Appendix C
NOISE AND AIR QUALITY MODELING

The standard methodology for analyzing noise conditions at airports involves the use of a computer simulation model. The Airport Environmental Design Tool, Version 2d (AEDT) is required by the Federal Aviation Administration (FAA) for developing noise exposure contours. AEDT is designed to predict annual average aircraft noise conditions at a given geographic location. The purpose of the noise model is to produce noise exposure contours that are overlain on a map of the airport and vicinity to graphically represent aircraft noise conditions.

Noise contours were prepared using the yearly day-night level sound level (DNL), which is FAA's primary noise metric. DNL accounts for the increased sensitivity during nighttime hours (10:00 p.m. to 7:00 a.m.). A 10-decibel weighting is applied to noise events occurring at night. DNL is a summation metric which allows for objective analysis and can describe noise exposure comprehensively over a large area. The primary benefit of using the DNL metric is that it accounts for the average community response to noise as determined by the actual number and types of noise events and the time of day they occur.

To achieve an accurate representation of an airport's noise conditions, the AEDT incorporates a combination of industry standard information and user-supplied inputs specific to the airport. The software provides noise characteristics, standard flight profiles, and manufacturer-supplied flight procedures for aircraft within the U.S. civil and military fleets, including those which commonly operate at Hillsboro Airport. As each aircraft has different design and operating characteristics (number and type of engines, weight, and thrust levels), each aircraft emits different noise levels. The most common way to spatially represent the noise levels emitted by an aircraft is with a noise exposure contour.

Based on AEDT-provided and user inputs shown on **Exhibit C1**, aircraft sound exposure for the annual average day is calculated for the points in a grid covering the Airport and surrounding areas. The grid values, represented with the DNL, at each intersection point on the grid represent a noise level for that geographic location. To create the noise contours, a line linking equal values, similar to those on a topographic map, is drawn which connects points of the same DNL noise value. In the same way that a topographic contour represents the same elevation, the noise contour identifies equal noise exposure.

The AEDT contains database tables correlating noise, thrust settings, and flight profiles for most of the civilian aircraft and many common military aircraft operating in the United States. This database, often referred to as the noise curve data, has been developed under FAA guidance based on rigorous noise monitoring in controlled settings. This information was developed through more than a decade of research, including extensive field measurements of more than 10,000 aircraft operations. The database also includes performance data for each aircraft to allow for the computation of airport-specific flight profiles (rates of climb and descent).

Airport-specific information, including runway configuration, flight paths, aircraft fleet mix, runway use distribution, elevation, atmospheric conditions, and numbers of daytime and nighttime operations, are also used as modeling inputs. Specific modeling assumptions for Hillsboro Airport are discussed in the following sections.

AIRCRAFT FLEET MIX AND OPERATIONS

Database Selection

Noise emissions from an aircraft vary by the type and number of engines, as well as the airframe. AEDT provides more than 3,000 engine and airframe combinations to represent many of the aircraft operating in the United States. **Table C1** lists the existing condition and 20-year forecast operations by aircraft type for the airport. The aircraft types were determined by reviewing FAA tower records for a 12-month period. This information is available from the FAA's Airport Traffic Activity Data System (ATADS).

Time-of-Day

The time of day which aircraft operations occur is important as input to the AEDT due to the 10-decibel nighttime (10:00 p.m. to 7:00 a.m.) weighting of flights. In calculating airport noise exposure, one operation at night has the same noise emission value as 10 operations during the day by the same aircraft.

Time-of-day information was estimated based upon analysis conducted as part of the master planning process. For the purposes of this analysis, it is assumed that 6.4 percent of operations occur during the DNL nighttime hours.

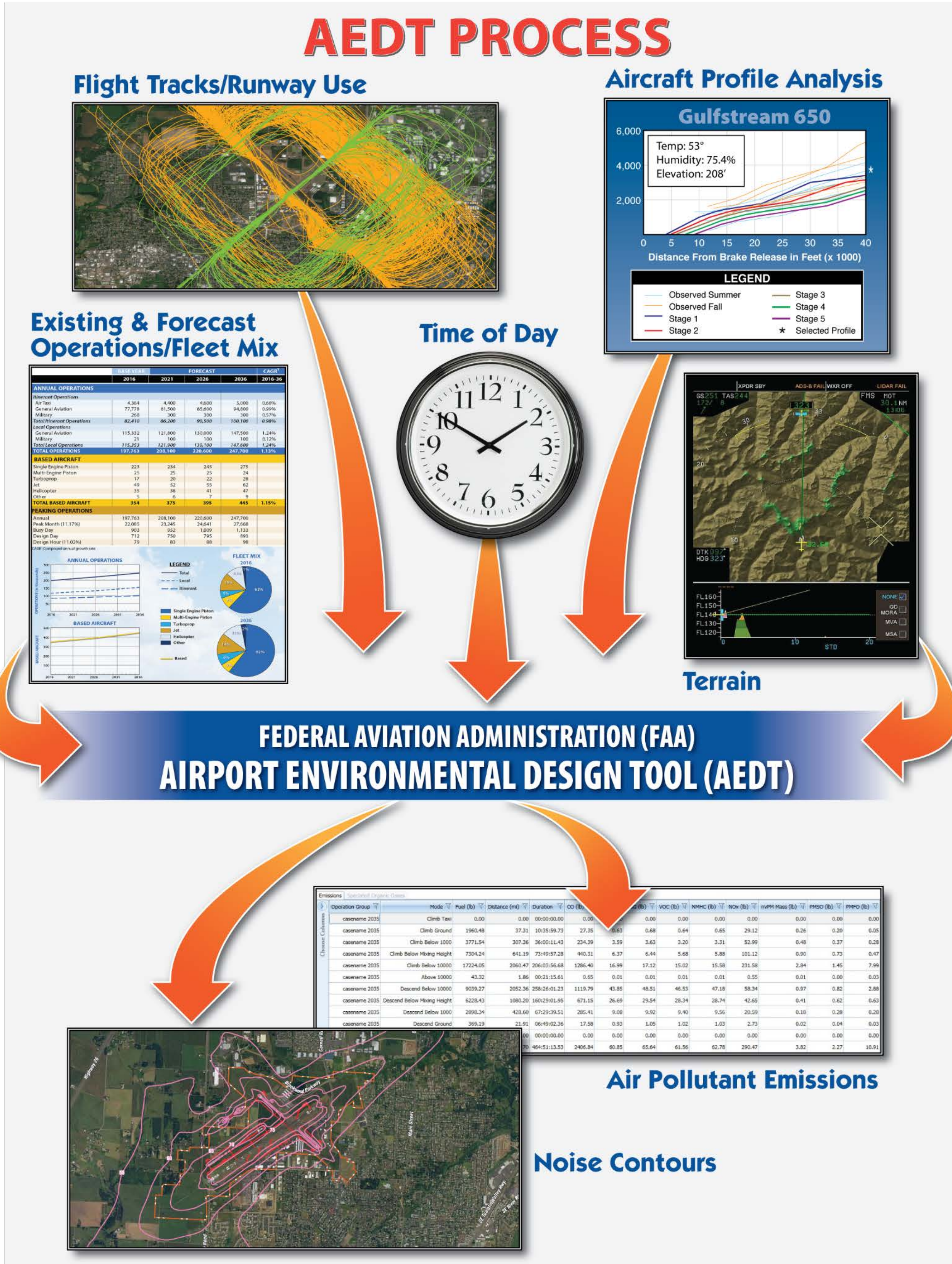


Exhibit C1
AEDT PROCESS

TABLE C1
Aircraft Fleet Mix and Operations
Hillsboro Airport

	AEDT Designator	Existing (2016)	Future (2036)
Itinerant			
Single Engine Piston	CNA182	1,867	2,050
Single Engine Piston	CNA206	961	1,055
Single Engine Piston	GASEPF	55,655	62,139
Multi-Engine Piston	BEC58P	2,085	2,062
Single Engine Turboprop	CNA208	298	463
Multi-Engine Turboprop	CNA441	1,958	3,039
Multi-Engine Turboprop	SD330	1,593	2,473
Business Jet - Small	CNA510	1,108	1,475
Business Jet - Small	ECLIPSE500	149	199
Business Jet - Medium	CIT3	582	776
Business Jet - Medium	CNA500	396	527
Business Jet - Medium	CNA55B	551	733
Business Jet - Medium	CNA560U	313	416
Business Jet - Medium	F10062	106	141
Business Jet - Medium	MU3001	118	157
Business Jet - Medium	IA1125	196	261
Business Jet - Medium	LEAR35	1,835	2,443
Business Jet - Large	CNA680	77	103
Business Jet - Large	CL600	1,048	1,395
Business Jet - Large	CNA750	119	158
Business Jet - Large	EMB145	3,536	4,708
Business Jet - Large	GIV	103	137
Business Jet - Large	GV	1,994	2,655
Business Jet - Large	737800	13	17
Business Jet - Large	MD81	56	75
Military Helicopter	CH47D	257	257
Military Jet	F16GE	114	143
Military Turboprop	P3A	29	29
Helicopter Piston	R22	7,784	9,575
Helicopter Piston	R44	1,103	1,357
Helicopter Turboprop	A109	303	372
Helicopter Turboprop	S70	507	624
Helicopter Turboprop	SA365N	33	42
Itinerant Subtotal		86,847	101,988
Local			
Single Engine Piston	CNA182	2,157	2,816
Single Engine Piston	CNA206	1,110	1,449
Single Engine Piston	GASEPF	59,171	77,213
Multi-Engine Piston	BEC58P	2,916	2,800
Single Engine Turboprop	CNA208	80	240
Multi-Engine Turboprop	CNA441	320	960
Helicopter Piston	R22	39,679	49,699
Helicopter Piston	R44	5,623	7,042
Helicopter Turboprop	A109	1,543	1,933
Helicopter Turboprop	S70	2,586	3,239
Helicopter Turboprop	SA365N	167	210
Local Subtotal		115,353	147,600
Total Operations		202,200	249,658

Source: Coffman Associates analysis

Runway and Helipad Use

Runway use indicates the typical paths aircraft fly when arriving or departing from the airport. At Hillsboro Airport, large jets are flown exclusively on Runway 13R-31L, while medium-sized jets are flown on Runway 13R-31L and Runway 2-20. Turboprop and single and multi-engine piston itinerant operations and local training operations occur on all runways. **Table C2** summarizes the runway use assumptions used in this analysis.

TABLE C2
Runway Use Percentages
Hillsboro Airport

Runway	Large Jet	Medium Jet	Turboprop	General Aviation	Local Fixed Wing
13R	25.0%	24.0%	20.0%	15.0%	10.0%
31L	75.0%	75.0%	70.0%	40.0%	25.0%
13L	0.0%	0.0%	3.0%	5.0%	10.0%
31R	0.0%	0.0%	3.0%	20.0%	35.0%
02	0.0%	0.5%	2.0%	10.0%	10.0%
20	0.0%	0.5%	2.0%	10.0%	10.0%

Source: Coffman Associates analysis

In the existing condition, two helicopter landing areas are assumed. The first is located in the southern portion of the airport east of the terminal area (identified as HP1), and the second is located on Taxiway Delta (identified as HP2). In this scenario, it is assumed that 80 percent of helicopter operations occur from HP1 and the remaining 20 percent occur at the HP2 location. It is assumed that all itinerant operations occur at HP1. The existing condition operations from **Table C1** are included in this scenario.

The preferred alternative includes three helipad locations, two of which are located east of Runway 13L-31R, and the third is located in the terminal area. In this scenario, it is assumed that 64 percent of activity would occur at the northernmost helipad, 35 percent of helicopter activity would occur at the helipad east of the Runway 31R end, and the remaining one percent would occur from the terminal area.

Hillsboro Airport has three established helicopter training areas (Alpha, Bravo, Delta) which are utilized by student pilots. The distribution of helicopter operations for the existing and future conditions is summarized in **Table C3**. As indicated in the table, it is assumed that use of the Bravo helicopter training pattern will be discontinued in the future based on coordination between the airport traffic control tower staff and airport staff.

TABLE C3
Helicopter Training Pattern Use Assumptions
Hillsboro Airport

	2016	2036
Alpha (A)	13%	25%
Bravo (B)	1%	0%
Delta (D)	86%	75%

Source: Hillsboro Airport

Flight Tracks

Flight patterns can be categorized within the following types: arrivals, departures, and local or touch-and-go. Arrivals and departures correspond to itinerant traffic traveling to or from the airport, while local operations represent those operations conducted within the local traffic pattern. The touch-and-go nomenclature refers to an aircraft landing briefly on the runway and then resuming flight. Pilots use this technique to practice landings or other procedures. These paths are included in the model to indicate where each aircraft type operates.

The AEDT arrival, departure, and local flight tracks and operations distribution for this report are based on radar data available from the airport and industry standard assumptions. The following exhibits depict the flight track assumptions used in the noise modeling.

Exhibit C2 – Fixed Wing Arrival Flight Tracks
Exhibit C3 – Fixed Wing Departure Flight Tracks
Exhibit C4 – Fixed Wing Touch-and-Go Flight Tracks
Exhibit C5 – Helicopter Flight Tracks

Flight Profiles

The standard arrival profile used in the AEDT program is a three-degree approach. No indication was given by airport staff that there was any variation on this standard procedure for civilian aircraft. Therefore, the standard approach was included in the model as representative of local operating conditions.

DNL Contour Results

To standardize the assessment of airport land use compatibility, the FAA has established guidelines, codified within 14 CFR Part 150, that identify suitable land uses for development near airport facilities. The Part 150 compatibility guidelines, summarized in **Exhibit C6**, are based on previous studies and recommendations by federal agencies.

It should be noted that although the FAA provides the Part 150 land use compatibility guidelines, land use planning is a local decision made by the city or county with jurisdiction over a specific property. However, upon receipt of FAA grant funding, the airport sponsor agrees to take appropriate action, including the adoption of zoning laws, to the extent reasonable to restrict the use of land next to or near the airport to uses that are compatible with normal airport operations in accordance with FAA Grant Assurance 21 Compatible Land Use.

