

The background image shows an airport tarmac under a clear blue sky. A prominent air traffic control tower stands on the right side. In the center, a large commercial airplane is parked at a gate. The foreground features a grassy field and a paved runway or taxiway.

NAV CANADA

Improving efficiency using
advanced navigation capabilities

November 2015



NEW NAVIGATION TECHNOLOGIES

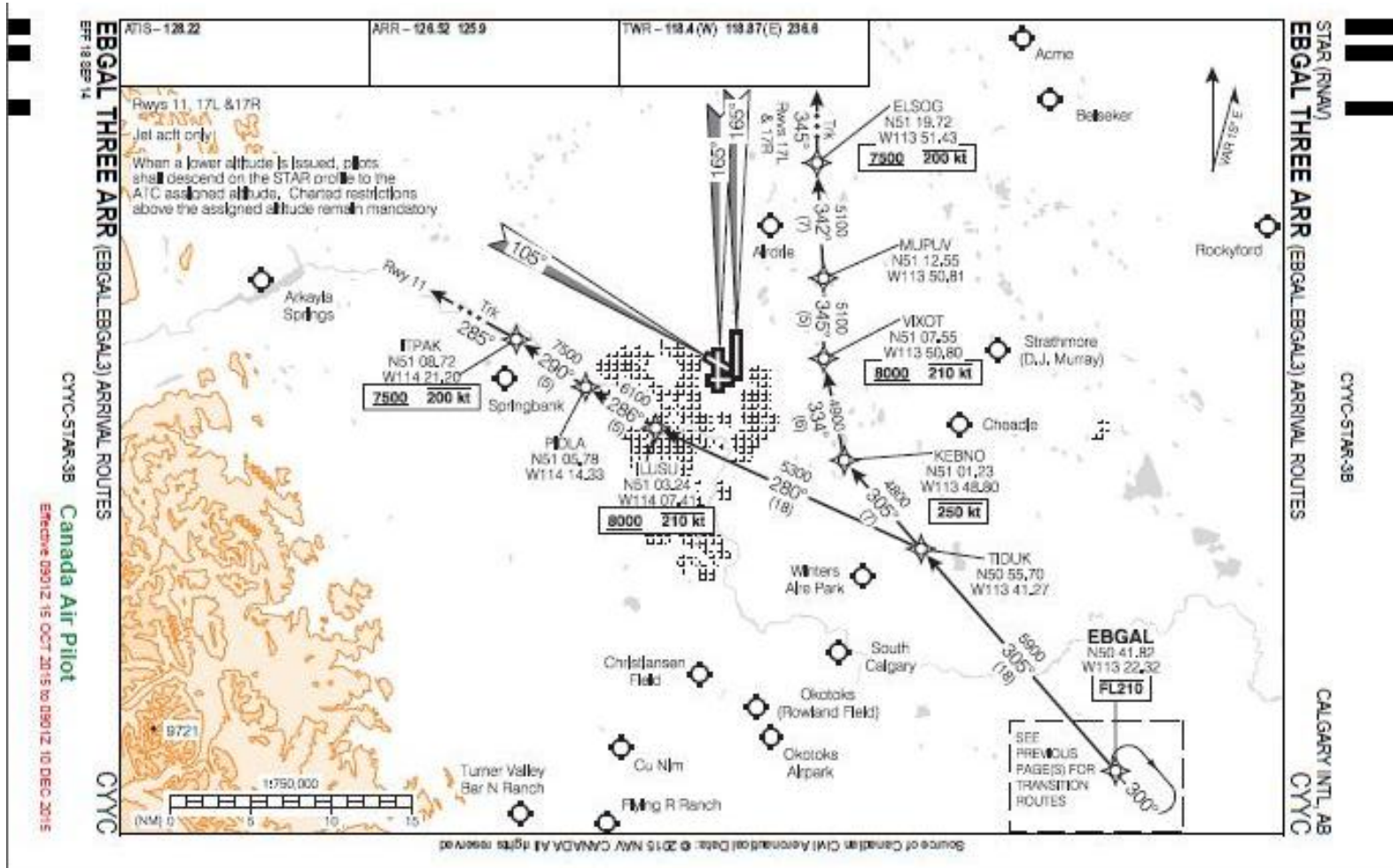


- Aviation is moving to the use of more advanced forms of GPS based navigation in all phases of flight
- CYYC has RNAV arrival procedures that provide a combination of GPS-based guidance and ATC instructions to a point where the pilot can intercept the glide path emanating from the ground based Instrument Landing System (ILS)
- CYYC also has advanced RNP procedures used by WestJet to all runway ends other than 17L/35R. RNP provides highly accurate guidance and a full Constant Descent Approach to the runway.



RNAV STAR

EXISTING EXAMPLE





REQUIRED NAVIGATION PROCEDURE

EXISTING EXAMPLE

CYYC-IAP-3E

This aeronautical information/data is published for OPS SPEC 605

CYYC / YYC
CALGARY INTL



GE Aviation

(B737-NG)

19-2
14 APR 14
EFF: 24 JUL 14

WESTJET

CALGARY, AB
RNAV (RNP) Y RWY 17R

GE PROPRIETARY AND CONFIDENTIAL

DWTS	CALGARY Terminal		CALGARY Tower		CALGARY Ground	
128.225	123.85	126.525	East 118.875	West 118.4	East 125.35	West 121.9
RNAV (RNP) RNV Y 17R	FMS Ray Heading 165°	Apt Elev. 3557' TDZE 3555'	KIPOR (IF) 8040' (3,00')	MUPUV (IF) 7500'A	OVEBI (IF) 7500'A	Trans Level FL180

① VNAV Path must be annunciated beyond this point (YC424 for KIPOR transition, YC434 for OVEBI transition, YC474 for MUPUV transition).

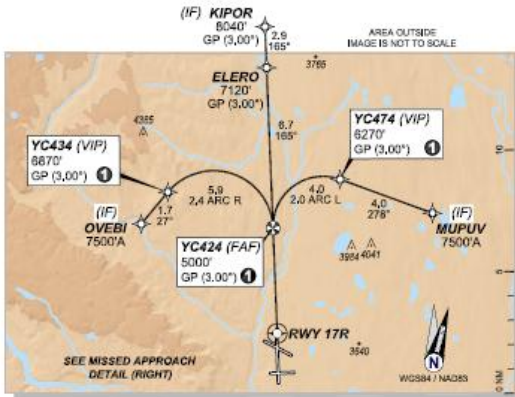
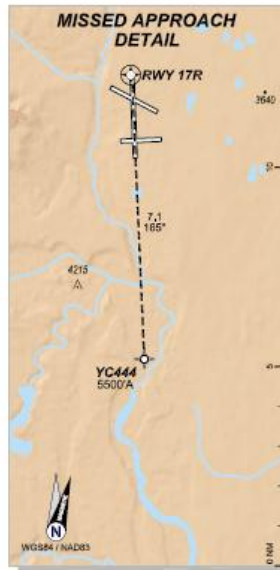
SPECIAL AIRCREW AUTHORIZATION REQUIRED

ROUTING: IGVEP ARRIVAL to RNV Y 17R
OVEBI transition; Set 210B/8600' at OMTUT.
Approach clearance RECEIVED prior to OMTUT;
Set and fly the RNV Y 17R OVEBI transition approach.

ROUTING: EBGAL ARRIVAL to RNV Y 17R
MUPUV transition; Set 210B/8900' at VIXOT.
Approach clearance RECEIVED prior to VIXOT;
Set and fly the RNV Y 17R MUPUV transition approach.



MISSED APPROACH:
Climb to 5500' via the RNAV (RNP) Missed Approach track to YC444.



RNP 0,10	RNP 0,15	RNP 0,20	RNP 0,30	YC424 GP 5000' (1444')	RWY 17R
DA(H) 3892' (337)	DA(H) 3894' (330)	DA(H) 3903' (348)	DA(H) 3956' (401)		
C 1	C 1	C 1 1/4	C 1 1/4		
D 1	D 1	D 1 1/4	D 1 1/4		

Revisions: Revise OVEBI transition, revise KIPOR transition, revise MUPUV transition, mag var heading changes, update frequencies, update routing.

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EFF 24 JUL 14

RESTRICTED

RESTRICTED

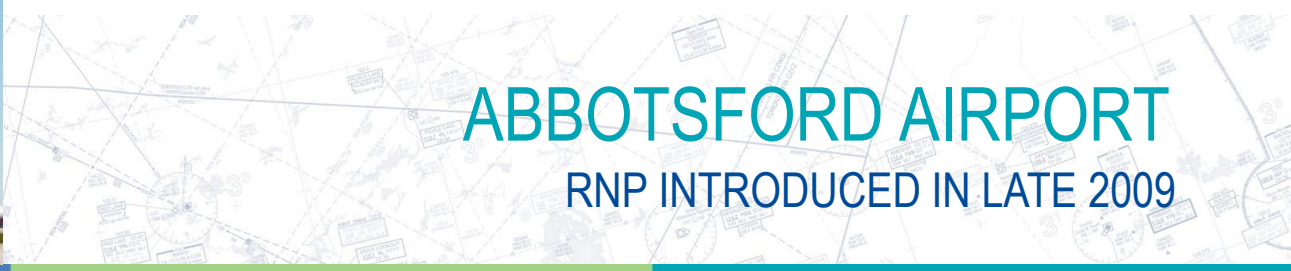


EXPANDING USE OF RNP

- RNP has been used in Canada since 2004, primarily by WestJet using specific “company approaches”
- Recently new criteria were published by Transport Canada that enable RNP procedures to be designed for use by more airlines and by more types of aircraft
- NAV CANADA is designing procedures now



- RNP procedures are being implemented for all of Calgary International Airport's runways (except 08/26).
- Existing procedures are being redesigned so that a larger number of aircraft can operate on them.
- Not all aircraft will use the new procedures.
 - Not all of the current fleet operating to CYYC are equipped to fly RNP procedures. But the number that can is growing.
 - Sequencing requirements will often necessitate continued staggering of the base leg portion of the flight path



