Calgary International Airport

Noise Exposure Contours Discussion Paper

07 August 2020 | Update

YYC CALGARY AIRPORT AUTHORITY | AIRBIZ

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INTRODUCTION

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PURPOSE

The Airport Vicinity Protection Area (AVPA) is a Regulation under the Province of Alberta's Municipal Government Act. The primary purpose of the Regulation is to ensure land use compatibility between YYC Calgary International Airport and development on surrounding lands. Associated with the Regulation are a series of NEF (Noise Exposure Forecast) Contours. The AVPA and the associated NEF contours, originally created in 1979, have NOT been updated since inception. Many airports in Canada continue to use dated NEF contours, such as YVR who continue to use NEF contours created in 1994.

The Calgary Airport Authority (YYC) engaged Airbiz to run updated noise exposure contours for the purpose of assessing projected operations within the YYC Airport Vicinity Protection Area (AVPA).

This report provides assumptions and resultant noise exposure contours. This detailed document has been prepared for discussion purposes. However, a noise exposure contour is NOT intended to inform the public as to whether or not they will be impacted by aircraft noise, other metrics are more appropriate for this purpose. Noise exposure contours are developed for land use planning purposes only.

Contours and assumptions presented in this report have NOT been reviewed by Transport Canada.

INTRODUCTION

NOISE EXPOSURE CONTOURS

There are three types of noise exposure contours produced depending on the planning horizon and review process involved.

NEF Contours

The Noise Exposure Forecast (NEF) is produced to encourage compatible land use planning in the vicinity of airports. NEFs are approved (official) contours and Transport Canada will support them to the level of accuracy of the input data. Traffic volume and aircraft type and mix used in calculating the noise contours are normally forecast for a period of between five and ten years into the future.

NEFs are made available to provincial and local governments for use in conjunction with Transport Canada's recommended Land Use Tables which will enable planners to define compatible land use in the vicinity of airports over the short term.

NEP Contours

It is recognized that much land use planning involves projections beyond five years into the future, when aircraft fleet mixes and runway configurations are most likely to be different from the known conditions of today. To provide provincial and municipal authorities with long range guidance in land use planning, Transport Canada introduced the Noise Exposure Projection (NEP). The NEP is based on a projection (not a forecast) of aircraft movements for more than ten years into the future, and includes aircraft types and runway configurations that may materialize within this period: NEPs are approved (official) contours and Transport Canada will support them to the level of accuracy of the input data.

Planning Contours

The third type of noise contour is the Planning Contour which is produced to investigate planning alternates and must be labelled as such. This may be released to the public by a regional TC Aviation office without Headquarters' (Ottawa) approval. Any agency may produce these contours as they do not have any official status.

The computer-produced contour lines in this report may be mechanically smoothed to remove irregularities that arise in the plotting process and to reflect natural and manmade boundaries such as zones, districts and water streams. This should be done particularly in areas of sharp corners or tips.

Source: Aviation Land Use in the Vicinity of Airports (Transport Canada TP1247)

NOISE MODELLING SOFTWARE

NEF-Calc

The NEF metric was developed by the Federal Aviation Administration (FAA) in the 1960s for the purpose of modelling noise exposure contours in the vicinity of airports. The contours are linked to community noise response predictions which are in turn associated with compatible land development guidelines. A software was developed to simplify calculations and progressively evolved from a DOS to Windows platform. The current version (NEF-Calc 2.0.6.1) has not been updated since 2011 and as a result many new generation aircraft are not included in the program's noise profile database.

This program is currently the only software which Transport Canada approves for producing noise exposure contours in Canada. The noise exposure contours contained in this report were created with NEF-Calc.

Recent Observations by Airbiz

In the March 2019 report "Assessing the Impact of Aircraft Noise in the Vicinity of Major Canadian Airports" by the Standing Committee on Transport, Infrastructure and Communities, a recommendation was made for Transport Canada to "support efforts to modernize outdated noise metrics. These efforts should include the review of Canada's Noise Exposure Forecast model…".

Other software

Canada is the only country that uses the NEF-Calc program. There are several other noise modelling software programs that exist and are used around the world, all of which have been generally developed to meet specific state requirements. For example, the FAA transitioned away from using INM in May 2015, and is actively maintaining its new software, AEDT.

AEDT is a software system that models aircraft performance in space and time to estimate fuel consumption, emissions, noise, and air quality consequences. AEDT most noticeably brings enhanced capabilities that extend beyond noise modelling outputs of INM.

There may be a possibility that the AEDT model could be adopted by Transport Canada as seen in countries such as Australia rather than maintain or upgrade NEF-Calc.

NOISE EXPOSURE CONTOURS

ASSUMPTIONS

ASSUMPTIONS

NOISE EXPOSURE CONTOURS

There are many ways to model the impact of aircraft noise around airports. A noise exposure contour is intended for the sole purpose of land use planning. It is a noise metric that accounts for cumulative operations (representing average operations over a year) and perception of noise (accounting for tone, frequency and time of day). A noise exposure contour is NOT intended to inform the public as to whether or not they will be impacted by aircraft noise, other metrics are more appropriate for this purpose.

