

**Climate Change Adaptation
Good Practice - Case Study**

Brisbane Airport - New Parallel Runway Project



About Adaptation Good Practice

Adapting to climate change is a relatively new concept to many. It is important to learn from practitioners who are undertaking adaptation activities that are beginning to have tangible outcomes. Documenting examples of good practice and identifying the criteria that makes them work, enables those interested in adaptation to learn about how to take action.

There are expectations that Adaptation Good Practice (AGP) includes a definite start and finish to a project. However climate change practitioners' experiences show that adaptation projects are often steps in longer learning journeys. There are no golden rules on how to adapt and often practitioners across Australia are inventing the wheel that drives future AGP.

This case study of Brisbane Airport - New Parallel Runway Project is part of a

series of 16 case studies that recognise exemplars for AGP in Australia. Through the development of these stories of successful adaptation it was refreshing to see an emergence of similar experiences and challenges regardless of the project or location. A synthesis of these stories can be seen in the Synthesis Report 'Climate Change Adaptation Good Practice: Key lessons from practitioners experiences', which will help practitioners to understand that they are not alone in their challenges and to see some of the clear lessons learned about what drives good practice in adaptation.

Following the Snapshot there is a more in depth narrative of the experiences, learnings and network links to stimulate further engagements and knowledge sharing among the growing community of adaptation practitioners.

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Case study snapshot

Brisbane Airport - New Parallel Runway Project



The Brisbane Airport, principal aviation gateway to Queensland, is a major driver in the State's economy. It is one of the fastest growing airports in Australia handling more than 21 million passengers in 2012 with passenger numbers forecast to exceed 25 million by 2015, and to be up around 50 million by 2035. Brisbane Airport provides services to 27 airlines flying to 43 national and 39 international destinations. It is owned and operated by the Brisbane Airport Corporation (BAC) which is 80% Australian-owned, principally by superannuation funds.

Located around 14 kms north-east of the Brisbane central business district, the Brisbane Airport is situated on a 2700 hectare precinct which accommodates a range of activities including domestic and international terminals, aviation and business operations, and by virtue of its size and geometry, enjoys large buffer zones providing a barrier between airport operations and surrounding communities. Furthermore, the site is adjacent to Moreton Bay Marine Park (a Ramsar site and marine park), Nudgee Beach, Boondall Wetlands and the Kedron Brook Floodway which have important ecological and social values which need strong consideration during any development planning.

The BAC recognised from its earliest design exercise that climate change could potentially affect the proposed New Parallel Runway. To deliver vitally needed capacity for current and future passenger and air traffic users, planning for a second runway at Brisbane Airport has been underway for over 20 years.

The project Journey

Functional long-term design must consider future condition predictions in order to deliver a product which is fit for purpose. Given the strong role weather plays in the successful and sustainable operation of an airport, the NPR design considered both historical and future predictions with respect to weather and climate.

Extensive stakeholder engagement was also undertaken and public comment was invited on an Environmental Impact Statement and Major Development Plan (MDP). To cope with the rapidly growing number of flights and accommodate future growth, a new major project is proposed to construct a new runway and associated infrastructure, on a low lying coastal area, parallel to Brisbane Airport's existing runway.



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Figure 1: New Parallel runway within Brisbane Airport precinct Brisbane, Queensland, Australia

Given the strong role weather plays in the successful and sustainable operation of an airport, the NPR design considered both historical and future predictions with respect to weather and climate.

Drivers for adaptation action

In 2005, engineering design and Environmental Impact Assessment process started.

→ Adaptation action

The NPR is a significant and complex piece of infrastructure. When completed it will be a contributor of considerable value to Brisbane and the surrounding region, as well as the nation. For longevity, it is essential to ensure that runway design and operations are resilient in the face of a changing climate.

Risks and impacts addressed

Sea level rise / tidal inundation

Key project aims

Factoring climate change considerations into infrastructure design.