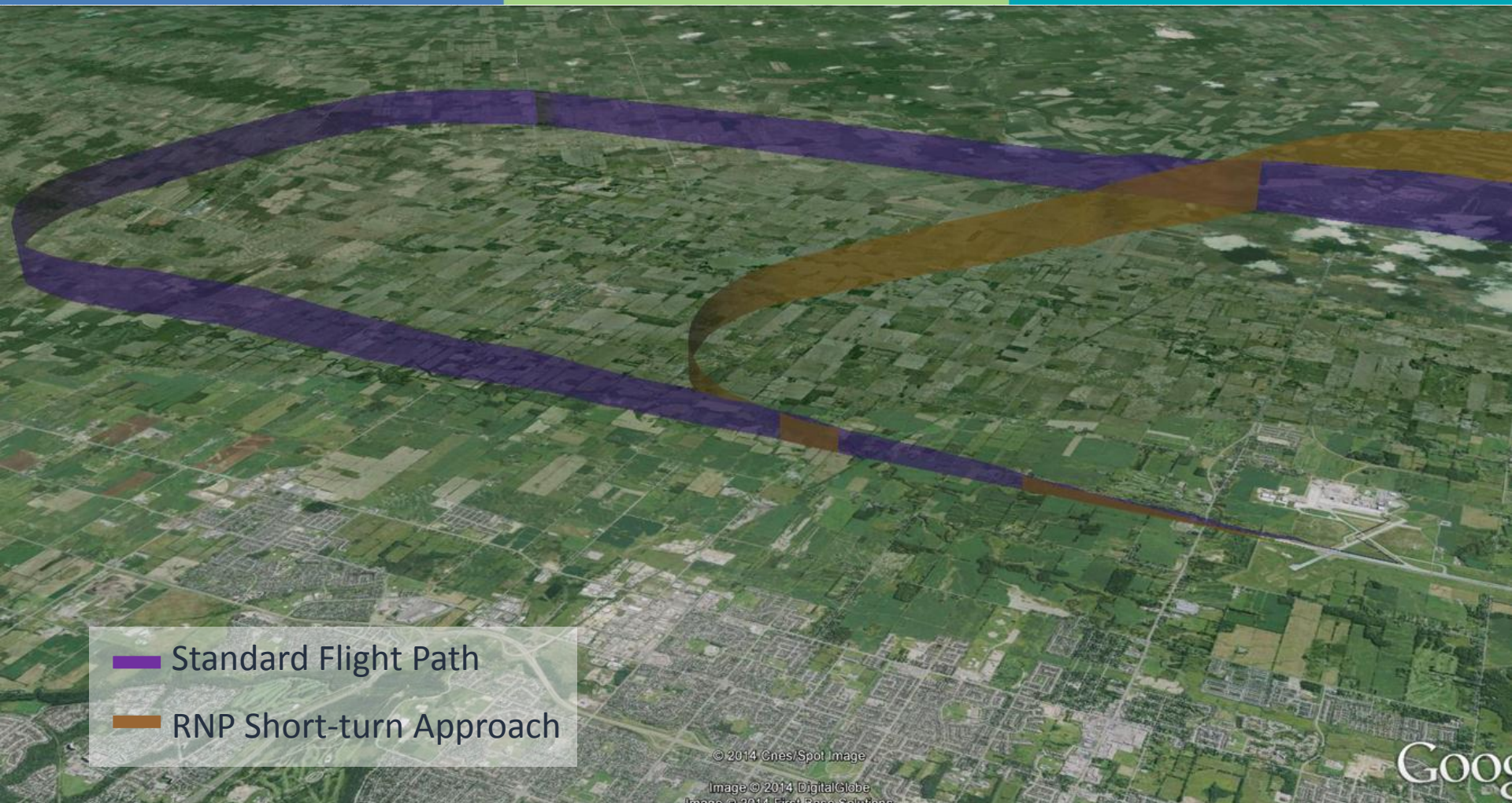
At Abbotsford, BC
RNP enabled a highly
accurate procedure to
be designed between
restricted airspace
blocks and challenging
terrain.





HAMILTON AIRPORT

RNP SHORT-TURN APPROACH





RNP: Improved Aircraft Operations at YYC



Runway 17 Arrival Operations

NAV CANADA





COMPARISON CURRENT STAR TO NEW RNP PROCEDURE

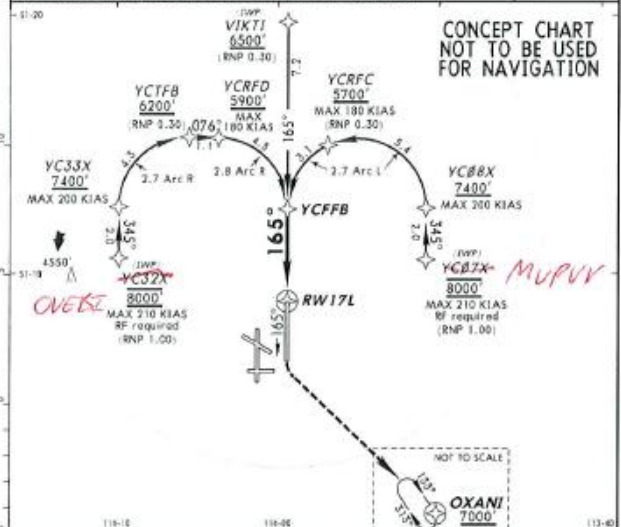
CYYC/YC CALGARY, ALTA RNAV (RNP) Y Rwy 17L

D-ATIS		EDMONTON Radio		CALGARY Arrival		CALGARY Type		Ground	
128.225		123.375		123.85 125.9 126.525		West East		West East	
RNAV	Final Apch Crz	Minimum Alt	RNP 0.10 DA:H	Apr Elev	3606'				
	165°	4800' (119')	3860' (25')	TDZE	3606'				

MISSED APCH: Climb to 4100' hdg165°. Then climbing LEFT turn to 7000' direct to OXANI.

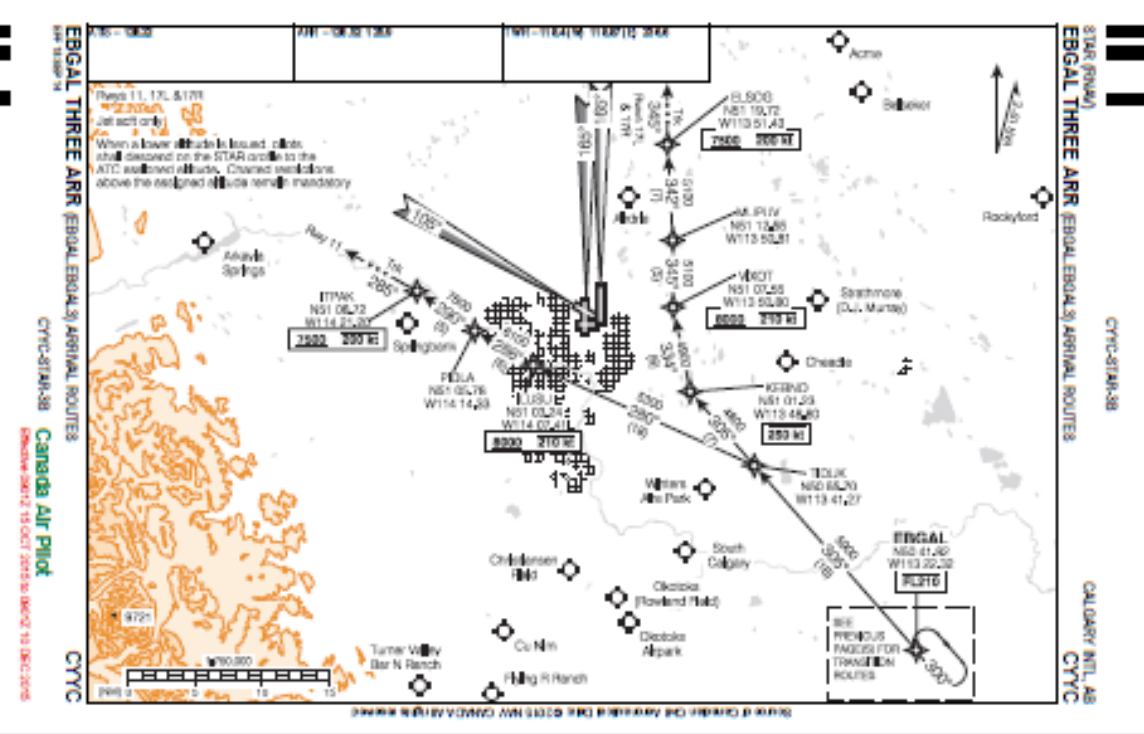
1. SAFE ALTITUDE WITHIN 100 NM 13,800'. 2. GNS REQUIRED.
3. Procedure not authorized below -25°C (-13°F) or above 53°C (123°F).

MSA RW17L



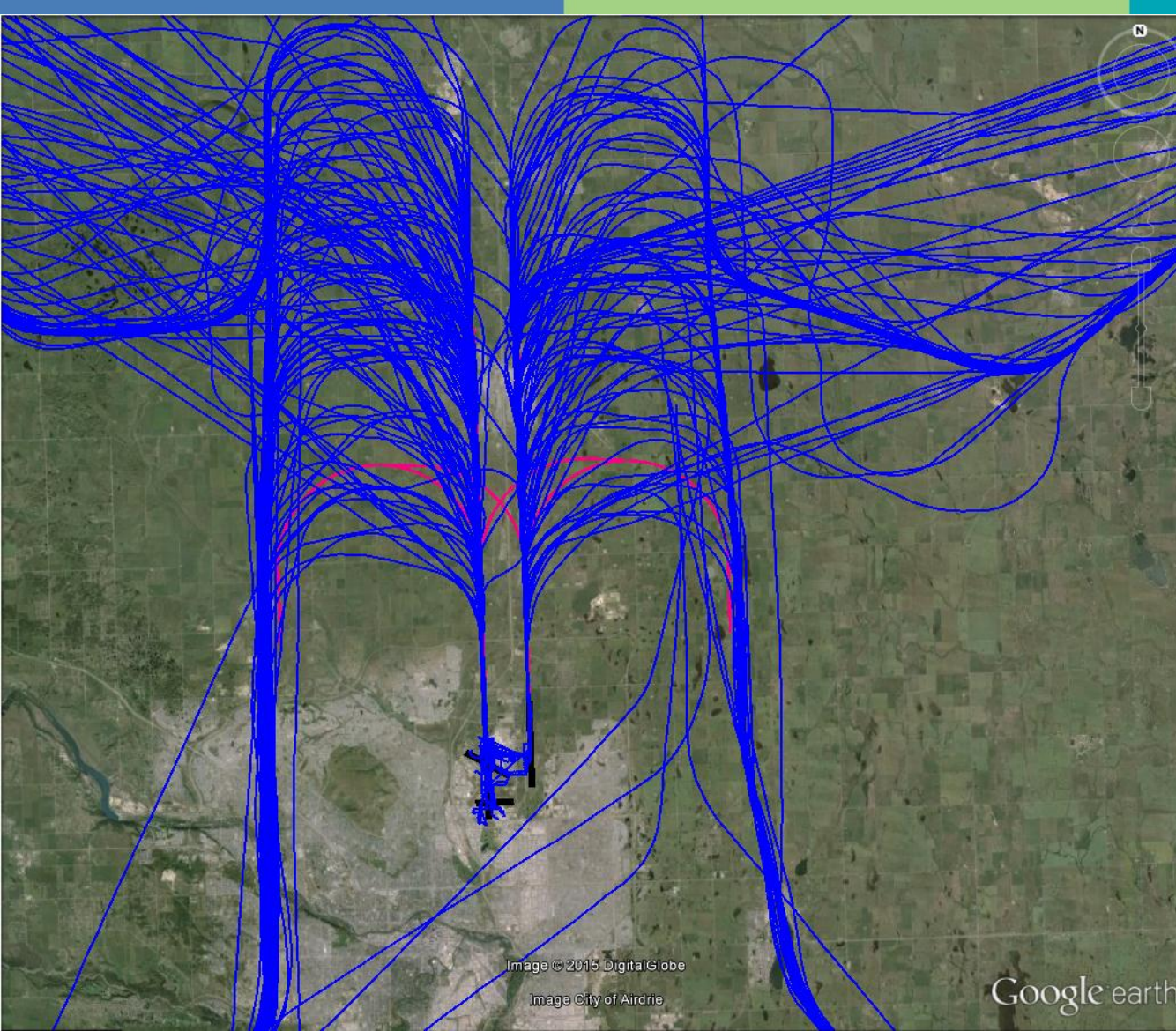
AUTHORIZATION REQUIRED		
STRAIGHT-IN LANDING RWY 17L		
RNP 0.10	RNP 0.20	RNP 0.30
DA:H 3860' (25')	DA:H 3902' (29')	DA:H 3932' (32')
VR 50 or 1	VR 50 or 1	VR 50 or 1

