Flight Procedure Design

An overview of how Flight Procedures are designed and the factors that influence their development.

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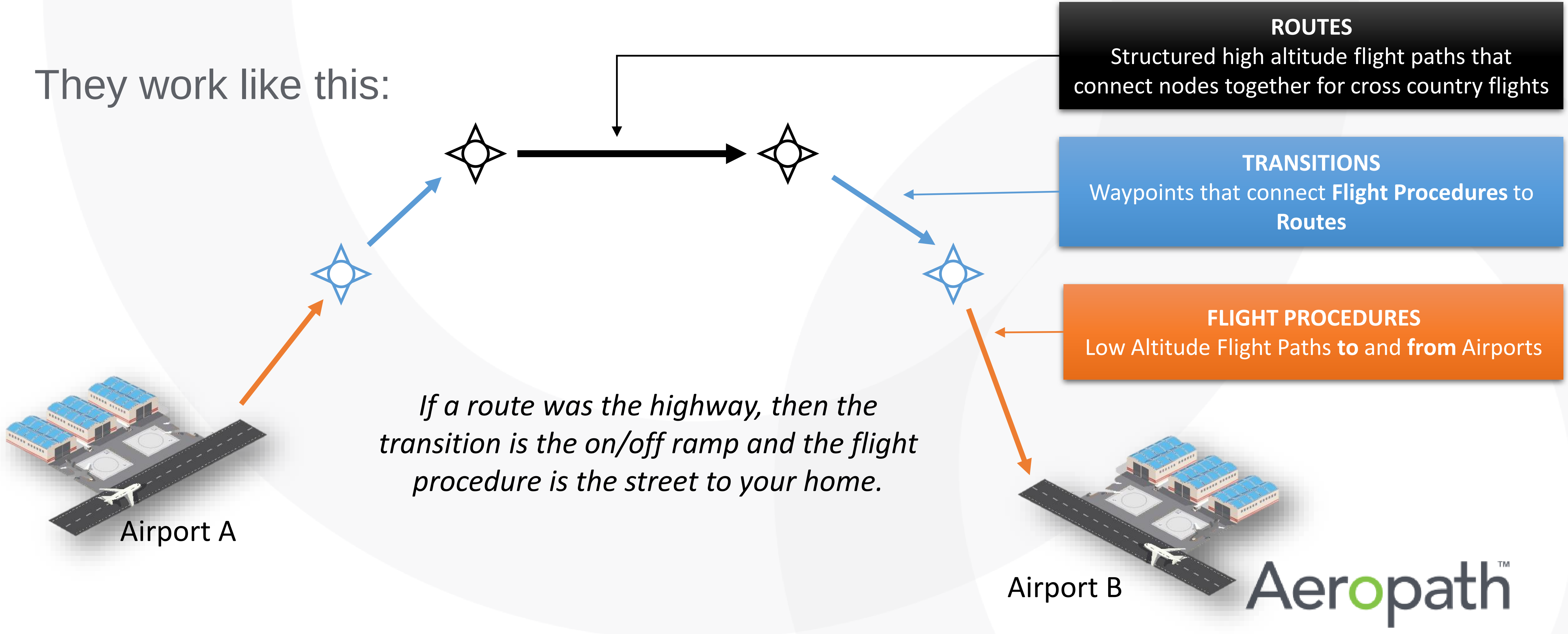
Flight Procedures: What are they?

In simple terms, “Flight Procedures” are the **flight paths** that modern aircraft follow to get from one airport to another.

They work like this:



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Flight Procedures: 3 Main Flavours

1. Visual Navigation

- The first form of navigation. Navigate literally by looking out the window. Low tech
- Still used today by all aircraft, but seldom used by commercial aircraft
- *Inefficient as it is subject to weather (cannot fly through cloud), relies on visual features on the ground to navigate, so it is not great over large bodies of water, less efficient than modern instrument navigation in terms of reduced track miles, noise and speed/throttle settings*

2. Conventional Instrument Navigation

- Aircraft navigate by referencing radio signals from Radio beacons on the ground. Impressive for its day!
- Based on 1930s technology with major updates in the 1960s. Introduced "common routes" that aircraft followed
- Overcame weather constraints, but was costly due to the large number of navigation beacons required
- Reliable, but required aircraft to fly zig zags to a destination in order to pick up signals along the way
- *Aircraft could fly part of the trip visually in good weather, thus deviating from routes and introducing noise to other areas*

3. GPS Navigation

- Introduced in the late 1980s. Uses multiple satellites to give precise locations at any point in a flight
- Enables more efficient routing as aircraft fly direct and do not need to zig zag to find radio beacons
- The predominate form of navigation for commercial aircraft today and in the future
- *Enables aircraft to fly very precise and efficient paths, managing speed and aircraft configurations. This all leads to better noise management and efficiencies*

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New Flight Procedures?