The FAA guidelines indicate that all land uses are acceptable in areas below 65 DNL. At the 65 DNL threshold, residential land uses without acoustic treatment, mobile homes, and transient lodging are all incompatible in areas of noise exposure above 65 DNL. The table notes that homes of standard construction and transient lodging may be considered compatible where local communities have determined these uses are permissible; however, acoustic treatment of these structures is recommended to meet

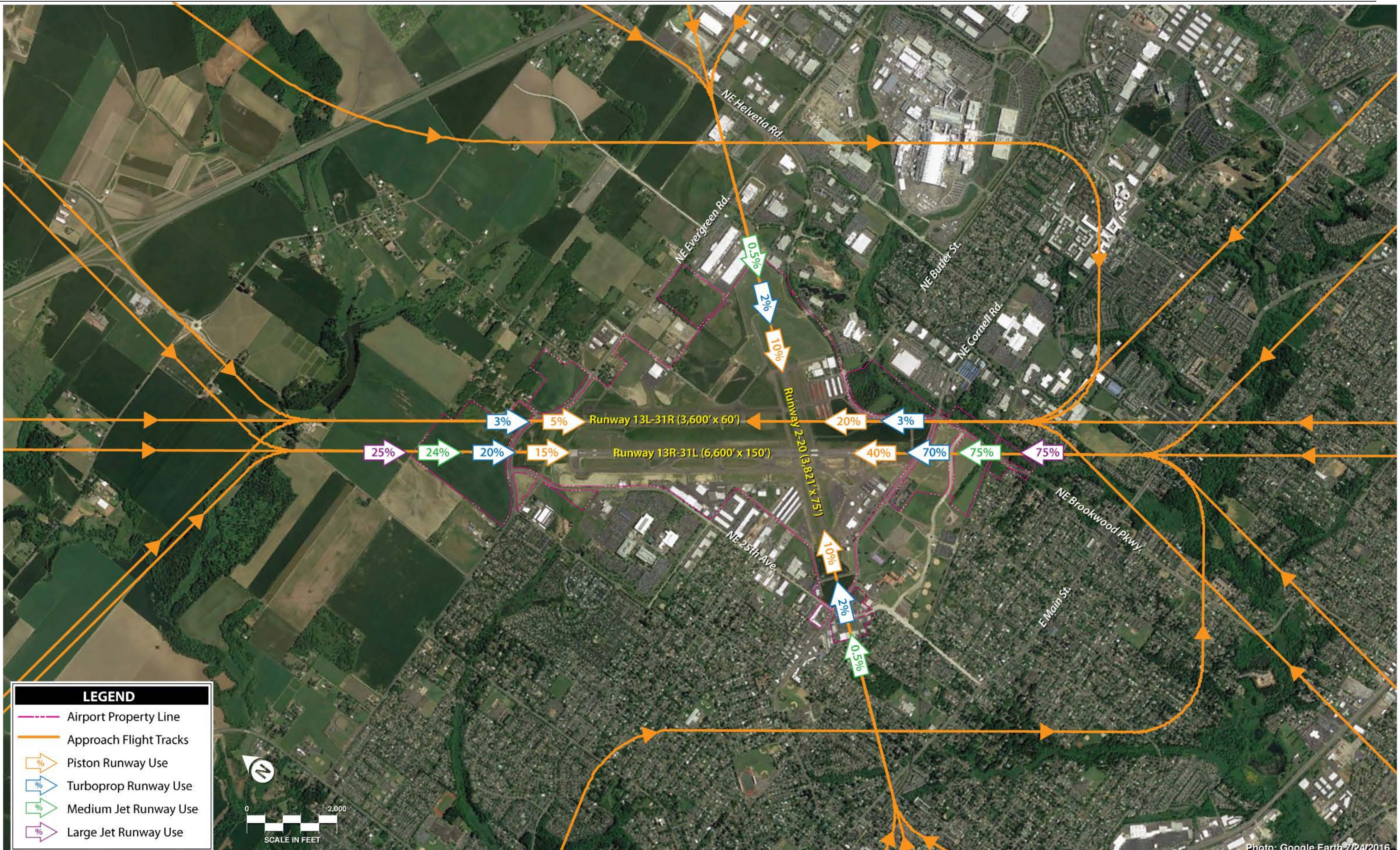


Exhibit C2
FIXED WING APPROACH FLIGHT TRACKS

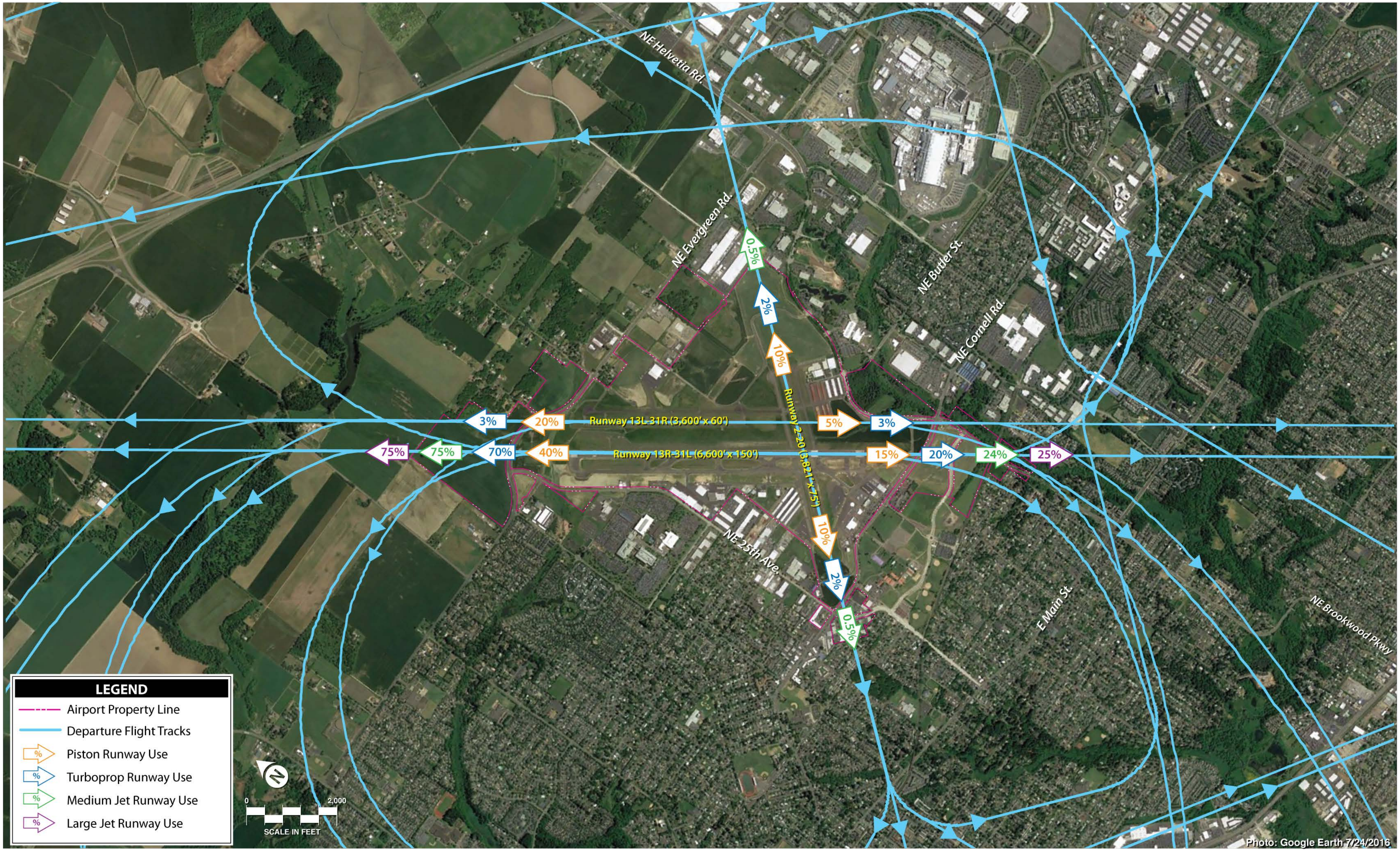
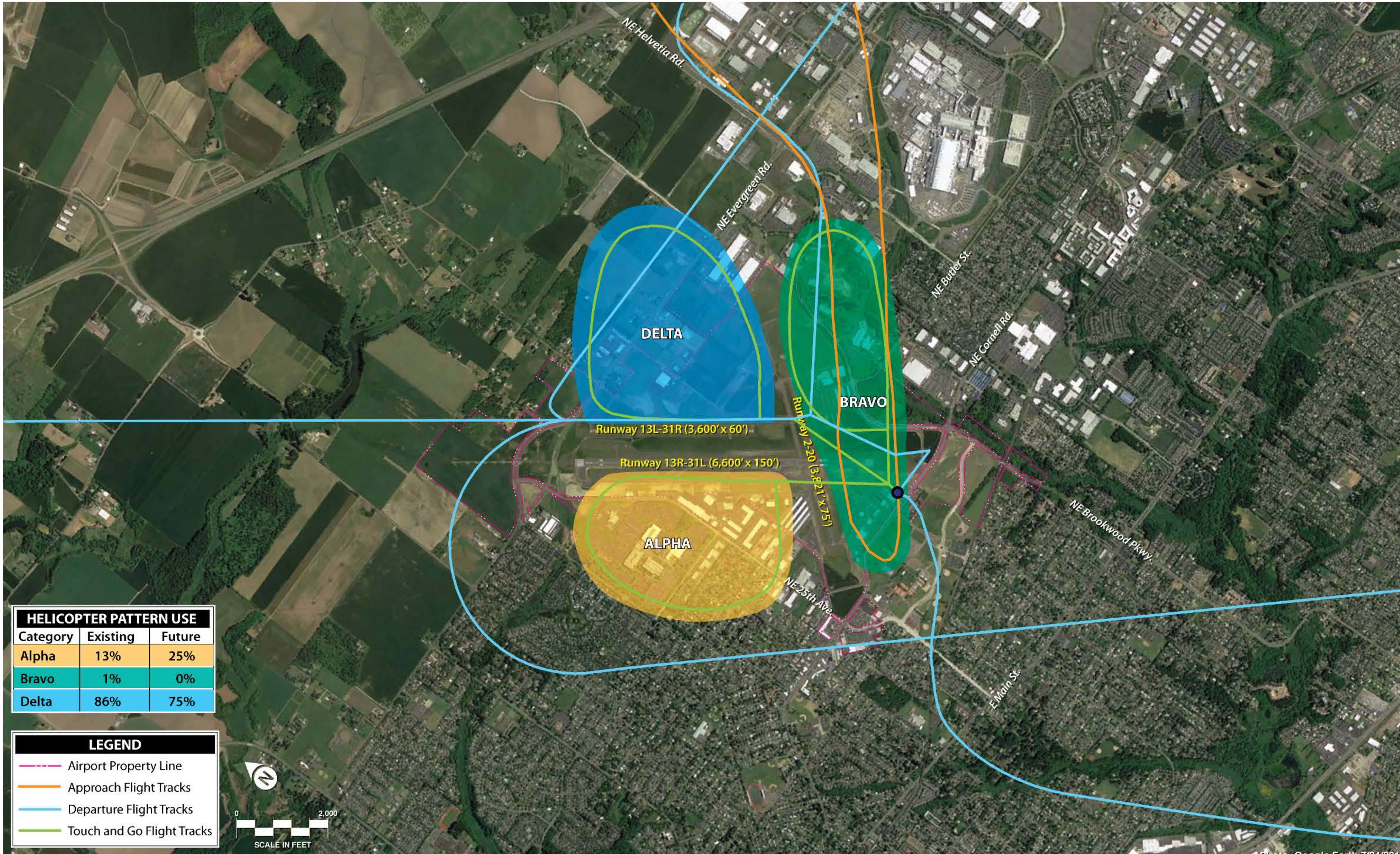


Exhibit C3
FIXED WING DEPARTURE FLIGHT TRACKS

Exhibit C4
FIXED WING TOUCH AND GO FLIGHT TRACKS



HELICOPTER PATTERN USE

Category	Existing	Future
Alpha	13%	25%
Bravo	1%	0%
Delta	86%	75%

Exhibit C5
HELICOPTER FLIGHT TRACKS

LAND USE	Yearly 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 lodgings	Y	N[1]	N[1]	N[1]	N	N
Public Use						
Schools	Y	N[1]	N[1]	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government 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

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

See other side for notes and key to table.

Exhibit C6
PART 150 NOISE COMPATIBILITY GUIDELINES

KEY

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, 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

NOTES

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

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

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

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

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

6. Residential buildings require an NLR of 25.

7. Residential buildings require an NLR of 30.

8. Residential buildings not permitted.

Source: ***14 CFR Part 150***, Appendix A, Table 1.

Exhibit C6 (continued)
PART 150 NOISE COMPATIBILITY GUIDELINES

noise level reduction thresholds when comparing the outdoor noise level to the indoor noise level. Schools and other public use facilities are also generally considered to be incompatible with noise exposure above 65 DNL. As with residential development, communities can make a policy decision that these uses are acceptable with appropriate sound attenuation measures. Hospitals and nursing homes, places of worship, auditoriums, and concert halls are structures generally compatible if measures to achieve noise level reduction are incorporated into design and construction of structures. Outdoor music shells and amphitheaters are not compatible and should be prohibited within the 65 DNL noise contour. Additionally, agricultural uses and livestock farming are generally considered compatible except for related residential components of these uses, which should incorporate sound attenuation measures.

Within the 70-75 DNL noise contour range, residences, transient lodging, and schools have the same sound attenuation recommendations as within the 65-70 DNL range. Additionally, as the noise levels increase, the following land uses identified in the table are recommended to have sound attenuation: governmental services, transportation, parking, offices, wholesale and retail, utilities, communication, manufacturing, photographic and optical, golf courses, riding stables, and water recreation. In addition to those identified within the 65-70 DNL contour range, the table recommends that the following land uses be prohibited within the 70-75 DNL contour range: nature exhibits and zoos. Beyond the 75 DNL contour, the land use recommendations are increasingly more stringent as the noise levels increase.

It should be noted that funding for noise mitigation projects is not available through an Airport Master Plan. Funding for noise mitigation projects is typically the result of a recommendation of a Part 150 study or a *National Environmental Policy Act* (NEPA) Environmental Assessment for a specific airport project.

As outlined in the State of Oregon's *Airport Land Use Compatibility Handbook*, 2003, the State Department of Environmental Quality (DEQ) standards for noise control, abatement, and mitigation are included in Oregon Administrative Rules Chapter 340, Division 35. The standards outline recommended mitigation methods (soundproofing, land acquisition, etc.) for noise-sensitive land uses exposed to 55 DNL and above; however, there is no funding currently available for these types of projects.

