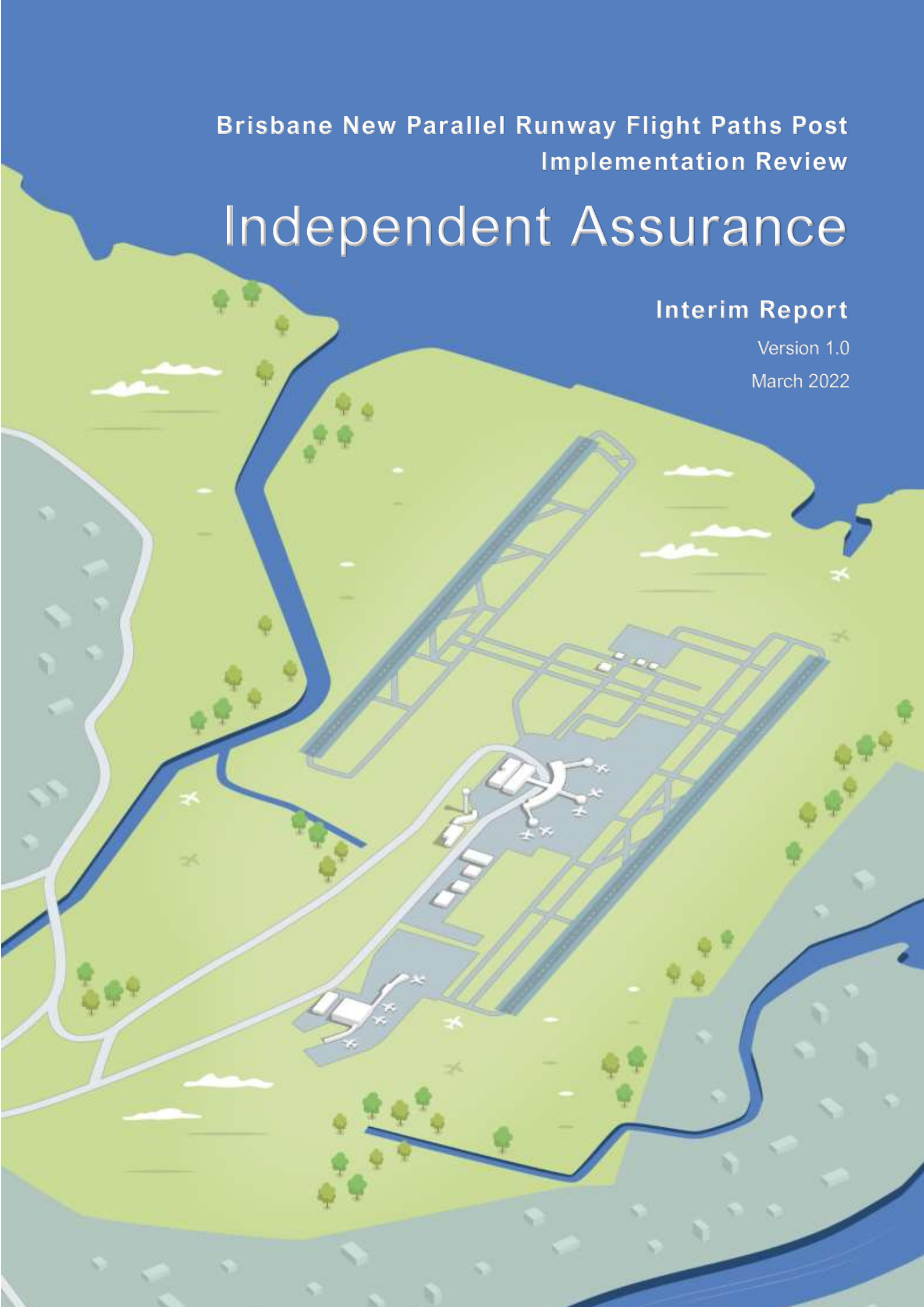
Brisbane New Parallel Runway Flight Paths Post Implementation Review

Independent Assurance

Interim Report

Version 1.0

March 2022



- Blank page -

Contents

Introduction

1. Airservices Australia (ASA) has engaged Trax International Limited (Trax) to conduct an independent assurance review of the Brisbane New Parallel Runway (NPR) Flight Paths Post Implementation Review (PIR). The Trax team report directly to the ASA CEO and are tasked with identifying potential improvement opportunities across all aspects of the PIR. This interim report summarises the initial outputs arising from the first phase of assurance activities conducted by Trax during February and March 2022. The outputs will be tested and refined during April and May 2022, working in collaboration with the key aviation and community stakeholders that have contributed to the first phase of the review. Full details of the Trax analysis and improvement recommendations will be set out in a final report that is due to be published in June 2022.

Scope and objectives of the first phase of the independent assurance review

2. The first phase of the assurance review concentrates on the environmental performance and operational efficiency of the NPR airspace design implemented by ASA to support Brisbane Airport's parallel runways, with a particular focus on opportunities to limit and where possible reduce the impacts of aircraft noise. It includes the use of new arrival and departure flight paths, their integration with the wider route network and the noise abatement procedures (NAPs) used to mitigate the impact of overflights on local populations. Although the safety of the operation and its compliance with regulatory standards are key aspects of the PIR, the Trax phase 1 activities do not extend to an independent safety assurance review or assessment of regulatory compliance.

3. In the first two months of the assurance review, the Trax team has engaged directly with specialists from ASA to examine the features of the NPR airspace design and conduct an independent analysis of potential improvement opportunities. We have discussed the approach to the PIR, the issues raised by Brisbane residents following runway opening and the potential for improvements with representatives from the local community through the Brisbane Airport Post Implementation Review Advisory Forum (BAPAF). Our analysis is also informed by inputs from Brisbane Airport Corporation (BAC), key airlines operating at the airport, other aviation stakeholders and the Australian Civil Aviation Safety Authority (CASA). In this capacity, we have:

   - Observed directly how the airfield operation and airspace is currently managed by Air Traffic Control (ATC) at the Brisbane Tower and Terminal Control Unit (TCU);
   - Gathered a range of operational, analytical and community feedback on the performance of the NPR airspace design; and
   - Identified an initial 'long list' of 49 potential improvement opportunities linked to the NPR airspace design, operational procedures, supporting technologies and the processes for coordinating the planning, community engagement and governance of any proposed changes.

4. We have organised the improvement opportunities identified during the first phase of the assurance review into groups based on their potential to support five key objectives arising from the feedback gathered so far:

   Objective A. Maximise flights over the bay

   Objective B. Reduce noise impacts when overflying populations

   Objective C. Optimise noise sharing arrangements

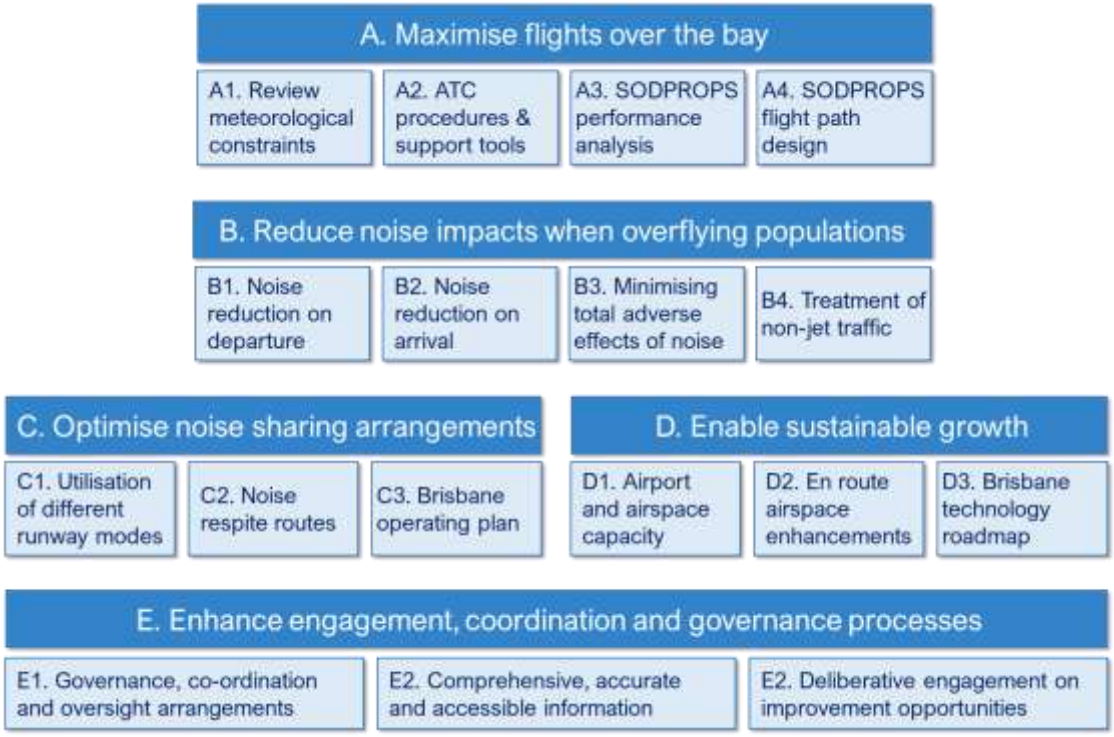
   Objective D. Support sustainable growth in the airport's operations

   Objective E. Enhance engagement, coordination and governance processes

5. These objectives are presented broadly in priority order from A to D. The engagement, coordination and governance processes considered under objective E are important enablers for the achievement of the other four, particularly for the medium and longer-term opportunities that may involve more extensive community and aviation stakeholder engagement and the prospect of difficult trade-off decisions.

6. The specific improvement opportunities are sub-divided into themes under each objective, as set out in the Independent Assurance Review Framework illustrated in figure 1.

Figure 1: Brisbane NPR PIR Independent Assurance Review Framework



7. The assurance review is still at a formative stage. The information provided in this interim report is intended to summarise, illustrate and provide a high-level evaluation of our initial observations and the feedback provided by stakeholders. The report draws on information gathered from a range of sources, including published documents, data samples, desktop analysis and discussions with stakeholders and operational experts.

8. The outputs of the interim report provide guidance on the areas where detailed further work may be required to inform decisions about which improvement opportunities to progress, how and when. It is important to highlight that on further examination, although technically viable, some of the potential opportunities may not prove to be operationally feasible or sufficiently beneficial in the context of the overall approach to improving the airspace and the trade-offs with other important areas of performance such as; the long-term capacity of the airport to meet the future demand for aviation; the resilience of the operation to adverse weather and unplanned events; and, the imperative to reduce aircraft emissions in line with Australia's commitment to achieving net-zero targets.

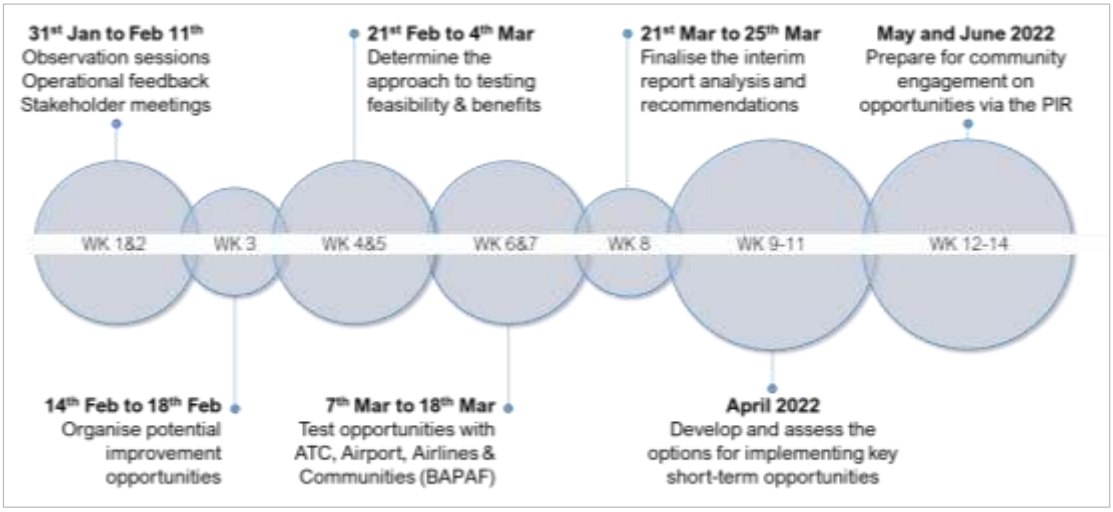
9. We intend to conduct a series of additional stakeholder meetings, including community workshops during May and June 2022 to examine the feasibility, benefits and dependencies associated with the improvement opportunities in greater detail. This analysis will be used to inform options for the implementation of key short-term improvement opportunities and to define the approach to further community and aviation stakeholder engagement on the medium-term and longer-term options.

10. Some of the improvement opportunities share interdependencies with others. It may make sense to progress certain opportunities before others where they affect related parts of the operation or aim to deliver similar outcomes. Some of the opportunities may build on the improvements achieved by others and should be sequenced accordingly. Other opportunities may seek to tackle the same challenge differently and trade-off decisions may be required to choose which approach to follow. Many of the medium and longer-term opportunities that would involve more fundamental changes to flight paths should be considered collectively as part of a coherent options development and assessment process. The opportunities captured under objective E offer suggestions on how this process might be conducted effectively, by drawing together analytical information on the potential impacts of various design choices with feedback from iterative rounds of stakeholder engagement to refine options towards an optimal outcome that seeks to balance the overall costs and benefits of the operation.

11. The availability of specialist resources and the rate and scale of change that the Brisbane operation can safely accommodate are important limiting factors on how many opportunities can be developed and implemented in a given timeframe. Local community and aviation stakeholders should be involved in the development of options to deliver on improvement opportunities from a formative stage, during the impact assessment and, for those options that progress, into implementation. The size and nature of the specific interdependencies between the improvement opportunities will be examined in greater detail, and informed by further stakeholder engagement, in preparation for the final report.

12. Figure 2 illustrates the scope and timeline for the first phase of the assurance review.

Figure 2: Summary of the scope and timelines for the first phase of the assurance review



13. The first phase of assurance activities have given us a high level of confidence that the further development and implementation of a combination of the improvement opportunities identified in the interim report can deliver:

- **Perceptible improvements** in the impacts of aircraft noise for residents currently affected by the NPR airspace design.
- **Greater predictability** for residents regarding the noise that is created by the Brisbane operation and the methods that are available to share the impacts across different areas.
- **Continuous improvements** in the environmental performance of the airspace, generating progressively more effective noise mitigations over time that are measured and managed through robust and transparent planning, community engagement, and oversight processes.