Why develop new flight procedures?

Safety

- A safer method of navigation (PBN over 25x safer than visual navigation)

Capability

- Access to aerodromes in low visibility or cloud – huge benefit to rescue services

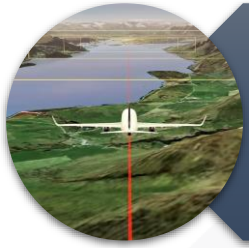
Efficiency

- Reduced track miles lead to reduced flight time, fuel burn and operating costs

Environment

- Reduced CO_2 emissions due to reduced flight time and quieter aircraft configurations

Who asks for them?



Operators

- Airlines, Rescue Helicopter operators

Airports

- Large commercial and small private

Air Traffic Control

- Airways

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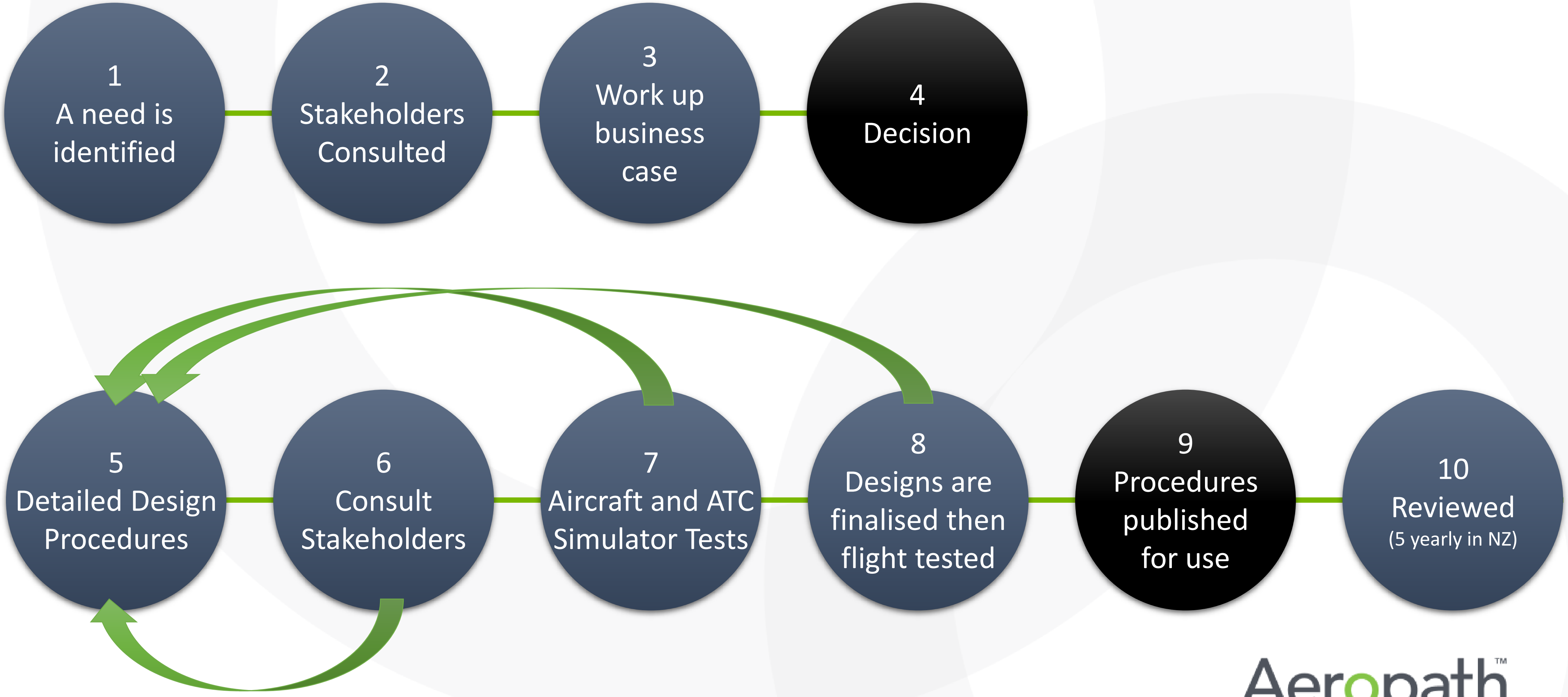
Flight Procedures: High Level Design Steps