Noise exposure contours are determined based on an average busy day of operations. The following key inputs are required:

- Runway usage
- Mix of aircraft
- Flight tracks
- Aircraft stage length
- Total daily movements (including day/night split)

The day (7am to 10pm) and night split (10pm to 7am) is an important component as nighttime operations are weighed as 16.7 times that of daytime operations to reflect the increased disturbance associated with operations during periods of sleep and reduced ambient noise levels.

This section provides an overview of these inputs and any relevant assumptions that have been made.

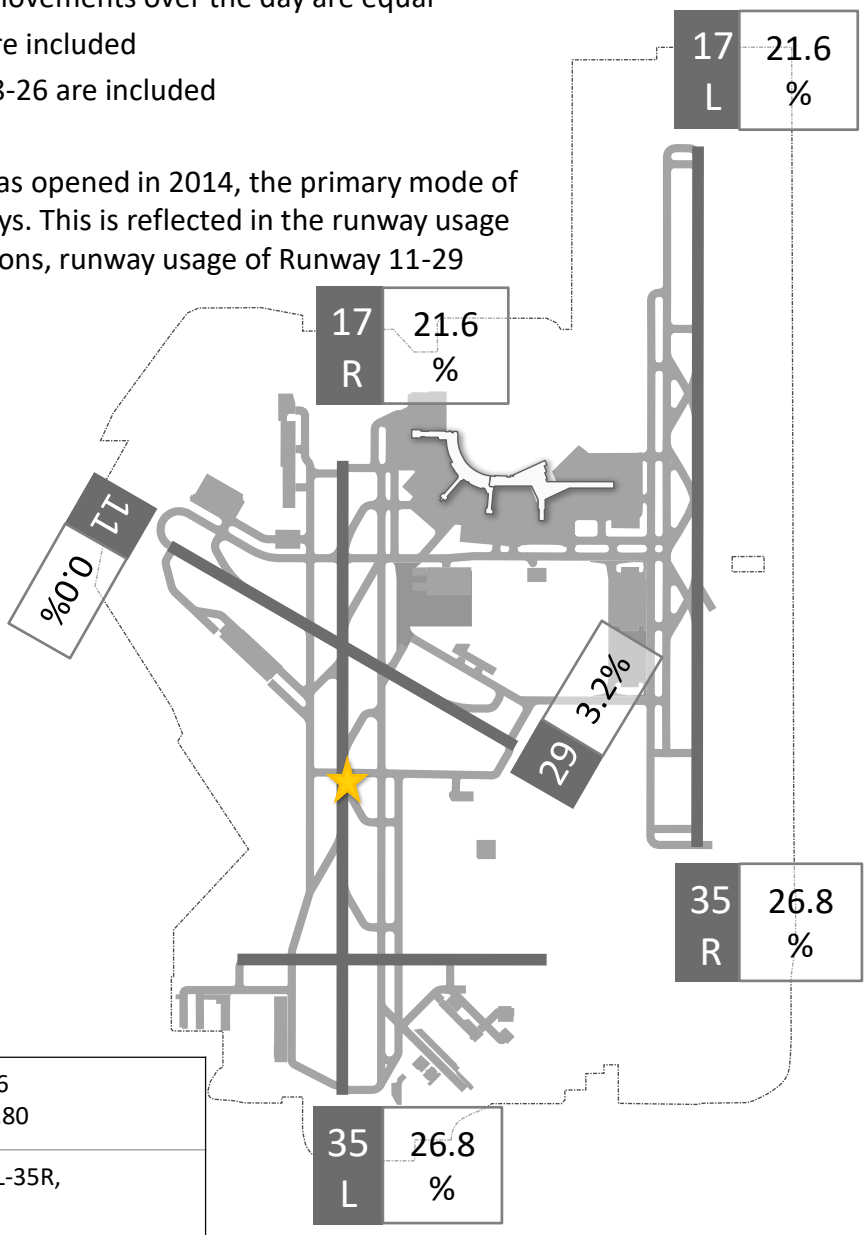
ASSUMPTIONS

RUNWAY USAGE

The runway system was developed using the existing layout in relation to the Aerodrome Reference Point (ARP). The graphic below illustrates the allocation of movements by runway end. Allocations were determined based on actual 2017 movement records with the following assumptions:

- Nominal usage of runways (below 1%) was ignored
- Total arrival and departure movements over the day are equal
- No helicopter movements are included
- No operations on Runway 08-26 are included

Note: Since Runway 17L-35R was opened in 2014, the primary mode of operations is for parallel runways. This is reflected in the runway usage chart. During crosswind conditions, runway usage of Runway 11-29 increases significantly.



ARP ★	N 51 07.36 W 114 00.80
Runways	11-29, 17L-35R, 17R-35L
Software	Transport Canada NEF calc

ASSUMPTIONS

MIX OF AIRCRAFT

Each aircraft has a distinct noise profile which is dependent on its unique design features. Noise modelling software, therefore, has a database of aircraft noise profiles, which is used to customize the mix of aircraft to match an airport's operation.

The aircraft database in NEF-Calc is, however, limited in size and doesn't include all aircraft types. Therefore, broad aircraft type categories are used to represent multiple aircraft types with a similar noise profile. Transport Canada provides guidance on how to assign aircraft to these categories.

