Interagency Committee On Noise 1992).

A number of nonacoustic factors have been identified that may influence the annoyance response of an individual. Newman and Beattie (1985) divided these factors into emotional and physical variables:

Emotional Variables

- Feelings about the necessity or preventability of the noise;
- Judgment of the importance and value of the activity that is producing the noise;
- Activity at the time an individual hears the noise;
- Attitude about the environment;
- General sensitivity to noise;
- Belief about the effect of noise on health; and
- Feeling of fear associated with the noise.

Physical Variables

- Type of neighborhood;
- Time of day;
- Season;
- Predictability of noise;
- Control over the noise source; and
- Length of time an individual is exposed to a noise.

1.3.2 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance to individuals on the ground. The disruption of routine activities such as radio or television listening, telephone use, or family conversation gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings and can cause fatigue and vocal strain in those who attempt to communicate over the noise. Speech is an acoustic signal characterized by rapid fluctuations in sound level and frequency pattern. It is essential for optimum speech intelligibility to recognize these continually shifting sound patterns. Not only does noise diminish the ability to perceive the auditory signal, but it also reduces a listener's ability to follow the pattern of signal fluctuation. In general, interference with speech communication occurs when intrusive noise exceeds about 60 dB (Federal Interagency Committee On Noise 1992).

Indoor speech interference can be expressed as a percentage of sentence intelligibility among two people speaking in relaxed conversation approximately 3 feet apart in a typical living room or bedroom (U.S. Environmental Protection Agency 1974). The percentage of sentence intelligibility is a non-linear function of the (steady) indoor background A-weighted sound level. Such a curve-fit yields 100 percent sentence intelligibility for background levels below 57 dB and yields less than 10 percent intelligibility for background levels above 73 dB. The function is especially sensitive to changes in sound level between 65 dB and 75 dB. As an example of the sensitivity, a 1 dB increase in background sound level from 70 dB to 71 dB yields a 14 percent decrease in sentence intelligibility. The sensitivity of speech interference to noise at 65 dB and above is consistent with the criterion of DNL 65 dB generally taken from the Schultz curve. This is consistent with the observation that speech interference is the primary cause of annoyance.

1.3.3 Sleep Interference

Sleep interference is another source of annoyance and potential health concern associated with aircraft noise. Because of the intermittent nature and content of aircraft noise, it is more disturbing than continuous noise of equal energy. Given that quality sleep is requisite for good health, repeated occurrences of sleep interference could have an effect on overall health.

Sleep interference may be measured in either of two ways. "Arousal" represents actual awakening from sleep, while a change in "sleep stage" represents a shift from one of four sleep stages to another stage of lighter sleep without actual awakening. In general, arousal requires a somewhat higher noise level than does a change in sleep stage.

Sleep is not a continuous, uniform condition but a complex series of states through which the brain progresses in a cyclical pattern. Arousal from sleep is a function of a number of factors that include age, sex, sleep stage, noise level, frequency of noise occurrences, noise quality, and pre-sleep activity. Because individuals differ in their physiology, behavior, habitation, and ability to adapt to noise, few studies have attempted to establish noise criterion levels for sleep disturbance.

Lukas (1978) concluded the following with regard to human sleep response to noise:

Children 5 to 8 years of age are generally unaffected by noise during sleep.
Older people are more sensitive to sleep disturbance than younger people.
Women are more sensitive to noise than men, in general.

There is a wide variation in the sensitivity of individuals to noise even within the same age group.
Sleep arousal is directly proportional to the sound intensity of aircraft flyover. While there have been several studies conducted to assess the effect of aircraft noise on sleep, none have produced quantitative dose-response relationships in terms of noise exposure level, DNL, and sleep disturbance. Noise-sleep disturbance relationships have been developed based on single-event noise exposure.

An analysis sponsored by the U.S. Air Force summarized 21 published studies concerning the effects of noise on sleep (Pearsons, et al. 1989). The analysis concluded that a lack of reliable studies in homes, combined with large differences among the results from the various laboratory studies, did not permit development of an acceptably accurate assessment procedure. The noise events used in the laboratory studies and in contrived in-home studies were presented at much higher rates of occurrence than would normally be experienced in the home. None of the laboratory studies were of sufficiently long duration to determine any effects of habituation, such as that which would occur under normal community conditions.
A study of the effects of nighttime noise exposure on the in-home sleep of residents near one military airbase, near one civil airport, and in several households with negligible nighttime aircraft noise exposure, revealed SEL as the best noise metric predicting noise-related awakenings. It also determined that out of 930 subject nights, the average spontaneous (not noise-related) awakenings per night was 2.07 compared to the average number of noise-related awakenings per night of 0.24 (Fidell, et al. 1994). Additionally, a 1995 analysis of sleep disturbance studies conducted both in the laboratory environment and in the field (in the sleeping quarters of homes) showed that when measuring awakening to noise, a 10 dB increase in SEL was associated with only an 8 percent increase in the probability of awakening in the laboratory studies, but only a 1 percent increase in the field (Pearsons, et al. 1995). Pearsons, et al. (1995), reported that even SEL values as high as 85 dB produced no awakenings or arousals in at least one study. This observation suggests a strong influence of habituation on susceptibility to noise-induced sleep disturbance. A 1984 study (Kryter 1984) indicates that an indoor SEL of 65 dB or lower should awaken less than 5 percent of exposed individuals.

Nevertheless, some guidance is available in judging sleep interference. The EPA identified an indoor DNL of 45 dB as necessary to protect against sleep interference (U.S. Environmental Protection Agency 1978). Assuming a very conservative structural noise insulation of 20 dB for typical dwelling units, this corresponds to an outdoor day-night average sound level of 65 dB to minimize sleep interference.

In 1997, the Federal Interagency Committee on Aviation Noise (FICAN) adopted an interim guideline for sleep awakening prediction. The new curve, based on studies in England (Ollerhead, et al. 1992) and at two U.S. airports (Los Angeles International and Denver International), concluded that the incidence of sleep awakening from aircraft noise was less than identified in a 1992 study (Federal Interagency Committee On Noise 1992). Using indoor single-event noise levels represented by SEL, potential sleep awakening can be predicted using the curve presented in Figure B-5. Typically, homes in the United States provide 15 dB of sound attenuation with windows open and 25 dB with windows closed and air conditioning operating. Hence, the outdoor SEL of 107 dB would be 92 dB indoors with windows open and 82 dB indoors with windows closed and air conditioning operating.

Using Figure B-5, the potential sleep awakening would be 15% with windows open and 10% with windows closed in the above example.

The new FICAN curve does not address habituation over time by sleeping subjects and is applicable only to adult populations. Nevertheless, this curve provides a reasonable guideline for assessing sleep awakening. It is conservative, representing the upper envelope of field study results.

The FICAN curve shown in Figure B-5 represents awakenings from single events. To date, no exact quantitative dose-response relationship exists for noise-related sleep interference from multiple events; yet, based on studies conducted to date and the USEPA guideline of a 45 DNL to protect sleep interference, useful ways to assess sleep interference have emerged. If homes are conservatively estimated to have a 20-dB noise insulation, an average of 65 DNL would produce an indoor level of 45 DNL and would form a reasonable guideline for evaluating sleep interference. This also corresponds well to the general guideline for assessing speech interference. Annoyance that may result from sleep disturbance is accounted for in the calculation of DNL, which includes a 10-dB penalty for each sortie occurring after 10 pm or before 7 am.

1.3.4 Hearing Loss

Considerable data on hearing loss have been collected and analyzed. It has been well established that continuous exposure to high noise levels will damage human hearing (U.S. Environmental Protection Agency 1978). People are normally capable of hearing up to 120 dB over a wide frequency range. Hearing loss is generally interpreted as the shifting of a higher sound level of the ear's sensitivity or acuity to perceive sound. This change can either be temporary, called a temporary threshold shift (TTS), or permanent, called a permanent threshold shift (PTS) (Berger, et al. 1995).

The EPA has established 75 dB for an 8-hour exposure and 70 dB for a 24-hour exposure as the average noise level standard requisite to protect 96% of the population from greater than a 5 dB PTS (U.S. Environmental Protection Agency 1978). Similarly, the National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) identified 75 dB as the minimum level at which hearing loss may occur (Committee on Hearing, Bioacoustics, and Biomechanics 1977). However, it is important to note that continuous, long-term (40 years) exposure is assumed by both EPA and CHABA before hearing loss may occur.

Federal workplace standards for protection from hearing loss allow a time-average level of 90 dB over an 8-hour work period or 85 dB over a 16-hour period. Even the most protective criterion (no measurable hearing loss for the most sensitive portion of the population at the ear's most sensitive frequency, 4,000 Hz, after a 40-year exposure) is a time-average sound level of 70 dB over a 24-hour period.

Studies on community hearing loss from exposure to aircraft flyovers near airports showed that there is no danger, under normal circumstances, of hearing loss due to aircraft noise (Newman and Beattie 1985). A laboratory study measured changes in human hearing from noise representative of low-flying aircraft on MTRs. (Nixon, et al. 1993). In this study, participants were first subjected to four overflight noise exposures at A-weighted levels of 115 dB to 130 dB. One-half of the subjects showed no change in hearing levels, one-fourth had a temporary 5-dB increase in sensitivity (the people could hear a 5-dB wider range of sound than before exposure), and one-fourth had a temporary 5-dB decrease in sensitivity (the people could hear a 5-dB narrower range of sound than before exposure). In the next phase, participants were subjected to a single overflight at a maximum level of 130 dB for eight successive exposures, separated by 90 seconds or until a temporary shift in hearing was observed. The temporary hearing threshold shifts resulted in the participants hearing a wider range of sound, but within 10 dB of their original range.

In another study of 115 test subjects between 18 and 50 years old, temporary threshold shifts were measured after laboratory exposure to military low-altitude flight (MLAF) noise (Ising, et al. 1999). According to the authors, the results indicate that repeated exposure to MLAF noise with Lmax greater than 114 dB, especially if the noise level increases rapidly, may have the potential to cause noise induced hearing loss in humans.

Because it is unlikely that airport neighbors will remain outside their homes 24 hours per day for extended periods of time, there is little possibility of hearing loss below a day-night average sound level of 75 dB, and this level is extremely conservative.

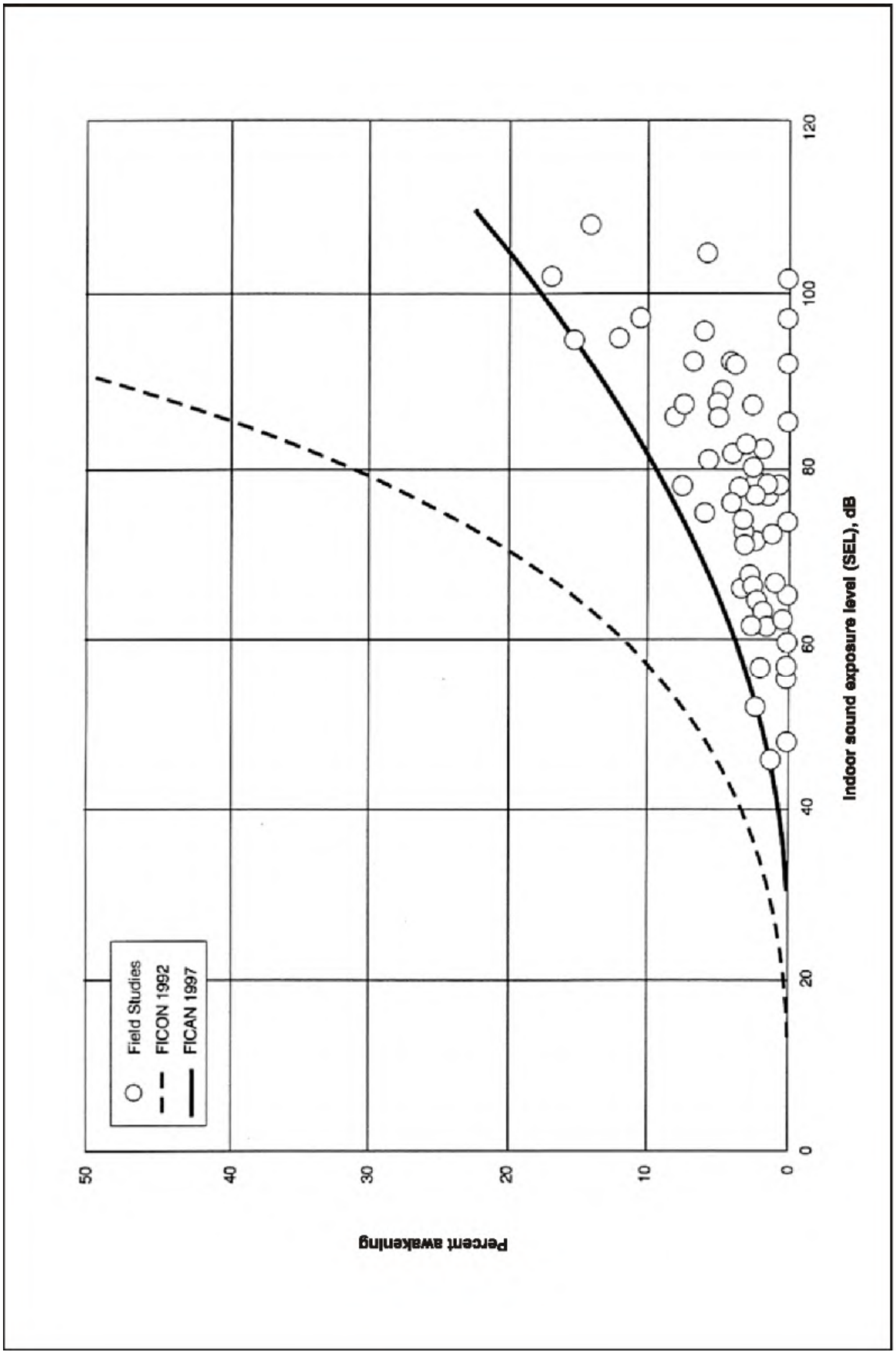


Figure B-5
Recommended Sleep Disturbance Dose-Response Relationship

1.3.5 Nonauditory Health Effects

Studies have been conducted to determine whether correlations exist between noise exposure and cardiovascular problems, birth weight, and mortality rates. The nonauditory effect of noise on humans is not as easily substantiated as the effect on hearing. The results of studies conducted in the United States, primarily concentrating on cardiovascular response to noise, have been contradictory (Cantrell 1974). Cantrell (1974) concluded that the results of human and animal experiments show that average or intrusive noise can act as a stress-provoking stimulus. Prolonged stress is known to be a contributor to a number of health disorders. Kryter and Poza (1980) state, "It is more likely that noise-related general ill-health effects are due to the psychological annoyance from the noise interfering with normal everyday behavior, than it is from the noise eliciting, because of its intensity, reflexive response in the autonomic or other physiological systems of the body." Psychological stresses may cause a physiological stress reaction that could result in impaired health.

The National Institute for Occupational Safety and Health and EPA commissioned CHABA in 1981 to study whether established noise standards are adequate to protect against health disorders other than hearing defects. CHABA's conclusion was that:

> Evidence from available research reports is suggestive, but it does not provide definitive answers to the question of health effects, other than to the auditory system, of long-term exposure to noise. It seems prudent, therefore, in the absence of adequate knowledge as to whether or not noise can produce effects upon health other than damage to auditory system, either directly or mediated through stress, that insofar as feasible, an attempt should be made to obtain more critical evidence.

Since the CHABA report, there have been more recent studies that suggest that noise exposure may cause hypertension and other stress-related effects in adults. Near an airport in Stockholm, Sweden, the prevalence of hypertension was reportedly greater among nearby residents who were exposed to energy averaged noise levels exceeding 55 dB and maximum noise levels exceeding 72 dB, particularly older subjects and those not reporting impaired hearing ability (Rosenlund, et al. 2001). A study of elderly volunteers who were exposed to simulated military low-altitude flight noise reported that blood pressure was raised by Lmax of 112 dB and high speed level increase (Michalak, et al. 1990). Yet another study of subjects exposed to varying levels of military aircraft or road noise found no significant relationship between noise level and blood pressure (Pulles, et al. 1990).

The U.S. Department of the Navy prepared a programmatic Environmental Assessment (EA) for the continued use of non-explosive ordnance on the Vieques Inner Range. Following the preparation of the EA, it was learned that research conducted by the University of Puerto Rico, Ponce School of Medicine, suggested that Vieques fishermen and their families were experiencing symptoms associated with vibroacoustic disease (VAD) (U.S. Department of the Navy 2002). The study alleged that exposure to noise and sound waves of large pressure amplitudes within lower frequency bands, associated with Navy training activities—specifically, air-to-ground bombing or naval fire support— was related to a larger prevalence of heart anomalies within the Vieques fishermen and their families. The Ponce School of Medicine study compared the Vieques group with a group from Ponce Playa. A 1999 study conducted on Portuguese aircraft-manufacturing workers from a single factory reported effects of jet aircraft noise exposure that involved a wide range of symptoms and disorders, including the cardiac issues on which the Ponce School of Medicine study focused. The 1999 study identified these effects as VAD.

Johns Hopkins University (JHU) conducted an independent review of the Ponce School of Medicine study, as well as the Portuguese aircraft workers study and other relevant scientific literature. Their findings concluded that VAD should not be accepted as a syndrome, given that exhaustive research across a number of populations has not yet been conducted. JHU also pointed out that the evidence supporting the existence of VAD comes largely from one group of investigators and that similar results would have to be replicated by other investigators. In short, JHU concluded that it had not been established that noise was the causal agent for the symptoms reported and no inference can be made as to the role of noise from naval gunfire in producing echocardiographic abnormalities

(U.S. Department of the Navy 2002).

Most studies of nonauditory health effects of long-term noise exposure have found that noise exposure levels established for hearing protection will also protect against any potential nonauditory health effects, at least in workplace conditions. One of the best scientific summaries of these findings is contained in the lead paper at the National Institutes of Health Conference on Noise and Hearing Loss, held on 22 to 24 January 1990 in Washington, D.C.:

> “The nonauditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease, and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dBA for complete protection against hearing loss for an 8-hour day). At the recent (1988) International Congress on Noise as a Public Health Problem, most studies attempting to clarify such health effects did not find them at levels below the criteria protective of noise-induced hearing loss, and even above these criteria, results regarding such health effects were ambiguous. Consequently, one comes to the conclusion that establishing and enforcing exposure levels protecting against noise-induced hearing loss would not only solve the noise-induced hearing loss problem, but also any potential nonauditory health effects in the work place” (von Gierke 1990).

Although these findings were specifically directed at noise effects in the workplace, they are equally applicable to aircraft noise effects in the community environment. Research studies regarding the nonauditory health effects of aircraft noise are ambiguous, at best, and often contradictory. Yet, even those studies that purport to find such health effects use time-average noise levels of 75 dB and higher for their research.

For example, two UCLA researchers apparently found a relationship between aircraft noise levels under the approach path to Los Angeles International Airport (LAX) and increased mortality rates among the exposed residents by using an average noise exposure level greater than 75 dB for the “noise-exposed” population (Meacham and Shaw 1979). Nevertheless, three other UCLA professors analyzed those same data and found no relationship between noise exposure and mortality rates (Frerichs, et al. 1980).
As a second example, two other UCLA researchers used this same population near LAX to show a higher rate of birth defects for 1970 to 1972 when compared with a control group residing away from the airport (Jones and Tauscher 1978). Based on this report, a separate group at the Center for Disease Control performed a more thorough study of populations near Atlanta’s Hartsfield International Airport (ATL) for 1970 to 1972 and found no relationship in their study of 17 identified categories of birth defects to aircraft noise levels above 65 dB (Edmonds, et al. 1979).

In summary, there is no scientific basis for a claim that potential health effects exist for aircraft time-average sound levels below 75 dB.

The potential for noise to affect physiological health, such as the cardiovascular system, has been speculated; however, no unequivocal evidence exists to support such claims (Harris 1997). Conclusions drawn from a review of health effect studies involving military low-altitude flight noise with its unusually high maximum levels and rapid rise in sound level have shown no increase in cardiovascular disease (Schwartze and Thompson 1993). Additional claims that are unsupported include flyover noise producing increased mortality rates and increases in cardiovascular death, aggravation of post-traumatic stress syndrome, increased stress, increase in admissions to mental hospitals, and adverse affects on pregnant women and the unborn fetus (Harris 1997).

1.3.6 Performance Effects

The effect of noise on the performance of activities or tasks has been the subject of many studies. Some of these studies have established links between continuous high noise levels and performance loss. Noise-induced performance losses are most frequently reported in studies employing noise levels in excess of 85 dB. Little change has been found in low-noise cases. It has been cited that moderate noise levels appear to act as a stressor for more sensitive individuals performing a difficult psychomotor task. While the results of research on the general effect of periodic aircraft noise on performance have yet to yield definitive criteria, several general trends have been noted including:

A periodic intermittent noise is more likely to disrupt performance than a steady-state continuous noise of the same level. Flyover noise, due to its intermittent nature, might be more likely to disrupt performance than a steady-state noise of equal level.

Noise is more inclined to affect the quality than the quantity of work.

Noise is more likely to impair the performance of tasks that place extreme demands on the worker.

1.3.7 Noise Effects on Children

In response to noise-specific and other environmental studies, Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (1997), requires federal agencies to ensure that policies, programs, and activities address environmental health and safety risks to identify any disproportionate risks to children.

A review of the scientific literature indicates that there has not been a tremendous amount of research in the area of aircraft noise effects on children. The research reviewed does suggest that environments with sustained high background noise can have variable effects, including noise effects on learning and cognitive abilities, and reports of various noise-related physiological changes.

1.3.7.1 Effects on Learning and Cognitive Abilities

In 2002 release of the “Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools,” the American National Standards Institute refers to studies that suggest that loud and frequent background noise can affect the learning patterns of young children. ANSI provides discussion on the relationships between noise and learning, and stipulates design requirements and acoustical performance criteria for outdoor-to-indoor noise isolation. School design is directed to be cognizant of, and responsive to, surrounding land uses and the shielding of outdoor noise from the indoor environment. ANSI has approved a new standard for acoustical performance criteria in schools. The new criteria include the requirement that the one-hour-average background noise level shall not exceed 35 dBA in core learning spaces smaller than 20,000 cubic-feet and 40 dBA in core learning spaces with enclosed volumes exceeding 20,000 cubic-feet. This would require schools be constructed such that, in quiet neighborhoods indoor noise levels are lowered by 15 to 20 dBA relative to outdoor levels. In schools near airports, indoor noise levels would have to be lowered by 35 to 45 dBA relative to outdoor levels (American National Standards Institute 2002).

The studies referenced by ANSI to support the new standard are not specific to jet aircraft noise and the potential effects on children. However, there are references to studies that have shown that children in noisier classrooms scored lower on a variety of tests. Excessive background noise or reverberation within schools causes interferences of communication and can therefore create an acoustical barrier to learning (American National Standards Institute 2002). Studies have been performed that contribute to the body of evidence emphasizing the importance of communication by way of the spoken language to the development of cognitive skills. The ability to read, write, comprehend, and maintain attentiveness, are, in part, based upon whether teacher communication is consistently intelligible (American National Standards Institute 2002).

Numerous studies have shown varying degrees of effects of noise on the reading comprehension, attentiveness, puzzle-solving, and memory/recall ability of children. It is generally accepted that young children are more susceptible than adults to the effects of background noise. Because of the developmental status of young children (linguistic, cognitive, and proficiency), barriers to hearing can cause interferences or disruptions in developmental evolution.

Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of schoolchildren. Although many factors could contribute to learning deficits in school-aged children (e.g., socioeconomic level, home environment, diet, sleep patterns), evidence exists that suggests that chronic exposure to high aircraft noise levels can impair learning.

Specifically, elementary school children attending schools near New York City's two airports demonstrated lower reading scores than children living farther away from the flight paths (Green, et al. 1982). Researchers have found that tasks involving central processing and language comprehension (such as reading, attention, problem solving, and memory) appear to be the most affected by noise (Evans and Lepore 1993; Hygge 1994; and Evans, et al. 1998). It has been demonstrated that chronic exposure of first- and second-grade children to aircraft noise can result in reading deficits and impaired speech perception (i.e., the ability to hear common, low-frequency [vowel] sounds but not high frequencies [consonants] in speech) (Evans and Maxwell 1997).

The Evans and Maxwell (1997) study found that chronic exposure to aircraft noise resulted in reading deficits and impaired speech perception for first- and second-grade children. Other studies found that children residing near the Los Angeles International Airport had more difficulty solving cognitive problems and did not perform as well as children from quieter schools in puzzle-solving and attentiveness (Bronzaft 1997; Cohen, et al. 1980). Children attending elementary schools in high aircraft noise areas near London's Heathrow Airport demonstrated poorer reading comprehension and selective cognitive impairments (Haines, et al. 2001a, and 2001b). Similarly, a study conducted by Hygge (1994) found that students exposed to aircraft noise (76 dBA) scored 20% lower on recall ability tests than students exposed to ambient noise (42-44 dBA). Similar studies involving the testing of attention, memory, and reading comprehension of schoolchildren located near airports showed that their tests exhibited reduced performance results compared to those of similar groups of children who were located in quieter environments (Evans, et al. 1998; Haines, et al. 1998). The Haines and Stansfeld study indicated that there may be some long-term effects associated with exposure, as one-year follow-up testing still demonstrated lowered scores for children in higher noise schools (Haines, et al. 2001a, and 2001b). In contrast, a study conducted by Hygge, et al. (2002) found that although children living near the old Munich airport scored lower in standardized reading and long-term memory tests than a control group, their performance on the same tests was equal to that of the control group once the airport was closed.