14. The next section of the interim report provides some important background information regarding the context for the independent assurance review. Thereafter, the remaining sections are organised around the five objectives outlined above and describe the potential improvement opportunities.

15. The expected timelines for the development and implementation of each opportunity (if it were proven both feasible and chosen to progress) are indicated in the following terms:

    - **Short-term**: 1-9 months, involving moderate regulatory, community and aviation stakeholder engagement and system/technology adaptations;
    - **Medium-term:** 9-18 months, involving some potential regulatory validation and approvals, more extensive community and aviation stakeholder engagement and system/technology developments.
    - **Long-term:** 18 months+, opportunities to be considered as part of a coherent longer-term planning process with potential policy, regulatory, community and aviation stakeholder engagement, system and/or technology developments.

Background

16. The introduction of a wide-spaced parallel runway was a key feature of the long-term plan for Brisbane Airport since it opened in 1988. The NPR is a key piece of infrastructure that will enable continued aviation growth in Brisbane and the surrounding region to meet the demands of the community that the airport serves, now, and for future generations. A proposal for the construction of the NPR was included in the Brisbane Airport Master Plan in 2003. This proposal was subject to two important pieces of legislation – the Airports Act, 1996 and the Environment Protection and Biodiversity Conservation Act, 1999. To fulfil the requirements of both Acts, BAC developed a Major Development Plan (MDP) and an Environmental Impact Study (EIS). The draft EIS and MDP were released for public comment between October 2006 and February 2007.

17. Ground improvement works for the NPR were delivered between 2012 and 2015. Runway construction started in 2016 and the NPR opened in July 2020, during the first phase of the COVID-19 pandemic. The EIS considered various concepts for potential flight path designs to support the parallel runway operation and recommended a preferred option. The actual NPR airspace design was produced by ASA several years later (between 2016 and 2019) and incorporated new ATC concepts, approaches to modelling noise impacts and changes in the fleet mix operating at the airport.

18. BAC published an updated Masterplan in 2020 that forecasts traffic will grow from a base of 195,000 annual flights in 2015 to 520,000 flights in 2054. Traffic levels were significantly lower than expected during 2020 and 2021 due to international and domestic travel restrictions. Annual passenger numbers dropped from 24m in 2019 to 7.7m in 2020. The airport served approximately 173,000 flights between August 2020 and January 2022, with traffic split relatively evenly between the new runway and legacy runway respectively. Jet aircraft accounted for around 70% of the traffic and turboprops for most of the remainder. Over 90% of the flights were Inter/Intra State journeys, of which approximately 55% were connections to other airports in Queensland.

19. For the majority of the day, Brisbane airport tends to operate a mixed-mode dual parallel runway operation with arrivals and departures operating from both runways simultaneously. From the period August 2020 to January 2022, the parallel runways were operated in three main modes:

    - 19 operations: Arrivals from the South over the bay on the legacy runway (19L) and arrivals from the North over the bay on the new runway (19R); Departures to the North from the new runway (19R) over the city and departures to the South from the legacy runway (19L) over the city. This was the most common mode during the winter.

    - 01 operations: Arrivals from the South over the city to the legacy runway (01R) and arrivals from the North over the city to the new runway (01L); Departures to the North over the bay from the new runway (01L) and departures to the South over the bay from the legacy runway (01R). This was the most common mode during the summer.

    - SODPROPS: Simultaneous Opposite Direction Parallel Runway Operations, enabling arrivals and departures to operate simultaneously over the bay. This was the most common mode during the night-time period.

20. ASA commenced the Brisbane NPR Flight Path PIR on July 30th 2021, 12 months after the NPR airspace design became operational and there was sufficient data (accounting for seasonal variations and accepting lower traffic levels due to COVID-19) to support the review. It is envisaged that the outcomes of the PIR will be used by ASA to inform future change proposals, decision-making and the continuous improvement of processes, as

well as to identify opportunities to improve noise outcomes and operational efficiency. The PIR is reviewing the actual noise and operational outcomes against those forecast during planning, the effectiveness of the Brisbane Airport NAPs, the efficiency of the flight paths and opportunities to minimise the impact of aircraft operations on the community.

21. Despite lower than expected traffic levels, complaints from Brisbane residents regarding aircraft noise started to grow following the NPR opening. The Aircraft Noise Ombudsman (ANO) received 265 complaints up to June 30th 2021. The majority were raised during November and December 2020, including one from the Brisbane Flight Path Community Alliance (BFPCA) that included a survey of 2,075 residents. Most complaints originated from areas nearer to the NPR. A small but significant number relate to areas considerably further away. When viewed collectively, the complaints highlight the community's general expectation that the NPR would lead to a much larger share of Brisbane traffic arriving and departing simultaneously over water and their concerns that noise impacts in the city and surrounding suburbs are greater than expected. Figure 3 illustrates the areas where the majority of the complaints were raised.

Figure 3: Areas where the majority of noise complaints were raised between Aug-20 and Jun-21

22. The BAPAF was established by the Government in September 2021, in recognition of the significant community interest in the NPR airspace design and the need to have an independent view of the PIR. The BAPAF aim to provide ASA with a community-orientated forum that can be actively engaged throughout the PIR process. The forum received 385 submissions from residents across 47 Brisbane suburbs about the PIR that raise several concerns, including the volume of flights over populations, the management of noise and the engagement process.

23. The first BAPAF quarterly report summarises the activities conducted by the forum between October and December 2021. The report focuses on short-term noise improvement measures, specifically; a trial requiring all jet traffic to use the full length of the runway on departure (captured in this report as opportunity B1.1); a trial to extend the use of SODPROPS between 6am and 8am on weekends (captured as part of opportunity A3.1) and the introduction of a NAP requiring jet traffic to remain on the published departure route until 10,000-12,000ft. (captured as part of opportunity B1.3). BAPAF also recommended the appointment of an independent specialist advisor to review and make improvement recommendations across all aspects of the PIR.

Objective A: Maximise Flights Over the Bay

24. The top priority objective of the potential improvement opportunities identified through the independent assurance activities is to maximise the number of Brisbane flights that arrive and depart simultaneously over water, rather than overflying populations in the city and surrounding suburbs.

25. The proportion of total flights that operate simultaneously over water is determined by how the parallel runways are used together. ATC at airports with parallel runways typically direct inbound and outbound flights to arrive and depart in the same direction. At Brisbane Airport, this means, when inbound flights arrive over water, outbound flights depart in the same direction over the city. Similarly, when flights arrive over the city they depart over the water. The impacts of aircraft noise arising from Brisbane operations reduces significantly when arrivals and departures operate simultaneously, in opposite directions, over the water, using a runway mode known as SODPROPS.

26. The EIS considered SODPROPS the preferred runway mode for operations when meteorological and capacity conditions permit. To maintain high standards of safety, simultaneous opposite direction operations can only be used when the weather is relatively calm and the flow of inbound and outbound flights is reasonably light. There is a clear expectation in the EIS that these conditions would mainly arise during the nighttime, early morning and late evening periods and that SODPROPS is a low to medium capacity mode.

27. One of the keys to unlocking the full potential of SODPROPS is to remove the obstacles and complications that may make using the mode at Brisbane complex to initiate, harder to operate within the current NPR airspace design, and difficult to exit when the airport must revert to a higher capacity mode. The potential improvement opportunities that may help to maximise the number of flights arriving and departing simultaneously over the water are grouped into four themes described in table 1.

Table 1: Themes linked to maximising flights over the bay

#	Theme	Description
A1	Review metrological constraints	The volume of time that SODPROPS may be used is, in part, determined by the wind speed, wind direction and other meteorological conditions. A review of the met constraints attached to the use of SODPROPS is intended to highlight specific opportunities to expand the potential use of the preferred mode when the conditions permit.
A2	ATC procedures and support tools	The ATC procedures and tools used in the Brisbane operation to plan for, initiate, deliver and exit SODPROPS are also an important determinant of how often the preferred mode can be used when the conditions permit. In general terms, the simpler it is to initiate SODPROPS and exit if the weather changes or a higher capacity mode is required, the more often it can be used.
A3	SODPROPS performance analysis	Analysis of post-operational data regarding the use of SODPROPS, by time and type of day (weekday or weekend), and correlation with the traffic situation and met conditions is intended to highlight the times when the preferred mode was available since runway opening. This analysis may help to identify short term opportunities to increase the use of SODPROPS at different times of the day and evaluate the specific constraints that may need to be addressed.

A4	SODPROPS flight path design	A review of the existing NPR airspace design to optimise the performance and capacity of the operation when SODPROPS is in use is intended to highlight specific options to enhance the use of the preferred mode. The review should consider the interdependencies with the wider route network that serves Brisbane and adjacent airports, the treatment of segregated portions of airspace linked to Military operations from Amberly and novel airspace design concepts that may increase runway throughput while SODPROPS are in use.

28. The specific improvement opportunities identified during the first phase of assurance activities that align with each theme are set out in the sections below.

A1: Review meteorological constraints associated with the use of SODPROPS

29. Two potential improvement opportunities associated with the met constraints that limit the overall volume of time when conditions permit the safe use of SODPROPS were identified during the first phase of assurance activities, these are:

- Safety assurance for a 7-knot tailwind limit [short-term]
- A wider review of the met constraints associated with SODPROPS [medium-term]

A1.1 Safety assurance for a 7-knot tailwind limit [short-term]

30. To assure the safety of the operation, a 5-knot tailwind limit is currently applied as a constraint on the use of SODPROPS. This caps the overall volume of time when the wind conditions are considered suitable to operate the runways in the preferred mode. The speed and direction of any crosswind is also a constraint above 20 knots. The development of a robust safety case that justifies increasing the tailwind limit for SODPROPS to 7-knots will expand the overall volume of time when the wind conditions permit arrivals and departures to operate simultaneously over the water.

31. A 5-knot tailwind limit is currently the maximum threshold that complies with the international regulatory framework laid down by ICAO.[1] Most standard operating procedures applied by aircraft operators, and the instructions provided to them by manufacturers, are aligned to ICAO guidance and may have to be amended for the Brisbane operation, to support the development of the safety case and implementation of a 7-knot limit. A significant amount of work has already been conducted by ASA and BAC to develop robust safety arguments for increasing the SODPROPS tailwind limit. Some of the work draws on international experience, regarding the application of tailwind limits at other large commercial air transport airports in Europe and North America. ASA and BAC expect that when the safety assurance material is finalised it will be submitted to CASA for review, validation and if appropriate regulatory approval to increase the tailwind limit.

A1.2 A wider review of the met constraints associated with SODPROPS [medium-term]

32. Additional met constraints associated with the use of SODPROPS (beyond wind speed and direction, considered in A1.1) include the requirement for dry runways and visual conditions. Specifically, conditions permit the use of SODPROPS if:

- Visibility is 8km or greater
- The cloud base is not lower than 2500ft.
- The runway surface is dry

[1] ICAO – International Civil Aviation Organisation sets the international air navigation standards for civil aviation.

33. These constraints are important mitigations for the safety assurance to increase the tailwind limit to 7-knots (A1.1), but also limits the overall volume of time when the preferred mode can be used. One potential improvement opportunity is to examine the safety arguments that support how the wider met constraints are applied to the Brisbane operation and consider potential mitigations that may further expand the conditions when SODPROPS can be used. This opportunity should be viewed as a potential option for consideration pending the outcome of the work conducted as part of A1.1.

A2: ATC procedures and support tools associated with the use of SODPROPS

34. Four potential improvement opportunities associated with the ATC procedures and tools used in the Brisbane operation to optimise the use of SODPROPS were identified during the first phase of assurance activities, these are:

- Clear and unambiguous instructions regarding the use of SODPROPS [short-term]
- Decision-making criteria for the use of SODPROPS [short-term]
- Forecasting and decision making support tools for SODPROPS [medium-term]
- System adaptations to support SODPROPS initiation and exit [medium-term]

A2.1 Clear and unambiguous instructions regarding the use of SODPROPS [short-term]

35. Ambiguity regarding how and when the SODPROPS mode can be used may lead to missed opportunities in the future to maximise flights arriving and departing simultaneously over water. The 'instructions' that describe what is permitted during SODPROPS and when are captured in a range of different materials. One potential improvement opportunity is to set out a single, consolidated set of SODPROPS instructions that offer ATC (and other stakeholders) with clear and unambiguous guidance on the approach to optimising the use of the preferred mode. The instructions may include delay criteria triggers, capacity considerations, the anticipated duration of SODPROPS in different scenarios, the time expected to change to SODPROPS from different runway modes of operation (some modes may be easier to change to SODPROPS than others) and the time expected to revert to higher capacity modes. Airport and airline feedback should be considered as part of the consolidation of the instructions. The use of SODPROPS during the daytime may have a knock-on effect with gate usage, scheduling, and fuel burn (through extra track miles). There may be other procedural or flight path design opportunities to ameliorate these issues but they should be considered as part of a coherent analysis of the overall instructions.

A2.2 Decision-making criteria for the use of SODPROPS [short-term]

36. Optimising the use of SODPROPS in the future may also be supported by the opportunity to clearly define the roles and responsibilities for the decision to initiate or exit the mode. These decisions are informed by tactical inputs from both the Tower ATC (with a focus on runway and airfield operations) and the TCU (with a focus on the emerging traffic situation in the surrounding airspace), but the final arbiter may be unclear, potentially creating missed opportunities to use the mode. Measures to further enhance the coordination and information sharing between ATC in the Tower and TCU may also improve the effectiveness of decision making regarding the optimisation of SODPROPS. For example, both parts of the operation may benefit from the provision of digital information to consistently gauge workload, capacity and demand in real-time based on a view of the emerging traffic situation in the air and on the ground.

A2.3 Forecasting and decision making support tools for SODPROPS [medium-term]

37. The tailwind and crosswind limits for SODPROPS require accurate wind measurement. The wind speeds are derived from anemometers, one based at each end of the two runways. There are reported issues with the anemometers in that the readings between the four devices can vary. One of the devices is potentially affected by sea breezes, another is affected to some degree by a bank of trees. Discrepancies in the data may deter the decision to optimise the use of SODPROPS.