The Transport Canada NEF-Calc model also doesn't include new aircraft models (such as the Airbus A220 and the A320neo or the Boeing 737 Max series and the 787) so the most appropriate substitute must be selected from the aircraft in the database. These newer aircraft are typically quieter than older generation aircraft that they replace. Therefore, it can be expected that noise contours in NEF-Calc are a conservative representation of the actual mix of aircraft.

Description	Representative Aircraft
Widebody Jet 	**Airbus A310, A330, A340** **Boeing 767, 747**
Narrowbody Jet 	**Airbus A320, A220** **Boeing 737** **Embraer 170, 190**
Turboprop + **Light turboprop** 	**Bombardier Dash 6, Dash 8 (Q series)** **Beechcraft 58, 1900**
Regional Jet 	**Bombardier CRJ 700, 900** **Embraer 145**
General Aviation 	**Cessna 172, 441, 500, 525**

ASSUMPTIONS

FLIGHT TRACKS

Noise modelling software requires the definition of arrival and departure flight tracks. However, NEF-Calc has limitations to the detail of flight tracks, these include:

- Straight-in approaches can only be modelled (i.e. flight tracks will be directly aligned with the orientation of the runway)
- Approaches can only have a fixed descent angle (typically 3 degrees)
- Departure tracks in Transport Canada's NEF-Calc can include one (1) turn either at a certain distance from the runway entry or at a certain altitude (dependent on aircraft performance)

The following table summarizes the flight track definition used for the purpose of preparing this report:

Operation	Runway	Description
Arrival	11	Straight approach @ 3° descent angle
	29	
	17L	
	35R	
	17R	
	35L	
Departures	11	Straight departure
	29	
	17L	10° LEFT turn at 400 ft above ground level from start of take-off, then straight*
	35R	10° RIGHT turn at 400 ft above ground level from start of take-off, then straight*
	17R	Straight departure
	35L	

*Original NEF Contours currently contained in AVPA regulation did NOT include departure divergence.

ASSUMPTIONS

STAGE LENGTH AND CAPACITY

Aircraft Stage Length

Aircraft carry the required amount of fuel needed to reach their destination. Therefore, the take-off weight and subsequent climb profile can vary depending on the destination. Noise modelling software is able customize the aircraft departure stage length (or flight distance) to account for this variable climb performance. Stage lengths were determined for each aircraft type based on destinations defined in a forecast schedule produced by YYC.

Hourly Capacity

The following hourly runway capacities were determined based on operational assumptions developed in consultation with NAV Canada. Assumptions included runway occupancy time (ROT) data, aircraft performance information (typical approach speeds) and aircraft separation standards.

Capacity has been broken down by three modes of operation:

1. RWY 17 – arrivals and departure on Runway 17L and 17R
2. RWY 35 – arrivals and departure on Runway 35L and 35R
3. RWY 29 – arrivals and departure on Runway 29

Three operational scenarios are provided to represent the dynamic nature of airport operations throughout a day:

1. Balanced operations – equal arrival and departure demand
2. Departure bias – increased departure demand
3. Arrival bias – increased arrival demand

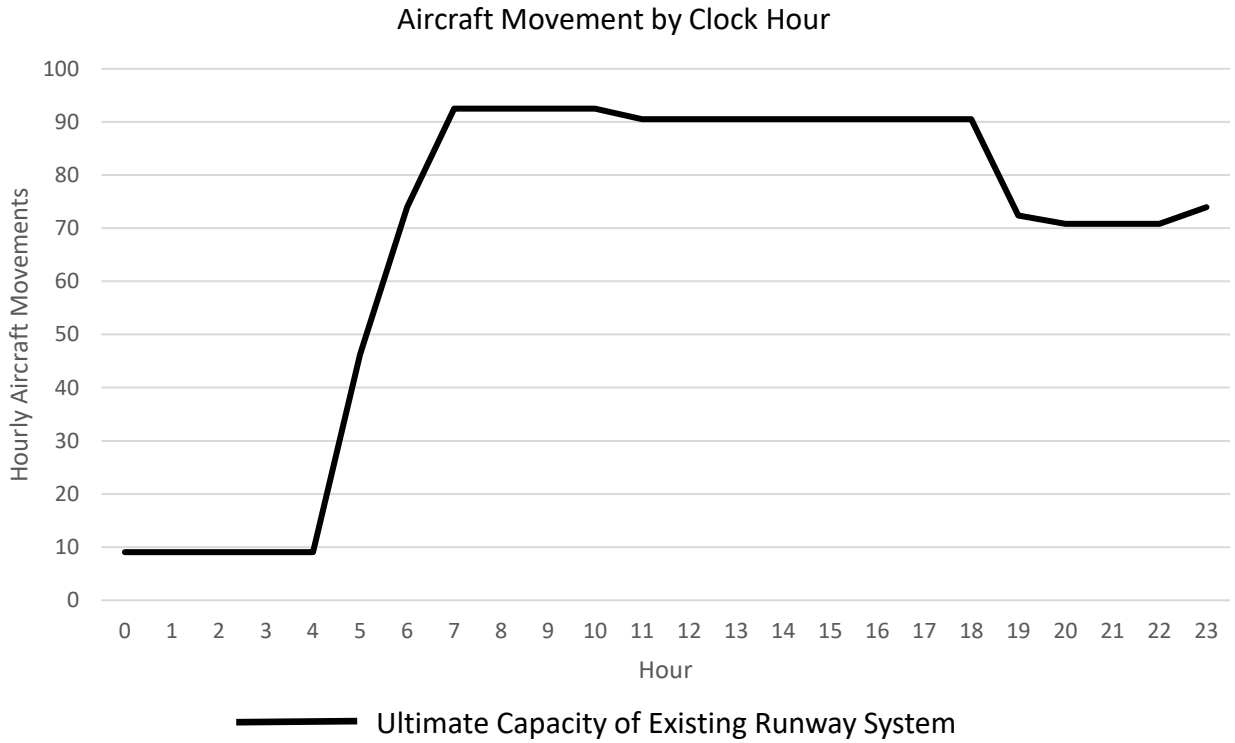
	Mode of Operation		
Operational Scenario	***RWY 17 (mvts/hr)***	***RWY 35 (mvts/hr)***	***RWY 29 (mvts/hr)***
Balanced Operations	92	92	46
Departure Bias	94	94	47
Arrival Bias	90	90	45