Outcomes achieved

Climate resilience factored into infrastructure design.

Emerging outcomes

Ongoing planning processes for climate resilience.

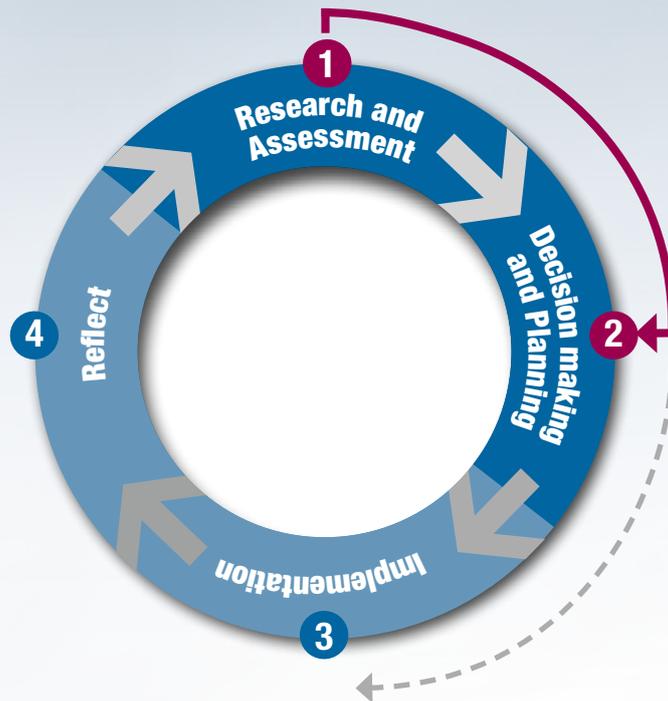


Figure 2: Brisbane Airport - New Parallel Runway Project Adaptation Good Practice phase

The project

In 2007 the Brisbane Airport New Parallel Runway (NPR) project was approved by the Australian Government following the completion and acceptance of a comprehensive Environmental Impact Statement (EIS) and Major Development Plan (MDP).

The objective of the project is to construct a new runway and associated infrastructure, on a low lying coastal area, west and parallel to Brisbane Airport's existing main runway. The proposed runway site is currently subject to inundation during flood events and at risk to future climate change impacts such as storm surge and sea level rise. As such, climate change impacts were considered in the planning and design for the ongoing continuity and long-term viability of operation of the new runway.

Due to potential social, economic and environmental impacts, over a long life cycle, major infrastructure projects such as this are complex. They require:

- Extensive site surveys and design studies
 - Numerous legislated planning conditions and approvals
 - Detailed stakeholder engagement;
- and, pose a range of construction and operational challenges.

Risks and impacts addressed

Given the sub-tropical location of the site and its proximity to the coast, the key climate change related risks were identified as sea level rise, storm surge, local/regional flood events and increase in average temperatures. Given the level these risks posed to the project it was appropriate to consider how best to



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Figure 3: Aerial view of the Brisbane airport showing the location of the new parallel runway.

As such, climate change impacts were considered in the planning and design for the ongoing continuity and long-term viability of operation of the new runway.

mitigate them in the design of the NPR. In doing so, design features needed to take account of, not only historical weather patterns but also, future projections of the localised impacts of climate change.

Specifically, there were a number of key design and planning decisions for the NPR where consideration of climate change and other related stakeholder issues featured. Specifically, these were:

- **Project go / no go decision:** As part of the design process for the NPR, alternatives to building a new runway were considered. After evaluation of

the options available to address the Airport's current operating constraints and future growth projections, construction of the NPR was found to be the most appropriate option

- **Runway placement and layout:** In considering the placement and configuration of the new runway six options were considered. Each option presented a range of issues for assessment, including cost, operating and safety standards, noise restrictions, environmental impacts, and climate change resilience. Based on a comprehensive assessment



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Figure 4: The 360 ha site of the NPR - 2 km west of the existing main runway at Brisbane Airport.