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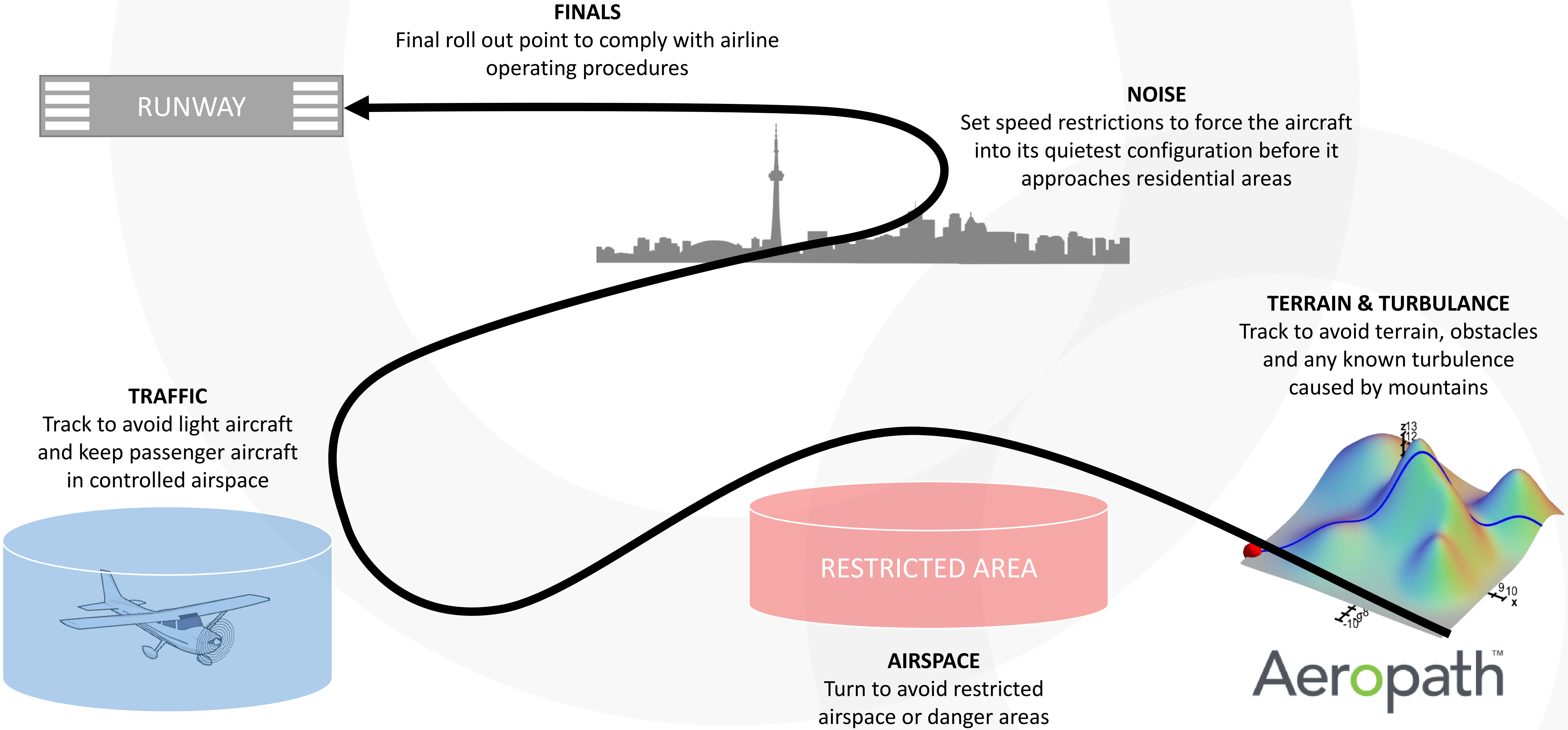
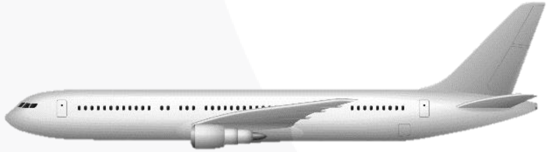
Flight Procedures: Design Considerations