ASSUMPTIONS

TOTAL DAILY MOVEMENTS

A noise exposure contour is based on a busy day of operation. The total daily movements for noise exposure contours produced in this report were determined through a runway capacity assessment. Additional assumptions for the runway capacity analysis are provided in the Appendix. Note: this approach is aligned with noise exposure contours called NEP Contours or Planning Contours rather than NEF Contours (refer to page 5).

The following graph represents the demand profile by clock hour used to determine total daily movements:



ASSUMPTIONS

TOTAL DAILY MOVEMENTS

Day vs. Night

In noise exposure contours, operations are weighted based on the time of operation. All movements including and between 7:00am and 9:59pm are considered daytime movements, while movements including and between 10:00pm and 6:59am are considered nighttime movements. Night movements are considered to have a greater impact than day movements and subsequently have a greater weighting in noise modelling calculations.

The following table illustrates the amount of day, night and total aircraft movements used for this modelling exercise.

	Day 7:00am – 9:59pm	**Night 10:00pm – 6:59am**	**Total**
Aircraft Movements	1308	310	1618

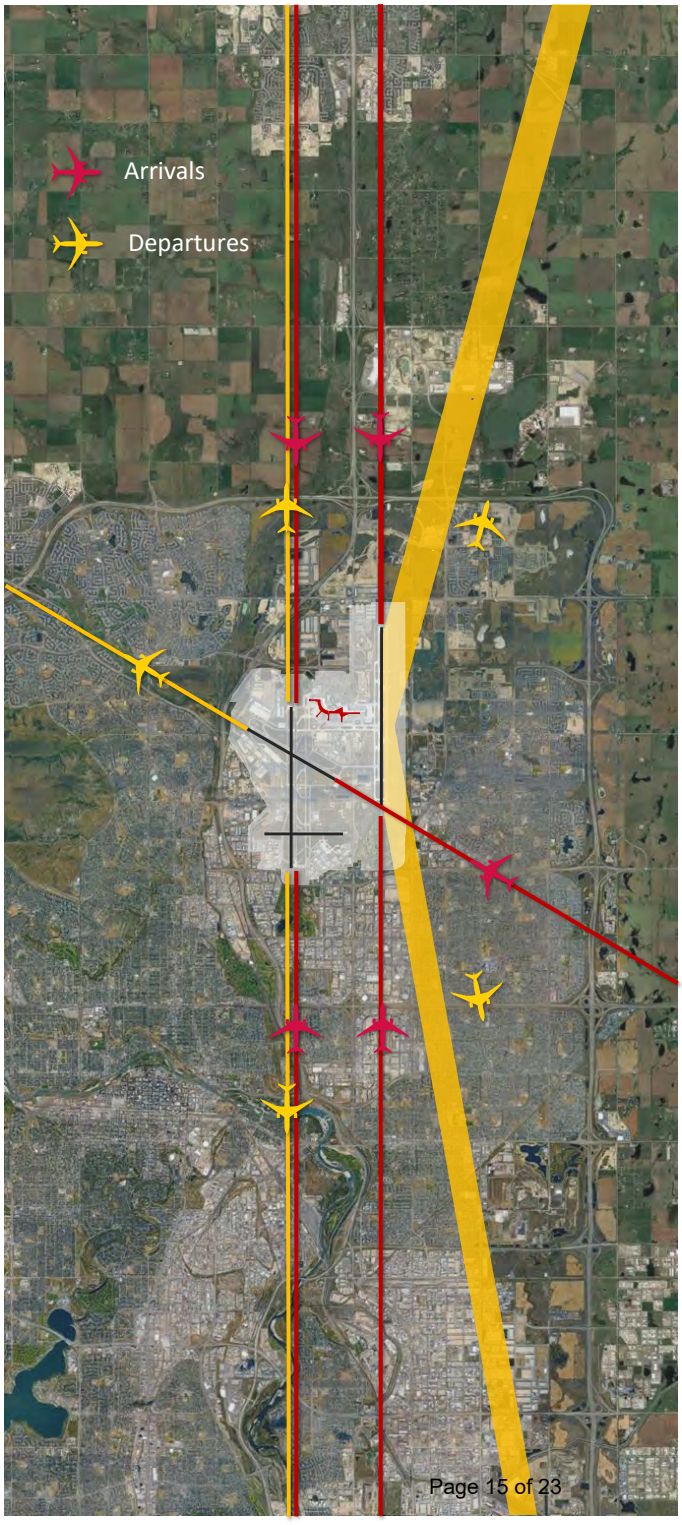
Note: Numbers rounded to nearest figure

ASSUMPTIONS

MIX OF AIRCRAFT AND FLIGHT TRACKS

The following table provides an overview of the mix of aircraft in terms of total movement and also a breakdown of day and night movements. The graphic demonstrates the flight tracks applied in the noise model.

