D5

**VOLUME D:** AIRSPACE

# Aircraft Noise Assessment

# D5 Noise Assessment

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## SUMMARY OF KEY FINDINGS

This report provides an assessment of noise impacts from the proposed NPR at Brisbane Airport. It includes assessment of:

- Noise from aircraft overflights;
- Noise from reverse thrust, take-off and taxi operations occurring on the airport; and
- Implication of future aircraft and navigation technology improvements on noise reduction.

With respect to noise from aircraft overflights in the **daytime (6am to 6pm) and evening (6pm to 10pm)**, the following key findings are noted:

- Overall noise impact from the airport will continue to rise between the present time and 2015, when the NPR is proposed to open due to the increase in aircraft movements.
- While there is an increase in aircraft movements, the N70 contours do not grow proportionately, as aircraft and navigation technology improves and older, noisier aircraft are replaced by newer, quieter aircraft (as discussed in section 5.8).
- Closure and re-opening of the cross runway (runway 14/32) for up to 2 years in 2008/2009, as proposed during construction, will have a negligible impact on the level and pattern of noise exposure during the closure period.
- Opening of the NPR in 2015 will result in an increase in the number of residences with both low-level and high-level exposure to aircraft noise. Residences experiencing an increase in noise exposure are beneath the approach and departure flight paths to the south of the NPR. However, some residences beneath existing flight paths will experience a reduction in noise exposure. Areas experiencing increases and reductions are indicated in detail in section 5.5 and 5.7 of the body of this report.
- After opening the NPR, there would be a slight benefit in operating the airport with arrivals and departures toward the south (on runway 19) as the preferred runway direction, rather than to the north (on runway 01) as at present. Operation on runway 19 also allows an easier transition to 'SODPROPS' mode, which provides for all operations to occur over Moreton Bay.
- There is benefit in adopting an 'active' approach to changing modes of operation over a 'passive' approach which is currently the situation. This means that as soon as a more preferable mode becomes available within the operating rules, air traffic control must enact it.
- Three alternative flight tracks are available for approaches to runway 01 from the north. These all have similar levels of overall noise impact, although the communities affected would be different. A choice between the three options was made on both acoustic and non-acoustic grounds. Option 2A (tracking furthest east) is preferred on most of these grounds, but public consultation and discussion is required before a final decision in this regard.

With respect to noise from aircraft overflights in the **night time (10pm to 6am)**, the following key findings are noted:

- Night time noise exposure can be expected to increase between the present time and 2015, before the NPR is proposed to open. This is particularly the case in summer, as movements in the 5am–6am period increase due to daylight saving in other states. There is some evidence that this process is already occurring.
- The introduction of the NPR would result in a decrease in night time noise exposure for a large number of residents under existing flight paths, although with unrestricted dual runway operating procedures when over Bay modes are not available, there would be some residents exposed to new night time noise associated with movements on the new runway.
- There are two options which together can reduce the noise effect at night when the new parallel runway opens:

  (i) The use of over Bay operations with the quieter turbo-prop aircraft taking off from the new runway in the city direction. This allows the maximum opportunity for jet aircraft to remain operating over the Bay whilst minimising delays; and

  (ii) When weather conditions do not allow for all flights over the Bay, to use only the existing runway for operations over the city at night (10pm - 6am).
- Between 2015 and 2035, night time exposure can be expected to increase. However, noise levels are not likely to increase proportionately to the increase in aircraft movements as aircraft and navigation technology improves and aircraft become quieter (as discussed in section 5.8).

With respect to noise from aircraft overflights **with and without the NPR in 2035**, the following key findings are noted:

- In 2035, during the day and evening periods, and winter night period, noise exposure will be lower without the NPR than with the NPR due to total lower movements.
- In 2035, during summer night period, however, noise exposure over residences in Brisbane will at times be lower with the NPR than without the NPR because of the flexibility offered by the NPR to maximise over Bay operations at night through the use of SODPROPS and DODPROPS modes.

With respect to noise from aircraft operations **on the airport**, the following key findings are noted:

- Noise levels from aircraft performing take-off, reverse thrust and to a lesser extent taxiing on the NPR are likely to be audible on occasion at some of the nearest residential locations under adverse meteorological conditions.
- At one residential location, representing an aged care facility, predicted noise levels from reverse thrusts occurring on the NPR are predicted to exceed 70 dBA for a proportion of evening and night periods. In view of this, adopting procedures which control the use of reverse thrust during the night period or using the existing runway only when possible at night may be considered appropriate.

## 5.1 Introduction

This Chapter provides details of the predicted aircraft noise exposure around Brisbane Airport under the following scenarios:

- Current operations (year 2005);
- Proposed temporary changes in operations in 2008, when the cross runway would be closed for up to two years for upgrades associated with the New Parallel Runway (NPR) construction;
- Operations in 2015 immediately before opening of the NPR, with the cross runway upgraded as proposed;
- Operations in 2015 immediately after the NPR becomes operational;
- Operations in 2035 with the NPR; and
- Operations in 2035 with the existing runway system (assuming no NPR or other runway system upgrades to increase capacity).

In each case, noise exposure is predicted for the day period (6am to 6pm), the evening period (6pm to 10pm) and night period (10pm to 6am).

Noise exposure calculations are based on predicted aircraft movements as provided by Tourism Futures International (Chapter D4, section 4.2), as well as predicted future aircraft types, and assumptions regarding continuity of air traffic control procedures and meteorological conditions (Chapter D4, section 4.4). Calculations are based on the most likely values of these parameters for any future year.

### 5.1.1 General Description of Project

The NPR project is designed to increase the capacity of Brisbane Airport by introducing an additional parallel runway to the west of the existing main runway and converting the smaller cross runway to a taxiway. The existing Airport layout is shown in **Figure 5.1**, together with the location of the proposed new runway.

New taxiways and other infrastructure would be required as part of the project, but the existing domestic and international terminals would remain in their current location.

The construction process for the NPR project is expected to occur over approximately seven years, and will involve:

- The closure and strengthening of the cross runway (runway 14/32), to allow it to function ultimately as a taxiway for heavy aircraft;
- The re-opening of the cross runway for approximately six years, with the potential for it to be used by some additional smaller jet aircraft in that period, such as Boeing 737s and the Airbus A320s; and
- The opening of the NPR and simultaneous final closure of the cross runway.

Opening of the NPR would be accompanied by changes to the airspace design around Brisbane Airport, with consequent changes to noise exposure. Changes to airspace design that are required to ensure the safe and efficient operation of the parallel runway system have been developed by Airservices Australia (AsA) on behalf of the Brisbane Airport Corporation (BAC) (refer to Chapter D3). The AsA airspace design has been used to assess the noise impacts addressed in this Draft Environmental Impact Statement and Major Development Plan (EIS/MDP).

***Figure 5.1:*** *Existing Airport Layout with NPR.*

### 5.1.2 Potential Sources of Noise Impact

During the construction process, aircraft flight tracks and operating procedures at the airport would remain as at present. However, there will be some re-distribution of the number and type of aircraft using those tracks during the period when the cross runway is out of commission during the upgrade construction works.

With the opening of the NPR, aircraft flight tracks and patterns of usage will need to change around Brisbane Airport to accommodate the requirements of a parallel runway system. The required changes are documented in Chapter D3 in this Volume.

Broadly, the changes would involve the introduction of new flight paths for approaches and departures on the new runway, and alterations to some flight paths for aircraft approaching the existing main runway. Flight paths for aircraft departing from the existing main runway will be substantially unchanged. Because aircraft operations would be segregated between runways, with operations to and from ports to the north and west of Brisbane generally occurring on the new runway, some flight paths associated with the existing main runway would see a reduction in usage.

A particularly important consideration is noise in the night time period, and in this respect the NPR would potentially provide a noise benefit compared with the present runway configuration. This is because the increase in capacity provided by the NPR would allow greater use of modes SODPROPS (Simultaneous Opposite Direction Parallel Runway Operations) and DODPROPS (Dependant Opposite Direction Parallel Runway Operations), in which both arrivals and departures occur over Moreton Bay at the same time. To a lesser extent, the SODPROPS mode would also be available in the quieter evening and day periods, when movement rates and weather permits (refer to section 5.2.5).

At residences immediately to the west of the airport, without mitigation measures there is the potential for noise exposure to increase due to aircraft performing take-off, reverse thrust and taxiing operations on the new runway. While not as significant as noise from aircraft in the air, this additional noise impact is also considered in this report.

There is no proposal to alter the procedures governing aircraft engine testing at the Airport in conjunction with the NPR project, and hence there would be no change to the present noise impact from this source, which is contained within the airport boundary.

In the longer term, increased usage of the Airport as a result of the proposal would result in alterations to the pattern of road traffic around the Airport. The noise impact from this change, while relatively minor, is assessed along with noise associated with construction works in Volume B of the Draft EIS/MDP.

### 5.1.3 Potentially-Affected Receivers

Noise-sensitive locations in the area around the Airport include residences, schools and other educational facilities, and hospitals and other health care facilities. In this Chapter, the potential impact of the proposal on these locations is assessed in terms of a number of descriptors of noise exposure, as set out in Chapter D2, section 2.8. Benefits and disadvantages of the proposal are assessed in terms of changes in noise exposure at these locations, and in terms of the number of residences experiencing a given level of noise exposure.

### 5.1.4 Project Stages

From the point of view of aircraft noise impacts, five project stages can be identified, as follows.

- Existing Operations. This stage would extend to the commencement of construction works for the project, nominally in 2008. No significant changes to airport operational procedures or aircraft flight paths are envisaged in this period. Noise impacts have been represented by impacts in 2005 (providing a direct reflection of existing noise levels).
- 2008–2009. In this period (corresponding to construction phases 1 and 2) the cross runway would be closed, resulting in increased operations on the existing main runway by turbo-prop and small general aviation aircraft.

- 2009– 2015. In this period (corresponding to construction phases 3 and 4) the cross runway would be re-opened after strengthening, and would be available for use by some additional smaller (mainly domestic) jet aircraft (B737s and A320s). Noise impacts can be represented by impacts in 2015, immediately before opening of the NPR. A 'no build' scenario is also considered, representing noise impacts in 2015 if the proposed cross runway strengthening did not occur.
- 2015 With NPR. This stage represents aircraft operations immediately after the opening of the NPR.
- 2035. This stage represents aircraft noise impacts 20 years after the opening of the NPR, taking account of projected growth in air traffic in this period. For comparison, noise impacts are also calculated for the 'no build' case using the existing runways and operating procedures, and a constrained forecast of future aircraft movements at the airport.

In this Volume, the descriptors of aircraft noise impact, which are outlined in Chapter D2, are considered for each of these five project stages. In some cases, the descriptors are calculated and compared for several alternative operating procedures within one stage.