The following exhibits depict the existing and future noise contours for Hillsboro Airport based on the modeling assumptions described above.

> **Exhibit C7** – Existing Condition (2016)
> **Exhibit C8** – Preferred Alternative (2036)

Existing Condition – As illustrated on **Exhibit C7**, the noise contours extend off airport property and encompass existing development. Land uses within the 55 DNL noise contour include industrial, commercial, agricultural, and residential land uses in all quadrants of the airport vicinity. The 65, 70, and 75 DNL noise contours extend off airport property to the south near NE Cornell Road, over the Washington County Fairplex and a hotel.

Preferred Alternative – As illustrated on **Exhibit C8**, land uses within the 55 DNL noise contour include industrial, commercial, agricultural, and residential land uses in all quadrants of the airport vicinity. The future 75 DNL remains entirely on airport property. There is one home that falls within the future 70 and 65 DNLs which extend slightly across airport property to the north near the intersection of NW 268th Avenue and Evergreen

Road. The northern limits of the 65 DNL noise contour are influenced by the addition of two helipads and associated helicopter training activity. The location of the Preferred Alternative helipads is shown on the exhibit. The 65 DNL noise contour approaches the property boundary of a residence on NW Sewell Road, but does not encompass the residence on this property. Additionally, the 65 DNL noise contour encompasses a portion of the Hillsboro Public Works Department facility north of NW Evergreen Road.

SUPPLEMENTAL NOISE METRICS

Cumulative noise metrics, such as the previously discussed DNL metric, are the most common method of depicting aircraft noise exposure. FAA's Order 10150.1F, *Environmental Impacts: Policies and Procedures* and 14 CFR Part 150 both require that analyses be conducted for a Part 150 Noise Compatibility Planning Study or a NEPA Environmental Assessment for a specific project use cumulative metrics. DNL, as previously stated, represents the noise experienced for an annual average day. Throughout the U.S., many find it difficult to relate to this concept; therefore, noise contours have been prepared using two supplemental noise metrics: Time Above and Number of Events Above. These two metrics were used during preparation of the previously completed *Hillsboro Airport Parallel Runway 12L/30R Environmental Assessment*. It is important to note that the discussion provided in this section is for informational purposes only. There are no federal or state thresholds related to the noise metrics.

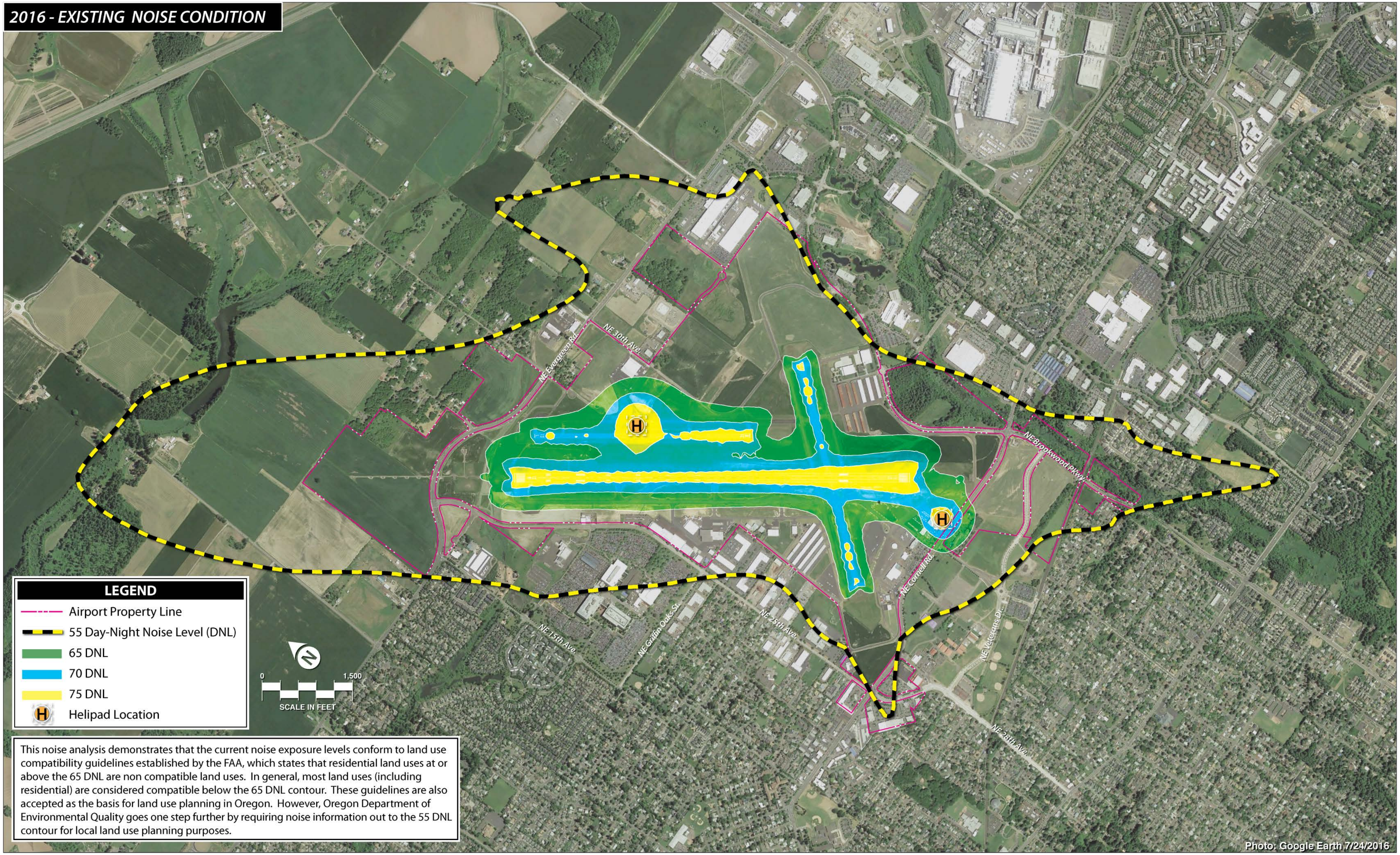
Time Above 70 Decibels (dB)

Using the previously discussed assumptions, Time Above noise exposure contours were prepared for the following scenarios:

Exhibit C9 – Existing Condition (2016) – Time Above
Exhibit C10 – Preferred Alternative (2036) – Time Above

Similar to the DNL noise exposure contours, the Time Above metric is calculated in a grid superimposed over the airport and vicinity. However, in contrast to the DNL noise metric, in which each intersection point on the grid represents a noise level for that geographic location, the points in the Time Above grid represent the amount of time in an average day in which that area will experience noise above 70 dB. The 70 dB threshold was selected for consistency with the *Hillsboro Airport Parallel Runway 12L/30R Environmental Assessment*. Common examples of 70 dB sounds include a nearby loud car engine, a vacuum cleaner, or the sound of a busy freeway at 50 feet. To create the Time Above noise contours, a line linking equal values is drawn connecting points of similar time values.

The outermost contour shown on the Time Above noise metric exhibits represents the area in which it is expected that aircraft noise above 70 dB will occur for between 6.0 and 8.9 minutes during the day.



This noise analysis demonstrates that the current noise exposure levels conform to land use compatibility guidelines established by the FAA, which states that residential land uses at or above the 65 DNL are non compatible land uses. In general, most land uses (including residential) are considered compatible below the 65 DNL contour. These guidelines are also accepted as the basis for land use planning in Oregon. However, Oregon Department of Environmental Quality goes one step further by requiring noise information out to the 55 DNL contour for local land use planning purposes.

Exhibit C7
EXISTING CONDITION (2016) - NOISE CONTOURS

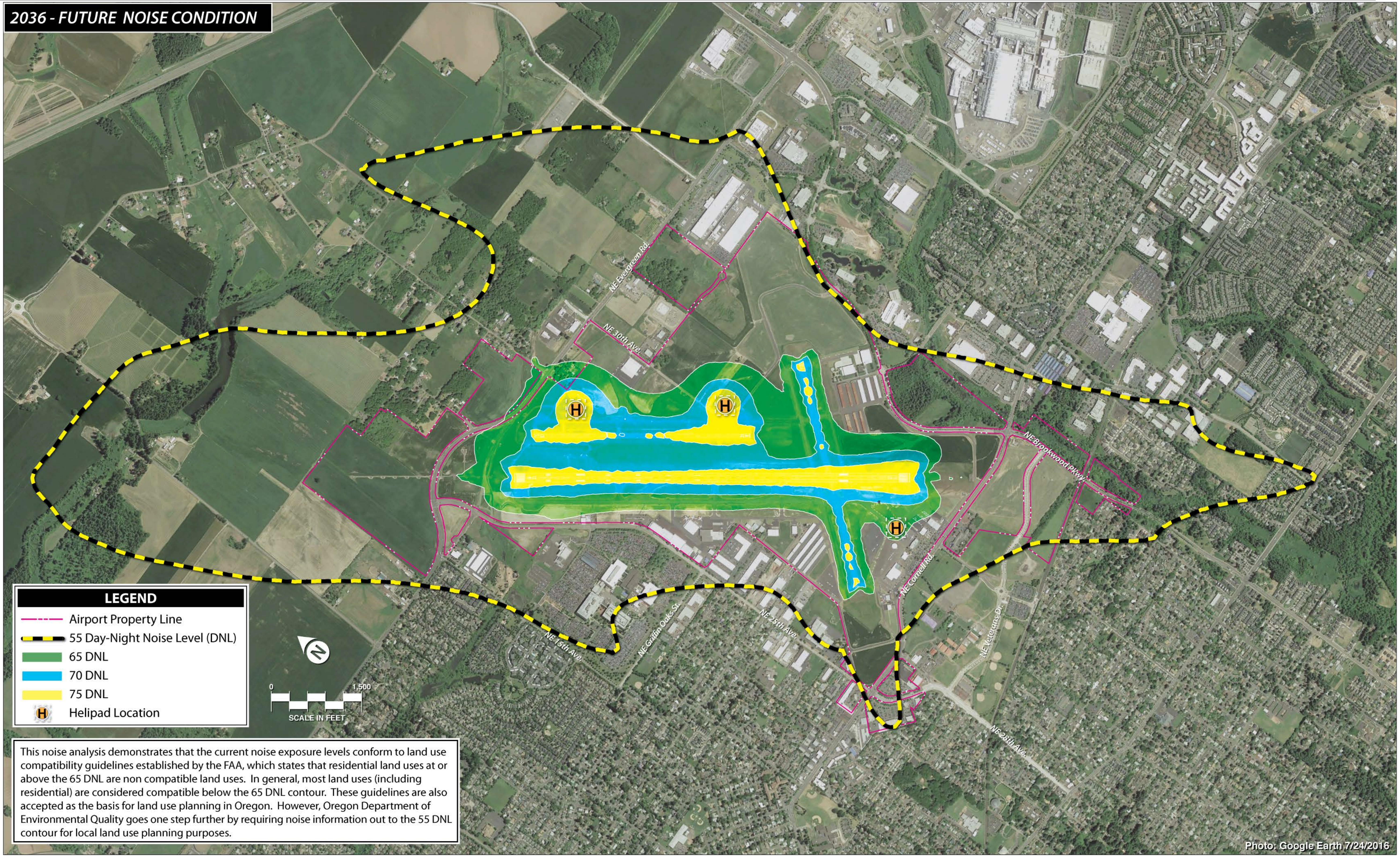


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Exhibit C8
PREFERRED ALTERNATIVE (2036) - NOISE CONTOURS