38. One potential improvement opportunity is to review the accuracy of the wind data provided to the operation to determine the extent of the discrepancies between the anemometers. The accuracy could also be assured by using readings derived from a LIDAR (Light Detection and Ranging) system. The review may also consider other anemometer positions that are more appropriate for the relevant runway ends. There is also an interdependency with the development of the safety assurance for a 7-knot tailwind limit (A1.1). If pilots and ATC are not confident in the anemometer's readings, they may apply additional caution when deciding to initiate SODPROPS, potentially eroding the benefits of the 7-knot tailwind limit if it is approved by CASA.

39. In addition to the tailwind and crosswind limits, the other data sets that may inform the decision to introduce SODPROPS are currently brought together and reviewed manually. One potential improvement opportunity is to examine the feasibility of an automated SODPROPS decision support tool that combines the relevant data streams and forecast information into a single definitive indication for ATC, e.g. a colour coded system giving indications of actual and forecast SODPROPS conditions for a set period of time. Another example opportunity may be to consider the provision of a dedicated calm weather forecast information service tailored for the Brisbane operation that provides advance notice to ATC of emerging conditions that permit the use of SODPROPS.

A2.4 System adaptations to support SODPROPS initiation and exit [medium-term]

40. One potential improvement opportunity is to examine options to reduce the time intervals and complexity associated with initiating SODPROPS. In the current operation, changing between runway modes seems to bring some considerable time penalties. For example, there is a minimum requirement of 8 minutes between the last arrival in the more common dual runway modes and the first landing aircraft in SODPROPS. Similarly, a minimum 12 minutes spacing is applied between the last dual runway mode departure and the first SODPROPS arrival. ATC use a support tool known as MAESTRO to establish an efficient sequence of inbound and outbound traffic flows. The MAESTRO sequencing function, whilst highly effective, is reasonably rigid. For example, outbound aircraft are typically committed to depart from a specific runway approximately 20 to 30 minutes before take-off during dual runway operations. These time intervals may add complexity and deter the decision to initiate SODPROPS when the conditions permit. Brisbane tower controllers use a system known as INTAS (the Integrated Tower Automation Suite) to manage traffic with greater flexibility as the demand and capacity situation changes. INTAS may offer the functionality to initiate SODPROPS more quickly and with less manual intervention, but this specific functionality is not currently active in the system in use at Brisbane.

A3. SODPROPS performance analysis

41. Two potential improvement opportunities associated with the analysis of the actual and theoretical capacity that may be achieved using SODPROPS were identified during the first phase of assurance activities, these are:

- Post operational analysis to evaluate SODPROPS potential [short-term]
- Modelling & simulation of SODPROPS maximum capacity threshold [medium-term]

A3.1 Post operational analysis to evaluate SODPROPS potential [short-term]

42. There are over 18 months of data available about the application of SODPROPS in the Brisbane operation that may be used to inform improvements via post-operational analysis. For example, there is a lack of clarity about the overall volume of time since runway opening when the conditions would have permitted SODPROPS (i.e. the met, schedule and capacity conditions were all appropriate) at different times of the day. One potential improvement opportunity is to conduct an analysis of the existing post-operational data to determine the total volume of time that SODPROPS could have been initiated compared to actual usage and examine the size and timings of the gaps.

43. Figures 4 and 5 provide a simple example of the potential impact of optimising the use of SODPROPS across different times of the day. Figure 4 illustrates the average proportion of time that SODPROPS were used during each hour of the day, from August 2020 to January 2022 (the bar portion shaded blue). A theoretical 10% increase in the use of SODPROPS is added from 6pm, through the night-time to 10am (the portion of the bars shaded orange). Figure 5 illustrates the total volume of traffic operating over the bay during each hour and highlights the additional flights achieved by the theoretical 10% increase in SODPROPS. The conclusion to this theoretical example is that a 10% increase in the use of SODPROPS in the mornings and evenings could lead to an overall 55% to 60% increase in the total volume of flights arriving and departing simultaneously over the water (if all other factors remain equal).

Figure 4: Actual proportion of SODPROPS use by hour of day (blue) and example 10% increase (orange)

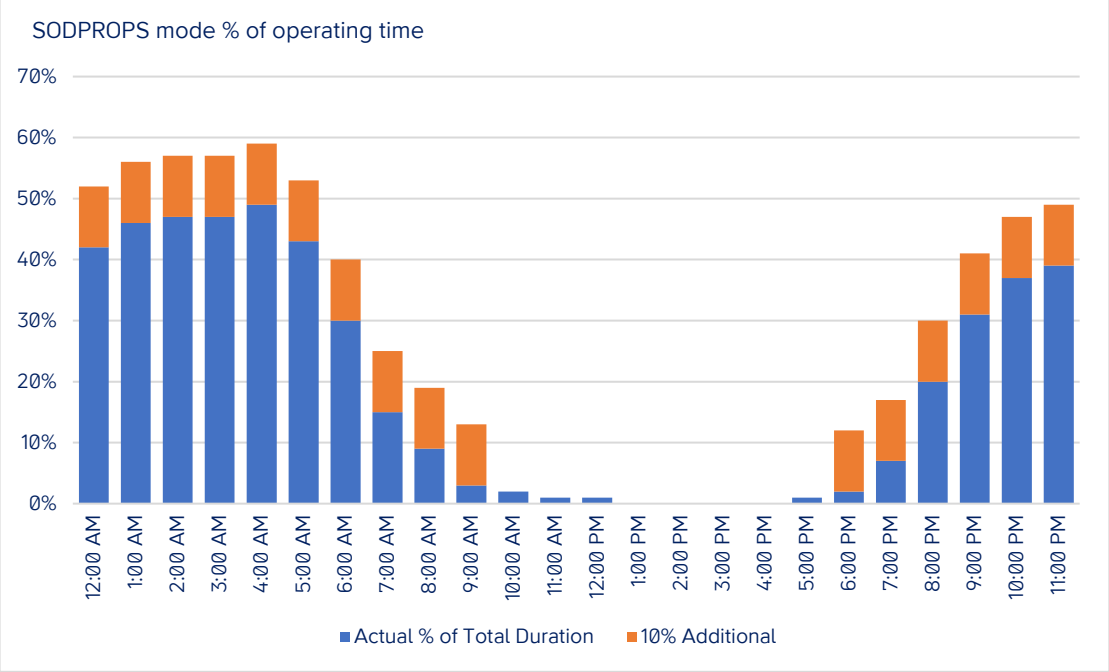
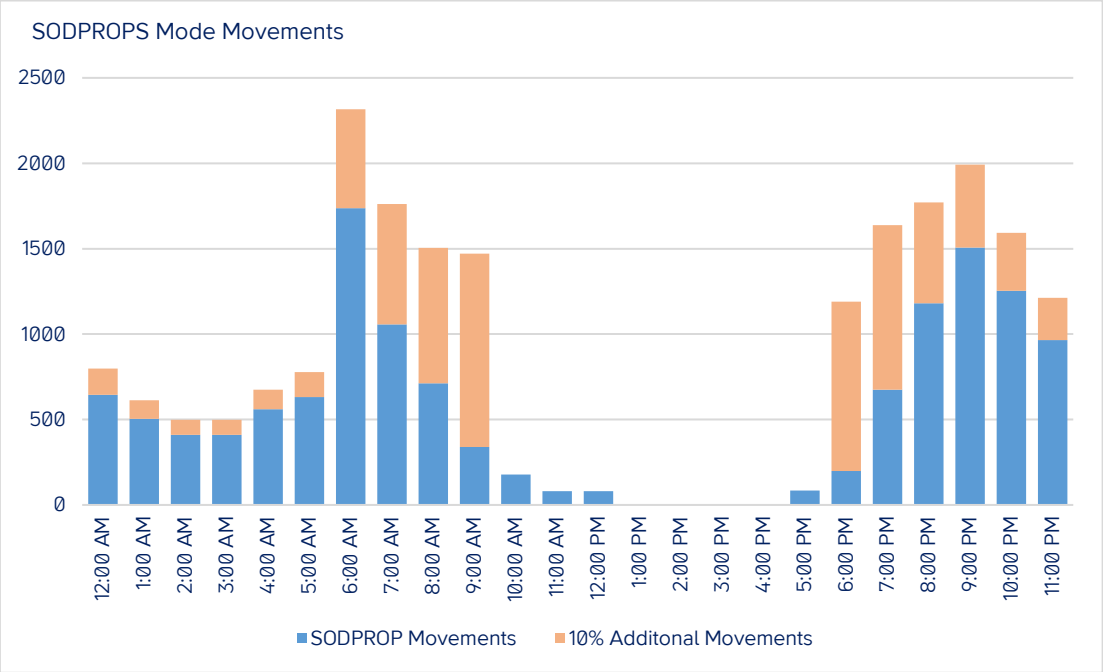


Figure 5: Total flights using SODPROPS by hour of day (blue) & impact of 10% increase (orange)



A3.2 Modelling and simulation of SODPROPS maximum capacity threshold [medium-term]

44. There is limited information available regarding the overall maximum capacity that the Brisbane operation could achieve during SODPROPS, through simulation or actual usage. The EIS highlights that when the total number of aircraft exceeds 55 in a single hour, the SODPROPS mode would not be available. The SODPROPS Arrival Acceptance Rate (AAR) for the Brisbane operation is promulgated at 20 arrivals per hour. Similarly, Sydney airport applies a standard flow rate for SODPROPS of 24 arrivals per hour.

45. One potential improvement opportunity is to produce an operational model, simulation or digital twin to determine the maximum theoretical runway capacity when operating SODPROPS in the Brisbane operation using the existing NPR airspace design, and again with all airspace constraints removed. The output of the modelling/simulation may indicate the size of the potential benefits generated by measures to optimise the use of SODPROPS at different times of the day.

A4. SODPROPS flight path design

46. Three potential improvement opportunities associated with the flight path design changes that may optimise the performance and capacity of SODPROPS were identified during the first phase of assurance activities, these are:

- Re-positioning routes that serve en route traffic [medium-term]
- Examining Big Amberly's impact on westerly arrivals during SODPROPS [short-term]
- Wider airspace redesign to enable the use of SODPROPS [long-term]

A4.1 Re-positioning the routes that serve en route traffic [medium-term]

47. The airspace interactions between the routes at higher altitudes that serve Brisbane airport and traffic transiting across the region seem to create interdependences that may limit the application of SODPROPS, especially during the daytime. The ATC workload dedicated to managing en route traffic flows seem to add unnecessary complexity to the primary Brisbane TCU functions. One potential improvement opportunity is to consider redesigning the routes that serve en route traffic in the region to deconflict them from the core Brisbane operations, reducing the complexity of the airspace that surrounds Brisbane and protecting ATC capacity that may, in turn, be dedicated to optimising the use of SODPROPS when conditions permit.

48. Figure 6 illustrates the locations of Brisbane Airport relative to other airports in the region.

Figure 6: Brisbane Airport location relative to adjacent airports and airfields

A4.2 Examine Big Amberly's impact on westerly arrivals during SODPROPS [short-term]

49. A standard approach route (known as the ENLIP STAR) that is used to manage some Brisbane traffic inbound from the West is restricted when the larger portion of segregated airspace (known as Big Amberly), which is reserved for Military operations from Amberly airfield, is activated. Operational feedback indicates that the constraints on the use of the ENLIP STAR may limit the ability to conduct SODPROPS efficiently during the daytime. One potential improvement opportunity is to examine this issue in greater detail in collaboration with military stakeholders and evaluate options to deconflict the ENLIP STAR from Amberly airspace either tactically or procedurally, optimising the use of SODPROPS when the conditions permit.

A4.3 Wider airspace redesign to enable the use of SODPROPS [long-term]

50. The Brisbane terminal airspace structure and route network are reasonably complex with route interactions and crossing traffic. The complexity of the ATC tasks for TCU controllers seems to increase further when SODPROPS are used in the current NPR airspace design. For example, some of the existing departure procedures used during SODPROPS seem to increase ATC workload and add considerable track miles to certain routes. One potential improvement opportunity is to conduct a comprehensive review of the Brisbane terminal airspace structure and route network from the ground to Flight Level 250 (approximately 25,000ft.) to determine the optimal (unconstrained) airspace configuration that maximises the performance and capacity of the operation when using SODPROPS. A wider airspace design to enable the use of SODPROPS should be considered as part of a coherent process to consider options for flight path redesign through engagement with community and aviation stakeholders that would encompass several of the other medium and longer-term opportunities highlighted in this report to update the Brisbane terminal airspace and wider route network.

Objective B. Reduce Noise Impacts When Overflying Populations

51. The second priority objective of the improvement opportunities identified during the first phase of assurance activities is to reduce noise impacts when overflying populations. Aircraft overfly populations living and working in the city and surrounding suburbs during busier times of the day when flights are more frequent, and at times when met conditions do not permit the use of SODPROPS. When SODPROPS is not available, aircraft arrive and depart in the same direction, overflying the city and the bay. The use of same direction dual runway operations offers significant capacity, flexibility and operational resilience (for example against technical failures and severe weather that may lead to a runway closure).

52. In Brisbane, across Australia and globally in States where there is a large commercial air transport sector, the pressure to reduce noise impacts when overflying populations is intensifying to a level that typically demands greater attention, and investment. Aviation is being met with a stronger challenge to reduce noise impacts while accommodating the longer-term growth in demand for flights. Some local communities that experienced comparatively quieter skies due to the extensive travel restrictions imposed during the COVID-19 pandemic are pushing for nearer-term improvements that may retain some of the peace and tranquillity as air travel recovers.

53. The aviation industry has a strong track record for innovations that help to mitigate its environmental impacts. Better aircraft engines and airframes have delivered most of the benefits so far. For example, aircraft entering service today create a noise footprint that is on average 30% to 50% lower than the aircraft they replace.[2] The optimisation of flight paths, especially at lower altitudes, remains a relatively untapped opportunity to deliver further improvements. As a result, the Trax team examined a range of potential opportunities as part of the assurance review, to upgrade the existing arrival and departure routes that serve Brisbane's parallel runways and capitalise on new concepts, technologies and the capabilities of modern aircraft. For example, the development of higher-performing flight paths may enable aircraft to climb higher sooner on departure, stay higher for longer on arrival and route accurately around more noise-sensitive areas. The outcome of these improvements would be measurable by a reduction in the average noise per flight that reaches the ground.