## 5.2 Preferred Modes of Operation and Flight Paths with the New Parallel Runway

Existing operational modes for Brisbane Airport are described in Chapter D2, section 2.6. These modes, and their existing order of priority and selection rules, would be retained for all scenarios involving only the existing runways, with the following exceptions:

- In the 2008–2009 case, no movements are allowed on the cross runway; and
- In the 2009–2015 case, some additional small domestic jet arrivals from the north would occur on the cross runway in '19' mode (refer Chapter D2, section 2.7), unless the movement rate exceeds 20 arrivals per hour or 45 total movements per hour, in which case all jet movements would revert to the main runway[1].

With the NPR, new modes and selection rules and flight paths would be required, as described in Chapter D3 Airspace Architecture. This section provides a summary of those procedures, with emphasis on changes that are relevant for assessment of noise impacts.

A flow chart describing how the preferred mode and flight path options for noise assessment have been determined is provided in **Figure 5.2a**.

[1] *Modelling as shown that when jet aircraft are arriving on both runway 19 and the cross-runway 14, the capacity is reduced to 45 movements per hour as greater separation distances are required.*

***Figure 5.2a:*** *Option Assessment Process.*

| Option Assessment Process | Assessment |
|---|---|
| **Identify Preferred Runway Mode**<br>*Active, Prefer* ***19****, Option 1, Night Ops Type 1*<br>Versus<br>*Active, Prefer* ***01****, Option 1, Night Ops Type 1* | Assessment of N70 difference plots |
| ↓ | Take Forward<br>*Active, Prefer 19, Option 1, Night Ops Type 1* |
| **Select Preferred Flight Path Option**<br>*Active, Prefer 19,* ***Option 1****, Night Ops Type 1*<br>Versus<br>*Active, Prefer 19,* ***Option 2A****, Night Ops Type 1*<br>Versus<br>*Active, Prefer 19,* ***Option 2B****, Night Ops Type 1* | Options rated against criteria<br>(refer to **Table 5.2**) |
| ↓ | Take Forward<br>*Active, Prefer 19, Option 2A, Night Ops Type 1* |
| **Optimise Night Time Operations**<br>*Active, Prefer 19, Option 2A, Night Ops* ***Type 1***<br>Versus<br>*Active, Prefer 19, Option 2A, Night Ops* ***Type 2***<br>Versus<br>*Active, Prefer 19, Option 2A, Night Ops* ***Type 3*** | Assessment of N70 difference plots |
| ↓ | |
| **Preferred Operations Confirmed**<br>***Active, Prefer 19, Option 2A, Night Ops Type 3*** | |

### 5.2.1 Standard Airport Operating Modes

With the NPR, standard (or primary) airport operating modes would be similar to existing modes, with the addition of one additional mode known as SODPROPS (refer to Chapter D3). The modes considered in initial modelling are:

**'01' – 01 Mixed Parallel (Mode 2).** In this mode, arrivals from ports to the north and west of Brisbane occur on the new runway (runway 01L) while other arrivals occur on the existing runway 01R. Flight tracks will, however, differ from existing tracks as described in Chapter D3. Chapter D3 also outlines three options for the precise location of arrival tracks from the ports to the north and west, and these are evaluated in section 5.3. Departures to ports to the north and west generally occur from the new runway, while the remainder occur on the existing runway. However, all departures by heavy jet aircraft (B747, B777, A340 and A380) are from the existing runway.

**'19' – 19 Mixed Parallel (Mode 6).** In this mode, arrivals from ports to the north, and 30 percent of arrivals from ports to the west, occur on the new runway (runway 19R) while other arrivals occur on the existing runway 19L. Departures to ports to the north, north-east and west will generally occur on the new runway, while others occur on the existing runway. However, all departures by heavy jet aircraft (B747, B777, A340 and A380) are from the existing runway (refer Modes 6 to 9 in Chapter D3).

**'Dependant Opposite Direction Parallel Runway Operations' (Modes 11 and 12).** These modes are similar to the existing 'Reciprocal' mode, with both arrivals and departures occurring over Moreton Bay, with the exception that all arrivals now occur on the new runway (runway 19R), with all jet departures on the existing runway.

**'Simultaneous Opposite Direction Parallel Runway Operations' (Mode 1).** The runways and flight tracks used in this mode are identical to those used in 'DODPROPS' mode. The difference is in the rules for mode selection, as described below in Chapter D3, section 3.3).

These modes are the 'standard' or primary operating modes used for initial assessment of noise impacts with the NPR. Alternative secondary operating modes were also investigated in terms of their potential to provide noise mitigation, particularly at night. These are described in section 5.2.4.

### 5.2.2 Constraints on Mode Selection

Rules for determining the availability of '01', '19' and 'DODPROPS' modes are very similar to those for the corresponding existing modes described in section D2.6. The major difference is that the maximum capacity for the '01' and '19' modes is significantly higher than for the corresponding single-runway modes, and allows for the anticipated higher number of aircraft movements beyond 2015. This is reflected in higher projected traffic numbers for 2035 in the 'NPR' scenario than in the 'No Build' scenario.

Capacity constraints for the 'DODPROPS' mode with the NPR will be similar to the corresponding existing single runway mode, but with operations now on two runways rather than one. This is because it is assumed in this report that the meteorological criterion of maximum 10 knots downwind component would be allowed only if arrivals and departures are 'dependent' – that is, the time between an arrival and a departure on different runways would be the same as if these operations were performed on the same runway. The maximum number of arrivals or departures allowed in any hour would remain at 10, however, the maximum total operations per hour would increase to 20, because a departing aircraft would not need to wait for an arriving aircraft to clear the runway.

'SODPROPS' mode represents operations using the same tracks as for 'DODPROPS' mode, but utilising the additional capacity afforded by operations on two runways, with the additional constraint that the maximum allowed downwind component would be five knots rather than 10 knots. In modelling, the capacity of this mode is taken as 25 arrivals and 30 departures per hour, with no other restriction on total operations.

‘SODPROPS’ mode allows for operations to be conducted over Moreton Bay, and therefore away from residential areas, up to significantly higher movement rates than are allowed under ‘DODPROPS’ mode. However, currently this mode can be used only under conditions of a maximum downwind component of five knots in either the 19 or the 01 direction.

At the time of writing this report the meteorological conditions under which SODPROPS could be used (i.e. five knot tailwind) were under discussion. Given this, the assumptions adopted in this report are conservative in that parameters for the use of SODPROPS represent the maximum potential aircraft movements over residential areas.

In terms of priority for selection of modes, the highest priority mode during the day or evening periods would be ‘SODPROPS’. In situations where ‘SODPROPS’ is not available, but both ‘01’ and ‘19’ are available, two options are possible – preferring ‘01’ over ‘19’ or *vice versa*. The implications of this choice, in terms of noise impact, are discussed in section 5.2.3.

### 5.2.3 Prioritisation of ‘01’ and ‘19’ Modes

The choice between preferring ‘01’ or ‘19’ mode, when both modes are available (only when downwind component is less than five knots and demand exceeds SODPROPS capacity), has implications for the number and type of aircraft movements (departures or arrivals) experienced by residents in different areas. This section compares the implications of this choice for noise exposure in the day and evening periods. Night time noise exposure is considered in the following section.

As discussed in section D2.7, N70 values (representing the number of overflights causing noise to exceed 70 dBA) can give a useful indication of the extent and nature of aircraft noise impact. Similarly, the reduction or increase in N70 values between alternative operating procedures gives an indication of the difference in aircraft noise exposure.

In comparing a ‘Preferred 01’ operating strategy with a ‘Preferred 19’ strategy, a difference of two overflights[2] in the N70 value at any point can be taken as an indication of a notable difference in noise exposure.

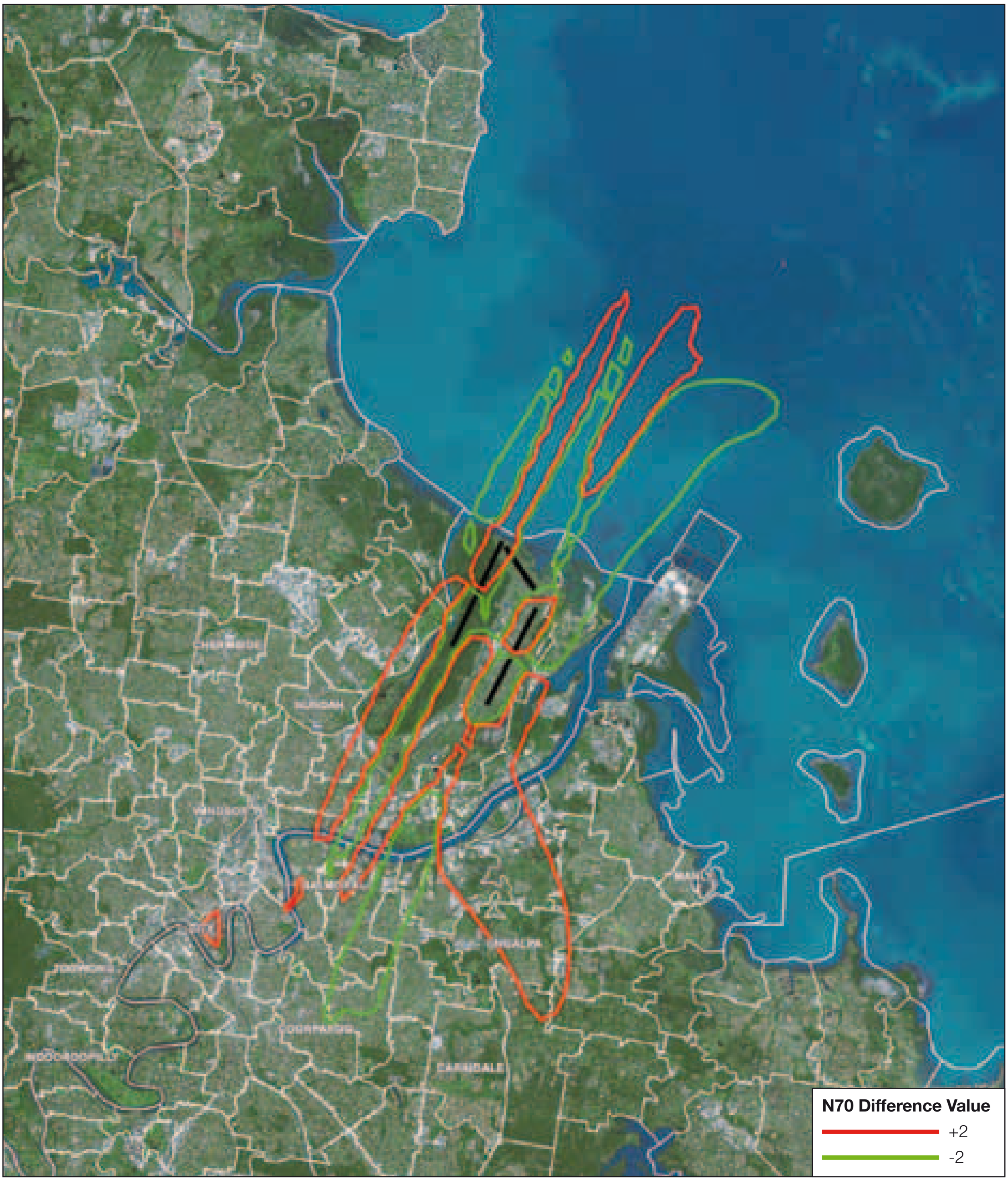
**Figure 5.2b** shows areas where N70 would be two overflights per day higher or lower if ‘01’ mode were preferred over ‘19’, for the 2015 Summer Weekday Day case. Other daytime and evening cases are similar. **Figure 5.2b** assumes that flight tracks corresponding to ‘Option 2A’, as described in section 5.3, are adopted. However, the conclusions of this analysis are not significantly affected by the flight tracks adopted.

