CHRISTCHURCH INTERNATIONAL AIRPORT

Air Noise Contours: Outer Control Boundary and Airport Safeguarding at Christchurch International Airport

14 June 2022

Final

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Introduction

1. Christchurch International Airport Limited (*CIAL*) is currently undertaking a review and update of the Christchurch International Airport (*CIA*) air noise contours which were last updated in 2008.

2. As part of this process Environment Canterbury (*ECan*) are peer reviewing the proposed updated contours, which were prepared by a group of independent noise and aviation experts.[1] In addition, ECan is undertaking a specific review of the basis for the Outer Control Boundary (*OCB*).

3. As will be explained in more detail in the following sections, all around the developed world, land use planning in the vicinity of airports is an essential tool to ensure compatibility with exposure from aircraft noise on arrival and departure from the runways. Land development outside the airport boundary is not prohibited, but zoning recommendations and regulations protect amenity values accordingly. For example, land in the vicinity of airports may be zoned for uses such as industrial and commercial (less sensitive to aircraft noise) more so than residential, hospitals, schools (more sensitive to high levels of exposure from aircraft noise).

4. Internationally the generic planning regime relies on a "noise-dose" response curve, correlating exposure to increased levels of aircraft noise with increased annoyance. In the New Zealand context this is described and regulated based on the New Zealand Standard NZS 6805, which defines two boundaries based on projected cumulative average daily noise exposure levels (in New Zealand based on the Ldn metric). The first boundary which relates to limiting residential and similar noise sensitive development is called the **Outer Control Boundary (*OCB*)**. The other, closer to the runways and with higher levels of noise exposure, is the **Air Noise Boundary (*ANB*)** which is also used to check airport compliance.

5. The OCB is a key tool in airport safeguarding, providing land use protection from *'incompatible land uses'*[2] around an airport, such as *'new residential, schools, hospitals or other sensitive uses'*[2]. For Christchurch Airport, the OCB is set at 50dB Ldn. We understand that the policy underpinning this is a specific focus of the OCB review by ECan.

6. The New Zealand Airport Noise Management and Land Use Planning Standard NZS 6805 provides recommendations for the *'minimum requirement needed to protect people from the adverse effect of airport noise'*[2] and defines a minimum requirement for an OCB at *'55dB Ldn'*[2].

7. It goes on to note that *'a local authority may determine that a higher level of protection is required in a particular locality'*[2] and *'This Standard shall not be used as a mechanism for downgrading existing or future noise controls designed to ensure a high standard of environmental health and amenity values'*[2].

[1] *Including representatives from Marshall Day Acoustics, Airbiz and Airways.*
[2] *NZS6805-1992 Airport Noise Management and Land Use Planning*

8. CIA's OCB at 50dB Ldn currently provides a higher level of protection for the community and airport operations than the minimum level noted in NZS 6805 of 55dB Ldn.

9. A change to the basis of the OCB from 50dB Ldn to 55dB Ldn around Christchurch Airport would effectively shift the OCB closer to the airport campus and provide opportunities for new noise sensitive uses such as residential, schools or hospitals to be exposed to levels of aircraft noise that they are currently protected from. This would downgrade existing protection to the minimum level recommended and reduce airport land-use protections or safeguards.

10. As well as exposing communities to additional aircraft noise, reduced land-use protection often results in reverse sensitivity issues that can impact the ability to operate an airport efficiently, often leading to operating restrictions at the airport and significant impacts on airport users and the communities they serve.

11. To specifically highlight this risk, this report includes an explanation of how the potential loss of existing levels of land-use protection could lead to restrictions on the airport, a reduced ability to operate the airport efficiently and negative impacts on existing operations.

12. In addition, this report examines international examples of approaches to land-use protection in the vicinity of airports and considers how, when these have not been implemented appropriately, they have resulted in constraints to airport operations.

13. This report sets out:
    1. **Airport Safeguarding Principles**
    2. **ICAO Balanced Approach to Aircraft Noise:** ICAOs recommended approach to noise management around airports.
    3. **Approaches to Land-Use Planning and Management Safeguards:** a brief survey of the variety of Land Use Controls in use internationally.
    4. **General Consequence of Inadequate Land use Protection**
    5. **CIA Importance and Potential Impacts of Relaxed Protection**
    6. **Appendix – Case Studies.**

1. Airport Safeguarding Principles

14. Safeguarding an airport and its operations is critical to protect its current and future ability to function efficiently and competitively, and to enable it to continue to serve local and national roles as essential transport infrastructure connecting communities.

15. Urban development encroachment into areas required for airport safeguarding is a "lose-lose" situation (for the airport and community it serves) and is irreversible. It is very expensive, if not impossible, to recover land for safeguarding purposes once it has been developed for urban purposes. A consistent conservative long-term approach is therefore justified and essential.

16. Inadequate protection can, and will often, lead to the creation of reverse sensitivity issues and constraints on air services operations, capacity and creation of hazards which could pose a risk to operational safety. Carefully considered and appropriate land-use planning is the most effective means to protect the airport and the community against adverse impacts. The New Zealand National Airspace Policy 2012 notes :

> *"To avoid or mitigate incompatible land uses or activities and potential obstacles or hazards that will impact, or have the potential to impact on the safe and efficient operation of aircraft, regional and district plans should have regard to applicable Civil Aviation Rules. Airport authorities and local authorities should work together in a strategic, cooperative and integrated way to ensure that planning documents (including those under the Resource Management Act) appropriately reflect the required noise contours and/or controls and approach and departure paths that take account of current and projected traffic flows.*
> ***Resource Management Act planning tools (including plan rules and designations) should as far as practicable seek to avoid the establishment of land uses or activities and potential obstacles or hazards that are incompatible with aerodrome operations or create adverse effects**."*

17. The New Zealand Airports Association (NZ Airports) is the industry association for New Zealand's airports. It represents the national network of 42 airports. In its 14 February 2020 submission on the Urban Development Bill[i] NZ Airports notes:

> *"Most airports in New Zealand rely heavily on district planning controls around airports to avoid or manage adverse effects on their operations due to incompatible (e.g. sensitive) activities locating in proximity to airports…… It is critical that the effects areas surrounding many of New Zealand's airports are well understood and maintained and their effectiveness is not undermined through inappropriate development. **The location of urban development within airports' effects areas without due consideration to the potential effects of such development on airports, and vice versa, has the potential to undermine the protections these areas provide for ongoing airport operations**."*

18. NZ Airports has adopted the Airport Master Planning Good Practice Guide February 2017[ii] which sets out good practice guidelines for development of airport master plans. This was developed in conjunction with the Australian Airports Association (AAA) and uses the Australian National Airports Safeguarding Framework to inform it. Section 3.2 - Off Airport Planning Objectives, notes that:

> *"Off-airport planning is often an area overlooked or inadequately addressed by airport Master Plans. Nevertheless this is a critical issue for the long term safeguarding of any airport and it should be addressed.*

19. It goes on to note:

> *"Outside the airport site, appropriate planning controls should be in place to protect the ongoing operation of the airport. …Local Government is not necessarily aware of the importance to the air transport network (and consequently national and regional economies) of safeguarding airports to enable them to meet current and future capacity requirements. It is therefore imperative that airports work with Local Government to provide the basis for safeguarding the ongoing capacity of the airport."*

20. Relaxation of existing airport safeguards, or insufficient safeguarding itself, can lead to 'reverse sensitivities' where effected populations lobby to restrict current or future operations at the airport.

21. Christchurch Airport, through consistent long term protection by planning authorities, has limited urban encroachment within areas that may be impacted by aircraft noise. Compared with the other primary New Zealand airports of Auckland and Wellington, there is very little conflicting land-use. The number of people within current and projected noise impacted areas in Christchurch is low when compared to these and other similar airports overseas.

22. To ensure that CIA's primary purpose as an important economic and community asset and that the amenity of the residents of Christchurch, Selwyn and Waimakariri is preserved, it is vital that long-term land use planning in the vicinity does not compromise CIA or the community. Any loosening or gap in airport safeguarding through deficiencies or relaxation of land-use controls will be irreversible. It will result in populations living in areas affected by noise from aircraft operations, or alternatively potential pressure for restrictions on airport operations and prejudice regional and national economic opportunities.

23. While there is pressure on Local Government to find areas for further development of new residential, schools, hospitals etc., the clear preference is to locate development outside of those neighbourhoods directly under flight paths. If development was permitted in those locations it would expose these sensitive populations to aircraft noise impacts.

2. ICAO Balanced Approach to Aircraft Noise

24. The United Nations agency setting international policy and regulation for civil aviation is the International Civil Aviation Organisation (*ICAO*), to which New Zealand is a signatory state. The main overarching ICAO policy on aircraft noise is the **Balanced Approach to Aircraft Noise Management**. It consists of four principal elements (pillars). The goal is to address local noise issues and identify the measures that most cost effectively achieve the maximum environmental benefit.

25. The four pillars of the balanced approach are:
    - **a.** Reduction of Noise at Source (Technology Standards);
    - **b.** Land-Use Planning and Management;
    - **c.** Noise Abatement Operational Procedures; and
    - **d.** Operating Restrictions.

26. The four pillars are summarised below with the author's added commentary indicating their relative severity on airport operations if not implemented properly:

ICAO Balanced Approach Pillar	Pillar Role and Process	Potential Significance of Impact on Airport Operations
Reduction of Noise at the Source	Technology-driven and dependant on airlines introduction of new technologies.	Low
Land-Use Planning and Management	Pro-active safeguarding of the airport and community in order to have the most significant and lasting benefits over the long term. It is important to prevent sensitive areas against the adverse impacts of aircraft noise through land use controls around the airport, despite changes in operations/growth. Compatible land-use planning and management is also a vital instrument in ensuring that the gains achieved by the reduced noise of the latest generation of aircraft are not offset by further residential development around airports [3]	Med
Noise Abatement Operating Procedures	Reactive mitigation of aircraft noise impacts through the modification of operating procedures to minimize aircraft noise over residential areas.	
Operating Restrictions	The final remedy if the other measures are not effective or not available. May include curfews, caps or other restrictions. These almost inevitably restrict capacity and airline connectivity options. Restrictions can be self-imposed or be the result of community/political pressure forcing regulatory restrictions.	High

Table 1

[3] https://www.icao.int/environmental-protection/pages/Land-use-Planning-and-Management-.aspx

27. ICAO notes that:
"it was important to consider equally all of these elements, and they agreed to the principle that operating restrictions should not be applied as a first resort, but only after consideration of the benefits to be gained from other elements in a manner that is consistent with the Balanced Approach" [4]

28. Airbiz professional experience supports the ICAO statement, as impacts on airport operations are expected to be greater when using the Noise Abatement Operational Procedures and/or Operating Restrictions pillars. Therefore, potential noise impacts on communities in the vicinity of airports should be avoided by Reduction of Noise at Source and then Land-use Planning and Management pillars, before moving to Noise Abatement Operating Procedures or Operating Restrictions to mitigate residual impacts.

29. Where the first two pillars fail to deliver adequate safeguarding and community amenity values are compromised, reverse sensitivity issues may require that the other pillars are brought into play, with resulting limitations on airport operations and efficiency.

30. To be more specific, where long-term Land-Use Planning and Management fails to limit residential or similar sensitive uses in areas of highest aircraft noise exposure, then Noise Abatement Operational Procedures will inevitably need to be investigated and implemented where feasible. Examples include preferential runway modes and rotation of flight path usage to provide respite or "share the noise".

31. The "last line of defence" relies on Operating Restrictions at an airport which can include:
    - Limits on the type of aircraft operating
    - Quotas for overall aircraft movements or for aircraft particular types, or for night movements
    - Curfews.

32. Operating Restrictions should be considered as a "last resort" as they will have the most significant impact on airport efficiency, capacity and flexibility of airlines to schedule flights to meet demand and fit in with global networks, with an economic and financial cost to various stakeholders and the travelling public.

33. The OCB regulatory framework described in the New Zealand Standard NZS 6805 fits into the Land-Use Planning and Management pillar. It can be considered as "prevention is better than cure". Currently, through appropriate use of this pillar in the OCB context, CIA has not had to resort to significant Noise Abatement Operating Procedures or Operating Restrictions. Although there are procedures in place to manage noise for cross-wind runway operations. CIAL is also required to ensure aircraft noise is complies with the noise limits set in the District Plan(s) related to the Air Noise Boundary (ANB) through and annual reporting process.

[4] Guidance on the Balanced Approach to Aircraft Noise Management, Second Edition, 2008, International Civil Aviation Organisation (ICAO)

34. Subsequent sections of this report illustrate the impacts of failing to provide adequate Land-Use Planning and Management safeguards (pillar 2) around an airport. They show how the mitigation of resulting reverse sensitivity impacts must then rely on the last two pillars, Operational Procedures to Mitigate Noise and/or Operating Restrictions, with associated negative impacts on an airport and the community and economy it serves.

35. The accepted method to develop Land-Use Planning and Management safeguards around an airport is to use noise contours, such as an Outer Control Boundary (OCB, the 55dB Ldn contour at a minimum, in New Zealand), or a Noise Exposure Forecast (ANEF 20 in Australia) to prevent noise sensitive uses such as residential developments and other sensitive-uses i.e. age-care centres, schools, hospitals, locating in areas adversely affected by aircraft noise.

36. The specific metrics used to define similar boundaries may vary around the world, but are typically based on a correlation between:

    a. a cumulative aircraft noise exposure level;
    b. the proportion of the community likely to be annoyed by the aircraft noise (noise-dose response curves); and
    c. level of annoyance (moderately or seriously affected).

37. Some provincial governments in Canada have their own land use planning instruments to manage development around an airport, such as an Airport Operational Area (AOA) and Airport Vicinity Protection Area (AVPA) for safeguarding like the OCB in New Zealand.

38. These various controls are discussed in the following section.

3. Approaches to Land-Use Planning and Management Safeguards

39. Aircraft noise related land-use safeguards, such as an OCB, are determined based on noise exposure metrics which correlate noise exposure to a self-reported level of annoyance or response from the community (moderately or seriously affected).

40. The mathematical calculation of noise exposure metrics vary but the compatible land use tables used to guide zoning are then correlated with community annoyance (at the societal rather than the individual level, based on literature or, where available, local surveys). Assumptions that determine the extent of the area within land-use planning control boundaries include:
    - Definition of a demand design day (e.g. average, 95th percentile, average of the 3 busiest months, etc).
    - Definition of a night movement (7pm-7am, 10pm-7am, 11pm-7am, etc.).
    - Definition of a night movement weighting factor (10 dB, 12 dB, etc.). Further explanation is included in Table 2 on the following page.
    - The air traffic forecast horizon (10 or 20 years, or airport/runway capacity).