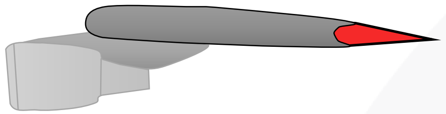


Flight Procedures: Aircraft Configurations

WING FLAPS

A
Cruise

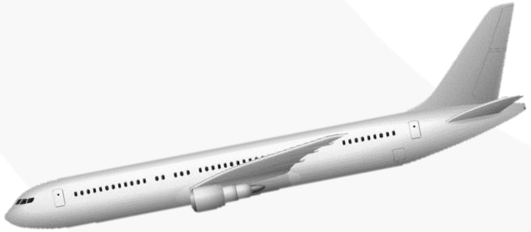


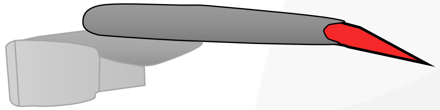


Prior to Approach
- 250kts level flight
- 60% thrust = moderate noise
- No Flaps = very little noise

Quiet above 6000 ft altitude

B
Approach

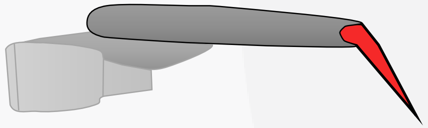




Prior to Approach
- 190kts descending
- 0% thrust = little noise
- Some Flaps = little noise