Areas where noise exposure would be higher if ‘01’ is preferred (those within the green contour in **Figure 5.2b**) include more densely populated areas, which in some cases are predicted to experience an increase in noise exposure with the opening of the NPR. Areas where N70 noise exposure would be lower by at least two overflights per day if ‘01’ is preferred (those within the red contour in **Figure 5.2b**) are generally less densely populated, and have existing noise exposure, which would already reduce with the opening of the NPR.

On this basis, it would appear generally that a policy which actively prefers ‘19’ mode would be preferable to one that actively prefers ‘01’ mode. Operating in the 19 direction also has the important advantage that it allows an easier transition to SODPROPS mode if that mode becomes available, hence maximizing the opportunity for SODPROPS to be used.

[2] *In this Volume, an overflight refers to an aircraft arriving or departing the airport and flying over the area in question. In this Chapter it is specifically discussing areas where the overflights are greater than 70 dBA (sometimes referred to as N70 events).*

*Figure 5.2b:* *Difference in N70 Overflights Between 01 and 19 Modes – Summer Weekday Day.*



The following analysis assumes that with the NPR in place a policy of active preference for '19' mode would be adopted during the day and evening periods as it appears to provide the best overall outcomes, which is consistent with Principle 1 in the AsA's *"Environmental Principles and Procedures for Minimising Impact of Aircraft Noise."*[3]

### 5.2.4 Alternative Flight Tracks with the New Parallel Runway

Flight tracks for aircraft approaching or departing from Brisbane Airport with the NPR are described in Chapter D3. In most cases, the location of these tracks is determined by safety and airspace design considerations. For safety and separation reasons, it was only possible to identify options for arrivals from the north and west on runway 01L. All other arrivals and departure flight paths essentially follow existing flight paths except where deviations are required by safety and separation or immediately after departures off the new runway in the case of runway 19R.

In the case of aircraft arriving on runway 01L, three options have been provided by AsA in Chapter D3, referred to as Options 1, 2A and 2B. The assessment approach outlined in section 5.2 has been used to compare the noise impact from these alternative track locations for the three options.

The nominal tracks used to model these approaches are shown in **Figure 5.2c** to **Figure 5.2e**. Option 1 (see **Figure 3.6c** in Chapter D3) involves approach tracks further to the west prior to joining 'Final' than existing tracks and then concentrating along the final approach track to the new runway.

Option 2A (see **Figure 3.6d** in Chapter D3) involves tracks that follow the existing tracks closely, but then diverge to the south from the eastern-most existing arrival track just before joining the final approach track to the new runway.

Option 2B (see **Figure 3.6e** in Chapter D3) is intermediate between these two. Under Options 2A and 2B, certain heavy aircraft would be unable to use the relevant visual tracks and would be required to use the ILS track (for instrument landings) – approximately the southern-most track shown – in all conditions. This effect is not included in modelling, but would have a very minor influence on modelled overall noise levels at relevant locations as the number of heavy aircraft movements affected is small.

**Figure 5.2f** shows the difference between N70 noise exposure with Option 1 approach tracks and with Option 2A approach tracks (the comparison shown is for Summer Weekday Day, in 2015.) In this figure, red contours indicate areas where N70 is greater under Option 2A than under Option 1 (by at least two overflights), while green contours indicate areas where N70 is lower under Option 2A than under Option 1 (by at least two overflights).

**Figure 5.2g** shows a similar comparison between Option 1 and Option 2B.

[3] *Principle 1: Noise Abatement procedures should be optimised to achieve the lowest possible overall impact on the community.*

*__Figure 5.2c:__ Nominal Tracks for Approaches for Option 1.*

***Figure 5.2d:*** *Nominal Tracks for Approaches for Option 2A.*

***Figure 5.2e:*** *Nominal Tracks for Approaches for Option 2B.*

**Figure 5.2f:** *Difference in N70 Overflights Between Option 1 and Option 2A Approach Tracks – Summer Weekday Day.*

***Figure 5.2g:*** *Difference in N70 Overflights Between Option 1 and Option 2B Approach Tracks – Summer Weekday Day.*

On opening of the NPR, fewer residences would experience a change (either an increase or a decrease of two overflights) in their existing N70 overflights under Option 2A than under either Option 1 or Option 2B. Therefore, Option 2A is most consistent with Principles 10 and 11 in the AsA's *"Environmental Principles and Procedures for Minimising Impact of Aircraft Noise."* [4]

Nevertheless, other factors which cannot be fully accounted for in the above analysis will also require consideration in the choice of these approach paths. Among these are:

- Whether approach tracks are coincident with departure tracks, giving less respite for affected residents;
- Whether the required procedures may result in increased noise emission from some aircraft due to the small-radius turns required;
- The possibility for future noise (and emissions) reduction using a 'continuous descent approach' procedure, which would be most beneficial under Option 2A; and
- Total track miles flown, which affects aircraft emissions and the extent of residential areas overflown but overflights are less than 70 decibels.

**Table 5.2** shows a comparison and approximate rating of the options using a number of relevant criteria. A simple rating procedure is used, in which the options are rated against criteria on a 1–3 scale (1 being worst, 3 being best), based on a qualitative assessment of each of the options. The 'scores' for each option have then been totalled and the option with the highest score is considered to have the best overall outcome for the community as a whole. The table indicates that over this set of criteria, Option 2A is preferred.

Therefore in the noise impact assessments presented in the following sections, the 'Option 2A' approach tracks for runway 01L are adopted.

[4] *Principle 10: Options which allow for a gradual change from the current to planned procedures should be given preference.*

*Principle 11: In deciding between mutually exclusive, but otherwise equivalent options, involving:*
*(i) the overflight of an area which has previously been exposed to aircraft noise for a considerable period of time (and which a large proportion of residents would therefore have been aware of the noise before moving in); or*
*(ii) a newly exposed area,*
*then Option (i) should be chosen.*

**Table 5.2:** Comparison of Approach Path Options Using Various Criteria.

| Criteria | Option 1 | Option 2A | Option 2B |
|---|---|---|---|
| **Community Facilities Overflown**<br>(Daytime N70 > 5, Summer/Winter)[1]<br>**Hospital**<br>**Childcare**<br>**Schools** | <br><br>1/5<br>22/21<br>26/40 | <br><br>1/5<br>22/21<br>25/39 | <br><br>1/5<br>22/22<br>25/39 |
| Rating 1 – 3 | 3 | 3 | 3 |
| **Coincident with Existing Tracks**<br>(i.e closely follows existing track) | Limited | Yes<br>(most-used track) | Limited |
| Rating 1 – 3 | 1 | 3 | 1 |
| **Arrivals tracks coincident with departure tracks** | Arrivals and some limited departures | Arrivals and limited departures | Arrivals and departures |
| Rating 1 – 3 | 2 | 3 | 1 |
| **Downwind Vectoring with more tighter noisy turns** | No | Yes – greater requirement | Limited |
| Rating 1 – 3 | 3 | 1 | 2 |
| **Best advantage for Required Navigation Performance (RNP) and Continuous Descent Approach**[2] | Least advantage | Yes | Yes |
| Rating 1 – 3 | 2 | 3 | 3 |
| **Extent of noise impact on final approach and areas over-flown**[3] | Greatest | Least | Least |
| Rating 1 – 3 | 1 | 3 | 3 |
| **Track Miles Flown (Shortest) and therefore lowest emissions** | 63-66Nm | 47Nm | 49Nm |
| Rating 1 – 3 | 1 | 3 | 3 |
| **TOTAL** | **13** | **19** | **16** |

*Notes:*

[1] *Number of facilities predicted to experience more than 5 overflights per summer/winter day greater than 70 decibels.*

[2] *RNP and CDA are new navigation technologies being trialled that may reduce noise impacts and be available in 2015 (refer section 5.10).*

[3] *If the flight path is longer on final, more residential areas will be over-flown.*

### 5.2.5 Special Night Time Operating Modes

The introduction of the NPR would allow additional flexibility in defining airport operating modes in the night time period, over and above the existing procedures which aim to maximise 'over-bay' operations. Three special operating modes are described in this section, which have the potential to reduce night time noise exposure by taking advantage of the flexibility afforded by a parallel runway system in periods of low traffic volume.

The modes used for night time operations in the assessment of flight path options earlier in section 5.2 included modes 1, 11, 6 and 2 (in order of preference). These are considered the primary operating modes (or Night Operations Type 1 in **Figure 5.2a**)

A secondary operating mode 12 (referred to as 'DODPROPS +19R' or Night Operations Type 2 in **Figure 5.2a**) involves the use of runway 19R for departures by non-jet aircraft only while DODPROPS mode is otherwise in use. It is understood that this would be permitted up to a certain maximum number of departures per hour, while still retaining the meteorological constraints of DODPROPS mode – that is, a maximum downwind component of 10 knots. While allowing some quieter non-jet movements over newly-affected areas, this permits the use of DODPROPS mode for much longer periods at night (especially in the 5am–6am period), and hence protects residents from jet aircraft noise by allowing more jet aircraft operations to occur over Moreton Bay.

The other two modes are mode 4 and mode 9 (referred to as '01Night' and '19Night' respectively or Night Operations Type 3 in **Figure 5.2a**). These are similar to '01' and '19' modes, but operations over land (both arrivals and departures) would take place only on the existing runway. These modes would be used at night, in cases where operations in DODPROPS or SODPROPS mode are not possible. This provides protection from night time noise for residential areas newly-exposed to aircraft noise from the NPR, which is consistent with Principle 11 in the AsA's "*Environmental Principles and Procedures for Minimising Impact of Aircraft Noise*"[5].