CHANGES: New procedure.





COMPARISON FLIGHT TRACKS TO NEW RNP



Runway 17 Operations

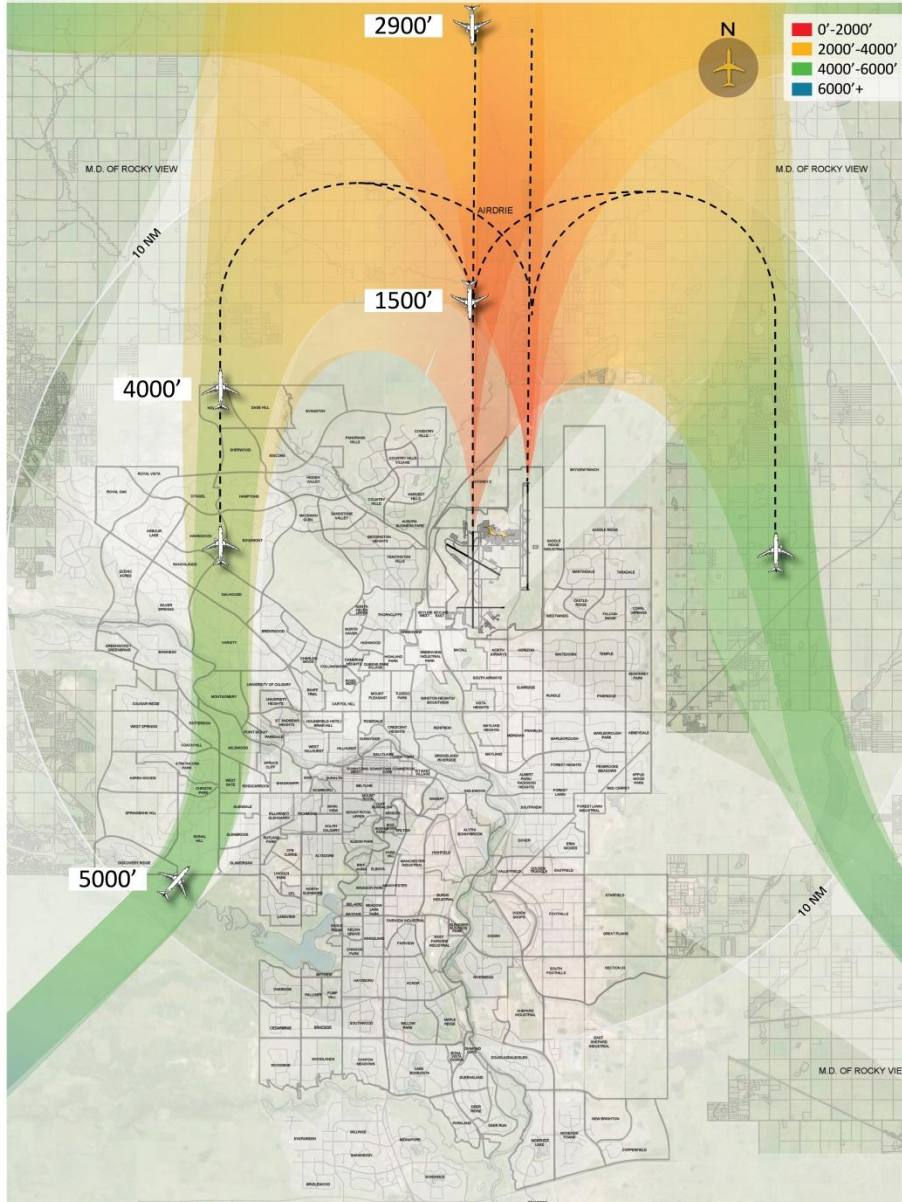
Arrival flight tracks 12
hours
(October 8, 2015)

