

# BRISBANE AIRPORT'S NEW PARALLEL RUNWAY (NPR)

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## Matters to be Addressed

*Brisbane Airport is located adjacent to a number of very sensitive ecologically areas including a Marine Park, wetlands listed on the National Estate, Internationally listed wetlands covered under the Ramsar Convention, and migratory birds covered by international treaties between Australia, Japan and China.*

*In addition to the environmental challenges, the ground conditions under the NPR footprint are extremely poor and this will necessitate a large dredging project to deliver up to 15 million m<sup>3</sup> of sand to the site to achieve the required ground settlement and stabilisation. This sand will need to be delivered through the active airfield. The dredging will represent one of the longest sand pump-out projects that the Dredgers have faced in the world.*

*BAC has undertaken an extensive engagement process with Australia's air traffic provider, Airservices, the Civil Aviation Safety Authority, and the Domestic and selected International airlines to determine the appropriate runway length and airspace operating plan. The current aviation commercial environment is seeing a strong focus on cost reductions. BAC undertook an extensive process to assess the required runway length under various scenarios of temperature, winds and operational routes.*

*From a community perspective, a new runway proposal brings anxiety about where aircraft will be flying and the noise impacts. BAC has developed a world leading computer package that enables each resident to assess the impact of the new runway from a flight frequency and noise perspective. The paper will outline how BAC has undertaken its extensive studies and its engagement with the community to*

*ensure the NPR addresses engineering, environmental and social issues.*

*BAC was required to prepare a very extensive Environmental Impact Statement (EIS) and a Major Development Plan (MDP) for the NPR.*

## 1 Project Description

Brisbane Airport was designed and constructed by the Australian Government in the early 1980s after extensive planning and investigations to determine the location for a new international standard airport for Brisbane. The site acquired for Brisbane's new airport was some 2700 hectares making it Australia's largest capital city airport in area.

As part of the Australian Government's airport privatisation initiative, Brisbane Airport Corporation Pty Ltd (BAC) acquired the long-term lease of Brisbane Airport in 1997. Part of BAC's responsibilities as airport lessee is to ensure the long-term efficient development and operation of aeronautical infrastructure.

The new parallel runway development is located adjoining some very sensitive environmental areas. The site adjoins a Ramsar listed wetland of International Significance as well as the Boondall Wetlands which is listed on the Australian Government's National Estate. The coastal intertidal flats that are located along the northern boundary of the new runway site also support migratory wader birds that are protected under the Japan Australia Migratory Bird Agreement (JAMBA) and the China Australia Migratory Bird Agreement (CAMBA) international treaties. The Queensland Government's Moreton Bay Marine Park adjoins the new runway construction area.

Being on a coastal delta at the mouth of the Brisbane River, the new parallel runway is situated on land that is both flood prone as well as subject to tidal inundation from cyclonic storm events. The site's geotechnical soil conditions are extremely poor with significant areas of both actual and potential acid sulphate soils. This will require large volumes of sand to be brought onto the site to provide a stable platform for runway and taxiway construction as well as providing flood and storm tide immunity. BAC intends to acquire this sand from Moreton Bay as supply of what would be a very large quantity from land-based means would have significant environmental, social and economic costs.

All of these environmental and geotechnical aspects presented substantial challenges to BAC in designing and planning for the construction of the new parallel runway. BAC also determined that it was essential that the engineering design was done concurrently with extensive environmental studies to ensure an environmentally sustainable outcome for the project.

## **2 Engineering Aspects of the Project**

BAC approached the Environmental Impact Statement (EIS) process for the NPR project seeking to integrate engineering design with the consideration of relevant environmental and social issues. This multi-disciplinary approach to the design of the runway, which included the identification of a dredge footprint at Middle Banks in Moreton Bay to provide fill, and the associated airspace architecture, demonstrates the efficiency and effectiveness of an integrated approach to delivering a major infrastructure project.