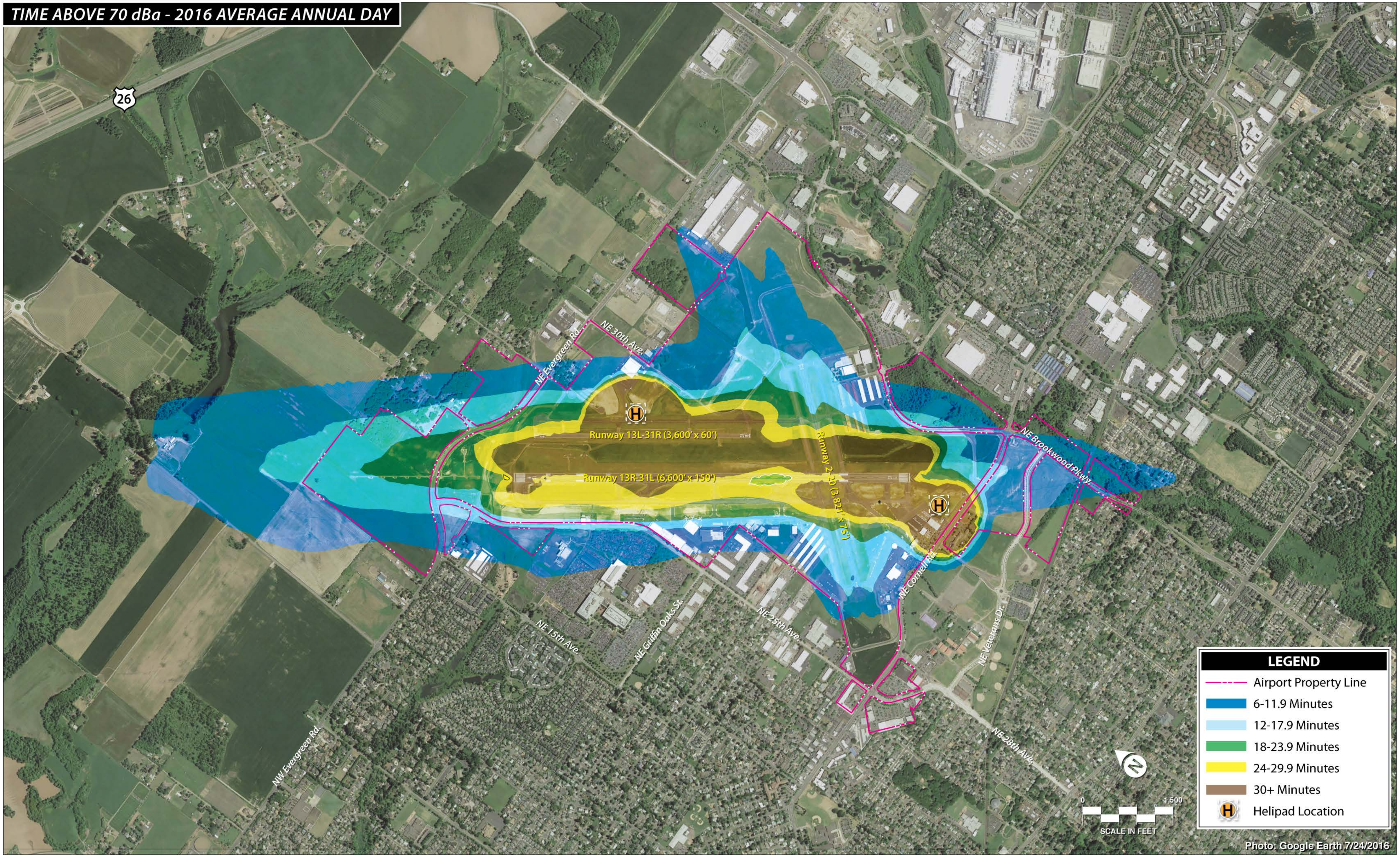


Exhibit C9
EXISTING CONDITION (2016) – TIME ABOVE

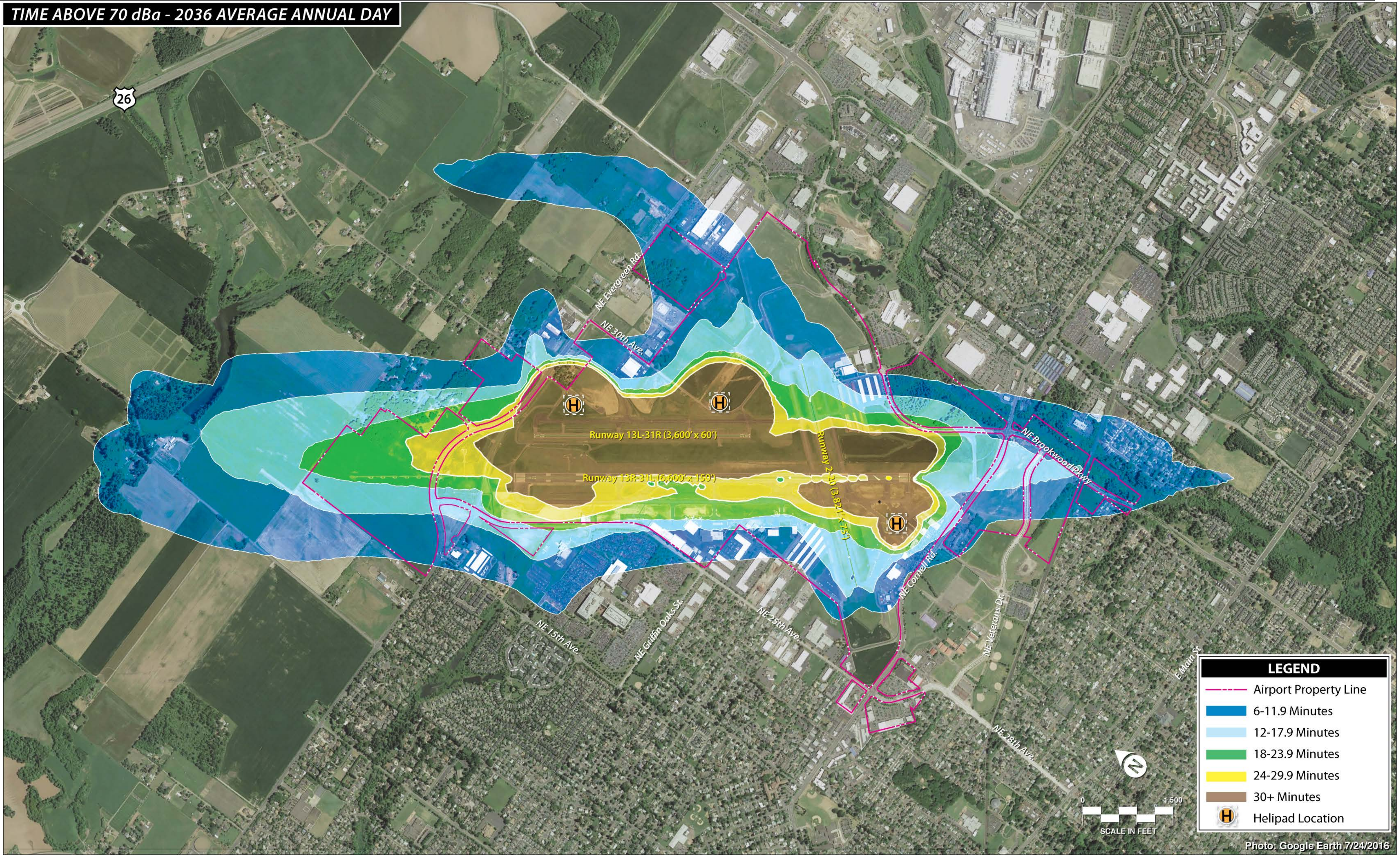


Exhibit C10
PREFERRED ALTERNATIVE (2036) – TIME ABOVE

Number of Events Above 70 Decibels (dB)

Using the previously discussed assumptions, Number Above noise exposure contours were prepared for the following scenarios:

Exhibit C11 – Existing Condition (2016) – Number Above
Exhibit C12 – Preferred Alternative (2036) – Number Above

The Number Above metric is calculated in a grid superimposed over the airport and vicinity. The points in the Number Above grid represent the number of events in an average day in which that area will experience noise above 70 dB based on the maximum A-weighted sound level or L_{max}. The L_{max} sound level descriptor represents the maximum magnitude of a sound which does not convey any information about the duration of the event. The 70 dB threshold was selected for consistency with the *Hillsboro Airport Parallel Runway 12L/30R Environmental Assessment*. To create the Number Above noise contours, a line linking equal values is drawn, connecting points of similar values when considering the number of events above 70 dB.

The outermost contour shown on the Number Above noise metric exhibits represents the area in which it is expected that 10 or more events above 70 dB will occur during an average day. The number of events above 70 dB increases with the inner contours.

ALTERNATIVES ANALYSIS

During preparation of the airport master plan, three alternatives were initially considered for the future scenario. These alternatives were evaluated by the Planning Advisory Committee and Port of Portland staff. Based on input received, the Preferred Alternative, described above, was developed. Noise exposure contours were also prepared for the initial three alternatives using the 2036 operations forecast shown in **Table C1**. It should be noted that during the preparation of the Master Plan, revisions were made to the noise modeling assumptions which are not reflected in the noise contours for the alternatives discussed below. The revisions relate to the distribution of operations among the types of helicopters, which resulted in an increase in Robinson R22 helicopter operations and a decrease among the other helicopter types. Additionally, the revisions included a decrease in helicopter operations originating and terminating near the existing terminal area. These operations were reassigned to occur from the Taxiway Delta helipad to better reflect training activity at the airport.

Alternative 1 is similar to the existing condition described above, with the exception of the Taxiway Delta helicopter operations shifting to a proposed helicopter landing facility located west of the NW 268th Avenue access road. In this future condition, it is assumed that 20 percent of helicopter activity is modeled at the southern location and 80 percent is modeled at the proposed helipad location. The helicopter landing area locations are shown on **Exhibit C13**.

For Alternative 2, a third helipad location is assumed. As shown on **Exhibit C13**, the alternate helipad is located on the east side of the Airport on the apron area accessed from NE Penny Way. In this future condition, it is assumed that ten percent of helicopter activity is modeled at the southern location, 60 percent is modeled at the proposed helipad location, and 30 percent is modeled on the apron area accessed from NE Penny Way.

In Alternative 3, a fourth helipad location is modeled. As shown on **Exhibit C13**, a potential helipad is located east of the Runway 31 end. In this future condition, it is assumed that ten percent of helicopter activity is modeled at the southern location, 60 percent is modeled at the proposed helipad location, and 30 percent is modeled in the area east of the Runway 31 end.

The following exhibits depict the noise contours prepared for the alternatives analysis:

Exhibit C14 – Future Condition (2036) – Alternative 1
Exhibit C15 – Future Condition (2036) – Alternative 2
Exhibit C16 – Future Condition (2036) – Alternative 3

Future Condition Alternative 1 – As illustrated on **Exhibit C14**, land uses within the 55 DNL noise contour include industrial, commercial, agricultural, and residential land uses in all quadrants of the airport vicinity. The 65, 70, and 75 DNL noise contours extend off airport property to the south near NE Cornell Road, over the Washington County Fairplex and a hotel. The 65 DNL noise contour approaches the property boundary of a residence on NW Sewell Road, but does not encompass the residence on this property. Additionally, the 65 DNL noise contour encompasses a portion of the Hillsboro Public Works Department facility north of NW Evergreen Road.

Future Condition Alternative 2 – The noise exposure contours shown on **Exhibit C15** are similar to the Future Condition Alternative 1 described above, but with a slightly different shape. Notably, these contours include a circular area on the east side of the Airport resulting from activity at a potential eastside helipad. As illustrated on the exhibit, land uses within the 55 DNL noise contours include industrial, commercial, agricultural, and residential land uses in all quadrants of the Airport vicinity. To the south, the 65, 70, and 75 DNL noise contours remain on airport property. This reflects the relocation of helicopter activity to a position directly north of the fuel island. Similar to Future Condition Alternative 1, the 65 DNL noise contour approaches the property boundary of a residence on NW Sewell Road, but does not encompass the residence on this property. Additionally, the 65 DNL noise contour encompasses a portion of the Hillsboro Public Works Department facility north of NW Evergreen Road.

Future Condition Alternative 3 – **Exhibit C16** depicts the Future Condition Alternative 3 noise contours. In this scenario, helicopter activity is modeled at a potential helipad located between the Runway 31R end and the Runway 20 end. Additionally, helicopter activity in the terminal area is modeled at a potential helipad located southwest of the Runway 31L end. As illustrated on the exhibit, land uses within the 55 DNL noise contours include industrial, commercial, agricultural, and residential land uses in all quadrants of the airport vicinity. To the south, the 65 DNL noise contour extends to the Airport property line.