New RNP flight path

Flight Tracks - RNAV with RNP Overlay

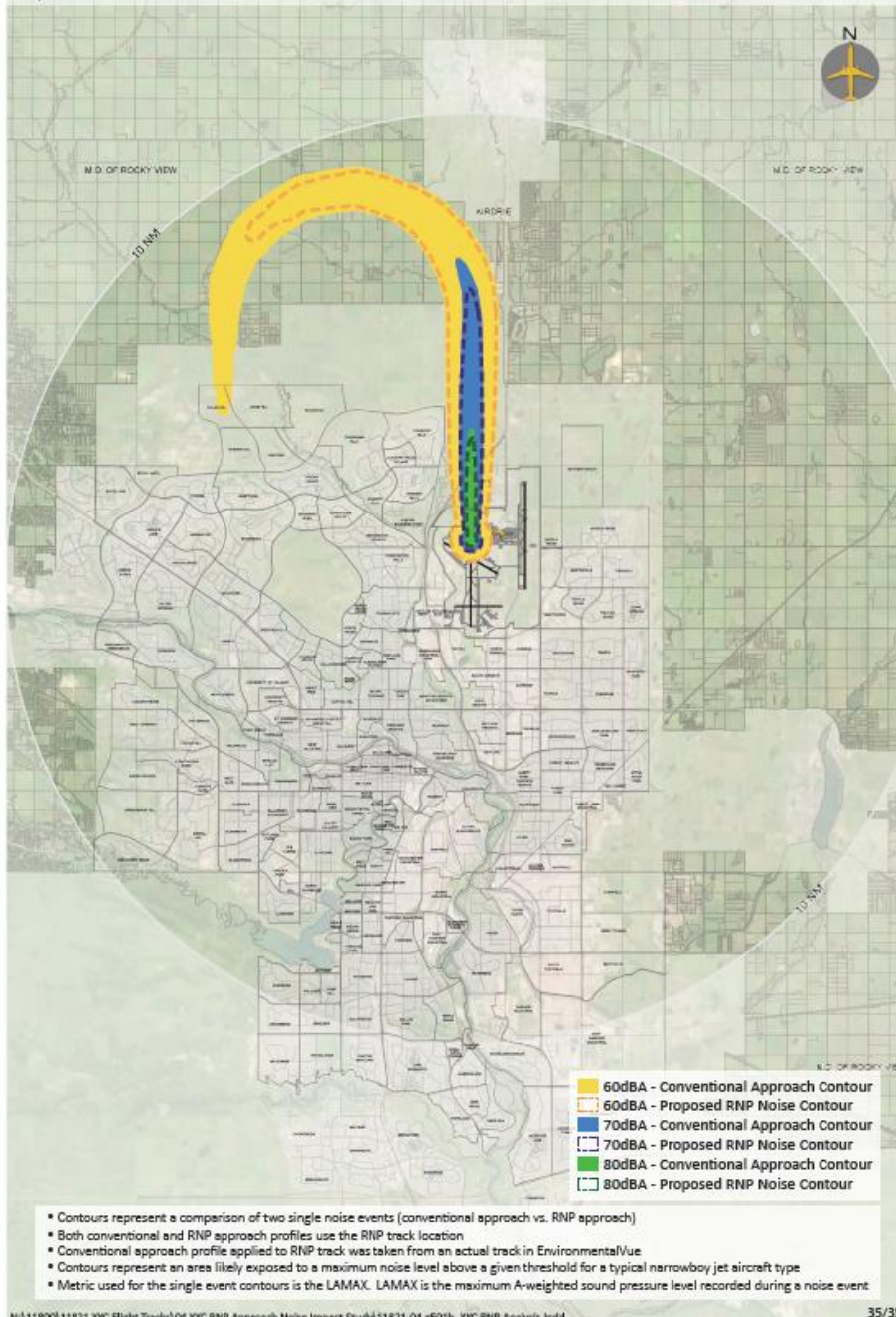
Arrivals Runway 17R + 17L

City Scale



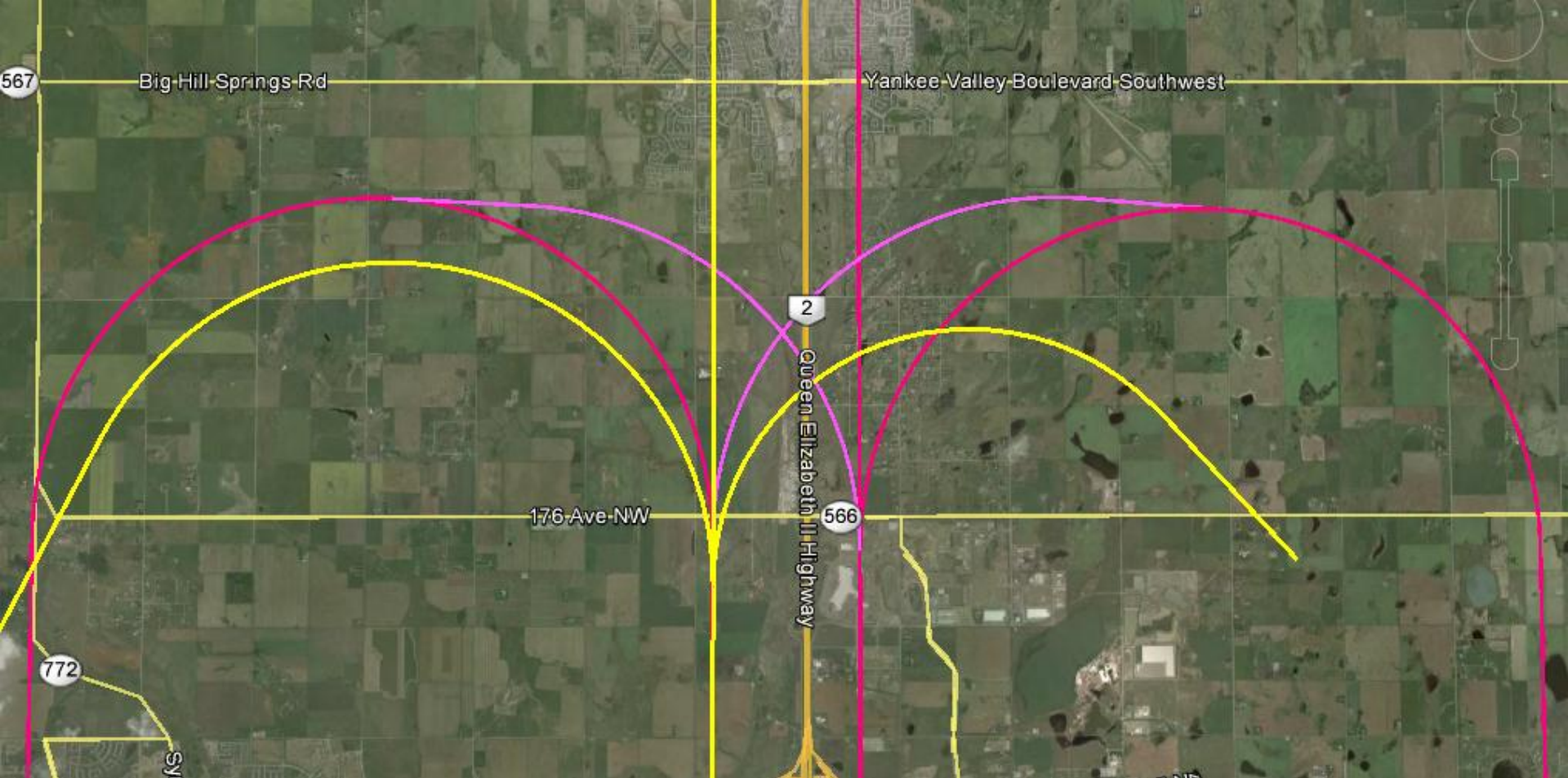
Notes and Assumptions:

- Altitude colours represent the minimum altitude that can be flown by aircraft using the STAR (RNAV)
- Flight Track Corridors capture at least 80% of all tracks
- Flight track altitudes indicate values as AARP (Above Aerodrome Reference Point). The Aerodrome Reference Point is 3606' Above Mean Sea Level



- 60dBA - Conventional Approach Contour
- 60dBA - Proposed RNP Noise Contour
- 70dBA - Conventional Approach Contour
- 70dBA - Proposed RNP Noise Contour
- 80dBA - Conventional Approach Contour
- 80dBA - Proposed RNP Noise Contour

- Contours represent a comparison of two single noise events (conventional approach vs. RNP approach)
- Both conventional and RNP approach profiles use the RNP track location
- Conventional approach profile applied to RNP track was taken from an actual track in EnvironmentalVue
- Contours represent an area likely exposed to a maximum noise level above a given threshold for a typical narrowbody jet aircraft type
- Metric used for the single event contours is the LAMAX. LAMAX is the maximum A-weighted sound pressure level recorded during a noise event



Existing WestJet RNP procedure 17R only

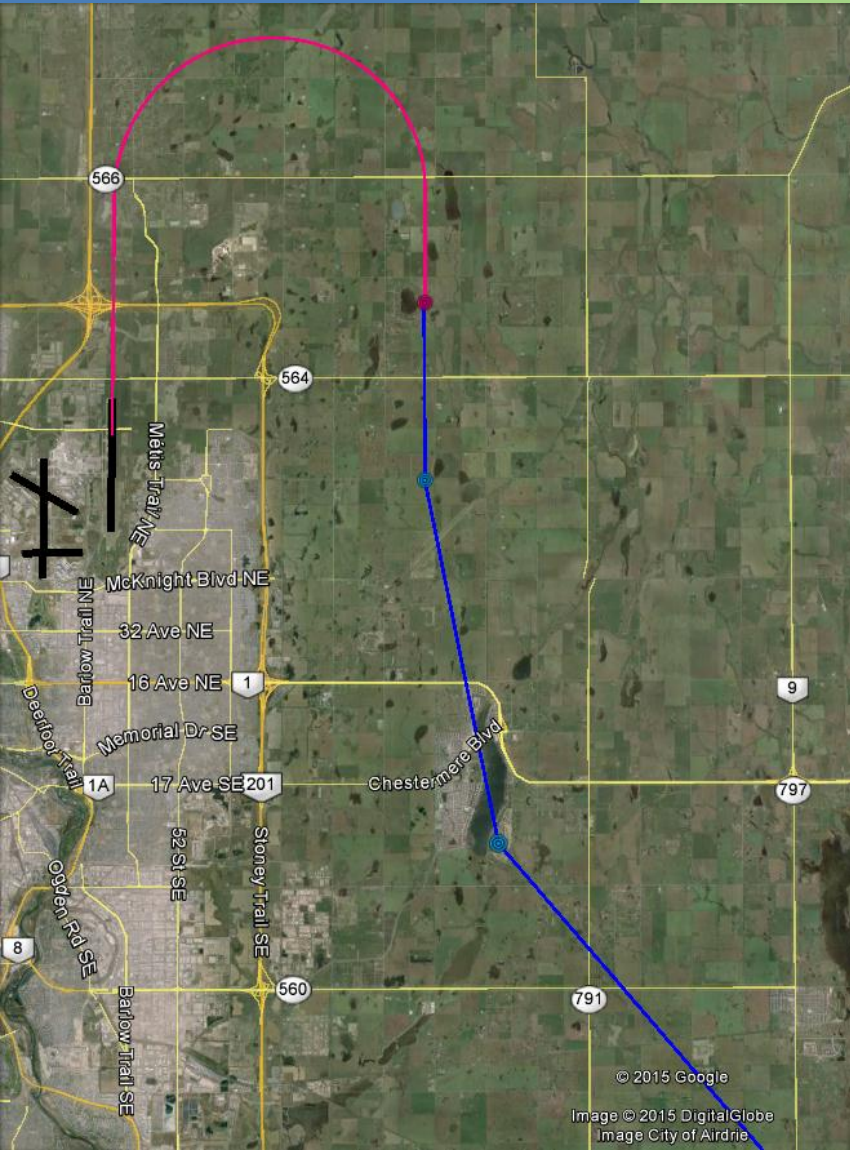
Proposed RNP procedure 17L and 17R

Crossover leg



ASSOCIATED STAR CHANGES

CHESTERMERE AREA

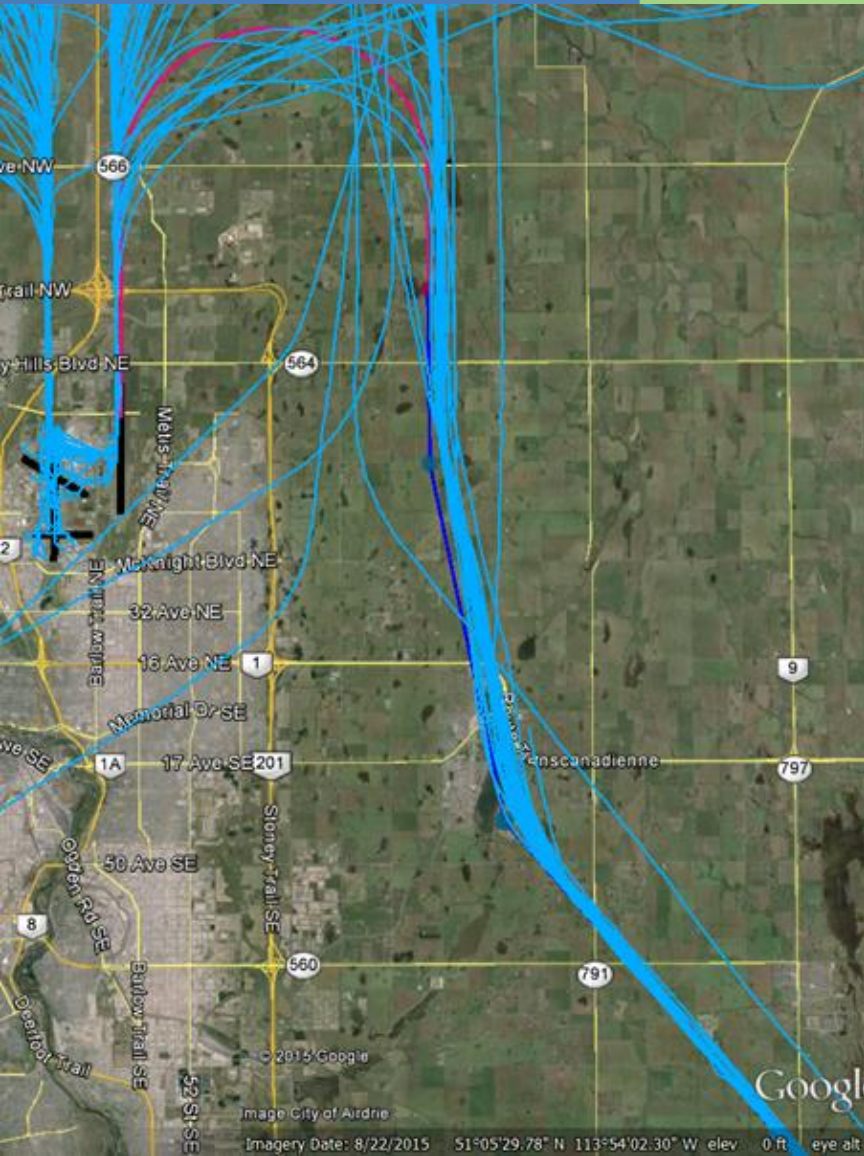


Current STAR with RNP transition

Provides insufficient “wings level” time for aircraft on RNP procedure.