41. Noise exposure contours used to limit residential and other sensitive uses such as schools, hospitals etc. in the vicinity of an airport vary in different jurisdictions – there is no universal contour or metric. However, the general principle of protecting the community from the adverse effects of aircraft noise and the airport from reverse sensitivity issues is a common goal. For example, in Australia the contour used to limit residential developments is the 20 ANEF and in Canada the 30 NEF is used.

42. Other noise metrics are used around the world for transparent communication with the community, and complement cumulative noise exposure contours which are generally adopted to support land-use planning compatibility tables. Other metrics include single event noise contours (SEL, LAmax) which have been used to research sleep disturbance, and 'number-above' (e.g. N70) contours to reflect the annoyance that may be associated with the number of perceptible noise events rather than the cumulative noise level of those events. This is now becoming more generally accepted to inform individuals in environmental studies (including evaluation of flight path changes) as they experience noise, rather than the more technically complex, community aggregated response, which guide land use policy decisions.

43. Whatever the metric used, noise does not stop at the contour boundary. There will still be significant numbers of individuals who will consider themselves annoyed, even at lower levels of noise exposure. Other acoustic and non-acoustic factors will influence how an individual will react to aircraft noise from individual and multiple events, during the day and at night.

44. Some airports have developed land-use planning controls based on a composite (i.e. worst case) of multiple operational scenarios and a combination of metrics (daytime cumulative, night-time cumulative etc.) to ensure future growth of airport operations is accounted for.

Examples of this are Melbourne and Perth which are protecting for future enhancements such as new or extended runways.

45. In New Zealand, as described in NZS6805-1992, the OCB is based on:
    - Average demand of the 3 consecutive busiest months ("or other such period as agreed between the operator and the local authority");
    - Ldn metric using night weighting factor of 10 dB for movements between 11pm and 7am; and
    - Composite of Ldn contours with a SEL single-event contour for the infrequent use of a critical aircraft or pattern, especially at night.

46. A comparison of New Zealand's OCB to other residential land-use controls around the world is provided below.

Metric	**Region/Airport**				
	NZ	**AUS**	**CAD**	**VIE**	**AMS**
Control boundary for residential development	OCB (55dB, Ldn)	20 ANEF	30 NEF	54 dB(A) Lday 45 dB(A) Lnight	48 dB(A) Lden 40 dB(A) Lnight
Demand Day	Average demand of the 3 consecutive busiest months	Average Day	95th percentile day for the year	Average Day based on busiest 6 months	Average Day based on cumulative annual traffic
Night Movement	11pm to 7am	7pm to 7am	10pm to 7am	10pm to 6am[5]	7pm to 11 pm (Evening) 11pm to 7 am (Night)
Night Movement weighting	10 dB	x4, or 6 dB	X16.7, or 12.2 dB	n/a	5 dB – evening 10 dB - night
Other Factors	SEL single-event contour for the infrequent use of a critical aircraft		Use of Composite contours	N65 contours	Cap based on number of people living within contours

Table 2

47. The commonality across all metrics in Table 2 is that they all use an equal energy/cumulative type metric averaged over a period (busy day, average day etc.), with a night weighting to account for increased sensitivity at night and sleep disturbance.

[5] https://www.dialogforum.at/jart/prj3/df/uploads/data-uploads/Publikationen/ergebnisse_eng_lo.pdf

4. General Consequences of Inadequate Land Use Protection

48. Prudent land use planning in Christchurch has achieved a level of safeguarding of community amenity that would be the envy of other similar urban and lifestyle communities. It has also safeguarded future operations of Christchurch Airport for the benefit of the community that it serves. Throughout New Zealand the OCB is generally at the 55 Ldn, as also mentioned in the New Zealand standard[6] (1.1.4). The Standard does allow for greater levels of protection, but this only seems to have been achieved at Christchurch. Internationally the equivalents of the OCB are at levels higher than Ldn 50 equivalent. This does not mean that in these jurisdictions a higher level of protection of community amenity would not be desirable.

49. Literature reviews of noise-dose response research and surveys show that there are still significant proportions of a population near airport flight paths that consider themselves high or moderately annoyed at exposure levels below 55 Ldn. This is discussed in the Marshall Day Acoustics '*Christchurch International Airport Land Use Planning*' report dated 23 May 2022.

50. Generally, with increased affluence and environmental awareness at the societal level, communities continue to increase their amenity expectations even if land use controls have not or cannot be implemented post-facto at lower levels, or where this cannot be achieved due to political pressure for expansion of urban areas around growing cities.

51. The case studies demonstrate that, whatever the actual metric selected and the position of a noise contour for planning purposes, there are linkages between urban encroachment and pressures to mitigate actual or perceived, current or future aircraft noise impacts through operational restrictions.

52. No cases were found where regulatory authorities relax protection in terms of an OCB equivalent level. Shrinkage of contours does occur due to periodic update of modelling of noise boundaries due to introduction of quieter aircraft (Brisbane) or flight paths (Calgary), but subsequent urban encroachment has clearly shown increased pressure for airport operational restrictions.

53. Inadequate land use protection in the vicinity of an airport, or the relaxation of existing controls, enables noise sensitive uses and urban development/intensification to encroach under flight paths, with associated reverse sensitivity risks to the airport.

54. To illustrate this risk, we have reviewed several international airports below where land use controls have proved ineffective and identified the consequences. Full case studies are included in the Appendix, and summaries of the case studies are discussed throughout the section below where relevant.

[6] NZS 6805-1992 Airport Noise Management and Land Use Planning

55. At Melbourne Airport, the late introduction of appropriate safeguards allowed urban encroachment around what was originally developed as a new "greenfield" airport. This encroachment has resulted in pressures for operational restrictions. This is outlined in Case Study 1 below.

CASE STUDY 1 SUMMARY: MELBOURNE AIRPORT

Airport Introduction and Context

Melbourne Airport is Australia's second largest airport, serving approximately 37 million annual passengers before the COVID-19 pandemic. The location was selected due to its proximity to the city, whilst still being far enough away from urban development to allow the airport to operate unconstrained.

When the airport was designed and built (1970), noise buffer zones were established in the surrounding area and along proposed flight paths. However, special protective land-use controls on the areas surrounding the airport weren't introduced until 1992 (in the form of the Melbourne Airport Environs Area), by which time significant urban encroachment had occurred through rezoning and development of land in the buffer zones. [7]

Constraint Imposed

Urban encroachment on Melbourne Airport has become a major factor in shaping and defining the proposed plans for a 3rd runway and its flight tracks. To mitigate noise impacts, Melbourne Airport are having to propose a range of operating controls (operating in segregated modes, SODPROPS (simultaneous opposite direction parallel runway operations) etc.), all limiting airport capacity. Despite these compromises, the airport still faces calls for a curfew from residents living far outside the current equivalent of an Outer Control Boundary. [8]

Key Findings

- Long-term safeguarding through land use controls needs to be in place early and consistently protected. The control buffers must be conservative enough to minimise noise impacts of unforeseen changes outside of the airport and community's control.
- Once controls are relaxed, development will occur and urban encroachment cannot be reversed.
- As a result of tardy implementation of regulated buffers against urban encroachment, the airport now faces calls for a curfew from residents in the vicinity of the airport and its arrival and departure flight paths.

[7] Michael Buxton & Arun Chandu (2016) When growth collides: conflict between urban and airport growth in Melbourne, Australia, Australian Planner, 53:4, 310-320, DOI: 10.1080/07293682.2016.1275718

[8] https://brimbanknorthwest.starweekly.com.au/news/runway-concerns-mount/

56. Calgary Airport provides an example where effective and conservative land-use planning controls enabled flexibility for necessary changes to airport operations associated with a new runway and limited the impacts of reverse sensitivities.

CASE STUDY 2 SUMMARY: Calgary Airport

Airport Introduction and Context

Calgary Airport is the 4th busiest airport in Canada with 18 million passengers in 2019. It was planned as a multiple runway system with a parallel runway commissioned in 2014. The airport is located 19km from downtown Calgary. In 1979 the Alberta provincial government enacted the Airport Vicinity Protection Area (AVPA) regulation to govern development close to the airport. Noise Exposure Forecast (NEF) contours were used to define the AVPA and protect for a future parallel runway which was finally commissioned 35 years later. Because the AVPA was enacted before significant urban encroachment occurred, the airport had appropriate long term protection in place to enable such a significant development and operational change.

Constraint Imposed

Despite this, in 2014, the commissioning of the new parallel runway triggered a negative response in the community. Detailed airspace design for the runway led to the implementation of flight tracks that weren't considered in modelling assumptions that formed the basis of the earlier AVPA.

Provisions for parallel operations were published in 1995, followed in 2004 by the first edition of the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR), including the need for 15 degrees divergence in circumstances when it is intended to use two instrument departure procedures from parallel runways simultaneously.

Hence, when the need to construct the parallel runway and finalise operational flight paths for the Calgary Airport arose, detailed flight path design rules based on operational safety were already in place and differed to those in the early AVPA assumptions. Communities under the new flight tracks were exposed to aircraft noise and flight tracks had to be altered (to 10 degrees rather than 15) to mitigate impacts and alleviate concerns. Because the NEF contours were implemented conservatively and to protect a future parallel runway, the airport retained flexibility when implementing the new runway. Without pro-active land-use controls, such a solution would not have been possible and more constraining operating restrictions may have been required.

Key Finding

Land-use protection based on conservative assumptions (e.g. protection of existing and future airfield layout) around the airport provided a degree of flexibility for changes to future operational assumptions and led to the adjustment of operations on the new runway and subsequent AVPA review reflecting a new airport operational outcome (parallel runway operations). The airport did not need to move to operating restrictions, in part, due to adequate land use safeguarding.

57. Brisbane Airport, with a long-term vision for a new parallel runway, prior to its development adjusted airport master planning to reduce the impact of future aircraft noise impacts on the community by increasing already substantial buffer zones. Even with this, since the development and operational commissioning of the new parallel runway and associated flight path changes, adverse community reaction has led to a trial of 3 three noise-reducing initiatives, two of which could reduce the long-term runway capacity. It could negate any gains from the substantial investment in the new parallel runway at substantial financial and economic cost to the region.

CASE STUDY 3: Brisbane Airport

Airport Introduction and Context

Like Melbourne, Brisbane was built as a greenfield airport in 1988 with a main and cross-wind runway, and an Airport Master Plan with associated reservation and protections for a future parallel runway when required. It's Australia's 3rd busiest airport, handling approximately 24 million passengers in 2019. The airport is located 13km from the CBD.
Over the years since its opening, the equivalent of the Outer Control Boundary for Brisbane Airport (the ANEF 20 within which new residential development is only conditionally acceptable (requires noise insulation) has significantly shrunk due to changes in technology (largely between 1983 and 1998) reducing noise of aircraft at the source, despite annual movements increasing.

Constraint Imposed

During the years leading up to the runway opening, including meeting requirements for regulatory approvals processes, Brisbane Airport undertook extensive community consultation on the expected noise impacts from the new runway and associated flight path changes in the vicinity of the airport. A number of noise abatement procedures were implemented, including a preference for operations over the bay when safe, and recommended flap settings to reduce airframe noise. However, despite these mitigation efforts and extensive community consultation, Brisbane Airport is now facing substantial political pressure from residents groups for operational restrictions to be imposed due to noise since the runway opened in 2020.

Despite the airport responding to community concern with additional noise mitigation initiatives, in February 2022 the Green party announced their plan to introduce a new bill to the Australian parliament to impose a curfew from 10pm to 6am and hourly flight caps of 45 movements per hour on the airport.[9] If this bill passes, it will have a very serious impact on the capacity of the airport, effectively rendering the development of the new parallel runway of no value since the airport was operating at around 50 movements per hour before its opening.

Key Findings

- Noise contours shrunk over the years due to changes in technology, allowing some urban development towards the airport.
- Brisbane Airport undertook a number of mitigative measures to reduce the impact of noise on the community including increasing an already substantial buffer zone, shifting the location of the new runway further from residents and implementing several noise abatements procedures.
- Even with a substantial buffer zone community reaction has led to a trial of three noise-reducing initiatives, two of which could significantly reduce runway capacity.
- Despite responsive actions to address community concerns, community lobby groups and political parties are still pushing for a curfew and hourly movement caps.

[9] https://australianaviation.com.au/2022/02/greens-push-to-introduce-brisbane-airport-curfew/

58. When land use planning tools are not effective, reverse sensitivity issues may require approaches to noise mitigation that rely on Noise Abatement Operating Procedures and/or Operating Restrictions.

59. Several different Noise Abatement Procedures and Operating Restrictions are used around the world to minimise the impact of aircraft noise on the community, impacting airport and aircraft operations. Most people are aware of curfews, but there are many other measures that are currently in place.

60. The table below lists some of those measures, including examples of airports with those measures imposed.[10] Measures 1-4 are Noise Abatement Operating Procedures, which have some impact on airport operations. Measures 5-10 are Operating Restrictions and have a greater impact on airport operations.

#	Noise Mitigation Measure	ICAO Balanced Approach Pillar	Description	Example Airports[11]							
				MEL	BNE	AMS	YYC	YYZ	VIE	YTZ	YWG
1	Noise Abatement Procedures	Noise Abatement Operating Procedures	Changes to arrival/flight tracks and/or flying techniques (eg. Reduced thrust, limits on reverse thrust, increased climb)	X	X	X	X	X	X	X	X
2	Preferential Runways	Noise Abatement Operating Procedures	Prioritise use of a particular runway when possible to minimise overflight of urban areas, or rotation of runway modes to share noise over different communities.	X	X	X	X	X	X		X
3	APU Operating Restrictions	Noise Abatement Operating Procedures	Prohibition of the APU (Auxiliary Power Unit) while the aircraft is on the ground and recommends the use of fixed or mobile GPU (Ground Power Units)			X			X		
4	Airport Curfews	Operating Restrictions	Time intervals in which take-off or landing is not permitted for some or all aircraft types			X		X	X	X	
5	Noise Charges	Operating Restrictions	Additional charge to airlines whose aircraft exceed the allowable values of noise as well as additional charge to companies using older (louder) aircraft types. Charges can vary with time of day, weight of aircraft etc.		X	X		X	X		

[10] Emir M. Ganic, Fedja Netjasov, Obrad Babic, Analysis of noise abatement measures on European airports, Applied Acoustics, Volume 92, 2015, Pages 115-123, ISSN 0003-682X

[11] https://www.boeing.com/commercial/noise/list.page

#	Noise Mitigation Measure	ICAO Balanced Approach Pillar	Description	Example Airports[11]							
				MEL	BNE	AMS	YYC	YYZ	VIE	YTZ	YWG
6	Noise Level Limits	Operating Restrictions	Permitted noise values in certain points of the noise monitoring system (usually per operation), the excess of which leads to additional charges (or fines) applied to airlines			X					
7	ICAO Annex 16 Chapter 3/Chapter 2 Restrictions	Operating Restrictions	Prohibition of flying for aircraft that are certified in accordance with Chapters 2 and 3 of ICAO Annex 16, Volume 1 (noise certification levels)	X	X	X	X	X	X		X
8	Operating Quotas	Operating Restrictions	Limit of the number of commercial operations at the annual or seasonal level as well as the limited number of arrivals and departures during peak hours			X		X		X	
9	Noise Budget Restrictions	Operating Restrictions	The process of slot allocation in order to meet the defined criteria (e.g. the annual number of operations) and approved overall noise level (noise total volume)			X		X			

Table 3

61. Whilst there's a variety of measures applied around the world, some are much more commonly used. Ganic et al. (2015) analysed 248 European airports with noise mitigation measures in place and found that curfews were applied more often than any other operating restrictions, being implemented at approximately 50% of the airports surveyed.