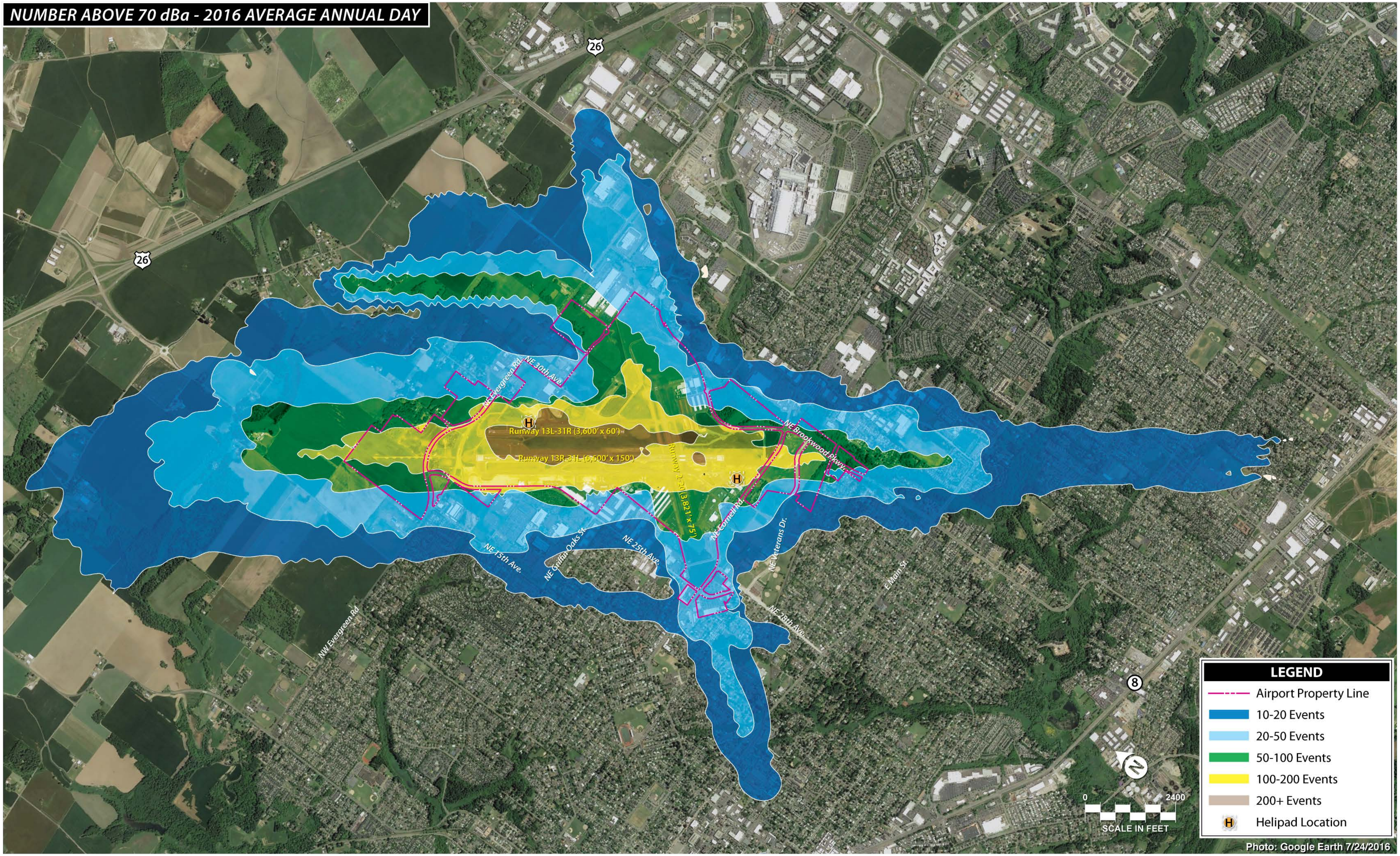


Exhibit C11
EXISTING CONDITION (2016) – NUMBER ABOVE

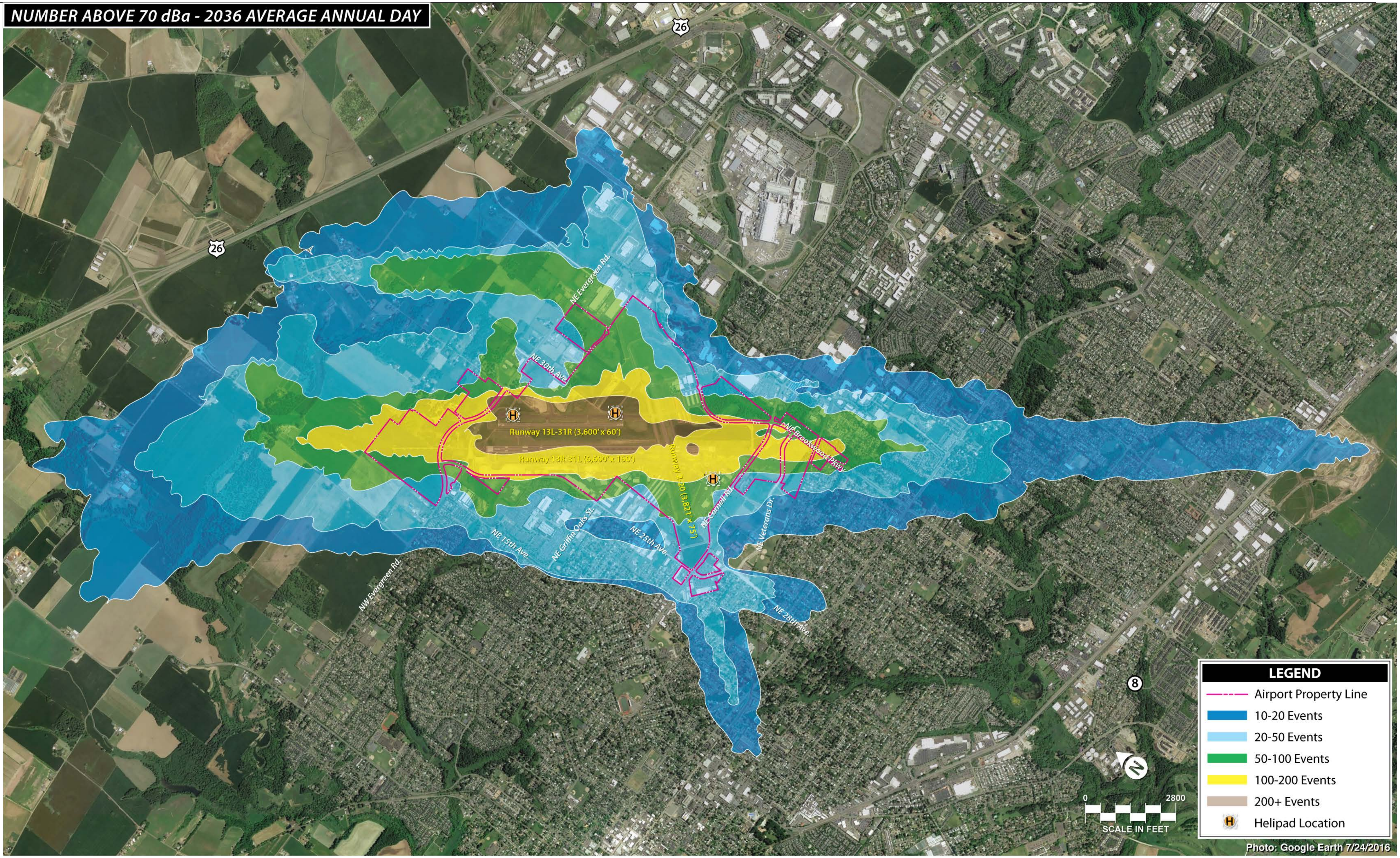


Exhibit C12
PREFERRED ALTERNATIVE (2036) – NUMBER ABOVE

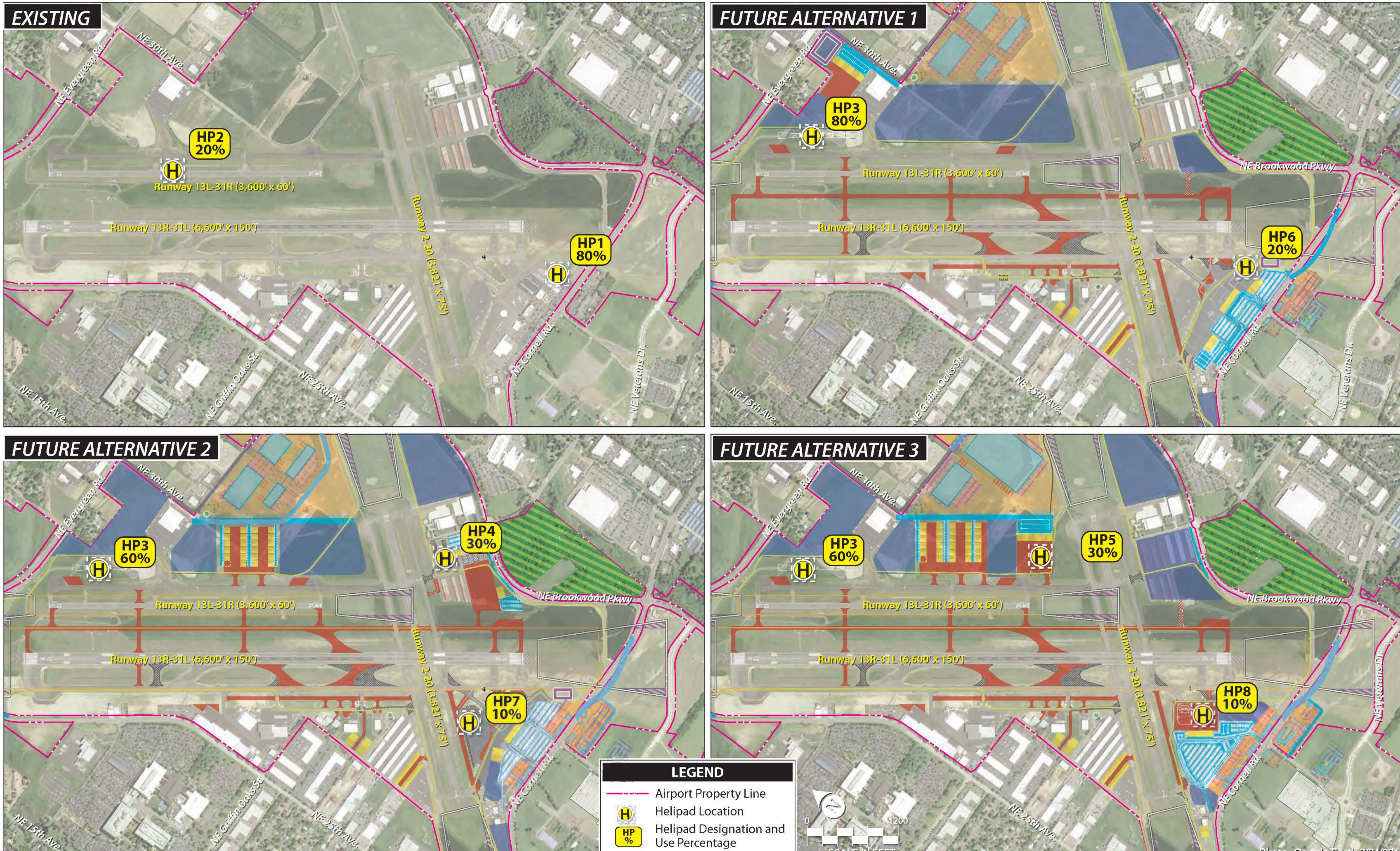
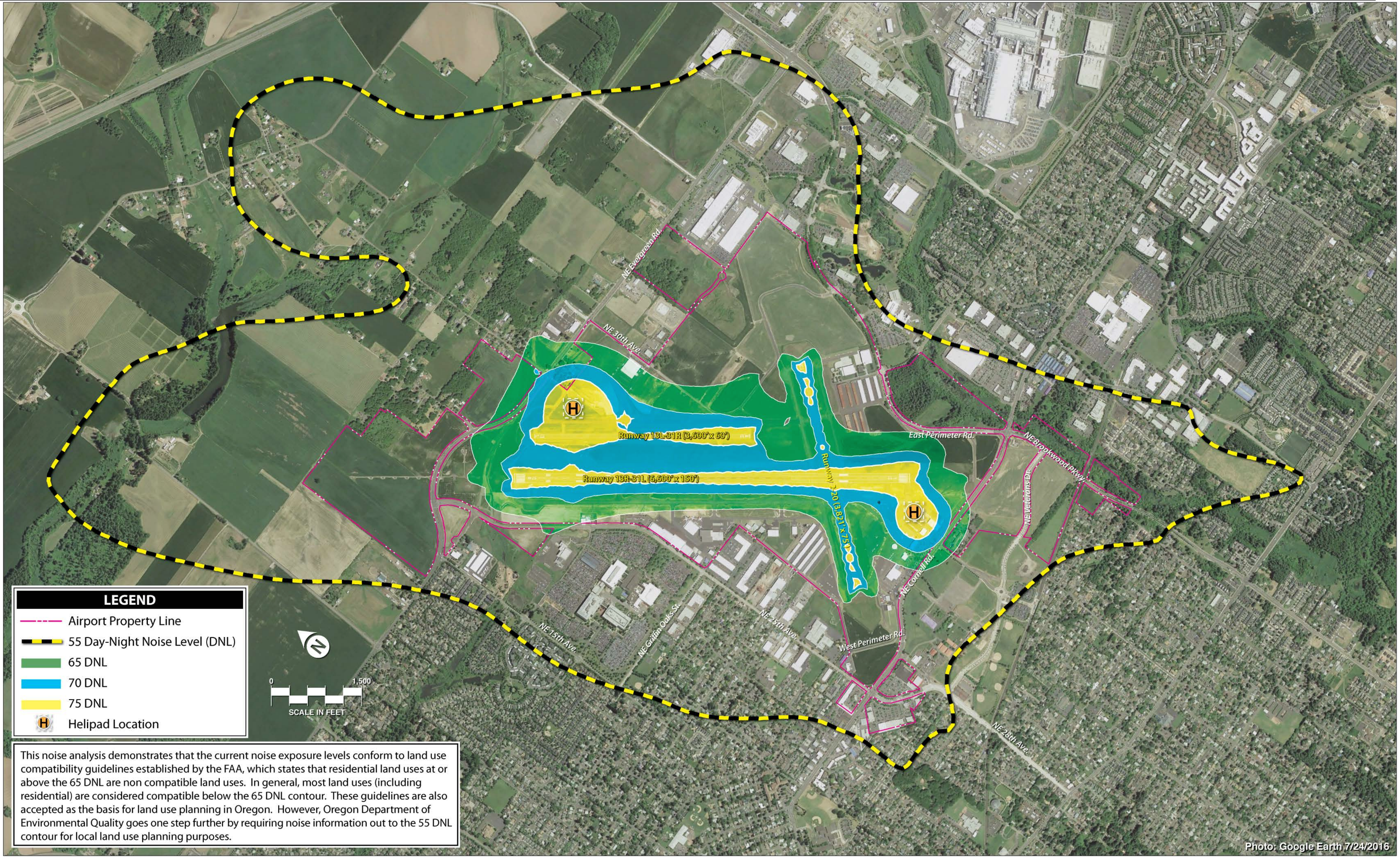
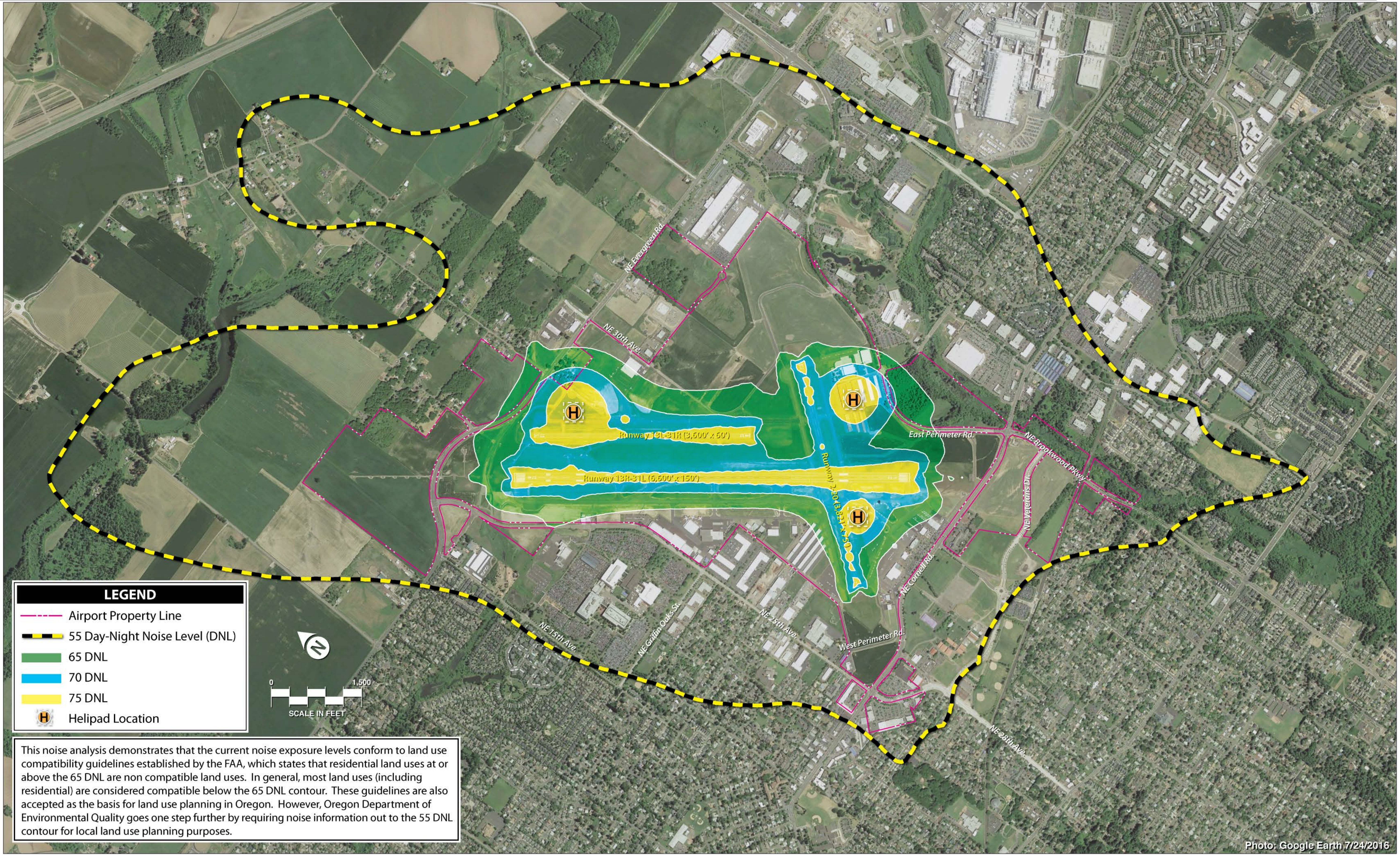