54. The redistribution of noise impacts away from more sensitive areas, of course, assumes that there are adjacent areas that flight paths can be moved to, which are less sensitive to noise. The relative noise sensitivity of areas is difficult to estimate. There is a risk that improvements delivered in one area may lead to a redistribution of noise impacts to other areas, disrupting new communities. The effects of new, more frequent or more concentrated noise arising from the deployment of opportunities that deliver improvements elsewhere must be carefully managed and guided by a coherent and transparent community engagement process that enables affected stakeholders to influence the trade-off decisions when noise redistribution may be the outcome.

55. Table 2 describes the scope of each theme associated with reducing noise impacts when overflying populations in greater detail.

[2] Noise roadmap: A blueprint for managing noise from aviation sources to 2050, Sustainable Aviation, 2017

Table 2: Themes linked to reducing noise impacts when overflying populations

#	Theme	Description
B1	Noise abatement on departure	One important operational and airspace design goal associated with reducing noise on departure is to enable aircraft to climb higher, sooner so that the volume of noise reaching the ground at a given point on the outbound flight path is lower. A second important goal is to concentrate noise impacts away from populations and other sensitive areas.
B2	Noise abatement on arrival	Similar to B1, one important operational and airspace design goal associated with reducing noise on arrival is to enable inbound aircraft to stay higher for longer so that the volume of noise that reaches the ground at a given point on the inbound flight path is lower. It may also be possible to reduce the amount of noise generated at source by aircraft on arrival by optimising the design of the approach path and the configuration of the airframe.
B3	Minimising total adverse effects of noise	The airspace structure and route network are key determinants of aircraft noise impacts on local populations. There is a range of potential improvement opportunities associated with flight path and airspace redesign, from shorter-term more moderate changes to longer-term fundamental upgrades.
B4	Treatment of non-jet traffic	Approximately 30% of the flights served by the Brisbane operation are non-jet aircraft. The majority are turbo-props. It is unclear how the impact of turbo-prop noise is perceived by communities. There are several potential improvement opportunities identified during the assurance activities that may mitigate turbo-prop noise impacts specifically and improve operational efficiency overall.

56. The specific improvement opportunities identified during the first phase of assurance activities that align with each theme are set out in the sections below.

B1. Noise abatement on departure

57. Four potential improvement opportunities associated with the airspace design changes that may lead to a reduction in aircraft noise on departure were identified during the first phase of assurance activities, these are:

- A full-length departure trial that is now in progress [short-term]
- Increasing the minimum climb gradient on the departure routes [short-term]
- Reduce tactical intervention to maintain route compliance [short-term]
- A best practice review of noise abatement departure procedures [short-term]

B1.1 Full-length departure trial that is now in progress [short-term]

58. Since the NPR opened in July 2020, narrow-body jets and smaller aircraft have often conducted intersection departures, using a shorter portion of the runway to take-off. Intersection departures are typically used to optimise ground movements and runway usage. There are concerns from residents (raised through the BAPAF) that intersection departures may position jets at a lower altitude over the ground than if aircraft used the full length of the runway during take-off. As a result, BAC has proposed a 12-month trial to remove intersection departures for aircraft departing on the NPR and overflying populations to assess the operational impacts and benefits of doing so, and to

determine longer-term options. ASA is delivering the trial that began on 24 February 2022 and aims to demonstrate the impacts on aircraft noise from outbound traffic, linked to the commitment to full-length departures.

B1.2 Increasing the minimum climb gradient on the departure routes [short-term]

59. Currently, the departure routes that serve the Brisbane operation require outbound traffic to achieve a minimum climb rate between 3.3% and 5.9% gradient to operate safely within the existing airspace structure. Many of the aircraft operating at Brisbane could achieve a much higher rate of climb, however, increasing the gradients might be difficult due to airspace constraints and aircraft performance on high-temperature days. One potential improvement opportunity is to carry out specific engagement with the aircraft operators to determine the minimum climb gradients that may be achievable for different components of the Brisbane operation and consider the potential for introducing higher-performing departure routes from a vertical perspective (with no change to the lateral track over the ground). The desired outcome is for aircraft to climb higher sooner, which could lead to a reduction in aircraft noise for some communities. For example, Edinburgh Airport in Scotland conducted a similar review in 2017 and deployed a jet only departure route with an 8% climb rate. In addition to potential noise mitigations, departure routes with a higher rate of climb may reduce aircraft track miles to the connecting points with the wider route network, potentially saving time, fuel and CO_2 emissions. By way of illustration, table 3 provides an indicative estimate of the potential increase in aircraft altitude in feet over the ground at a given distance from take-off using a 5% and 8% climb rate on departure.

Table 3: Comparison of altitude over the ground using a 5% and 8% climb rate

Distance from RWY	Altitude over the ground at 5%	Altitude over the ground at 8%	Increase in altitude over the ground
1 mile	102 ft.	158 ft.	56 ft.
3 miles	288 ft.	454 ft.	167 ft.
5 miles	473 ft.	751 ft.	278 ft.
10 miles	936 ft.	1492 ft.	556 ft.
20 miles	1862 ft.	2973 ft.	1110 ft.
40 miles	3713 ft.	5936 ft.	2223 ft.

B1.3 Reduce tactical intervention to maintain route compliance [short-term]

60. The departure routes that serve the Brisbane operation are designed to comparatively high altitudes (e.g. Flight Level 200, approximately 20,000ft.). Brisbane ATC sometimes intervenes tactically during the departure phase of flight and direct traffic away from the centreline of the published route to fly to a particular network way point or follow a specific compass heading. The majority of the tactical interventions seem to occur when aircraft are at altitudes below 7000ft. where changes in the distribution of aircraft noise is a greater concern. Strengthening compliance with the published route would redistribute noise as traffic is concentrated back onto the published centreline and may bring the noise distribution closer in line with the intended airspace design. In response to concerns raised by residents via the BAPAF, BAC has confirmed it will work with ASA to introduce a NAP requiring jet aircraft to remain on the published departure route until 10,000ft. or above, bringing flight paths closer in line with the corridors communicated before the runway opening. ASA is conducting a detailed review into the current use of

the Brisbane departure routes, including noise modelling to determine if such a NAP may increase aircraft operations over communities, and require additional engagement with affected stakeholders before implementation.

B1.4 Best practice review of noise abatement departure procedures [short-term]

61. One potential improvement opportunity is to conduct a best practice review of the noise abatement departure procedure options available to the Brisbane operation, based on the experience of the measures deployed at other similar airports around the world. For example, the Brisbane airport estate features a reasonably large distance from the runway thresholds to the boundary. The current NAPs on departure may not maximise the opportunity to concentrate noise closer to the runway (within the airport boundary). Another best practice opportunity may be to examine the potential noise benefits associated with a new NAP to require outbound traffic to reach 1000ft by a set distance (e.g. 6.5km) from the start of roll. This might generate a reduction in the population impacted by aircraft noise by requiring climb performance improvements for aircraft that may currently be operating lower.

B2. Noise abatement on arrival

62. Four potential improvement opportunities that may assist with noise abatement for aircraft on arrival were identified during the first phase of assurance activities, these are:

- Slightly steeper approaches for arrivals over the city [medium-term]
- Displace the landing thresholds for arrivals over the city [medium term]
- Engage airlines to reduce the noise by flying quieter approaches [medium-term]
- Review the potential for GBAS to improve noise management [medium-term]

B2.1 Slightly steeper approaches for arrivals over the city [medium-term]

63. Currently, all approaches for inbound traffic to Brisbane Airport follow a 3.0° descent path. This is the international standard for an Instrument Landing System (ILS) glide path angle. Aircraft could be kept higher for longer on arrival with the application of a steeper approach gradient. Although it is possible to design approach paths at a much steeper rate, this must be agreed with the airline community required to operate them. From experience, the airline community is generally accepting of approach path angles of up to 3.25° because they are unlikely to pose significant issues. Approach path angles greater than 3.25° may require aircraft modifications (for some types) and additional training for the flight crew, which may not be practicable at larger airports such as Brisbane that have a diverse fleet mix and a range of different operators.

64. One possible improvement opportunity would be to consider the introduction of a slightly steeper approach path for Brisbane arrivals over the city, set to a gradient of 3.2°. The result may be to keep inbound flights higher for longer on arrival to potentially offer noise relief for those overflown. The slightly steeper approach would need to include an assessment of airline support and an analysis of the impacts on arrival speeds and runway usage. CASA would need to be assured that the wake turbulence separations would remain as promulgated and that there would be no change to the ICAO wake vortex separations between consecutive arrivals on final approach during any such trial or in the implemented procedure.

65. Frankfurt airport has operated a runway with a 3.2° approach path since 2015. Heathrow airport has conducted operational trials of a similar approach that is now in the process of full implementation. Based on the Frankfurt experience, the size of the noise reduction is expected to be moderate given the acoustic difference between a 3° and

3.2° approach path angle. There is only a small reduction in altitudes on approach and consequently noise. It may be that communities experience a benefit from this opportunity as one component of a longer-term noise management plan (see C3.1).

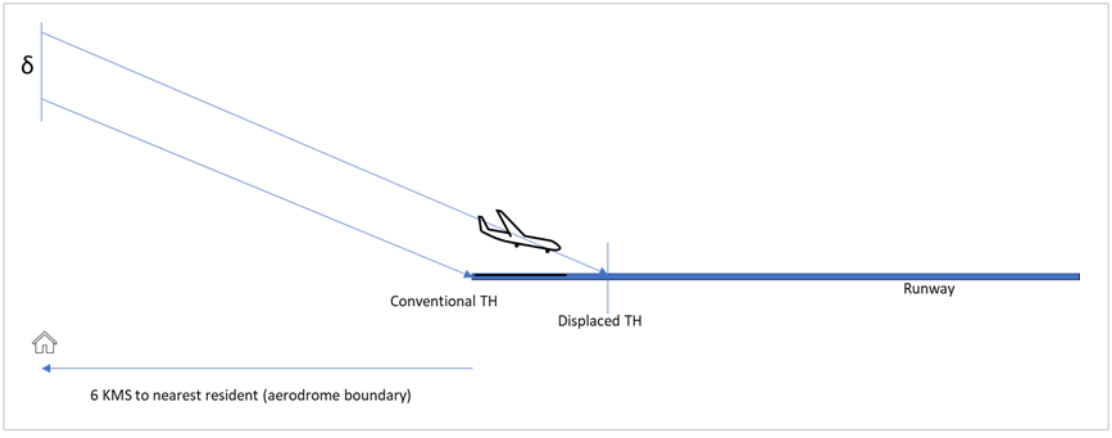
B2.2 Displace the landing thresholds for arrivals over the city [medium-term]

66. Inbound traffic overflying the city use the full length of the runway on arrival but may only require a shorter portion to land efficiently. The runway threshold is the beginning of the portion of runway that is usable for landing. One potential improvement opportunity is to review the feasibility of displacing the landing threshold for arrivals over the city. It may be possible to mitigate the impact of aircraft noise by displacing the runway threshold thereby moving the approach profile of an aircraft closer to the airfield and the aircraft touchdown point further down the runway. The lowest part of the approach is then within the airport perimeter. Brisbane is well suited in this regard because the airport boundary is a significant distance from residents.

67. It is a well-established practice to displace runway thresholds to increase the clearance between approaching aircraft and obstacles. To do so for noise purposes is more novel. In this regard, ICAO prescribes the following criteria, "the practice of using a displaced runway threshold as a noise abatement measure shall not be employed unless aircraft noise is significantly reduced by such use and the runway length remaining is safe and sufficient for all operational requirements."[3] Assessments against the ICAO criteria are by their nature site-specific. The feasibility of the opportunity should be considered on a case-by-case basis by any airport considering the use of displaced runway thresholds as a noise abatement procedure. The key element of the ICAO criteria is that aircraft noise must be 'significantly reduced' whilst the runway remains safe and operationally supportive (particularly in the context of the risk of runway excursions).

68. Displaced thresholds are relatively common at larger airports. For example, the landing thresholds for the single mixed-mode runway at Gatwick airport are displaced by 424m (for arrivals to 26L) and 393m (for arrivals to 08R). At Paris Charles De Gaulle both thresholds for 27L and 26R arrivals are displaced by 600m. Runway 13R at New York JFK has a threshold displacement of 623m. Figure 7 illustrates the expected benefits of a displaced landing threshold from a noise management perspective.

Figure 7: Illustration of the expected noise mitigation achieved by displacing the landing threshold



[3] ICAO Doc 8168, Part I, Section 7, Chapter 3, Page 4, Subsection 3.6.

B2.3 Engage airlines to reduce the noise by flying quieter approaches [medium-term]

69. Aircraft operators may potentially be able to reduce the levels of airframe noise and engine noise that reaches the ground by configuring the approach procedures differently to optimise arrivals from a noise management perspective. One potential improvement opportunity is to consider the merits of introducing a 'Fly Quiet' type programme for Brisbane operations. This would require engagement with airlines to promote fly quieter concepts such as continuous descent operations, landing gear deployment, configuration of the flaps and the use of reverse thrust. The outcome could result in tangible noise relief and help the airlines to actively participate in measures to mitigate aircraft noise impacts. Any potential impacts on the airlines' standard operating procedures (SOPs) and safety management systems must be carefully managed.

70. Fly Quiet type programmes are common at airports in North America with operators at Los Angeles, San Francisco, Boston, Seattle and Chicago O'Hare airports all participating in similar schemes. The concept is less common in Europe, with Heathrow the main large airport adopting a similar arrangement. The programmes usually include a published league table that ranks airlines according to their noise performance. The league tables may help airlines to identify their strengths and weaknesses or highlight areas they can target to make improvements based on good practices exhibited by others at the airport. Some schemes even include financial incentives for the quietest operators. Other components of the programme may include the noise rating of the fleet, flight track monitoring, noise event reporting and arrival and departure quality ratings.