### **2.1 Geotechnical and Settlement Investigations**

The poor site conditions were identified during the initial investigations when soft soils, deep in-filled subsurface channels (>30m in depth) and the presence of the original Brisbane River alignment indicated a requirement for up to 15million cubic metres of material to fill the

site above flood and storm tide levels and to provide sufficient material for ground surcharging and treatment.

Analysis of the ground conditions on the site indicate a typical settlement range of between 1m and 2m during the construction phase with target average post construction settlement over 40 years of 200mm. The target post construction settlement was determined through a risk-based approach that incorporated the statistical probability of settlements exceeding the target and the expected consequences.

### **2.2 Terrain Modelling and Survey**

BAC required an accurate terrain model of the site to (1) determine the quantity of sand that would need to be dredged from Moreton Bay, and (2) to enable flood modelling and drainage design to be undertaken to ensure that a significant reclamation of the floodplain would not cause unacceptable flood impacts.

Getting an accurate terrain model without extensive clearing of existing vegetation posed a challenge to the Project Team. BAC and the Queensland University of Technology (QUT) undertook a research project to determine if airborne laser scanning could be utilised to develop the required terrain contour model. The results of this research project showed this was possible but required careful capture of ground truth data. The results of this research was then utilised by BAC's consultants to develop a digital terrain model using airborne laser scanning which had a design accuracy of +/- 100mm with very minimal vegetation clearance. The use of airborne laser scanning also provided a substantial cost saving over the use of more traditional ground based surveying methods given the large areal extent of the runway footprint.

### **2.3 Aviation Safety and Operational Assessment**

Aviation safety is always paramount when designing new aeronautical facilities and procedures. BAC commissioned a range of studies to ensure the location of the new runway

and how air traffic control manages flights under parallel runway operations maintained the highest standards. These studies included an assessment of worldwide air crashes to determine where the highest on-ground risk areas would be in the unlikely event of a crash. As these areas are within a few hundred metres of the ends of the new runway, BAC is able to ensure that such areas will remain free of development or other infrastructure.

BAC also undertook extensive studies of the bird populations around the airport. This includes a research project with QUT to determine the best height for airfield grass to deter birds feeding near to the runway. Bird management has been a high priority at Brisbane Airport since it opened in 1988. BAC has continued efforts to investigate and improve bird management including actively working with well respected groups such as the Queensland Wader Study Group and Griffith University's reputable ornithologist.

In addition to these safety studies, BAC worked closely with Air Traffic Control in the design of the air space routes and procedures.

## **2.4 Drainage Design**

Site drainage was a major consideration in the design as the project is in a low-lying tidal area that occupies a large flood plain currently carrying regional flooding from Kedron Brook. The drainage system was designed to cater for the secondary settlements, maintenance of the airfield, maintenance of the drainage, security, stormwater retention and water quality. A system of linked detention ponds was designed between the new taxiways and runway to reduce any potential increase in runoff velocities and flow volumes into the surrounding creek system. The detention system also provided excellent water quality outcomes and resulted in a water sensitive design that integrates the water quality and stormwater management outcomes.

The engineering design of the major drainage channels addressed stormwater management, regional flooding and the dredge tailwater discharge (construction water management) within the one system by considering the constructability of the

reclamation during development of the drainage concepts. This benefited the project and the surrounding environment by providing for the fewest number of new drainage outfalls into Moreton Bay and Kedron Brook and a minimal change to the current drainage regime.

## **2.5 Groundwater Investigations**

BAC's Consultants carried out extensive testing of groundwater quality as part of the studies for the NPR project. This resulted in the establishment of 21 groundwater wells within or adjacent to the proposed NPR footprint. Based on monitoring results, groundwater modelling was carried out to predict and assess any impacts from the potential movement of groundwater as a result of placement of fill and surcharge associated with the construction of the new runway. This informed the design of the major drains and the innovative use of a range of interceptor lime layers both in the drains and an engineered lime trench between the reclamation site and Kedron Brook Floodway. These measures will ensure groundwater migrating off the site from the reclamation surcharge can be neutralised and treated prior to entering surrounding waterways.