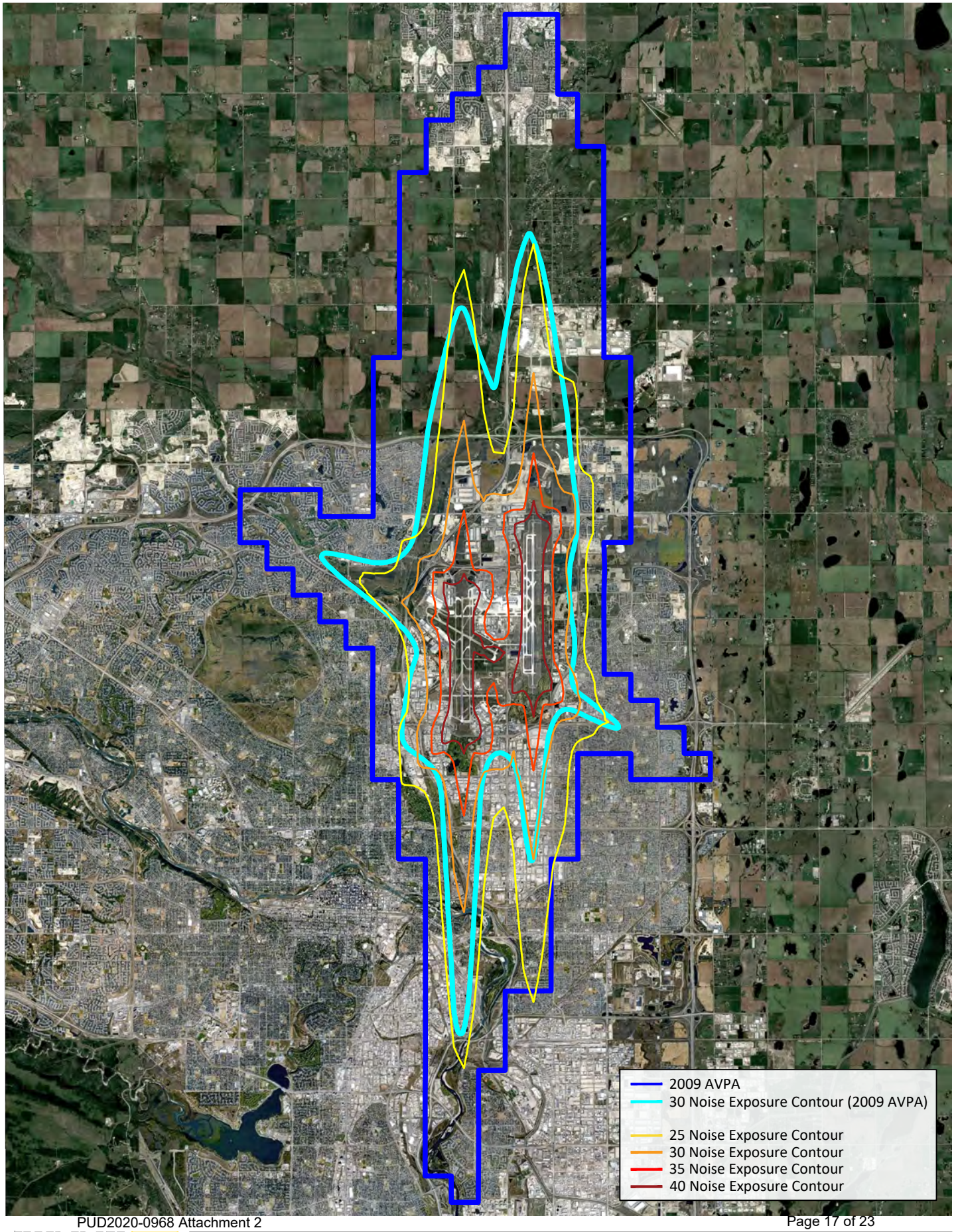
Description	Daily Mvts. Day/Night	
Widebody	**84.8**	
	65.3	**19.5**
Narrowbody	**886.9**	
	719.1	**167.8**
Turboprop + Light turboprop	**610.7**	
	500.7	**110.0**
Regional Jet	**6.8**	
	5.1	**1.7**
General	**29.0**	
	23.9	**5.1**



NOISE EXPOSURE CONTOURS

PRELIMINARY CONTOURS

YYC Noise Exposure Contours (NEF Calc)