process of the available alternative runway configurations the preferred option for the NPR was selected as it:

- Avoided any land reclamation in Moreton Bay
- Had minimal impact on Moreton Bay foreshore habitats
- Had a lower cost than other configurations
- Maximised the number of planes that can arrive and depart over Moreton Bay rather than over surrounding suburbs, thereby having the lowest impact on ground based noise
- Rated well on safety
- Allowed for maximum flexibility with regards to the design and construction of future infrastructure between runways (e.g. terminals)
- **Runway height:** The height above sea level of the runway became the major climate change related design issue. The final design had to take account of historic and projected severity and frequency of sea level rise, storm surge and local/regional flood events. Based on the available evidence a design decision was then made to take account of the level and likelihood of the risk (e.g. sea level rise) and the cost of mitigation (e.g. raising the height of the runway).

Information and knowledge gaps

In considering the impacts of climate change on the proposed runway the project drew upon information and expertise from across a range of scientific and engineering sources. Initial considerations for flood and storm tide surge modelling were derived from the 2004 report - Queensland Climate Change and Climate Vulnerability to Tropical Cyclones – Ocean Hazards Assessment Stage 3. This report presented the findings from a joint project multi-agency (Queensland Government agencies Environment Protection Agency,



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Figure 5: The site of the NPR at its Moreton Bay end showing the current low lying estuarine nature of the site. The existing smaller cross runway (Runway 14/32) can be seen in the background and the newly constructed NPR construction access road in the left of the picture.

Department of Natural Resources and Mines, Department of Emergency Services, Australian Government Bureau of Meteorology, James Cook University, CRC Reef Research Centre and Sustainable Energy Association) investigation to assess the magnitude of the present and future ocean threats from tropical cyclones in Queensland and the vulnerability of coastal communities to extreme winds.

Response strategy

From the early stages of the project the BAC's New Parallel Runway project team were fully aware of the need to

consider future climate change impacts in the design, construction and operation of this major asset and the role that engagement with key stakeholders would play in the design and approval process.

Climate change impacts

Given the vital importance of the infrastructure and its long-term operating life the design response to potential climate change impacts was as follows:

- Sea level rise and increased frequency of cyclonic events was addressed by incorporating a 400 mm allowance + 500 mm additional wave set up freeboard in the hydrological

modelling undertaken for the project in accordance with research available at the time for the Queensland coast which included advice specific to the Airport site. The inclusion of these allowances was recommended by BAC's hydrological consultant (DHI) and accepted on the basis of best practice at the time

- Consideration of temperature increases in future decades was automatically accounted for in the ultimate length planning for both the existing main runway and for the new runway, each of which had significant additional lengths available to be added in the future. Prudent

runway planning allows for future additional length in the event a larger aircraft type than is currently known or planned to be in construction becomes operational during the life of the asset.

With regards to further design specifications for the runway height, the design team drew upon design frequency curves obtained from the Queensland Climate Change and Community Vulnerability to Tropical Cyclones (2004) report. Specifically, the design storm tide levels were derived representing the combined effect of tide level, storm surge effect and wave propagation. A 1% Average Exceedence Probability (AEP) design storm tide level for the Airport precinct consisted of:

- Current storm surge level of 1.5 m Australian Height Datum (AHD)
- Climate change increase of 400 mm (including 300mm sea level rise and increased cyclone frequency); and
- Wave set up freeboard of 500 mm
- This resulted in a design storm tide level of 2.4 m AHD or 3.53 m Airport Datum (AD) for a 1% AEP storm surge event being adopted for preliminary design of the NPR.

In addition to the storm tide, climate change and freeboard allowance, further design considerations influenced the final design elevation for the NPR. The existing main runway has an existing level of approx 5.1 m (AD). BAC decided that it would be preferable to select a minimum level of 5.0 m (AD) for the NPR so as not to have an undesirable incline (gradient) along the linked taxiway. This would also have presented gradient issues in terms of taxiway links into aprons.