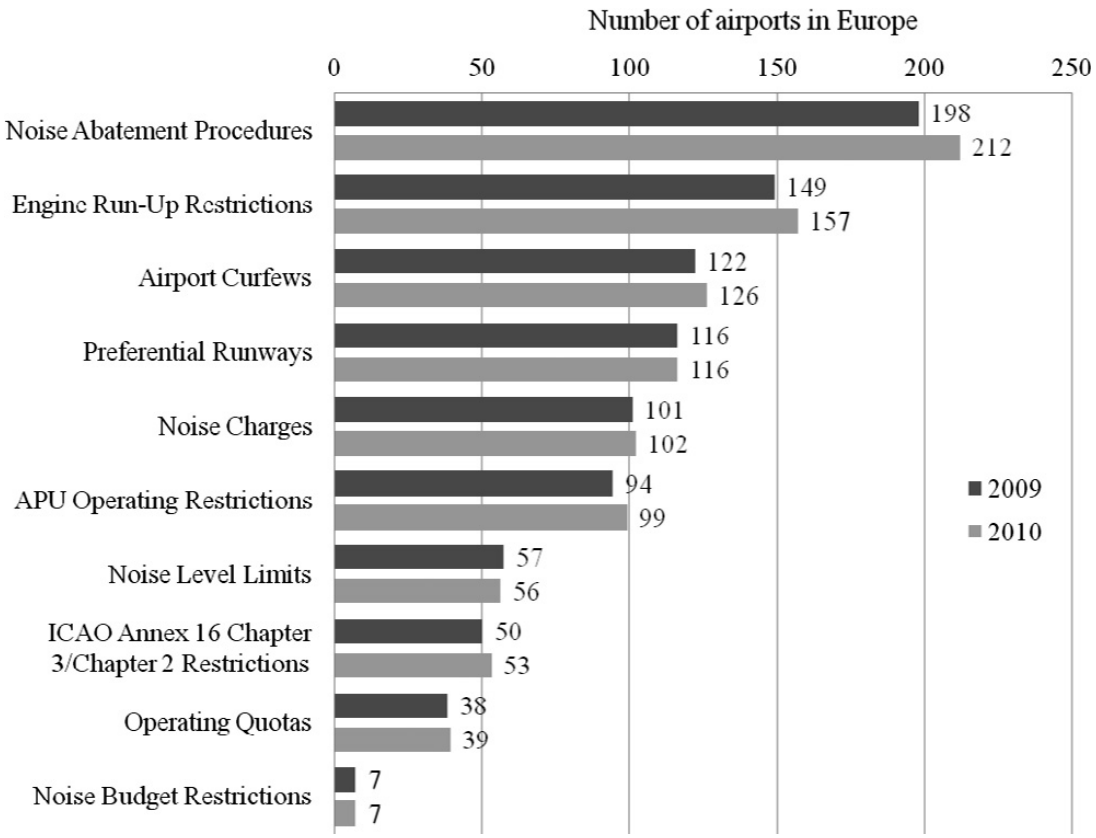


Figure 1 Distribution of number of airports in Europe that introduced Noise Mitigation Measures in years 2009 and 2010 [10]

62. At CIA the impacts of these types of restrictions could be significant for passenger and freight aircraft operations.

63. Passenger services are highly tuned towards operating at optimum times that maximise passenger volumes across services and networks. Noise mitigation measures that restrict operational flexibility for airlines such as curfews or movement quotas (annual/daily/hourly) reduce airline flexibility to operate at optimum times, potentially impacting the viability of existing services. More detailed examples of these types of impacts are included in Section 5 of this report.

64. Airfreight services are also highly tuned towards commercial drivers. In New Zealand, domestic airfreight typically operates overnight to enable parcels and mail to be distributed the next morning. Again, noise mitigation measures that restrict operational flexibility for airfreight services such as curfews or movement quotas (annual/daily/hourly) reduce flexibility to operate at optimum times. In fact, such restrictions may force air freight operations to other airports that can continue to enable overnight delivery services or where freight services do not have to compete for 'slots' that may be forced by movement quotas. More detailed examples of these types of impacts are included in Section 5 of this report.

65. To support the above explanation around the risk of operational controls resulting from reverse sensitivities, we have reviewed several international examples below.

CASE STUDY 4 SUMMARY: SCHIPHOL AIRPORT

Airport Introduction and Context

Schiphol is the busiest airport in the Netherlands (and one of the busiest in the world) with over 80 million passengers per year before the COVID-19 pandemic. The airport is located 15km from the downtown area of Amsterdam. In the 1970's a new town, Hoofddorp, was built right next door to Schiphol, and in the 1980's and 90's neighbouring cities like Amsterdam and Amstelveen built new areas expanding towards the airport.[12]

Constraint Imposed

Although aircraft noise has been an ongoing issue, following commissioning of a new runway, a 'consultation table' was setup by the government to provide advice on the development of Schiphol. This group was tasked with establishing the constraints that now define how the airport can grow and operate. Negotiations produced a new system to control aviation noise with operating constraints imposed based on the number of aircraft movements as well as exposure noise levels. Total numbers of aircraft movements per year and at night are now restricted (movement quota). In the years leading up to the pandemic, Schiphol were consistently operating at or close to the movement quota capacity.
These 'environmental constraints' limit runway capacity, potentially requiring slot allocation rules to be developed and pushing some operations to other airports. In 2017, Singapore Airlines relocated half of their freight operations to Brussels Airport due to a significant reduction in freighter slots at Schiphol because of the movement cap.[13]

Key Findings

- Growing encroachment leads to an increased need for community engagement to maintain buy-in. However, operating restrictions may be required to maintain community support.
- Operating restrictions can result in loss of flights to other airports.

[12] M, Wijk & Brattinga, Kes & Bontje, Marco. (2010). Exploit or Protect Airport Regions from Urbanization? Assessment of Land-use Restrictions in Amsterdam-Schiphol. European Planning Studies. 19. 261-277. 10.1080/09654313.2011.532671.
[13] https://www.lloydsloadinglist.com/freight-directory/news/SQ-to-transfer-half-its-Schiphol-freighter-flights-to-Brussels/70526.htm#.Yo3lx6hByUk

CASE STUDY 5 SUMMARY: TORONTO AIRPORT

Airport Introduction and Context

Toronto Pearson International Airport is Canada's busiest hub at over 50 million passengers per year prior to the COVID-19 pandemic. The airport is located 30km from downtown Toronto. Despite being opened in 1938, it was only in 1959 that land use development policies using noise contours were considered, ahead of a significant phase of expansion. By that time, urban encroachment was already present. An Airport Operating Area (AOA) was eventually implemented in official city plans to control residential development in the vicinity of the airport.

Constraint Imposed

In February 2012, NAV CANADA implemented flight track changes in the Toronto-Ottawa-Montreal corridor (the main flight route between these centres), triggering negative community reactions. This led to a significant community consultation process to better disclose the impacts from airspace changes and to identify means to mitigate the impacts of aircraft noise primarily through noise abatement procedures. Interestingly many of the community responses came from locations outside the revised contours. This highlights how noise and associated impacts do not stop at a specific contour boundary.

Key Finding

- Community annoyance can occur outside the designated noise contours and in places where communities were previously exposed to less frequent aircraft noise.
- Attempts to retrospectively establish appropriate safeguarding areas around the airport have been difficult to effect, due to lack of early and conservative land use planning controls

66. The case studies have illustrated that land use protections are generally changed when there is a trigger to update them such as an operational change, change to regulatory requirements, or a demand/capacity driver. These may be caused by systemic change to the airport's usage such as a change in airfield layout (e.g. new runway) or technology advances in air navigation for aircraft operations (e.g. RNP). Conservative land-use protection is required to limit the impact of these changes on the airport and community when they do occur.

67. Our research did not find any instances where airports or local governments actively reduced land use planning protections (e.g. reduced an OCB from 50 to 55Ldn). Rather, that airports actively aim to retain noise related safeguards and contours that provide conservative land-use protection where possible in order to protect from current and future reverse sensitivities and potential operational restrictions. Any changes in contours were a result of changes in inputs (e.g. fleet mix, flight tracks) rather than a change in the contour level used as the outer control boundary.

68. In the CIA OCB context, while the trigger to change this land use planning control may differ (triggers do differ in most cases surveyed), the risk of reverse sensitivities is the same and the potential range of operational impacts is the same.

5. CIA Importance and Potential Impacts of Relaxed Protection

69. A relaxation of the CIA OCB from 50dBA Ldn to 55dBA Ldn would provide a framework to enable new noise sensitive activity such as residential, schools, hospitals etc to be developed closer to Christchurch Airport. The risk of negative amenity impacts on those new occupants, and reverse sensitivities then impacting airport operations and efficiency is real. This risk is demonstrated by global examples documented in previous sections of this report.

70. This section documents the specific risks to CIA and the wider Canterbury community if reverse sensitivity issues result in noise abatement procedures and/or operating restrictions at CIA.

71. Below we set out the following:

    A: General Role and Importance of CIA;

    B: Operations and Dynamics at CIA;

    C: Generic Operating Constraints that could be imposed due to Aircraft Noise Sensitivities (reverse sensitivities); and

    D: Potential Impacts of Constraints to Operations

A: General Role and Importance

General

72. Christchurch Airport is of significant importance to New Zealand, the South Island, the Canterbury region and Christchurch City as an essential transportation connectivity hub and base for all types of aviation activity now and in the future. CIA has no curfew and is operationally available 24 hours a day, seven days a week. Its 24/7 availability is a significant operational advantage for the CIA's users and the communities it serves.

73. Prior to the COVID-19 pandemic there were direct air service connections from CIA to ten international destinations including Sydney, Melbourne, Brisbane, Perth, Gold Coast, Singapore, Guangzhou, Hong Kong, Rarotonga and Nadi, with nine international airlines represented. Scheduled traffic in the financial year 2019 comprised 92,345 domestic and 11,593 international aircraft movements[14] carrying 6.3 million annual passengers[15] and making CIA the second busiest commercial passenger airport in New Zealand[16].

74. Christchurch Airport is also of international importance, due to its proximity to Antarctica and its role in facilitating scientific exploration of the continent.

75. CIA is a nominated "alternate" for Auckland International Airport. If aircraft bound for Auckland are not able to land there for reasons such as poor weather, an accident blocking the runway or other operational reasons, they can be diverted to Christchurch Airport. Other "alternate" options for Auckland Airport diversions include;

    - Wellington Airport, however the runway is not suitable for most large wide body aircraft, and
    - the Ohakea Royal New Zealand Air Force Base in Palmerston North, however this does not have suitable passenger processing facilities, the runway is shorter than Christchurch and the Airport does not have other scheduled services making it slower for passengers to be processed and sent on to final destinations.

76. As the gateway to the South Island, CIA serves as a regional hub, connecting international and domestic passengers across the South Island. Christchurch Airport also provides critical air connectivity for the movement of international air freight into and out of the South Island and New Zealand, linking into international freight hubs in Australia, Singapore, China and the United States.

77. Statistics New Zealand notes that Christchurch Airport is the second ranking airport for air freight imports and exports in New Zealand (after Auckland), accounting for $3.14 billion New Zealand dollars' worth of air freight in 2017/18[17]. Statistics New Zealand also notes that: *"Air freight carries less than 1% of our trade by volume, but about 16% of our exports and 22% of our imports by dollar value.*[iii]*"* Christchurch International Airport plays a key role in this trade.

[14] A "movement" of an aircraft (or a passenger) is counted for each arrival, departure or transit/transfer
[15] Christchurch Airport 2019 Annual Report and CIAL data
[16] New Zealand Ministry of Transport website - Air and Sea transport - air passengers AR005
[17] https://www.transport.govt.nz/statistics-and-insights/air-and-sea-transport/sheet/air-freight

78. Infrastructure at CIA, such as the runways, taxiways and aprons, provide the basis for air service operators to connect Christchurch, the wider region and the South Island to the rest of New Zealand and the world.

79. The main runway at Christchurch Airport is the second longest runway in New Zealand at 3,287m, allowing air services by new generation aircraft such as the Airbus A350 and Boeing 787, and the world's largest passenger aircraft, the Airbus A380. These aircraft types are critical to passenger capacity and the supply of capacity for international air freight which travels in the belly-hold of these aircraft or on dedicated freight aircraft.

80. The main runway at Christchurch is the only runway in the South Island capable of servicing these large wide body aircraft types without restrictions. If this runway is consistently not available for use, widebody international aircraft (passenger and dedicated freighters) would need to use runways in the North Island. Therefore, Christchurch International Airport it is an essential piece of transport infrastructure for the South Island.

81. The COVID-19 pandemic dramatically altered the aviation landscape as borders were closed and most aviation activity ceased or was severely curtailed. In New Zealand there was a relatively rapid recovery of domestic traffic towards the end of 2020, although international borders were still closed to passengers. CIAL has updated passenger growth projections which considered scenarios for the short, medium and long term air traffic recovery. These updated projections identified that growth in International and Domestic passengers would be reached some 5 years later than in earlier projections due to COVID related impacts i.e. originally forecasted traffic levels for 2025 were identified in the updated forecast to now be reached in 2030.

82. In a press release[18] dated 1st March 2022 the International Air Transport Association (*IATA*) has set out its forecast for air passenger recovery from the pandemic. This notes that air traffic is expected to reach generally 2019 levels by 2024 globally and 2025 in the Asia-Pacific:

    a. *"The International Air Transport Association (IATA) expects overall traveller numbers to reach 4.0 billion in 2024 (counting multi-sector connecting trips as one passenger), exceeding pre-COVID-19 levels (103% of the 2019 total)."*
    b. *"Asia-Pacific: The slow removal of international travel restrictions, and the likelihood of renewed domestic restrictions during COVID outbreaks, mean that traffic to/from/within Asia Pacific will only reach 68% of 2019 levels in 2022, the weakest outcome of the main regions. 2019 levels should be recovered in 2025 (109%) due to a slow recovery on international traffic in the region."*[19]

83. General descriptions of Christchurch Airport's role and operational profiles are provided in this document based on 2019 operations, with some specific references to current (2022) operations where required. 2019 is representative of typical non-pandemic operations at

[18] https://www.iata.org/en/pressroom/2022-releases/2022-03-01-01/

CIA and the associated volume and profile of traffic at Christchurch Airport is expected to generally recover to 2019 levels in the medium term (approximately 5 years). \

Commercial Scheduled Passenger Services

Domestic

84. In 2019 Christchurch Airport recorded 5,164,504 domestic passenger movements[20] making it the third busiest airport in New Zealand[21] for domestic passengers.