Quietest configuration

C
Landing

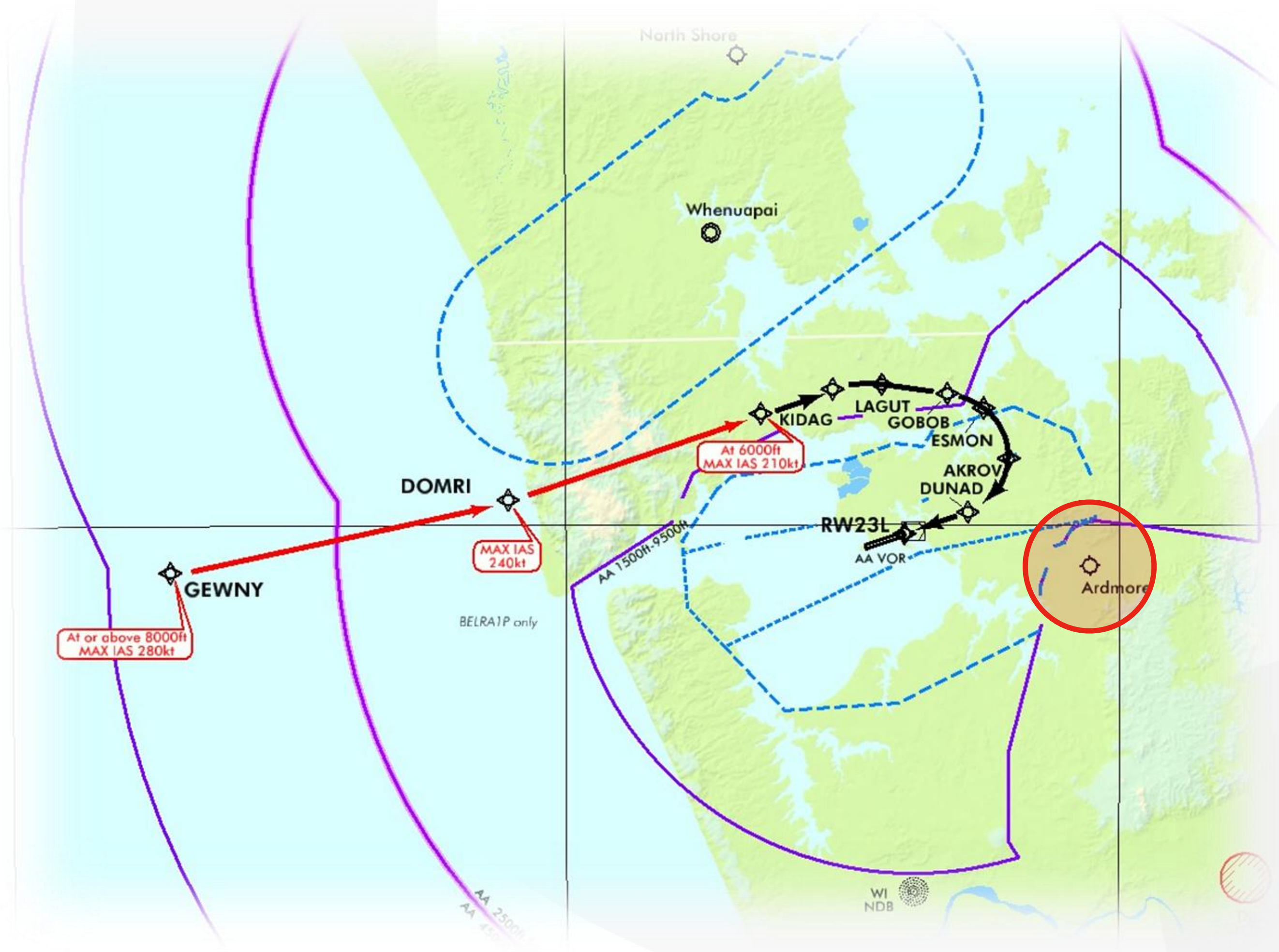


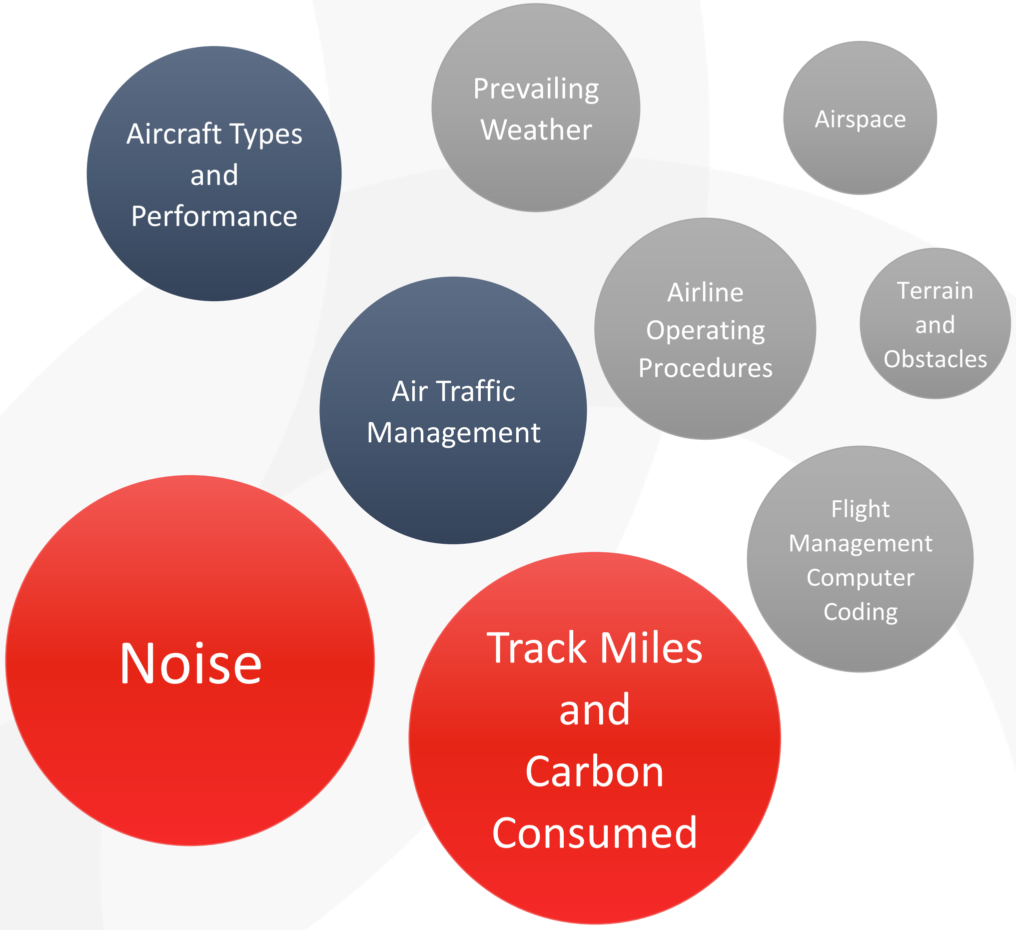
Configured for Landing
- 140kts
- 60% thrust = moderate noise
- Moderate Flaps = some noise