B2.4 Review the potential for GBAS to improve noise management [medium-term]

71. Inbound flights on arrival to Brisbane are not currently supported by a Ground Based Augmentation System (GBAS) to improve the precision and flexibility of the final approach. GBAS is also known as a SmartPath system and relies on satellite-based navigation technology that compliments ground-based ILS technologies. When accompanied by changes to ATC procedures and the flight path design, GBAS can enable steeper approach gradients and curved arrival paths that may offer noise abatement. GBAS also provides operational resilience against lower visibility and adverse weather situations. One potential improvement opportunity is to conduct a review into the ability of GBAS to deliver tangible improvements in noise management for the Brisbane operation in addition to the RNP-AR routes that are already in place and serve a similar purpose. Investment is required to deploy and optimise the systems and some aircraft operators may also incur costs associated with equipping their fleets with a GBAS Landing System (GLS) to derive the benefits. Similar systems are already in use at Sydney and Melbourne airports and some aircraft types operating at Brisbane are already GLS equipped. Spaced Based Augmentation Systems (SBAS) may offer a similar mix of benefits to GBAS but with a different business case determined by variations in the systems capabilities, deployment costs and fleet equipage levels. The potential for SBAS to deliver noise management improvements at Brisbane may also be incorporated into the review.

B3. Minimise total adverse effects of noise

72. Four potential improvement opportunities that may contribute to minimising the total adverse effects of aircraft noise were identified during the first phase of assurance activities, these are:

- Examine the runway mode preference for departures over arrivals [short-term]
- Delegated use of Amberley at lower altitudes [short-term]

- Small flight path changes to mitigate noise [medium-term]
- Larger flight path changes to mitigate noise and improve efficiency [long-term]

B3.1 Examine the runway mode preference for departures over arrivals [short-term]

73. The current preferred runway mode for overflying the city prioritises departures over arrivals. International best practice, recent research and the application of new operational concepts indicate that arrivals may have the potential to be less impactful than departures. One potential option is to consider a trial to reverse the preference and increase the proportion of arrivals overflying the city rather than departures.

B3.2 Delegated use of Amberley at lower altitudes [short-term]

74. Populations with lower ambient noise to the west of the airport experience aircraft noise on arrival and departure, in part because of the proximity of the routes to the segregated airspace that support Military operations from Amberly airfield. Moving the Amberly airspace boundary or sharing the operational 3-mile buffer do not appear to be viable opportunities when considering repositioning the routes. One potential improvement opportunity is to agree a vertical delegation of small portions of the Amberly airspace in the south and east below 4000ft and 3000ft. This could result in the repositioning of the Brisbane routes redistributing aircraft noise impacts away from populations.

B3.3 Small flight path changes to mitigate noise [medium-term]

75. The first phase of assurance activities has identified several small potential adaptations to the existing flight path designs that may offer different forms of noise mitigation without widespread changes. However, the potential for small adaptations to create new or more frequent noise impacts for populations that were previously less affected should be carefully managed. One potential improvement opportunity is to develop and assess the potential benefits of a portfolio of small flight path adaptations that could be deployed quickly, following community engagement. This may be followed by engagement with communities on a package of larger flight path redesign opportunities (see B3.4) that offer different forms of noise mitigation and potentially more significant benefits.

B3.4 Larger flight path changes to mitigate noise and improve efficiency [long-term]

76. The first phase of the assurance activities has identified potential improvement opportunities associated with a fundamental redesign of the Brisbane airspace structure and route network. However, larger flight path changes may create a range of interdependencies, impacts and trade-off decisions that should be considered as part of a coherent options development, assessment and community and aviation stakeholder engagement process (see E3.1 and E3.2). Larger changes may incorporate a fundamental redesign of the NPR airspace design, using enhanced route spacing standards to deconflict traffic by design and enable efficient noise sharing.

B4. Treatment of non-jet traffic

77. Three potential improvement opportunities regarding the treatment of non-jet traffic were identified during the first phase of assurance activities, these are:

- Examine the community perception of turboprop noise [short-term]
- Re-evaluate the turboprop radar SIDs based on the outcome of B4.1 [medium-term]
- Reintroduce non-jet visual approaches over the river [short-term]

B4.1 Examine the community perception of turboprop noise [short-term]

78. Approximately 30% of Brisbane traffic are turboprop aircraft that are not directly monitored from a noise management perspective. A potential solution is to evaluate complaint data generated by community submissions and engage directly with stakeholders to understand the general perception of turboprop noise and identify specific potential mitigations. The desired outcome is to target attention on some reasonably short term, tangible measures that may be deployed to mitigate turboprop noise if it is considered a significant issue in certain areas.

B4.2 Re-evaluate the turboprop radar SIDs based on the outcome of B4.1 [medium-term]

79. Turboprop traffic follow Radar SIDs on departure. It is currently unclear if departure noise generated by turboprops is a widespread issue for communities. If it is, there is the potential to modify the Radar SID tracks over the ground. Redesigning the turboprop Radar SIDs and potentially replacing them with full departure procedures, may mitigate the impact of departure noise (if turboprop noise is considered a significant issue), could reduce the frequency and/or intensity of turboprop noise events and may mitigate interactions with jet traffic that lead to reductions in SID compliance and jet aircraft flying lower than necessary on arrival to avoid climbing turboprops.

B4.3 Reintroduce a visual approach over the river [short-term]

80. Following the new runway opening an existing procedure that allowed 'close-in' visual approaches for some smaller aircraft arriving over the city was removed. The visual approach required greater coordination between ATC and flight crews but did seem to allow some smaller aircraft to approach clear of noise-sensitive areas. One potential improvement opportunity is to consider reintroducing a similar visual approach procedure for some smaller aircraft arriving over the city that may deliver moderate noise relief for communities that are currently affected.

Objective C: Optimise Noise Sharing Arrangements

81. Despite the opportunities to limit aircraft noise, some disturbance is unfortunately inevitable from large commercial air transport airports situated close to population centres like Brisbane. Whilst significant improvements in airframe noise generation and jet engine noise reduction have been made in recent years, adverse community reaction towards airport operations and expansion has increased over time. Providing periods of respite or a break from aircraft noise has become a crucial issue in making airport operations more tolerable, in particular for the population directly under the flight paths. As a result, the third priority objective of the improvement opportunities identified by the independent assurance review is to optimise potential noise sharing arrangements.

82. The introduction of the NPR, and the airspace system that supports it, create opportunities to deploy new operating concepts and route designs that may be used to share the impacts of aircraft noise in different ways. The opportunities associated with objective C focus on the development of effective strategies and practical steps to offer communities that live under flight paths with options to consider about planned breaks from aircraft noise. These steps may include deploying multiple flight paths that disperse the impacts across different areas or by alternating runway modes to offer some communities with scheduled relief from aircraft noise.

83. The Trax team also examined potential opportunities to improve the longer-term planning and predictability of the noise management strategy that is used to mitigate impacts and share noise as traffic levels recover and continue to grow. The goal of the longer-term planning is to mitigate the impacts of airport growth on local communities by setting out a robust package of measures and a transparent management framework that delivers progressive improvements over time.

84. Table 4 describes the scope of each theme associated with optimising noise sharing arrangements in greater detail.

Table 4: Themes linked to optimising noise sharing arrangements

#	Theme	Description
C1	Utilisation of different runway modes	This theme considers improvement opportunities related to the potential options to offer predictable relief from aircraft noise by alternating the use of runways in different modes (incorporating both segregated and dual-use) to a published schedule.
C2	Noise respite routes	This theme considers improvement opportunities related to the deployment of multiple route options for arrivals and departures that may be alternated to a published schedule to offer predictable relief from aircraft noise.
C3	Brisbane Operating Plan	This theme considers improvement opportunities related to the development of a Brisbane Operating Plan that offers communities the ability to participate in an open and transparent planning process for the continuous improvement of noise management arrangements as traffic levels recover from the impacts of the COVID-19 pandemic and continue to grow.

85. The specific improvement opportunities identified during the first phase of assurance activities that align with each theme are set out in the sections below.

C1. The utilisation of different runway modes of operation

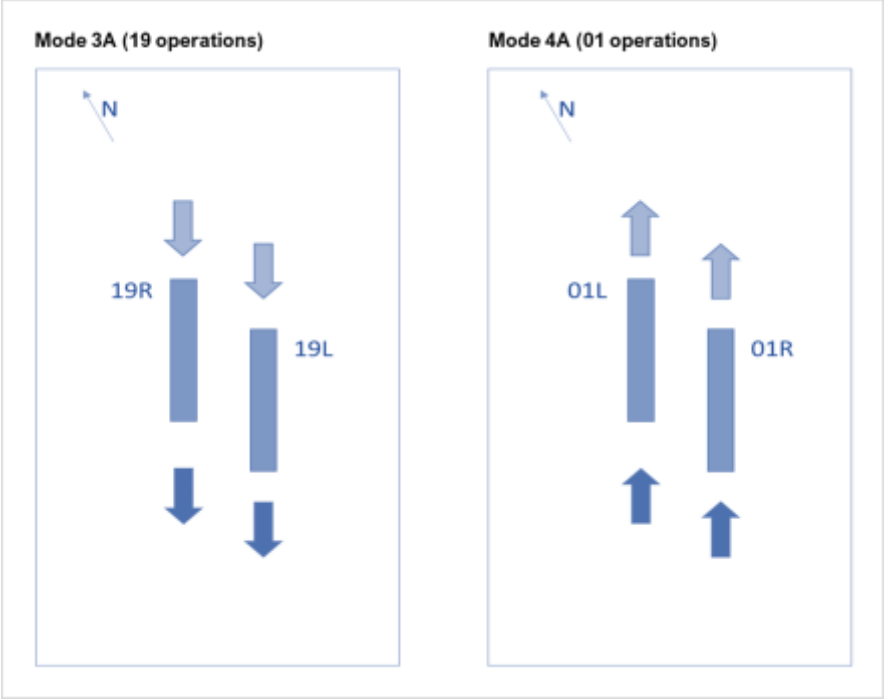
86. Two potential improvement opportunities associated with utilising different runway modes of operation were identified during the first phase of assurance, these are:

- Noise relief by runway alternation in segregated mode [medium-term]
- Use of mixed-mode and tactical arrival and departure enhancements [medium-term]

C1.1 Noise relief by runway alternation in segregated mode [medium-term]

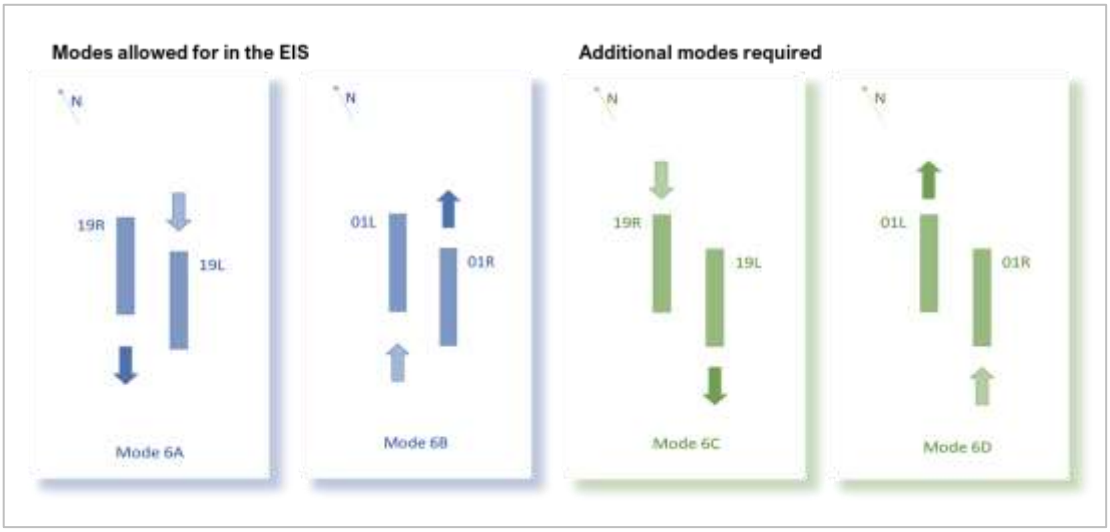
87. Brisbane ATC manage traffic following a compass operations principle. Flights to/from the north and west generally use the new runway and the legacy runway is generally used for traffic to/from the south and east. This principle is based on a mixed-mode dual parallel runway operation with arrivals and departures operating from both runways simultaneously. This mode provides the maximum capacity, particularly when the runways are operated fully independently. The modes are referred to as Mode 3A (Mixed Parallel RWY19) and Mode 4A (Mixed Parallel RWY01), as illustrated in figure 8 below.

Figure 8: Illustration of the mixed-mode dual parallel runway modes of operation



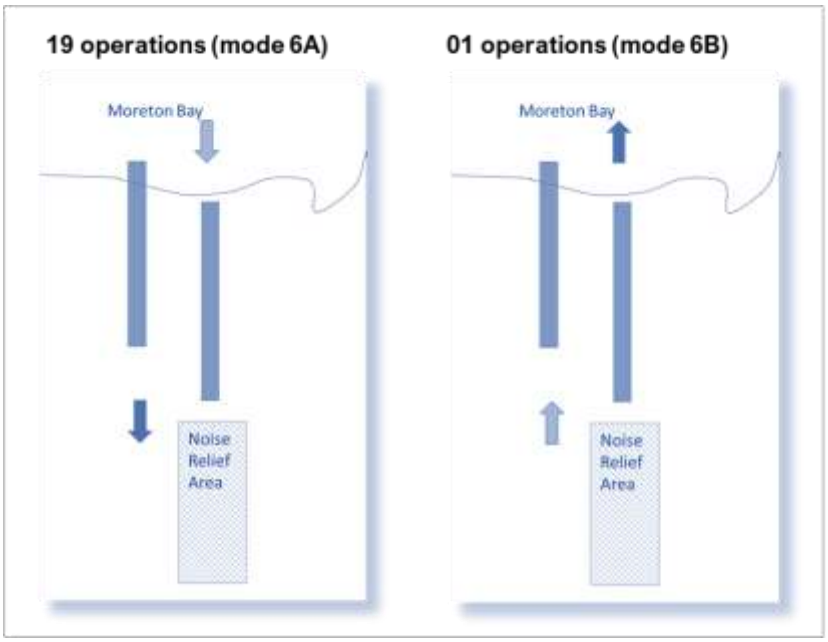
88. The compass operations approach, while efficient for other reasons, may limit the potential to offer communities adjacent to the airport with predictable relief from noise through runway alternation. One potential improvement opportunity is to introduce the use of segregated runway modes, alongside the dual modes, and publish a planned schedule of alternation that offers predictable noise relief. The EIS and current procedures allow for the use of two modes of segregated runway operations, known as 6A and 6B. Two further modes, perhaps termed 6C and 6D, allowing segregated arrivals and departures to each of the four runway ends, would need to be introduced to enable effective noise relief by runway alternation. The two segregated runway modes of operation allowed in the EIS are illustrated in blue in figure 9, with the two additional modes required in green.