## **2.6 Constructability Assessments**

With currently more than 20 million passengers per year and with this number forecast to grow to some 30 million passengers during the construction phase of the new parallel runway, disturbance of the terminal precinct and other operational airfield infrastructure was a key consideration in the planning and design for the new runway. BAC undertook a detailed study of constructability issues to determine how the new runway could be constructed whilst ensuring the operation and safety of the existing airfield could be maintained. A staging plan was also developed that enabled the full taxiway system to be delivered over 10 years as demand increases.

## 2.7 Dredging – Middle Banks, Moreton Bay

An extensive range of marine surveys, studies and modelling were commissioned with the view of establishing a robust baseline of data for the design and planning and to inform decision-making.

From the studies and investigations, a spatial database of opportunities and constraints at Middle Banks was developed. With the information in hand, a multi-disciplinary panel of experts from the various consultancies involved with the project were brought together to discuss the results of the investigations and to determine the best location and depth for the proposed dredge footprint and the likely impacts from the dredging on in-situ and neighboring environmental values.

## 2.8 Seismic and Geotechnical Survey

Bathymetric Surveys of the seabed and Seismic surveys of sediment layers beneath the seafloor at Middle Banks targeted areas for the geotechnical investigations. These surveys identified the areas of Middle Banks with the best sand (eg. clean Holocene-age sands) for the intended use and identified older sediment layers (known as Pleistocene layers) that were to be avoided due to these sediments containing a high proportion of silts, clays and organic material.

Based on the seismic studies, boreholes taken by marine vibrocores were then able to confirm the physical characteristics of the material and to avoid localised clay and silt lenses present within the Holocene layers.

## 2.9 Environmental Surveys

As a State Marine Park, the project needed to establish what effect, if any, the proposed dredging could have on other users of the park. A social impact assessment and an assessment of impacts on commercial and recreational fishers, were carefully considered in selecting the dredge footprint. Through this process, conflicts with other users such as the commercial prawn fleet and small-scale extractive industry that operates elsewhere in

the Middle Banks area were avoided or minimised.

A Cultural Heritage Management Plan with the traditional indigenous people for the Airport and Moreton Bay land was also developed.

## 2.10 Airspace Design

A new airspace design is required for the new parallel runway to become operational once its construction is complete. Airspace design consists of flight paths, operating modes, and operating procedures which can be used for a new runway design. Airfield capacity studies and airline forecasts predict the optimum timing for the new runway to become operational while airspace architecture and procedures are required for operational safety and efficiency.

## 2.11 Aviation Capacity Modelling

As part of the planning for the new parallel runway project, BAC commissioned extensive computer modelling to determine when the new runway would be required.

Forecasting was developed in 15 minute blocks over an entire 24 hour period for four representative busy days (weekday and weekend, summer and winter). Each forecast aircraft movement included aircraft type, origin/destination, and time of day. This detail of forecasting also enabled this dataset to be used for other studies, including vehicle traffic modelling (for passenger travel to and from the airport), aircraft noise modelling and air emissions. This enabled all studies to use a consistent dataset.

## 2.12 Airspace Architecture

Introduction of the new parallel runway necessitates new airspace architecture for Brisbane. BAC commissioned Airservices Australia, Australia's current airspace and navigation service provider to develop new flight paths and operating rules for Brisbane Airport for when the new runway becomes operational. In general, Brisbane's airspace will be split into two sectors - traffic from the south and east will use the existing runway while



traffic from the north and west will use the new runway. Procedures have been developed to ensure the safe segregation of aircraft while maintaining operational efficiency and consideration of the noise implications for residents on the ground.

The Airspace Architecture design was finalised closely with the Airlines. BAC and Airservices Australia established an Aviation Industry Working Group (AIWG) with a number of airlines. The AIWG looked at various flight path and runway operating modes which would provide the greatest efficiency in terms of flight costs (airborne and taxiing costs) and parallel runway capacity.