Finally, although it is recognized that there are many factors that could contribute to learning deficits in school-aged children, there is increasing awareness that chronic exposure to high aircraft noise levels may impair learning. This awareness has led the World Health Organization and a North Atlantic Treaty Organization working group to conclude that daycare centers and schools should not be located near major sources of noise, such as highways, airports, and industrial sites (World Health Organization 2000; North Atlantic Treaty Organization 2000).

1.3.7.2 Health Effects

Physiological effects in children exposed to aircraft noise and the potential for health effects have also been the focus of limited investigation. Studies in the literature include examination of blood pressure levels, hormonal secretions, and hearing loss.

As a measure of stress response to aircraft noise, authors have looked at blood pressure readings to monitor children's health. Children who were chronically exposed to aircraft noise from a new airport near Munich, Germany, had modest (although significant) increases in blood pressure, significant increases in stress hormones, and a decline in quality of life (Evans, et al. 1998). Children attending noisy schools had statistically significant average systolic and diastolic blood pressure ($p<0.03$). Systolic blood pressure means were 89.68 mm for children attending schools located in noisier environments compared to 86.77 mm for a control group. Similarly, diastolic blood pressure means for the noisier environment group were 47.84 mm and 45.16 for the control group (Cohen, et al. 1980).

Although the literature appears limited, relatively recent studies focused on the wide range of potential effects of aircraft noise on school children have also investigated hormonal levels between groups of children exposed to aircraft noise compared to those in a control group. Specifically, Haines, et al. (2001b and 2001c) analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise. In both instances, there were no differences between the aircraft-noise-exposed children and the control groups.

Other studies have reported hearing losses from exposure to aircraft noise. Noise-induced hearing loss was reportedly higher in children who attended a school located under a flight path near a Taiwan airport, as compared to children at another school far away (Chen, et al. 1997). Another study reported that hearing ability was reduced significantly in individuals who lived near an airport and were frequently exposed to aircraft noise (Chen and Chen 1993). In that study, noise exposure near the airport was reportedly uniform, with DNL greater than 75 dB and maximum noise levels of about 87 dB during overflights. Conversely, several other studies that were reviewed reported no difference in hearing ability between children exposed to high levels of airport noise and children located in quieter areas (Fisch 1977; Andrus, et al. 1975; Wu, et al. 1995).

1.3.8 Effects on Domestic Animals and Wildlife

Hearing is critical to an animal's ability to react, compete, reproduce, hunt, forage, and survive in its environment. While the existing literature does include studies on possible effects of jet aircraft noise and sonic booms on wildlife, there appears to have been little concerted effort in developing quantitative comparisons of aircraft noise effects on normal auditory characteristics. Behavioral effects have been relatively well described, but the larger ecological context issues, and the potential for drawing conclusions regarding effects on populations, has not been well developed.

The relationships between potential auditory/physiological effects and species interactions with their environments are not well understood. Manci, et al. (1988), assert that the consequences that physiological effects may have on behavioral patterns is vital to understanding the long-term effects of noise on wildlife. Questions regarding the effects (if any) on predator-prey interactions, reproductive success, and intra-inter specific behavior patterns remain.

The following discussion provides an overview of the existing literature on noise effects (particularly jet aircraft noise) on animal species. The literature reviewed here involves those studies that have focused on the observations of the behavioral effects that jet aircraft and sonic booms have on animals.
A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on the public and the potential for adverse ecological impacts. These studies were largely completed in response to the increase in air travel and as a result of the introduction of supersonic jet aircraft. According to Manci, et al. (1988), the foundation of information created from that focus does not necessarily correlate or provide information specific to the impacts to wildlife in areas overflown by aircraft at supersonic speed or at low altitudes.

The abilities to hear sounds and noise and to communicate assist wildlife in maintaining group cohesiveness and survivorship. Social species communicate by transmitting calls of warning, introduction, and other types that are subsequently related to an individual's or group's responsiveness.

Animal species differ greatly in their responses to noise. Noise effects on domestic animals and wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system, and most likely include the masking of auditory signals. Masking is defined as the inability of an individual to hear important environmental signals that may arise from mates, predators, or prey. There is some potential that noise could disrupt a species' ability to communicate or could interfere with behavioral patterns (Manci, et al. 1988). Although the effects are likely temporal, aircraft noise may cause masking of auditory signals within exposed faunal communities. Animals rely on hearing to avoid predators, obtain food, and communicate with, and attract, other members of their species. Aircraft noise may mask or interfere with these functions. Other primary effects, such as ear drum rupture or temporary and permanent hearing threshold shifts, are not as likely given the subsonic noise levels produced by aircraft overflights. Secondary effects may include non-auditory effects such as stress and hypertension; behavioral modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects, and include population decline and habitat loss. Most of the effects of noise are mild enough that they may never be detectable as variables of change in population size or population growth against the background of normal variation (Bowles 1995). Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) also influence secondary and tertiary effects, and confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith, et al. 1988). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci, et al. 1988).

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife “flight” due to noise. Apparently, animal responses to aircraft are influenced by many variables, including size, speed, proximity (both height above the ground and lateral distance), engine noise, color, flight profile, and radiated noise. The type of aircraft (e.g., fixed wing versus rotor-wing [helicopter]) and type of flight mission may also produce different levels of disturbance, with varying animal responses (Smith, et al. 1988). Consequently, it is difficult to generalize animal responses to noise disturbances across species.

One result of the 1988 Manci, et al., literature review was the conclusion that, while behavioral observation studies were relatively limited, a general behavioral reaction in animals from exposure to aircraft noise is the startle response. The intensity and duration of the startle response appears to be dependent on which species is exposed, whether there is a group or an individual, and whether there have been some previous exposures. Responses range from flight, trampling, stampeding, jumping, or running, to movement of the head in the apparent direction of the noise source. Manci, et al. (1988), reported that the literature indicated that avian species may be more sensitive to aircraft noise than mammals.

1.3.8.2 Wildlife

Studies on the effects of overflights and sonic booms on wildlife have been focused mostly on avian species and ungulates such as caribou and bighorn sheep. Few studies have been conducted on marine mammals, small terrestrial mammals, reptiles, amphibians, and carnivorous mammals. Generally, species that live entirely below the surface of the water have also been ignored due to the fact they do not experience the same level of sound as terrestrial species (National Park Service 1994). Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock (Manci, et al. 1988). This may be due to previous exposure to disturbances. One common factor appears to be that low-altitude flyovers seem to be more disruptive in terrain where there is little cover (Manci, et al. 1988).

1.3.8.2.1 MAMMALS

Terrestrial Mammals

Studies of terrestrial mammals have shown that noise levels of 120 dBA can damage mammals’ ears, and levels at 95 dBA can cause temporary loss of hearing acuity. Noise from aircraft has affected other large carnivores by causing changes in home ranges, foraging patterns, and breeding behavior. One study recommended that aircraft not be allowed to fly at altitudes below 2,000 feet above ground level over important grizzly and polar bear habitat (Dufour 1980). Wolves have been frightened by low-altitude flights that were 25 to 1,000 feet off the ground. However, wolves have been found to adapt to aircraft overflights and noise as long as they were not being hunted from aircraft (Dufour 1980).

Wild ungulates (American bison, caribou, bighorn sheep) appear to be much more sensitive to noise disturbance than domestic livestock (Weisenberger, et al. 1996). Behavioral reactions may be related to the past history of disturbances by such things as humans and aircraft. Common reactions of reindeer kept in an enclosure exposed to aircraft noise disturbance were a slight startle response, raising of the head, pricking ears, and scenting of the air. Panic reactions and extensive changes in behavior of individual animals were not observed. Observations of caribou in Alaska exposed to fixed-wing aircraft and helicopters showed running and panic reactions occurred when overflights were at an altitude of 200 feet or less. The reactions decreased with increased altitude of overflights, and, with more than 500 feet in altitude, the panic reactions stopped. Also, smaller groups reacted less strongly than larger groups. One negative effect of the running and avoidance behavior is increased expenditure of energy. For a 90-kg animal, the calculated expenditure due to aircraft harassment is 64 kilocalories per minute when running and 20 kilocalories per minute when walking. When conditions are favorable, this expenditure can be counteracted with increased feeding; however, during harsh winter conditions, this may not be possible. Incidental observations of wolves and bears exposed to fixed-wing aircraft and helicopters in the northern regions suggested that wolves are less disturbed than wild ungulates, while grizzly bears showed the greatest response of any animal species observed.

It has been proven that low-altitude overflights do induce stress in animals. Increased heart rates, an indicator of excitement or stress, have been found in pronghorn antelope, elk, and bighorn sheep. As such reactions occur naturally as a response to predation, infrequent overflights may not, in and of themselves, be detrimental. However, flights at high frequencies over a long period of time may cause harmful effects. The consequences of this disturbance, while cumulative, is not additive. It may be that aircraft disturbance may not cause obvious and serious health effects, but coupled with a harsh winter, it may have an adverse impact. Research has shown that stress induced by other types of disturbances produces long-term decreases in metabolism and hormone balances in wild ungulates.

Behavioral responses can range from mild to severe. Mild responses include head raising, body shifting, or turning to orient toward the aircraft. Moderate disturbance may be nervous behaviors, such as trotting a short distance. Escape is the typical severe response.

Marine Mammals
The physiological composition of the ear in aquatic and marine mammals exhibits adaptation to the aqueous environment. These differences (relative to terrestrial species) manifest themselves in the auricle and middle ear (Manci, et al. 1988). Some mammals use echolocation to perceive objects in their surroundings and to determine the directions and locations of sound sources (Simmons 1983 in Manci, et al. 1988).

In 1980, the Acoustical Society of America held a workshop to assess the potential hazard of manmade noise associated with proposed Alaska Arctic (North Slope-Outer Continental Shelf) petroleum operations on marine wildlife and to prepare a research plan to secure the knowledge necessary for proper assessment of noise impacts (Acoustical Society of America, 1980). Since 1980 it appears that research on responses of aquatic mammals to aircraft noise and sonic booms has been limited. Research conducted on northern fur seals, sea lions, and ringed seals indicated that there are some differences in how various animal groups receive frequencies of sound. It was observed that these species exhibited varying intensities of a startle response to airborne noise, which was habituated over time. The rates of habituation appeared to vary with species, populations, and demographics (age, sex). Time of day of exposure was also a factor (Muyberg 1978 in Manci, et al. 1988).

Studies accomplished near the Channel Islands were conducted near the area where the space shuttle launches occur. It was found that there were some response differences between species relative to the loudness of sonic booms. Those booms that were between 80 and 89 dBA caused a greater intensity of startle reactions than lower-intensity booms at 72 to 79 dBA. However, the duration of the startle responses to louder sonic booms was shorter (Jehl and Cooper 1980 in Manci, et al. 1988).

Jehl and Cooper (1980) indicated that low-flying helicopters, loud boat noises, and humans were the most disturbing to pinnipeds. According to the research, while the space launch and associated operational activity noises have not had a measurable effect on the pinniped population, it also suggests that there was a greater “disturbance level” exhibited during launch activities. There was a recommendation to continue observations for behavioral effects and to perform long-term population monitoring (Jehl and Cooper 1980).

The continued presence of single or multiple noise sources could cause marine mammals to leave a preferred habitat. However, it does not appear likely that overflights could cause migration from suitable habitats as aircraft noise over water is mobile and would not persist over any particular area. Aircraft noise, including supersonic noise, currently occurs in the overwater airspace of Eglin, Tyndall, and Langley AFBs from sorties predominantly involving jet aircraft. Survey results reported in Davis, et al. (2000), indicate that cetaceans (i.e., dolphins) occur under all of the Eglin and Tyndall marine airspace. The continuing presence of dolphins indicates that aircraft noise does not discourage use of the area and apparently does not harm the locally occurring population.

In a summary by the National Parks Service (1994) on the effects of noise on marine mammals, it was determined that gray whales and harbor porpoises showed no outward behavioral response to aircraft noise or overflights. Bottlenose dolphins showed no obvious reaction in a study involving helicopter overflights at 1,200 to 1,800 feet above the water. Neither did they show any reaction to survey aircraft unless the shadow of the aircraft passed over them, at which point there was some observed tendency to dive (Richardson, et al. 1995). Other anthropogenic noises in the marine environment from ships and pleasure craft may have more of an effect on marine mammals than aircraft noise (U.S. Air Force 2000). The noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna along the coast of California have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc. 1997).

Manatees appear relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats [although their hearing is actually similar to that of pinnipeds (Bullock, et al. 1980)]. Little is known about the importance of acoustic communication to manatees, although they are known to produce at least ten different types of sounds and are thought to have sensitive hearing (Richardson, et al. 1995). Manatees continue to occupy canals near Miami International Airport, which suggests that they have become habituated to human disturbance and noise (Metro-Dade County 1995). Since manatees spend most of their time below the surface and do not startle readily, no effect of aircraft overflights on manatees would be expected (Bowles, et al. 1991b).

1.3.8.2.2 BIRDS

Auditory research conducted on birds indicates that they fall between the reptiles and the mammals relative to hearing sensitivity. According to Dooling (1978), within the range of 1 to 5 kHz, birds show a level of hearing sensitivity similar to that of the more sensitive mammals. In contrast to mammals, bird sensitivity falls off at a greater rate to increasing and decreasing frequencies. Passive observations and studies examining aircraft bird strikes indicate that birds nest and forage near airports. Aircraft noise in the vicinity of commercial airports apparently does not inhibit bird presence and use.

High-noise events (like a low-altitude aircraft overflight) may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests (Ellis, et al. 1991). These activities impose an energy cost on the birds that, over the long term, may affect survival or growth. In addition, the birds may spend less time engaged in necessary activities like feeding, preening, or caring for their young because they spend time in noise-avoidance activity. However, the long-term significance of noise-related impacts is less clear. Several studies on nesting raptors have indicated that birds become habituated to aircraft overflights and that long-term reproductive success is not affected (Grubb and King 1991; Ellis, et al. 1991). Threshold noise levels for significant responses range from 62 dB for Pacific black brant (Branta bernicla nigricans) (Ward and Stehn 1990) to 85 dB for crested tern (Sterna bergii) (Brown 1990). Songbirds were observed to become silent prior to the onset of a sonic boom event (F-111 jets), followed by “raucous discordant cries.” There was a return to normal singing within 10 seconds after the boom (Higgins 1974 in Manci, et al. 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

Manci, et al. (1988), reported a reduction in reproductive success in some small territorial passerines (i.e., perching birds or songbirds) after exposure to low-altitude overflights. However, it has been observed that passerines are not driven any great distance from a favored food source by a nonspecific disturbance, such as aircraft overflights (U.S. Forest Service 1992). Further study may be warranted.

A recent study, conducted cooperatively between the DoD and the USFWS, assessed the response of the red-cockaded woodpecker to a range of military training noise events, including artillery, small arms, helicopter, and maneuver noise (Pater, et al. 1999). The project findings show that the redcockaded woodpecker successfully acclimates to military noise events. Depending on the noise level that ranged from innocuous to very loud, the birds responded by flushing from their nest cavities.

When the noise source was closer and the noise level was higher, the number of flushes increased proportionately. In all cases, however, the birds returned to their nests within a relatively short period of time (usually within 12 minutes). Additionally, the noise exposure did not result in any mortality or statistically detectable changes in reproductive success (Pater, et al. 1999). Red-cockaded woodpeckers did not flush when artillery simulators were more than 122 meters away and SEL noise levels were 70 dBA.

Lynch and Speake (1978) studied the effects of both real and simulated sonic booms on the nesting and brooding eastern wild turkey (Meleagris gallopavo silvestris) in Alabama. Hens at four nest sites were subjected to between 8 and 11 combined real and simulated sonic booms. All tests elicited similar responses, including quick lifting of the head and apparent alertness for between 10 and 20 seconds. No apparent nest failure occurred as a result of the sonic booms.

Twenty-one brood groups were also subjected to simulated sonic booms. Reactions varied slightly between groups, but the largest percentage of groups reacted by standing motionless after the initial blast. Upon the sound of the boom, the hens and poults fled until reaching the edge of the woods (approximately 4 to 8 meters). Afterward, the poults resumed feeding activities while the hens remained alert for a short period of time (approximately 15 to 20 seconds). In no instances were poults abandoned, nor did they scatter and become lost. Every observation group returned to normal activities within a maximum of 30 seconds after a blast.

1.3.8.2.2.2 MIGRATORY WATERFOWL

A study of caged American black ducks was conducted by Fleming, et al. in 1996. It was determined that noise had negligible energetic and physiologic effects on adult waterfowl. Measurements included body weight, behavior, heart rate, and enzymatic activity. Experiments also showed that adult ducks exposed to high noise events acclimated rapidly and showed no effects.

The study also investigated the reproductive success of captive ducks, which indicated that duckling growth and survival rates at Piney Island, North Carolina, were lower than those at a background location. In contrast, observations of several other reproductive indices (i.e., pair formation, nesting, egg production, and hatching success) showed no difference between Piney Island and the background location. Potential effects on wild duck populations may vary, as wild ducks at Piney Island have presumably acclimated to aircraft overflights. It was not demonstrated that noise was the cause of adverse impacts. A variety of other factors, such as weather conditions, drinking water and food availability and variability, disease, and natural variability in reproduction, could explain the observed effects. Fleming noted that drinking water conditions (particularly at Piney Island) deteriorated during the study, which could have affected the growth of young ducks. Further research would be necessary to determine the cause of any reproductive effects.

Another study by Conomy, et al. (1998) exposed previously unexposed ducks to 71 noise events per day that equaled or exceeded 80 dBA. It was determined that the proportion of time black ducks reacted to aircraft activity and noise decreased from 38 percent to 6 percent in 17 days and remained stable at 5.8 percent thereafter. In the same study, the wood duck did not appear to habituate to aircraft disturbance. This supports the notion that animal response to aircraft noise is species-specific. Because a startle response to aircraft noise can result in flushing from nests, migrants and animals living in areas with high concentrations of predators would be the most vulnerable to experiencing effects of lowered birth rates and recruitment over time. Species that are subjected to infrequent overflights do not appear to habituate to overflight disturbance as readily.

Black brant studied in the Alaska Peninsula were exposed to jets and propeller aircraft, helicopters, gunshots, people, boats, and various raptors. Jets accounted for 65% of all the disturbances. Humans, eagles, and boats caused a greater percentage of brant to take flight. There was markedly greater reaction to Bell-206-B helicopter flights than fixed wing, single-engine aircraft (Ward, et al. 1986).
The presence of humans and low-flying helicopters in the Mackenzie Valley North Slope area did not appear to affect the population density of Lapland longspurs, but the experimental group was shown to have reduced hatching and fledging success and higher nest abandonment. Human presence appeared to have a greater impact on the incubating behavior of the black brant, common eider, and Arctic tern than fixed-wing aircraft (Gunn and Livingston 1974).

Gunn and Livingston (1974) found that waterfowl and seabirds in the Mackenzie Valley and North Slope of Alaska and Canada became acclimated to float plane disturbance over the course of three days. Additionally, it was observed that potential predators (bald eagle) caused a number of birds to leave their nests. Non-breeding birds were observed to be more reactive than breeding birds. Waterfowl were affected by helicopter flights, while snow geese were disturbed by Cessna 185 flights. The geese flushed when the planes were under 1,000 feet, compared to higher flight elevations. An overall reduction in flock sizes was observed. It was recommended that aircraft flights be reduced in the vicinity of premigratory staging areas.

Manci, et al. 1988 reported that waterfowl were particularly disturbed by aircraft noise. The most sensitive appeared to be snow geese. Canada geese and snow geese were thought to be more sensitive than other animals such as turkey vultures, coyotes, and raptors (Edwards, et al. 1979).

1.3.8.2.2.3 WADING AND SHORE BIRDS

Black, et al. (1984), studied the effects of low-altitude (less than 500 feet AGL) military training flights with sound levels from 55 to 100 dBA on wading bird colonies (i.e., great egret, snowy egret, tricolored heron, and little blue heron). The training flights involved three or four aircraft, which occurred once or twice per day. This study concluded that the reproductive activity--including nest success, nestling survival, and nestling chronology--was independent of F-16 overflights. Dependent variables were more strongly related to ecological factors, including location and physical characteristics of the colony and climatology. Another study on the effects of circling fixed-wing aircraft and helicopter overflights on wading bird colonies found that at altitudes of 195 to 390 feet, there was no reaction in nearly 75% of the 220 observations. Ninety percent displayed no reaction or merely looked toward the direction of the noise source. Another 6 percent stood up, 3 percent walked from the nest, and 2 percent flushed (but were without active nests) and returned within 5 minutes (Kushlan 1978). Apparently, non-nesting wading birds had a slightly higher incidence of reacting to overflights than nesting birds. Seagulls observed roosting near a colony of wading birds in another study remained at their roosts when subsonic aircraft flew overhead (Burger 1981). Colony distribution appeared to be most directly correlated to available wetland community types and was found to be distributed randomly with respect to military training routes. These results suggest that wading bird species presence was most closely linked to habitat availability and that they were not affected by low-level military overflights (U.S. Air Force 2000).

Burger (1986) studied the response of migrating shorebirds to human disturbance and found that shorebirds did not fly in response to aircraft overflights, but did flush in response to more localized intrusions (i.e., humans and dogs on the beach). Burger (1981) studied the effects of noise from JFK Airport in New York on herring gulls that nested less than 1 kilometer from the airport. Noise levels over the nesting colony were 85 to 100 dBA on approach and 94 to 105 dBA on takeoff. Generally, there did not appear to be any prominent adverse effects of subsonic aircraft on nesting, although some birds flushed when the concorde flew overhead and, when they returned, engaged in aggressive behavior. Groups of gulls tended to loaf in the area of the nesting colony, and these birds remained at the roost when the concorde flew overhead. Up to 208 of the loafing gulls flew when supersonic aircraft flew overhead. These birds would circle around and immediately land in the loafing flock (U.S. Air Force 2000).

In 1970, sonic booms were potentially linked to a mass hatch failure of Sooty Terns on the Dry Tortugas (Austin, et al. 1970). The cause of the failure was not certain, but it was conjectured that sonic booms from military aircraft or an overgrowth of vegetation were factors. In the previous season, Sooties were observed to react to sonic booms by rising in a “panic flight,” circling over the island, then usually settling down on their eggs again. Hatching that year was normal. Following the 1969 hatch failure, excess vegetation was cleared and measures were taken to reduce supersonic activity. The 1970 hatch appeared to proceed normally. A colony of Noddies on the same island hatched successfully in 1969, the year of the Sooty hatch failure.

Subsequent laboratory tests of exposure of eggs to sonic booms and other impulsive noises (Bowles, et al. 1991a; Bowles, et al. 1994; Cottereau 1972; Cogger and Zegarra 1980) failed to show adverse effects on hatching of eggs. A structural analysis (Ting, et al. 2002) showed that, even under extraordinary circumstances, sonic booms would not damage an avian egg.

Burger (1981) observed no effects of subsonic aircraft on herring gulls in the vicinity of JFK International Airport. The concorde aircraft did cause more nesting gulls to leave their nests (especially in areas of higher density of nests), causing the breakage of eggs and the scavenging of eggs by intruder prey. Clutch sizes were observed to be smaller in areas of higher-density nesting (presumably due to the greater tendency for panic flight) than in areas where there were fewer nests.

1.3.8.3 Fish, Reptiles, and Amphibians

The effects of overflight noise on fish, reptiles, and amphibians have been poorly studied, but conclusions regarding their expected responses have involved speculation based upon known physiologies and behavioral traits of these taxa (Gladwin, et al. 1988). Although fish do startle in response to low-flying aircraft noise, and probably to the shadows of aircraft, they have been found to habituate to the sound and overflights. Reptiles and amphibians that respond to low frequencies and those that respond to ground vibration, such as spadefoots (genus Scaphiopus), may be affected by noise. Limited information is available on the effects of short-duration noise events on reptiles. Dufour (1980) and Manci, et al. (1988), summarized a few studies of reptile responses to noise. Some reptile species tested under laboratory conditions experienced at least temporary threshold shifts or hearing loss after exposure to 95 dB for several minutes. Crocodilians in general have the most highly developed hearing of all reptiles. Crocodile ears have lids that can be closed when the animal goes under water. These lids can reduce the noise intensity by 10 to 12 dB (Wever and Vernon 1957). On Homestead Air Reserve Station, Florida, two crocodilians (the American Alligator and the Spectacled Caiman) reside in wetlands and canals along the base runway suggesting that they can coexist with existing noise levels of an active runway including DNLs of 85 dB.

1.3.8.4 Summary

Some physiological/behavioral responses such as increased hormonal production, increased heart rate, and reduction in milk production have been described in a small percentage of studies. A majority of the studies focusing on these types of effects have reported short-term or no effects.

The relationships between physiological effects and how species interact with their environments have not been thoroughly studied. Therefore, the larger ecological context issues regarding physiological effects of jet aircraft noise (if any) and resulting behavioral pattern changes are not well understood.
Animal species exhibit a wide variety of responses to noise. It is therefore difficult to generalize animal responses to noise disturbances or to draw inferences across species, as reactions to jet aircraft noise appear to be species-specific. Consequently, some animal species may be more sensitive than other species and/or may exhibit different forms or intensities of behavioral responses. For instance, wood ducks appear to be more sensitive and more resistant to acclimation to jet aircraft noise than Canada geese in one study. Similarly, wild ungulates seem to be more easily disturbed than domestic animals.

The literature does suggest that common responses include the “startle” or “fright” response and, ultimately, habituation. It has been reported that the intensities and durations of the startle response decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects. The majority of the literature suggests that domestic animal species (cows, horses, chickens) and wildlife species exhibit adaptation, acclimation, and habituation after repeated exposure to jet aircraft noise and sonic booms.