Figure 9: Illustration of segregated runway modes of operation



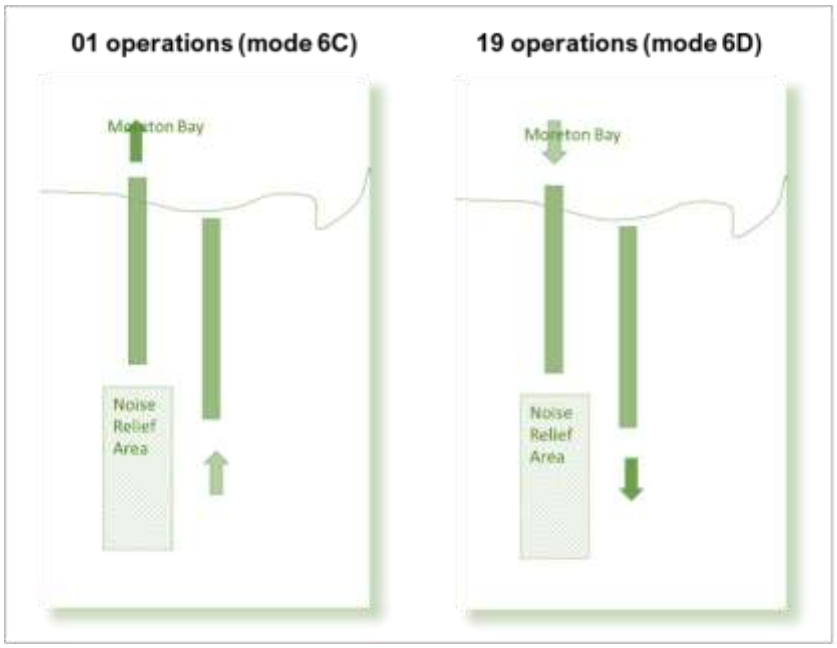
89. Experience from similar airports suggests that a segregated runway mode of operation can be configured to deliver between 30 and 36 arrivals and departures per hour. This level of hourly throughput was achieved with a single runway operation in 2019 and does not imply any significant changes to the existing NPR airspace design to deliver (although some ATC training and air traffic simulations would likely be required to develop the operational capability). Communities located adjacent to the airport that are affected by aircraft noise may be offered predictable relief through a planned schedule of runway alternation, as illustrated in figure 10. The noise relief area illustrated when in 19 operations (mode 6A) are used can be protected if ATC has to change runway direction (e.g. due to a shift in the wind) by alternating the runways to 01 operations (mode 6B).

Figure 10: Example of noise relief from runway alternation in segregated mode



90. The noise relief area would need to be defined and protected, either by adaptations to ATC procedures or small changes in the flight path design. The same noise management arrangement can be applied to the other segregated mode pairing to deliver predictable relief for another adjacent community, as illustrated in figure 11.

Figure 11: Example of noise relief from runway alternation in segregated mode



91. These pairings could be alternated daily, offering some days of noise relief followed by some days without. The relief pattern could also alternate by week, month, season of some other defined schedule. Crucially the pattern of relief should be published to encourage predictability. Targeted community engagement with the affected stakeholders is essential to test the desirability of sharing noise by runway alternation in this way and to inform decisions about the pattern of relief that is most effective, in conjunction with the use of dual runway operations.

92. The departure routes in the existing NPR airspace design are not configured to support segregated runway operations and would need to be adapted. The existing arrival routes are sufficient but the closed STAR concept (aircraft following the published route to final approach rather than reliance on a radar vectoring area) may limit the capacity that a single arrival runway can achieve. The impact on airport and airline operations in terms of gate usage, scheduling, ground movements, taxi times and track miles would also have to be examined in detail, along with the impact on longer-term airport infrastructure planning linked to the location of passenger terminals and other airfield facilities.

C1.2 Use tactically enhanced arrival and departure procedures [medium-term]

93. The flexibility to offer noise respite for some communities that is enabled by operating in a segregated mode is reduced if one runway is used for both arrivals and departures. One potential solution is to consider the use of tactically enhanced arrival and departure procedures for peak periods, to manage capacity while retaining noise respite opportunities. This could strike an efficient balance between capacity, traffic growth and noise sharing. The tactically enhanced modes refer to the use of one runway to deliver extra arrivals or departure, while ostensibly remaining in a segregated mode. The extra

arrivals or departures may be allowed within a pre-agreed quota and/or time-limited as determined by a noise management planning process (see C3.1). For example, tactical enhancements to mode 6A in figure 9, may allow for a set number of extra departures from RWY19L during a defined time window as illustrated in figure 12.

Figure 12: Example of a tactical enhancement to a segregated runway mode of operation

C2. Noise respite routes

94. Two potential improvement opportunities associated with noise respite routes were identified during the first phase of assurance activities, these are:

- Multiple RNP-AR routes for noise respite on arrival [medium-term]
- Multiple departure route configurations for noise respite [medium-term]

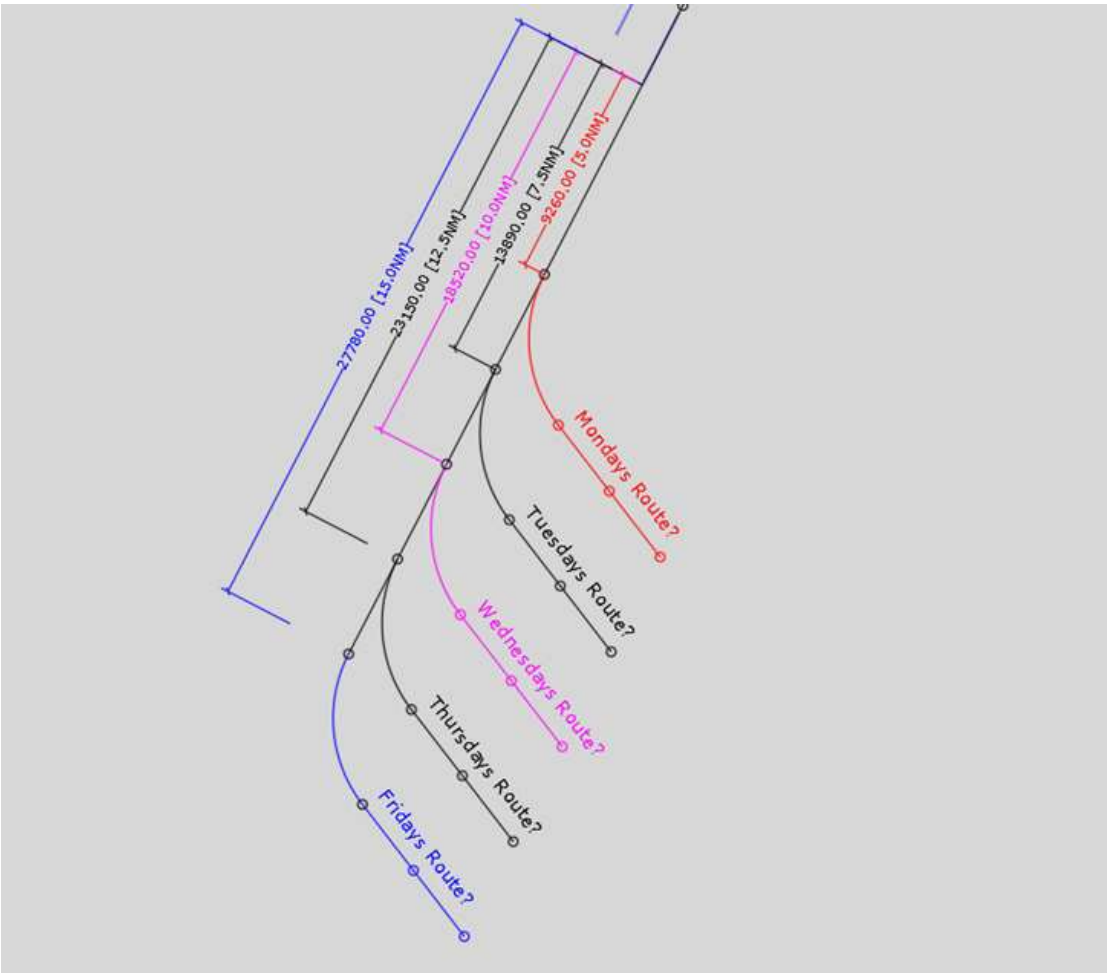
C2.1 Multiple RNP-AR routes for noise respite on arrival [medium-term]

95. The NPR airspace features flight paths that are designed using an advanced navigation specification known as RNP-AR (Required Navigation Performance – Authorisation Required). Aircraft must be equipped with RNP compatible avionics and authorisation is required from the regulator for the specific pilot training needed to fly the routes. A large proportion of the jet fleet operating at Brisbane is RNP-AR equipped and approved. Arrival routes designed to an RNP-AR standard can be flown with a higher degree of track keeping accuracy. The lateral distance required between RNP-AR routes to assure safe separation is lower than conventional alternatives, offering more design flexibility, for example, to introduce shorter curved approaches that turn onto the final approach path earlier.

96. One of the main concerns associated with the use of RNP-AR routes is the concentration of noise impacts arising from aircraft operating with precision navigation. Currently, only one short RNP-AR approach is used to support the Brisbane operation. No noise respite opportunities on the approach are possible with this configuration, apart from the traffic dispersion created by inbound traffic alternating between the RNP-AR route and the

conventional ILS flight path. One potential improvement opportunity is to deploy multiple RNP-AR arrival routes that can be alternated, for example on a daily basis, to offer planned and defined periods of noise relief to people living directly under a flight path. In the short-term, the database capacity of the IT system used in the Brisbane operation to process flight information may constrain the application of multiple RNP-AR arrival routes. ASA is currently developing a national programme of IT system upgrades that once deployed in the Brisbane operation is expected to enable the use of multiple RNP-AR arrival routes. Figure 13 illustrates the concept using five theoretical flight paths that join the final approach track at 5, 7, 10, 12 and 15 nautical miles respectively and are designed to operate in an alternating pattern, rotating by day of the week, to provide a form of noise respite for the affected communities.

Figure 13: Illustration of multiple RNP-AR arrival routes that can be alternated for respite



97. The use of multiple RNP-AR arrival routes to create alternation of flight paths may be appropriate in some local circumstances, but it is also likely to increase the number of people who are affected by aircraft noise (albeit in a more predictable manner). The concept also adds complexity to the approach operation, may create interactions with other arrival and departure routes and is likely to generate additional track miles for inbound flights. As a result, the options associated with this opportunity should be developed through engagement with the affected community and aviation stakeholders as part of a coherent flight path redesign process (see E2 and E3).

C2.2 Multiple departure route configurations for respite [medium-term]

98. Similar to the issues summarised in C2.1, the existing NPR airspace design does not allow for noise respite options for outbound traffic on departure from Brisbane Airport. One potential improvement opportunity is to consider the introduction of different departure route configurations that include respite options, which could be used to offer predictable relief for communities living under the departure flight paths. As with the arrivals (C2.1), multiple departure route configurations might introduce additional complexity to the operation and interact with other features of the airspace design. Multiple departure route configurations should be considered as part of a coherent process to consider all viable options for flight path redesign through engagement with community and aviation stakeholders that would encompass several of the other medium and longer-term opportunities highlighted in this report to update the Brisbane terminal airspace and wider route network.

C3. Brisbane Operating Plan

99. One potential improvement opportunity associated with the optimisation of noise sharing arrangements is to develop a Brisbane Operating Plan that offers communities with the ability to participate in an open and transparent planning process for the continuous improvement of noise management arrangements as traffic levels recover from the impacts of the COVID-19 pandemic and continue to grow.

C3.1 Brisbane Operating Plan [long-term]

100. There is currently no long-term plan to optimise the performance of the Brisbane operations from a noise management perspective as traffic levels recover and continue to grow. Local communities and aviation stakeholders could be invited to participate in a coherent process to determine the noise relief and respite performance that the operation and airspace design should deliver over time and how noise should be shared as the demand for aviation in Brisbane grows. One potential solution would be to conduct a broad stakeholder engagement process to develop a Brisbane Operating Plan that may incorporate flight path changes, technology solutions, use of different runway modes and performance monitoring aligned to environmental targets, traffic growth and capacity.

Objective D: Support Sustainable Growth in Airport Operations

101. The fourth priority objective of the improvement opportunities identified by the independent assurance review is to support the sustainable growth in the airport's operations as the demand for air transport recovers from the COVID-19 pandemic and continues to grow. Recent aviation growth forecasts estimate that air passenger numbers in Australia and the Asia Pacific region will recover to 2019 pre-pandemic levels in approximately 2025.

102. The sustainable growth in Brisbane airport's operations benefits local communities and the wider Queensland economy given its unique geographical position and the needs of its residents, businesses, industrial sectors and tourists. Queensland has traditionally been considered a resource state with mining activity contributing c.12% of economic activity in 2020. A large proportion of the non-jet traffic operating to/from Brisbane airport provides essential connectivity for the mining sector.[4] Tourism is one of Queensland's leading industries, with millions of interstate and international visitors visiting the region each year, contributing AUD $23 billion to the local economy and both, directly and indirectly, employing 207,000 Queenslanders in 2020.[5] Tourism consumption in Queensland from international travel enabled by Brisbane airport totalled AUD $6.4bn in 2020. More recently, Queensland's economy has diversified successfully into professional and financial services, supported by an innovative and highly-skilled workforce. The air transport connections enjoyed by Brisbane helps it play an increasingly important financial role on the Asia Pacific and Global stage.

103. Table 5 describes the scope of each theme associated with supporting sustainable growth in the airport's operations.

Table 5: Themes linked to supporting sustainable growth in the airport's operations

#	Theme	Description
D1	Airport and airspace capacity	This theme concentrates on potential improvement opportunities associated with the optimisation of the runway and airspace capacity of the Brisbane operation.
D2	En-route airspace enhancements	This theme concentrates on potential improvement opportunities related to the interactions between the Brisbane terminal airspace structure and the wider route network that serves traffic flows en route to other destinations.
D3	Brisbane technology roadmap	This theme concentrates on the potential improvement opportunities related to the evolution of the Brisbane airspace design and operating concepts driven by the introduction of more advanced ATC systems and tools.

104. The specific improvement opportunities identified during the first phase of assurance activities that align with each theme are set out in the sections below.