### **3 Benefits to the Community**

Lessons learnt from the introduction of the third runway at Sydney Airport in the early 1990s and past Master Planning processes for Brisbane Airport highlighted the need to focus on preparing comprehensive, but legible, information for the community in relation to the NPR project. To do this BAC, developed an engagement strategy which informed and prepared the community in the lead up to the public comment phase.

In the 18 months prior to the public comment phase the community was prepared for the release of the Draft EIS/MDP by:

- Establishment of a dedicated website and 1800 freecall line;
- Two community newsletters (350,000 copies of each newsletter were inserted into local community newspapers and posted to the website);
- 16 Fact Sheets (issued to elected representatives, local libraries and posted to the website).

### **4 Runway Layout and Design for Over-bay Operations**

The protection of residential communities from aircraft noise poses the challenge to airports globally. Airports perform a delicate balancing act to plan and deliver operational solutions that reduce aircraft noise in residential

areas, whilst complying with international safety standards, providing for passenger and freight service demand and remaining commercially viable.

BAC purposely planned an airfield configuration designed to maximise the use of opposite direction parallel operations, what BAC colloquially refer to as “over-bay operations”. The NPR design - wide-spaced parallel runways separated by 2000 metres, with the new runway staggered towards Moreton Bay - effectively allows a significant proportion of air traffic to be directed away from the residential areas of Brisbane, out over Moreton Bay, particularly in the noise sensitive night hours.

A detailed analysis of weather patterns and demand forecasts, both of which affect how often over-bay operations can be implemented, was undertaken.

### **5 Forecasting Future Schedules and Noise Modelling**

The community needed to be informed of the expected noise impacts of the NPR so they could assess how the project may affect them once operational. In order to provide this information, BAC rejected traditional means of modelling aircraft noise, delving to a new level of detail in modelling situations for the NPR.

Traditionally, aircraft noise information presented is based on annual average day information which in turn allows only annualised average day information to be presented. It gives no feel for the variation which can occur between seasons, times of the week or times of the day.

The aircraft noise modelling process combines a complex set of variables including, future airport operating schedules, operating modes, weather, flight paths and noise levels of the various aircraft types. These were modelled at 15 minute intervals over a 24-hour period for summer week days, summer weekend days, winter week days and winter weekend days for 2015 (with and without the NPR) and 2035 (with the NPR). This is especially important for Brisbane Airport where seasonal wind

variations significantly alter operational modes from summer to winter. This forecasting exercise was underpinned by forecasts from airlines, domestic and international tourism agencies, and economic data.

With this level of detail, a range of scenarios were able to be presented to the community including summer and winter, weekday and weekend, day (6am to 6pm), evening (6pm to 10pm) and night (10pm to 6am), in the years 2005, 2015, 2035 both with the runway and without the runway.

## 6 Flight Path and Noise Information

Any talk of changes to runways resulting in changes to flight paths and aircraft noise has the potential to create community alarm and political apprehension. Another of the NPR's notable innovations is the tools used to describe and convey aircraft noise impacts to the community. BAC developed two key public engagement tools, the Transparent Noise Information Package (TNIP) and the Flight Path and Noise Information Booklet, which were used successfully during the public comment phase to illustrate the changes in aircraft noise.

Learnings from other new runway projects have provided insight into the type and extent of information the community seeks in order to gain an understanding of the project and be able to make an informed decision about the impact it may have.