In conjunction with the introduction of modes '01Night' and '19Night', the order of preference for these modes should be considered. A preference for '01Night' over '19Night' appears to offer benefits in terms of noise exposure in the night time period at times. This is because night time noise over land occurs largely in the 5am–6am period, and at this time operations are dominated by departures. Preferring '01Night' mode ensures that departures will be over water wherever possible. (Of course, if the number of arrivals were to exceed the number of departures in any night time period, '19Night' mode would be preferred).

**Figure 5.2h** shows the impact of the introduction of 'DODPROPS +19R' secondary mode, compared with a continuation of just primary modes (Type 2 compared to Type 1 in **Figure 5.2a**). Once again, areas inside the red contour would experience an increase of at least two overflights in the night time N70 value, while areas inside the green contour would experience a decrease of at least two overflights on average. The use of 'DODPROPS +19R' mode leads to benefits in terms of night time noise exposure at sensitive receivers.

**Figure 5.2i** shows the impact of the introduction of additional secondary '01Night' and '19Night' modes (with '01Night' being preferred) compared with the use of primary modes plus 'DODPROPS+19R' (Types 3 and 2 compared to Type 2 only in **Figure 5.2a**). The overall impact of this change appears to be beneficial, although there is a small area in which night time noise exposure increases compared with the previous case. However, this is an area which would still experience a reduction in night time noise exposure with the introduction of the NPR (see section 5.7), whereas the area receiving a benefit by the use of '01Night' and '19Night' modes would otherwise experience an increase in night time noise at this time.

[5] *Principle 11: In deciding between mutually exclusive, but otherwise equivalent options, involving:*
*(i) the overflight of an area which has previously been exposed to aircraft noise for a considerable period of time (and which a large proportion of residents would therefore have been aware of the noise before moving in); or*
*(ii) a newly exposed area, then Option (i) should be chosen.*

*Figure 5.2h:* *Difference in N70 Overflights Between 'DODPROPS +19R' (Type 2) and Primary Operating (Type 1) Modes – Summer Weekday Night.*

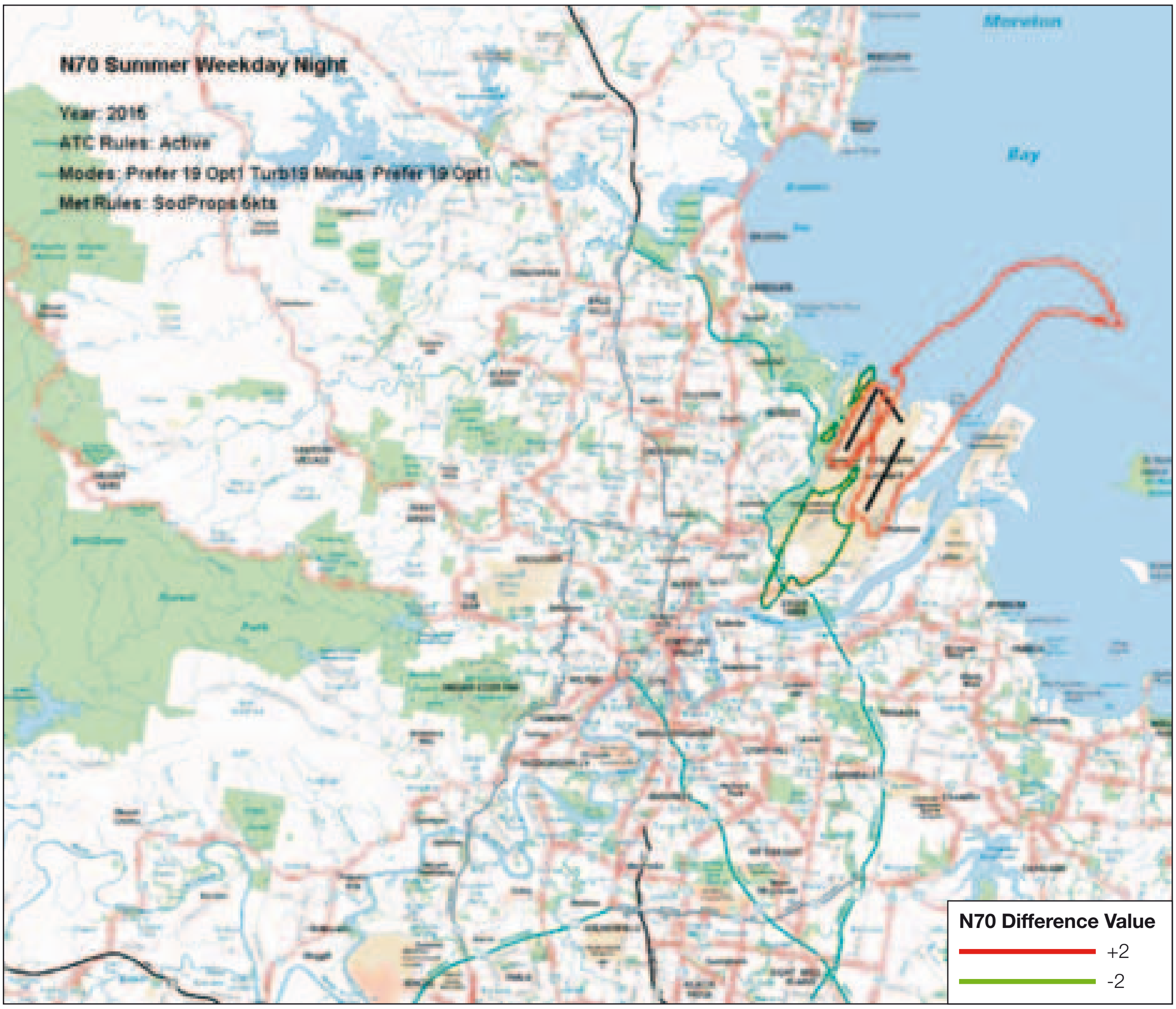
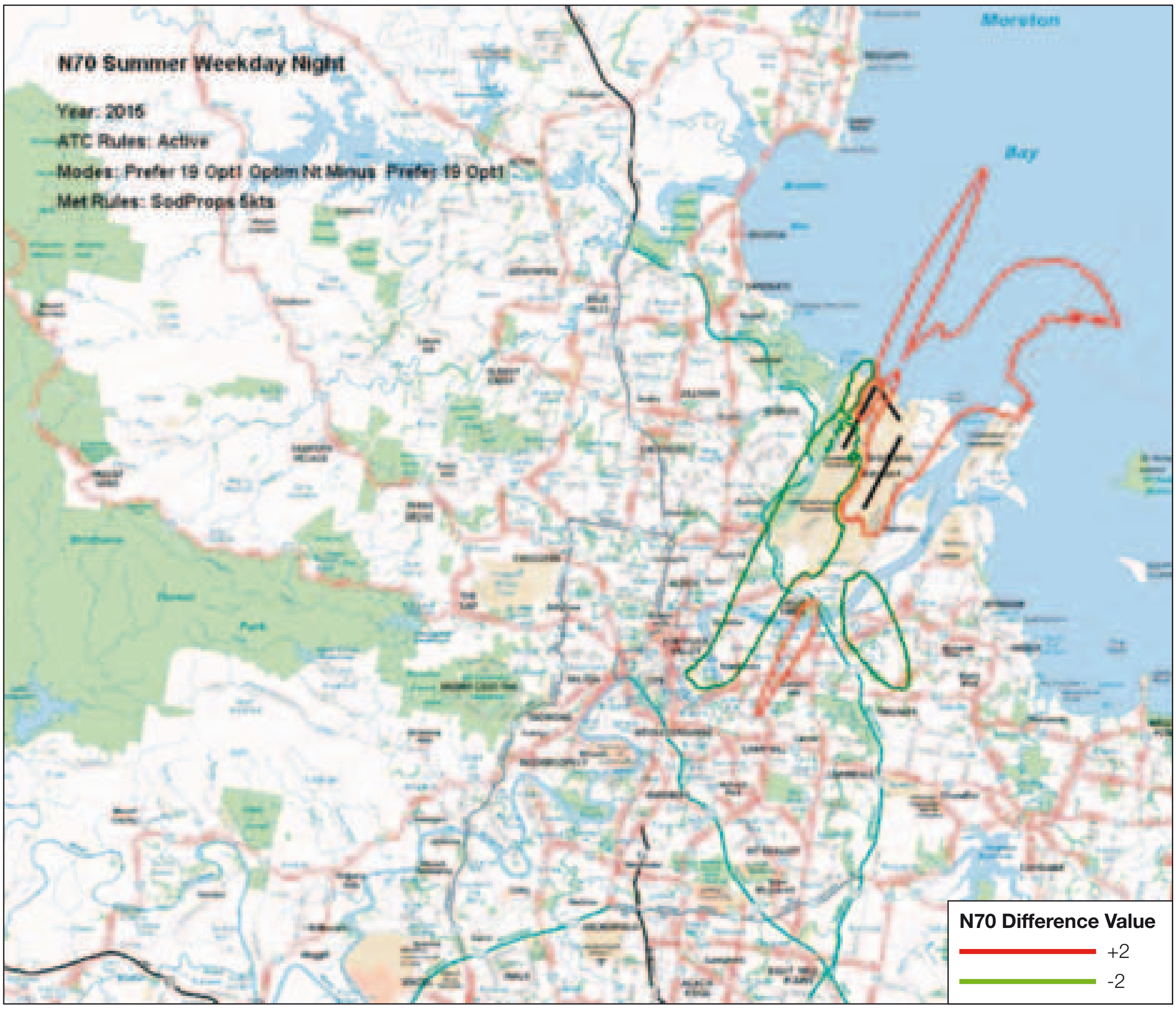


***Figure 5.2i:*** *Difference in N70 Overflights Between '01Night' and '19Night' (Type 3) and 'DODPROPS +19R' (Type 2) Modes – Summer Weekday Night.*



If the secondary modes for night time (Type 3) operating procedures considered in this section are adopted, then with the opening of the NPR based on current forecasts, there will be a decrease in jet aircraft movements over residential Brisbane at night and no residence is likely to be exposed to additional aircraft movements at night above 70 dBA (see section 5.7). This is the best overall outcome, as it is consistent with Principle 1 and Principle 8 in the AsA's "*Environmental Principles and Procedures for Minimising Impact of Aircraft Noise*"[6]. Therefore, the detailed analysis below adopts the use of these procedures.