Animal responses to aircraft noise appear to be somewhat dependent on, or influenced by, the size, shape, speed, proximity (vertical and horizontal), engine noise, color, and flight profile of planes. Helicopters also appear to induce greater intensities and durations of disturbance behavior as compared to fixed-wing aircraft. Some studies showed that animals that had been previously exposed to jet aircraft noise exhibited greater degrees of alarm and disturbance to other objects creating noise, such as boats, people, and objects blowing across the landscape. Other factors influencing response to jet aircraft noise may include wind direction, speed, and local air turbulence; landscape structures (i.e., amount and type of vegetative cover); and, in the case of bird species, whether the animals are in the incubation/nesting phase.

1.3.9 Property Values

Property within a noise zone (or Accident Potential Zone) may be affected by the availability of federally guaranteed loans. According to U.S. Department of Housing and Urban Development (HUD), Federal Housing Administration (FHA), and Veterans Administration (VA) guidance, sites are acceptable for program assistance, subsidy, or insurance for housing in noise zones of less than 65 DNL, and sites are conditionally acceptable with special approvals and noise attenuation in the 65 to 75 DNL noise zone and the greater than 75 DNL noise zone. HUD’s position is that noise is not the only determining factor for site acceptability, and properties should not be rejected only because of airport influences if there is evidence of acceptability within the market and if use of the dwelling is expected to continue. Similar to the Navy’s and Air Force’s Air Installation Compatible Use Zone Program, HUD, FHA, and VA recommend sound attenuation for housing in the higher noise zones and written disclosures to all prospective buyers or lessees of property within a noise zone (or Accident Potential Zone).

Newman and Beattie (1985) reviewed the literature to assess the effect of aircraft noise on property values. One paper by Nelson (1978), reviewed by Newman and Beattie, suggested a 1.8 to 2.3 percent decrease in property value per decibel at three separate airports, while at another period of time, they found only a 0.8 percent devaluation per decibel change in DNL. However, Nelson also noted a decline in noise depreciation over time which he theorized could be due to either noise sensitive people being replaced by less sensitive people or the increase in commerical value of the property near airports; both ideas were supported by Crowley (1978). Ultimately, Newman and Beattie summarized that while an effect of noise was observed, noise is only one of the many factors that is part of a decision to move close to, or away from, an airport, but which is sometimes considered an advantage due to increased opportunities for employment or ready access to the airport itself. With all the issues associated with determining property values, their reviews found that decreases in property values usually range from 0.5 to 2 percent per decibel increase of cumulative noise exposure.

More recently Fidell, et al. (1996) studied the influences of aircraft noise on actual sale prices of residential properties in the vicinity of two military facilities and found that equations developed for one area to predict residential sale prices in areas unaffected by aircraft noise worked equally well when applied to predicting sale prices of homes in areas with aircraft noise in excess of LDN 65 dB. Thus, the model worked equally well in predicting sale prices in areas with and without aircraft noise exposure. This indicates that aircraft noise had no meaningful effect on residential property values. In some cases, the average sale prices of noise exposed properties were somewhat higher than those elsewhere in the same area. In the vicinity of Davis-Monthan AFB/Tucson, AZ, Fidell found the homes near the airbase were much older, smaller and in poorer condition than homes elsewhere. These factors caused the equations developed for predicting sale prices in areas further away from the base to be inapplicable with those nearer the base. However, again Fidell found that, similar to other researchers, differences in sale prices between homes with and without aircraft noise were frequently due to factors other than noise itself.

1.3.10 Noise Effects on Structures

Normally, the most sensitive components of a structure to airborne noise are the windows and, infrequently, the plastered walls and ceilings. An evaluation of the peak sound pressures impinging on the structure is normally used to determine the possibility of damage. In general, with peak sound levels above 130 dB, there is the possibility of the excitation of structural component resonances. While certain frequencies (such as 30 hertz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than one second above a sound level of 130 dB are potentially damaging to structural components (Committee on Hearing, Bioacoustics, and Biomechanics 1977).

Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations, or rattling of objects within the dwelling such as hanging pictures, dishes, plaques, and bric-a-brac. Window panes may also vibrate noticeably when exposed to high levels of airborne noise. In general, such noise-induced vibrations occur at peak sound levels of 110 dB or greater. Thus, assessments of noise exposure levels for compatible land use should also be protective of noise-induced secondary vibrations.

1.3.11 Noise Effects on Terrain

It has been suggested that noise levels associated with low-flying aircraft may affect the terrain under the flight path by disturbing fragile soil or snow, especially in mountainous areas, causing landslides or avalanches. There are no known instances of such effects, and it is considered improbable that such effects would result from routine, subsonic aircraft operations.

1.3.12 Noise Effects on Historical and Archaeological Sites

Because of the potential for increased fragility of structural components of historical buildings and other historical sites, aircraft noise may affect such sites more severely than newer, modern structures. Particularly in older structures, seemingly insignificant surface cracks initiated by vibrations from aircraft noise may lead to greater damage from natural forces (Hanson, et al. 1991). There are few scientific studies of such effects to provide guidance for their assessment.

One study involved the measurements of sound levels and structural vibration levels in a superbly restored plantation house, originally built in 1795, and now situated approximately 1,500 feet from the centerline at the departure end of Runway 19L at Washington Dulles International Airport. These measurements were made in connection with the proposed scheduled operation of the supersonic Concorde airplane at Dulles (Wesler 1977). There was special concern for the building’s windows, since roughly half of the 324 panes were original. No instances of structural damage were found. Interestingly, despite the high levels of noise during Concorde takeoffs, the induced structural vibration levels were actually less than those induced by touring groups and vacuum cleaning.

As noted above for the noise effects of noise-induced vibrations of conventional structures, assessments of noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites.

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Appendix C

Study Advisory Committee Materials

Philadelphia International Airport
Noise Compatibility Program Update

FAR Part 150 Noise Exposure Maps Update Report

Prepared by:
DMJM Aviation | AECOM

In association with:
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Portfolio Associates, Inc.

Part 150 Noise Compatibility Program Update

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as of: October 30, 2007

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PHL PHILADELPHIA INTERNATIONAL AIRPORT

Noise Compatibility Program Update

Study Advisory Committee Meeting #4

Mercy Wellness Center

Conference Room

November 20, 2008 – 1:00 PM

Purpose and Role of the SAC

- **Participation in the development of proposed actions and measures**
- **Provide feedback and suggestions based on your experience and any known concerns of the surrounding communities.**
- **Two main goals of today's meeting:**
  - Convey the changes in noise exposure between 2007 and 2008, and
  - Solicit this group for ideas/concepts for the alternative analysis.

Summary Community Workshop Round 2

June 17, 2008 - Paulsboro, NJ	**12 attendees**
June 18, 2008 - Essington, PA	**64 attendees**
June 19, 2008 - Claymont, DE	**17 attendees**
June 24, 2008 - Cherry Hill, NJ	**14 attendees**
June 25, 2008 - Philadelphia, PA	**18 attendees**
	125 attendees

- 49 meeting evaluations were submitted
- Feedback was generally positive
- Suggestions on noise abatement alternatives and land use measures were submitted

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Noise Compatibility Program Update

Study Initiation

The Noise Study Process

Data Collection
- Airport Operations
- Aircraft Fleet Mix
- Runway Utilization
- Flight Tracks
- Local Land Use
- Base Mapping

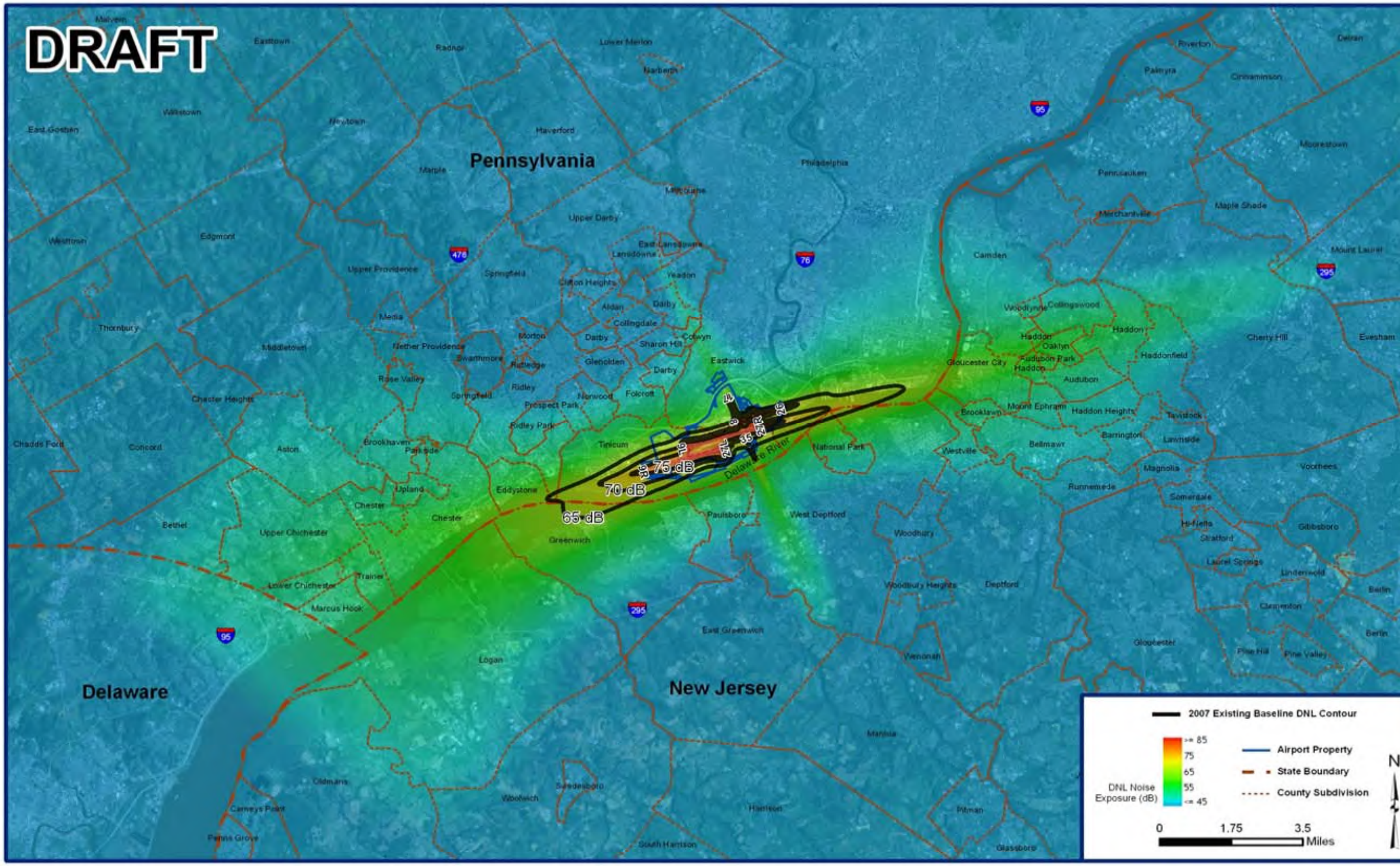
Noise Exposure Maps
- FAA's Integrated Noise Model
- Existing and Forecasted
- Determine level of impacts

Noise Compatibility Program
- Noise Abatement/Operational Measures
- Land Use Management Measures
- Program Management Measures

Submittal to FAA
- NEMs are accepted
- 180 day NCP review

Noise Contour Review Process

- FAA Requirement – That the existing conditions noise contour be representative of actual conditions at the airport and show existing incompatible land uses *at the time the study is submitted to the FAA*.
- Partial implementation of the Airspace Redesign (ARD) procedures in late 2007 changed the existing conditions at PHL.
- The study team then analyzed data through June 2008 and modeled noise exposure, resulting in the 2008 Existing Conditions Noise Exposure Contour.
- The study team then examined the assumptions previously used to model the 2013 Future Baseline noise contour.



2007 Existing Baseline DNL Noise Exposure

PHL Philadelphia International Airport

Noise Compatibility Program Update

DMJM AVIATION | AECOM

2007ExistingBaselineGradient.mxd

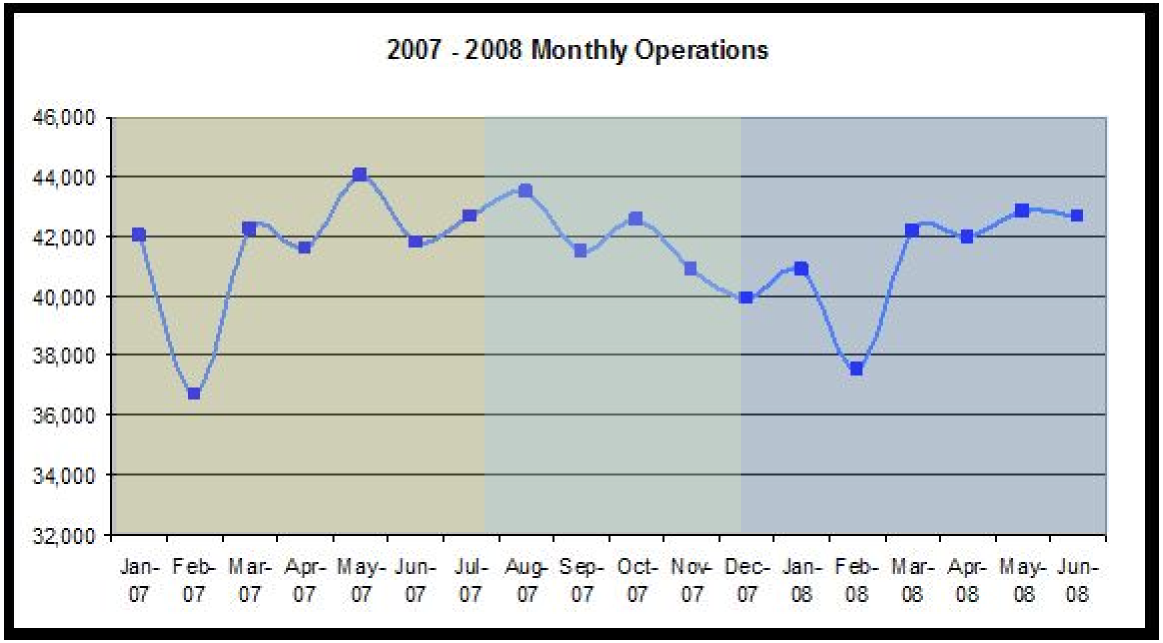
11-07-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

Noise Compatibility Program Update

PHL Noise Model Input Data

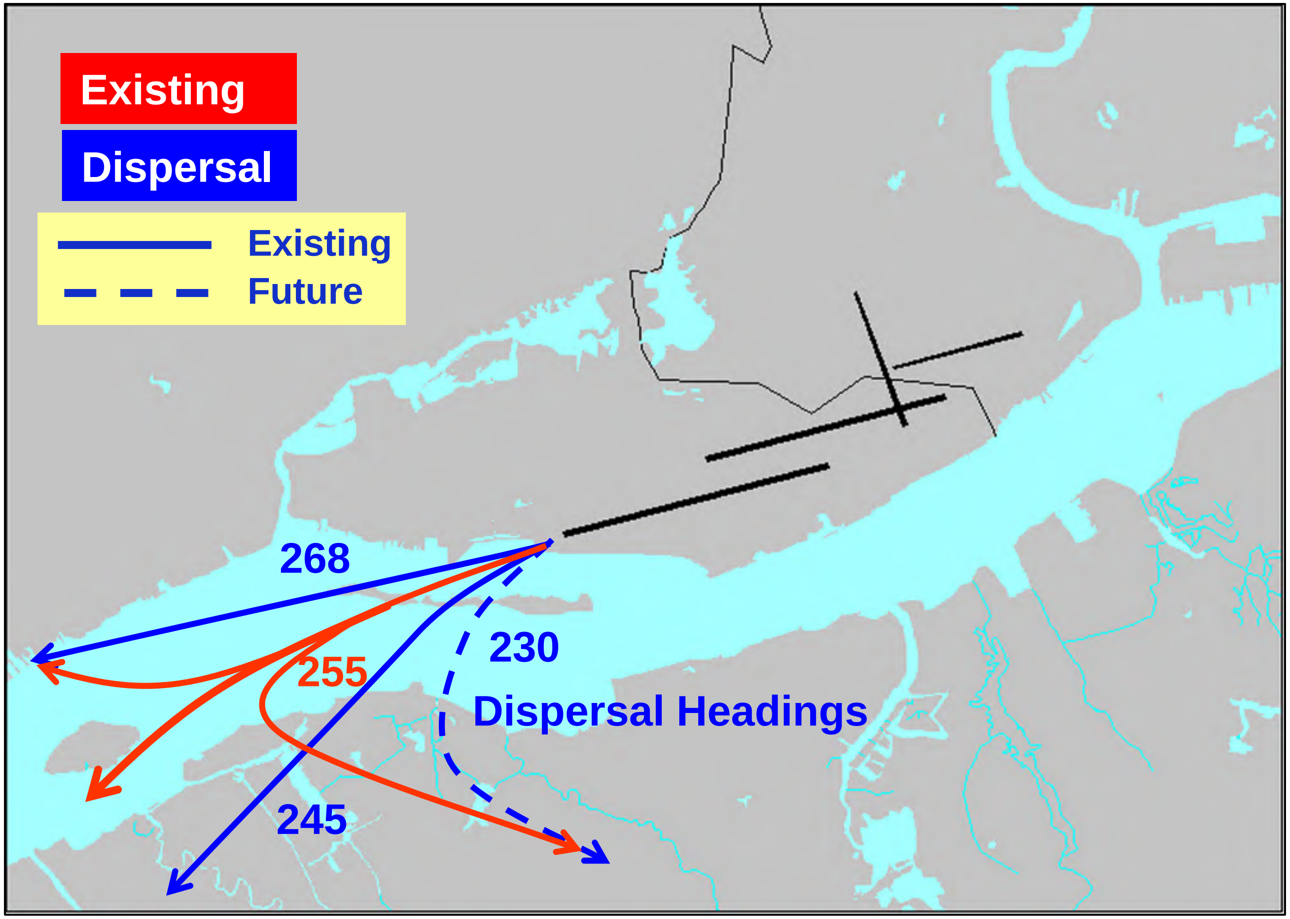


2008 Operational Input Data

- Airport Facilities
- Runway Use
- Operations Levels
- Time of Day
- Aircraft Fleet Mix
- Flight Track Location
- Ground Noise
- Weather

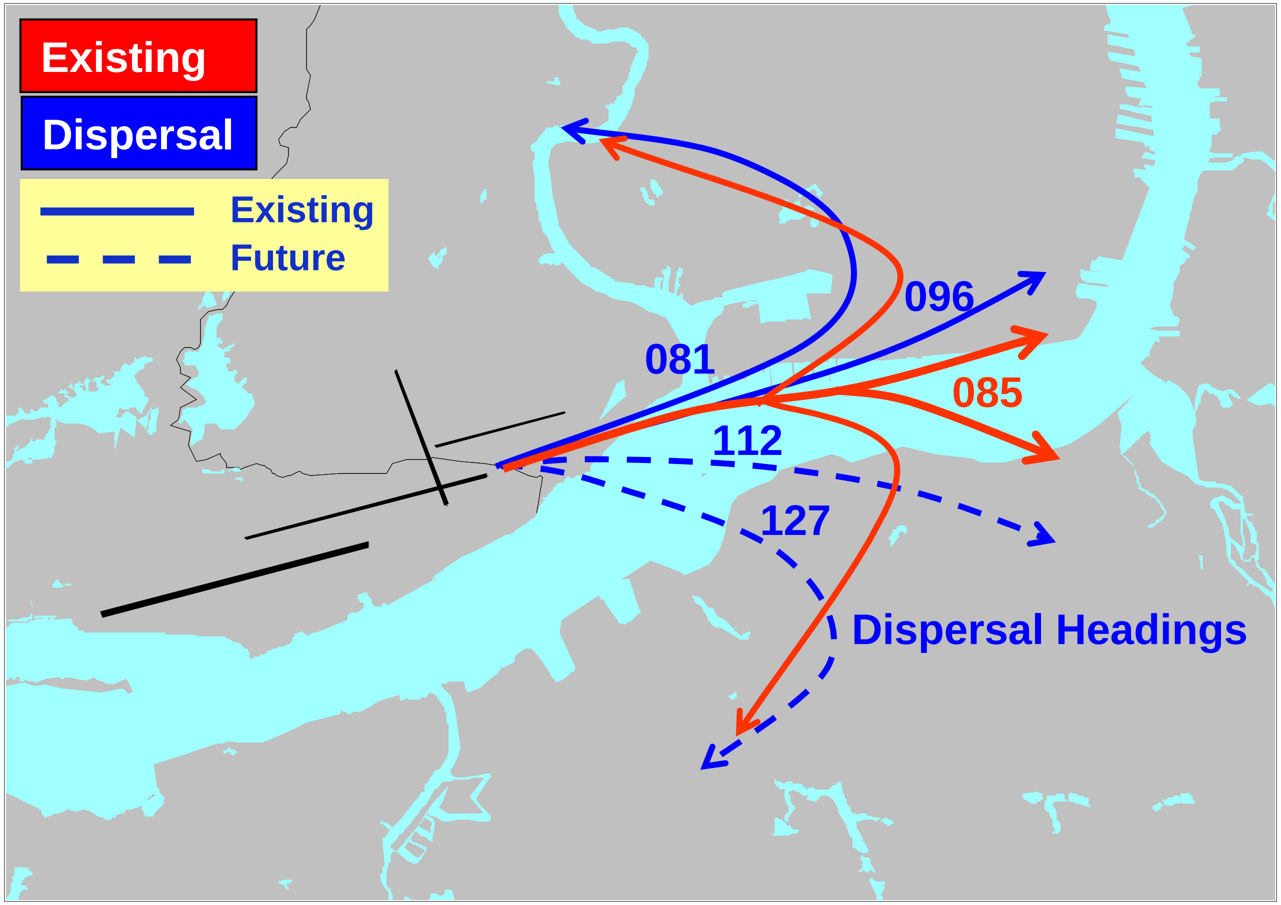
- Operations levels, runway use, time of day, and aircraft fleet mix remained relatively constant.
- The most notable change was the implementation of the revised departure headings from Runways 09L/27R and 09R/27L.

