Flight Path Design
The management of Airspace in an Australian Context

What is Airspace Management?

Often referred to as our "network in the sky", Airspace Management relies on a complex, invisible infrastructure that helps a variety of airspace users - including commercial, military and general aviation - to operate safely in our skies.
So who is allowed to fly where?

In Australia, airspace is divided into different classifications that determine the rules for flying, and are either "controlled" or "uncontrolled".

Controlled airspace keeps passenger aircraft within airspace safely above obstacles and terrain, and separated from other users. To enter controlled airspace, an aircraft must first gain a clearance from an air traffic controller.

Uncontrolled airspace allows access for light aircraft to operate to and from smaller airports following visual or instrument flight rules.

Some airspace is also classified "no fly zones" enabling military or general aviation training aircraft to operate independently to civil aircraft.
Airspace Classification

As well as being broken into controlled or uncontrolled airspace, Australian airspace is further divided into different classes, where internationally agreed rules for visual flight and instrument flying apply.

Depending on how far and how high an aircraft wants to fly, it will pass through different classes of airspace, in which different rules will apply.
This high-level, en route controlled airspace is used predominantly by commercial jets and passenger jets. Only IFR flights are permitted and they require air traffic control clearance.

**Class A**

This mid-level en route controlled airspace is open to both IFR and VFR aircraft. IFR flights are required to communicate with air traffic control and must request a clearance.

**Class E**

This is the controlled airspace surrounding major airports. Both IFR and VFR flights are permitted and both require air traffic control clearance.

**Class G**

This airspace is uncontrolled. Both IFR and VFR aircraft are permitted and neither require air traffic control clearance.

**Class D**

This is the controlled airspace that surrounds general aviation and regional airports equipped with a control tower. All flights require an air traffic control clearance.
Who regulates Airspace and Flight Path Designs?
International Regulations


- ICAO Performance Based Navigation Manual (ICAO Doc 9613)
National Regulations

- Civil Aviation Safety Authority Regulation (CASR) Part 172 regulatory requirements as outlined in the Manual of Standards Part 172 and Part 173

- Environment Protection Biodiversity and Conservation Act 1999

- Air Services Act 1995
Airspace Design Requirements

There are a range of requirements Airservices needs to address when designing flight paths and airspace.
Designs Must...

Meet regulatory standards and safety requirements

Be contained inside controlled airspace

Use the latest satellite navigation technology and systems to provide predictable and reliable vertical and lateral paths

Consider separate flight paths for jets and non-jet aircraft to allow orderly flow of aircraft at different speeds on consistent and predictable paths
Designs Must...

Position the crossover of departing and arriving flight paths to ensure continuous climb and descent from and to the runway in all weather conditions, minimising engine throttle and reducing engine noise and fuel burn/C02 emissions.

Introduce Smart Tracking technology. Smart Tracking flight paths can be designed to curve around obstacles, follow existing noise corridors or allow curved flight paths over less populated areas/water where possible.

Meet Airport Approval requirements such as Master Plans and Master Development Plans.
Designs Must...

- Improve and increase surveillance through satellite network and ADS-B (Automatic Dependent Surveillance - Broadcast)
- Optimise airspace to provide enhanced services to IFR (Instrument Flight Rules) flights and improved access to VFR (Visual Flight Rules) flights
- Improve flight paths accommodating optimal climb and descent profiles of current and newer aircraft
- Balance safety requirements with minimising aircraft noise impacts on community
Flight Path Design Procedures

There are a range of technical procedures that are considered in designing and managing airspace.
Separation

Separation standards refer to the minimum distance apart that aircraft operating in controlled airspace and at airports with an operational control tower must be kept.

They include aircraft being separated vertically, laterally, in-trail or visually.

The airspace design must allow for the appropriate application of separation standards.
Terrain and Obstacle Clearance

Under the CASA Manual of Standards (MOS), aircraft operating during the initial and final stages of flight, or manoeuvring in the vicinity of an airport, are to be protected by obstacles through Obstacle Limitation Surface procedures.

This includes assessment of surrounding terrain and obstacles to provide protection to a height of up to 300 metres for take-off and landing.

If an obstacle is within the proposed flight approach or departure procedure, it would need to be withdrawn wherever possible, or procedures re-designed to ensure safe operation of aircraft.
Navigation

Airspace designs and procedures leverage the new capabilities that Performance-based Navigation (PBN) brings. PBN is area navigation that uses on-board systems based on global navigation satellite systems (GNSS), reducing reliance on ground-based navigation aids.