ASSOCIATED STAR CHANGES CHESTERMERE AREA



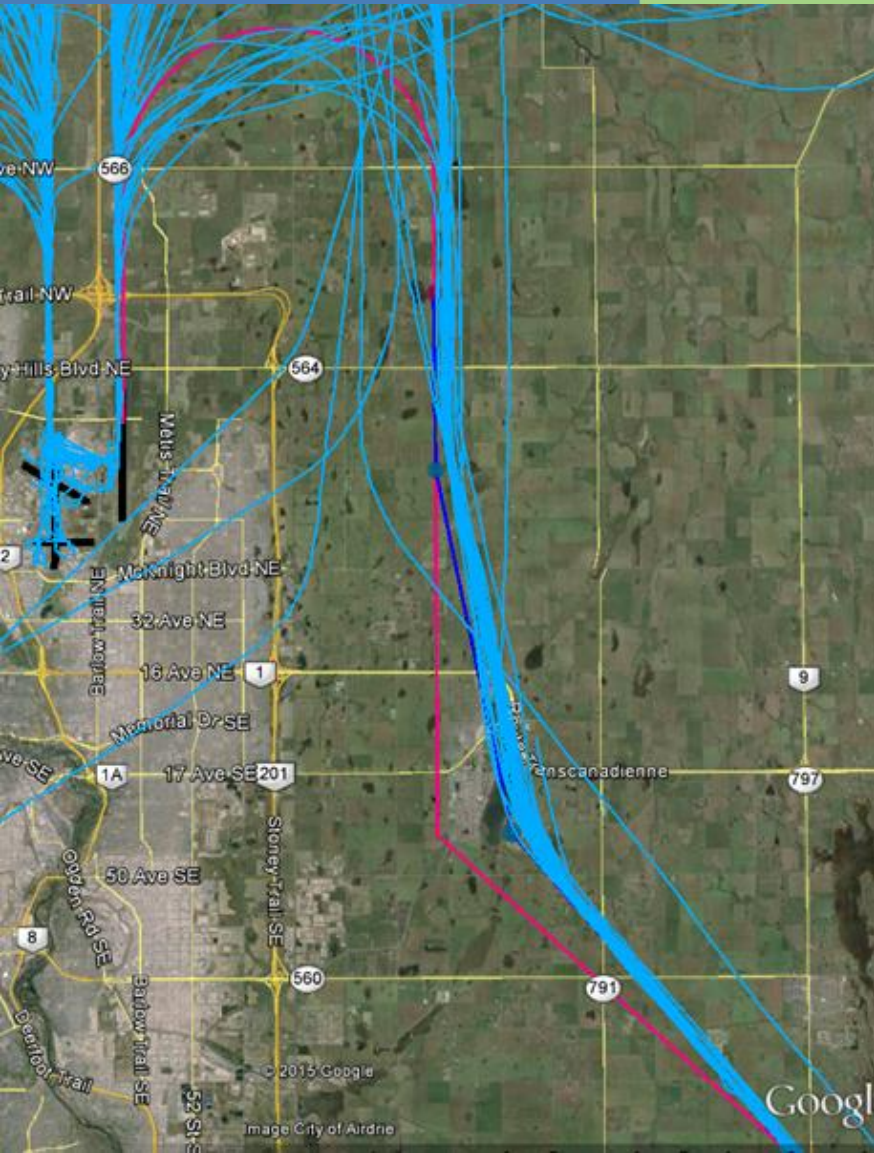
Current STAR
with **RNP transition**
with **current flight tracks**

Altitudes generally above
9,000 ft ASL over Chestermere
area



ASSOCIATED STAR CHANGES

CHESTERMERE AREA



Amended STAR
with RNP transition
with current flight tracks

Should move overflight traffic
west of the Town of
Chestermere



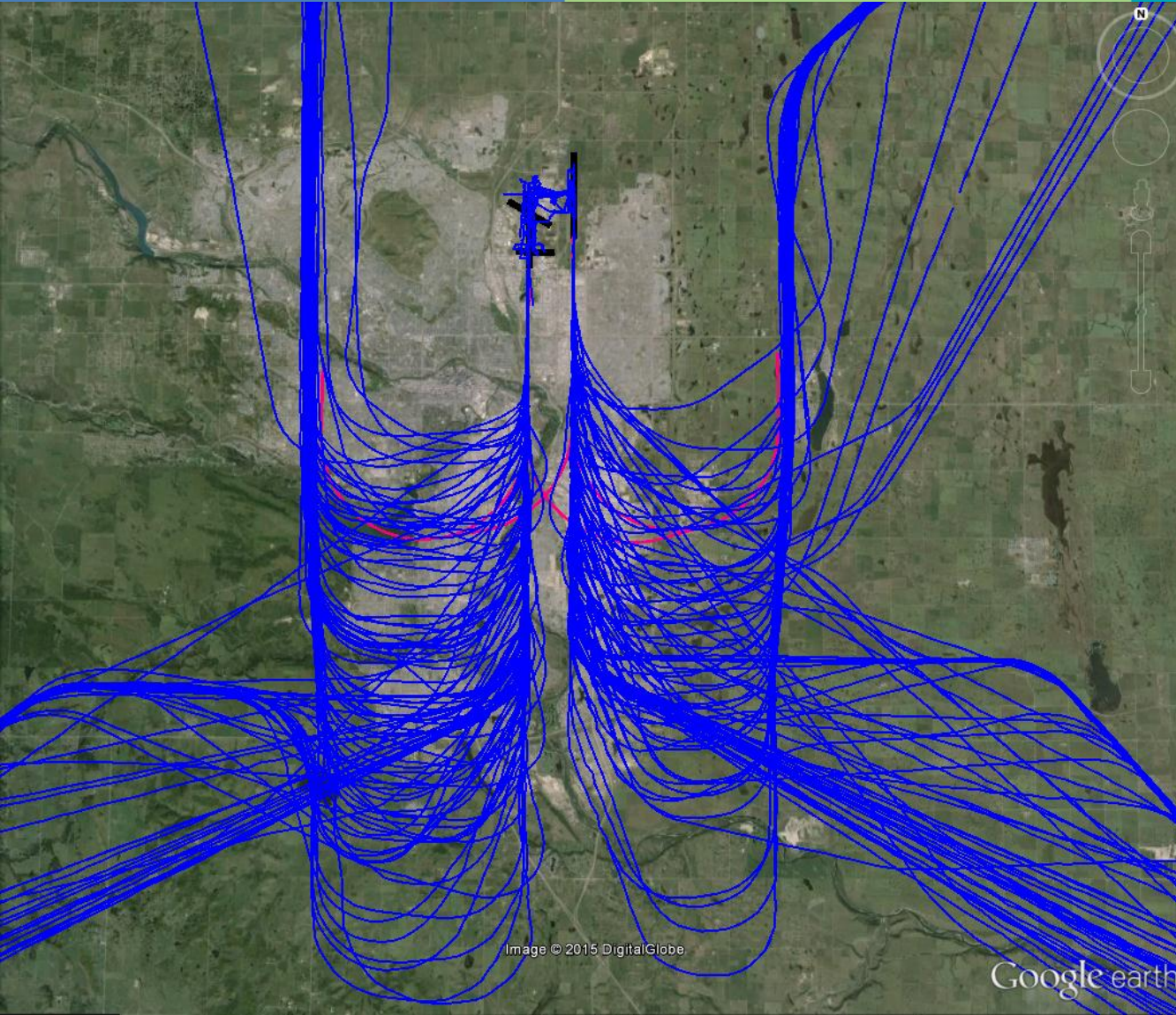
Runway 35 Arrival Operations

NAV CANADA





COMPARISON FLIGHT TRACKS TO NEW RNP

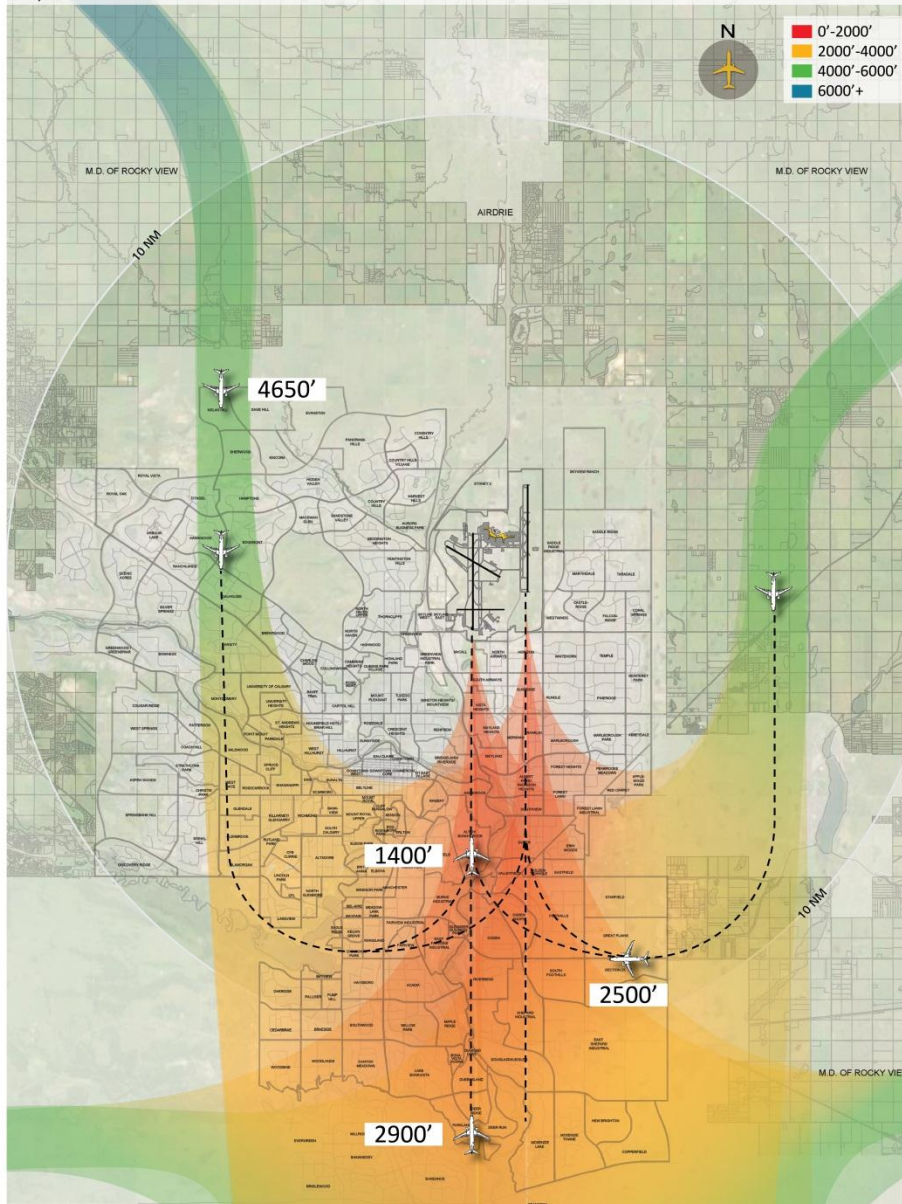


Runway 35 Operations

Arrival flight tracks
12 hours
(October 19, 2015)