CALGARY INTERNATIONAL AIRPORT | YYC CONTOURS

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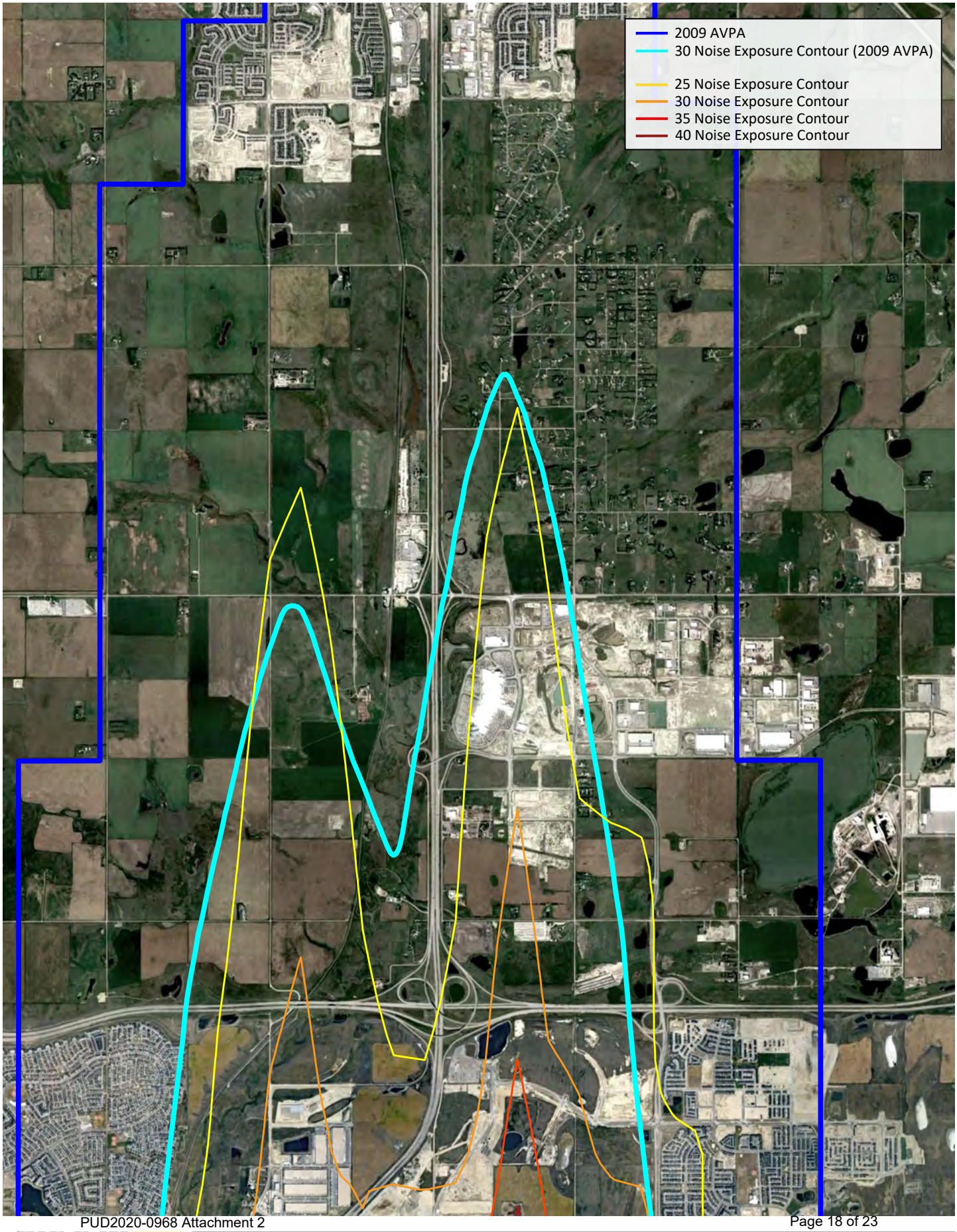
YYC Noise Exposure Contours (NEF Calc)