Runways 27R & 27L Dispersal Headings



http://www.faa.gov/airports_airtraffic/air_traffic/nas_redesign/regional_guidance/eastern_reg/nynjphl_redesign/

Runways 09R & 09L Dispersal Headings



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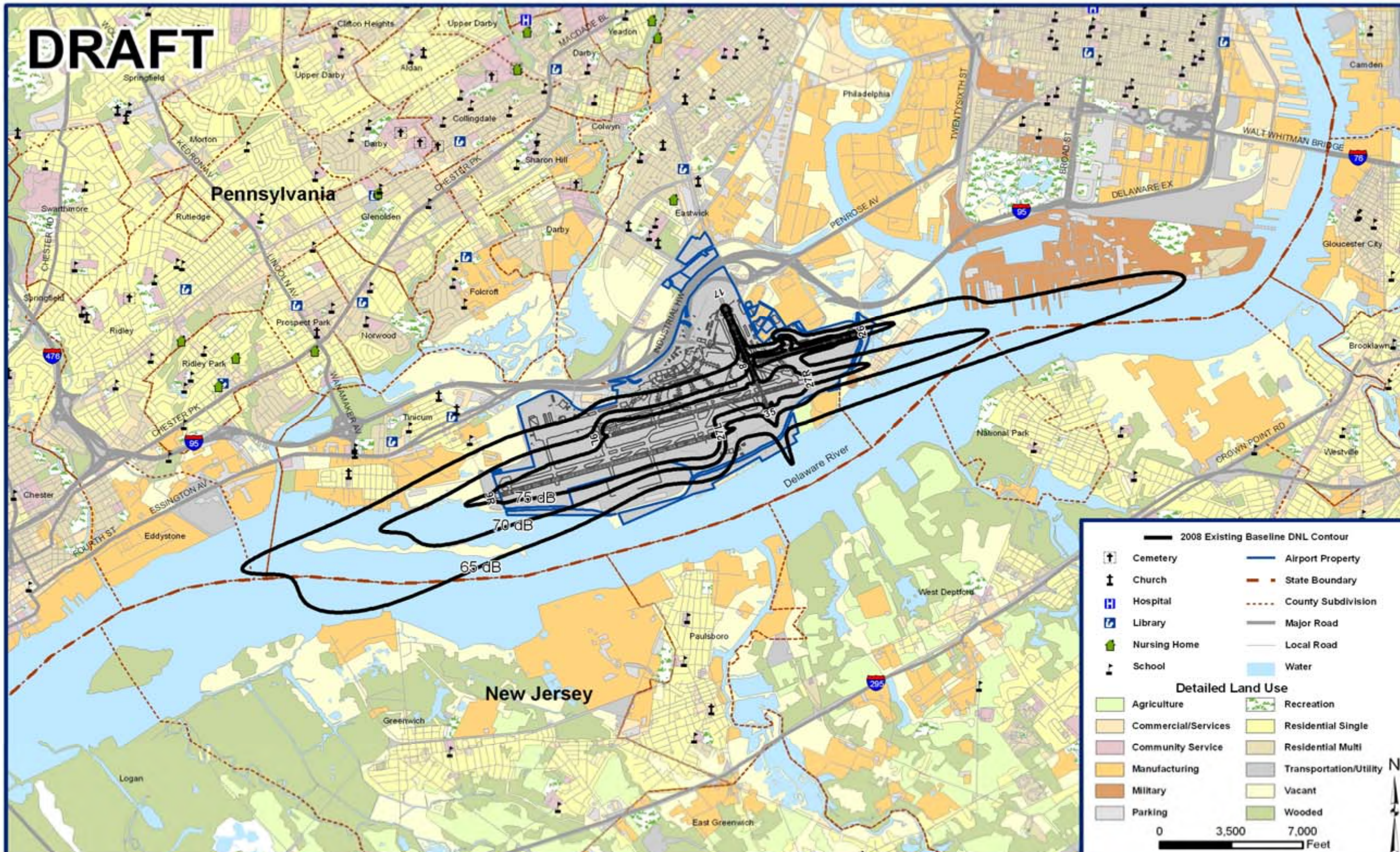

2008 Existing Baseline DNL Noise Exposure Contour

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Noise Compatibility Program Update

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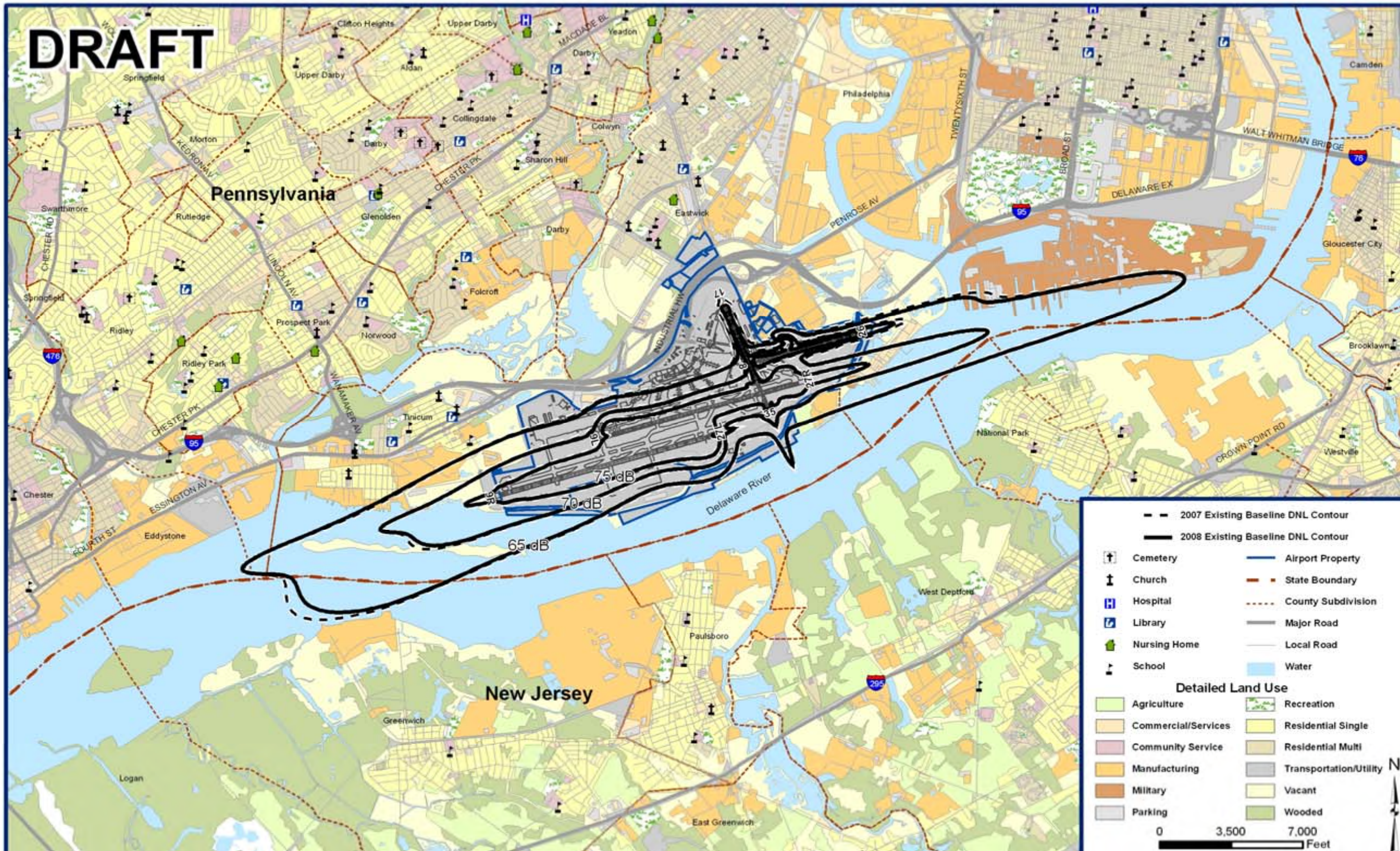
2008ExistingBaseline.mxd

11-07-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2007 Existing versus 2008 Existing Baseline DNL Noise Exposure Contour Comparison

Noise Compatibility Program Update

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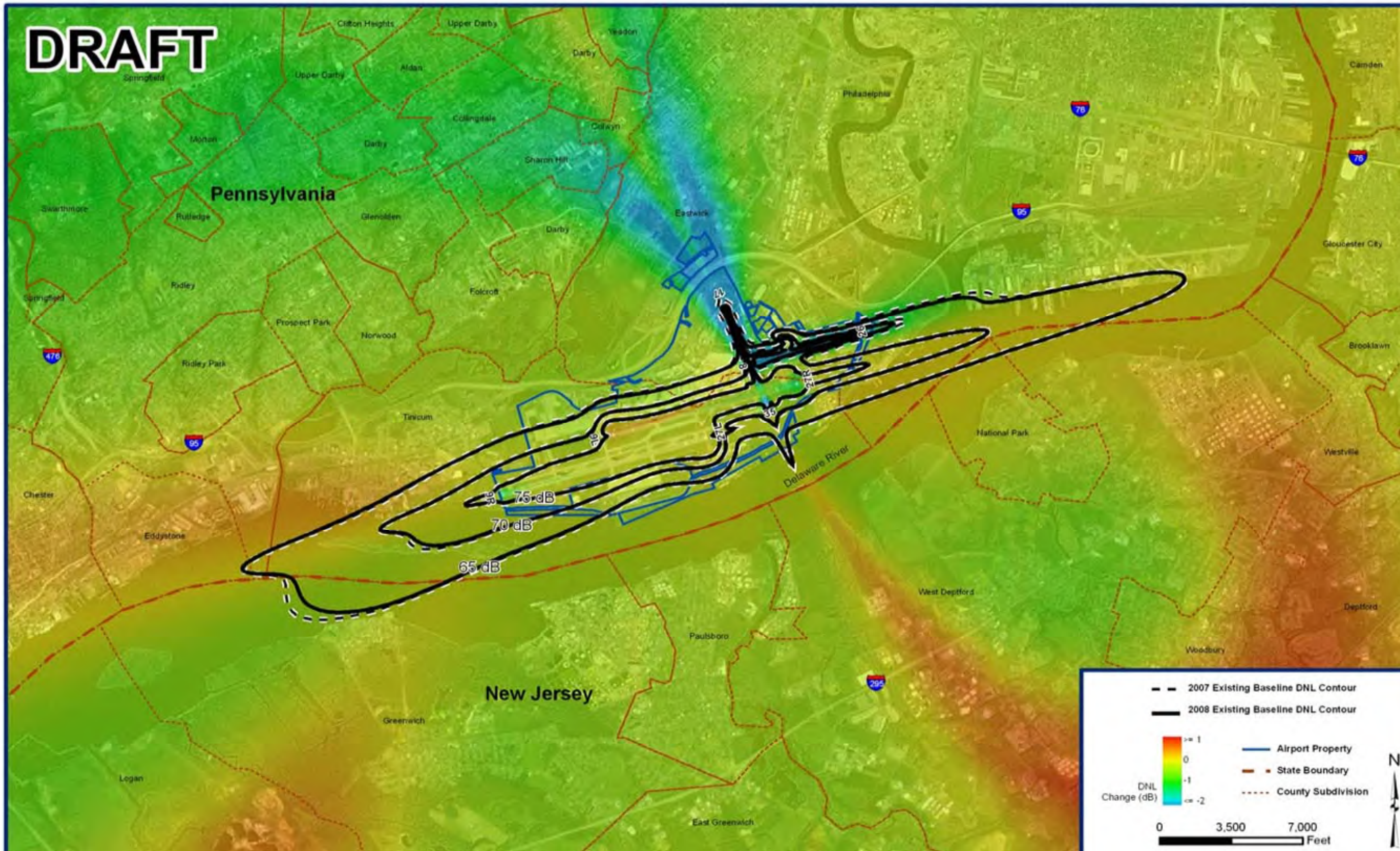
2008Existing\s2007ExistingBaseline.mxd

11-07-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2007 Existing versus 2008 Existing DNL Noise Exposure Contour Comparison

Noise Compatibility Program Update

DMJM AVIATION | AECOM

2008-2007GradientCloseIn.mxd

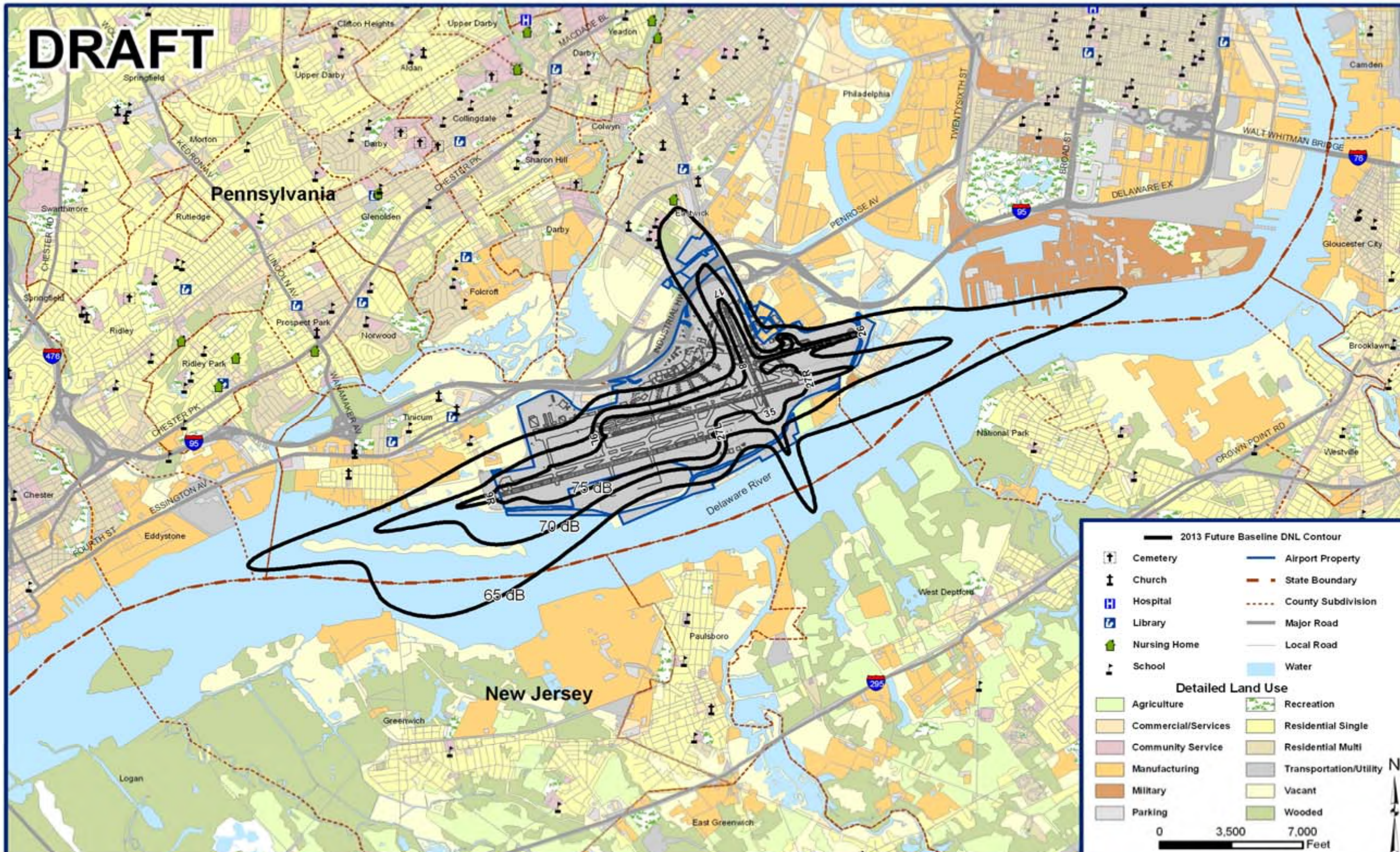
11-07-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

Future Noise Exposure

- Part 150 regulations require an evaluation of noise exposure for a period five years into the future (2013).
- **Operating levels** for 2013 are expected to increase by 19% to over 594,000 (1,628 AAD Operations).
- **Extended Runway 17/35** is expected to be fully operational in early 2009 (6,500 feet).
- Additional **ARD** changes not yet implemented:
  - Additional east and west flow dispersal headings
  - Establishing a new arrival route
  - Third westbound departure fix



2013 Future Baseline DNL Noise Exposure Contour

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Noise Compatibility Program Update

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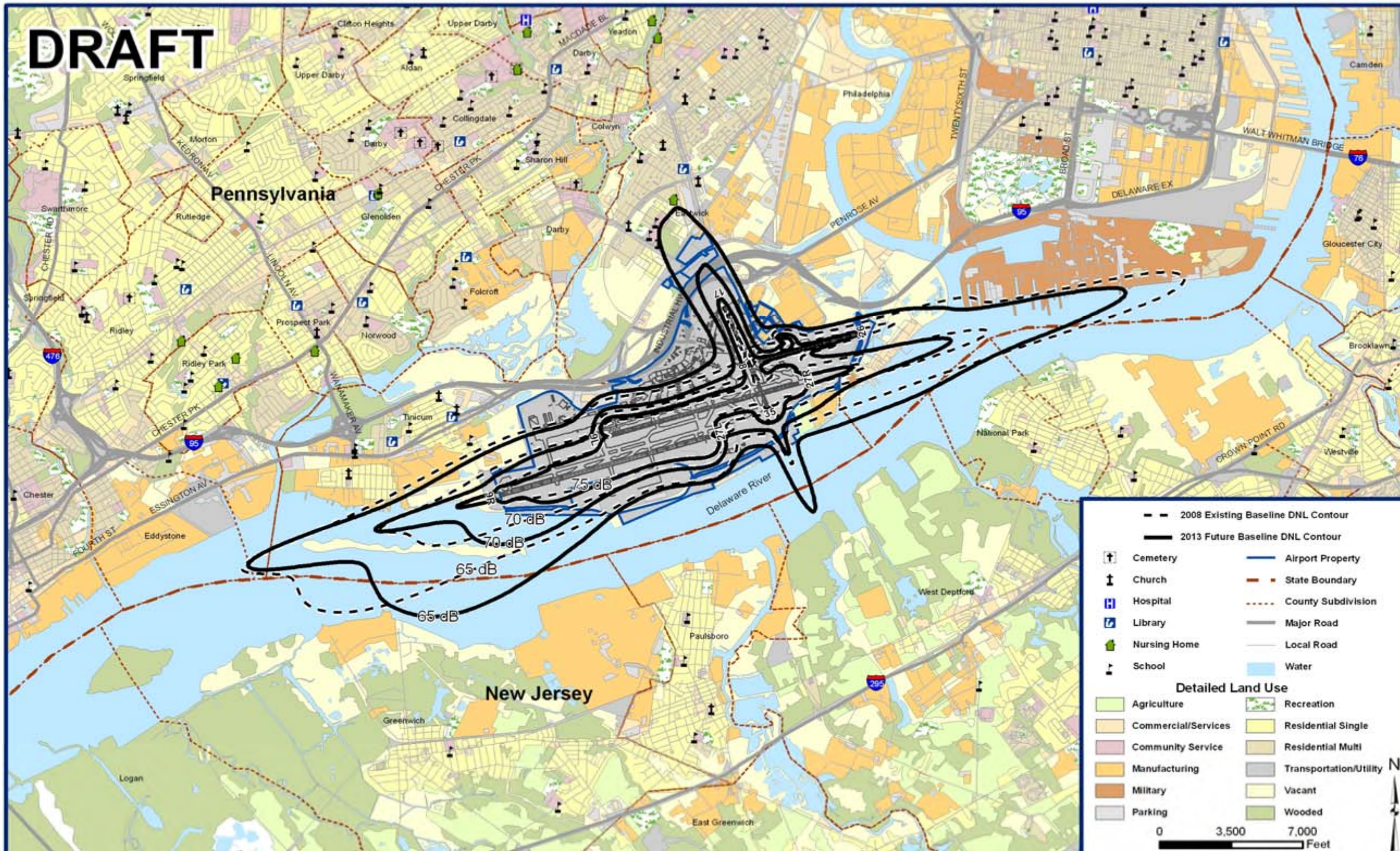
2013FutureBaseline.mxd

11-07-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2008 Existing versus 2013 Future Baseline DNL Noise Exposure Contour Comparison

PHL Philadelphia International Airport

Noise Compatibility Program Update

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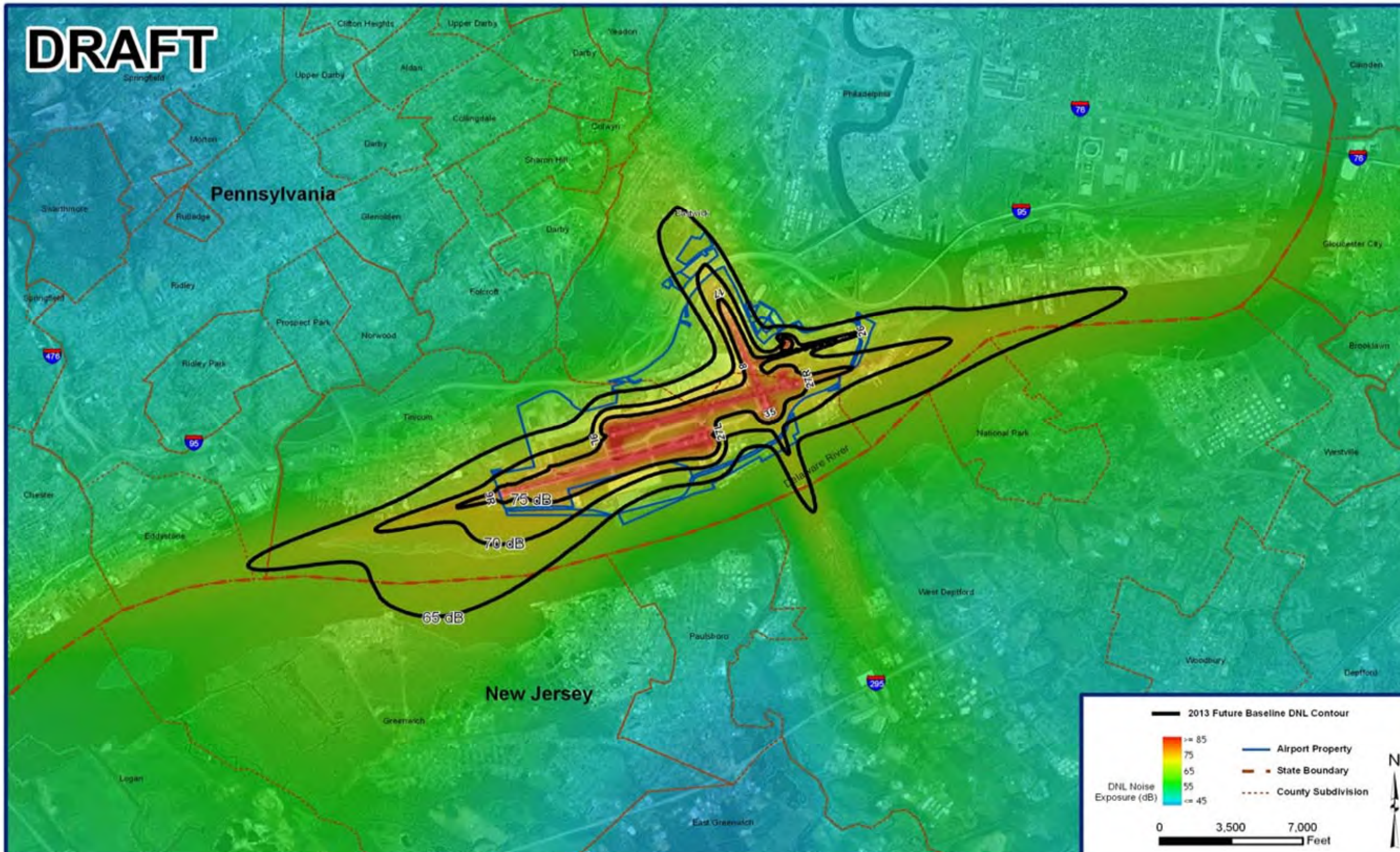
2008Existing\s2013FutureBaseline.mxd

11-07-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2013 Future Baseline DNL Noise Exposure

Noise Compatibility Program Update

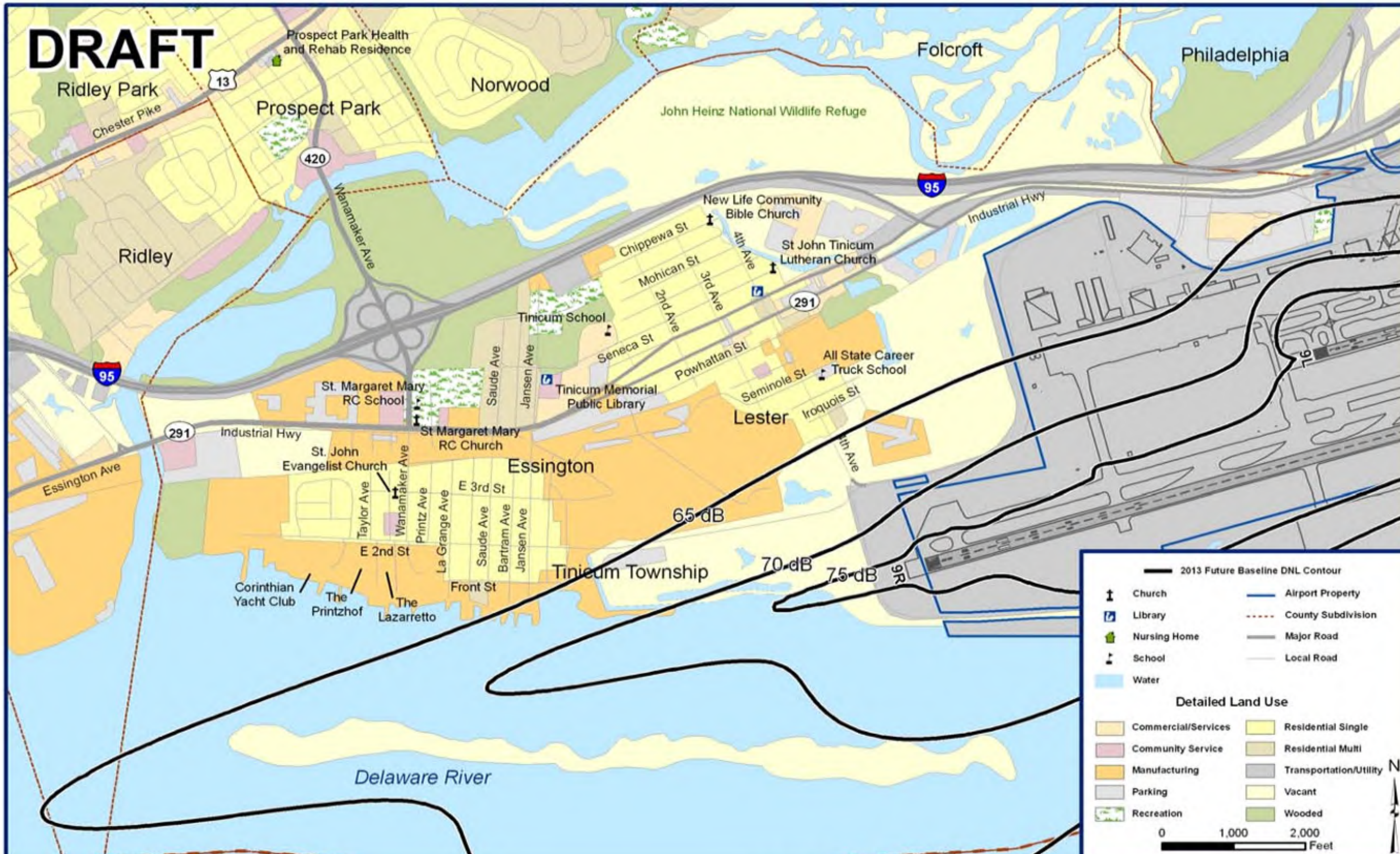
DMJM AVIATION | AECOM

2013FutureBaselineGradientCloseIn.mxd

11-09-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2013 Future Baseline DNL Noise Exposure Contour - Tinicum Township