Exhibit C13
HELICOPTER LANDING AREAS



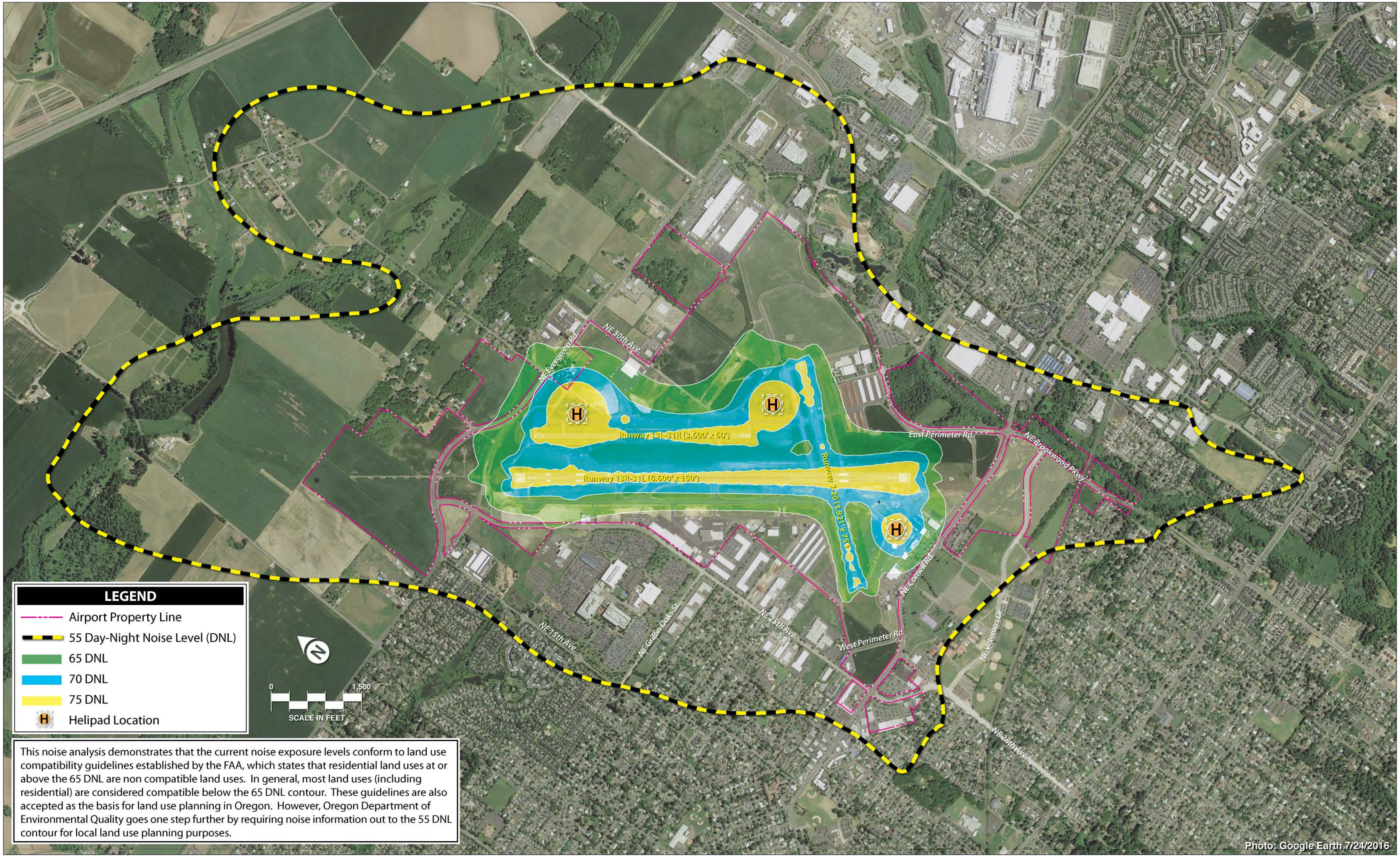
This noise analysis demonstrates that the current noise exposure levels conform to land use compatibility guidelines established by the FAA, which states that residential land uses at or above the 65 DNL are non compatible land uses. In general, most land uses (including residential) are considered compatible below the 65 DNL contour. These guidelines are also accepted as the basis for land use planning in Oregon. However, Oregon Department of Environmental Quality goes one step further by requiring noise information out to the 55 DNL contour for local land use planning purposes.

Exhibit C14
FUTURE CONDITION (2036) - ALTERNATIVE 1



This noise analysis demonstrates that the current noise exposure levels conform to land use compatibility guidelines established by the FAA, which states that residential land uses at or above the 65 DNL are non compatible land uses. In general, most land uses (including residential) are considered compatible below the 65 DNL contour. These guidelines are also accepted as the basis for land use planning in Oregon. However, Oregon Department of Environmental Quality goes one step further by requiring noise information out to the 55 DNL contour for local land use planning purposes.

Exhibit C15
FUTURE CONDITION (2036) - ALTERNATIVE 2



This noise analysis demonstrates that the current noise exposure levels conform to land use compatibility guidelines established by the FAA, which states that residential land uses at or above the 65 DNL are non compatible land uses. In general, most land uses (including residential) are considered compatible below the 65 DNL contour. These guidelines are also accepted as the basis for land use planning in Oregon. However, Oregon Department of Environmental Quality goes one step further by requiring noise information out to the 55 DNL contour for local land use planning purposes.

Exhibit C16
FUTURE CONDITION (2036) - ALTERNATIVE 3

ALTERNATIVES ANALYSIS SUPPLEMENTAL METRICS

Contours depicting the supplemental noise metrics described above were also prepared during the alternatives analysis.

Time Above 70 Decibels (dB)

The following exhibits present the Time Above noise contours for Alternatives 1, 2, and 3:

Exhibit C17 – Future Condition (2036) – Alternative 1 (Time Above)
Exhibit C18 – Future Condition (2036) – Alternative 2 (Time Above)
Exhibit C19 – Future Condition (2036) – Alternative 3 (Time Above)

Number of Events Above 70 Decibels (dB)

The following exhibits present the Number Above noise contours for the Alternatives 1, 2, and 3:

Exhibit C20 – Future Condition (2036) – Alternative 1 (Number Above)
Exhibit C21 – Future Condition (2036) – Alternative 2 (Number Above)
Exhibit C22 – Future Condition (2036) – Alternative 3 (Number Above)

AIR POLLUTANT EMISSIONS

Air quality in a given location is described by the concentrations of various pollutants in the atmosphere. For Criteria Pollutants, the significance of a pollutant concentration is determined by comparing it to the federal and state ambient air quality standards. The Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for six pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), and lead (Pb). Based upon both federal and state air quality standards, a specific geographic area can be classified under the federal and state *Clean Air Act* (CAA) as either being an "attainment," "non-attainment," or "maintenance" area for each criteria pollutant. The criterion for non-attainment designation varies by pollutant. Hillsboro Airport is located in Washington County, which is designated as an attainment area for all federal criteria pollutants.

Ground level ozone is not emitted directly into the air but is created by chemical reactions between oxides of nitrogen and volatile organic compounds (NO_x and VOCs). Therefore, NO_x and VOCs are considered precursors for ozone and will be used in this analysis. Additionally, AEDT does not calculate lead emissions. Lead emissions were calculated using FAA Aviation Emissions and Air Quality Handbook, Version 3, Update 1, Section A1.3. The lead emissions calculations are based on fuel consumption outputs from AEDT assumptions for how much lead remains in the engine. For the purposes of these calculations, it is assumed that all piston aircraft at Hillsboro Airport are conducted using leaded Avgas in the existing and future scenarios.

Air quality analyses are not required by FAA as part of the airport master planning process; therefore, this information is presented for informational purposes only. In addition to noise modeling, AEDT may also be used to calculate air pollutant emissions related to aircraft operations. Using the aircraft operational assumptions described for the noise exposure contours, air pollutant emissions were calculated for the existing condition and the future condition. For the purposes of this discussion, all three future condition alternatives are equivalent as they were modeled with the same operational assumptions. The only differences between the future scenarios is the location of the flight tracks. **Table C4** summarizes the annual airport operational pollutant emissions for the existing condition (2016) and future condition (2036).

TABLE C4
Emissions Inventory (Tons per Year)
Hillsboro Airport

Pollutant	CO	VOC	NO_x	SO_x	$PM_{2.5}$	PM_{10}	Pb[1]
Existing Condition (2016)	478.8	5.2	14.9	2.0	0.6	0.6	0.69
Future Condition (2036)[2]	558.2	6.3	19.8	2.6	0.7	0.7	0.74

carbon monoxide (CO)
nitrogen dioxide (NO_2)
sulphur dioxide (SO_2)
ozone (O_3)
particulate matter ($PM_{2.5}$ and PM_{10})
lead (Pb)

Note: AEDT does not calculate emissions for lead. Lead emissions calculated using FAA *Aviation Emissions and Air Quality Handbook*, Version 3, Update 1, Section A1.3.
For the purposes of this discussion, all future condition alternatives are equivalent as they were modeled with the same operational assumptions.
Ground level ozone is not emitted directly into the air but is created by chemical reactions between oxides of nitrogen and volatile organic compounds (NO_x and VOCs). Therefore, NO_x and VOCs are considered precursors for ozone and will be used in this analysis.
Source: AEDT analysis prepared by Coffman Associates, March 2019.

GREENHOUSE GAS EMISSIONS (GHGs)

Increasing concentrations of GHGs in the atmosphere are thought to cause global climate change, a phenomenon that can also have local impacts (IPCC 2014; U.S. Global Change Research Program 2009). Scientific measurements show that Earth's climate is warming; concurrent atmospheric events include warmer air temperatures, increased sea level rise, increased storm activity, and an increased intensity in precipitation events.

In addition, research has shown there is a direct correlation between fuel combustion and GHG emissions (U.S. EPA 2009). As outlined in FAA's *Aviation Emissions and Air Quality Handbook* (FAA 2015b: p. 15), "GHG emissions associated with aviation are principally in the form of CO_2 and are generated by aircraft, APUs (auxiliary power units), ground support equipment (GSE), motor vehicles, and an assortment of stationary sources. For the most part, CO_2 emissions from these sources arise from the combustion of fossil fuels (e.g., jet fuel, Avgas, diesel, gasoline, and compressed natural gas [CNG]) and are

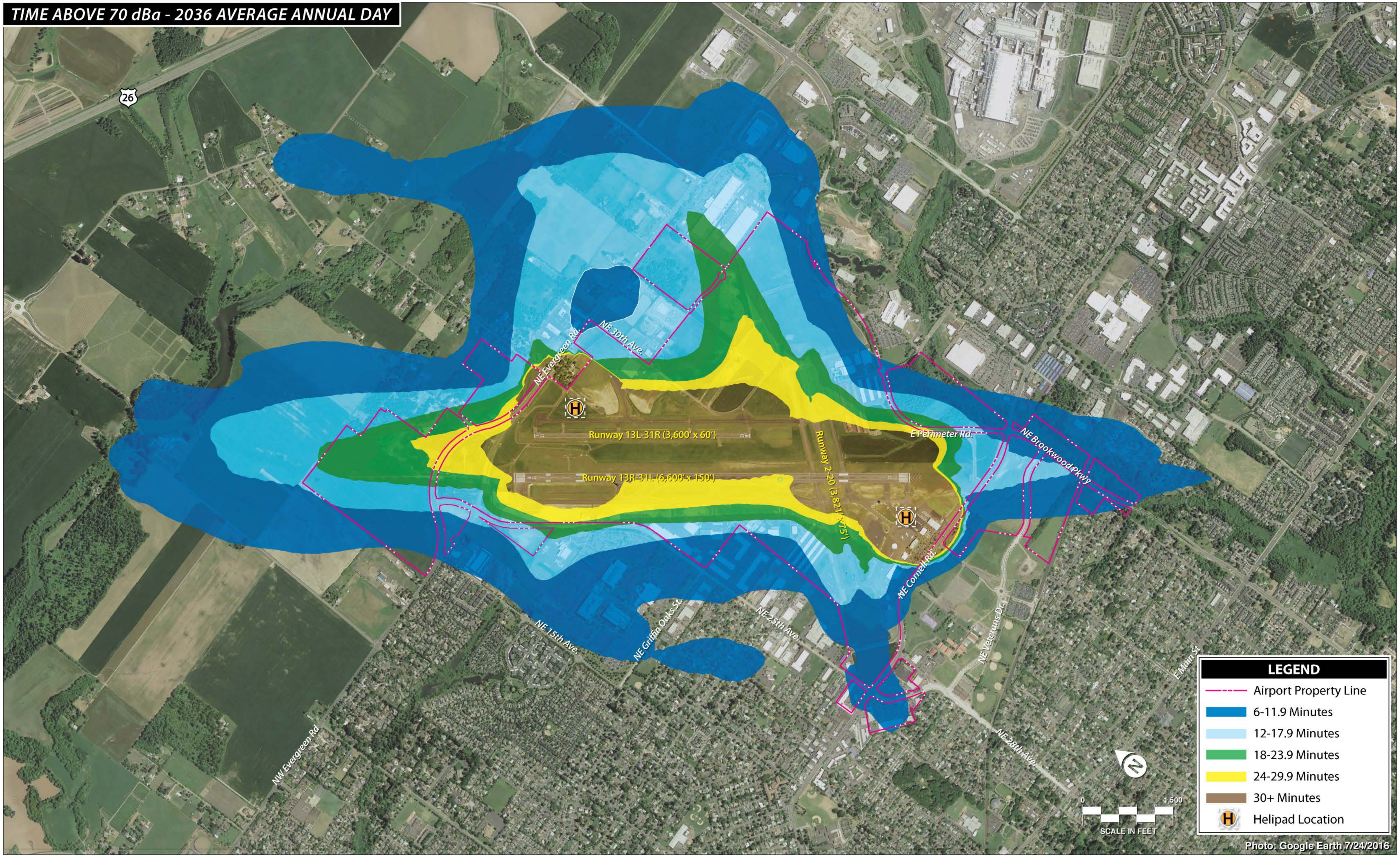


Exhibit C17
FUTURE CONDITION (2036) - ALTERNATIVE 1 (TIME ABOVE)