North



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CALGARY INTERNATIONAL AIRPORT | YYC CONTOURS

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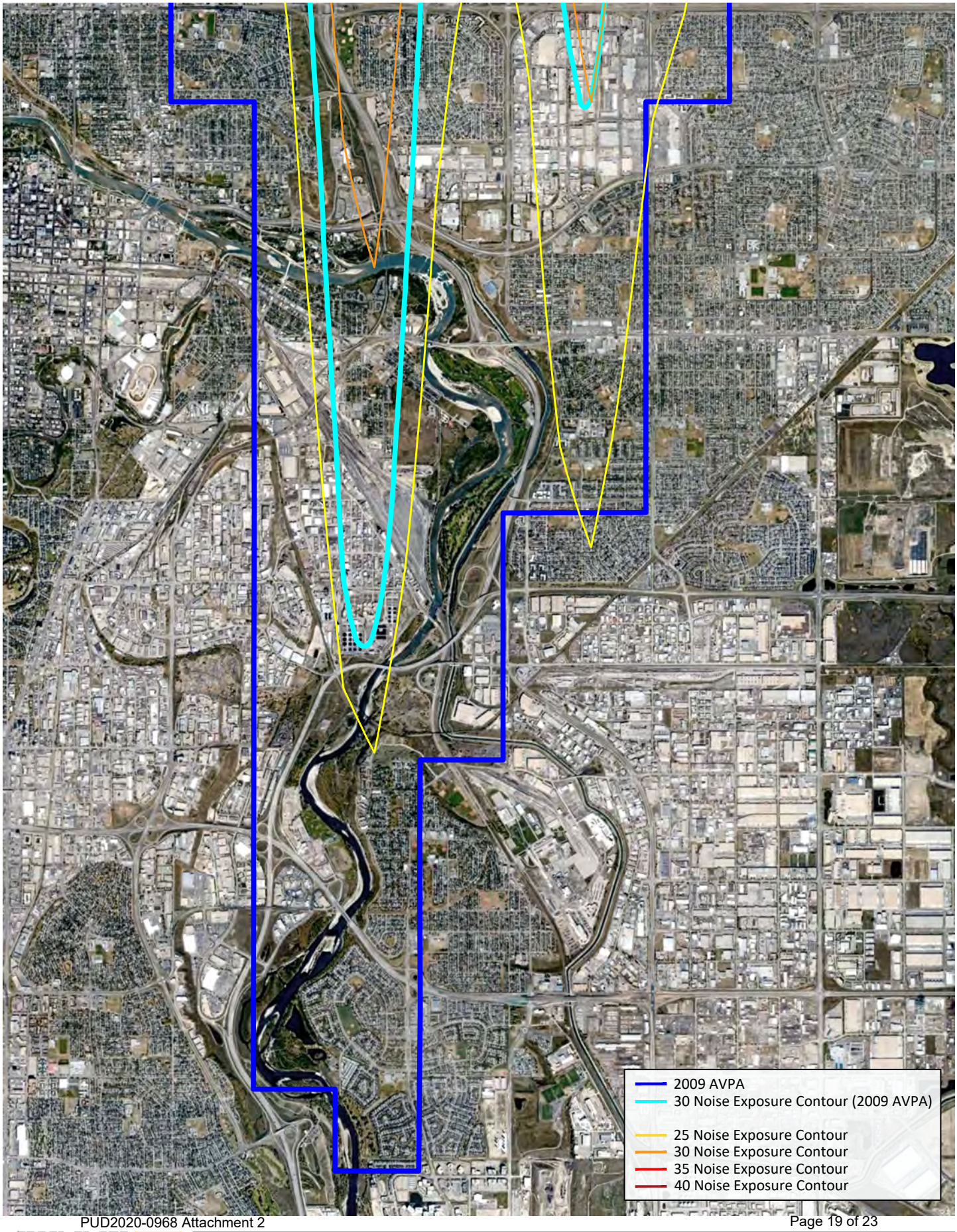
YYC Noise Exposure Contours (NEF Calc)

South



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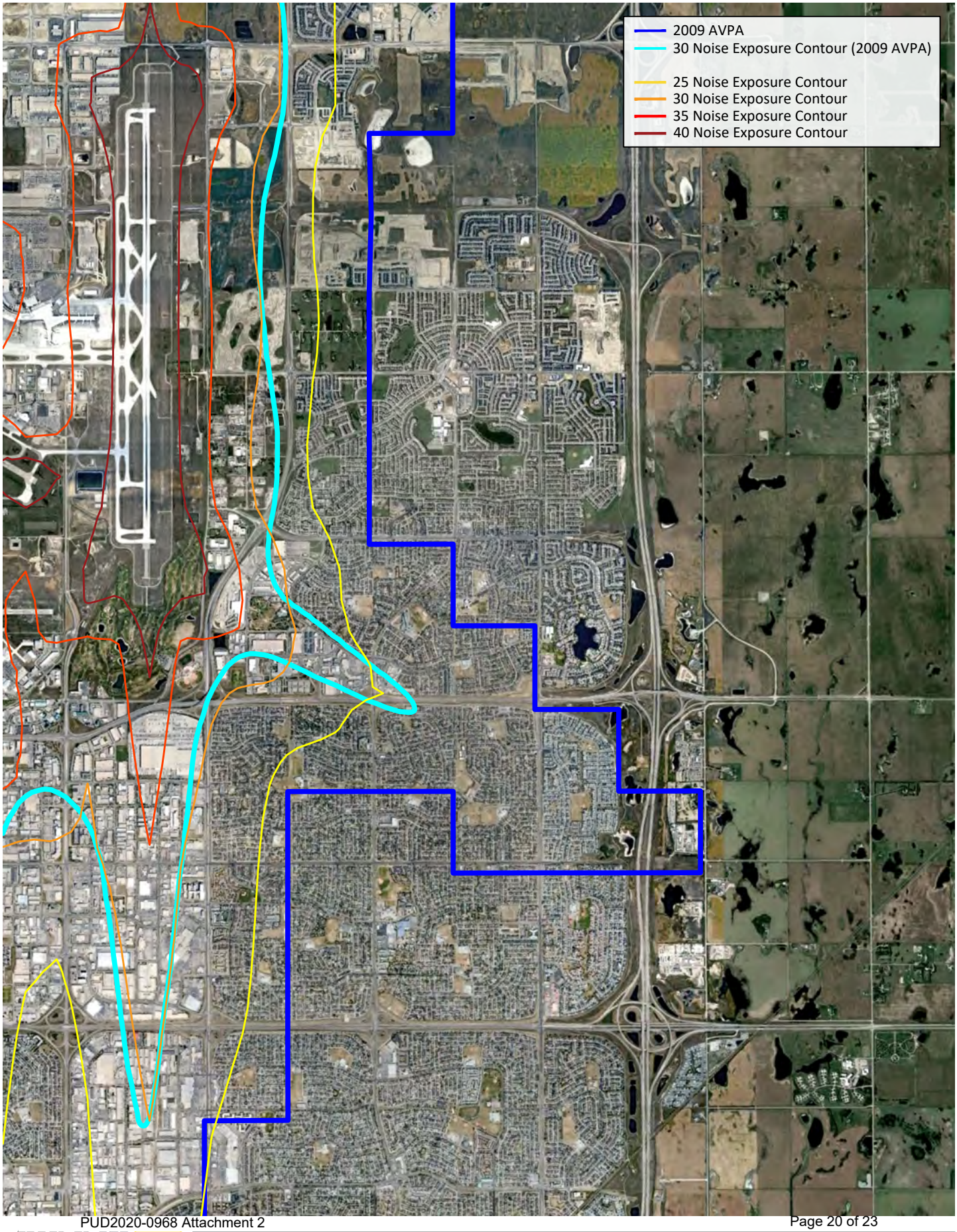
YYC Noise Exposure Contours (NEF Calc)