85. In 2019 Christchurch Airport had 105,000 domestic-to-international transferring passengers and 245,000 domestic-to-domestic transferring passengers[22], illustrating its key role in regional connectivity for the lower South Island and as a hub for Air New Zealand in the South Island, distributing and collecting passengers onto trunk domestic services.

86. Domestic data recording reasons for travel is not generally collected other than in periodic sample surveys, however it is generally understood that CIA facilitates travel for leisure, business, visiting friends and relatives (*VFR*), education and medical reasons amongst others.

87. In 2019 Christchurch Airport was serviced domestically[23] by Air New Zealand, Jetstar, Air Chathams and Sounds Air on trunk and regional routes.

International

88. In 2019 Christchurch Airport recorded 1,766,937 international passenger movements[24] making it the second busiest airport in New Zealand[25] for international passengers.

89. CIA provides a key role across a range of social and economic needs and is important in delivering tourists directly to the South Island. In 2019 the main reasons for travel for international passengers arriving at Christchurch Airport were holiday/leisure (63%) and VFR (24%). Discretionary travel is therefore highly significant for Christchurch Airport, with 6 in 7 international visitors arriving for the purpose of holiday or VFR.[26]

90. In 2019 Christchurch Airport was serviced internationally[27] by Air New Zealand, Emirates, Qantas, Jetstar, Virgin Australia, Singapore Airlines, China Southern Airlines, Cathay Pacific Airlines and Fiji Airways.

[20] Christchurch Airport 2019 Financial Statements
[21] New Zealand Ministry of Transport website - Air and Sea transport - air passengers AR004
[22] CIAL data
[23] Source: Airbiz analysis of Flight Global Diio 2019 domestic schedules for Christchurch Airport
[24] Christchurch Airport 2019 Financial Statements
[25] New Zealand Ministry of Transport website - Air and Sea transport - air passengers AR006
[26] Airbiz analysis of NZ Stats Infoshare International Travel and Migration data for Christchurch Airport international visitor arrivals for the year to June 2019
[27] Source: Airbiz analysis of Flight Global Diio 2019 international schedules for Christchurch Airport

Air Freight and Mail

Domestic

91. Air freight, small parcels and mail is carried into and out of Christchurch Airport in the belly-hold of commercial passenger operations or on dedicated air freight services.

92. Christchurch Airport is one of three South Island locations for Air New Zealand's domestic air freight operation 'Air New Zealand Cargo' (the others are Nelson and Queenstown). The airline's air freight products tend to focus on general and perishable goods and pets, and are principally transported on their scheduled passenger aircraft services which operate through the day and early evening.

93. Additionally, there is currently (2022) some domestic heavy freight being carried between Christchurch and Auckland on Air New Zealand's dedicated international freighter operations conducted under the Government's MIAC programme (described later in this report at point 130). Domestic "heavy freight" (heavy freight generally excludes non-perishables or small parcels and mail) is usually carried on trucks over the road network.

94. Air freight is also carried in the belly-hold of other domestic commercial airlines such as Jetstar and Air Chathams; this is handled by a ground handler at CIA such as Menzies where it is consolidated for air transport or distributed via freight forwarding companies such as Mainfreight onto the road network.

95. Christchurch Airport is a critical component in New Zealand's small parcel and mail distribution infrastructure, serving as the South Island hub in Parcelair's network, connecting to Auckland for the upper North Island and Palmerston North for the lower North Island.

96. Parcelair is a joint venture between Fieldair Holdings (a subsidiary of Freightways) and Airwork, and services the overnight air freight, courier and mail connectivity needs for principal clients Freightways and NZ Post.

97. Christchurch Airport facilitates the transfer of domestic and regional air freight onto international services, supporting industries such as salmon farming from Nelson/Tasman onto international services.

International

98. In 2019 Christchurch Airport recorded approximately 120,000 international tonnes of air freight and mail. In terms of volume and value, CIA accounts for 14% of all New Zealand's international air freight, making it the second busiest airport [28]in New Zealand for freight and mail.

99. In 2019 at Christchurch Airport, 70% of international air freight and mail was carried in the belly-hold of passenger aircraft and 30% on dedicated international freight aircraft[29].

[28] Airbiz analysis of New Zealand Ministry of Transport website Air Freight statistics for FY18
[29] CIAL data

100. DHL, Qantas and Air New Zealand have used Christchurch Airport for their dedicated international air freight operations, linking into their individual distribution centres located at CIA.

101. During and prior to the Covid-19 pandemic, Christchurch Airport had a typical 5 day a week dedicated freighter service (with some weekly variations) on a B767 freighter taking freight from the Christchurch to Sydney. This is a triangular AKL-CHC-SYD flight operating year-round. On top of this, Christchurch occasionally have freighters going to Brisbane and Melbourne, especially during the summer peak export season.

102. International heavy air freight is screened at Christchurch Airport before being imported or exported on dedicated freighters or in the belly-hold of commercial passenger services.

Antarctic Operations

103. Christchurch Airport is New Zealand's gateway to Antarctica, with a well-established International Antarctic Centre[iv]. This includes a dedicated Antarctic aircraft apron where cargo is airlifted, with its own airport departure terminal for personnel travelling to and from Antarctica during the summer season. It serves as a base for the United States, New Zealand and Italian[v] Antarctic Programs.

104. Christchurch Airport also provides key emergency access to the continent as recently illustrated by an emergency medical evacuation. Stuff.co.nz quotes:

> *"A military aeroplane was called in to carry out a medical evacuation of a member of the United States Antarctic Program who had been injured in Antarctica. A Royal New Zealand Air Force C-130 Hercules left Christchurch at 10.25pm on Sunday for the seven-hour, 3920km flight to the US-run McMurdo Station on Ross Island."*[30]

This further illustrates the essential role Christchurch Airport in Antarctic operations.

Airport Campus Role

105. Aviation servicing infrastructure on CIA's campus is intrinsically linked to the air service operations and passenger, baggage and freight flows that Christchurch Airport facilitates. There are a range of businesses located at CIA that provide ancillary support to the air service operations, as well as commercial and service-related offerings.

Covid-19 Pandemic Role

106. During the current Covid-19 pandemic, Christchurch Airport has played a key role maintaining international and domestic passenger connectivity, whilst meeting health requirements through specific operational protocols enabled within CIA's terminal infrastructure.

107. During the pandemic, the importance of air freight has been further emphasised. Christchurch Airport enables direct and large capacity freighter movements and belly-hold freight and forms part of a connected and diversified freight transport network to and from New Zealand. This helps ensure the availability of key goods in New Zealand that require

[30] https://www.stuff.co.nz/national/125725259/air-force-carries-out-nighttime-medical-evacuation-from-antarcticas-mcmurdo-station

movement by air, and helps mitigate the worst impacts of supply chain constraints to freight movements via shipping brought on by the pandemic.

Disaster Recovery

108. Airports are critical links in disaster response and recovery, providing critical staging areas for disaster management, enabling fast medical evacuations and transport and providing important resilience to the overall transport network when roads, rail and maritime transport are compromised.

109. CIAL is a designated 'Lifeline Utility' in the New Zealand Civil Defence Emergency Management Act 2016. Section 60 of that Act notes that Lifeline Utilities must:

> *"… ensure that it is able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency and participate in the development of the national civil defence emergency management strategy and civil defence emergency management plans."*

110. Christchurch Airport plays an essential role in local, regional and national disaster management. This places a range of requirements on CIA and confirms its importance as a key asset for Canterbury and the wider South Island following any large-scale incident. The following are examples of Christchurch Airport's role in Disaster Recovery.
    a. 2011 Christchurch Earthquakes – Christchurch Airport was the main arrival and departure point for a wide range of local and international rescue teams. Emergency supplies were airlifted into Christchurch and many of the critically injured were evacuated out. Christchurch Airport was credited with contributing to helping save dozens of lives due to the ability to reopen the facility so quickly and keep it open 24/7. In the seven days following the initial earthquake, more than 45,000 passengers were moved out of Christchurch utilising a 'shuttle service' to Auckland.
    b. 2016 Kaikoura Earthquake – Due to Kaikoura being essentially cut off from all other towns by road and rail, air transport into and out of Kaikoura was vital. Christchurch Airport was the initial staging point for military and private air response. Large aircraft with supplies would arrive at Christchurch Airport and be helicoptered out to Kaikoura. Those evacuated from Kaikoura would often be airlifted back to Christchurch.
    c. 2017 Port Hills Fires – Christchurch Airport quickly became the staging point for all fixed wing and many helicopter aerial assault aircraft fighting the Port Hills fires. Christchurch Airport hosted on site the various aircraft and crews, making sure they had water available to refill aircraft as well as resting facilities for crews. In addition, over a period of 10 days, Christchurch Airport provided over 20 skilled staff to assist in the Emergency Operations Centre in Rolleston supporting the response effort.
    d. 2020 COVID-19 Repatriation Evacuations – In April and May 2020, thousands of stranded tourists visiting the South Island were evacuated to their home countries through Christchurch Airport. Visitors from Germany, the Netherlands, the UK, France and a range of other European countries all boarded repatriation flights at Christchurch Airport in a desperate attempt to get home as international borders shut. At the same time, hundreds of Kiwis were repatriated back to NZ on charter flights due to the disruption to commercial flights and border restriction.
    e. 2019 Rangitata Floods – This affected many international tourists and there were many general aviation fixed wing and helicopter operators ferrying passengers

between Timaru and Christchurch to enable them to continue their journey or catch international flights which would otherwise have not occurred due to road and rail outages.

B: Operations and Dynamics

111. This section presents an overview of the different types of aeronautical (or related) operations that use Christchurch Airport and describes the dynamics (operational characteristics) of each operation.

112. All operations and dynamics discussed in this section refer to pre-COVID 2019 operations unless otherwise stated.

113. Air services that use Christchurch Airport can be categorised as follows:
    a. Commercial scheduled passenger flights;
    b. Dedicated air freight and mail;
    c. Non-scheduled operations (airline repositioning and maintenance; Fixed base operations and small commercial including flight training; medivac, military, helicopters government and Antarctic flights)

Commercial Scheduled Passenger Flights

Domestic

114. Domestic aircraft services are split into trunk (i.e. major, usually jet operated, routes) and regional services. Both types generally operate during the day and late evening with minor operations (aircraft repositioning) occurring between midnight and 6am.

115. Domestic jet services only operate on the trunk routes of Auckland (AKL) and sometimes Wellington (WLG). Busy periods are early morning, around the middle of the day and in the evening and typically on narrowbody jets (165-214 seats), with periodic widebody (275-302 seats) services.

116. In addition to local domestic passengers travelling for the purpose of business, leisure and VFR, domestic services are also important as a transfer service for international passengers landing at Auckland or Wellington and transferring to/from the South Island via Christchurch Airport.

117. Turboprop services operate on trunk (WLG) and regional routes. Busy periods are early morning, around lunchtime and in the evening and occur typically on 50-70 seat turboprop aircraft and smaller piston engine aircraft types.

118. Regional services are generally timed to link into trunk services, using Christchurch Airport as a hub to collect and distribute passengers from around the South Island to and from the North Island trunk destinations.

119. There are several smaller airline operators, such as Sounds Air, which service thinner routes and smaller centres, playing a key role in distributing passengers around the South Island via the Christchurch Airport hub.

International

120. International services arrive from long haul destinations in Asia and short haul destinations in Australia and the Pacific.

121. The arrival and departure times of mid- and long-haul services at CIA are primarily dictated by available slot times, the network schedules and onward connectivity to major destinations at the hub airport overseas.

122. CIA can be described as a "slot-taker" in that the scheduled times of arrival and departure at Christchurch Airport are often not able to be tailored to local requirements, but rather are dictated by the network operation of overseas carriers and timing (slot) availability at major overseas destinations. An example of slot-taking is the timing of CIA's China Southern flight from Guangzhou (pre-COVID). The aircraft leaves Guangzhou at just before 1am (local), arriving in Christchurch at 1720 (local). By leaving at 1am, the aircraft load benefitted from the connecting traffic coming into Guangzhou from the rest of the China Southern network across Asia. The aircraft was then on the ground for four hours in Christchurch, before departing at 2230, arriving back in Guangzhou at 0530. The benefit of arriving in Guangzhou at 0530 is the ability for passengers to then connect on to the first wave of aircraft departing Guangzhou to the rest of the China Southern network across Asia. Passengers are able to sleep on the returning aircraft as it is scheduled to operate through the night. This demonstrates that the scheduling of the aircraft is dictated by commercial and operational imperatives in Guangzhou and maximising the hub potential of the China Southern network.

123. Long haul services typically arrive and depart on wide body aircraft types such as the A359 and B789.

124. Long haul Asian services typically originate from Asian hub airports (Hong Kong, Guangzhou and Singapore) with the timing of departures from these airports typically aligned to maximise connecting passengers onto the point-to-point service to Christchurch. In 2019 arrivals into Christchurch from these destinations are typically during the daytime, turning and departing again during daylight hours.

125. Pacific services are generally leisure based and operate during daylight hours on narrowbody or widebody aircraft.

126. Trans-Tasman operations occur throughout the day on a range of narrowbody and widebody aircraft types. New Zealand-based aircraft typically operate two return services across the Tasman each day to maximise utilisation of the aircraft, typically starting from a New Zealand airport, including Christchurch, departing from 0545 onwards and arriving in eastern Australian seaboard destinations for the start of their work day, returning to New Zealand early afternoon (local), then departing again for Australia, offering an end of workday departure back to NZ, arriving back into New Zealand (CHC) around midnight or a little later.

127. Christchurch Airport plays a critical role in international airline disruption recovery and as an alternate to Auckland Airport. The availability of round the clock air services at Christchurch is critical in the event of aircraft emergencies, weather disruptions and critical incidents at Auckland which would necessitate large scale diversions.

Air Freight and Mail

Domestic

128. Domestic air freight and mail is carried into and out of Christchurch Airport in the belly-hold of passenger aircraft and also by dedicated air freight or airmail operators such as those described earlier. These operators deliver freight and mail to distribution centres located on CIA's campus (i.e. NZ Post and Freightways distribution centre).