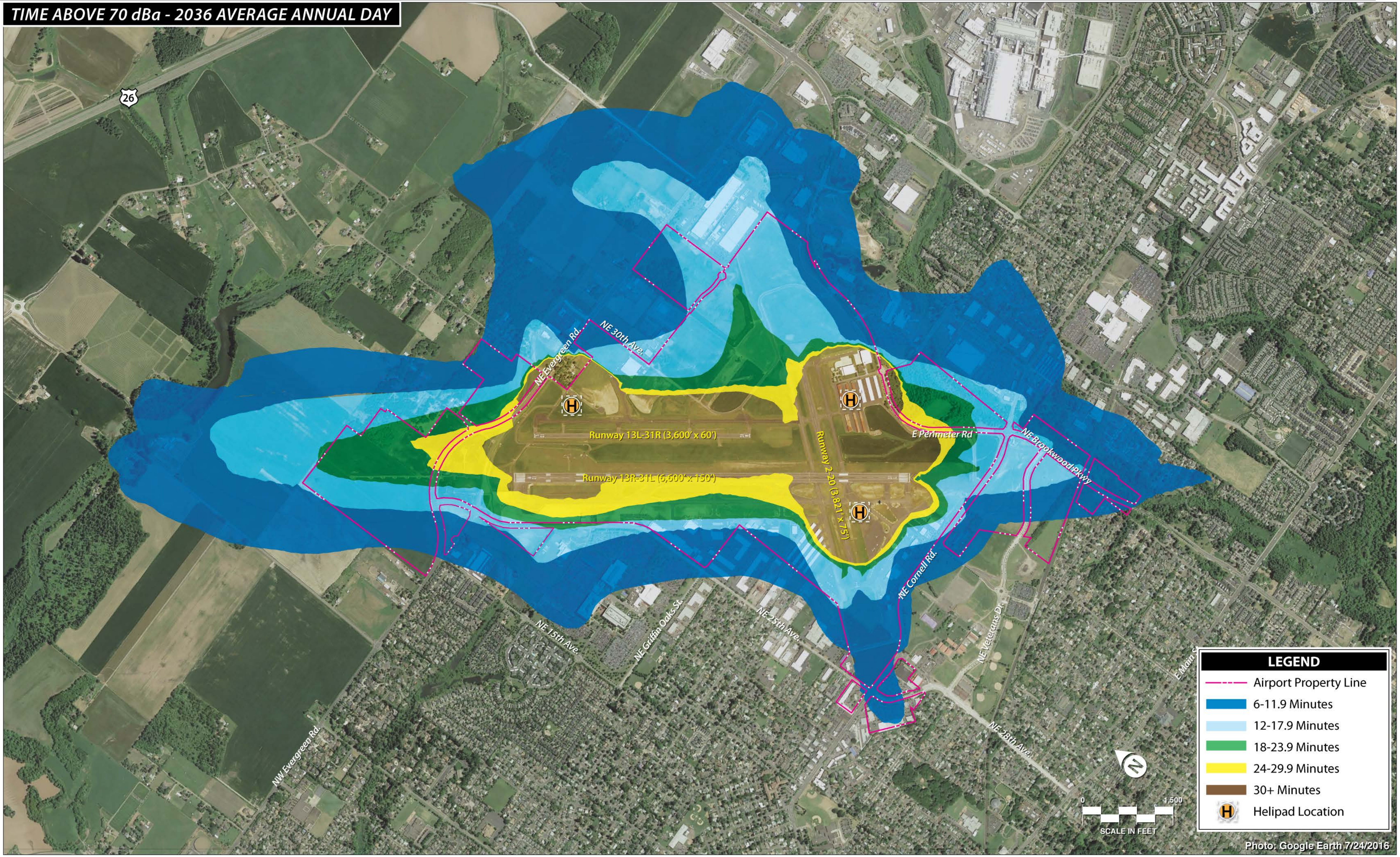


Exhibit C18
FUTURE CONDITION (2036) – ALTERNATIVE 2 (TIME ABOVE)

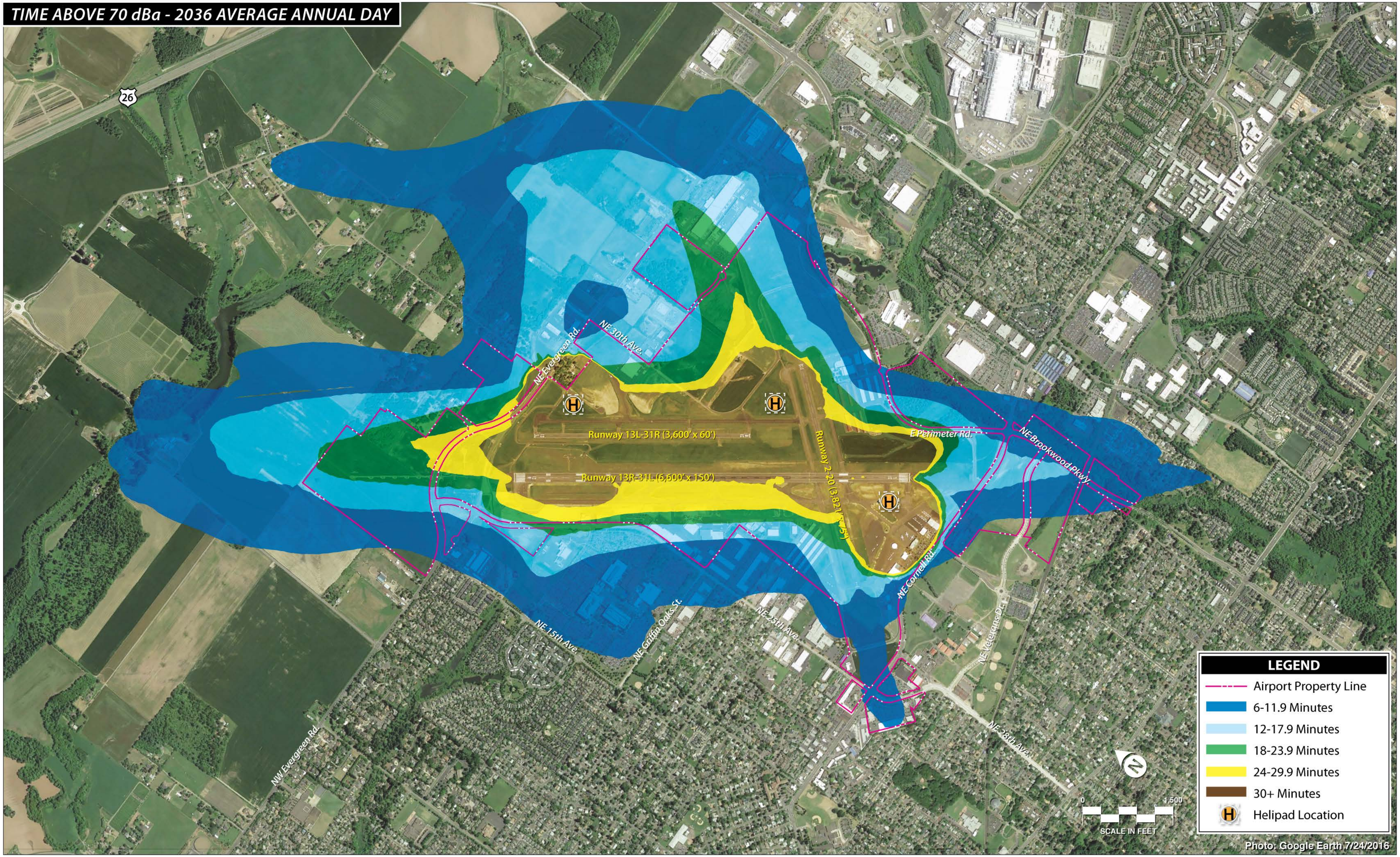


Exhibit C19
FUTURE CONDITION (2036) – ALTERNATIVE 3 (TIME ABOVE)

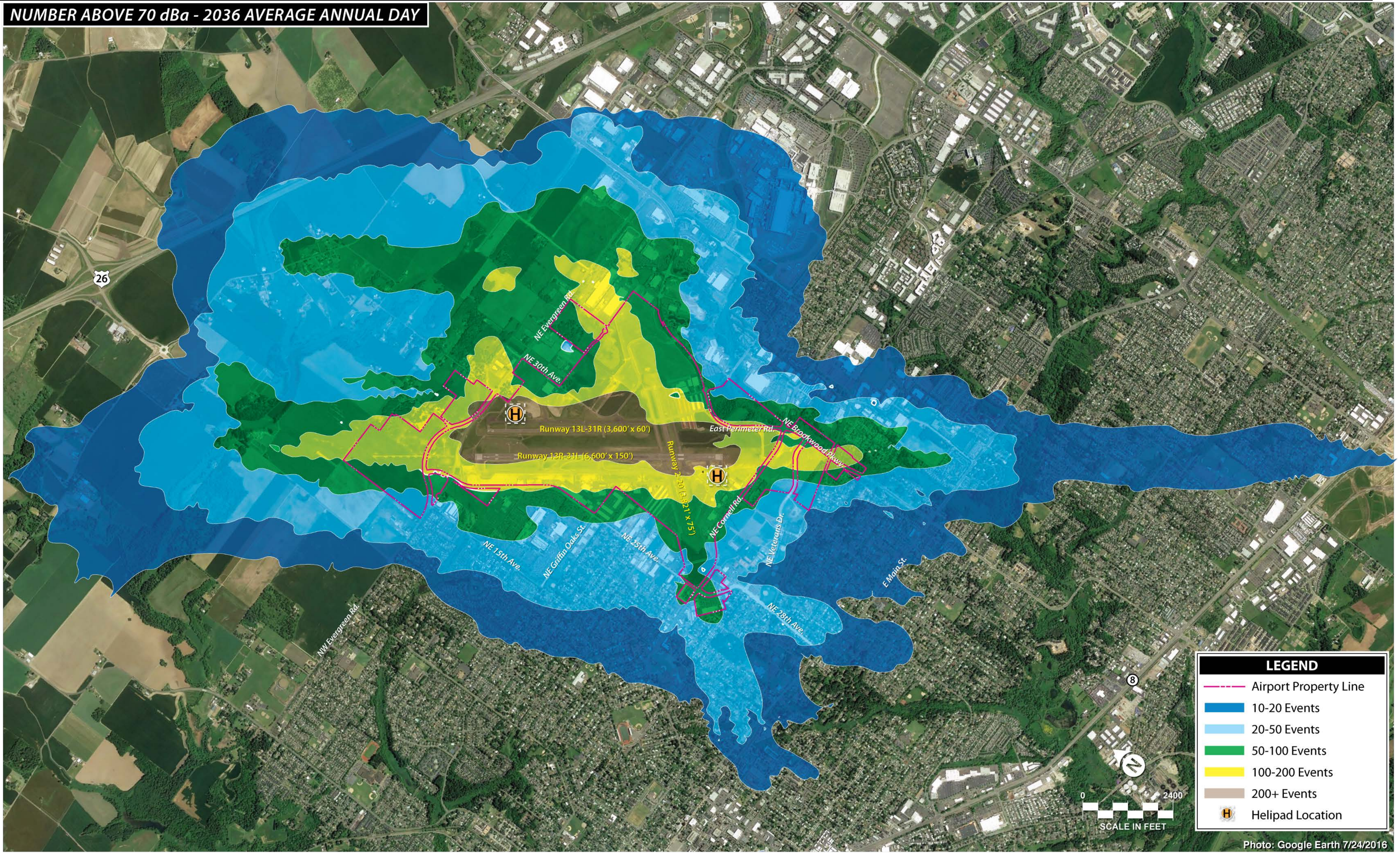


Exhibit C20
FUTURE CONDITION (2036) – ALTERNATIVE 1 (NUMBER ABOVE)

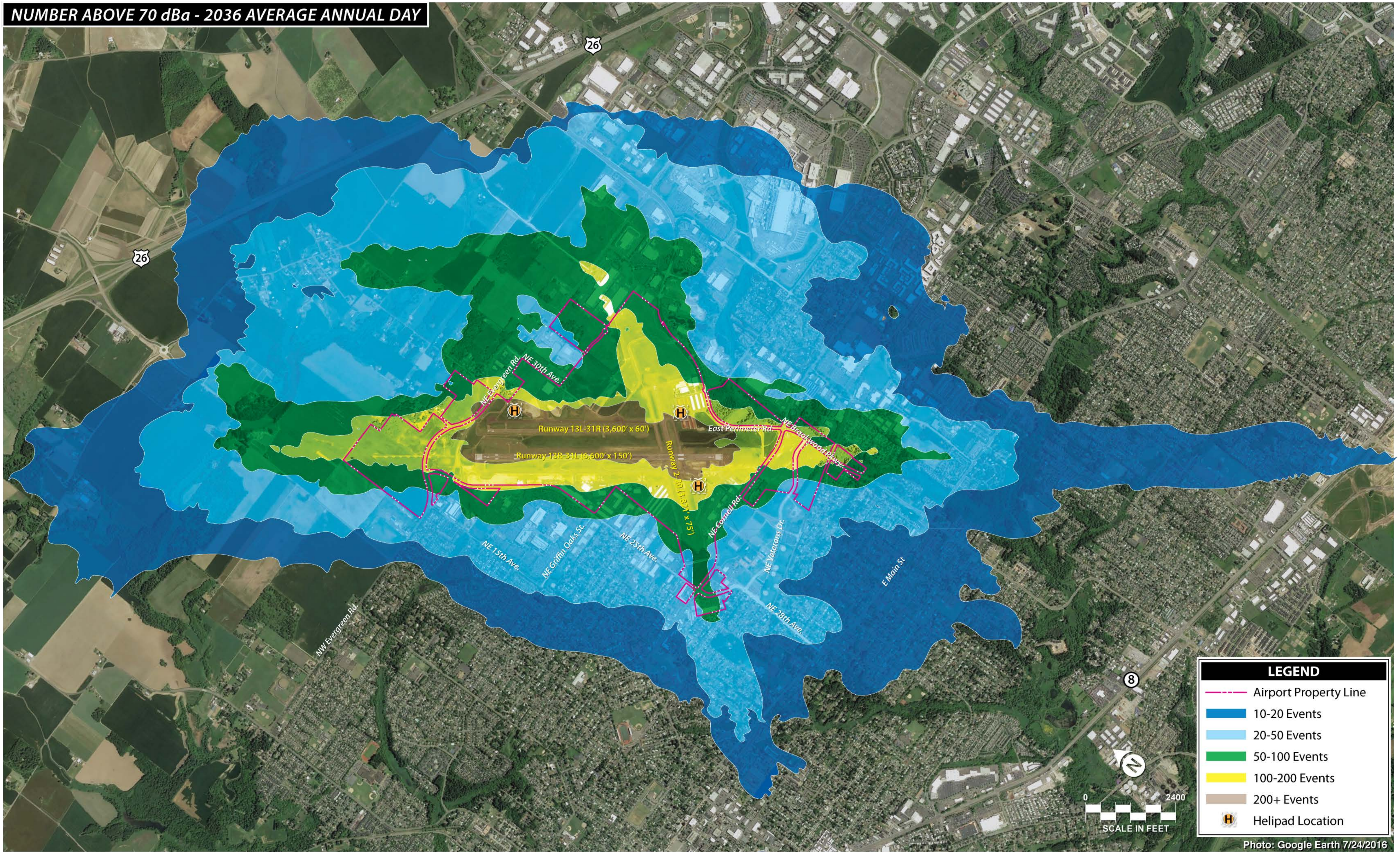


Exhibit C21
FUTURE CONDITION (2036) – ALTERNATIVE 2 (NUMBER ABOVE)