To further assure the proposed runway height, in 2009 the Antarctic Climate and Ecosystems Collaborative Research Centre (ACE CRC) was engaged to evaluate the runway height specifications using the latest climate and sea level data available. Using a customised sea level calculator (CANUTE), the ACE CRC suggested a runway design level of 4.1 m above mean sea level as 'strongly precautionary'.

Given the combination of original design modelling, compatibility requirements with the existing infrastructure, and updated, independent sea level rise evaluation conducted by the ACE CRC, the design level adopted for the new runway at RL 5.0 m (AD) was validated as providing sufficient freeboard above the design storm tide level. Furthermore, the taxiways linking the new runway with the apron areas are also set above the 1% AEP storm surge event.

So, with the new runway at a minimum elevation of 5.0m (AD), this would result in both runways being of a similar design level. As the minimum design elevation for the NPR is at least 1.5 m above the 1 in 100 year storm tide level, additional sea level rise (above the 400mm already built into the modelling) is not anticipated to present concerns for the life of the project. In addition to the height of the NPR other climate change impact-related measures included in the design were the construction of tidal channels and the installation of a new sea wall along the northern boundary of the Airport.

Stakeholder engagement

Given the profile and complexity of the NPR project, a key factor in progressing the design and approval of the project was engagement with a broad range of stakeholders. A 22-month stakeholder engagement process was undertaken in order to understand stakeholder perspectives across a diverse range of issues. This process culminated in late 2006 when the BAC released for public comment the New Parallel Runway Project Environmental Impact Statement and Major Development Plan (EIS/MDP).

The release of this documentation provided a formal opportunity for stakeholders to raise issues and concerns for BAC to consider in preparing the final EIS/MDP submitted to the Australian Government for approval. The 90-day consultation period consisted of a range of materials and activities including:

- Information kits
- Project website
- Freecall information line
- Media announcements
- Print advertising
- Fact sheets
- Public information sessions
- Project displays in shopping centres and libraries
- Targeted briefings with key stakeholder groups.

At the conclusion of the consultation period BAC had received 196 submissions. The submissions were received from:

- Individual community members
- Relevant agencies from across Australia
- Queensland Government and Local Government
- Non-Government Organisations
- Elected representatives from Councils and members of the Queensland; and Australian Parliaments.

Of the submissions received, three specifically questioned whether the proposed runway design adequately took account of the long-term impacts of climate change and sea level rise.

In responding to the climate change issues raised in the engagement process BAC drew upon research and design data applied in the modelling and the final design specifications for the runway height and other supporting measures.

Implementation phases

The project has progressed through the usual adaptation phases:

1. Assessment and Research
2. Engagement
3. Decision-making
4. Planning
5. Phase One of project construction commenced in 2012.

Outcomes achieved

The level of detailed consideration to potential climate change impacts on the NPR at Brisbane Airport will ultimately result in safe and continuous operation of a vital piece of infrastructure in a changing climate. The design project has determined runway height specifications and other complementary measures that far exceed minimum requirements to ensure future climate impacts are mitigated.

Emerging outcomes

Ongoing planning processes for climate resilience.

Critical success factors

AGP analysis of the project

Success of this approach has been driven by strong leadership and excellent connectivity between all stakeholders, extensive engagement and by sustainable vision.

This project is strong in:

- Leadership
- Engagement
- Connectivity
- Sustainability

Leadership

This case study reflects the strong leadership within Brisbane Airport Corporation to incorporate considerations of climate change impacts in the decision making processes that underpin the design of the New Parallel Runway (NPR) project. The leadership's long term view of the high dollar value of this vital infrastructure asset takes into account high level risk elements in coming decades, to ensure that the new runway is designed to remain operational even in the face of the worst climate change scenarios for sea level rise and tidal inundation.