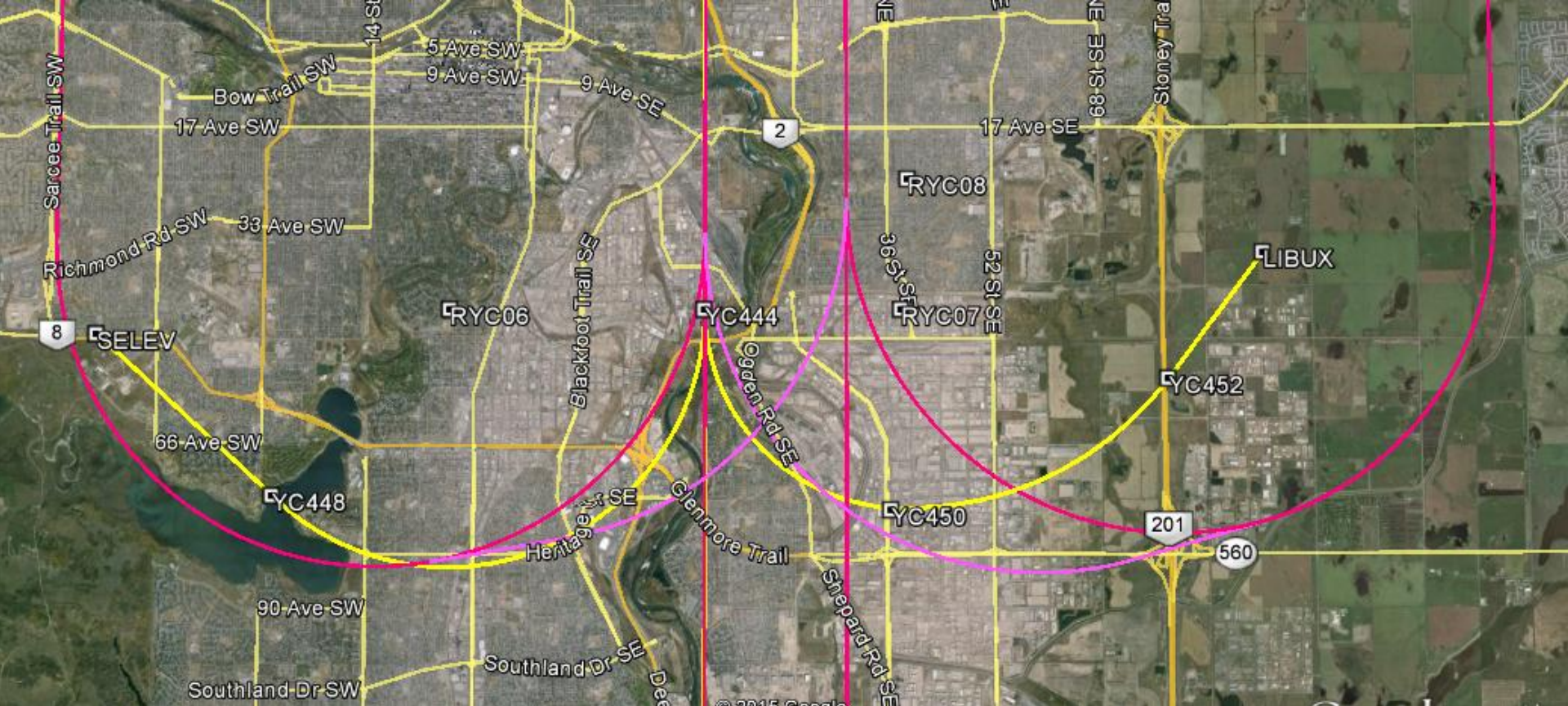
New RNP flight path

Flight Tracks - RNAV with RNP Overlay
 Arrivals Runway 35R + 35L
 City Scale



Notes and Assumptions:

- Altitude colours represent the minimum altitude that can be flown by aircraft using the STAR (RNAV)
- Flight Track Corridors capture at least 80% of all tracks
- Flight track altitudes indicate values as AARP (Above Aerodrome Reference Point). The Aerodrome Reference Point is 3606' Above Mean Sea Level



Existing WestJet RNP procedure 35L only

Proposed RNP procedure 35L and 35R

Crossover leg



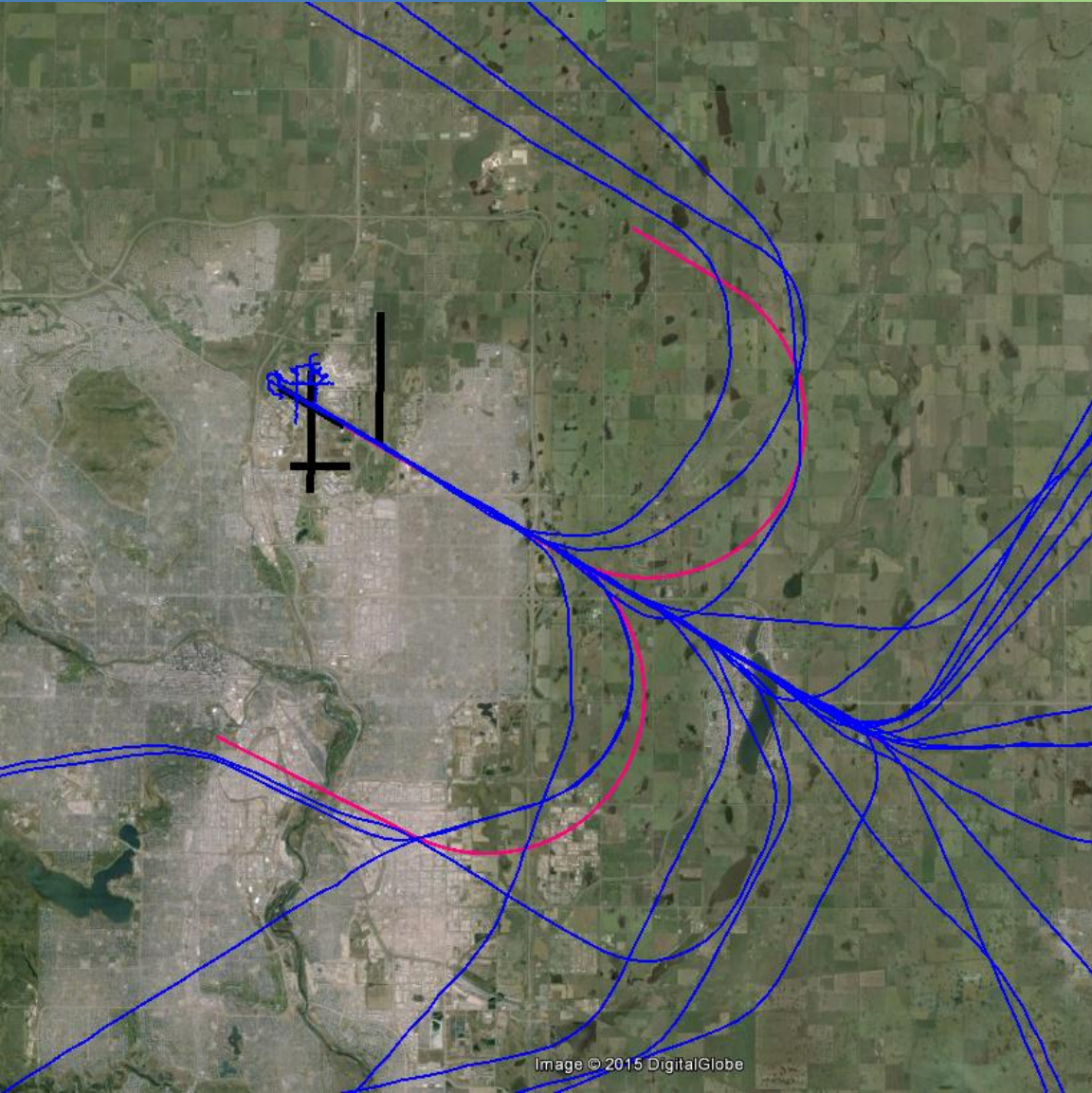
Runway 29/11 Arrival Operations

NAV CANADA





COMPARISON FLIGHT TRACKS TO NEW RNP



Runway 29 Operations*

Arrival flight tracks 12 hours
(October 8, 2015)

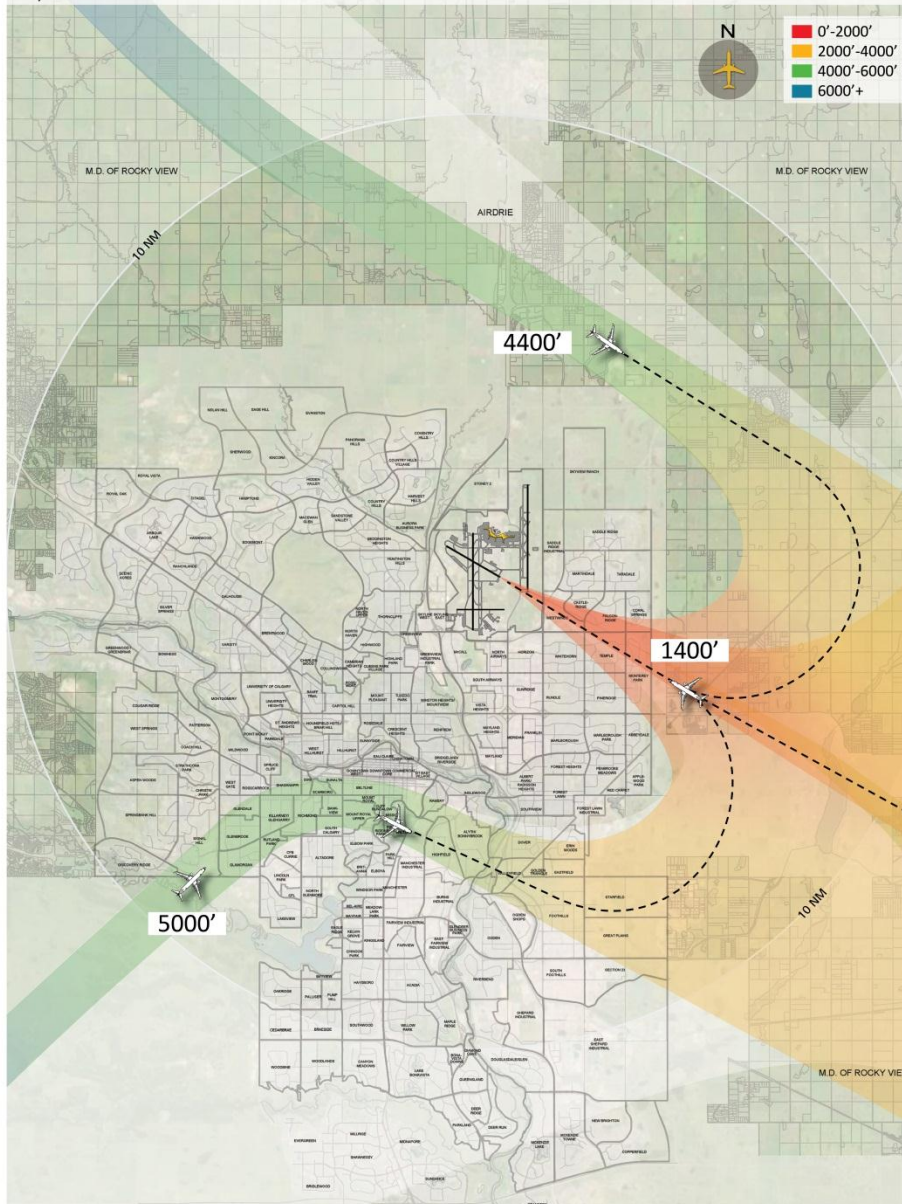
New RNP flight path

* Common overnight arrival
runway

Flight Tracks - RNAV with RNP Overlay

Arrivals Runway 29

City Scale



Notes and Assumptions:

- Altitude colours represent the minimum altitude that can be flown by aircraft using the STAR (RNAV)
- Flight Track Corridors capture at least 80% of all tracks
- Flight track altitudes indicate values as AARP (Above Aerodrome Reference Point). The Aerodrome Reference Point is 3606' Above Mean Sea Level



COMPARISON EXISTING RNP VS PROPOSED RNP



Existing WestJet RNP
procedure Runway 29

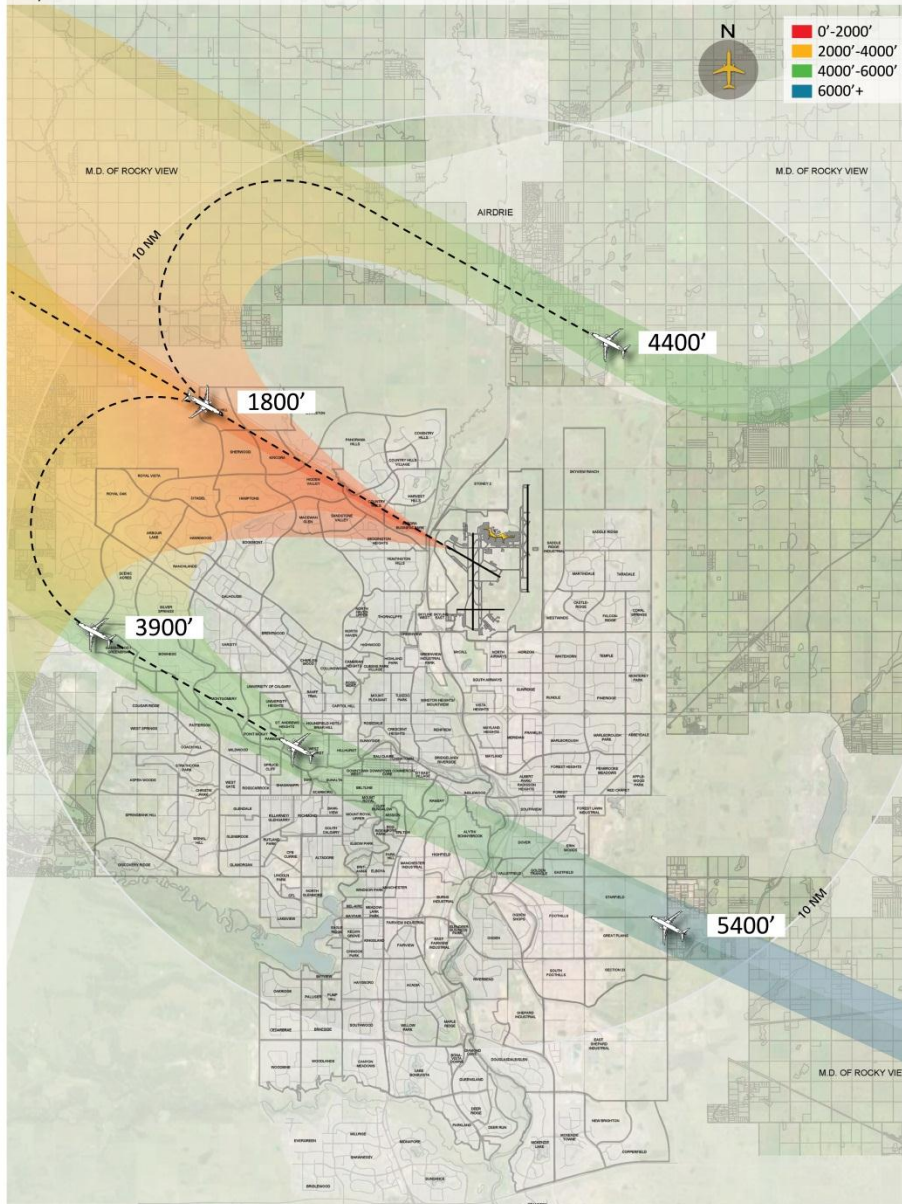
Proposed RNP
procedure Runway 29

*Common overnight
arrival runway

Flight Tracks - RNAV with RNP Overlay

Arrivals Runway 11

City Scale



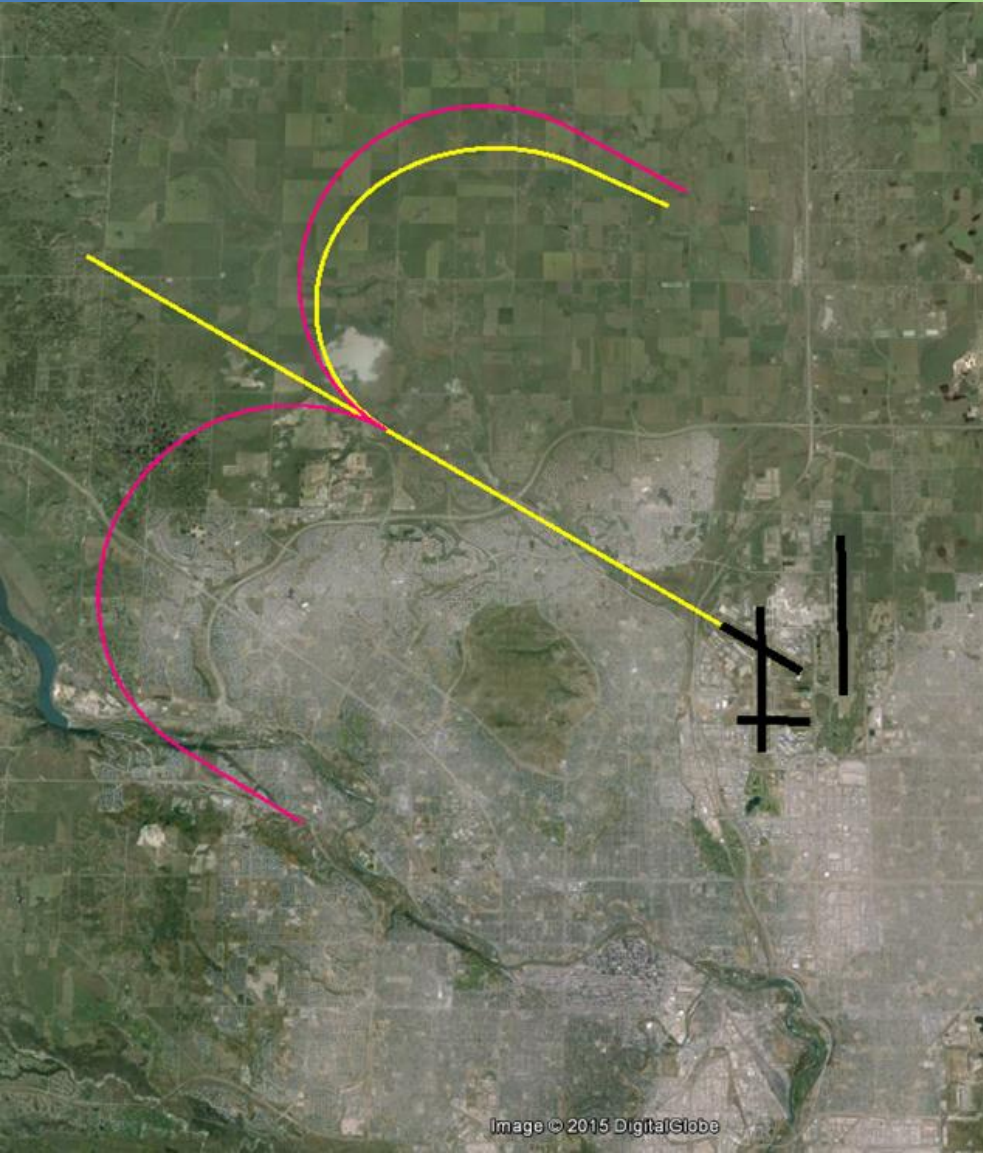
Notes and Assumptions:

- Altitude colours represent the minimum altitude that can be flown by aircraft using the STAR (RNAV)
- Flight Track Corridors capture at least 80% of all tracks
- Flight track altitudes indicate values as AARP (Above Aerodrome Reference Point). The Aerodrome Reference Point is 3606' Above Mean Sea Level