129. Parcelair operates four B737-400 aircraft in an overnight operation 7 days a week between the three airport hubs. On weekdays, there are typically 9-12 aircraft movements during the night by Parcelair aircraft at Christchurch Airport, connecting to and from a road and rail distribution network serving the needs of the entire South Island. An example schedule for the 7th -8th March 2022 is presented below, illustrating the significance of night time (highlighted yellow) operations:

Arrive/ Depart	Flight number	Aircraft type	Date	Time	To/from
D	80	73F	7/03/2022	1730	AKL
D	72	73F	7/03/2022	2010	AKL
A	71	73F	7/03/2022	2030	AKL
D	62	73F	7/03/2022	2115	PMR
A	73	73F	7/03/2022	2150	AKL
D	74	73F	7/03/2022	2235	AKL
A	75	73F	7/03/2022	2305	AKL
A	63	73F	7/03/2022	2345	PMR
A	31	73F	8/03/2022	0005	AKL
D	76	73F	8/03/2022	0005	AKL
D	64	73F	8/03/2022	0055	PMR
D	32	73F	8/03/2022	0125	AKL
A	77	73F	8/03/2022	0200	AKL
D	78	73F	8/03/2022	0240	AKL
A	65	73F	8/03/2022	0330	PMR
A	83	73F	8/03/2022	0810	AKL

130. Christchurch Airport is the main distribution and consolidation centre for air freight and mail into and out of the South Island.

131. Dedicated air freight or mail services typically occur during the night to enable overnight national delivery of freight and mail.

International

132. International air freight moves in a similar way to domestic services, with freight and mail moving the belly-hold of passenger aircraft or on dedicated air freight or airmail operators such as DHL.

133. Christchurch Airport plays a significant role in freight exports, with nearly a quarter (23%) of New Zealand's air freight export value[31] being exported directly from Christchurch Airport. With much of the passenger traffic being discretionary and price sensitive, the ability to access the freight market is important to contribute to overall air route economics and make international services sustainable for airlines across multiple revenue streams.

134. CIA plays a significant role in facilitating the supply chain for the export of high-value, perishable and seasonal produce direct from the South Island to international markets. The value of some produce (e.g. aquaculture) is directly linked to freshness and the speed from farm to market is critical in attracting the highest price. Without the ability to export direct from Christchurch, speed to market would be impacted by the necessity to connect over other export gateways.

135. Air freight exports and imports are screened through Customs and Ministry of Primary Industries (*MPI*) screening facilities, with imports sent to a distribution centre where cleared imports are sorted and sent for delivery and exports are loaded onto departing aircraft.

136. Recently (2021/22) Christchurch Airport continues to play a key role in the South Island's international air freight system. Due to the reduced belly-hold capacity resulting from the COVID-19 pandemic, capacity constraints have limited air freight supply. Recognising its importance, the New Zealand Government has supported the international air freight market through the Maintaining International Air Connectivity (*MIAC*) subsidy scheme, essentially replacing the lost belly-hold air freight capacity with dedicated air freight operations. MIAC flights operate a triangular routing, coming into Christchurch Airport from Auckland Airport and then out to their overseas destination and back into Auckland, supporting exports from the South Island to international markets. Currently night-time freight operations run by Air New Zealand under this scheme are:
    - Guangzhou (CAN), departing 2130 (2x week);
    - Shanghai Pudong (PVG), departing 2330 (3x week); and
    - Los Angeles (LAX), departing 2355 (2x week).

Non-Scheduled Operations

137. The following describes typical non-scheduled operations at Christchurch Airport.

[31] Airbiz analysis of New Zealand Ministry of Transport website Air Freight statistics for FY18

Airline Repositioning and Maintenance

138. Airlines may need to reposition aircraft, typically as a result of operational delays accrued across the day, so they can return to a home port for the next day's scheduled departures. This usually occurs at night.

139. Further, Christchurch Airport hosts a major maintenance base for Air New Zealand.

> *"Air New Zealand is a major supplier of aircraft, and component MRO (maintenance, repair and overhaul) services with customers in New Zealand, Australia, Asia, the Americas and Europe"*[32]

There are associated maintenance movements of aircraft for this operation.

Military, Government and Antarctic

140. Christchurch Airport facilitates military and government aircraft, as well as Antarctic operations (both military and non-military).

Fixed Base Operation (FBO) and Small Commercial

141. Most of these movements are air ambulances, but they also include charters, business jets and other small commercial operators. However, jet aircraft movements are anticipated to increase at a greater rate as FBO operations continue to grow and air ambulance fleets are upgraded from turboprops. Air Ambulance operations are time critical and require a 24/7 operating environment.

142. Christchurch Airport facilitates flight training schools including the International Aviation Academy of New Zealand and the Canterbury Aero-Club. Flight training schools are valuable to airport communities in that they create multiple economic benefits for the region. Students often come from overseas and spend extended periods in the region. Schools create valuable, higher-worth jobs for flight training personnel. The competitive attraction of a flight training school is enhanced when it is located on or near an international airport with services from regional aircraft up to widebody jets. The level of experience for student pilots in studying in the operating environment is enhanced, for example, compared to studying at an aerodrome in a small country town away from an existing international airport.

Helicopters

143. Helicopter operations at Christchurch Airport cater for a wide range of operations and facilities, being a hub for the regional rescue helicopters, two training providers, maintenance operators as well as tourism and agricultural services.

144. The current operators have long-term commitments to their facilities, some of which are purpose-built, making relocation to other facilities unlikely. With the presence of helicopter maintenance facilities, many non-Christchurch Airport based operators regularly visit CIA.

145. There is a rescue helicopter base at Christchurch Airport, Canterbury West Coast Air Rescue Trust Inc. This is a time critical operation requiring a 24/7 operational capability.

[32] https://www.airnewzealand.co.nz/engineering-and-maintenance

146. There are also occasional military helicopter operations that use Christchurch Airport.

C: Generic Capacity Constraints due to Aircraft Noise Sensitivities

147. In the event that Noise Abatement Procedures and/or Operating Restrictions are imposed on CIA, with operational capacity or timings explicitly restricted due to aircraft noise sensitivities, the following consequences may result:
    a. At the higher end, night-time curfews to all or specific operations (typically between the hours of 11pm and 6am);
    b. Annual aircraft movement quotas or caps;
    c. Daily or hourly aircraft movement caps restricting the number of arrivals or departures;
    d. Preferential runway regimes (rotating use of runways and associated flight paths to "share" the noise burden) which are often "sub-optimal" in terms of runway or airspace capacity;
    e. Development of additional runways to cater for air traffic growth, to ensure no additional noise burden is placed on current flight paths;
    f. Other noise abatement and mitigation (noise charges, aircraft auxiliary power unit restrictions etc).

148. The above examples, if imposed, will reduce operating efficiency at Christchurch Airport and impose restrictions (several being extremely serious) on the existing operations detailed in this report.

D: Potential Impacts of Capacity Constraints to Operations

149. This section provides examples of how some of the capacity constraints noted above could conceivably manifest at Christchurch Airport, should reverse sensitivities result in restrictions being imposed, for each of the operations and dynamics described.

Commercial Scheduled Passenger Flights Impacts

- From a Night-Time Curfew

150. Christchurch Airport's **role as a nominated alternative airport would possibly change,** due to its unavailability at night time. This would reduce New Zealand's resilience for unexpected disruptions to the aviation network resulting from weather, schedule disruptions or emergency situations.

151. **Reduced overall runway capacity** through reductions in available runway operating times. As a generic example, in a pure capacity sense, assuming a fictional runway could handle 10 aircraft movements (arrivals and departures) per hour across a 24hr operational day, capacity would be approximately 240 movements per day. If this operational day was reduced to 17hrs for example, the capacity of the runway would drop to approximately 170 movements per day.

152. **Restrictions on future opportunities for international services** from hub airports seeking to arrive/depart during an imposed curfew.

153. **Impacts on the viability of mid- to long-haul routes** established prior to COVID-19 if restricted hours of operation were in place, e.g. a flight with a delay may not be able to depart from an overseas hub if its estimated arrival time in Christchurch falls after a curfew starts. In such a case, that air service would either be cancelled or diverted to a curfew-free airport, inconveniencing the passengers and creating complexity for the airline in recovering from the disruption. Over time, the operational risk of a curfew would be noted by airlines and ultimately the competitiveness of Christchurch Airport would be damaged.

154. **The scheduled China Southern flight from Christchurch to Guangzhou** historically departed at 2230. An airline would be cautious of operating this flight under a curfew scenario (should a curfew commence at 2300). If there was a delay to the departure of greater than 30 minutes, it is likely the flight would be unable to depart due to the curfew. The airline would then face a complex scenario of accommodating the passengers in hotels and checking them in again for departure the next day, plus the loss of a day's operation for the aircraft which would not be able to operate its planned schedule the next day. If a curfew commenced at 2200, this flight would have to be cancelled or retimed, which may not be possible or viable for the airline.

155. It is possible that **early morning trans-Tasman departures may need to be reduced, retimed, or cancelled** (depending on curfew times), reducing choice for business travellers to arrive in Australia for the start of the working day.

156. It is possible that **late night trans-Tasman arrivals may need to be reduced, retimed, or cancelled,** reducing choice for business travellers to leave Australia late in the day. For example, with a 2300 curfew in Christchurch, a flight leaving Melbourne would have to depart by 1730 MEL, meaning passengers would need to be at the airport by approximately 1530. This would effectively reduce the business day by nearly half, considering travel time from the Melbourne CBD to Melbourne Airport.

- From an Annual Movement Quota

157. The creation of an **annual movement quota would detrimentally impact Christchurch Airport**, as the Airport's growth approaches the quota number. Airlines are constrained by the volume of frequencies they can fly (i.e. the number of flights an aircraft can be used for over an operational day). For example, for a 3hr sector (assuming a 24hr operational day) the aircraft flying that sector might be able to make approximately 5 frequencies per day (assuming a 1.5hr on-ground time between frequencies).To accommodate growth in demand, they can only resort to up-gauging aircraft to greater seating density, rather than increasing frequency of services. This is sub-optimal for both the consumer and the airline, particularly domestically, as it is the frequency of service that the consumer market values. For the airline, it requires a more complex fleet with higher seating-density aircraft, which may not be economic to operate on other "thinner" routes in their network.

- From a Daily or Hourly Movement Quota

158. During the course of the day, there are peak periods of demand when more air services operate compared to other times. Domestically, these periods are typically morning and evening, book-ending the business day. For the trans-Tasman market, the scheduling is in two distinct waves, creating peak demand and dictated by the practicalities of the time difference and passenger flows. **An hourly movement quota, if reached, would adversely**

impact air services if the airlines were not able to schedule aircraft to meet passenger demand for services.

159. An example of hourly movement quotas overseas is at Sydney Airport, where there is an allocation of 80 hourly movements. Within the quota is an allocation to accommodate regional services, which then restricts the number of services which can operate on interstate and international routes. **The airport's growth and competitiveness is constrained by the quota.** This has partly led to the need for a new airport in the region, Western Sydney Airport, which is currently being designed.

- From Preferential Runway Regimes

160. Preferential runway regimes are interventionist measures utilised to distribute air traffic across an airport's runways and associated flight paths in order to "share" the noise burden. While this solution is often seen as equitable to residents, it often results in **sub-optimal use of runways and/or airspace capacity, and increased costs of operation on the ground**. For example, longer taxiing time for aircraft on the airfield, resulting in increased time and fuel burn. Any impact on operational costs for airlines is significant, however in a port such as Christchurch, which has a higher than average discretionary passenger mix[33], increased costs negatively impact the economic viability of marginal routes, making the operation less competitive.

Air Freight and Mail Impacts

- From a Night-Time Curfew

161. Domestic freight services fly overnight, linking domestic ports nationwide. **The entire national air freight network would be impacted if Christchurch was effectively removed**. It would not be economically viable nor logistically possible for domestic air freight services to operate during the day, just to service Christchurch.

162. The entire air freight supply chain has been developed and optimised to work overnight, utilising the hub of Christchurch and the intermodal connectivity to road and rail, which facilitates next day delivery. **A curfew would be highly detrimental to the freight supply chain**. Substitution of air freight services into other South Island airports is unrealistic, particularly given other airports lack Christchurch's geographic advantage and critical mass (and Queenstown is already curfewed).

163. Should a curfew be imposed, a consequence would be **slower distribution of freight and mail and possibly reduced overnight collection and delivery services** i.e. a package picked up in AKL during the day may be required to be air freighted to the South Island the following day (not overnight) missing early morning distribution of packages and arriving late in the day or the following day (2 or 3 day delivery not overnight).

[33] *The passenger market splits over people travelling for 1. Business 2. Leisure and 3. Visiting family/friends. The latter two categories are generally self-funded and discretionary. As such, travel competes for the consumer's share of wallet with other discretionary expenditure and is significantly more price sensitive than business travel. Airlines offer baskets of air fares to capture different demand segments, having business class seats and higher fares that offer greater flexibility and service levels versus lower fares to attract discretionary travellers with reduced flexibility and service levels. Previous work by Airbiz highlighted that international visitors to the South Island gateway airports differ substantially to other airports in terms of reasons for travel. The vast majority of international visitors arriving at Christchurch have been visiting for leisure. Long-haul visitors will be facing destination competition in their home source markets. If costs rise and fares on trips to Christchurch/the South Island increase, then the destination's appeal may decline in the face of other competing destinations.*

164. **Domestic just-in-time impacts would arise** in multiple industries, e.g. potential impacts on the just-in-time industries such as flowers and seafood if these are not able to be freighted in overnight for early morning distribution to retail outlets across the South Island.

165. The **export market for high-value, perishable produce may be impacted** if direct export was not available from the South Island to international markets. The value of some produce (e.g. molluscs and crayfish) is directly linked to freshness and the speed of delivery from producer to market is critical in attracting the highest price. Without the ability to export direct from Christchurch, speed to market would be impacted by the necessity to connect over other export gateways.

166. Opportunities for freight and goods entering New Zealand and the South Island during a **pandemic** may be restricted.

167. Opportunities for **new/seasonal Asian freight services in the future, which may wish to arrive during curfew hours, may be constrained**.

- From an Annual Movement Quota

168. The domestic air freight network is successful because it connects multiple ports, generating multiple movements. An overall cap on annual movements creates pressure between the scheduled passenger airlines and the freight operators as they compete for movement allocations. This was experienced at Schiphol as documented in the earlier Case Studies (see Appendix).
169. An element of the international air freight activity at CIA is seasonal, being the export of summer fruit (e.g. cherries and nectarines) on dedicated freighter services from December to February. On an annual basis, the flight volume is small and appears insignificant against year-round scheduled movements, however the economic significance of those flights is high in facilitating direct export of South Island produce. Examples of the implementation of movement caps at other airports globally have been detrimental to such freighter services, because of the small number of movements and the metrics established to allocate movements, meaning freight services have been deemed lower priority and pushed out.