### 5.2.6 Estimated Percentage Usage of Modes in 2015 and 2035

Using the detailed modelling procedures described in Chapter D4, and with NPR operating modes and selection procedures as described in the preceding sections, the proportion of the time for which each operating mode would be used has been calculated. **Figure 5.2j** and **Figure 5.2k** show the results, for the traffic volumes predicted for 2015 and 2035 (with the NPR) respectively.

[6] *Principle 1: Noise abatement procedures should be optimised to achieve the lowest possible overall impact on the community.*

*Principle 8: When comparing options, operations that are conducted at night or on weekends should be treated as being more sensitive than those which occur during the daytime or on weekdays.*

**Figure 5.2j:** *Percentage Usage of Modes, Year 2015 with NPR.*

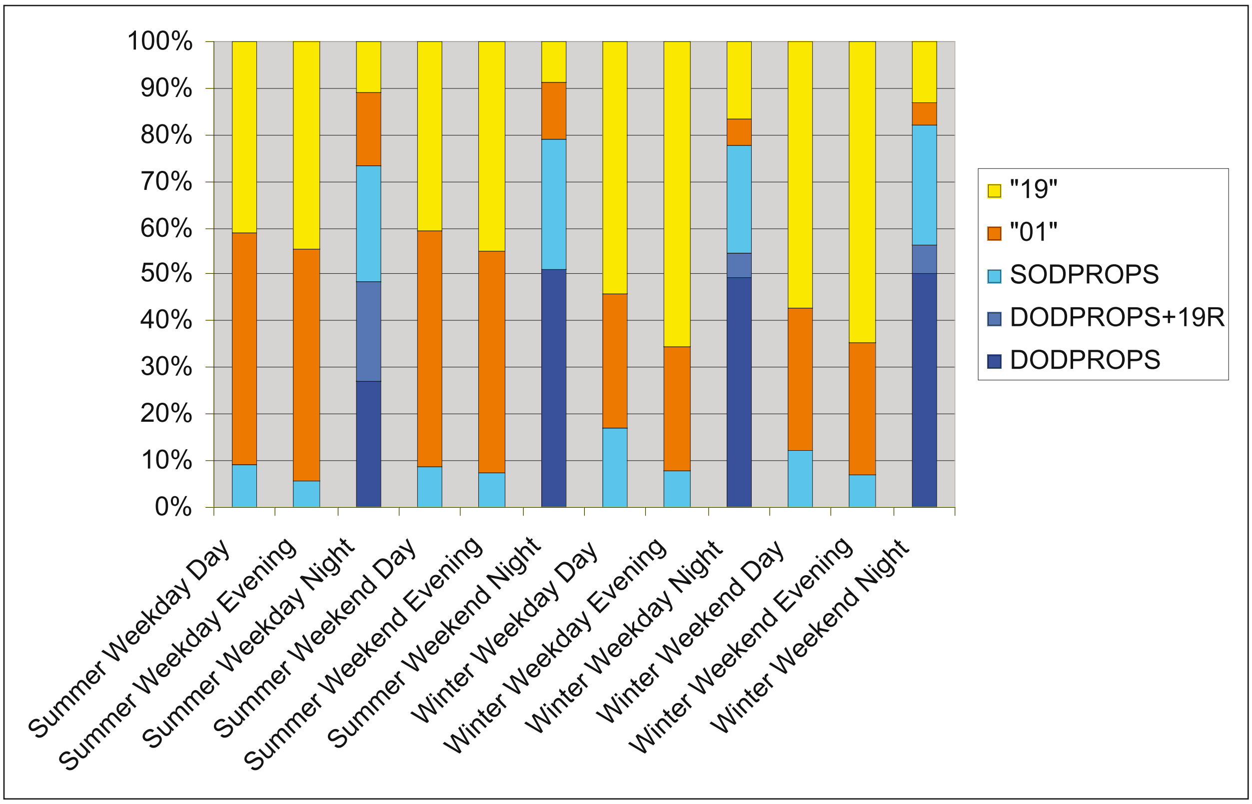
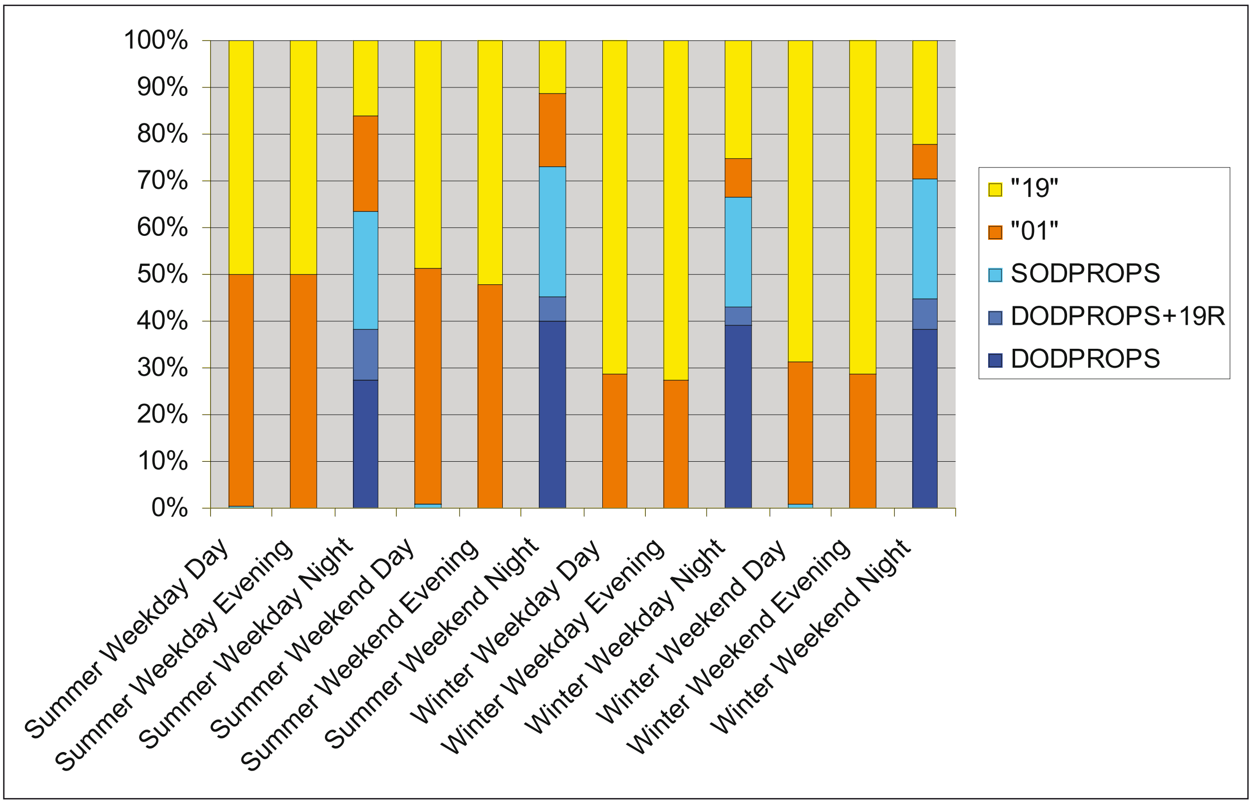



**Figure 5.2k:** *Percentage Usage of Modes, Year 2035 with NPR.*




*Note: SODPROPS, DODPROPS and DODPROPS + 19R are full over-bay jet operations and are the preferred modes when weather and air traffic permits.*

## 5.3 Results of Modelling

### 5.3.1 Flight Path Movement Charts

As described in Chapter D2, section 2.7.3, flight path movement charts indicate the predicted number of aircraft operations within various ‘flight path zones’, often in addition to other information. They give a general and easily-understood picture of the pattern of aircraft noise exposure.

For this assessment, the following scenarios are considered:

- Year 2005, existing runway system (ERS) (i.e. existing tracks and modes, ‘passive’ preference for ‘01’ mode);
- Year 2008, during closure of the cross runway;
- Year 2015 ‘No Build’. This scenario represents conditions in 2015 if the project does not proceed – that is, without upgrading of the cross runway;
- Year 2015 ‘Before NPR’. This scenario includes the upgraded cross runway (i.e. small jets on cross runway, other conditions as for ‘existing’), and represents conditions immediately before opening of the NPR;
- Year 2015 NPR. This is modelled as described in sections 5.2 and 5.3;
- Year 2035, NPR. This is modelled as for Year 2015 NPR; and
- Year 2035, ‘No Build’. This is modelled as for the ERS, with movement numbers constrained by capacity limitations.

Flight zones were defined for the ERS and for the NPR configuration. They represent a majority of where actual aircraft fly. An occasional individual track may be counted as occurring within a zone if it is slightly outside the area actually shown.

Flight path movement charts were produced indicating:

- Mean number of operations per period of day (for day, evening and night);
- The range of numbers of operations in any given day; and
- The proportion of days having no operations.

Care should be taken in interpreting these figures, as the same location may be affected by both arrivals and departures and by operations in more than one flight zone.

**Figure 5.3a** to **Figure 5.3h** show examples for the Summer Weekday Day and Summer Weekday Night periods in the 2005, 2015 Before NPR, 2015 NPR and 2035 NPR scenarios These figures also include the N70 figures overlaid. More detail on the N70s is provided in section 5.3.3.