Noisy. Generally the last 4 miles before landing

Procedure Examples

Example: Auckland RNP-AR RWY 23L X-ray - (Flight over the city)





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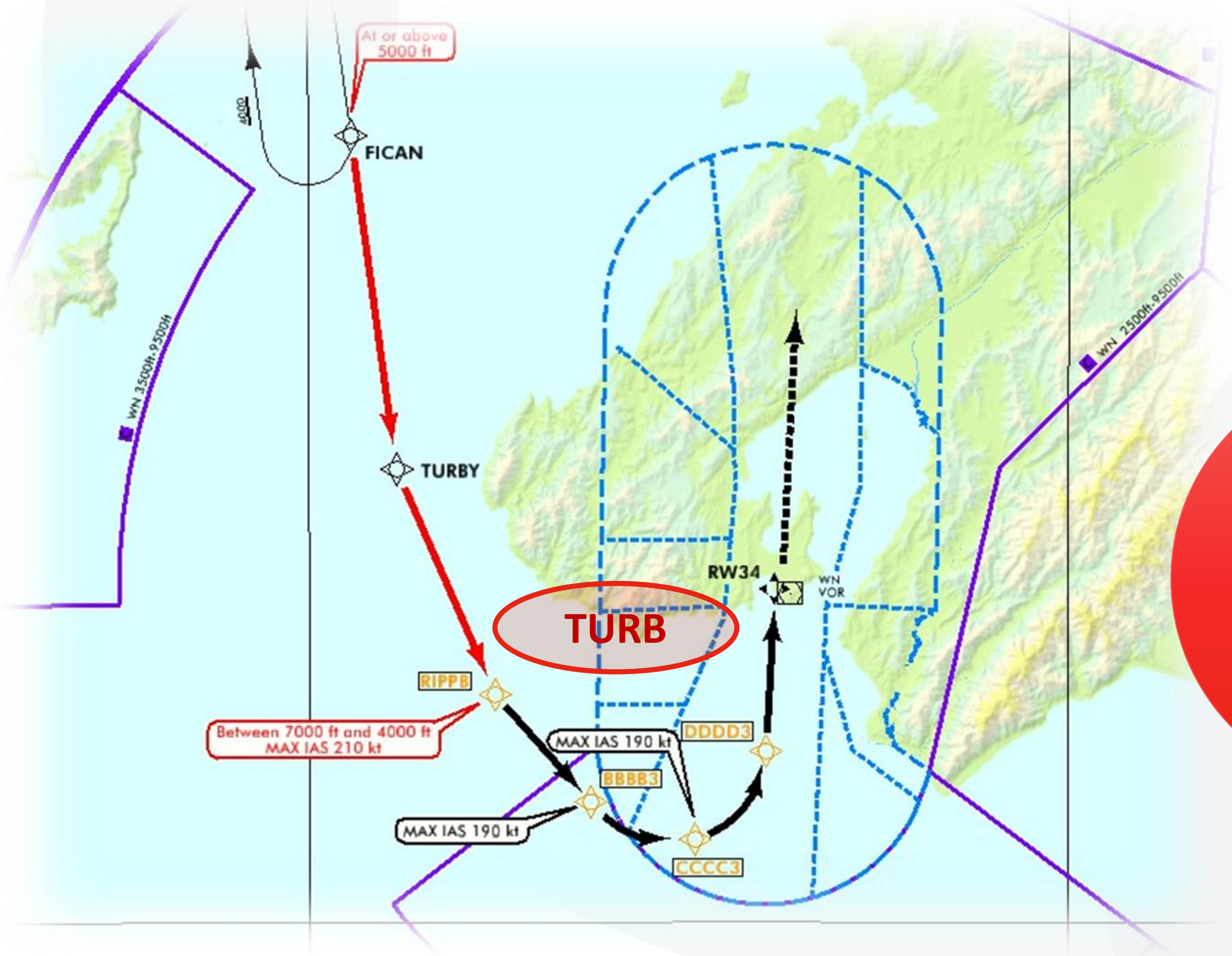
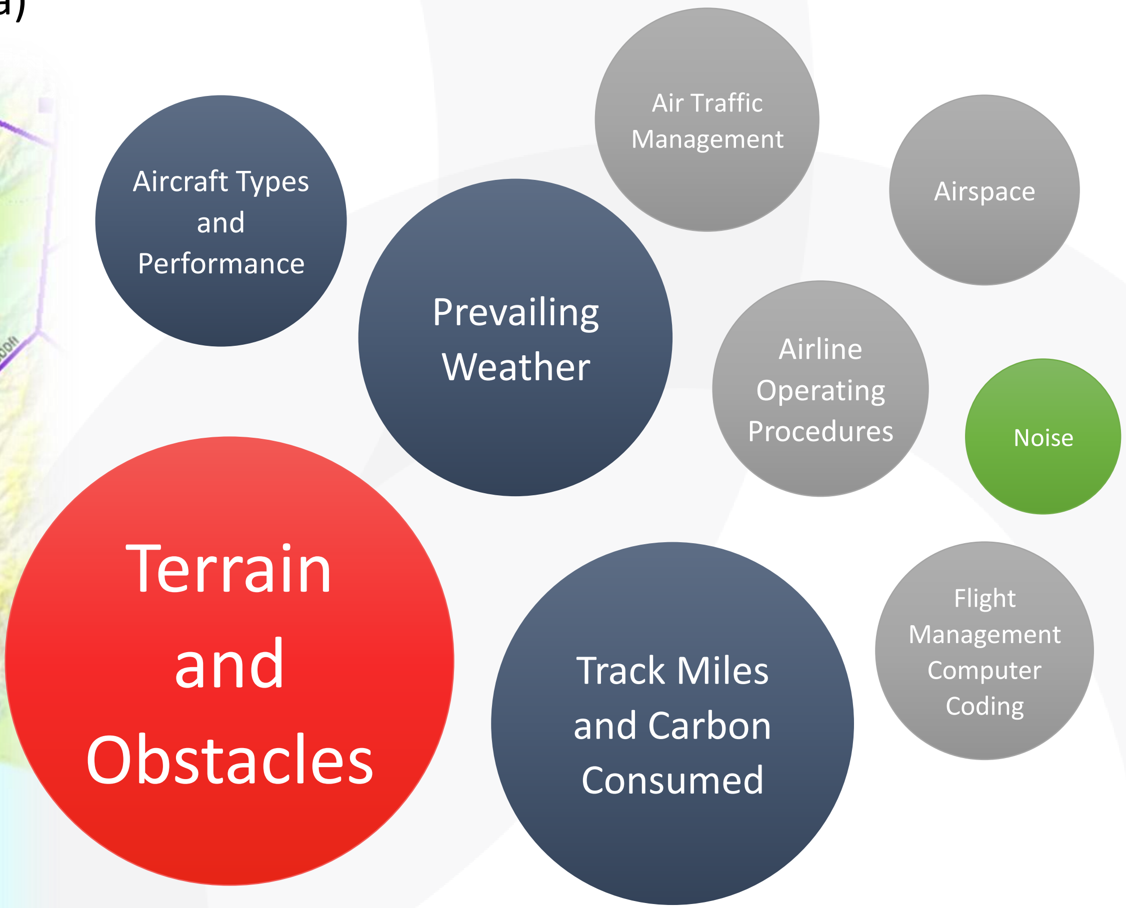
Procedure Examples