Fixed Base Operation (FBO) and Small Commercial Impacts

- From a Night-Time Curfew

170. Air service activities for air ambulance (LifeFlight etc) and medivac purposes are critical. Medivac services would be compromised by a curfew even if they were able to land or take-off at Christchurch with a dispensation. No other South Island airport/hospital combination would be as efficient as Christchurch. The key to Christchurch's success as a medivac hub is the ability to develop a fixed base at CIA, use of the runways for fixed wing operations, the extent of medical expertise and specialisms available at the hospitals and proximity to the city from CIA. By comparison, the airport at Dunedin is located 30km from the hospital, necessitating a lengthy ambulance transfer.

171. The small commercial air operator businesses and FBOs have a degree of inter-dependence, benefitting from "clustering" and relying on each other for a degree of commercial viability. Some businesses would be compromised by a night-time curfew and, if those businesses choose to relocate, that may then impact the economic viability of others not directly impacted by the imposition of a curfew. Ultimately, a curfew would be detrimental to the health of the whole non-scheduled community based on Christchurch Airport.

- From an Annual Movement Quota

172. Businesses such as flying schools and helicopter operations generate high volumes of movements. The addition of an annual movement quota would put pressure on these businesses to be relocated away from Christchurch, as they utilise valuable movements which could otherwise be allocated to scheduled passenger and freight services likely deemed of greater social and economic benefit to the region.

- From a Daily or Hourly Movement Quota

173. As with annual caps, FBO and small commercial businesses would be a lower priority in the allocation of daily or hourly movement caps when compared to scheduled passenger and medivac services likely deemed of greater social and economic benefit to the region. The prioritisation of air services at peak hours may have a negative impact on the operation of FBO and small commercial businesses. These flights may be restricted to flying in hours of lower demand, impacting the overall viability of their businesses.

Airline Repositioning and Maintenance Impacts

- From a Night-Time Curfew

174. Late night repositioning of aircraft for maintenance or repositioning would be restricted, meaning aircraft may have to be repositioned earlier in the day, potentially removing an aircraft rotation over the day and reducing passenger choice for flights.

Military, Government and Antarctic Impacts

- From a Night-Time Curfew

175. Air service activities for military, government and Antarctic purposes are critical and should be factored into any interventionist measures.

176. Overnight and early morning operations would be stopped, reducing flexibility for Antarctic operations, reducing opportunities to operate to avoid unsuitable weather and meaning services could not arrive early in the morning. Assuming a 5hr flight time, an aircraft departing for the Antarctic at 7am would not return until the evening.

Helicopter Impacts

- From a Night-Time Curfew

177. Rescue operators might potentially require relocation to another airport to ensure 24/7 capability.

Appendix

This Appendix presents the following Case Studies which were summarised in the report.

1. Melbourne Airport
2. Calgary Airport
3. Brisbane Airport
4. Schiphol Airport
5. Toronto Airport

CASE STUDY 1: MELBOURNE AIRPORT

Airport Introduction

Melbourne Airport is Australia's second largest airport, serving approximately 37 million annual passengers before the COVID-19 pandemic. It was built as a greenfield airport and opened to commercial flights in 1970 as a 2-runway (crossing) system. The location was selected due to its proximity to the city, whilst still being far enough away from urban development to allow the airport to operate unconstrained without a curfew unlike its main competitor, Sydney Airport. Ultimate plans for a 4-runway system have been in place since the airport's conception, with the 3rd runway now being required to meet demand. The airport is located 23km from the Melbourne CBD.

Context

When the airport was designed, noise buffer zones were established in the surrounding area and along proposed flight paths. They were implemented through land acquisition and land-use zoning to minimise the impact of noise on the community. At the time of opening, the land acquired for the buffer zones was the most extensive of any Australian airport. These buffer zones were designed based on the ultimate 4-runway configuration so that the flight tracks for all runways would be over open areas and the effect of noise on the community would be kept to a minimum. However, special protective land-use controls on the areas surrounding the airport weren't introduced until 1992 (in the form of the Melbourne Airport Environs Area), by which time significant urban encroachment had occurred through rezoning and development of land in the buffer zones. [34]

In 1970, the Commonwealth advised that land-use zoning should "not be subject to uncoordinated change by local authorities" and it advocated legislation for Tullamarine to "ensure avoidance of later change to incompatible use". In the 1970's, councils and State Government went against this advice, approving the rezoning of several plots of land from rural to residential inside the airport buffer zones and surrounding areas. This included substantial residential developments less that 100m away from the proposed new runway locations and under the existing east-west runway flight paths.[7]

In the 1980's, the proposed location of the new north-south runway had to be relocated from the south-east of the airport site to the west of the existing north-south runway. This was a result of the decision that Essendon Airport would remain open, whereas original plans had assumed it would close.[35] Buffer zones had been aligned with the original airfield configuration, so development was able to occur unrestricted under what is now the proposed flight paths for the 3rd runway.

By the time more stringent protections were introduced in the early 90's, a lot of the land surrounding the airport had already been developed. Despite increased protection, rezoning of land under flight paths and surrounding the airport has continued over the last 30 years, with the airport often not hearing about the developments until they have already been approved by councils.[36] Residential growth continues around the airport, with the Hume local government area (where Melbourne Airport is located) being identified as a potential "growth area" in a planning strategy for 2030.[37]

Trigger for Constraint

The need to build the 3rd runway now demonstrates the impact on the airport of not properly protecting the land around an airport and allowing urban encroachment over 50 years. The proposed new runway has been a trigger for a community already impacted by aircraft noise to call for increased operating restrictions.

Constraint Imposed

With current stakeholder and community consultations as part of statutory approval process, the urban encroachment on Melbourne Airport has become a major factor in shaping and defining the proposed plans for the 3rd runway and its flight tracks. To mitigate noise impacts, Melbourne Airport are proposing operating in segregated modes, like Heathrow Airport, where one runway is for arrivals only and the other for departures. This is expected to reduce the number of houses exposed to night-time noise by between 15,550 to 24,795 when the new runway opens.[38] However, segregated modes operate at a lower capacity than mixed mode operations (arrivals and departures permitted on both runways). They are also proposing to operate SODPROPS (simultaneous opposite direction parallel runway operations) when possible, which is a reduced capacity mode that will allow traffic to both depart and arrive to the north to reduce noise impacts on residents to the south. Despite these compromises, the airport still faces calls for a curfew from residents living far outside the current Outer Control Boundary complaining of sleep disturbance. [39]

Key Findings

- Even with well published plans for noise corridors or buffer zones, over the years urban encroachment can occur if the proper protections are not correctly enforced.
- Legislative protection needs to be in place as early as possible, as once development has occurred it is very difficult to reverse it.
- Protections need to be conservative enough to minimise noise impacts of unforeseen changes outside of the airport and community's control.
- As a result of poor protection against urban encroachment, the airport now faces calls for a curfew from residential developments in locations incompatible with airport activities.

[34] Michael Buxton & Arun Chandu (2016) When growth collides: conflict between urban and airport growth in Melbourne, Australia, Australian Planner, 53:4, 310-320, DOI: 10.1080/07293682.2016.1275718

[35] https://www.melbourneairport.com.au/getmedia/9faa35c0-7b47-4ff8-9e86-28e50dfc97de/Q_A_Online_Event_Health___Social_FINAL.pdf.aspx

[36] https://www.theage.com.au/politics/victoria/melbourne-airport-asks-for-powers-to-stop-development-underneath-flight-paths-20210115-p56uid.html

[37] https://www.planning.vic.gov.au/policy-and-strategy/planning-for-melbourne/melbournes-strategic-planning-history/melbourne-2030-a-planning-update-melbourne-@-5-million/docs/DPC051_M5M_A4Bro_FA_WEB-1.pdf

[38] https://caportal.com.au/melair/virtual?hview=modalAirportAirspace

[39] https://brimbanknorthwest.starweekly.com.au/news/runway-concerns-mount/

Balanced Approach to Noise Management – Review of Key Pillars in respect of Melbourne Airport

	Balanced Approach Pillar	Pillar Role and Process
1	Reduction of Noise at the Source	Enhanced technology but increased demand is justifying the need for a parallel runway. Larger aircraft as international services grow.
2	Land-Use Planning and Management	Buffer zones of rural land-use zoning based on original 4-runway configuration when airport built in 1970, but no legislative protection until 1990's.
3	Noise Abatement Operating Procedures	Preferential use of runway 16 and aircraft routed to avoid residential centres when possible. [40] Proposed noise-mitigating operating modes with the new runway.
4	Operating Restrictions	Current stakeholder and community consultations include calls for a curfew.
	Triggers	Proposed parallel runway project & urban encroachment into noise-affected areas

[40] http://www.bom.gov.au/aviation/data/education/reference-card-ymml.pdf

CASE STUDY 2: Calgary Airport

Airport Introduction

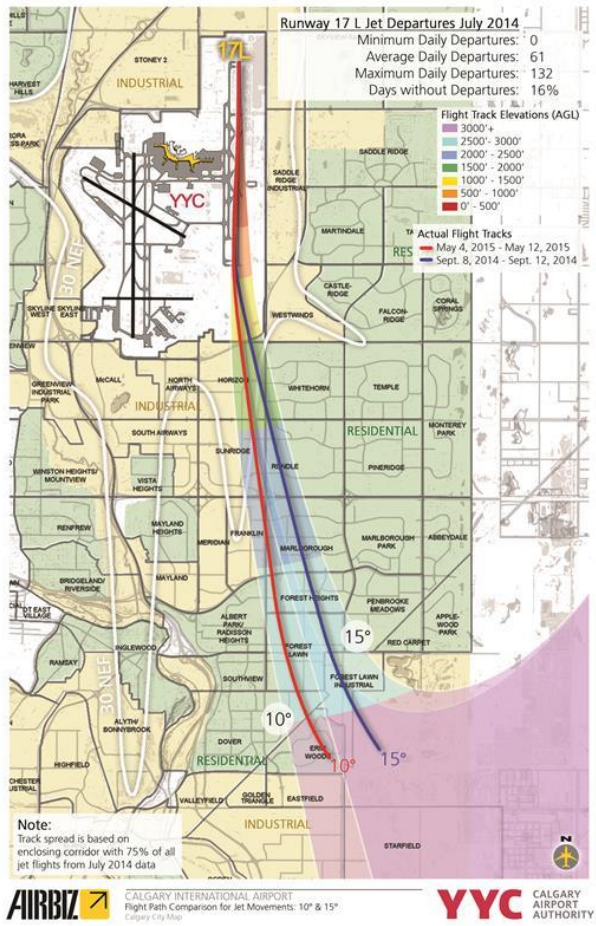
Calgary Airport is the 4th busiest airport in Canada with 18 million passengers in 2019. It was planned as a multiple runway system with a parallel runway commissioned in 2014. The airport is located 19km from downtown Calgary.

Context

The Alberta provincial government enacted the Airport Vicinity Protection Area (AVPA) regulation in 1979 to govern development close to the Calgary International Airport. This prevents land from being developed near the airport that will negatively affect airport operations, including its runway arrival and departure areas. The Noise Exposure Forecast (NEF) contours used to define the AVPA were based on the existing airfield layout, as well as a scenario with a future parallel runway which was finally commissioned 35 years later. Because the AVPA was enacted before significant urban encroachment occurred, appropriate land-use controls were implemented to protect conservatively a future parallel runway.

Trigger for Constraint

Despite this, in 2014, the commissioning of the new parallel runway triggered a negative response in the community. Detailed airspace design for the runway led to the implementation of flight tracks that weren't considered in modelling assumptions that formed the basis of the earlier AVPA. Provisions for parallel operations were published in 1995, followed in 2004 by the first edition of the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (*SOIR*), including the need for 15 degrees divergence when it intends to use two instrument departure procedures from parallel runways simultaneously. Hence, when the need to construct the parallel runway and finalise operational flight paths for the Calgary Airport detailed flight path design rules based on operational safety were in place and differed to those in the early AVPA assumptions, communities under the new flight tracks were exposed to aircraft noise and flight tracks had to be altered to mitigate impacts and alleviate concerns. Divergence for take-off towards the south was subsequently reduced to 10 degrees (rather than 15 degrees) to mitigate those impacts. Without pro-active land-use controls, such a solution would not have been possible and more constraining operating restrictions may have been required.



Constraint Imposed

While there was community engagement to discuss concerns following commissioning of the parallel runway, a revised take-off procedure was allowed to reduce the impact on communities towards the south. Without conservative land-use controls, such a solution would not have been possible and more constraining operating restrictions may have been required.

Future of Land-Use Planning approach at Calgary:
Following introduction of the new runway, a revised AVPA was developed to reflect the increased reliance on the N-S parallel runways and quieter fleet mix. This led to a reduction of the AVPA area (land-use control), especially benefitting existing urban areas which could not previously densify because of current restrictions on land development. While it is too early to assess the impacts of that reduction in land-use controls, it is worth noting how this modification was triggered by a significant change to prevailing modes of operation.