PBN allows pilots and air traffic control to make the best use of advances in navigation technology and brings increased predictability, safety, efficiency and environmental benefits.

PBN helps the aviation community by reducing congestion, helping to maintain reliable all weather operations, conserving fuel, protecting the environment and reducing the impact of aircraft noise.
Approach Procedures

Approach procedures are a series of pre-determined manoeuvres that take an aircraft from the beginning of the initial approach to a point from where a landing can be completed, providing protection from obstacles.

There are different categories of approach procedures:

- Precision approach and approach with vertical guidance – utilises a navigation system that provides lateral and vertical guidance
- Non-precision approach – utilises lateral guidance only

For all categories of approach the final approach path needs to be lined up with the runway and aircraft need to be stabilised before commencing final descent to landing.
Continuous Descent Approaches

Continuous Descent Approach (CDA) is an aircraft operating technique in which an arriving aircraft descends from an optimal position with minimum thrust. CDA avoids level flight to the extent possible while ensuring safety and compliance with published procedures and air traffic instruction.

The objective is to reduce aircraft noise, fuel burn and emissions by means of a continuous descent, and to intercept the approach glidepath at an appropriate altitude for the landing. Keeping aircraft as high as possible, for as long as possible, can be effective at reducing noise impact.
Missed Approach Procedures

A missed approach is a design route that has to be provided in the case that landing cannot be safely completed.

During the missed approach phase of the instrument approach procedure, the pilot is faced with the demanding task of changing the aircraft configuration, attitude and altitude. For this reason, the design of the missed approach has been kept as simple as possible and consists of three phases (initial, intermediate and final).

The missed approach path has to cater for reduced aircraft performance:
- Maximum bank angle of 15 degrees
- Tailwind of up to 10 knots (18km/hr)
- Climb gradient of 2.5% (1.43 degrees)
Wind and Runways

Each aerodrome is unique with its elevation and range of facilities, the needs for obstacle clearance, and the number and orientation of runways.

Wind speed and direction is the main factor in determining the direction of runways and how they are used at an airport. This is because aircraft need to take off and land in to the wind as much as possible.

Runway selection is monitored at all times, as weather conditions can quickly change.
Noise Abatement Procedures

Air traffic control can use Noise Abatement Procedures (NAPs), that are designed to reduce the impact of aircraft noise on the community. They include procedures for use of runways and flight paths, to reduce flights over residential areas, as well as the designation of noise abatement areas.

NAPs are implemented by air traffic control but their use is subject to weather conditions and aircraft requirements. Airline operators can have their own NAPs which relate to how they operate their aircraft.
Airspace Management Complexity

The design of Flight Paths also needs to consider other constraints and stakeholders.
Flyability

- Flight path designs must be assessed to ensure they are 'flyable' - that is that they are operationally feasible for aircraft to fly, while ensuring terrain and obstacle clearance for departures, approaches and missed approaches.

- This is considered on a case by case basis for locations as it depends on the aircraft size and type that operate into and out of the airport.
Human

- Safety considerations also extend to understanding the human performance limitations of pilots and air traffic controllers in managing their workloads.

- Flight path designs need to consider critical phases of flight to ensure that timely communication and separation can be safely achieved.
Local Conditions

- Prevailing atmospheric conditions are also a factor in airspace design, to including temperature, wind speed and direction.

- Some local conditions have an affect on how noise is experienced including wind and the level of and height of cloud cover as they can change how aircraft noise dissipates.
Stakeholders - Community

- Understand the social and environmental impact on the community
- Examine flight path designs that manage noise from aircraft arriving and departing
- Where possible, explore flight path designs that manage the effect of aircraft noise on community
Stakeholders - Airlines

- Support safe, efficient and technically advanced approach procedures including SIDs, STARs, RNP-AR using satellite technology wherever possible

- Reduce the miles flown to limit fuel burn, aircraft emissions and the length of time in the air

- Facilitate a range of procedure options for final approach to the airport

*RNP-AR (Required Navigation Performance Approach), SIDs (Standard Instrument Departures), STARs (Standard Arrival Routes)*
Stakeholders - General Aviation

- Facilitate flexible and efficient operations with surrounding aerodromes and provide equity of access

- Accommodate training aerodrome operations to the extent that is practicable

- Use increased surveillance to create more efficient airspace management

- Provide a Visual Flight Rules corridor for entry and exit where possible
Stakeholders - Airports

- Support Airports visions as per their Master Development Plans

- Receive the same level of safety and service, and use technology capability available at many other major airports

- Minimise impact on the surrounding community wherever possible