East



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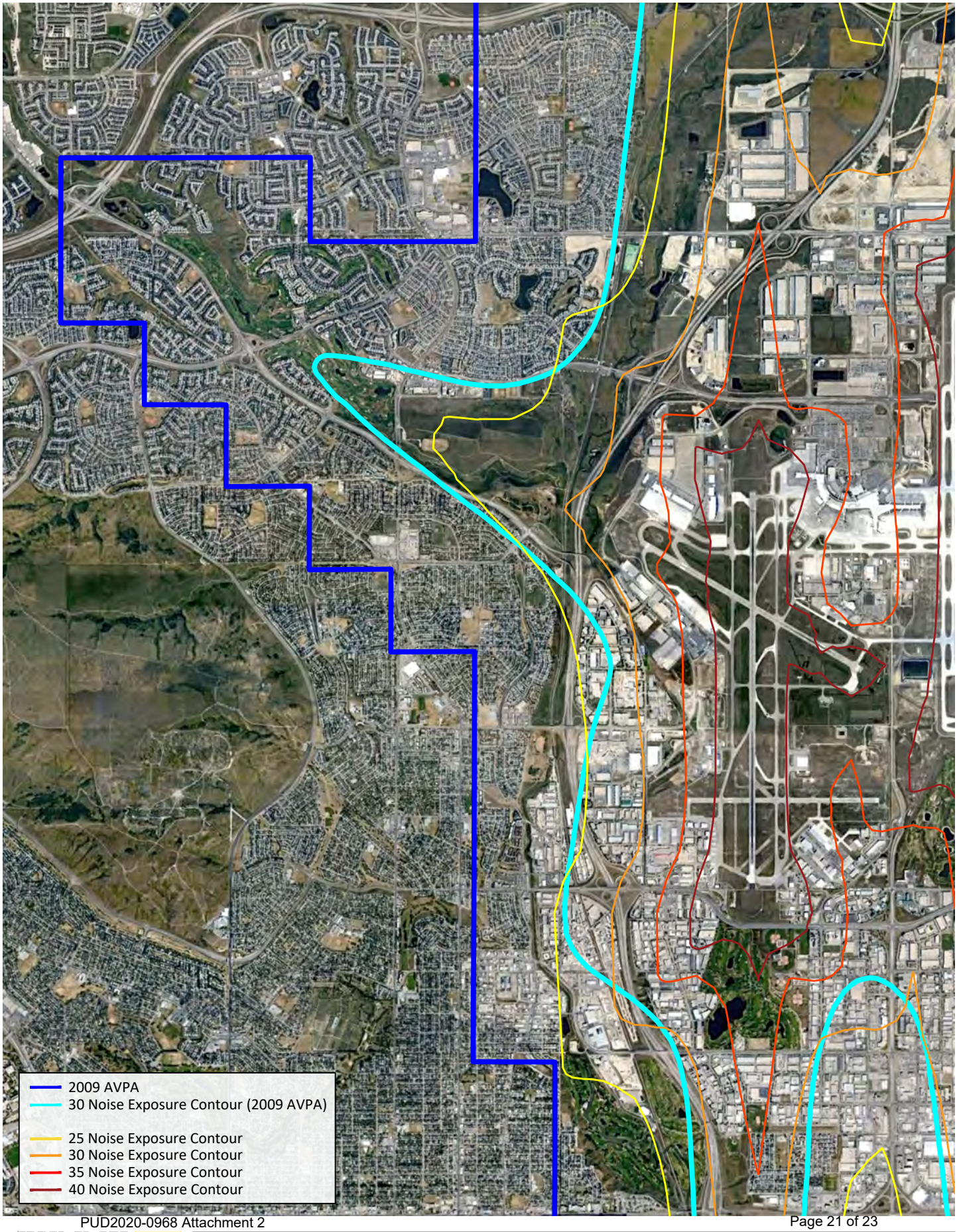
YYC Noise Exposure Contours (NEF Calc)

West



AIRBIZ CALGARY INTERNATIONAL AIRPORT | YYC CONTOURS

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NOISE EXPOSURE CONTOURS

CLOSING COMMENTS

CLOSING COMMENTS

The noise contours generated as part of this report represent a long-term operational scenario that is based on an estimated capacity of the runway system and current operational realities of YYC since the opening of the parallel runway.

As such, the noise exposure contours contained in this report should be used **for information and discussion purposes only**.