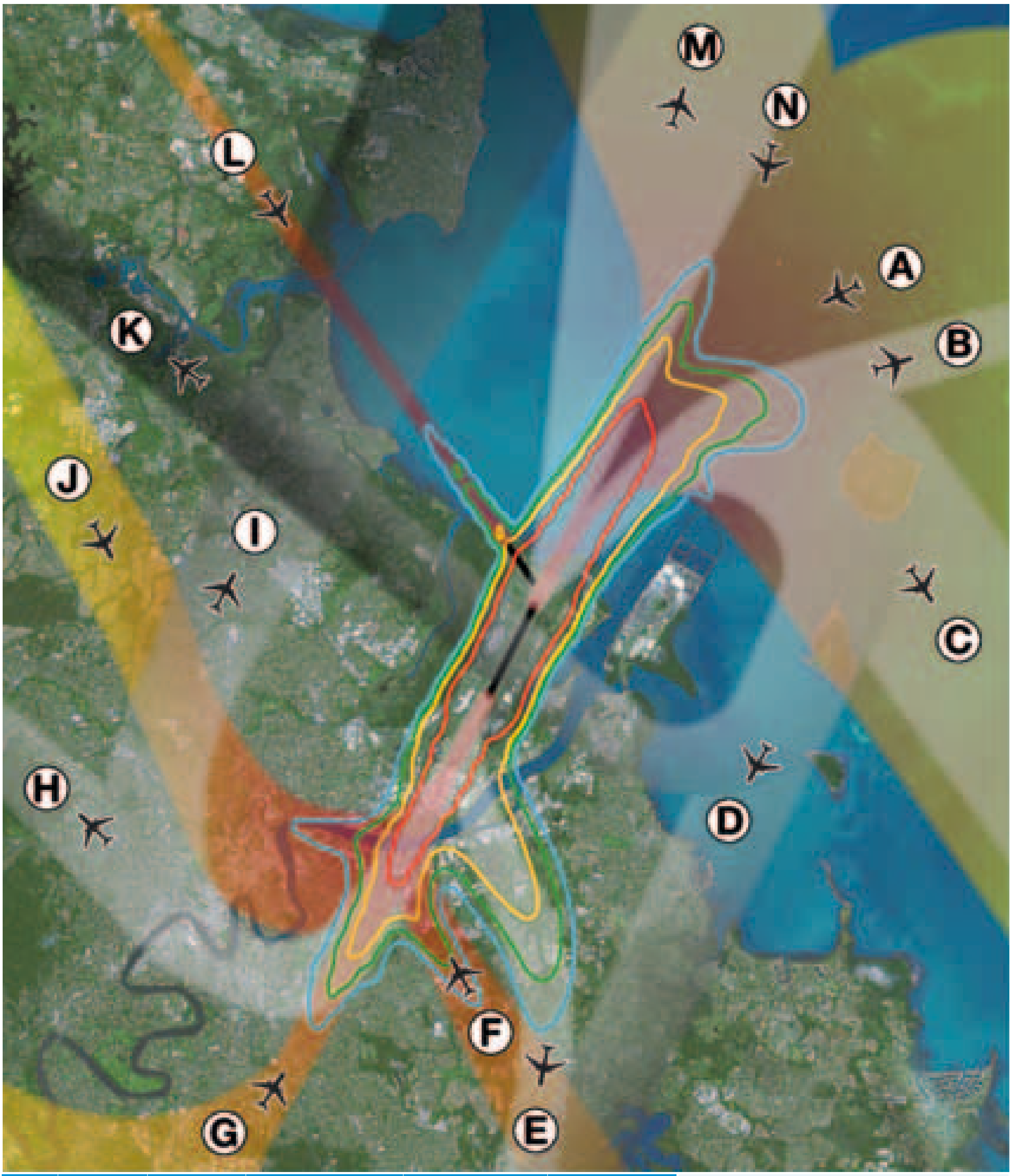
The Flight Path and Noise Information Booklet (FPNIB) supplied with the Draft EIS/MDP contains flight path movement charts for all 12 periods in each of the relevant scenarios.

The FPNIB also provides a detailed explanation on how the flight path zones were developed. It is important to note that these flight path zones represent the area in which an aircraft overflight may be experienced. In most cases, on any given day, the number of movements may be greater in some areas than another within the same flight path zone or may be even spread across the zone with an slight concentration closer to the centre of the flight path zone. Refer to section 5.7 for further details on the FPNIB.

Between 2005 and 2015, numbers of operations in all flight zones increase in line with the overall increase in air traffic. Between the 2015 Before NPR and 2015 NPR scenarios, the total number of operations over land decreases slightly, particularly at night. However, the area covered by flight zones increases, particularly in the case of arrivals.

The Transparent Noise and Information Package (TNIP) software provided with the Draft EIS/MDP allows flight path movement charts to be generated for all relevant scenarios, and allows for detailed examination and comparisons of information on movement numbers and flight tracks, which forms the basis of the charts.

***Figure 5.3a:*** *2005 Existing Runway System Flight Path Movement Chart – Summer Weekday Day.*




| Flight path | Flight path type | Average number of jet flights on flight path | Expected minimum and maximum numbers of jet flights on path | Percentage of Brisbane Airport's total jet flights on path | Percentage of days with no jet flights on path |
|---|---|---|---|---|---|
| A | Arrival | 38 | 0 - 83 | 16% | 27% |
| B | Departure | 1 | 0 - 1 | <1% | 25% |
| C | Departure | 4 | 0 - 8 | 2% | 25% |
| D | Departure | 35 | 0 - 66 | 15% | 25% |
| E | Departure | 34 | 0 - 73 | 15% | 27% |
| F | Arrival | 30 | 0 - 69 | 13% | 30% |
| G | Arrival | 17 | 0 - 113 | 8% | 25% |
| H | Departure | 5 | 0 - 10 | 2% | 27% |
| I | Departure | 14 | 0 - 30 | 6% | 27% |
| J | Arrival | 16 | 0 - 36 | 7% | 25% |
| K | Departure | 2 | 0 - 3 | 1% | 25% |
| L | Arrival | <1 | 0 - 1 | <1% | 29% |
| M | Departure | 19 | 0 - 36 | 8% | 25% |
| N | Arrival | 16 | 0 - 36 | 7% | 28% |

**Altitude Key**

**Arrivals**
Mean Altitude
4,500 ft
0 ft

**Departures**
Mean Altitude
12,000 ft
0 ft

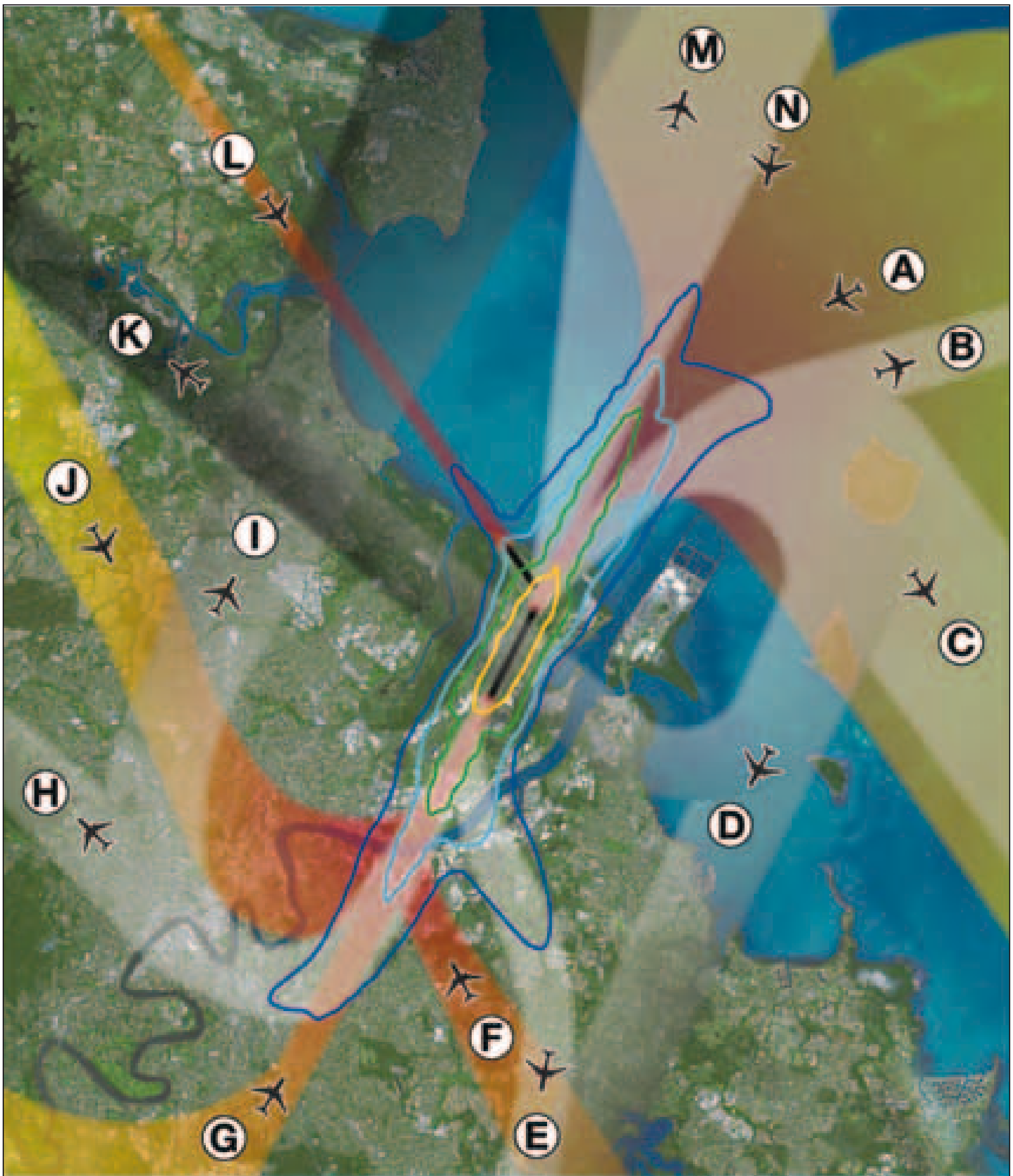
**Contour Key**

The number of overflights of 70dB(A) and above during the indicated time period

- 5 to 9 overflights
- 10 to 19 overflights
- 20 to 49 overflights
- 50 or more overflights

*Individual values are rounded. Totals may not add to 100% due to rounding.*

**Figure 5.3b:** *2005 Existing Runway System Flight Path Movement Chart – Summer Weekday Night.*




| Flight path | Flight path type | Average number of jet flights on flight path | Expected minimum and maximum numbers of jet flights on path | Percentage of Brisbane Airport's total jet flights on path | Percentage of days with no jet flights on path |
|---|---|---|---|---|---|
| **A** | Arrival | 10 | 0 - 27 | 14% | 55% |
| **B** | Departure | <1 | 0 - 1 | <1% | 33% |
| **C** | Departure | 1 | 0 - 2 | 2% | 33% |
| **D** | Departure | 13 | 0 - 20 | 18% | 31% |
| **E** | Departure | 8 | 0 - 22 | 11% | 57% |
| **F** | Arrival | 9 | 0 - 20 | 12% | 44% |
| **G** | Arrival | 10 | 0 - 36 | 14% | 31% |
| **H** | Departure | 2 | 0 - 4 | 2% | 55% |
| **I** | Departure | 3 | 0 - 8 | 4% | 56% |
| **J** | Arrival | 5 | 0 - 11 | 7% | 31% |
| **K** | Departure | 1 | 0 - 2 | 2% | 31% |
| **L** | Arrival | <1 | 0 - 1 | <1% | 55% |
| **M** | Departure | 6 | 0 - 10 | 9% | 31% |
| **N** | Arrival | 4 | 0 - 11 | 5% | 55% |