[4] About the Queensland Economy - Queensland Treasury (2020)

[5] Tourism Queensland - Economic Key Facts (2021)

D1. Airport and airspace capacity

105. Five potential improvement opportunities associated with airport and airspace capacity were identified during the first phase of assurance activities, these are:

- Airport/airspace capacity study for inbound and outbound traffic [short-term]
- Coordination of arrival and departure sequencing [medium-term]
- Re-evaluate the delay threshold to relax compass operations [short-term]
- Arrival sequencing with RNP and the use of targeted vectoring [medium-term]
- Airspace redesign to enable independent operations [medium-term]

D1.1 Airport/airspace capacity study for inbound and outbound aircraft [short-term]

106. The maximum capacity of the airport and airspace to handle inbound and outbound traffic flows, and the saturation thresholds for the surrounding airspace sectors is unclear. Future flight path design and operational developments may require more detail about the capacity constraints present in the current airspace and ATC operation for arrivals and departures. One potential improvement opportunity is to produce an updated Capacity Study for the Brisbane operation that examines the maximum airfield and airspace capacity and the main features that may constrain arrivals, departures, en route sectors and ground movements. This study would be used as part of a coherent process to consider options for flight path redesign through engagement with community and aviation stakeholders that would encompass the other medium and longer-term opportunities to update the Brisbane terminal airspace and wider route network.

D1.2 Coordination of arrival and departure sequencing [medium-term]

107. It seems that the current procedures and ATC practices that support the Brisbane operation may lead ATC to stream traffic onto the approach without significant regard to the possible delay implications for departures. This situation is tolerable at the current, comparatively lower levels of traffic, but may risk curtailing the opportunity to maximise capacity as flight numbers recover and continue to grow. One potential improvement opportunity is to carry out a trial of coordination techniques between Tower and Approach controllers to ensure efficient runway utilisation. This may prove to be a comparatively cost-effective way to deliver moderate increases in runway utilisation and effective capacity.

D1.3 Re-evaluate the delay threshold to relax compass operations [short-term]

108. To comply with compass arrival procedures all inbound traffic from the North is allocated to the new runway and inbounds from the South to the legacy runway. In the event of excess demand on one runway, aircraft are subject to airborne holding delays, instead of swapping onto the other available runway. This concept could be simplified by changing ATC procedures to allow runway 'swaps' more freely when it is safe to do so. A trial has commenced that enables runway swaps if delays grow to a certain level (e.g. 10 minutes for a single inbound flight). Optimising runway swaps when the traffic situation requires would result in a reduction in arrival delays that are attributable entirely to the airspace design (rather than a runway/airfield capacity constraint).

D1.4 Arrival sequencing with RNP and the use of targeted vectoring [medium-term]

109. The current mix of RNP-AR approaches and conventional transitions to the ILS leads to a complicated approach stream for inbound traffic. The complexity of the existing arrival routes limits the efficiency of approach spacing. A potential improvement opportunity could be to consider a combination of measures to increase the arrival rate including

the development of ATC capability (focused for example on streaming and sequencing) and redesigning and simplifying the arrival routes. This may result in fewer delays from capacity optimisation for inbound traffic and a reduction in ATC workload. Redesigning and simplifying the arrival routes should be considered as part of a coherent process to consider options for flight path redesign through engagement with community and aviation stakeholders that would encompass several of the other medium and longer-term opportunities highlighted in this report to update the Brisbane terminal airspace and wider route network.

D1.5 Airspace redesign to enable independent operations [medium-term]

110. The current airspace design creates a technical loss of separation between simultaneous arrivals to the parallel runways. The parallel runways cannot be operated independently with the current airspace design, based on existing regulatory guidance limiting capacity and resilience. In addition to the suggestions made in C2.1 and C2.2, independent operations may be enabled by changes to the procedure for flight crews to report that they are established on the final approach, amending the altitude on the low side routes and redesigning the approach paths.

D2. En-route airspace enhancements

111. Three potential improvement opportunities associated with en-route airspace enhancements were identified during the first phase of assurance activities, these are:

- Modelling and simulation to inform modifications to en-route sectors [short-term]
- Terminal-wide airspace re-design [long-term]
- Adaptations to manage other aerodromes/airspace users [medium-term]

D2.1 Modelling and simulation to inform modifications to en-route sectors [short-term]

112. There appear to be some complex interactions that are affecting the capacity and efficiency of the connectivity between the Brisbane terminal airspace and the wider route network in certain circumstances. It is possible that the overall network is not optimised for the management of higher density traffic flows. One potential solution would be to conduct modelling and simulations which could inform the redesign of the wider route network and the interactions with Brisbane terminal airspace to optimise the capacity and efficiency of operations across the region. This could result in a reduction in delay for higher demand routes and a more efficient overall operation. It is envisaged that the options which may be developed in response to this opportunity would generate flight path changes at higher altitudes with no impact on the distribution of aircraft noise on the ground.

D2.2 Terminal-wide airspace re-design [long-term]

113. Some of the features of the overall airspace system that serves the Brisbane operation and adjacent airports (including Military and General Aviation aerodromes) may be suboptimal. A holistic set of changes may be required to the system as a whole to maximise long term environmental performance and deliver the required levels of capacity and resilience. A potential solution would be to examine the scope and expected benefits of a fundamental redesign to the wider airspace system, including Brisbane terminal airspace, adjacent airports and en-route sectors. This opportunity should be considered as part of a coherent process to consider all viable options for flight path redesign through engagement with community and aviation stakeholders that would encompass several of the other medium and longer-term opportunities highlighted in this report.

D2.3 Adaptations to manage other aerodromes/airspace users [medium-term]

114. Considerable controller workload is currently used to manage 'peripheral' traffic for example General Aviation users operating in the vicinity of Brisbane Airport. This may reduce controller capacity as traffic levels recover and grow. Archerfield and Redcliff aerodromes operate close to Brisbane and may require updated procedures to optimise the capacity of the wider airspace system. A potential solution to this issue would be to introduce a package of measures, for example, the creation of low-level crossing routes, (that do not require ATC clearances) and the simplification of access and integration procedures for traffic to/from smaller aerodromes. This may reduce ATC workload, with a resultant higher capacity dedicated to the Brisbane operation, to deal with increased commercial air transport flights as traffic levels grow.

D3. Brisbane airspace technology roadmap

115. Two potential improvement opportunities associated with the Brisbane airspace technology roadmap were identified during the first phase of assurance activities, these are:

- Optimisation of new ATM systems and tools [medium-term]
- Greater Civil/Military integration to enable FUA [medium-term]

D3.1 Optimisation of new ATM systems and tools [medium-term]

116. Advanced air traffic management systems and tools (e.g. Queue Management and Time-based Operations) offer the functionality to operate Brisbane's airspace in more efficient ways as they are developed and introduced in the coming years. The commissioning and deployment of new systems and tools should be aligned to the Brisbane airspace improvement opportunities to maximise the benefits of advanced technologies. A potential solution is to create a roadmap for the introduction of new ATM systems and tools with a link to the expected benefits and airspace dependencies. This would align the long-term evolution of Brisbane operation and flight path design with the new functions offered by advanced systems and tools to maximise performance overall.

D3.2 Greater Civil/Military integration to enable FUA [medium-term]

117. There is currently limited tactical and pre-tactical airspace sharing between Military ATC operating Amberly and civil ATC operating the Brisbane airspace which results in civil traffic being unable to maximise available airspace opportunities as dynamically as they might. A potential solution that is already being progressed by civil and military stakeholders is to define a programme of technology, organisational and airspace design measures to optimise the Flexible Use of Airspace (FUA); For example regarding civil access to the segregated airspace reserved for military operations by Amberley and the corridor for Military user to route via Brisbane airspace to training and testing ranges over water.

Objective E. Enhance Engagement, Coordination & Governance

118. It is clear from international experience of airport expansion and airspace development projects that for stakeholder engagement, coordination and governance arrangements to function correctly they should be conducted in an open, fair, transparent and effective way. These principles should underpin the development, assessment and where appropriate implementation of the potential improvement opportunities, in the following terms:

    - **Open:** Stakeholders should be assured that the options developed to deliver on any particular improvement opportunity are not a foregone conclusion. Community and aviation stakeholders should be engaged in the formative stages of the options development and throughout, their feedback should be conscientiously taken into account and they should have reasonable opportunities to influence the final proposed option, before an agreement on its implementation is made.
    - **Fair:** Stakeholders should have advanced notice of the engagement process to plan their contribution and adequate time and information to form meaningful inputs.
    - **Transparent:** Stakeholders should be presented with accurate information to help them understand the impacts on them of the various options under development. All information should be clear and accessible. Although the concepts associated with some improvement opportunities may be complex, the language used to communicate them should not be.
    - **Effective:** The engagement process and information should be tailored to suit the specific stakeholder groups that may be affected by the opportunity in question, concentrating on the factors that are decisive and of substantial importance to the development and assessment of options.

119. In the context of this report, engagement is a general term that encompasses all activities associated with developing stakeholder relationships, conducting communications and participating in a dialogue with individuals and organisations with an interest in the Brisbane operation. The term includes information provision, written briefings, communications campaigns, meetings, focus groups, workshops, online resources, social media content and formal consultation exercises.

120. Very few opportunities to deliver improvements identified in this report can be further developed or implemented by ASA in isolation of BAC or the airlines and other aircraft operators that use the airport. Some opportunities require the input of aviation stakeholders operating at other adjacent airports (both civil and military). Some may also require guidance and approvals from CASA. In the context of this report, the term coordination arrangements refer to the processes, forums and management approach that supports joint-working across community and aviation stakeholders to develop options, assess their feasibility and impacts and if appropriate plan for implementation.

121. Engagement and coordination, incorporating a broad range of stakeholders is a complex and multifaceted endeavour. Strong, integrated governance arrangements are required to oversee engagement and coordination activities, bringing discipline and rigour to the development of options, clarity and oversight to decision making, drive to the implementation of the chosen options and assurance regarding the expected outcomes and benefits. The governance arrangements should be broadly representative of the stakeholder groups with an interest in the Brisbane operation and

integrated in the sense that relationships between the constituent forums and processes are clear and coherent.

122. Table 6 describes the scope of each theme associated with enhancing engagement, coordination and governance arrangements.

Table 6: Themes linked to enhancing engagement, coordination and governance arrangements

#	Theme	Description
E1	Governance, co-ordination and oversight	This theme concentrates on the process and governance-related improvement opportunities that are intended to strengthen the integration of programme planning, delivery and performance management across both community and aviation stakeholders.
E2	Comprehensive, accurate and accessible information	This theme concentrates on potential improvement opportunities to enhance the information about the environmental performance of the Brisbane operation, the data that is used to make decisions about options and the mechanisms by which the information is shared with communities.
E3	Deliberative engagement on improvement opportunities	This theme concentrates on the potential opportunities to enhance the airspace design process and encourage meaningful engagement with communities on the development of options and the assessment of trade-off decisions that are made when benefits in one area are pursued at the expense of improvements elsewhere.

123. The specific improvement opportunities identified during the first phase of assurance activities that align with each theme are set out in the sections below.

E1. Governance, coordination and oversight

124. Three potential improvement opportunities associated with governance, co-ordination and oversight were identified during the first phase of assurance activities, these are:

- Integrated planning, delivery and governance arrangements [short-term]
- Community Noise Management Board [short-term]
- Cross-industry Airspace Optimisation Working Group [short-term]

E1.1 Integrated planning, delivery and governance arrangements [short-term]

125. ASA, BAC, the aircraft operators and other aviation stakeholders each have important roles to play in the development of options to improve the operation and engage with communities accordingly. Community stakeholders have highlighted concerns about gaps in the coordination and collaboration between the aviation stakeholders when developing options and conducting engagement. The many (sometimes overlapping) responsibilities held by different organisations can result in a fog of accountability for community stakeholders. Insufficient or inconsistent transparency about the collaboration between aviation stakeholders can, if persistent, damage community trust in the process. One potential improvement opportunity that is already someway to being implemented is the creation of integrated programme planning, delivery and governance arrangements to jointly oversee the collaboration between aviation stakeholders and coordinate the approach to community engagement.

126. The integrated arrangements should aim to ensure joint executive-level sponsorship for the work conducted by aviation stakeholders on the improvement opportunities, providing coordination and oversight for all related initiatives. Detailed development, engagement activities and implementation planning would be conducted by a framework of sub-groups. The activities of some existing aviation working groups may be incorporated into the integrated arrangements rather than starting all-new forums. Joint executive-level sponsorship is intended to ensure closer alignment and more effective interactions between the aviation stakeholder organisations. In this capacity, it is envisaged that the integrated planning, delivery and governance arrangements would:

    - Track the progress of options development, assessment, engagement and implementation plans linked to specific improvement opportunities.
    - Manage dependencies, including the rate and scale at which the operation can adopt changes and resolve issues that impact the achievement of agreed milestones.
    - Ensure that initiatives (trials, work packages, projects etc.) are scoped effectively, with agreed objectives, milestones, accountabilities and performance measures.
    - Maintain cross-industry involvement in the development and implementation of options from the formative stages, throughout community engagement and into implementation.

127. A joint executive sponsor forum may meet every two to three months with sub-groups meeting more frequently and delivery activity coordinated on a day to day basis. The desired outcome is that options to deliver on specific improvement opportunities are developed and implemented faster, with stronger industry alignment and consistent information shared with communities about how they can participate and influence the process.

E1.2 Community Noise Management Board [short-term]

128. One potential feature of the integrated arrangements described in E1.1 could be the creation of a dedicated Community Noise Management Board. Brisbane airport already organises a Community Aviation Consultation Group (CACG) that meets quarterly to discuss a range of topics including aircraft noise. A Community Noise Management Board would provide a dedicated setting for more detailed discussions about the current impacts of noise, mitigating actions and the development of improvement opportunities (based on quantitative information and qualitative community feedback). The goal of the Board would be to generate a more open and transparent discussion about the management of aircraft noise that empowers community stakeholders to influence how improvement opportunities are developed and implemented.