Noise Compatibility Program Update

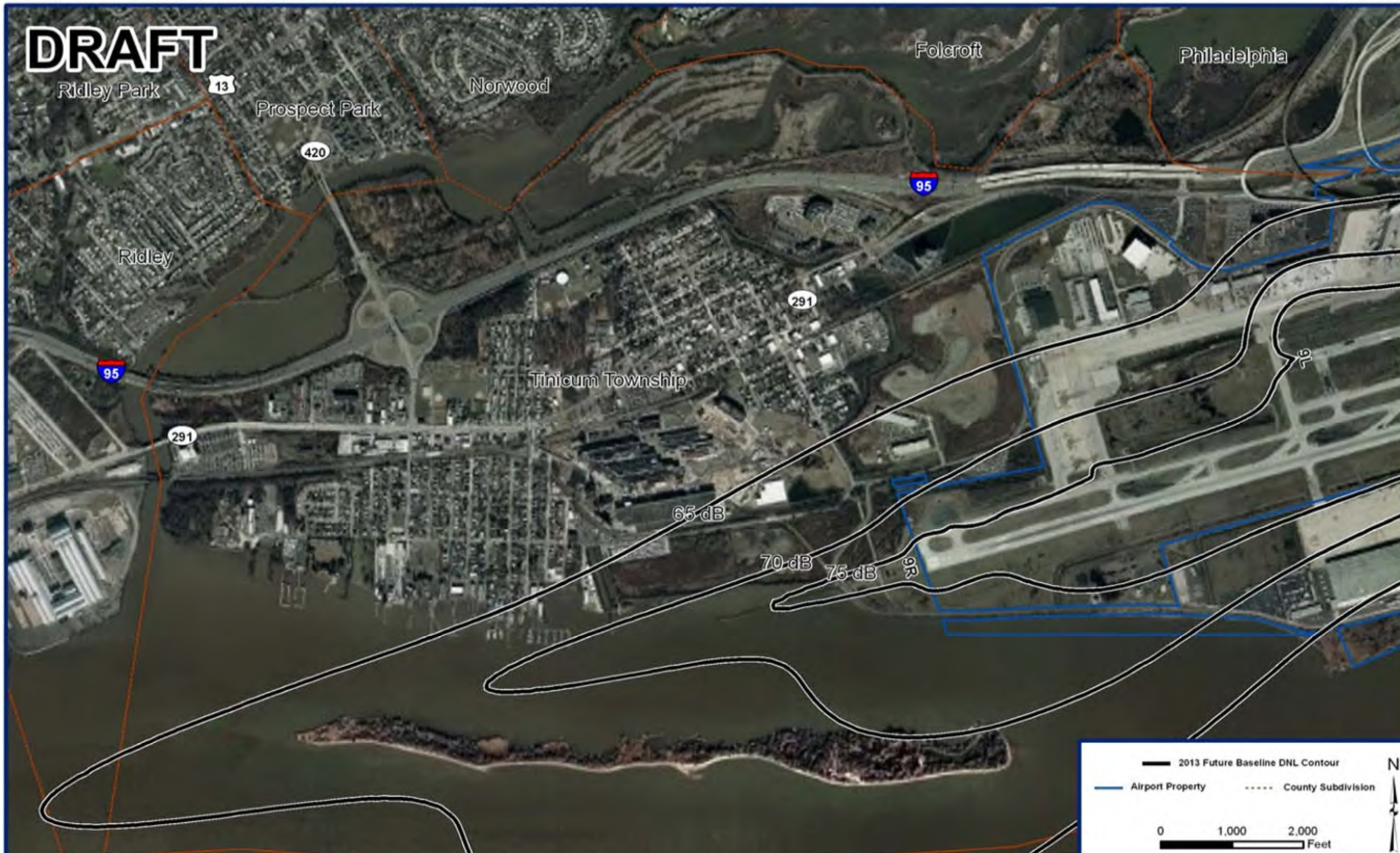
DMJM AVIATION | AECOM

2013FutureBaseline_Tinicum.mxd

11-07-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2013 Future Baseline DNL Noise Exposure Contour - Tinicum Township

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Noise Compatibility Program Update

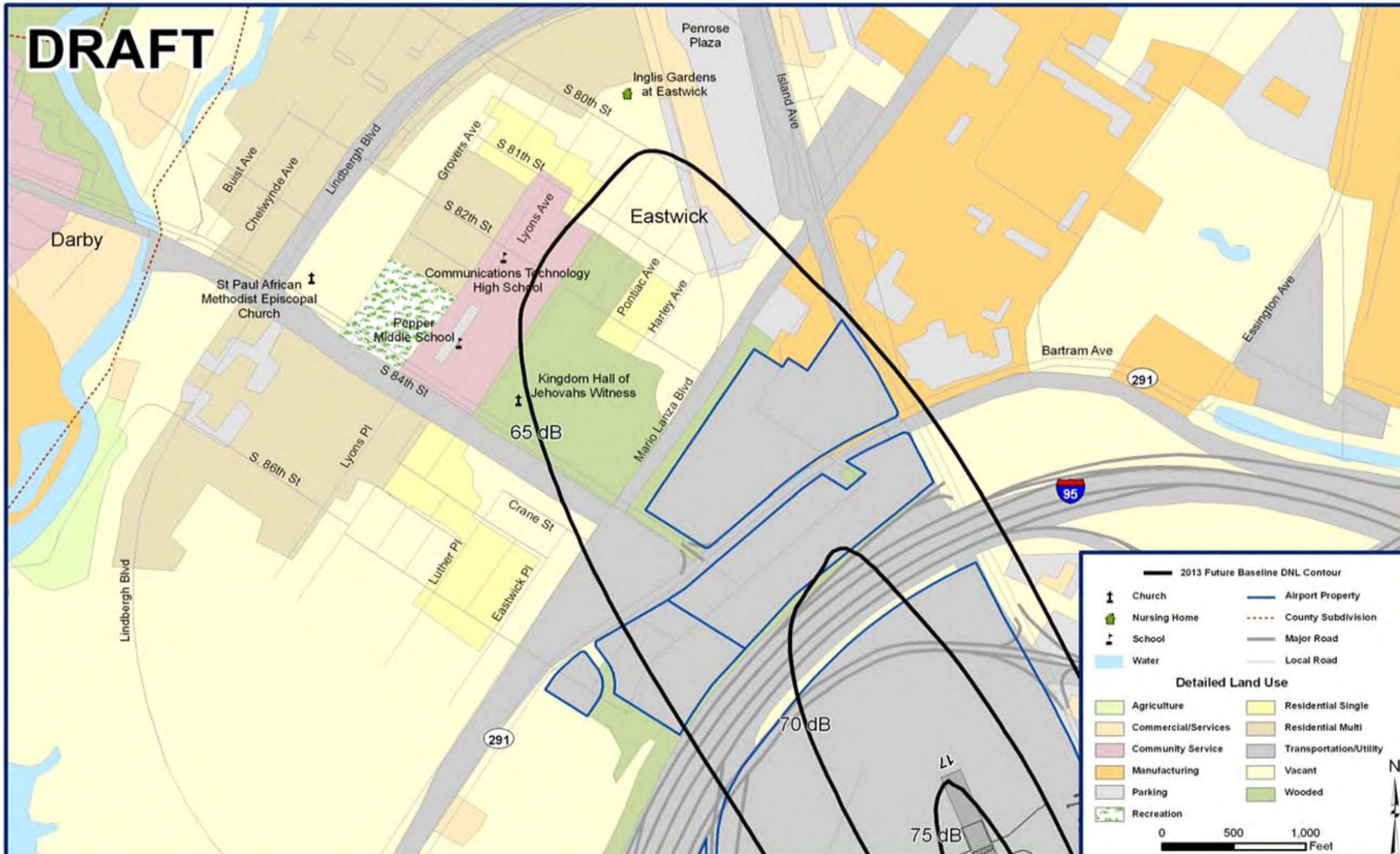
DMJM AVIATION | AECOM

2013FutureBaseline_Tinicum_Imagery.mxd

11-07-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2013 Future Baseline Noise Exposure Contour - Eastwick

Noise Compatibility Program Update

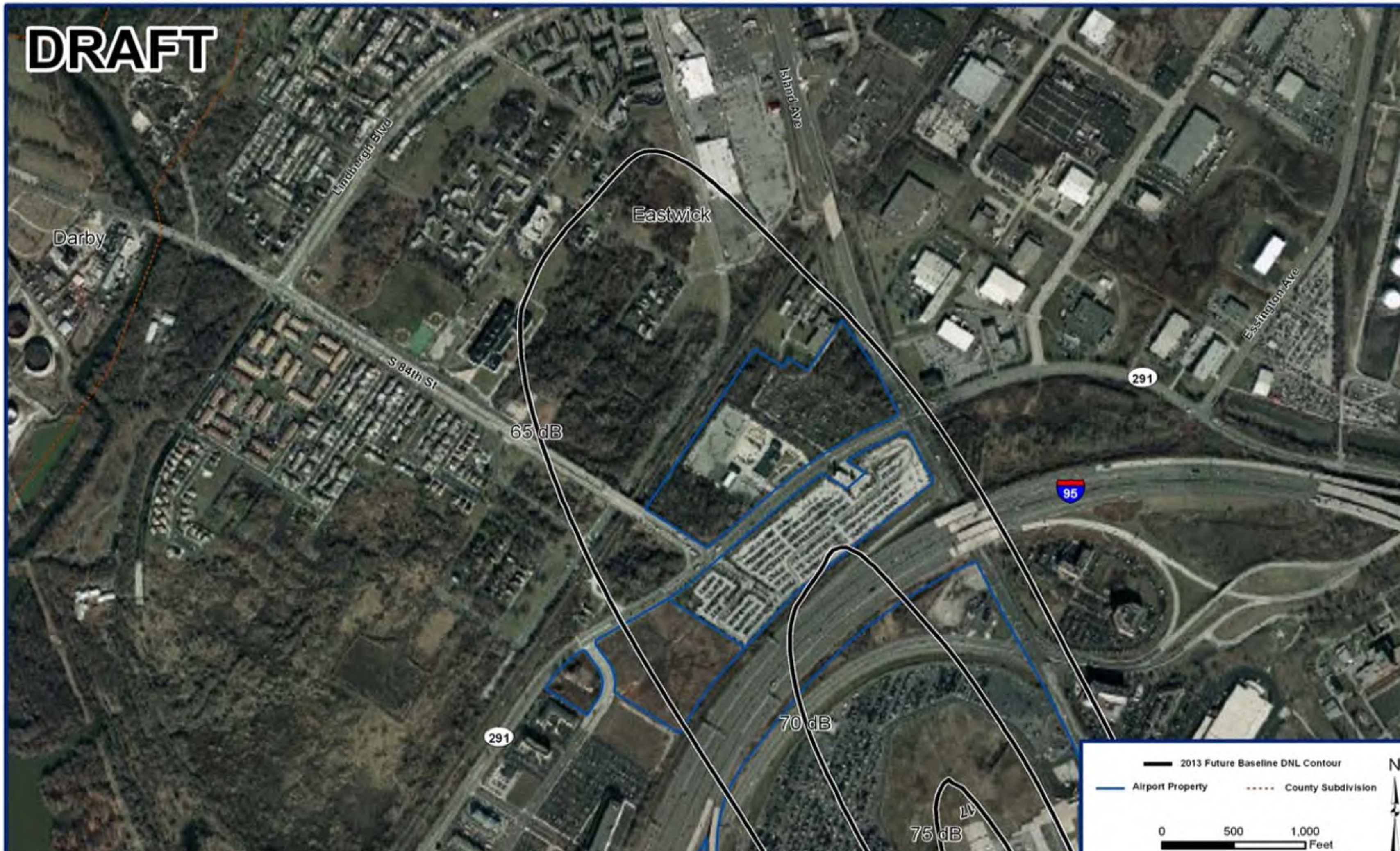
DMJM AVIATION | AECOM

2013FutureBaseline_Eastwick.mxd

11-09-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2013 Future Baseline Noise Exposure Contour - Eastwick

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Noise Compatibility Program Update

DMJM AVIATION | AECOM

2013FutureBaseline_Eastwick_imagery.mxd

11-09-08

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

Review of NEMs

- Two phase process – NEMs and NCP
- NEMs (2008 & 2013) will be submitted to the FAA for ***acceptance***.
- Prior to FAA submittal – opportunity to comment is required
  - **SAC** review and comment
    - Via SAC Meeting #3 (June) and SAC Meeting #4 (today)
  - **Public** review and comment
    - NEM summary document is being prepared for distribution to project mailing list.
    - Document will also be posted on the internet and made available for review at local libraries, noise office etc.,
    - There will be a 45 day comment period
    - The team will review and address comments, then submit the NEMs to the FAA

Noise Compatibility Program (NCP)

- We are now ready to move forward on identifying and modeling noise abatement, land use management, and program management alternatives designed to *reduce the incompatible land uses* within the *2013 Future Baseline* Noise Exposure Contour.
- An airport's NCP addresses three goals:
  - Minimizing noise *impacts*
  - Mitigating remaining noise-sensitive land uses
  - Preventing future noise-sensitive development

Who Controls Noise?

- Who is responsible for addressing noise associated with an airport and aircraft activity?

- **Responsibility is shared amongst all stakeholders**
  - The Federal Government
  - Aircraft Manufacturers
  - Airport Proprietors
  - Airlines & Operators
  - Local Jurisdictions
  - Existing and Prospective Residents

Noise Compatibility Program (NCP)

- Three categories of alternatives
  - Noise Abatement Alternatives
  - Land Use Management Alternatives
  - Program Management Alternatives
- Alternatives are evaluated based on:
  - Safety
  - Noise Benefit
  - Cost of implementation
  - Feasibility of implementation

Range of Alternatives to be Evaluated

Regulations specify many types of alternatives which must be considered. However, initiatives are considered from:

- Suggestions by the SAC/General Public
- DOA Initiatives
- Local or State Jurisdiction Initiatives
- ATCT Initiatives
- Part 150 Requirements

Noise Abatement Alternatives address aircraft noise at its source:

- Flight Path Locations;
- Flight Frequency;
- Flight Management;
- Flight Restrictions;
- Ground Activity Restrictions; and
- Facility Design and Construction.

2003 Noise Abatement Measures

NA-1 – Aircraft weighing 12,500 pounds or more departing Runways 9L/9R/17/35/8 fly runway heading until reaching 2,000' Above Ground Level.

NA-2 - Aircraft weighing 12,500 pounds or more departing Runway 27L turn left to a 255 degree heading until reaching 3,000' Above Ground Level.

NA-3 - Aircraft weighing 12,500 pounds or more departing Runway 27R turn left to a 240 degree heading until reaching 3 DME, thence turn right to a 255 degree heading until reaching 3,000' Above Ground Level.

NA-4 - Continue existing nighttime runway use program from midnight to 6:00 a.m.

NA-5 - Continue existing run-up procedures providing for location and orientation preferences with requirements for pre-approval and limitation to 20 minutes or less.

NA-6 - Support creation of Area Navigation (RNAV) overlay procedures for selected existing and future flight procedures.

Status of 2003 Part 150 Measures

- **NA-1** – Existing Procedure.
- **NA-2** – Existing Procedure, impacted by ARD changes.
- **NA-3** – Existing Procedure, impacted by ARD changes.
- **NA-4** – Nighttime runway use program still in use.
- **NA-5** – Ground Run Ups are generally limited to two locations on the airfield.
- **NA-6** – Selected RNAV procedures have been implemented, and more are expected to be developed.

PHL PHILADELPHIA INTERNATIONAL AIRPORT

Noise Compatibility Program Update

What types of alternatives will we be evaluating?

Flight Path Location Alternatives
- Build a new runway to move operations
- Extend an existing runway to raise the altitude of aircraft over noise-sensitive locations
- Arrival Procedures (Use of the river corridor)
- Departure Procedures (use of ARD flight tracks)

Flight Frequency Alternatives
- Runway Utilization (Overall, Nighttime-specific)
- East Flow/West Flow Operations (tailwind limitations)

Flight Management Alternatives
- Use of Continuous Descent Approaches (CDA)
- Advanced Navigation Techniques (RNAV)
- Intercept altitudes (Arrival Operations)
- Fly-Quiet Procedures (Speed, thrust settings, etc)
- Reverse Thrust (Arrival Operations)

What types of alternatives will we be evaluating?

Flight Restrictions

- Restrict the operation of specific aircraft
- Restrict the hours the airport is in use (curfews)
- Restrict operations based on aircraft noise levels
- Limit the number of operations at PHL (Use other airports)

Ground Activity Restrictions

- Limit engine maintenance run-ups
- Construct a ground run-up enclosure
- Restrict aircraft Auxiliary Power Unit (APU) usage
- Build noise berms/walls around the airport

Facility Construction and Design

- Encourage Noise Attenuating Standards in Airport Development

Specific SAC Suggestions

Discussion of Potential Noise Abatement Alternatives

Ground Rules for Discussion

Desired Outcome:
A detailed list of alternatives

Evaluation Criteria

At the next SAC meeting, we will present each alternative that has been considered, and the Airport's preliminary recommendation for inclusion in the NCP. For each alternative, we will provide:

- Description
- Benefits to the Noise Environment
- Drawbacks of the Alternative
- Costs of Implementation
- Party responsible for implementation
- Feasibility of implementation
- Preliminary Recommendation

Next Steps

- Public Review of NEM maps and documentation
- Comment Period and Response to Comments
- Submission of NEM document to FAA for acceptance
- Noise Abatement, Land Use Management, and Program Management Alternative Analysis

Prior to, and during, the next SAC Meeting:

- Analysis of Alternatives mailed to SAC
- Identification of any additional Alternatives
- Discussion on Preliminary Recommended Noise Compatibility Plan

PHL PHILADELPHIA INTERNATIONAL AIRPORT

Noise Compatibility Program Update

Study Advisory Committee Meeting #3

Mercy Wellness Center

Conference Room

June 17, 2008 – 1:00 PM

Meeting Agenda

- Welcome and Introductions
- Status of the Program
- Noise Exposure Map (NEM) Development
  - Draft Existing Baseline Noise Contour – 2007
  - Draft Future Baseline Noise Contour– 2013
  - Contour Review Process
- Community Workshops Overview
- Noise Compatibility Program Update (NCP) Development
  - Overview of Noise Mitigation Alternatives

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Noise Compatibility Program Update

Where we are in the process

Data Collection: Identify and document existing airport conditions and surrounding land uses. Conduct aircraft noise monitoring.

Noise Exposure Maps: Run the Integrated Noise Model program to develop existing and future noise exposure maps.

Mitigation Alternatives: Revisit existing noise abatement, land use and program management alternatives. Recommend new alternatives; suggest changes to existing alternatives as needed.

Noise Compatibility Program: Select noise abatement, land use and program management measures, and develop the Noise Exposure Maps.

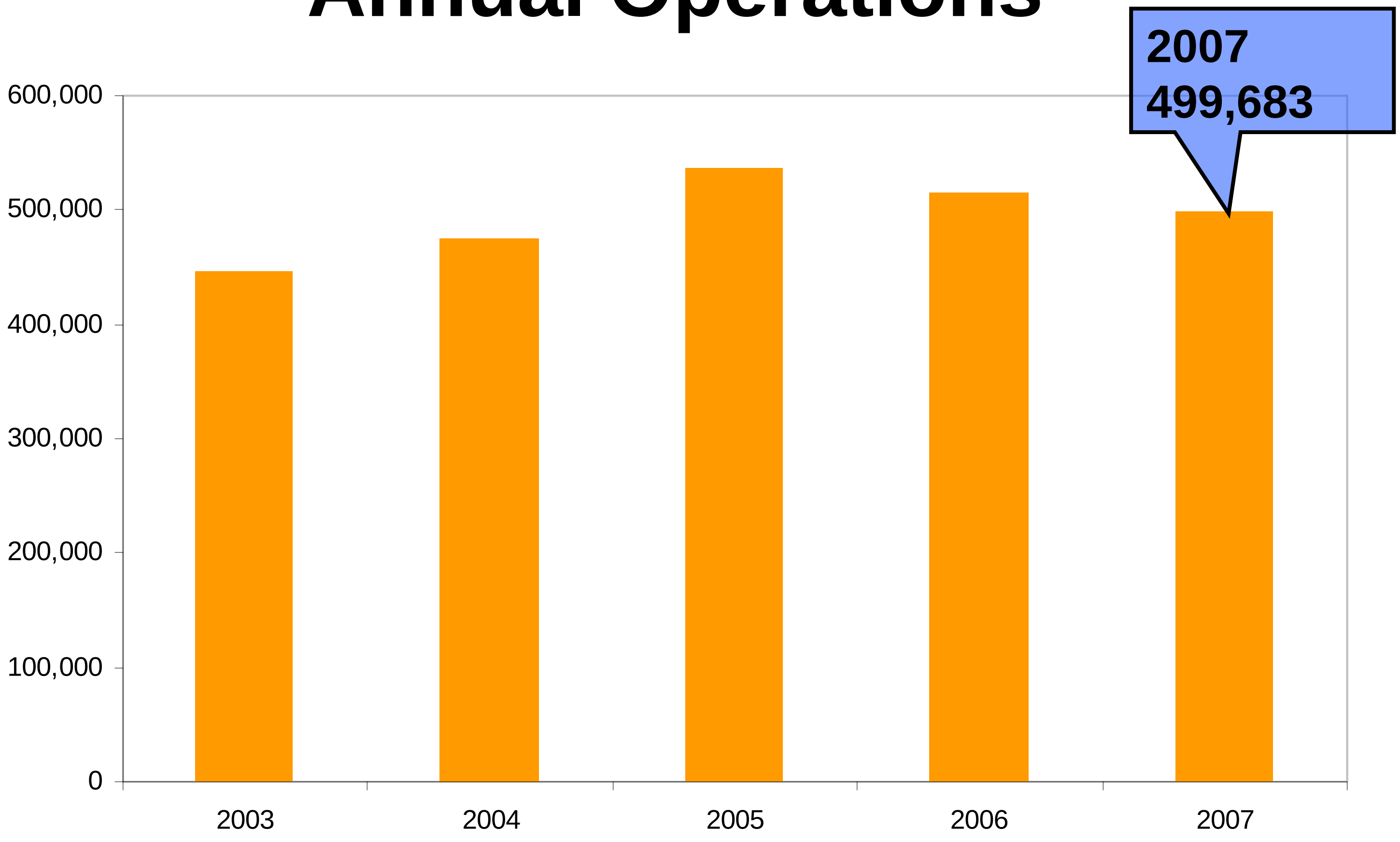
● = Study Advisory and Community Participation point

Integrated Noise Model Input Data

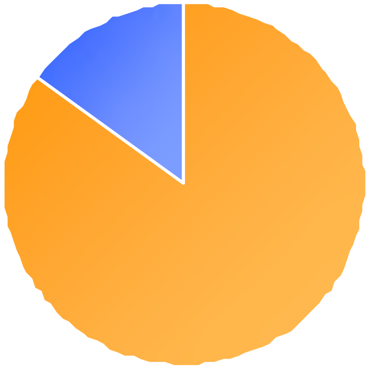
- Airport Facilities
- Operations Levels
- Time of Day
- Aircraft Fleet Mix
- Flight Track Location
- Ground Noise
- Weather

INM

Annual Operations



Temporal Distribution



2007

Daytime Ops = 85%

Nighttime = 15%

Runway Utilization

- **West Flow (80% during 2007)**
  - Runway 27L is the predominant departure runway, followed by Runway 27R.
  - Runways 27R and 35 are the predominant arrival runways.
- **East Flow (20% during 2007)**
  - Primary departure runway is Runway 09L, followed by Runway 35 and Runway 26.
  - Primary arrival runway is Runway 09R, followed by Runway 17.
- **In 2007, Runways 09R/27L and 09L/27R served 94% of departure traffic and 67% of arrival traffic.**