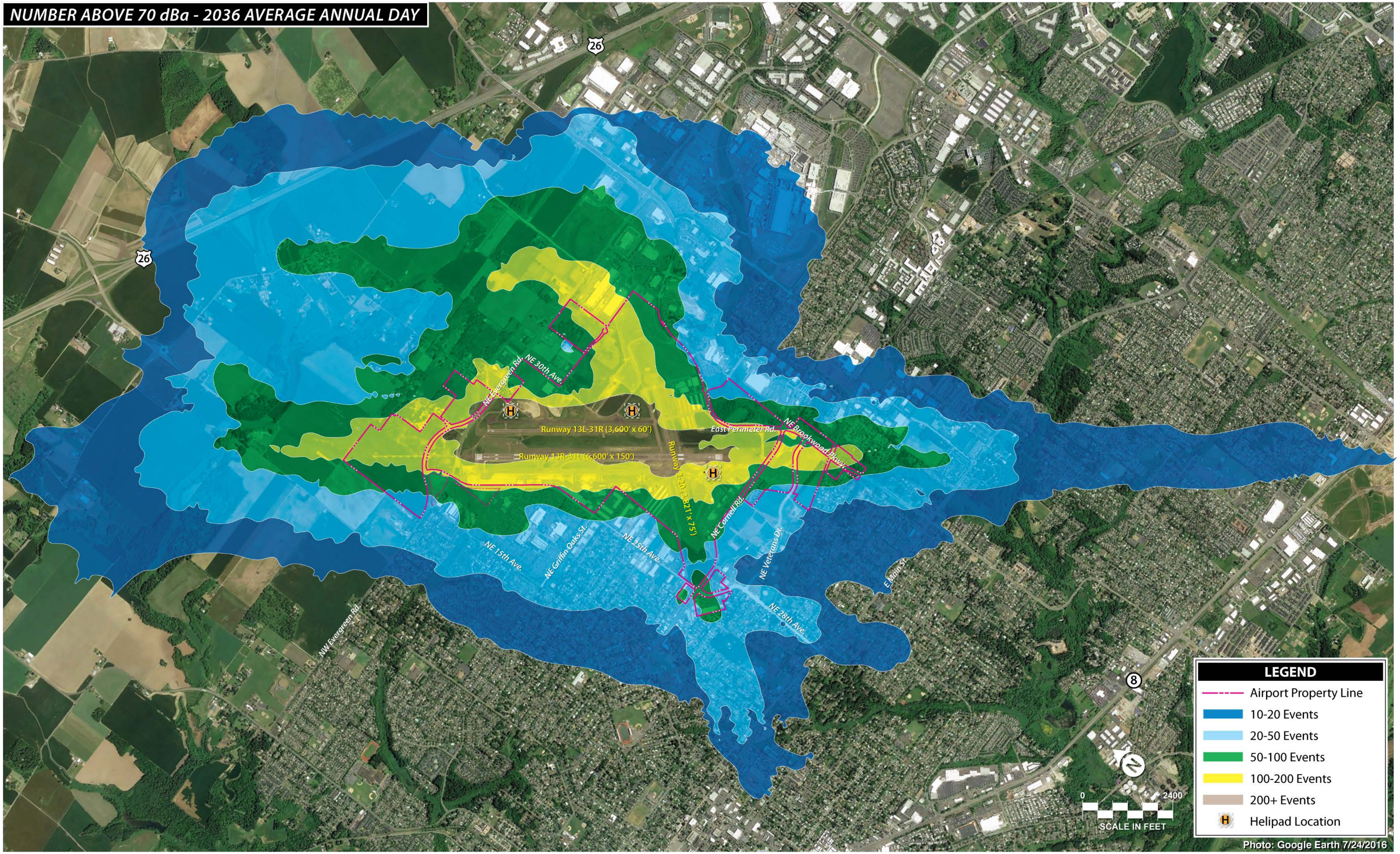


Exhibit C22
FUTURE CONDITION (2036) – ALTERNATIVE 3 (NUMBER ABOVE)

emitted as by-products contained in the engine exhausts. Other GHGs associated with airport operations include CH_4 and N_2O, water vapor (H_2O), soot, and sulfates - but are emitted by airports to a far lesser extent than CO_2. Emissions of HFCs (hydrofluorocarbons), PFCs (perfluorinated chemicals), and SF_6 (sulfur hexafluoride) are most commonly linked with refrigeration, air conditioning, and other coolants."
In terms of U.S. contributions, the U.S. Government Accountability Office (GAO) reports that "domestic aviation contributes about 3 percent of total carbon dioxide emissions, according to EPA data," compared with other industrial sources, including the remainder of the transportation sector (20 percent) and power generation (41 percent) (U.S. GAO 2009). The International Civil Aviation Organization (ICAO) also estimates that GHG emissions from aircraft account for roughly three percent of all anthropogenic GHG emissions globally (ICAO 2010).

As previously discussed, FAA's AEDT was used to calculate existing and future airport emissions. Using the methodology outlined in FAA's *Aviation Emissions and Air Quality Handbook*, Version 3, Update 1, Appendix C – Emissions Inventory for Greenhouse Gases, kilograms of fuel burned during operations were converted to metric tons of CO_2e based on the same fleet mix assumptions used for the air pollutant emissions inventory and noise modeling. For the future scenarios, the runways and operations assumptions are the same. The primary difference between the alternatives is the location of the helipads. As a result, the emissions totals from all three future condition alternatives are equivalent as they were modeled with the same operational assumptions. The only differences between the future scenarios is the location of the flight tracks. **Table C5** summarizes the existing and future operational aviation greenhouse gases for Hillsboro Airport in metric tons per year.

TABLE C5
GHG Operational Emissions Inventory
Hillsboro Airport

	Emissions (metric tons per year)			
	CO_2	N_2O	CH_4	Total CO_2e[1]
Existing Condition (2016)	4,316.4	0.1	0.3	-
Future Condition (2036)[2]	5,610.3	0.2	0.4	-
GWP	1	34	298	-
Existing Condition (2016) CO_2e	4,316.4	4.5	90.2	4,411.1
Future Condition (2036) CO_2e	5,610.3	5.9	105.3	5,721.4

carbon dioxide (CO_2)
nitrous oxide (N_2O)
methane (CH_4)

[1] Emissions totals for CO_2e are reported in metric tons. Emissions of CO_2, CH_4 and N_2O were converted to CO_2e using global warming potentials of 1, 34, and 298, respectively, as contained in the United Nation's Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (2009).
[2] For the purposes of this discussion, all three future condition alternatives are equivalent as they were modeled with same operational assumptions
Source: AEDT analysis prepared by Coffman Associates, March 2019.

ZONING OVERLAY

Exhibit C23 provides an additional point of analysis of the extent of both the 55 and 65 DNL noise contours as overlaid on an area zoning map. As noted previously, the 65 DNL is the threshold of significant for the FAA, while the 55 DNL is the State of Oregon standard.

The existing 65 DNL encompasses 328 acres of industrial zoned airport property and six acres of land zoned as institutional. The institutional zoned land is south of NE Cornell Road, a small portion of which is part of the Washington County Fairplex.

The future 65 DNL will shift toward the north due to the planned relocation of the flight schools to the north sector of the Airport. The 65 DNL would no longer extend south of NE Cornell Road.

As would be expected, the 55 DNL noise contours extend well beyond Airport property. The existing 55 DNL encompasses approximately 1,754 acres of land. The vast majority is zoned for commercial, industrial, institutional, or agriculture. Approximately 62 acres is existing residential zoning.

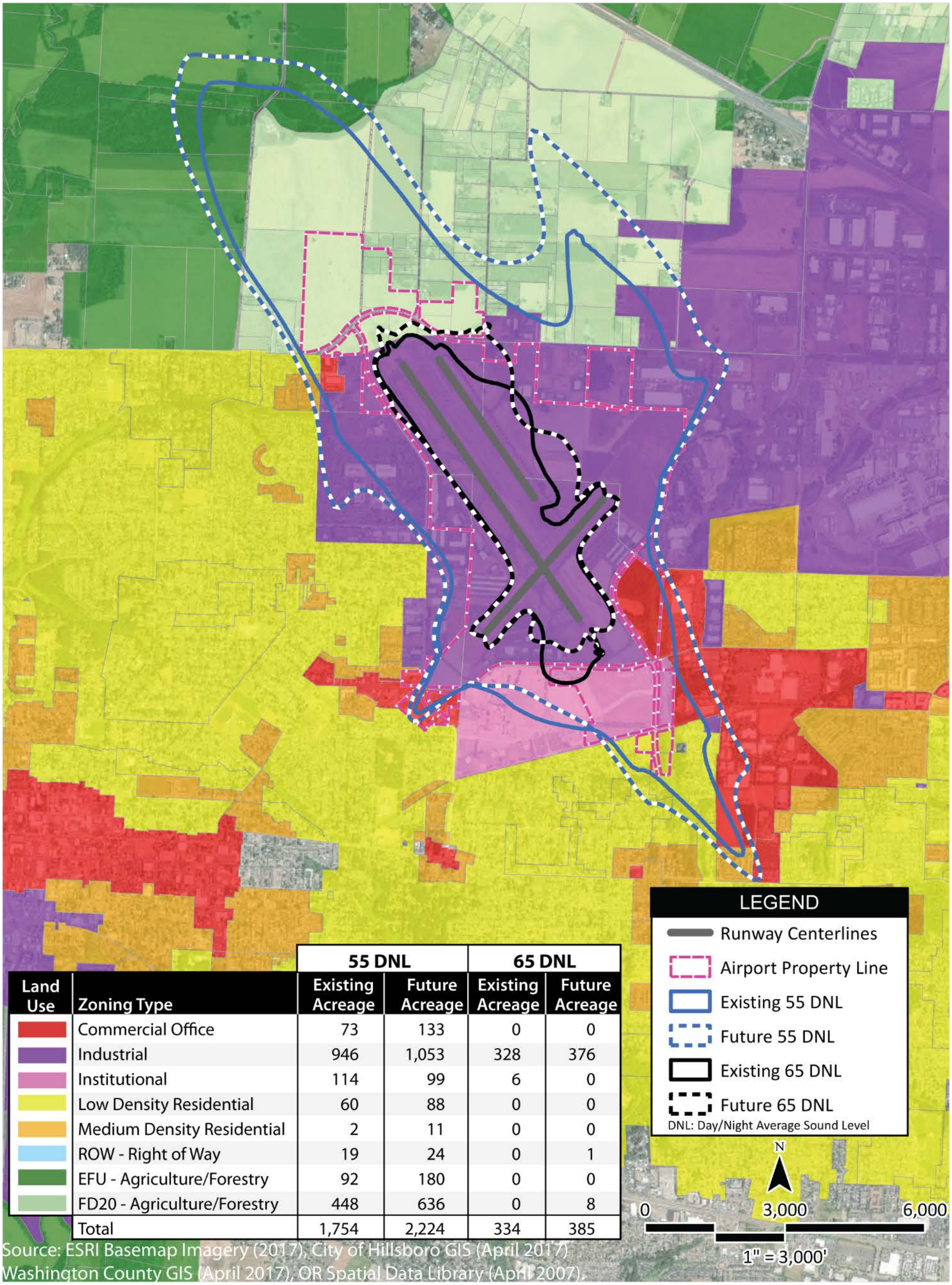
The future 55 DNL encompasses approximately 2,224 acres which includes approximately 99 acres of residential zoning. The remaining 2,125 acres within the 55 DNL are zoned for compatible land uses such as commercial, industrial, institutional, and agriculture.

NOISE AND AIR QUALITY INFORMATION SESSION

Continuing its ongoing efforts to engage the public on airport noise matters, the Port of Portland hosted a Noise and Air Quality Information Session on October 12, 2017. The purpose of the session was to share information about airport noise and to answer questions from members of the public on the topic as it relates to Hillsboro Airport. The specific objectives were to:

- Share information about factors that affect noise and air quality surrounding Hillsboro Airport;
- Report on previous work related to noise and air quality;
- Answer questions about noise and air quality management.

The information session was well attended with more than 80 people signing in. More than 40 questions, both written and verbal, were presented and addressed. A set of comprehensive meeting notes was made available within several weeks of the information session.



		55 DNL		65 DNL	
Land Use	Zoning Type	Existing Acreage	Future Acreage	Existing Acreage	Future Acreage
	Commercial Office	73	133	0	0
	Industrial	946	1,053	328	376
	Institutional	114	99	6	0
	Low Density Residential	60	88	0	0
	Medium Density Residential	2	11	0	0
	ROW - Right of Way	19	24	0	1
	EFU - Agriculture/Forestry	92	180	0	0
	FD20 - Agriculture/Forestry	448	636	0	8
	Total	1,754	2,224	334	385

Source: ESRI Basemap Imagery (2017), City of Hillsboro GIS (April 2017), Washington County GIS (April 2017), OR Spatial Data Library (April 2007).

Exhibit C23
ZONING WITH DNL OVERLAY