129. Well established Noise Management Board type arrangements are in place at many large commercial air transport airports including Heathrow, Gatwick, Toronto Pearson, Frankfurt, Schiphol and the New York airports. At Heathrow, the Community Noise Forum was established in 2015 to discuss the impacts of runway expansion and airspace upgrades with community representatives and local government stakeholders. It meets every two months and is chaired by the airport. The forum aims to raise awareness of the key technical topics associated with flight path design, build trust in the data used to inform options development and enhance the approach to wider community engagement on change proposals. The Gatwick Noise Management Boards remit extends to all noise management issues related to the airport's operations and intends

to be a body with real influence over key decisions. Both the Heathrow and Gatwick noise forums are attended by representatives from communities affected by noise and local employers that rely on aviation to conduct their business. Both forums aim to positively influence the noise debate by helping to create consensus across the various interested parties that participate in the process. The New York Community Aviation Roundtable was established by the New York and New Jersey Port Authority to encourage meaningful dialogue between aviation stakeholders, residents and businesses that rely on aviation. It covers JFK, LaGuardia, Newark and Teterboro airports in one regional forum that supports the Port Authority's goal of minimizing the effect of aircraft noise on surrounding communities while maintaining safe and efficient air transport facilities.

E1.3 Cross-industry Airspace Optimisation Working Group [short-term]

130. Another potential feature of the integrated arrangements described in E1.1 is the creation of a cross-industry Airspace Optimisation Working Group. A cross-section of aviation stakeholders would participate in the Working Group, using a consistent set of accurate data about operational performance and the consequences for noise impacts/management to inform the development and implementation of improvements. BAC and ASA already co-chair an Aircraft Noise and Performance Improvement Working Group, with participation from aircraft operators, that monitors the efficiency and environmental performance of the existing operation and coordinates the development of improvement options. This group could be integrated into the wider governance arrangements to receive requests, tasking and feedback from the Noise Management Board (see E1.2) and oversight from the joint executive-level sponsorship forum (see E1.1).

131. It is envisaged that the Working Group would play an important role, maintaining alignment across all aviation stakeholders and managing the interactions between dependent improvement opportunities at an operational level. Alongside changes to operational procedures and participation in flight path redesign activities, the Working Group would also be well placed to monitor changes made by aircraft operators that may affect the distribution of aircraft noise or other areas of performance. Aircraft operators may make changes to their procedures to improve efficiency, incorporate new regulatory guidance or respond to suggestions from pilots. The Fly Quiet type programme described in B2.3 might be monitored from a technical and operational perspective by the Working Group. Military and General Aviation stakeholders may also participate in the Working Group, for example, to align the management of traffic crossing the NPR airspace. The measures used to track the performance of new trials and flight path design options might be defined by the Working Group and members may be requested to provide expert technical and operational support to community engagement activities.

E2. Comprehensive, accurate and accessible information

132. Three potential improvement opportunities associated with comprehensive, accurate and accessible information were identified during the first phase of assurance activities, these are:

- Noise and other overflight data used to inform decision making [short-term]
- Operational data used to inform decisions & enhance performance [short-term]
- Mechanisms for sharing information with communities [short-term]

E2.1 Noise and other overflight data used to inform decision making [short-term]

133. The approach to evaluating the potential benefits and impacts of different airspace design options is based on an important but limited set of noise metrics. The impacts of overflight on some portions of the Brisbane community may not be adequately reflected by analysis that relies on a limited set of metrics. One potential solution is to broaden the set of noise and overflight metrics used to inform the assessment of improvement opportunities and describe the expected impacts to stakeholders. This would result in the benefits and impacts of airspace use, and improvement opportunities being evaluated from a broader perspective incorporating potentially important non-acoustic factors.

134. The community stakeholder groups that should be taken into account when evaluating impacts include:

- Individuals and groups representing the views of local people affected by overflights and/or potential improvement opportunities.
- Local Government Authorities, including those responsible for land use planning and environmental affairs.
- Environmental and Special Interest Groups.
- The owners and operators of buildings and land that is particularly sensitive to environmental impacts (e.g. Hospitals, Schools, Protected Habitats, Farming etc.)

135. The environmental impacts of overflight at lower altitudes that should be considered in the data used to inform decisions include:

- The impacts of aircraft noise (the primary focus of this review).
- The impacts of aircraft visual intrusion and artificial light.
- The impacts on areas prized for their heritage, tranquillity or natural beauty.
- The impacts on areas with densely populated residential properties and rural areas with comparatively lower levels of ambient noise.
- The impacts of overflight on biodiversity.

E2.2 Operational data used to inform decisions and enhance performance [short-term]

136. ASA, BAC and the aircraft operators rely on much of the same key operational data about the specific causes of noise and community annoyance and the potential to enhance performance. Key operational data that relates to noise impacts are not always effective as a means to describe the issues to communities or guide options development. A potential solution is to define the key operational data that relates to noise impacts and collate it on a monthly basis to share with all affected stakeholders, so it can be used to inform decisions. This would result in decisions being based on up to date, accurate information about the specific causes of noise, making the options developed to deliver on improvement opportunities more targeted and effective. The EIS and MDP provide baseline information against which improvement opportunities can be appraised using operational data. Other sources of baseline information, including operational data from the years before runway opening and qualitative information provided in feedback from communities, could also be incorporated.

E2.3 Mechanisms for sharing information with communities [short-term]

137. Communities affected by noise are requesting more information about flight paths, operational performance, and noise impacts as they press for improvements to be made. Community engagement is often challenging because the information about the environmental impacts of overflights and potential improvement opportunities is technical in nature, can be hard to articulate and difficult for non-expert stakeholders to understand. Environmental impacts are dynamic in nature and change depending on the weather conditions, traffic levels or prevailing mode of air traffic operation. The level of sensitivity to a particular impact can vary widely across stakeholders within a community, and over time, making information about them difficult to quantify and share.

138. Currently, noise-related information is shared with communities via a range of mechanisms that are not always well-coordinated, creating confusion and potentially mistrust. One possible solution is to establish a consistent set of core communications mechanisms that ASA, BAC and other stakeholders use to share noise-related information. These mechanisms may be overseen as part of the integrated governance arrangements described in E1.1 to ensure they are coherent, accurate and accessible, generating greater awareness and trust amongst community stakeholders.

139. Understanding which stakeholder groups may be impacted by which opportunities and the options developed to deliver them is a key determinant of the mechanisms used for sharing information. Identifying and prioritising the stakeholder groups as options are developed may help to ensure the mechanisms are as effective, efficient and comprehensive as possible. Specific mechanisms might be needed for seldom heard or harder to reach stakeholder groups like the elderly or people with language barriers. More resource-intensive mechanisms may need to be targeted toward areas where the impacts are comparatively higher and concentrated, with other more proportionate methods used where impacts are less acute but perhaps spread over a wider area. Digital tools are now essential to sharing data with communities and helping people to participate remotely (especially following the impact of the Covid-19 pandemic). Online engagement can enable greater reach and allow some audiences to participate who would otherwise not have engaged, but it should not replace traditional face-to-face approaches. Adopting the right mix of mechanisms should mean that stakeholders are aware of the engagement process, understand how they may be affected by specific improvement opportunities and find it easy to participate in the development of options.

E3. Deliberative engagement on improvement opportunities

140. Two potential improvement opportunities associated with deliberate engagement on improvement opportunities were identified during the first phase of assurance activities, these are:

- Engagement approach for options development and assessment [short-term]
- An iterative approach to flight path design and impact assessment [short-term]

E3.1 Engagement approach for options development and assessment [short-term]

141. The interim report demonstrates the wide range of potential improvement opportunities that may be considered as part of the PIR process. Some of the opportunities share interdependencies and some may create benefits at the expense of impacts elsewhere. In practice, it will not be possible to pursue all the opportunities simultaneously. As a result, it is important to incorporate as many options as possible within a coherent process that examines the range of potential impacts in collaboration with affected

stakeholders and seeks to balance the positives and negatives. The process followed and decisions made to determine what mix of opportunities is feasible and which ones progress towards implementation must be robust and considered to be credible.

142. One solution could be to publish a development and assessment framework for the improvement opportunities that is tailored specifically to the Brisbane operation. The framework might include design criteria, metrics and priorities that can be influenced and endorsed by community and aviation stakeholders. The use of an endorsed framework may help to demonstrate how decisions have weighed the views of a wide range of different stakeholder groups against each other in an objective manner. The views of stakeholders that may be negatively affected by an option should be appropriately counterbalanced by the positive outcomes if an optimised and broadly accepted set of improvements opportunities is to be successfully implemented.

E3.2 Iterative approach to flight path design and impact assessment [short-term]

143. Several of the improvement opportunities involve adaptations to the established flight path design at lower altitudes, that may change the distribution of aircraft noise. The environmental impacts of flight path design options developed to deliver on specific improvement opportunities may be assessed too late in the process to support meaningful engagement with communities. A potential solution is to introduce an iterative approach to options development and environmental assessment, where a broad range of opportunities are progressively refined via rounds of appraisal, supported by targeted community engagement. The result is the mix of flight path improvements is optimised, the process is viewed as coherent and credible, and the balance of benefits and impacts is considered fair and equitable.

144. One of the main goals of this iterative approach is that the options are developed and progressively refined through successive rounds of appraisal and dialogue with stakeholders. The conventional process for airspace design, where options are created and considered by subject matter experts in isolation from external stakeholders and the most efficient solution is determined internally by the proponent before there is any meaningful engagement on the treatment of impacts is not well suited to the deliberative approach.

145. The iterative approach recognises that a wide range of different stakeholders may be affected by an option, depending on how the various positive and negative impacts might fall. The development process should be integrated with the community engagement approach described above so that a wide range of potential options are considered transparently and can be refined through assessment and engagement towards the best outcome overall.

146. This can be achieved through a comparative analysis of each option that is developed using a range of different performance metrics and draws in contributions from the representative stakeholders to distil accurate information about the potential impacts and how they relate to one another (working within the kind of framework described in E3.1). In this context, one of the main principles that guide the iterative approach is that all viable options are developed and assessed in a manner that is consistent, repeatable, objective, open and transparent. Specifically that the process:

- Ensures all viable options have been adequately considered (it is consistent).
- Enables the stakeholders or independent third parties to re-run aspects of the appraisal to validate the outputs (it is repeatable).

- Demonstrates that there is no bias in the application of the process (it is objective).
- Enables stakeholder representatives and the public to understand and participate (it is open and transparent).

147. The iterative approach may focus on engagement with smaller groups of representative stakeholders, drawn from a range of different backgrounds, who participate in several rounds of discussion. Some of the stakeholders may have prior knowledge or experience of environmental impacts, overflights or airspace change. The approach lends itself to focus groups, workshops and established forums like the Noise Management Board suggested in E1.2. For example, the iterative approach may be used during the early part of an options development process to understand the impacts of a shortlist of designs that are then shared more widely as part of a formal consultation.

Appendix A: List of potential improvement opportunities

148. Table 7 provides a full list of the potential improvement opportunities identified during the first phase of the assurance review that will be subject to further analysis and refinement in collaboration with community and industry stakeholders in the next phase.

Table 7: List of potential improvement opportunities

#	Potential Improvement Opportunity	Expected timescales
A1.1	Safety assurance for a 7-knot tailwind limit [short-term]	Short-term
A1.2	A wider review of the met constraints associated with SODPROPS [medium-term]	Medium-term
A2.1	Clear and unambiguous instructions regarding the use of SODPROPS	Short-term
A2.2	Decision-making criteria for the use of SODPROPS	Short-term
A2.3	Forecasting and decision making support tools for SODPROPS	Medium-term
A2.4	System adaptations to support SODPROPS initiation and exit	Medium-term
A3.1	Post operational analysis to evaluate SODPROPS potential	Short-term
A3.2	Modelling and simulation of SODPROPS maximum capacity threshold	Medium-term
A4.1	Re-positioning the routes that serve en route traffic	Medium-term
A4.2	Examine Big Amberly's impact on westerly arrivals during SODPROPS	Short-term
A4.3	Wider airspace redesign to enable the use of SODPROPS	Long-term
B1.1	Full-length departure trial that is now in progress	Short-term
B1.2	Increasing the minimum climb gradient on the departure routes	Short-term
B1.3	Reduce tactical intervention to maintain route compliance	Short-term
B1.4	A best practice review of noise abatement departure procedures	Short-term
B2.1	Slightly steeper approaches for arrivals over the city	Medium-term
B2.2	Displace the landing thresholds for arrivals over the city	Medium-term
B2.3	Engage airlines to reduce the noise by flying quieter approaches	Medium-term
B2.4	Review the potential for GBAS to improve noise management	Medium-term
B3.1	Examine the runway mode preference for departures over arrivals	Short-term
B3.2	Delegated use of Amberley at lower altitudes	Short-term
B3.3	Small flight path changes to mitigate noise	Medium-term
B3.4	Larger flight path changes to mitigate noise and improve efficiency	Long-term

B4.1	Examine the community perception of turboprop noise	Short-term
B4.2	Re-evaluate the turboprop radar SIDs based on the outcome of B4.1	Medium-term
B4.3	Reintroduce a visual approach over the river	Short-term
C1.1	Noise relief by runway alternation in segregated mode	Medium-term
C1.2	Use of mixed-mode and tactical arrival and departure enhancements	Medium-term
C2.1	Multiple RNP-AR routes for noise respite on arrival	Medium-term
C2.2	Multiple departure route configurations for noise respite	Medium-term
C3.1	Brisbane Operating Plan	Long-term
D1.1	Airport/airspace capacity study for inbound and outbound aircraft	Short-term
D1.2	Coordination of the arrival and departure sequencing	Medium-term
D1.3	Re-evaluate the delay threshold to relax compass operations	Short-term
D1.4	Arrival sequencing with RNP and the use of targeted vectoring	Medium-term
D1.5	Airspace redesign to enable independent operations	Medium-term
D2.1	Modelling and simulation to inform modifications to en-route sectors	Short-term
D2.2	Terminal-wide airspace re-design	Long-term
D2.3	Adaptations to manage other aerodromes/airspace users	Medium-term
D3.1	Optimisation of new ATM systems and tools	Medium-term
D3.2	Greater Civil/Military integration to enable FUA	Medium-term
E1.1	Integrated planning, delivery and governance arrangements	Short-term
E1.2	Community Noise Management Board	Short-term
E1.3	Cross-industry airspace optimisation forum	Short-term
E2.1	Noise and other overflight data used to inform decision making	Short-term
E2.2	Operational data used to inform decisions and enhance performance	Short-term
E2.3	Mechanisms for sharing information with communities	Short-term
E3.1	Engagement approach for options development and assessment	Short-term
E3.2	An iterative approach to flight path design and impact assessment	Short-term