**Altitude Key**

**Arrivals**
Mean Altitude
4,500 ft
0 ft

**Departures**
Mean Altitude
12,000 ft
0 ft

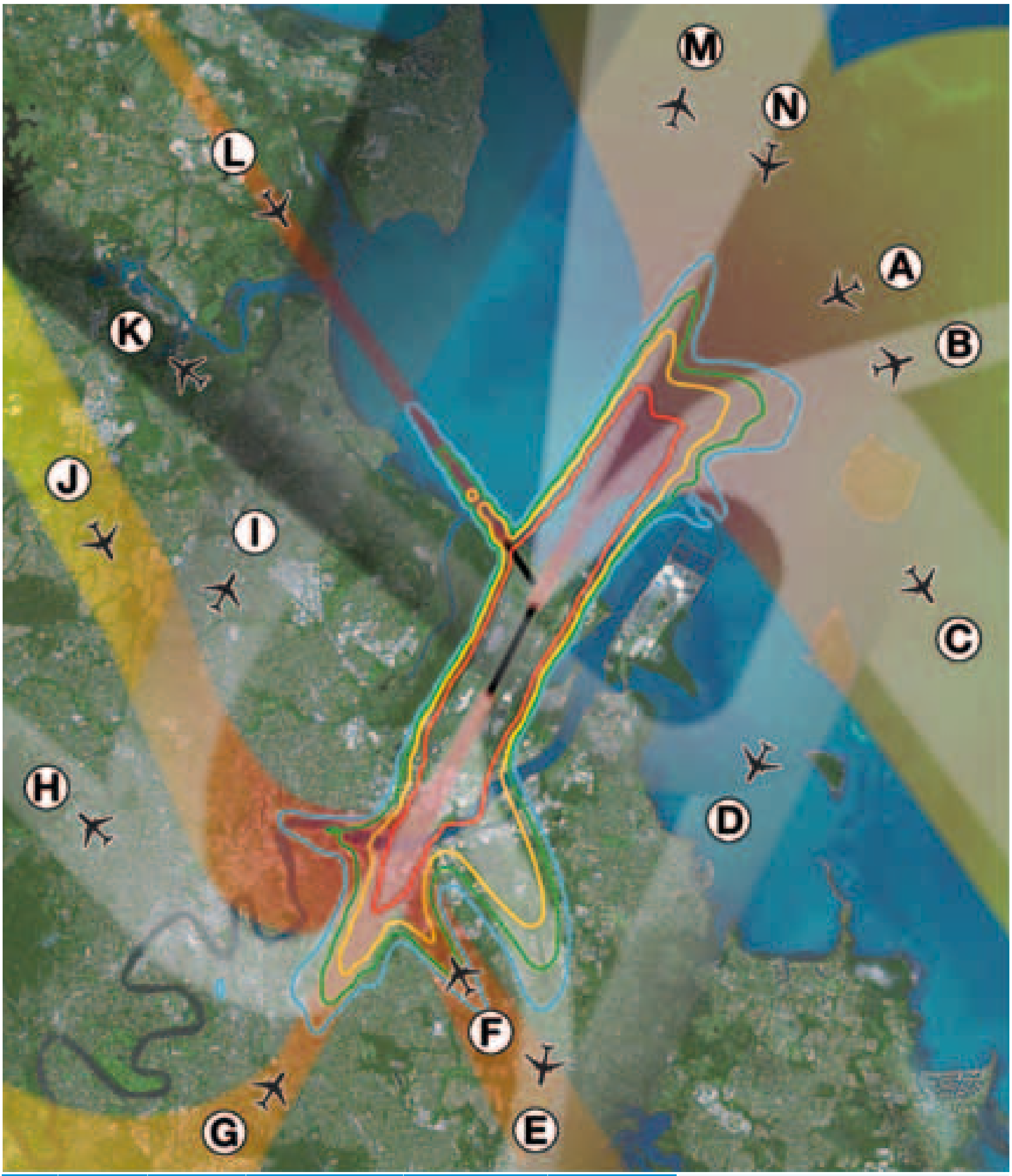
**Contour Key**

The number of overflights of 70dB(A) and above during the indicated time period

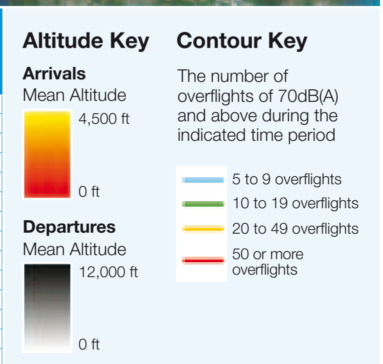
- 2 to 4 overflights
- 5 to 9 overflights
- 10 to 19 overflights
- 20 to 49 overflights
- 50 or more overflights

*Individual values are rounded. Totals may not add to 100% due to rounding.*

**Figure 5.3c:** *2015 Existing Runway System Flight Path Movement Chart – Summer Weekday Day.*

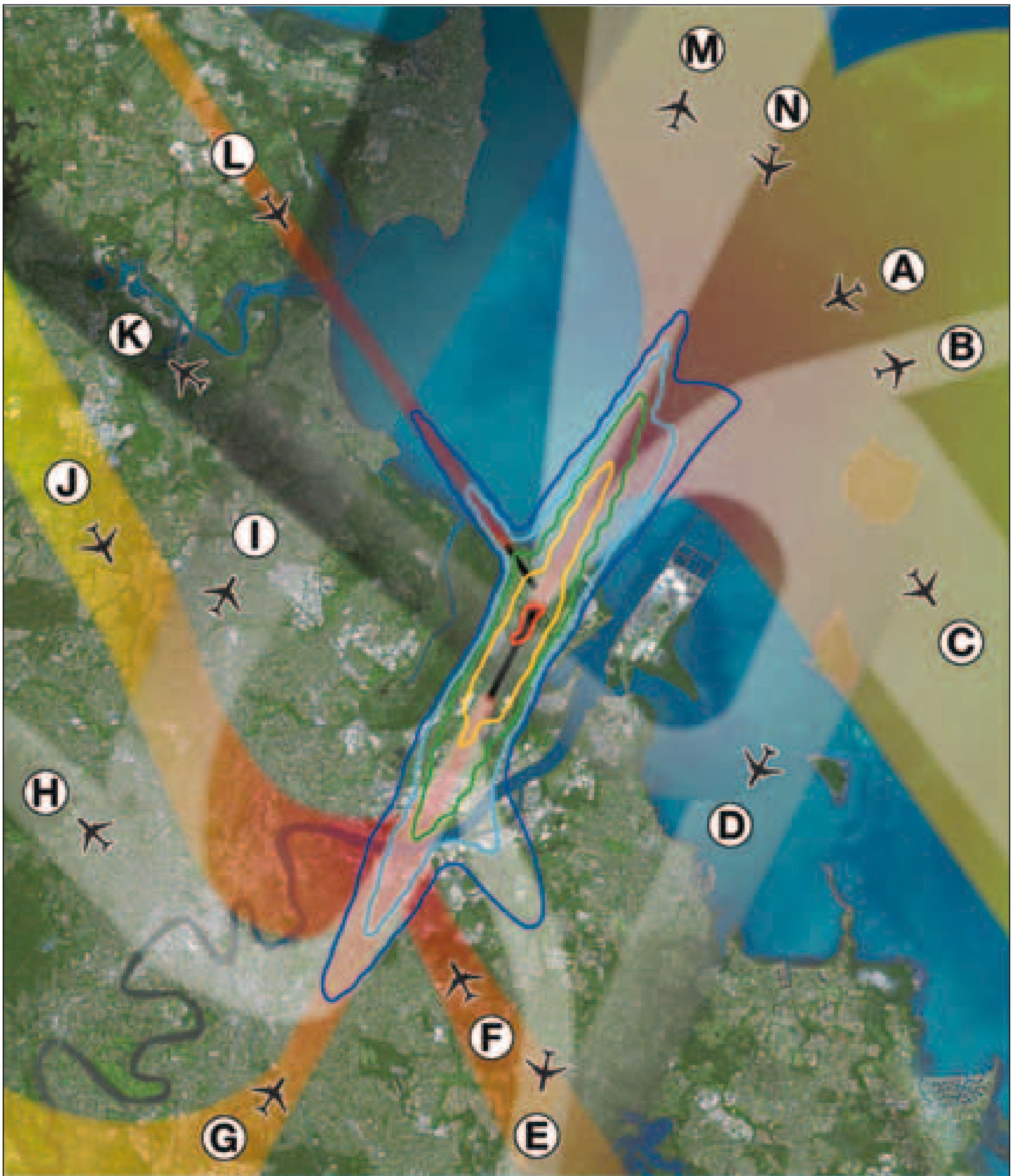



| Flight path | Flight path type | Average number of jet flights on flight path | Expected minimum and maximum numbers of jet flights on path | Percentage of Brisbane Airport's total jet flights on path | Percentage of days with no jet flights on path |
|---|---|---|---|---|---|
| A | Arrival | 60 | 0 - 133 | 16% | 27% |
| B | Departure | 1 | 0 - 2 | <1% | 25% |
| C | Departure | 7 | 0 - 13 | 2% | 25% |
| D | Departure | 59 | 0 - 110 | 16% | 25% |
| E | Departure | 56 | 0 - 122 | 15% | 27% |
| F | Arrival | 46 | 0 - 108 | 12% | 30% |
| G | Arrival | 28 | 0 - 177 | 8% | 25% |
| H | Departure | 9 | 0 - 19 | 2% | 27% |
| I | Departure | 21 | 0 - 47 | 6% | 27% |
| J | Arrival | 23 | 0 - 53 | 6% | 25% |
| K | Departure | 3 | 0 - 6 | 1% | 25% |
| L | Arrival | 1 | 0 - 2 | <1% | 28% |
| M | Departure | 31 | 0 - 57 | 8% | 25% |
| N | Arrival | 25 | 0 - 54 | 7% | 28% |




*Individual values are rounded. Totals may not add to 100% due to rounding.*

***Figure 5.3d:*** *2015 Existing Runway System Flight Path Movement Chart – Summer Weekday Night.*




| Flight path | Flight path type | Average number of jet flights on flight path | Expected minimum and maximum numbers of jet flights on path | Percentage of Brisbane Airport's total jet flights on path | Percentage of days with no jet flights on path |
|---|---|---|---|---|---|
| A | Arrival | 16 | 0 - 46 | 15% | 55% |
| B | Departure | <1 | 0 - 1 | <1% | 34% |
| C | Departure | 1 | 0 - 1 | 1% | 34% |
| D | Departure | 19 | 0 - 30 | 17% | 31% |
| E | Departure | 11 | 0 - 30 | 10% | 55% |
| F | Arrival | 15 | 0 - 34 | 13% | 44% |
| G | Arrival | 16 | 0 - 57 | 14% | 31% |
| H | Departure | 4 | 0 - 10 | 3% | 55% |
| I | Departure | 5 | 0 - 13 | 4% | 56% |
| J | Arrival | 6 | 0 - 14 | 6% | 31% |
| K | Departure | 3 | 0 - 5 | 3% | 31% |
| L | Arrival | <1 | 0 - 1 | <1% | 55% |
| M | Departure | 12 | 0 - 18 | 10% | 31% |
| N | Arrival | 5 | 0 - 15 | 4% | 55% |