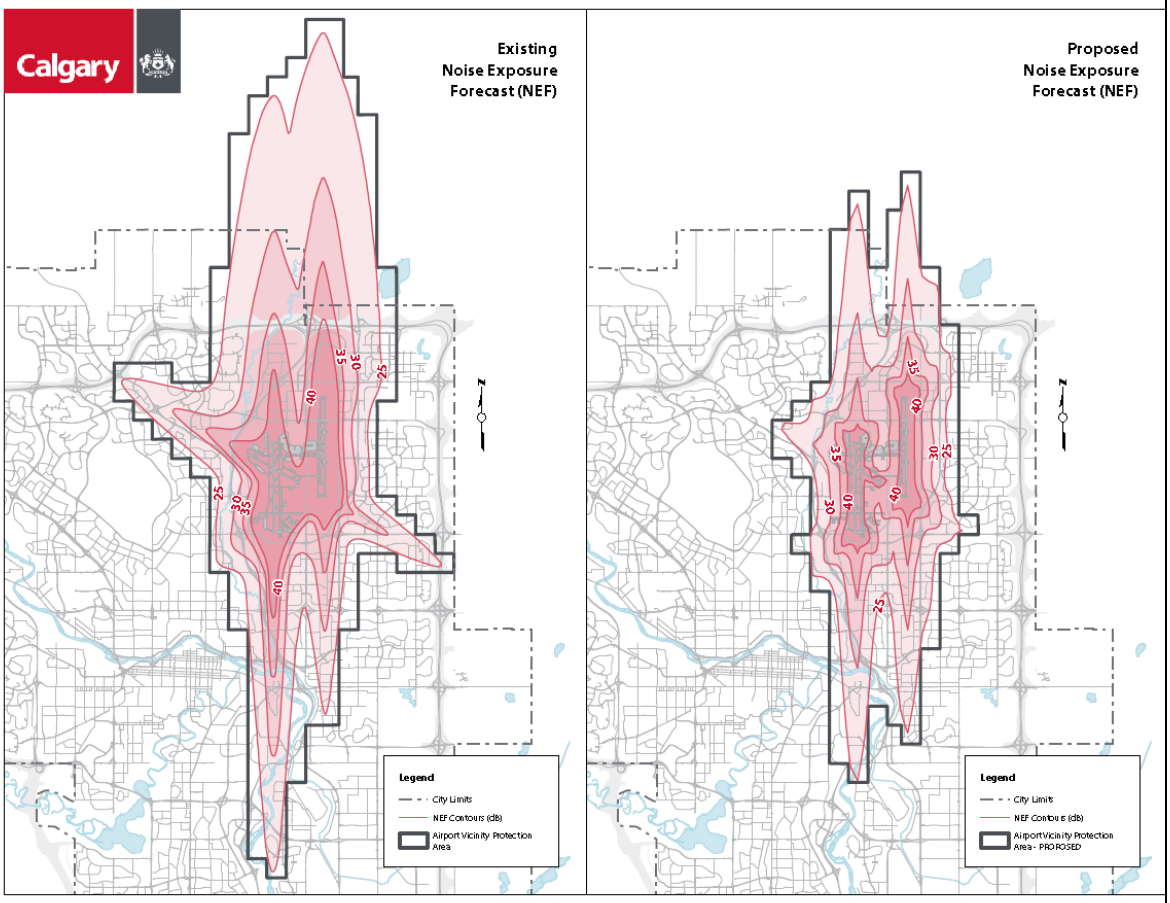
Key Finding

Conservative land-use protection around the airport (i.e. protection of existing and future airfield layout) provided flexibility for changes to future operational assumptions and led to the successful development of a new runway and subsequent AVPA review, reflecting a new airport operational outcome (parallel runway operations). The airport did not need to move to operating restrictions, partly due to adequate land use safeguarding.

A new runway is consistently a key trigger as it exposes new areas to aircraft noise with permanent changes to airport runway operations. However, proactively implementing land-use

controls to protect for a new runway mitigates the impacts of new noise and to provides flexibility for future modes of operations.

Some airports may review the level of land-use controls following a significant permanent change to operations.



Existing and Revised AVPA Contours (2021)

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https://www.cbc.ca/news/canada/calgary/city-council-airport-restrictions-1.5710044

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Balanced Approach to Noise Management – Review of Key Pillars in Respect of Calgary Airport

	Balanced Approach Pillar	Pillar Role and Process
1	Reduction of Noise at the Source	Enhanced technology but more larger aircraft
2	Land-Use Planning and Management	NEF Contours. AVPA recently updated with reduced protection due to new operating model.
3	Noise Abatement Operating Procedures	Preferential runways. Turn upon reaching a minimum altitude.
4	Operating Restrictions	None
	Triggers	New Runway (2014)

CASE STUDY 3: Brisbane Airport

Airport Introduction

Like Melbourne, Brisbane was built as a greenfield airport in 1988, with a Master Plan reserving land and safeguarding for a future parallel runway when required. It's Australia's 3rd busiest airport, handling approximately 24 million passengers in 2019. The airport is located 13km from the CBD.

Context

Over the years since its opening, the equivalent of the Outer Control Boundary for Brisbane Airport (the ANEF 20 contour) has significantly shrunk due to changes in technology (largely between 1983 and 1998) reducing noise of aircraft at the source, despite annual movements increasing. The images below illustrate the evolution of future noise contours used for land use planning purposes around Brisbane Airport at various stages.

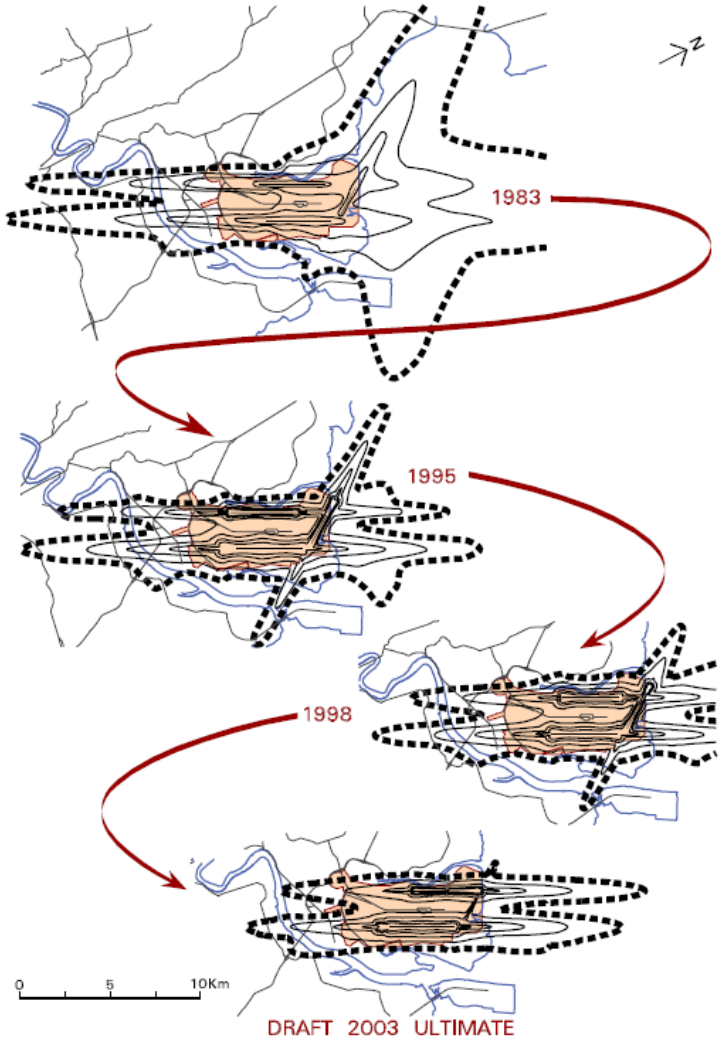


Figure 2 Contours shrinking over time[41]

Trigger for Constraint

Community concern over noise from the new parallel runway. In 1998 Brisbane Airport pushed the proposed location of the new parallel runway 950m towards Moreton Bay in response to community concern over aircraft noise. As a result of community feedback, this was slipped a further 1,300m in the 2003 Master Plan. The resulting location ensured the largest noise buffer zone for any Australian capital city airport.[42]

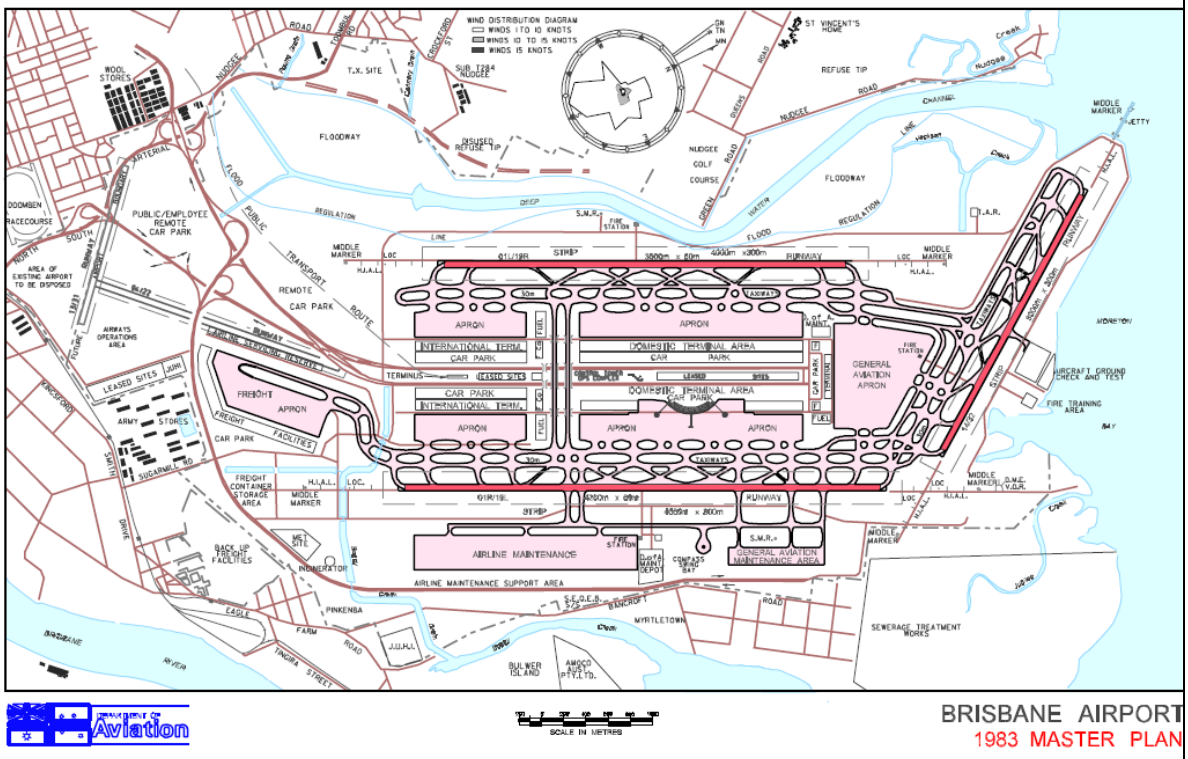


Figure 3 Original Airfield Layout from the 1983 Master Plan[43]

Constraint Imposed

During the years leading up to the runway opening, Brisbane Airport undertook extensive community consultation on the expected noise impacts from the new runway opening. A number of noise abatement procedures were implemented, including a preference for operations over the bay when safe, and recommended flap settings to reduce airframe noise. However, despite these mitigation efforts and extensive community consultation, Brisbane Airport is now facing substantial pressure from residents for operational restrictions to be imposed due to impacts from changes to flight paths and noise redistribution since the new parallel runway opened in 2020.

[41] Brisbane Airport 2003 Master Plan
[42] Brisbane Airport 2003 Noise Management Strategies
[43] Brisbane Airport 2003 Master Plan

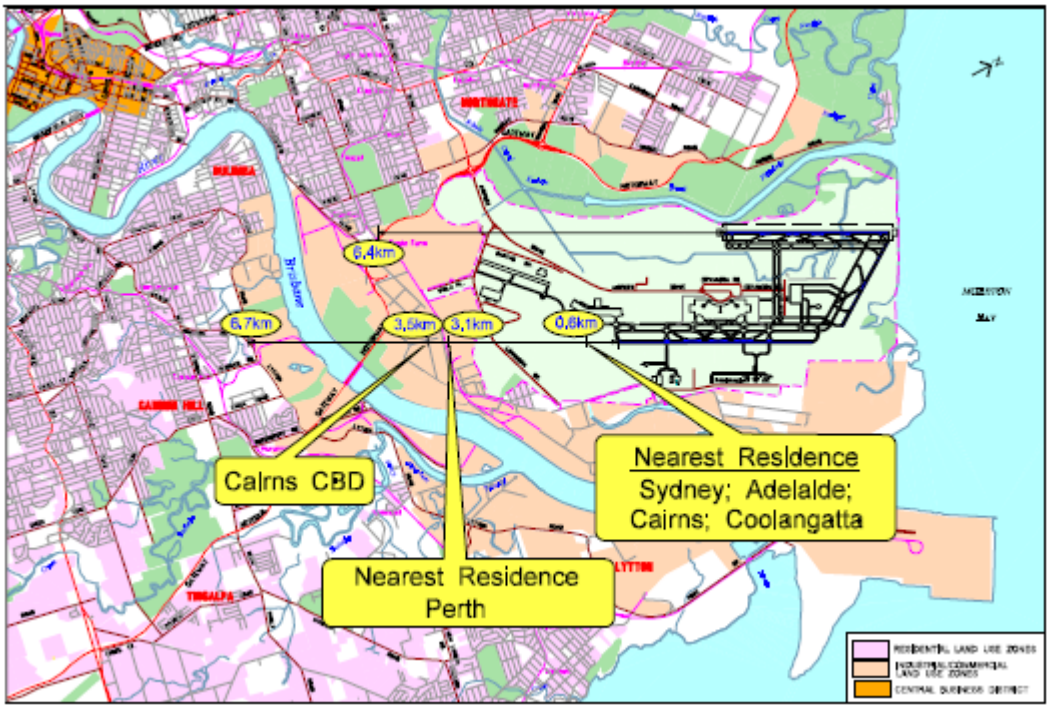


Figure 4 Brisbane Airport Noise Buffer Zones[Error! Bookmark not defined.]

In response to community concern, the airport announced in January 2022 that it would be running a 12-month trial of 3 initiatives to reduce noise[44]:

1. Extended use of SODPROPS (simultaneous opposite direction parallel runway operations);
2. Removal of intersection departures on the parallel runway; and
3. Introduction of a noise abatement procedure requiring jet aircraft to fly on standard flight paths until they reach 10,000-12,000ft.

Despite the airport responding to community concern with these noise mitigation initiatives, in February 2022 the Green party announced their plan to introduce a new bill in the Australian parliament to impose a curfew from 10pm to 6am and hourly flight caps of 45 movements per hour on the airport.[45] If this bill passes, it will have a very serious impact on the capacity of the airport, effectively rendering the development of the new parallel runway of no value since the airport was operating at around 50 movements per hour before its opening.

Key Findings

- Noise contours shrunk over the years due to changes in technology, allowing some urban development towards the airport.
- Brisbane Airport undertook a number of mitigative measures to reduce the impact of noise on the community including providing a substantial buffer zone, shifting the location of the new runway further from residents and implementing several noise abatements procedures.

[44] https://australianaviation.com.au/2022/01/brisbane-airport-to-trial-new-tactics-to-reduce-aircraft-noise/
[45] https://australianaviation.com.au/2022/02/greens-push-to-introduce-brisbane-airport-curfew/

- Even with a substantia buffer zone community outcry has led to a trial of three noise-reducing initiatives, two of which could reduce the capacity of the airport if kept in the long-term.
- Despite responsive actions to allay community concerns, community lobby groups and political parties are still pushing for a curfew and hourly movement caps.

Balanced Approach to Noise Management – Review of Key Pillars in Respect of Brisbane Airport

	Balanced Approach Pillar	Pillar Role and Process
1	Reduction of Noise at the Source	Enhanced technology but increased demand led to the need for parallel runway. Larger aircraft as international services grow.
2	Land-Use Planning and Management	Parallel runway location shifted towards Moreton Bay to reduce impacts on growing residential encroachment near the new runway.
3	Noise Abatement Operating Procedures	Opening of the new runway came with a number of noise abatement procedures to reduce noise impact on community, including increased operations over the bay.
4	Operating Restrictions	Trial of increased SODPROPS use and removal of intersection departures. Threats of curfew and hourly movement caps.
	Triggers	Changes to flight paths and redistribution of traffic on opening of new parallel runway

CASE STUDY 4: SCHIPHOL AIRPORT

Airport Introduction

Schiphol is the busiest airport in the Netherlands with over 80 million passengers per year before the COVID-19 pandemic. It has a mature runway system, with a 6th runway built in 2003 (known as the Polderbaan). The airport is located 15km from the downtown area of Amsterdam.