This project benefitted from the strong leadership shown by the Brisbane Airport Corporation Board (BAC). The BAC's NPR project team demonstrated leadership by including possible climate change impacts in the original design brief back in 2005. Consideration of climate change impacts had been a

The stakeholder engagement process for the NPR's EIS/MDP was significant and effective. Over a 22-month period all key stakeholders and affected communities were engaged via a range of channels and activities.

constant throughout the design process through the EIS/MDP process in 2005 - 2007 and up to and beyond the 2009 sea level rise study conducted by the ACE CRC. The long lived nature of the NPR asset commands that climate related issues be taken into account.

→ Leadership lesson learnt:

Project leaders having a long term view meant climate change was considered from the original design brief, throughout research stage and throughout the life of the project to completion.

Engagement

The stakeholder engagement process for the NPR's EIS/MDP was significant and effective. Over a 22-month period all key stakeholders and affected communities were engaged via a range of channels and activities. The outcome of the process was the inclusion of relevant issues raised being addressed in the final EIS/MDP which was formally approved in late 2007.

→ Engagement lesson learnt:

Use a range of channels and activities to reach all key stakeholders and effected communities.

Connectivity

The two major regulatory requirements the NPR project was subject to were:

- The *Airports Act* 1976
- The *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999.

The NPR project is also included under the BAC's Brisbane Airport Master Plan. The Master Plan is a statutory document required every five years under the *Airports Act* 1996.

Sustainability

The design specifications for the NPR project result in appropriate consideration of possible climate change impacts now and into the future. By designing and building for a long timeframe, once the runway is constructed there will be reduced pressure for additional construction into the next 50 - 60 years. This will reduce the potential impact on Moreton Bay (a Ramsar Wetlands and Marine Park). In particular, with the runway height being prescribed at a height exceeding both minimum regulatory requirements for flood and storm tide immunity levels and currently predicted sea level rises, the risk of

higher sea level rise and/or storm tide inundation in the future is significantly reduced.

→ **Sustainability lesson learnt:**

Planning for predicted impacts and exceeding minimum regulatory requirements alleviates pressure of additional construction for the next 50 - 60 years.

Cost

The cost during the preliminary design to incorporate consideration of climate change impacts was negligible. Given that storm and flood modelling is a normal requirement for any project, it was a very simple process to include allowances for climate change impacts in these modelling exercises. In terms of the impact on construction costs, BAC looked to balance the amount of fill required to raise the site to a particular level with the benefit that the continual reliable operation of the asset would deliver. In the final analysis, efficient aircraft operations drove the higher ultimate design level but with the confidence that all future climate change impacts had been considered and its impacts were under the ultimate design cloak.

→ **Cost lesson learnt:**

The cost of good design and the additional outlay of funds is outweighed by the confidence that all future climate change impacts have been considered and there will be no need to upgrade the runway for some time.

The cost during the preliminary design to incorporate consideration of climate change impacts was negligible.

Conclusion

In conclusion, the BAC recognised from its earliest design exercise that climate change could potentially affect the proposed NPR. As such, BAC ensured appropriate, climate-specific planning, scientific and engineering advice was taken into account in the design of the NPR. This advice, alongside operational and compatibility requirements with existing infrastructure, should ensure the new runway remains operational even in the worst case climate change scenarios for sea level rise.

Links to more information and projects

- New Parallel Runway fact sheet
[www.bne.com.au/sites/all/files/content/files/NPR%20A4%20\(Concertina\)%20Fact%20sheet.pdf](http://www.bne.com.au/sites/all/files/content/files/NPR%20A4%20(Concertina)%20Fact%20sheet.pdf)
- Brisbane Airport Corporation NPR -
www.bne.com.au/corporate/upgrading-your-airport/new-parallel-runway-project
- Colonial First State NRP Case Study www.cfsgam.com.au/uploadedFiles/CFSGAM/PdfResearch/Infrasrtucture_Brisbane_Airport_Dec12.pdf
- Sustainable Energy Association
www.seaaus.com.au



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