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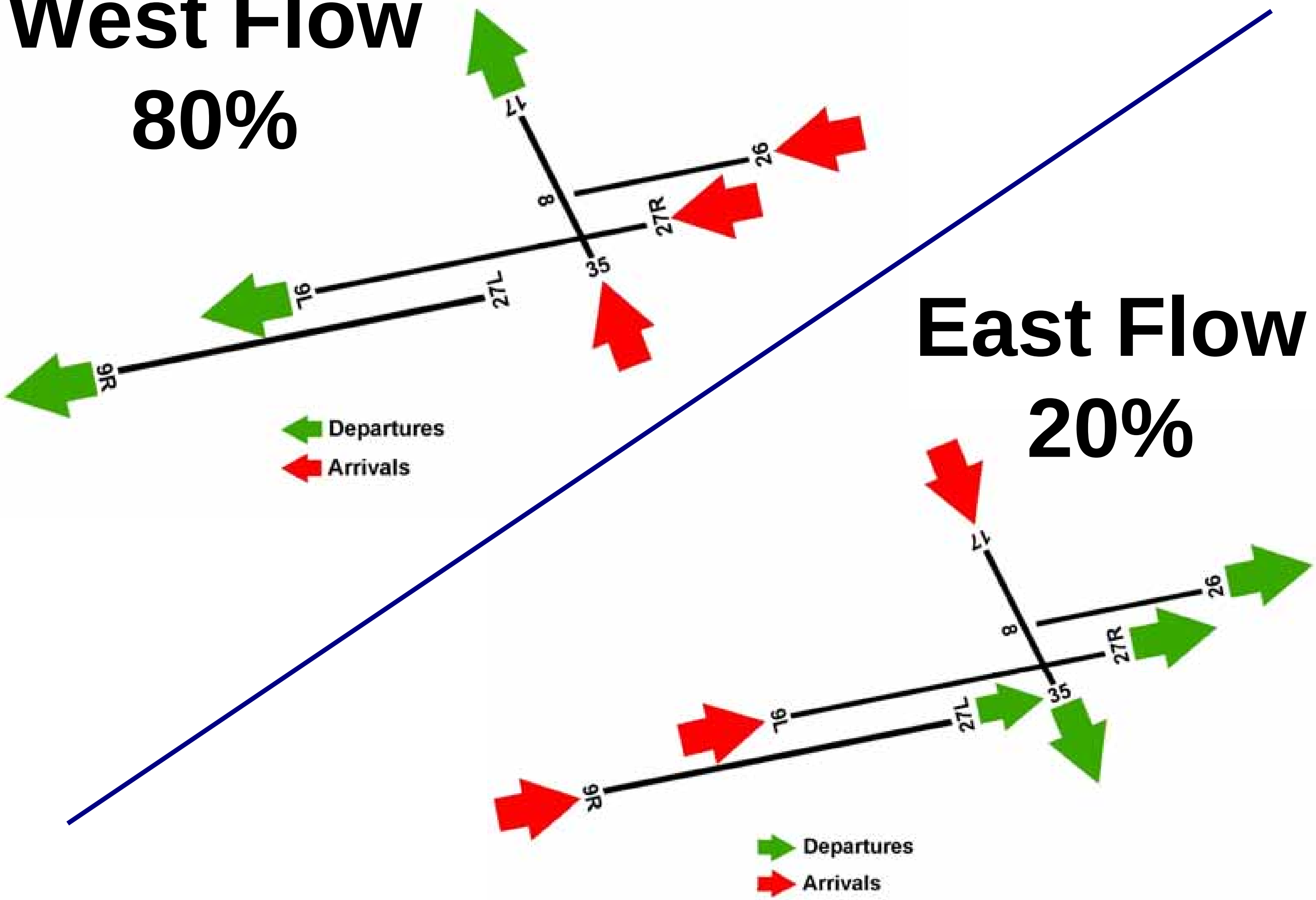
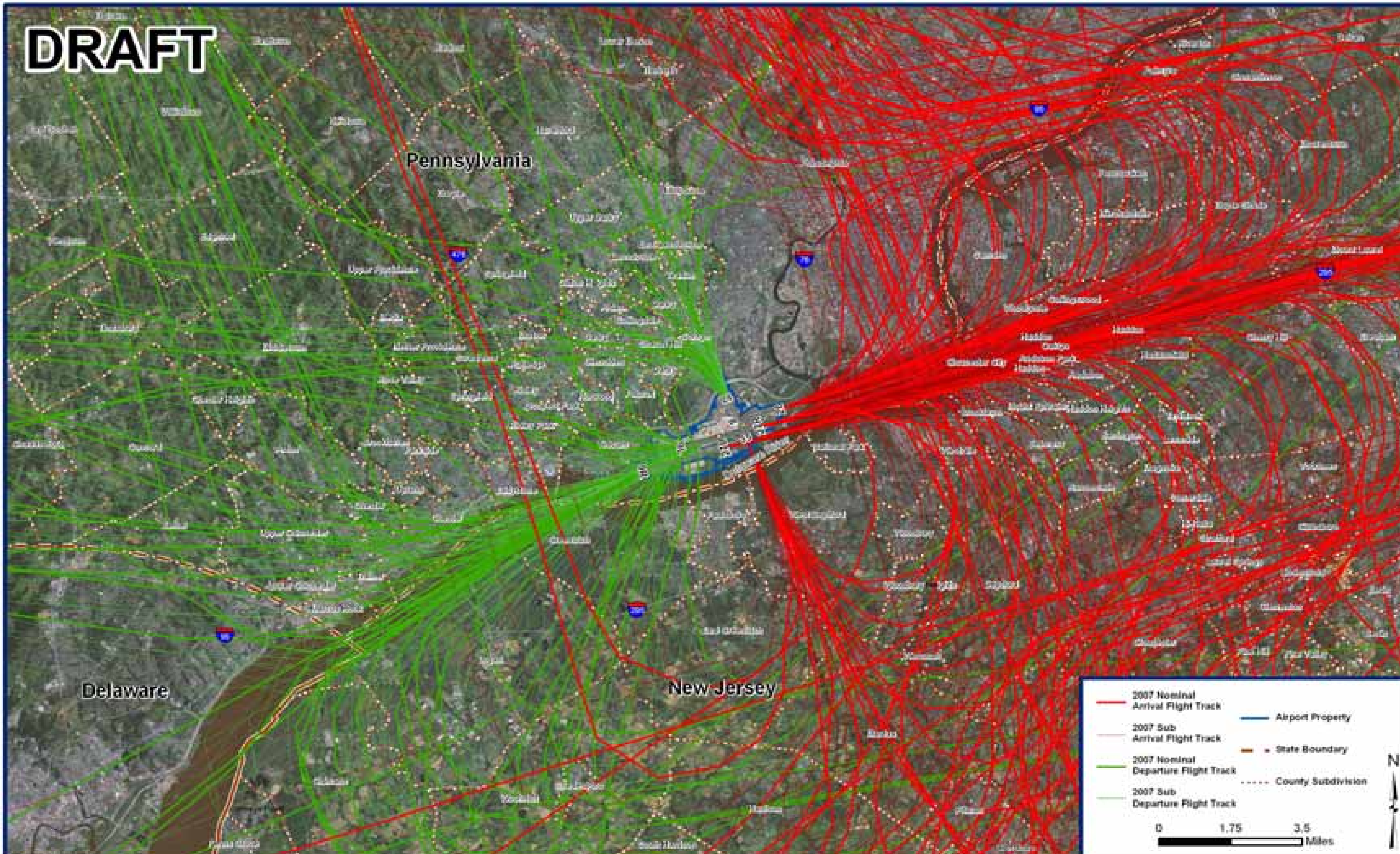
West Flow
80%

East Flow
20%





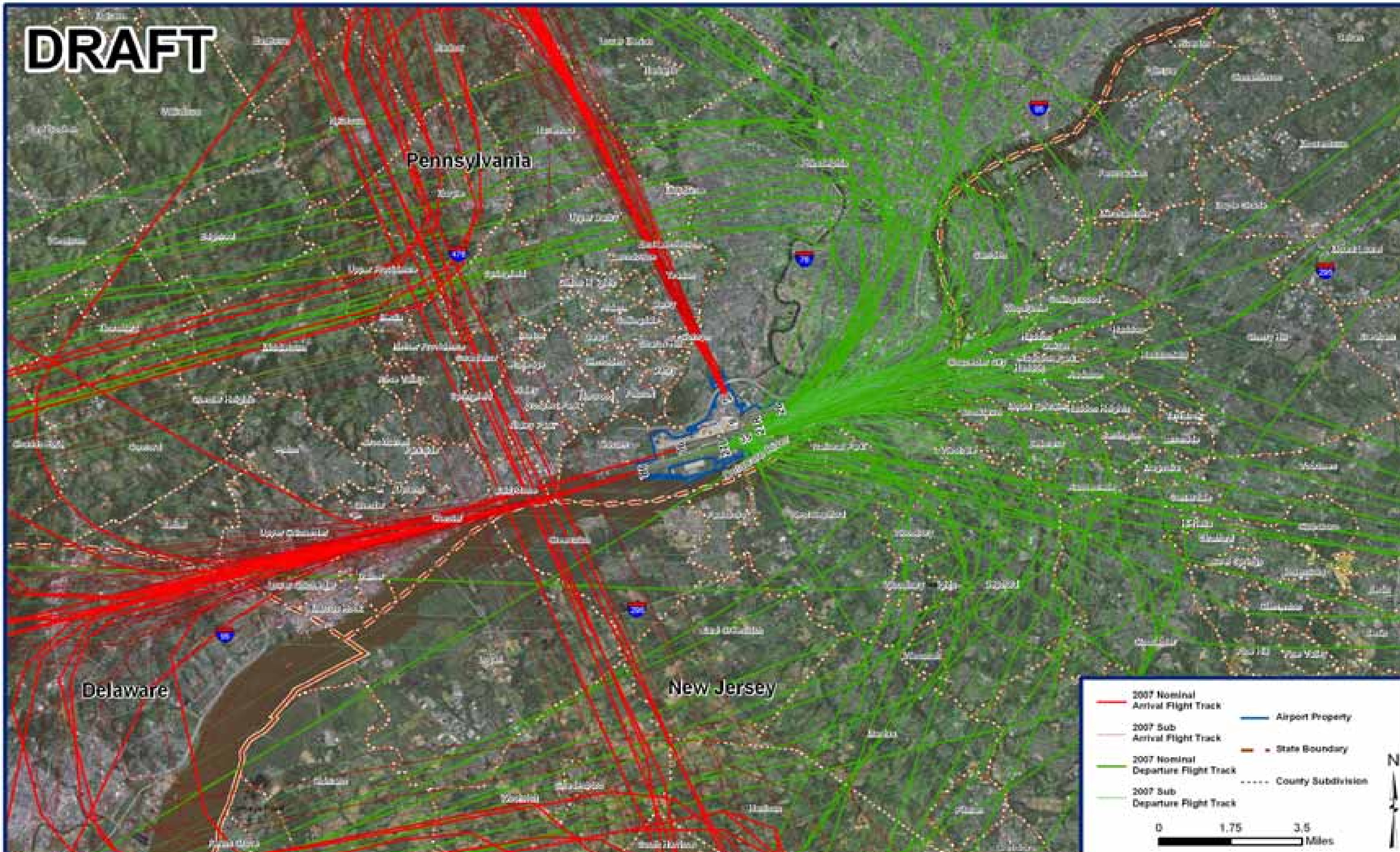
2007 West Flow Flight Tracks

Noise Compatibility Program Update

DMJM AVIATION | AECOM

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2007 East Flow Flight Tracks

Noise Compatibility Program Update

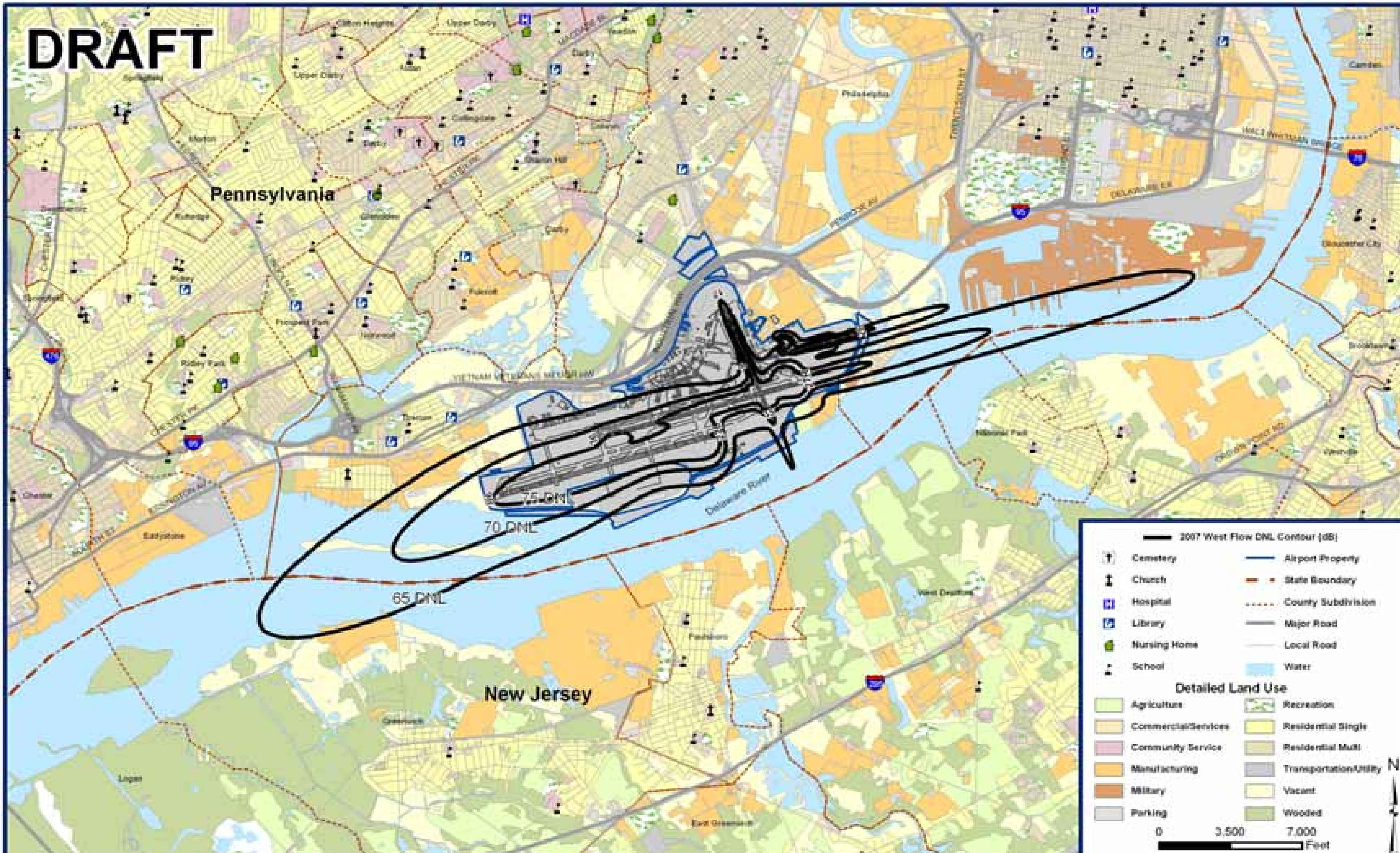
DMJM AVIATION | AECOM

2007EastFlowFlTrks.mxd

06-13-2008

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



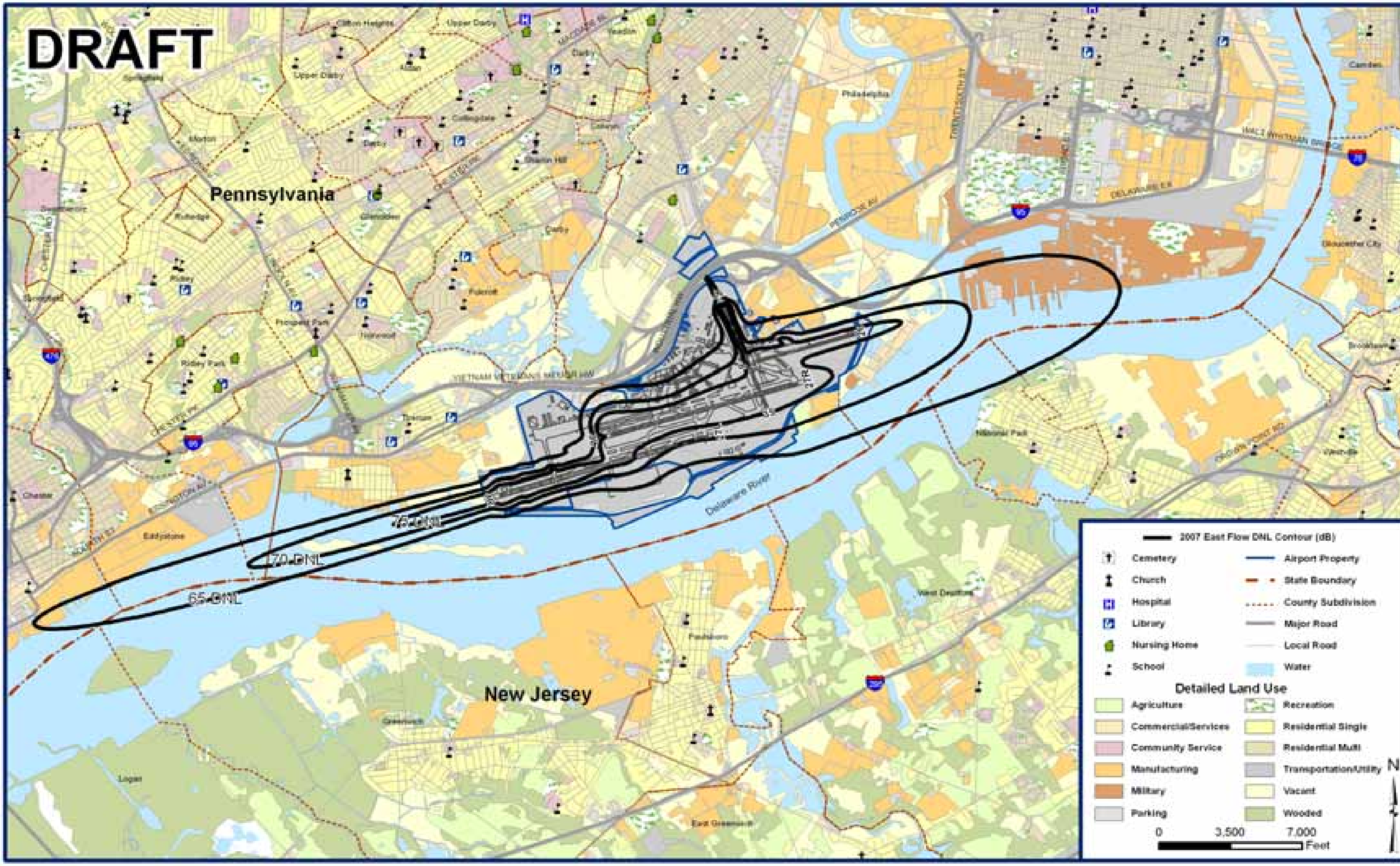
2007 West Flow Noise Exposure Contour

Noise Compatibility Program Update

DMJM AVIATION | AECOM

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2007 East Flow Noise Exposure Contour

Noise Compatibility Program Update

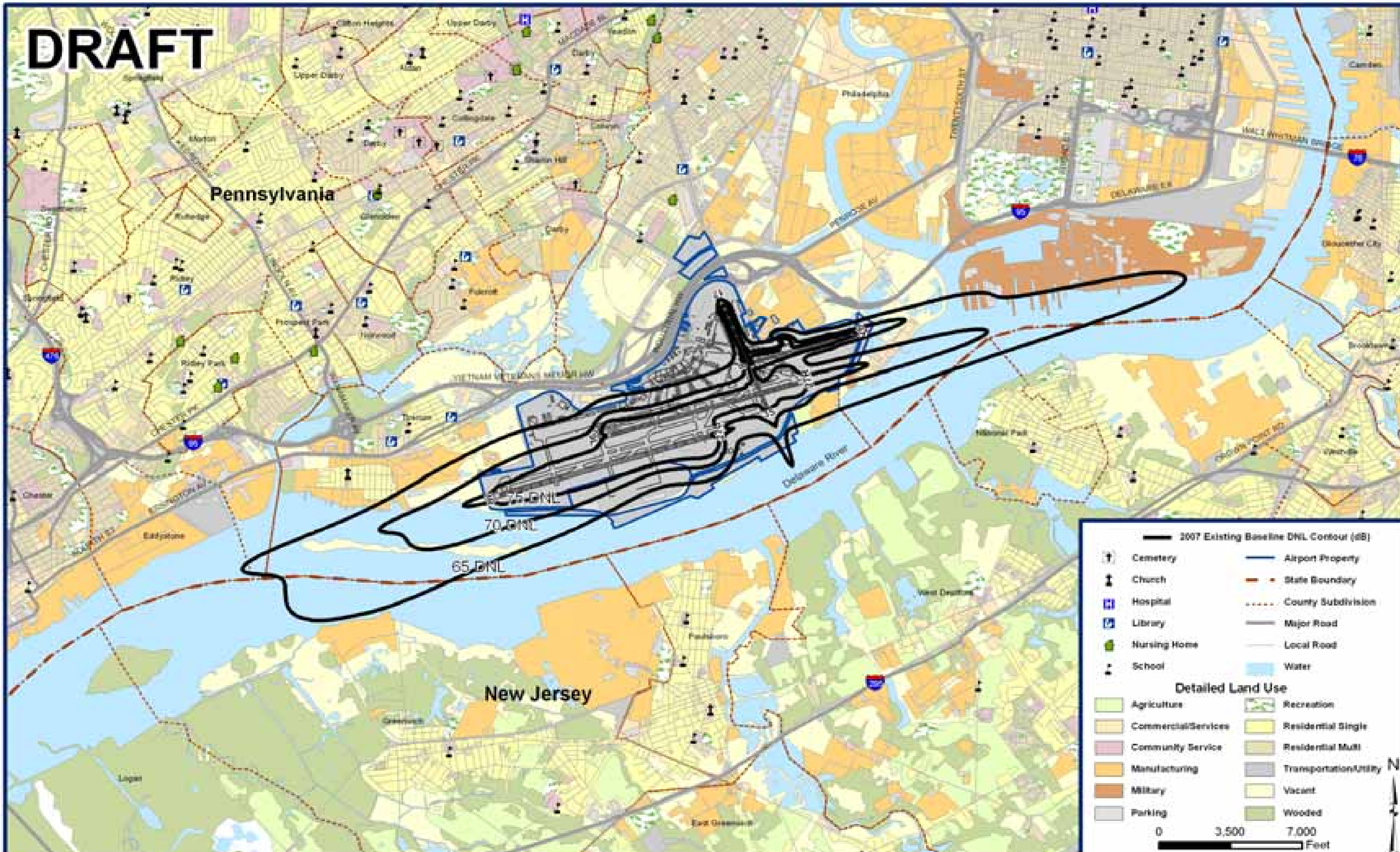
DMJM AVIATION | AECOM

2007EastFlowContour.mxd

06-13-2008

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2007 Existing Baseline Noise Exposure Contour

PHL

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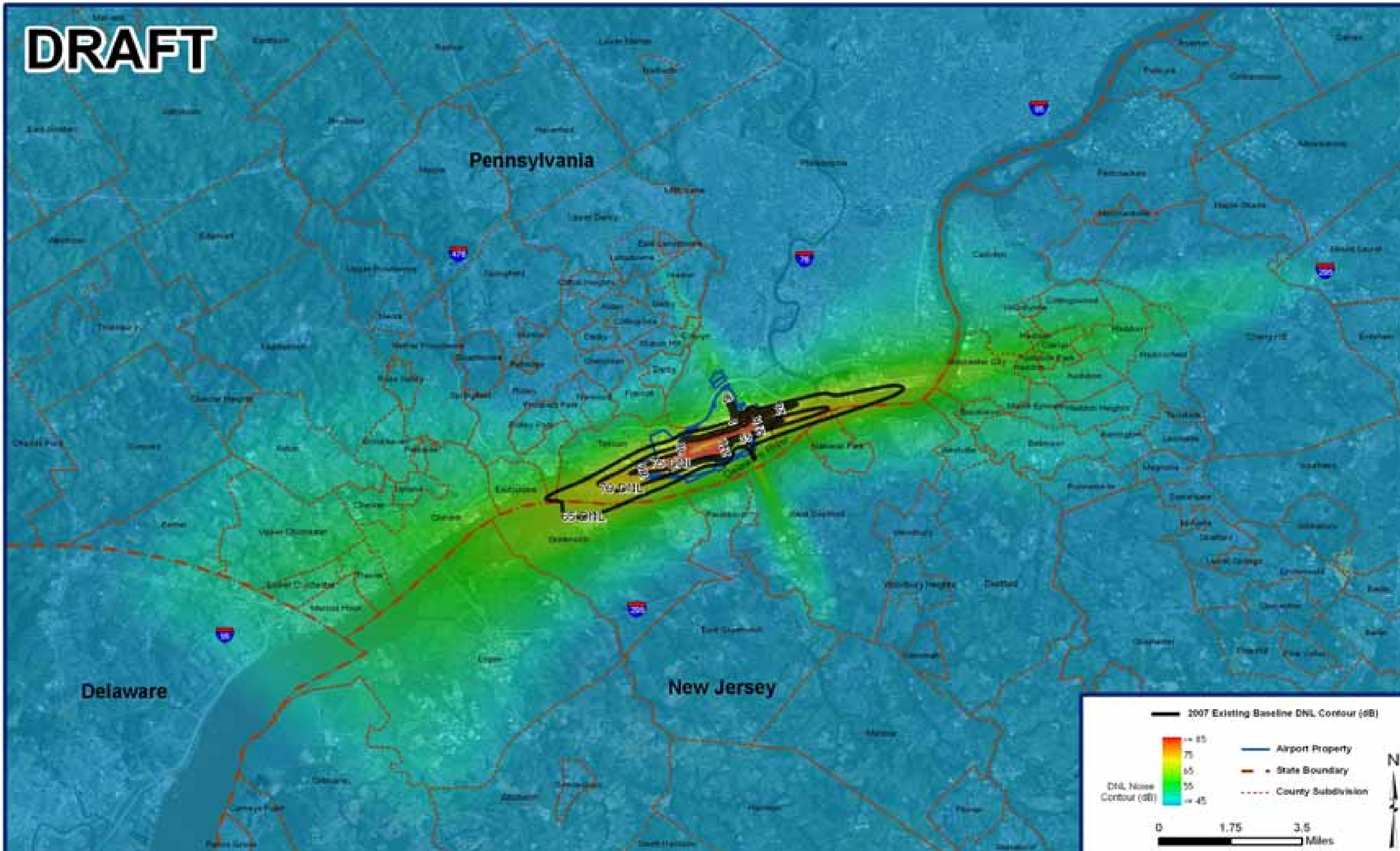
Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2007 Existing Baseline Noise Exposure

Noise Compatibility Program Update

DMJM AVIATION | AECOM

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

Future Noise Exposure

- The regulations (Part 150) require an evaluation of noise exposure for a period five years into the future (2013).
- All changes expected to occur at the airport are modeled.
- Three important changes may impact noise exposure at PHL:
  - **Increases in the overall number of operations**
  - **Runway 17/35 Extension**
  - **Implementation of the Airspace Redesign**

Operating Levels

- Operating levels for 2013 are expected to increase by 19% to over 594,000.
- Average Annual Day operations are expected to be 1,628.