COMPARISON

EXISTING RNP VS PROPOSED RNP



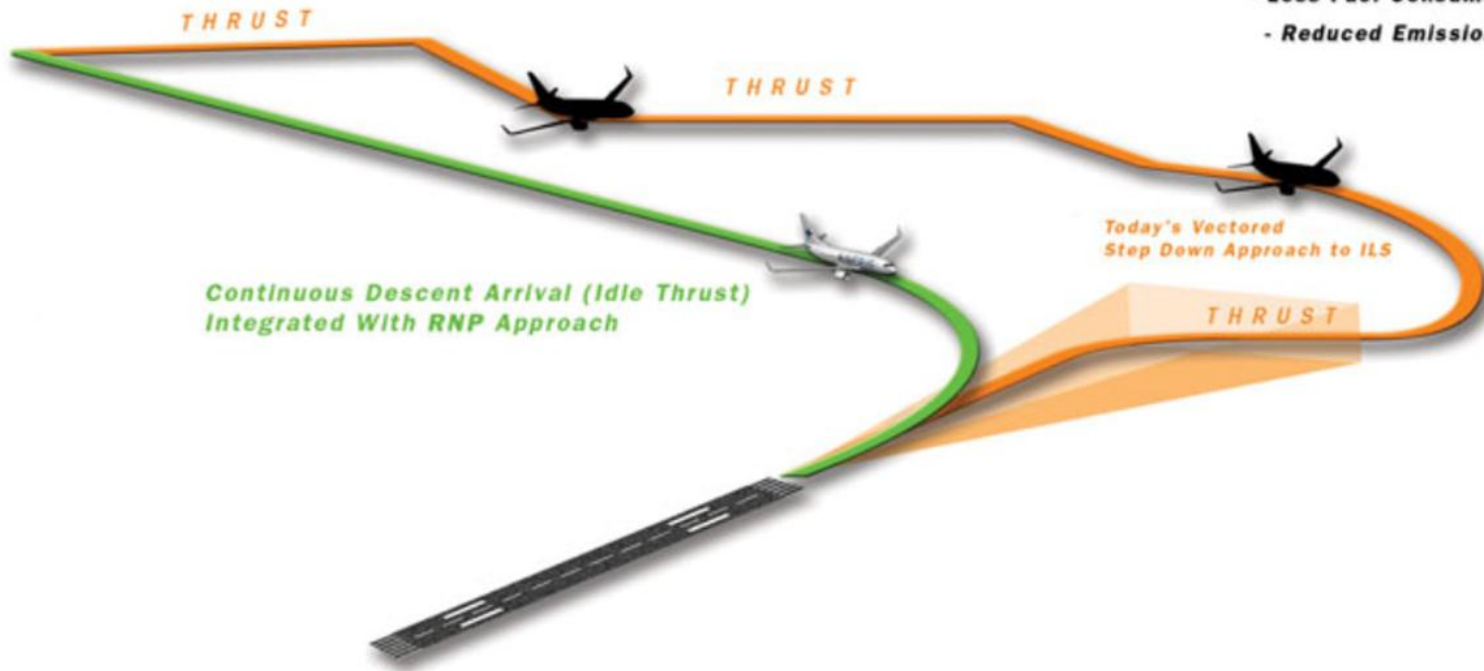
Existing WestJet RNP
procedure Runway 11

Proposed RNP
procedure Runway 11



GREEN RNP APPROACH BENEFITS

- Lower Noise
- Reduced Track Mile Distance
- Less Fuel Consumed
- Reduced Emissions



*Continuous Descent Arrival (Idle Thrust)
Integrated With RNP Approach*

*Today's Vectored
Step Down Approach to ILS*

NAV CANADA



BENEFITS OF RNP @ YYC



- Save 3-4 minutes of flying time and an average of 18-20 kms per flight



- Up to 200 liters of fuel saved per flight, depending on aircraft type



- fuel savings could exceed 2,5 million litres per year, eliminating 6,000 tonnes of greenhouse gas emissions.

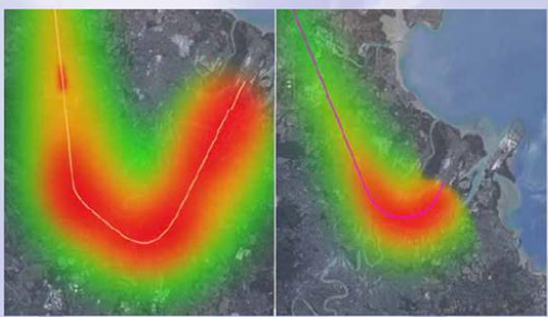


RNP ELSEWHERE

OUTCOMES IN OTHER JURISDICTIONS

Implementation of Terminal Area RNP

The Brisbane Trial – Noise Footprint



Standard ILS Approach RNP Approach



- #### Brisbane Trial
- RNP operations commenced Jan 07
 - Data collection and monitoring installed to support regulatory change
 - RNP operations limited to Qantas B737NG
 - By Oct 08 10,915 RNP AR approaches
 - 3,402 flights saving:
 - 8952 minutes (149hrs / 6 days!)
 - 39,391 track miles
 - 492,388kg of fuel
 - 1,575,640kg of CO2

Greener Skies **SEA**

See how just one satellite-based NextGen procedure – the HAWKZ arrival – is saving time, saving fuel and reducing emissions.

NextGen Precision Route

SAVES

- 73 FLIGHTS PER DAY, ARRIVALS ONLY
- :09 MINUTES SAVED PER FLIGHT
- 1.5 MILLION GALLONS SAVED ANNUALLY, VIA SOUTH FLOW
- ANNUAL CO₂ REDUCTION EQUAL TO EMISSIONS BY DRIVING FROM SEATTLE TO MIAMI AND BACK 4,800 TIMES

www.faa.gov/nextgen

NextGEN



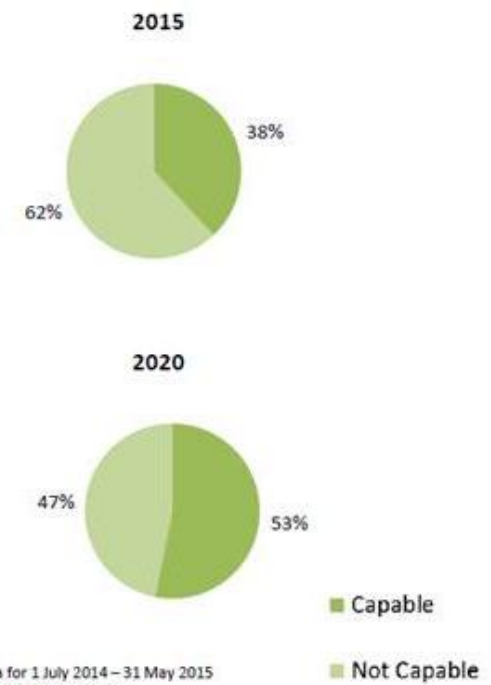
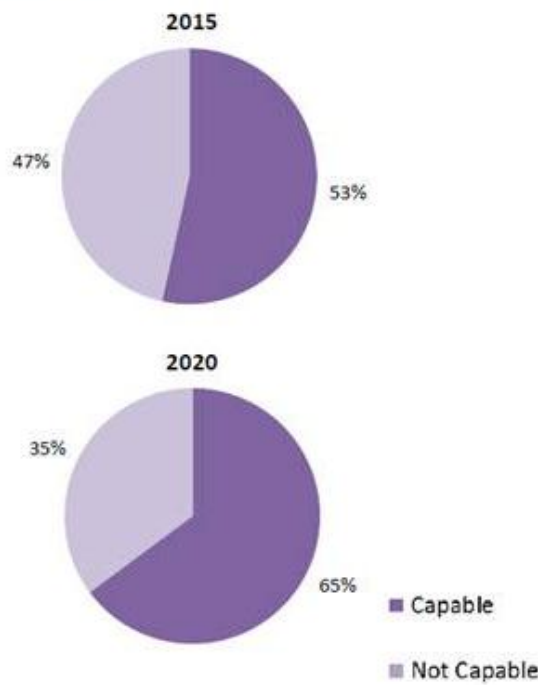
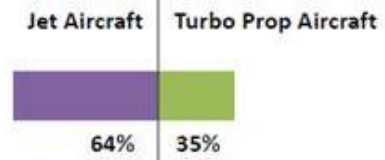
IMPACT

- New portions of RNP AR base leg occur in areas already overflown
- Aircraft will be in a “clean” configuration and in continuous descent
- Number of eligible aircraft + ATC’s ability to fit in the sequence will start small initially





DATA ANALYSIS
RNP CAPABILITY



- Sourced from data for 1 July 2014 – 31 May 2015
- Remaining 1% Piston Engine Aircraft



- Community outreach as per the Airspace Change Communication and Consultation Protocol released in June 2015
- Launching a public comment period until January 30, 2016



COMMUNITY OUTREACH

- Publishing information on the proposed procedures on yyc.com
 - this presentation
 - video
 - feedback forms
- Newspaper ads to appear shortly directing residents to website to learn more and advertising locations for community Open Houses
 - Open Houses will provide opportunity for one-on-one dialogue



COMMUNITY OPEN HOUSES

LOCATIONS AND DATES

Ambrose University
150 Ambrose Circle SW
December 2, 2015
6 p.m. – 8:30 p.m.

Airdrie Town & Country Centre
103, 275 Jensen Drive NE
December 3, 2015
6 p.m. – 8:30 p.m.

Marlborough Community Association
636 Marlborough Way NE
December 9, 2015
6 p.m. – 8:30 p.m.

Uplands Recreational Centre
20 Hawkside Close NW
January 5, 2016
6:30 p.m. – 9 p.m.

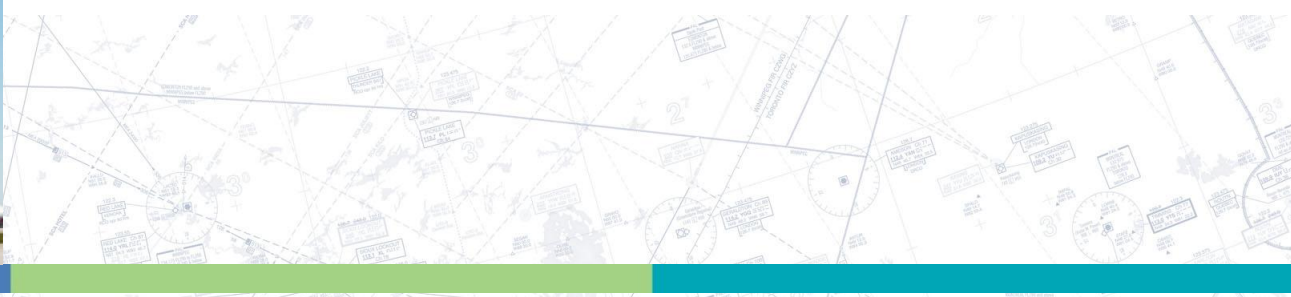
Palliser Bayview Pumphill Community Association
2323 Palliser Drive SW
January 6, 2016
6:30 p.m. – 9 p.m.

Acadia Community Association
240 - 90 Avenue SE
January 8, 2016
6 p.m. – 8:30 p.m.

Strathcona Christie Aspen Community Association
277 Strathcona Drive SW
January 13, 2016
6 p.m. – 8:30 p.m.

Millican Ogden Community Association
6901 20 A Street SE
January 19, 2016
6 p.m. – 8:30 p.m.

Residents are encouraged to provide their feedback by **January 30, 2016**.



- We will update the committee at the end of the consultation
 - What we heard
 - Next steps



Thank you