Example: Wellington RNP-AR RWY 34 X-ray (Flight over the sea)





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Auckland: a look at waypoint LOSGA

Key Considerations

- **Noise and Track miles.** Noise levels alongside reducing track miles was a primary factor in the redesign of the Auckland RNP-AR X-ray procedures. These new procedures are designed to minimise aircraft drag and are therefore faster and quieter

- **Noise.** The original RNP-AR procedures started at 4000ft at LOSGA. The re-design shifted the commencement position further back and raised the altitude to 6000ft. Noise energy has a squared relationship with distance e.g. if you double the distance, noise energy reduces by four

The Location of LOSGA

- **Use what exists.** LOSGA is a historic waypoint, having existed since 2006. LOSGA is only used by international arrivals and based on the location of the airport is the natural joining point for aircraft arriving from the north and west

- **Aircraft Configuration.** LOSGA's position was dictated by the design of the curved segments (RF legs). If the turn is too tight, the aircraft is forced into the noisy configuration of thrust against drag. The 190kt RF legs place the aircraft into a quiet configuration of flap (A320 flap 2, B737 flap 5°), and zero thrust

- **Air Traffic Control.** Additionally, LOSGA sits just beyond 5NM from the runway, so if there is a radar failure (the minimum separation between aircraft goes from 3 nautical miles to 5 nautical miles), the procedure can continue to be used, and not impact on departing aircraft