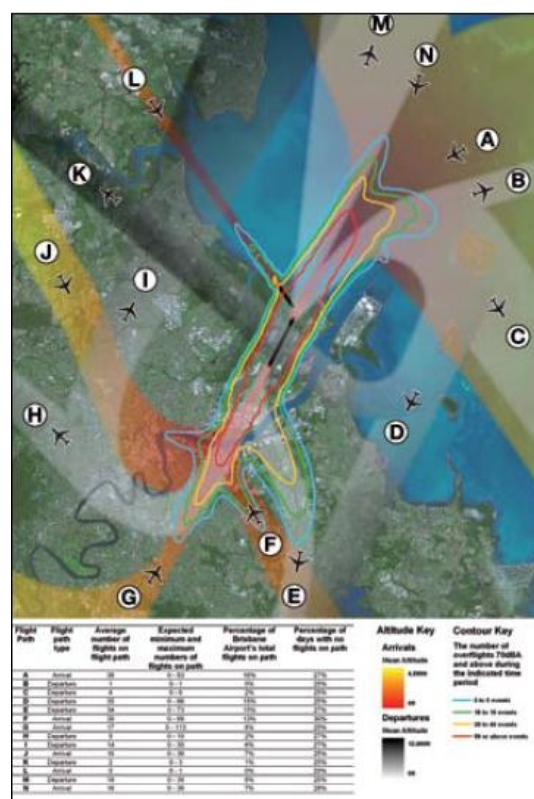
The challenge is to present highly technical and variable information in a way that they can determine for themselves what the impacts may be. Previous experience in Australia has shown that a negative reaction to runway projects can be due to a discrepancy between the presentation of noise information and how this noise was experienced once the new runway becomes operational.

TNIP and the Flight Path and Noise Information Booklet were the principal instruments used in the public consultation process to explain the aircraft noise implications of the new runway.

## 7 The Flight Path and Noise Information Booklet

The Flight Path and Noise Information Booklet is a non-digital aid to understanding the noise impacts. The booklet consisted of 48 different Flight Path and Noise Charts, each relating to 1 of 48 different time period combinations outlined above, with a 70 decibel (N70) contour overlaid on the major flight path zones for Brisbane. The charts also showed the following important information:

- Flight paths coloured to identify for arrivals and departures;
- Approximate height of the aircraft shown by variegated colour;
- The average, maximum and minimum number of times per day a plane uses or is likely to use the flight path;
- The percentage of all jet aircraft that a particular flight path will carry; and
- The number of days the flight paths are expected to have no flights.



Feedback from three community focus group sessions was used to finalise the design of these charts in order to best present how the public wanted such complex information

displayed. Australian Government officers who deal with community aircraft noise and who sit on international committees have voiced their opinion that the approach taken by BAC in developing and presenting information to the community on aircraft noise is amongst the best in the world and sets a new benchmark for other airports to follow.

## 8 Working group structure

Due to the complexity of the project and that all three levels of government have a role in its assessment and approval, BAC established a working group model as an innovative means to co-ordinate and engage the relevant government stakeholders. This method of co-ordination by a private proponent has not been observed previously and was developed on the basis of “no surprises” for those who would ultimately be involved in its regulatory assessment.

The NPR Working Group Model comprised a Steering Group which oversaw a series of five discipline focused Working Groups. The Steering Group consisted of high level officers from the key Government coordinating agencies while representation on the Working Groups was project officer level from the range of Australian, Queensland and local Government agencies. The groups met 4-5 times during the course of the EIS at critical milestones during the process.

The principal role of the Working Groups was to provide a forum for discussion and direction between relevant Government agencies and BAC during the course of the EIS. In particular, the Working Groups were able to:

- Provide clarification on issues that sub-consultants raised within the course of their investigations;
- Comment on whether the scope of the studies met the intent of the guidelines;
- Advise on relevance of independent peer review requirements;
- Identify if additional work was likely based on the baseline and impact assessment findings
- Provide comment on study reports.

## 9 Summary

BAC first started the detailed studies and investigations for Brisbane Airport's New Parallel Runway (NPR) in 2005. BAC undertook extensive engineering and scientific studies to address a range of environmental and social matters.

BAC established new benchmarks for community engagement and the interaction with government agencies as part of its planning and approval phase of the NPR. Construction on the NPR will commence in mid 2012 with an 8 year construction timeframe.

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