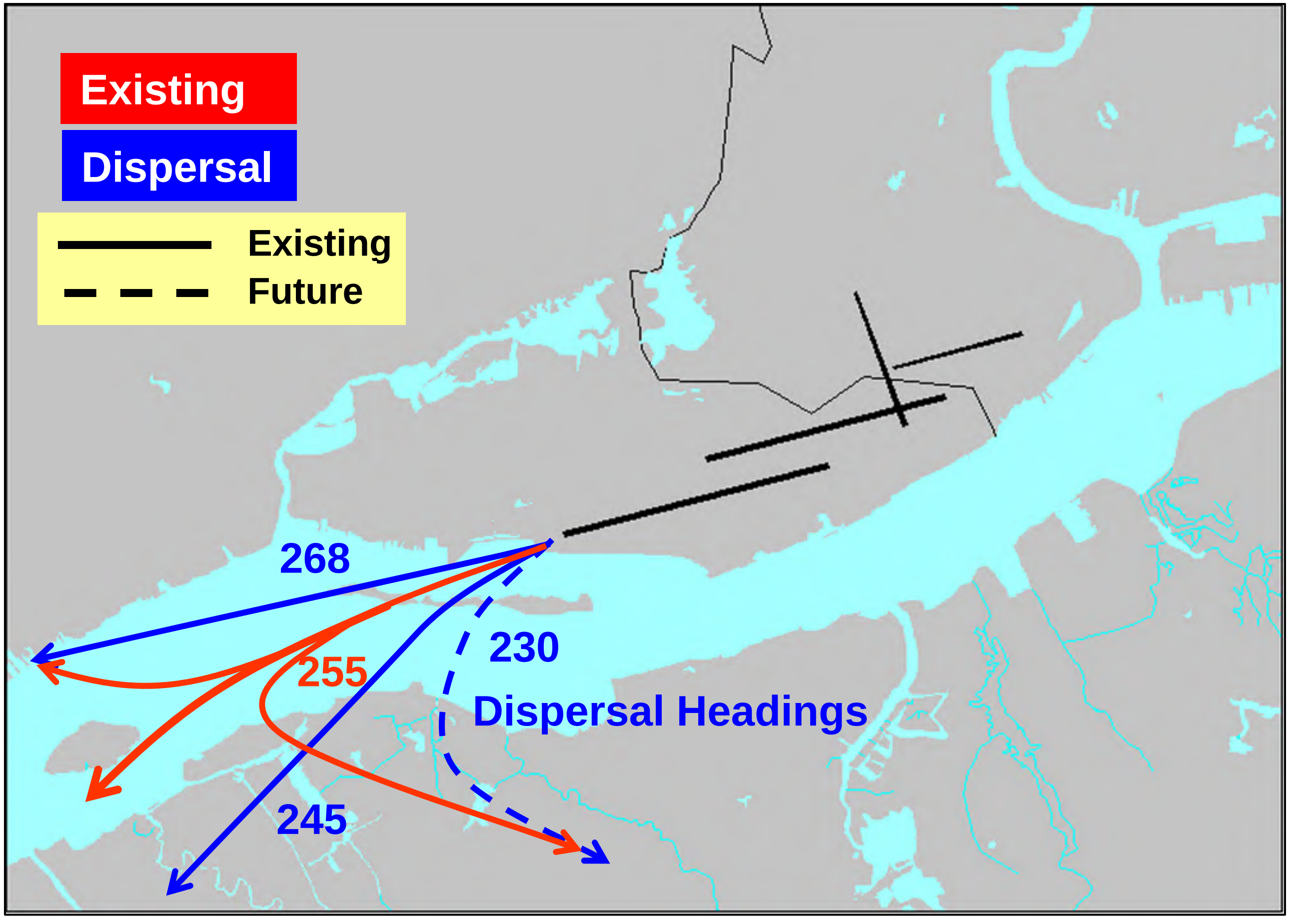
Airport Facilities

- Extended Runway 17/35 is expected to be fully operational (2009).
- To the north, an additional 640 feet will be added, and to the south, an additional 400 feet will be added, for a total length of 6,500 feet.

Incorporation of Airspace Redesign

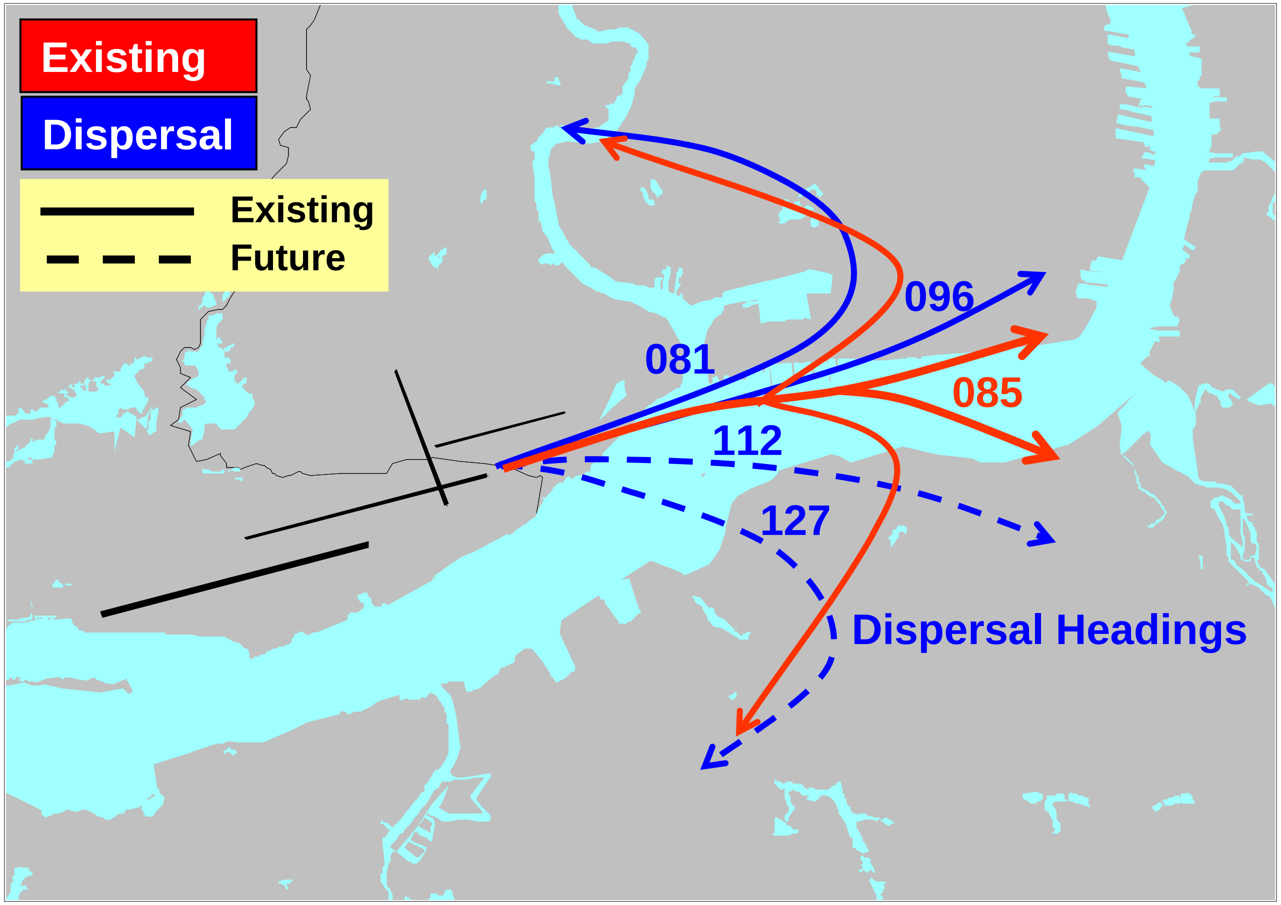
- Implementation of the Airspace Redesign (begun in late 2007) is expected to be complete by 2013.
- Revised departure headings in both West and East Flows.
- Additional airspace changes not yet implemented:
  - West flow dispersal heading
  - Establishing a new arrival route
  - Third westbound departure fix

Runways 27R & 27L Dispersal Headings

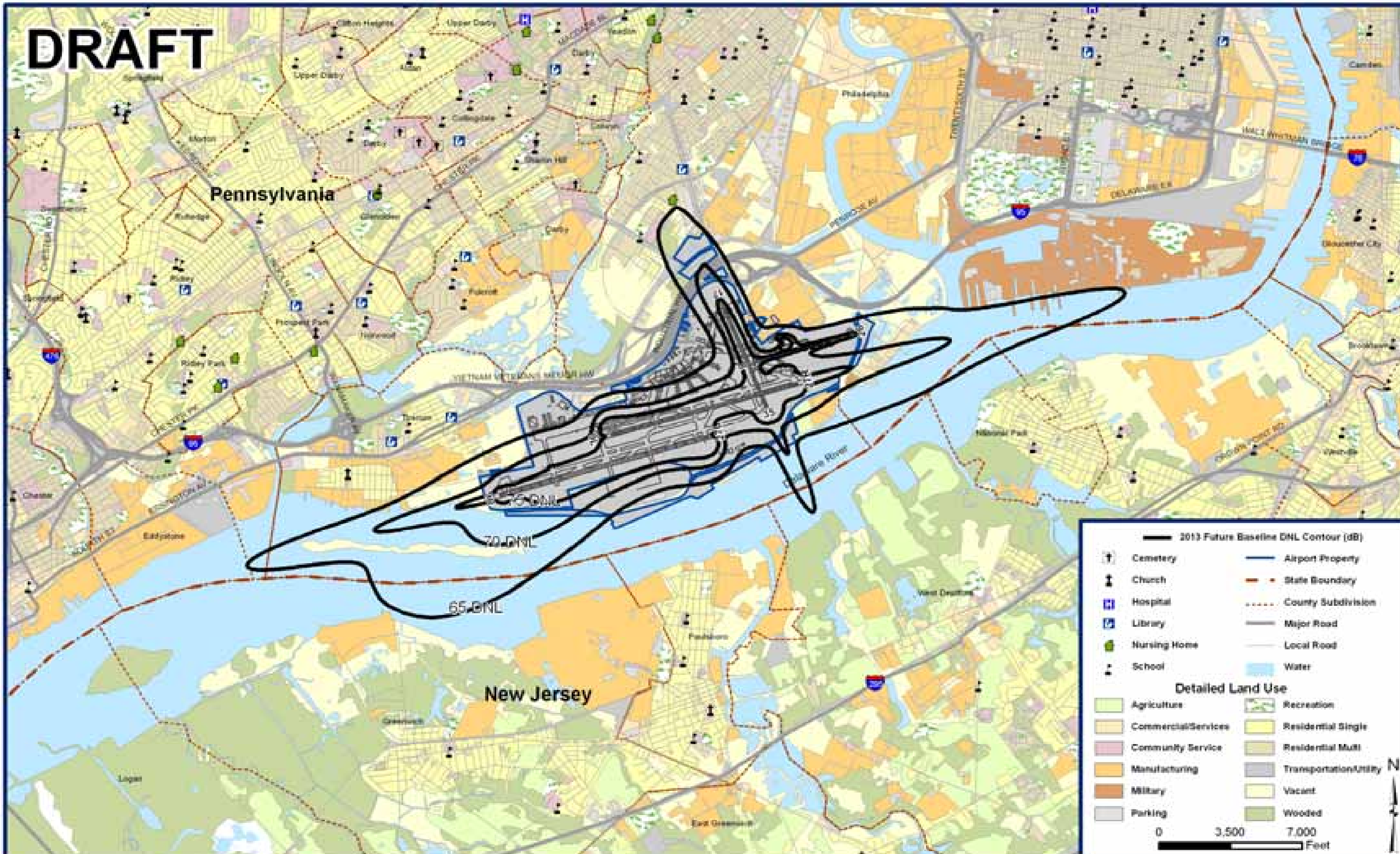


http://www.faa.gov/airports_airtraffic/air_traffic/nas_redesign/regional_guidance/eastern_reg/nynjphl_redesign/

Runways 09R & 09L Dispersal Headings



http://www.faa.gov/airports_airtraffic/air_traffic/nas_redesign/regional_guidance/eastern_reg/nynjphl_redesign/



2013 Future Baseline Noise Exposure Contour

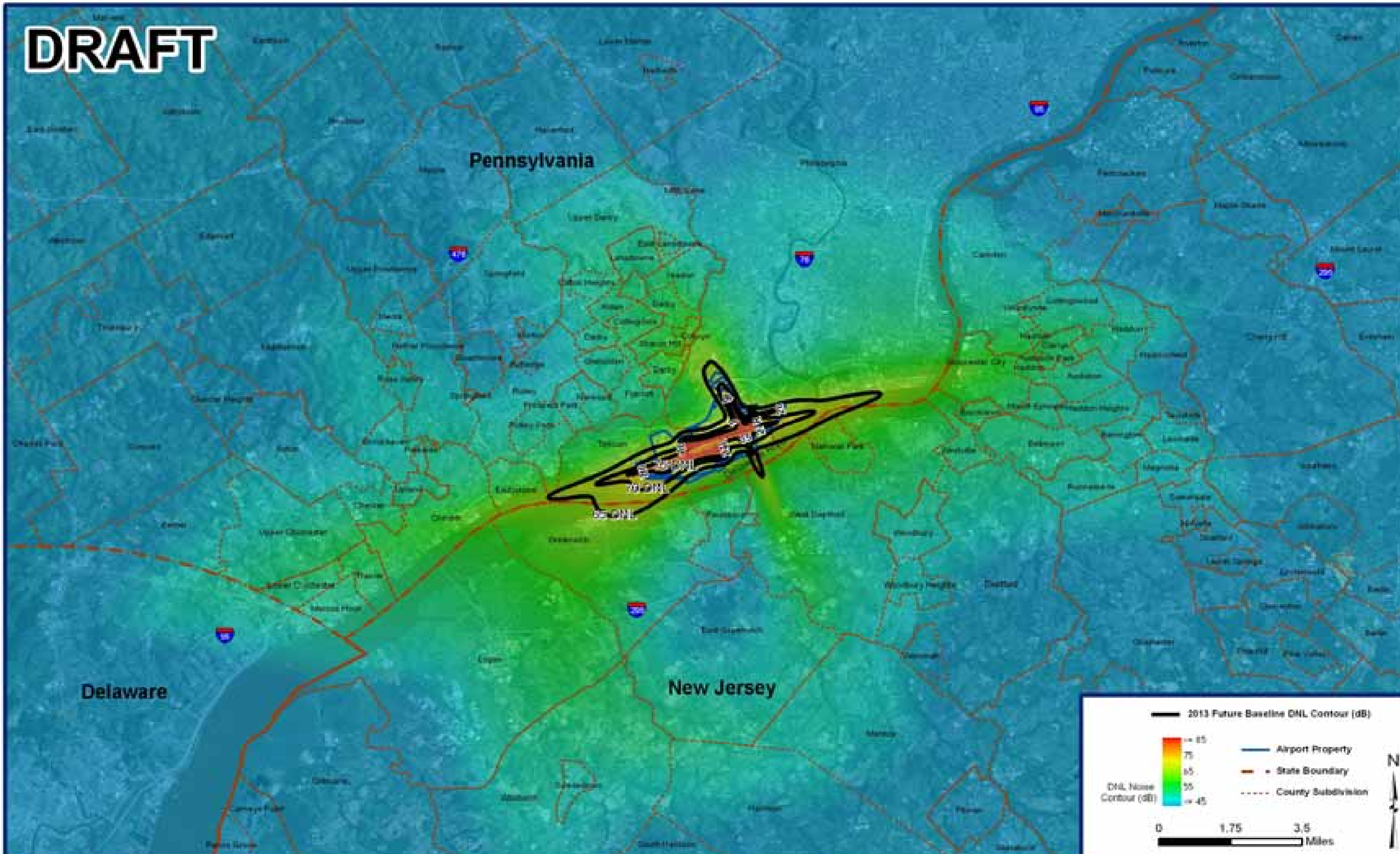
Noise Compatibility Program Update

DMJM AVIATION | AECOM

2013FutureBaseline.mxd

Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2013 Future Baseline Noise Exposure

Noise Compatibility Program Update

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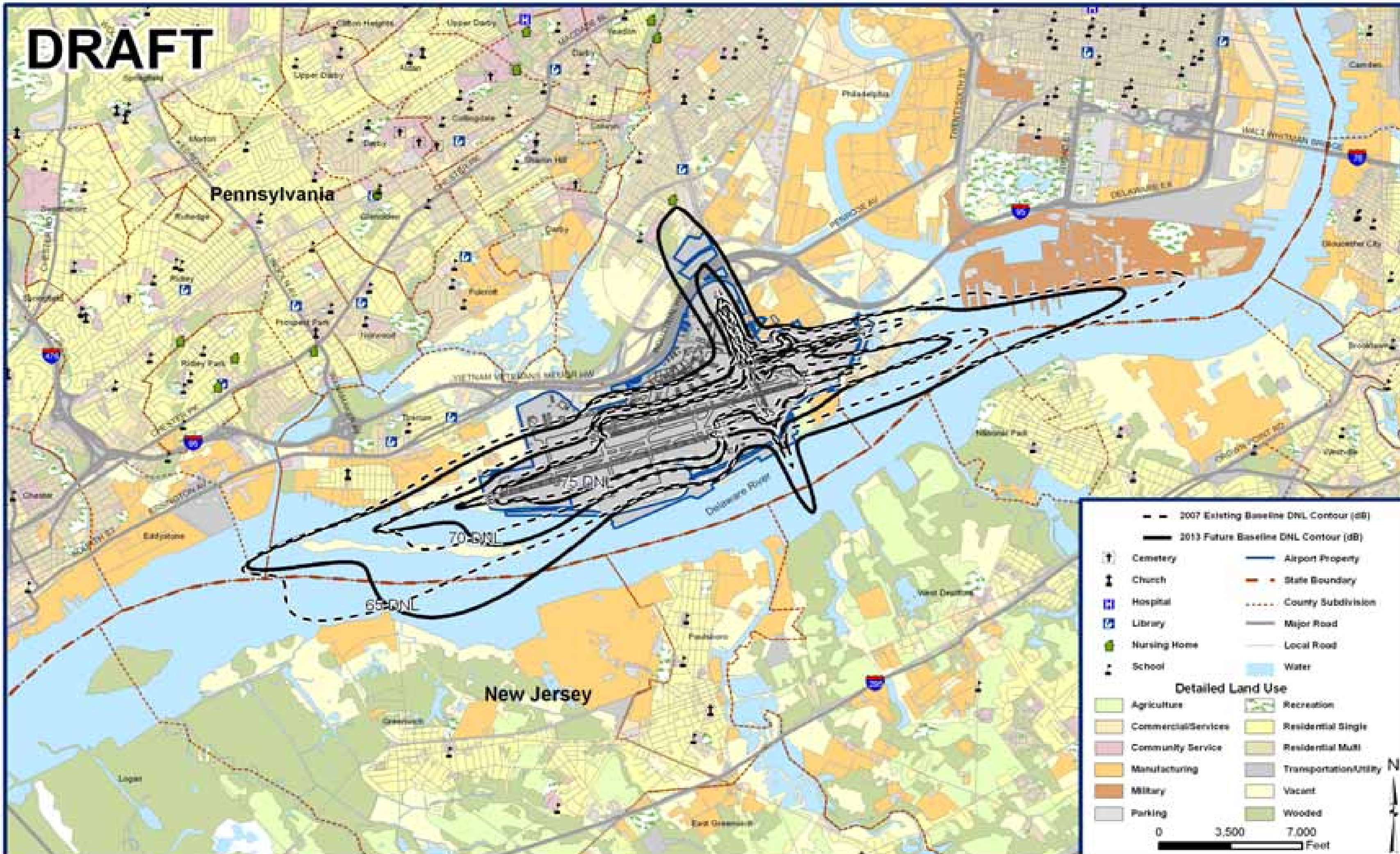
Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle



2007 Existing versus 2013 Future Baseline Noise Exposure Contour Comparison

Noise Compatibility Program Update

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Coordinate System: NAD 1983 StatePlane Pennsylvania South Feet

Prepared by Wyle

Contour Review Process

- The requirements (Part 150) state that the existing conditions contour be representative of actual conditions at the airport when the study is submitted.
- As the Airspace Redesign is currently being implemented, the Existing Baseline contour for 2007, as presented today, may no longer be representative of operating conditions at the airport.
- As such, as the study progresses, the Airport may elect to prepare a noise contour showing representative 2008 operating conditions.
- *It should be noted that neither the 2007 or 2008 noise contours will be the basis for mitigation – each is prepared only to document current conditions.*

Community Workshop Schedule

- **Second round of Community Workshops**
  - **June 17, 2008**
    Paulsboro Volunteer Fire Association **Paulsboro, NJ**
  - **June 18, 2008**
    Tinicum School **Essington, PA**
  - **June 19, 2008**
    Claymont Community Center **Claymont, DE**
  - **June 24, 2008**
    Cherry Hill Public Library **Cherry Hill, NJ**
  - **June 25, 2008**
    Mercy Wellness Center **Philadelphia, PA**

Community Workshops Overview

- Workshops are in an open house format
- Each workshop is from 6:00 to 8:00 pm
- Study team members will be available to answer questions and take comments
- Present Existing and Future Baseline Noise Exposure Contours
- Solicit comments on contour maps
- Solicit ideas on potential mitigation alternatives

Noise Mitigation Alternatives

Noise Mitigation Alternatives will be based on the *Future Contour*

Three Types of Noise Mitigation Alternatives:

- Noise Abatement / Operational Measures
- Land Use Measures
- Program Management Measures

Noise Abatement /Operational Measures

- These measures address aircraft and airport noise at the source
- General Examples of this type include:
  - Changes in runway or flight track use
  - Changes in flight track location
  - Modifications to aircraft performance
- PHL Example (from existing Program):
  - Aircraft weighing 12,500 pounds or more departing Runways 9L/9R/17/35/8 fly runway heading until reaching 2,000 feet above ground level

Land Use Alternatives

- These measures prevent the introduction of additional noise sensitive land uses within existing and future airport noise contours.
- Examples of this type include:
  - Zoning regulations
  - Building codes
  - Real estate disclosures
  - Sound insulation programs
- PHL Example (from existing Program):
  - Develop and implement a residential sound insulation program

Program Management Measures

- These measures relate to the oversight and management of the Airport's noise program.
- Examples of this type include:
  - Continued operation of the Noise Office
  - Community interaction (information exchange)
  - Continuation of the noise monitoring system
- PHL Example (from existing Program)
  - Establish full time noise office with staff

Next Steps

- Public Workshops
- Contour Review
- Noise Abatement Alternatives Analysis

DMJM Aviation
1700 Market Street, Suite 1700, Philadelphia, Pennsylvania 19103
T 215.399.4300 F 215.399.4350 www.dmjmaviation.com

MEETING MINUTES

Subject:	PHL Noise Compatibility Study Update – Study Advisory Committee (SAC) Meeting #3
Place:	Mercy Wellness Center, 2821 Island Avenue, Philadelphia, PA 19153
Date of Meeting:	June 17, 2008
Attendees:	See attached sign in sheet
Date Prepared:	June 29, 2008
Prepared By:	Morgan Barlow, Portfolio Associates, Inc. & Lynn Keeley, DMJM Aviation

Purpose: The purpose of this meeting was threefold: 1) to update the SAC on the progress of the study; 2) to introduce the preliminary noise contours for existing baseline year 2007 and future baseline year 2013, and 3) to explain the next steps in the process – development of the noise compatibility program.

Discussion: The discussion followed the meeting agenda.

1. Welcome and Introductions

Mike McCartney (PHL) welcomed the SAC. Each of the attendees introduced themselves (see the attached sign in sheet). Beverly Harper (Portfolio Associates) reviewed the attendee's folder contents and encouraged participants to complete the evaluation form.

Following the introductions, Allan A'Hara (DMJM Aviation) announced a personnel change in the project management. Bill Allen has taken a job with a consultant to the FAA and is no longer with DMJM Aviation. Allan explained that he, Lynn Keeley, and Royce Bassarab will be the leads on the project going forward. Also, the Airport has hired a new noise officer, Jonathan Collette. Mr. Collette is filling the position previously held by Mike Jeck.

2. Noise Exposure Map (NEM) Development

Mr. A'Hara reviewed the meeting agenda and stated that the most important portion of the presentation would be the noise exposure maps (NEM). He pointed out that the noise contours are a preliminary "work in progress" and that further analysis is needed before these NEMs are finalized.

Mr. Royce Bassarab (Wyle Labs) provided an overview of the Integrated Noise Model (INM), and explained the input data that is required to generate the noise contours.

Mr. Michael Bonnette, representing Mayor Colombi of Haddonfield, NJ, introduced himself and his organization: the Haddonfield/South Jersey Noise Abatement Coalition. Mr. Bonnette noted that there are currently no noise abatement arrival procedures at

PHL and that his organization has developed noise abatement arrival procedures which they are willing to share with the Airport. He indicated that these procedures have been discussed with the FAA Air Traffic Control Manager at PHL, but to date no action has been taken on them. Mr. Bassarab noted that the next step in the process is to collect and analyze noise mitigation suggestions. Any suggestions received will be studied to determine their benefits, costs, and implementation feasibility. Mr. Bonnette believes the procedures he's proposing are implementable today and his Coalition is willing to assist in their implementation.

Ms. Maryanne Mahoney, representing Philadelphia City Council President Anna Verna, asked about the 2013 NEM and how far the 65 DNL contour extends into Eastwick. Mr. A'Hara indicated that it extended north between Bartram Avenue and Lindbergh Boulevard.

Ms. Elvira Stewart, President of the Eastwick PAC noted that planes are frequently flying over the neighborhood on weekends. Ms. Mahoney concurred and asked "why is it noisier on Saturday? It seems that the area at 76th and Buist has had an increase in air traffic, particularly on Saturday." The project team committed to provide an answer to Ms. Mahoney and Ms. Stewart.

Mr. Bill Erickson, Philadelphia City Planning Commission, asked that if the east flow and west flow contours were combined, would the average reduce the size of the contour. Mr. Bassarab explained that the overall (combined) contour, which averages activity in both directions, does not typically extend as far out as the single direction contour does. Mr. A'Hara noted that the FAA requires the average contour be used in this analysis.

Mr. Erickson asked if an east flow NEM and west flow NEM had been run for 2013. His observation was that the draft 2013 NEM indicated that 80% of the people who were inside the previous DNL contour may be outside of final contour. Mr. A'Hara responded that some of the homes included in the current RSIP program were outside of the 65 DNL contour on the existing NEM and that recommendations on current and potential RSIP program will be assessed after the NEM is finalized.