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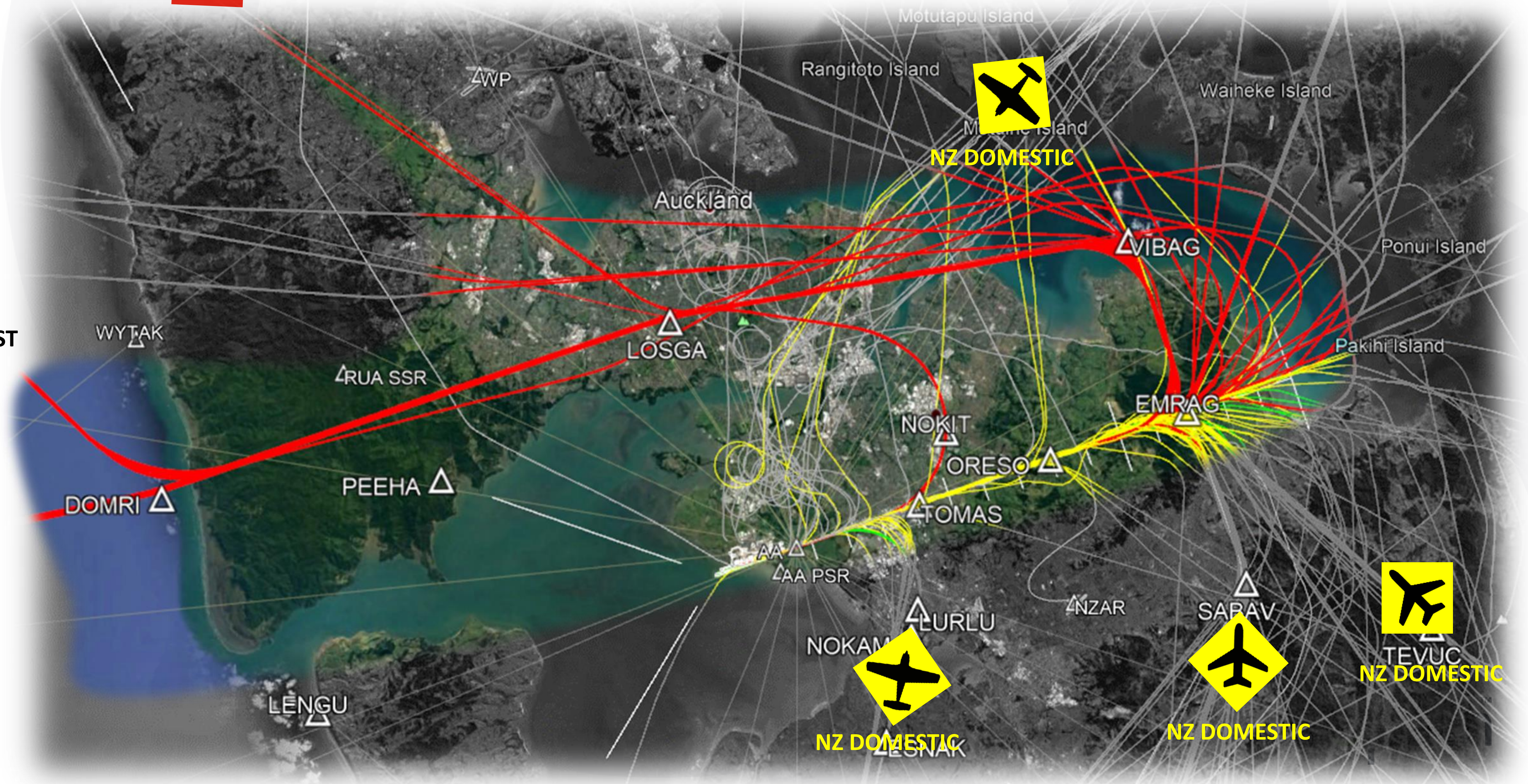
RWY 23L Arrivals



Future Enhancements

- **Noise Sharing Technology.** A feature being planned for the new Air Traffic Control system is noise sharing, whereby aircraft can be spread across different routes so that one route does not always get the nosiest aircraft flying on it

- **Quieter Aircraft.** A lot of resource is being spent on developing quieter aircraft and each generation or aircraft are getting better at managing noise generation

- **New procedures.** New Air Traffic and aircraft systems that will enable more complex routing. This may enable new routes to be introduced, which can be designed to further reduce noise over populated areas.

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