Context

In the 1970's a new town, Hoofddorp, was built right next door to Schiphol and, in the 1980's and 90's, neighbouring cities like Amsterdam and Amstelveen built new areas expanding towards the airport.[46]

Schiphol has had capacity limitations due to noise since the 1960's, but the extent to which noise has constrained the airport has changed over time.[47]

The new runway was constructed to increase capacity and to mitigate existing noise impacts in the vicinity of the airport. While it led to a reduction in the total number of people exposed to aircraft noise, new areas were exposed to aircraft noise that previously weren't.

Trigger for Constraint

Although aircraft noise has been an ongoing issue, following commissioning of the new runway, a 'consultation table' (developed during the 'Alderstafel' negotiations) was setup by the government in 2006 to provide advice on the development of Schiphol and other Dutch airports. This group was tasked with establishing the constraints that now define how the airport can grow and operate.

Constraint Imposed

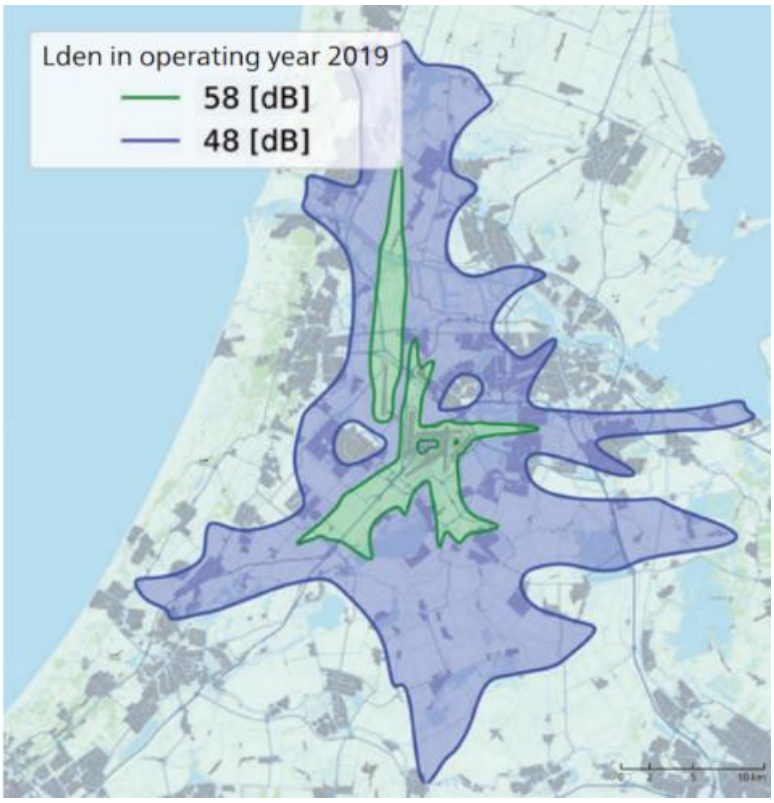
The Alderstafel negotiations produced a new system to control aviation noise. Constraints are now imposed based on the number of aircraft movements as well as exposure noise levels. Limits are for the total number of aircraft movements per year (500,000) and between 23:00 and 07:00 (32,000)[48]. The sound exposure allows up to 12,800 hours within the 58 Lden contours and 180,000 people within the 48 Lden contours. These legal maximum values are supposed to produce an equivalent protection against noise, existing in an older legal noise protection system before the reference year 2005. In the years leading up to the pandemic, Schiphol were consistently operating at or close to the 500,000 capacity, reaching 499,466 movements in 2018. In 2017, Singapore Airlines relocated half of their freight operations to Brussels Airport due to a significant reduction in freighter slots as a result of the movement cap.[49]

[46] M, Wijk & Brattinga, Kes & Bontje, Marco. (2010). Exploit or Protect Airport Regions from Urbanization? Assessment of Land-use Restrictions in Amsterdam-Schiphol. European Planning Studies. 19. 261-277. 10.1080/09654313.2011.532671.

[47] https://www.itf-oecd.org/sites/default/files/docs/airport-restricted-capacity-analysis.pdf

[48] https://slotcoordination.nl/wp-content/uploads/2021/09/Capacity-declaration-Amsterdam-Airport-Schiphol_Summer-2022.pdf

[49] https://www.lloydsloadinglist.com/freight-directory/news/SQ-to-transfer-half-its-Schiphol-freighter-flights-to-Brussels/70526.htm#.Yo3lx6hByUk



The system consists of 35 points around Schiphol, where the actual noise of passing planes is physically measured, and added up to annual totals per point. If a total at a certain point will exceed its legal maximum, the relating runway can no longer be used and traffic should be diverted to alternative runways.[50] This adds complexity for air traffic control and impacts on the capacity of the airport.

Environmental constraints, rather than operational constraints, limit runway capacity. This limits the number of slots available and potentially requires slot allocation rules to be developed to ensure the air traffic movement quota is not exceeded. As slots become scarce, there may be conflict between potential users and uses of the airport on who gets a slot at this airport and who must shift to secondary and commercially less desirable airports.

There has been a proposal for overflow traffic (beyond environmental capacity limit) to be shed to neighbouring airports, although it is now perceived that this just shifts the problem (shares the noise) and leads to NIMBY (not in my back yard) resistance.

Operational capacity is also limited by a preferential runway system to share the noise, which introduces complexity to runway operations and air traffic control.

Key Findings

- Noise contours are a means to cap movements;
- Growing encroachment leads to an increased need for community engagement to maintain buy-in. However, operating restrictions may be required to maintain community support;
- The airport was reaching the imposed movement limits before the COVID-19 pandemic and is needing to find ways to continue to grow under existing constraints without shifting the noise to other communities.

[50] https://hacan.org.uk/blog/wp-content/uploads/2015/04/Noise-reduction-Schiphol-.pdf

Balanced Approach to Noise Management – Review of Key Pillars in Respect of Schiphol Airport

	Balanced Approach Pillar	Pillar Role and Process
1	Reduction of Noise at the Source	Enhanced technology but more larger aircraft
2	Land-Use Planning and Management	Noise contours of 58 dB(A)Lden (“inner area”) and 48 dB(A)Lden (“outer area”). Legally binding limits.
3	Noise Abatement Operating Procedures	NADP2 could help increase AC movements cap.
4	Operating Restrictions	Maximum amount of noise is legally determined by maximum values for numbers of houses and people seriously hindered by aircraft noise. Far lower maximum noise values are applicable for night flights. Annual movement caps for all movements and separate nightly restrictions.
	Triggers	2008 Schiphol Table of Hans Alders (Alderstafel)

CASE STUDY 5: Toronto Pearson International Airport

Airport Introduction

Toronto Pearson International Airport is Canada's largest hub at over 50 million passengers per year prior to the COVID-19 pandemic. It currently has 5 runways, with Runway 15R/33L added in 1997 and Runway 06R/24L completed in 2002. The airport is located 30km from downtown Toronto.

Context

Despite being opened in 1938, it was only in 1959 that land use development policies using noise contours were considered, ahead of a significant phase of expansion. By that time, urban encroachment was already present and the airport was expanding beyond its original boundaries. While noise contours were used to inform growth plans, it was only after privatization that an Airport Operating Area (AOA) was implemented in official city plans to control residential development in the vicinity of the airport, albeit with some exemptions. The AOA was developed using composite contours (i.e. multiple scenario envelopes based on prevailing winds for the 95th percentile day).[51]

Trigger for Constraint

Constraints on aircraft movements were initially triggered by the privatization of the airport in 1997. Furthermore, in February 2012, NAV CANADA implemented changes in the Toronto-Ottawa-Montreal corridor (the main flight route between these centres) and the relocation of the downwind arrival flight paths 1.8 km south, triggering negative community reactions and operational constraints. Interestingly many of the community responses came from locations outside the revised contours which highlights how noise does not stop at the NEF contour's boundary and residential areas outside of defined contours can influence airport operational constraints.[52]

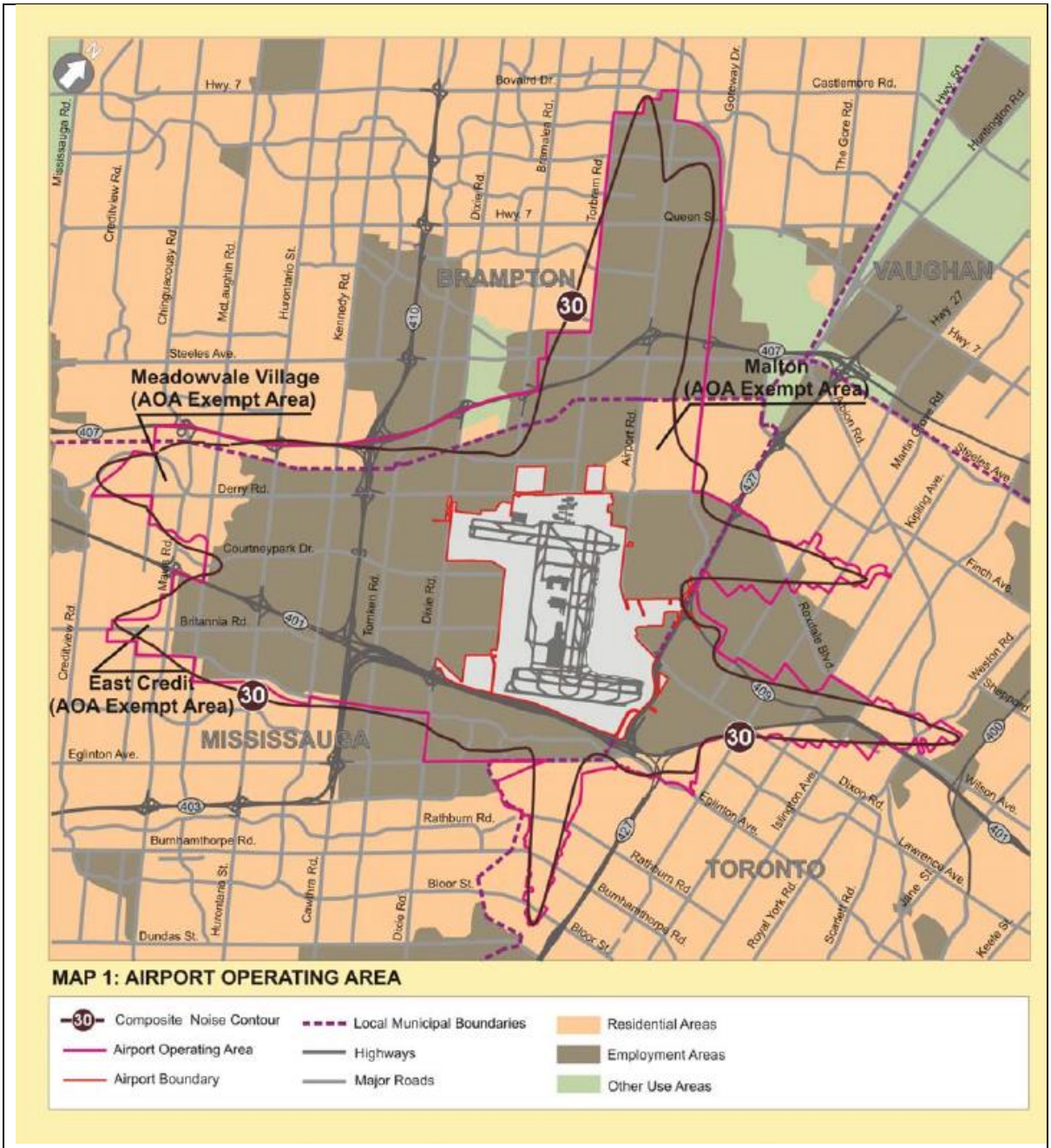
Constraint Imposed

The main constraint is a night flight "budget" which is the maximum number of movements per year to operate between 12:30am and 6:30am. It can be increased by a percentage equivalent to the growth in passenger movements although a 10% bump up is allowed if 95% of the night cap is reached.

Attempts to introduce noise sharing were thwarted by the community, feeling that they were being forced to decide who would get exposed to noise rather than how everyone could be better off.

Key Finding

Community reaction can occur well outside the contours, where communities are not normally exposed to aircraft noise. In the case of Toronto-Pearson, contours are used to minimise further encroachment rather than to prevent it altogether. Attempts to establish proper safeguarding areas around the airport have been difficult to effect due to lack of land use planning controls, leading to various development concessions within the AOA and exposing more people to aircraft noise. Mitigation options are therefore limited if the noise contours cannot enable flexible operational changes (e.g. preferential runways) without impacting residents living within the contours.



YYZ Airport Operating Area (AOA)

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[51] https://cdn.torontopearson.com/-/media/project/pearson/content/community/noise-management/pdfs/noise-forums/2013-04-backgrounder---gtaa-land-use-planning-section-and-its-role-in-municipal-development.pdf

[52] https://cdn.torontopearson.com/-/media/project/pearson/content/community/noise-management/pdfs/annual-noise-reports/2013-annual-noise-report.pdf?modified=20190426200044&rev=c29fe5c549754a8eb536954b8f9f11b8&hash=31AC0267C3FACB2F64CAB4BCEC3C4411

Balanced Approach to Noise Management – Review of Key Pillars in Respect of Toronto Airport

	Balanced Approach Pillar	Pillar Role and Process
1	Reduction of Noise at the Source	Enhanced technology but more larger aircraft.
2	Land-Use Planning and Management	NEF Contours. AOA based on multiple scenarios.
3	Noise Abatement Operating Procedures	Preferential Runways.
4	Operating Restrictions	Night noise budget.
	Triggers	Privatization Airspace Redesign (2012)

[i] https://www.nzairports.co.nz/assets/Files/public/NZ-Airports-Submission-on-the-Urban-Development-Bill2.pdf (accessed 14/07/2021)

[ii] https://www.nzairports.co.nz/assets/Files/public/Airport-Master-Planning-NZ-Airports-Feb-2017-FINAL2.pdf (accessed 14/07/2021)

[iii] https://www.infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/index.aspx

[iii] https://www.transport.govt.nz/statistics-and-insights/air-and-sea-transport/sheet/air-freight (accessed 14/07/2021)

[iv] https://www.christchurchairport.co.nz/about-us/who-we-are/gateway-to-antarctica/ (accessed 14/07/2021)

[v] https://www.comnap.aq/our-members/programma-nazionale-di-ricerche-in-antartidepnra/ (accessed 14/07/2021)