Ms. Shirley Loveless, representing PA Congressman Joe Sestak, indicated that she expected more of a shift of the 65 DNL contour over Delaware County as a result of the FAA Airspace Redesign. Mr. A'Hara responded that the project team will be seeking an update from FAA on the Airspace Redesign implementation, but the draft 2013 NEM shows a shift of noise more over the Delaware River than Delaware County.

3. Contour Overview

Mr. A'Hara explained that the FAA requirements under Part 150 state that the existing conditions contour must be representative of actual conditions at the airport when the study is submitted. As the Airspace Redesign is currently being implemented, the Existing Baseline contour for 2007, as presented, may no longer be representative of existing operating conditions at the airport. As such, as the study progresses, the Airport may elect to prepare a noise contour showing representative 2008 operating conditions.

Mr. Bassarab reminded the SAC that neither the 2007 (or 2008) noise contour will be the basis for mitigation – each is prepared only to document current conditions.

4. Community Workshop Overview

Mr. A'Hara explained that the second round of community workshops are being held over the next several evenings at various locations around PHL. The workshops are an open house forum where team members will be available to answer questions or take comments. The purpose of these meetings is to present the development of the existing and future baseline noise exposure contours; to solicit comments on the contour maps; and to solicit ideas on potential mitigation alternatives.

5. Questions/Next Steps

Dr. Gary Stolz, John Heinz National Wildlife Refuge, asked when the next SAC meeting might be held. Mr. A'Hara said quite likely this fall or before the year is out.

Mr. Steve Rich (FAA Air Traffic Control) and Ms. Sue McDonald (FAA Harrisburg Airports District Office) explained that PHL is a unique airport that is not comparable to other airports in the nation and that implementing operational changes here is complicated and requires extensive coordination with the FAA, Airport, and airport users.

Before the meeting concluded, Ms. Phyllis VanIstendal, PHL's Government Affairs Manager, reminded the attendees that the SAC was assembled based on the fact that elected officials, PHL stakeholders, and area planning agencies are well suited to disseminate project information to their constituents. The study team relies on the SAC to keep interested parties informed.

Distribution:

Attendees (see attached sign-in sheet)
Calvin Davenger, Division of Aviation
Charles Romick, Gloucester Co. Planning
Steven Sweeney, Gloucester County, NJ
David Schreiber, Tinicum Township
Trey Hettinger, UPS
Steve Huff, US Airways
Reiner Pelzer, DVRPC
Ed Yewdall, PennDOT Bureau of Aviation
David Woods, Office of Senator Dominic Pileggi
Lee Patrick Anderson, Ft. Mifflin
Mark Kamp, Paulsboro, NJ
John Butterworth, Atlantic Aviation
Anthony Bucci, Camden County, NJ
Anna Docimo, West Deptford Twp., NJ
Tish Colombi, Haddonfield, NJ
Mike Wagner, FAA ATA

NOTE: If attendees have any suggestions, please submit material within three (3) business days.

Attachment:

Sign-in Sheet

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Noise Compatibility Program Update

SAC MEETING – June 17, 2008
SIGN-IN SHEET

NAME	ORGANIZATION TITLE	TELEPHONE #	E-MAIL	INITIALS
Rich, Steve	Federal Aviation Administration Air Traffic Manager	215-492-4100	steve.rich@faa.gov	
Romick, Charles	Gloucester County Planning Department Director	856-307-6650	cromick@co.gloucester.nj.us	
Schweiker, Mark *represented by:* **Earley, Denise**	Greater Phila. Chamber of Commerce President & CEO	215-545-1234 215-545-1234	dearley@greaterphilachamber.com	
Sestak, Joe *represented by:* **Loveless, Shirley**	7th District of Pennsylvania	610-892-8623 610-566-1132	shirley.loveless@gmail.com	
Sisneros, Steve *represented by:* **John Minor**	Southwest Airlines Properties Manager	214-792-4745	steve.sisneros@wnco.com	
Stewart, Elvira	Eastwick PAC	215-365-8825	audreyist@aol.com	
Stolz, Gary	John Heinz Natl. Wildlife Refuge ~~Deputy~~ Refuge Manager	215-365-3118	Gary_Stolz@fws.gov	
Sweeney, Steven	Gloucester County, NJ Freeholder Director	856-853-3390	ssweeney@co.gloucester.nj.us	

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SAC MEETING – June 17, 2008
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NAME	ORGANIZATION TITLE	TELEPHONE #	E-MAIL	INITIALS
Giancristoforo, Thomas Jr. *represented by:* **Wunder, Joe** **Schreiber, David**	Tinicum Township President-Commissioner	610-521-3530 610-521-1815 610-521-3530	tjgjr@tinicumtownshipdelco.co m dschreiber@tinicumtownshipdel co.com	
X **Hettinger, Trey**	UPS Airport Properties Manager	502-329-3992	air1hjh@ups.com	
Jastrzab, Gary *represented by:* **Erickson, Bill**	Phila. City Planning Commission Acting, Executive Director	215-683-4600 215-683-4646	gary.jastrzab@phila.gov bill.erickson@phila.gov	[signature]
Huff, Steve	US Airways Manager ATC and Airfield Ops.	623-2292022	Steve_huff@usairways.com	
X **Moog, Roger** *represented by:* **Pelzer, Reiner**	DVRPC Office of Aviation Planning Manager	215-592-1800	rmoog@dvrpc.org rpelzer@dvrpc.org	
Pickett, John *represented by:* **Shaffer, Tom**	Delaware County Planning Dept. Director	610-891-5210 610-891-5200	pickettj@co.delaware.pa.us shaffert@co.delaware.pa.us	Sea George Kobyn
Reeb, Ralph *represented by:* **Geier, Roberta**	Delaware Dept of Transportation Director of Planning	302-760-2080 302-760-2121	Ralph.Reeb@state.de.us Roberta.Geier@state.de.us	[signature]

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SAC MEETING – June 17, 2008
SIGN-IN SHEET

NAME	ORGANIZATION TITLE	TELEPHONE #	E-MAIL	INITIALS
Anderson, Lee Patrick	Historic Fort Mifflin Executive Directorr	215-685-4167	lee.anderson@phila.gov	
Burzichelli, John *represented by:* **Mark Kamp**	Mayor - Paulsboro, NJ	856-423-1500	wardlafrance@hotmail.com	
Butterworth, John	Atlantic Aviation General Manager	215-492-7060	jbutterworth@atlanticaviation.c om	
Cappelli, Louis Jr. *represented by:* **Bucchi, Anthony**	Camden County, NJ Confidential Aide to Freeholder Director	856-225-5451 856-225-5451	louc@camdencounty.com abucchi@camdencounty.com	
Colombi, Letitia *represented by:* **Michael Bonnette**	Mayor - Haddonfield, NJ	856-428-0348	tcolombi@comcast.net	MBB
Docimo, Anna	Mayor - West Deptford Township, NJ	856-845-4004 ext. 130	campoe07@westdeptford.com	
McDonald, Sue	Federal Aviation Admin. Harrisburg Environmental Protection Specialist	717-730-2841	Susan.McDonald@FAA.GOV	SCM
Gabsewics, Edward	Federal Aviation Admin. Harrisburg Environmental Specialist	717-730-2832	Edward.Gabsewics@faa.gov	EJG

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SAC MEETING – June 17, 2008
SIGN-IN SHEET

NAME	ORGANIZATION TITLE	TELEPHONE #	E-MAIL	INITIALS
Verna, Anna *represented by:* **Mahoney, Maryanne**	City of Philadelphia City Council President	215-686-3412 215-686-3412	Maryanne.Mahoney@phila.gov	M M
X **Wagner, Mike**	Federal Aviation Administration Air Traffic Manager	215-492-4100	michael.wagner@faa.gov	
Madden, Eric *represented by:* **Yewdall, Ed**	PENNDOT Bureau of Aviation	717-705-1200 717-705-1251	emadden@state.pa.us eyewdall@state.pa.us	
X **Woods, David**	Office of State Senator Dominic F. Pileggi Chief of Staff	717-787-4712	dwoods@pasen.gov	
Kobryn, George	Del County Plg Dept	610-891-5200	Kobryng@co.delaware.pa.us	[illegible]
Webb, Michelle	Phila City Planning Com	215-683-4654	michelle.webb@phila.gov	MSW
/				

AIRPORT & CONSULTANTS

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Noise Compatibility Program Update

SAC MEETING – June 17, 2008
SIGN-IN SHEET

NAME	ORGANIZATION TITLE	TELEPHONE #	E-MAIL	INITIALS
Ahara, Allan	DMJM Aviation		Allan.Ahara@dmjmaviation.com	AA
Barlow, Morgan	Portfolio Associates, Inc., Marketing Director	215-627-3660	mbarlow@portfolioassociates.net	MB
Bassarab, Royce	Wyle Labs	512-253-5502	royce.bassarab@wylelabs.com	KRB
Cummings, Fred	Philadelphia International Airport, Airport Planner	215-937-6726	Freddric.Cummings@phl.org	FC
Collette, Jonathan	Philadelphia International Airport, Noise Officer	215-937-6233	Jonathan.Collette@phl.org	JC
Davenger, Calvin	Philadelphia International Airport,		DAVENGC.PHLEXEC.PHLDOM1@phl.org	
Harper, Beverly	Portfolio Associates, Inc., President	215-627-3660	bevharper@portfolioassociates.net	BAH
Isdell, Charles	Philadelphia International Airport, Acting Director of Aviation	215-937-6800	Charles.Isdell@phl.org	
Keeley, Lynn	DMJM Aviation, Senior Environmental Planner	215.399.4338	Lynn.Keeley@dmjmaviation.com	LK
McCartney, Mike	Philadelphia International Airport		Mike.McCartney@phl.org	MM

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Noise Compatibility Program Update

SAC MEETING – June 17, 2008
SIGN-IN SHEET

NAME	ORGANIZATION TITLE	TELEPHONE #	E-MAIL	INITIALS
Vanlstendal, Phyllis	Philadelphia International Airport, Government Affairs Manager	215 937 6946	Phyllis.Vanlstendal@phl.org	PVI
Patrick Adesso	DMJM Aviation, Planner	(813) 675-2100	patrick.adesso@dmjmaviation.com	PWA

Portfolio Associates, Inc. 6/08

Study Advisory Committee Meeting #2

Mercy Wellness Center

Conference Room

March 13, 2008 – 1:00 PM

Part 150 Noise Compatibility Program Update

Meeting Agenda

- Welcome
- Update on Status of Project
- Airspace Redesign Update
  - Mike Wagner, Air Traffic Manager, PHL ATCT
- Noise Measurement Program Results
  - Noise Metric Review
  - Airport Operations
  - Noise Measurement Site Characteristics
- Noise Exposure Modeling Overview
- Next Steps

Part 150 Noise Compatibility Program Update

Update on Status of Project

- **Noise Measurement Program was completed.**
- **Airport/aircraft operational data was collected for FY 2007 (Oct. 2006 through Sept. 2007).**
- **While the 2007 NEM's were being prepared, the FAA implemented parts of the Airspace Redesign (ARD).**
- **Part 150 Update process was paused to re-evaluate any potential impacts from the ARD.**
- **Decision was made to use 2007 calendar year's data (Jan. 2007 through Dec. 2007) that included ARD alterations to airport operations.**

Update on Airspace Redesign

- Mike Wagner, Air Traffic Manager, PHL ATCT

Noise Measurement Program

- Provide an understanding of current community noise exposure.
- Assess the contribution of aircraft noise to overall community noise exposure.
- Measure the sound levels of individual aircraft operations at locations around the airport.
- Evaluate “Slice-in-Time” Noise Environment over a 10-day period (11/7/07 through 11/16/07) at the 28 selected sites.
- Measurements can be used to supplement INM data, but not to take the place of modeling.

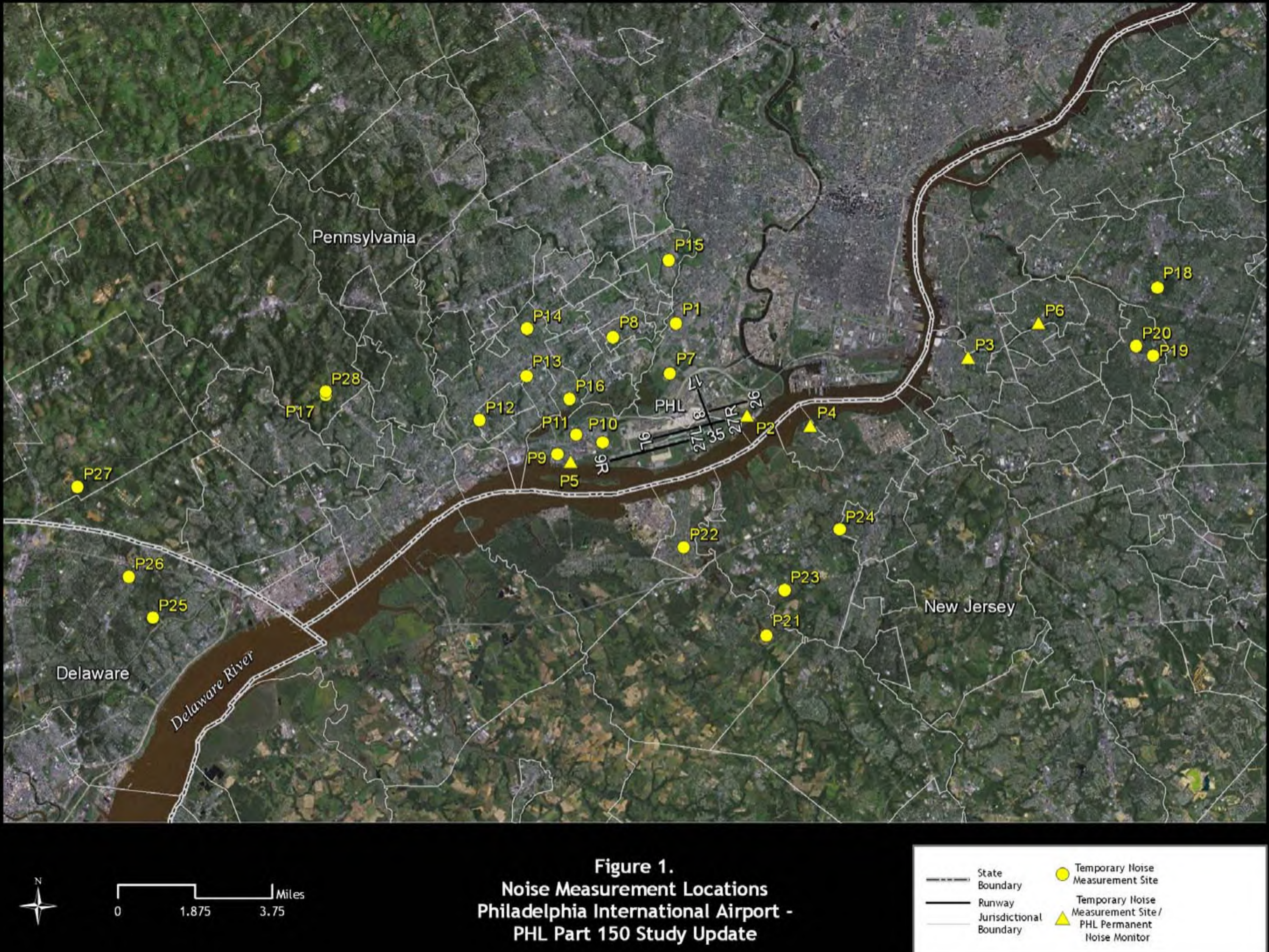
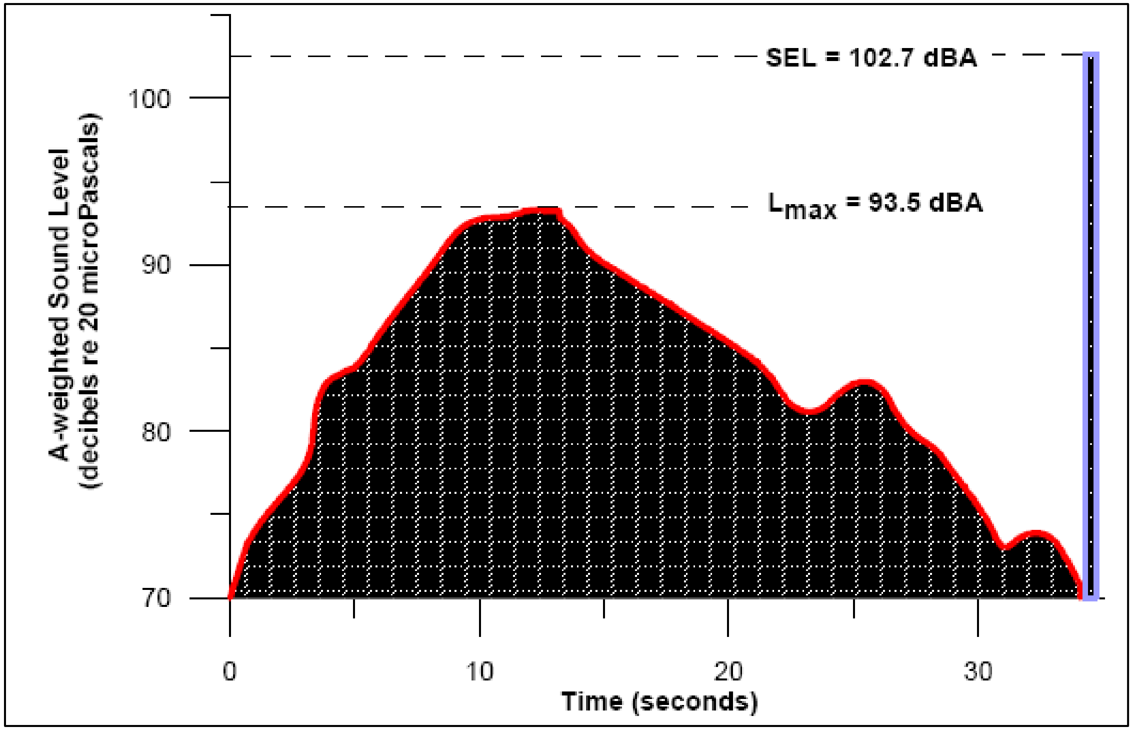


Figure 1.
Noise Measurement Locations
Philadelphia International Airport -
PHL Part 150 Study Update

Noise Metric Review

Maximum Sound Level (L_{max}) - **The highest sound level measured during a single event.**

Sound Exposure Level (SEL) - **The total energy of a noise event to a 1-second duration.**

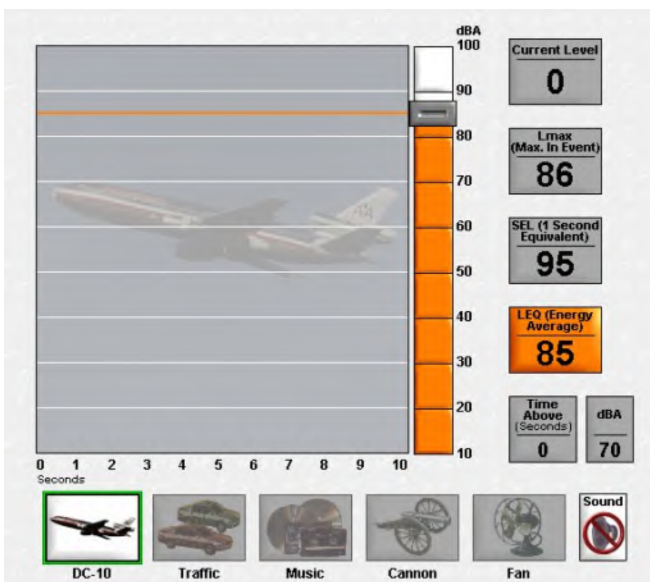


Part 150 Noise Compatibility Program Update

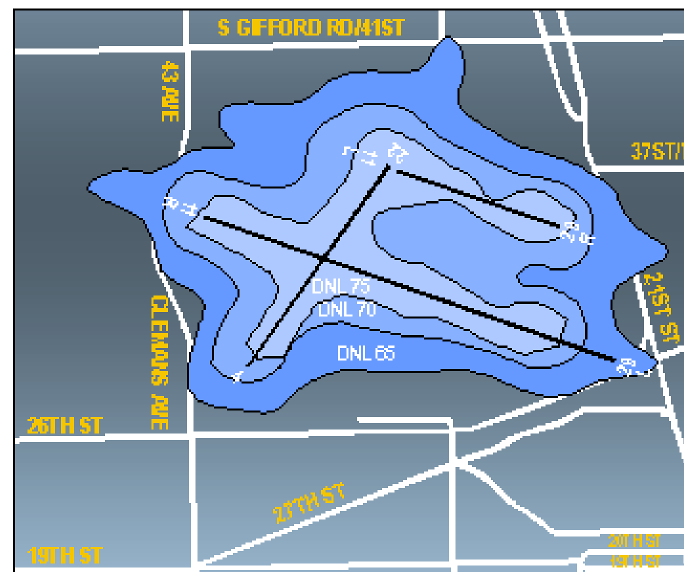
Noise Metric Review

Equivalent Sound Level (Leq) - **Time-average of the total sound energy over a specified time period.**

Day-Night Average Sound Level (DNL) - **24-hour average with a 10-db weighting for nighttime events.**



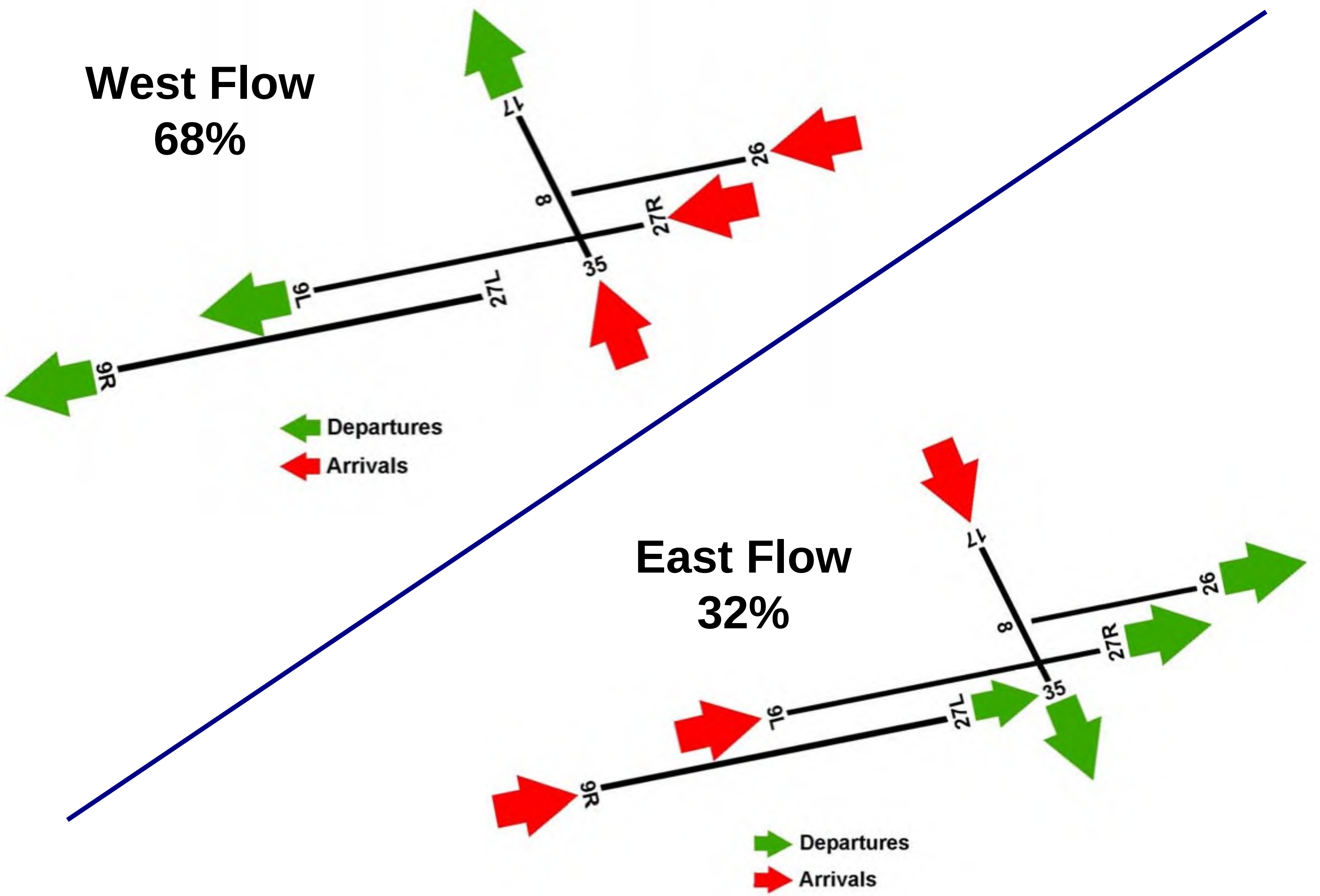
Equivalent Sound Level (Leq)



Day Night Sound Level (DNL)

PHL PHILADELPHIA INTERNATIONAL AIRPORT

Part 150 Noise Compatibility Program Update



Operational Flow During Noise Measurement Period

Date	West Flow	East Flow
7-Nov	99.9%	0.1%
8-Nov	98.0%	2.0%
9-Nov	97.9%	2.1%
10-Nov	69.3%	30.7%
11-Nov	99.9%	0.1%
12-Nov	99.7%	0.3%
13-Nov	98.5%	1.5%
14-Nov	9.3%	90.7%
15-Nov	99.6%	0.4%
16-Nov	99.9%	0.1%