**Altitude Key**

**Arrivals**
Mean Altitude
4,500 ft
0 ft

**Departures**
Mean Altitude
12,000 ft
0 ft

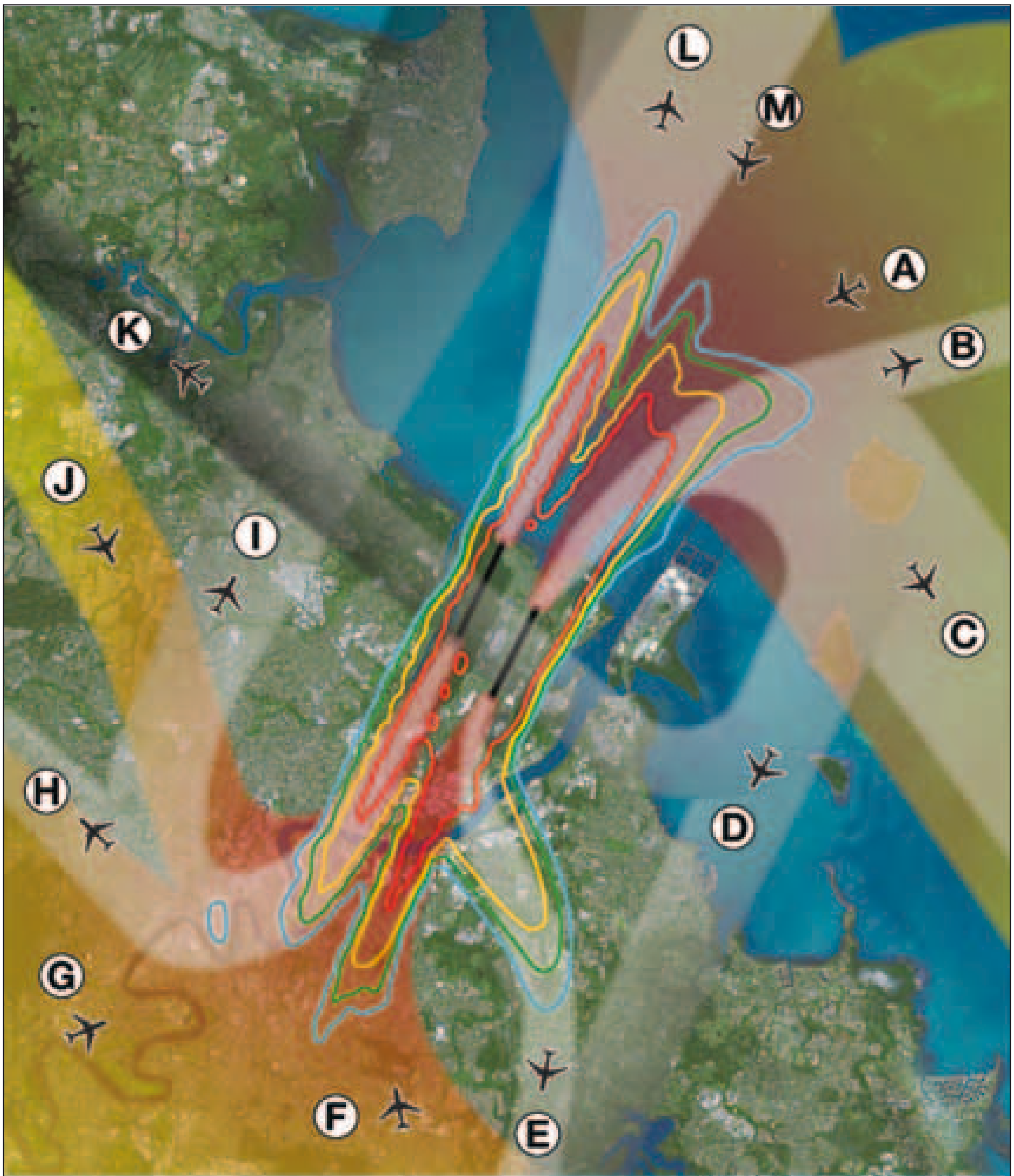
**Contour Key**

The number of overflights of 70dB(A) and above during the indicated time period

- 2 to 4 overflights
- 5 to 9 overflights
- 10 to 19 overflights
- 20 to 49 overflights
- 50 or more overflights

*Individual values are rounded. Totals may not add to 100% due to rounding.*

***Figure 5.3e:*** *2015 NPR Flight Path Movement Chart – Summer Weekday Day.*




| Flight path | Flight path type | Average number of jet flights on flight path | Expected minimum and maximum numbers of jet flights on path | Percentage of Brisbane Airport's total jet flights on path | Percentage of days with no jet flights on path |
|---|---|---|---|---|---|
| A | Arrival | 57 | 0 - 135 | 15% | 22% |
| B | Departure | 11 | 0 - 22 | 3% | 7% |
| C | Departure | 7 | 0 - 13 | 2% | 9% |
| D | Departure | 64 | 0 - 110 | 17% | 7% |
| E | Departure | 53 | 0 - 125 | 14% | 22% |
| F | Arrival | 62 | 0 - 126 | 17% | 23% |
| G | Arrival | 7 | 0 - 69 | 2% | 23% |
| H | Departure | 7 | 0 - 17 | 2% | 23% |
| I | Departure | 18 | 0 - 46 | 5% | 23% |
| J | Arrival | 22 | 0 - 53 | 6% | 27% |
| K | Departure | 5 | 0 - 10 | 1% | 8% |
| L | Departure | 22 | 0 - 42 | 6% | 23% |
| M | Arrival | 35 | 0 - 92 | 9% | 17% |

**Altitude Key**

**Arrivals**
Mean Altitude
4,500 ft
0 ft

**Departures**
Mean Altitude
12,000 ft
0 ft

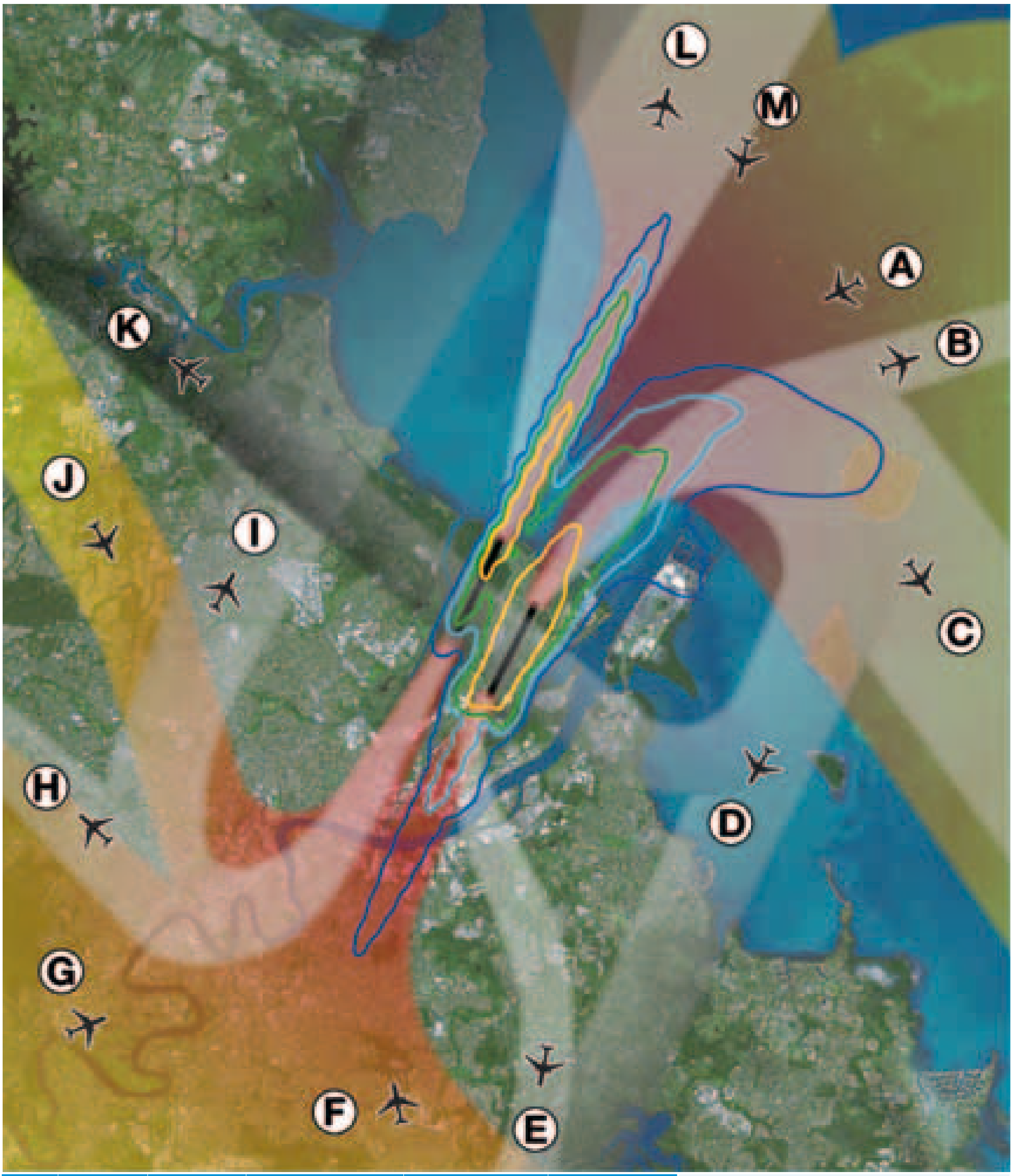
**Contour Key**

The number of overflights of 70dB(A) and above during the indicated time period

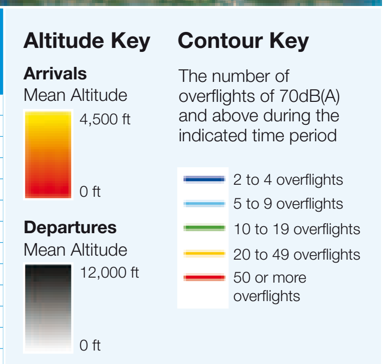
- 5 to 9 overflights
- 10 to 19 overflights
- 20 to 49 overflights
- 50 or more overflights

*Individual values are rounded. Totals may not add to 100% due to rounding.*

***Figure 5.3f:*** *2015 NPR Flight Path Movement Chart – Summer Weekday Night.*

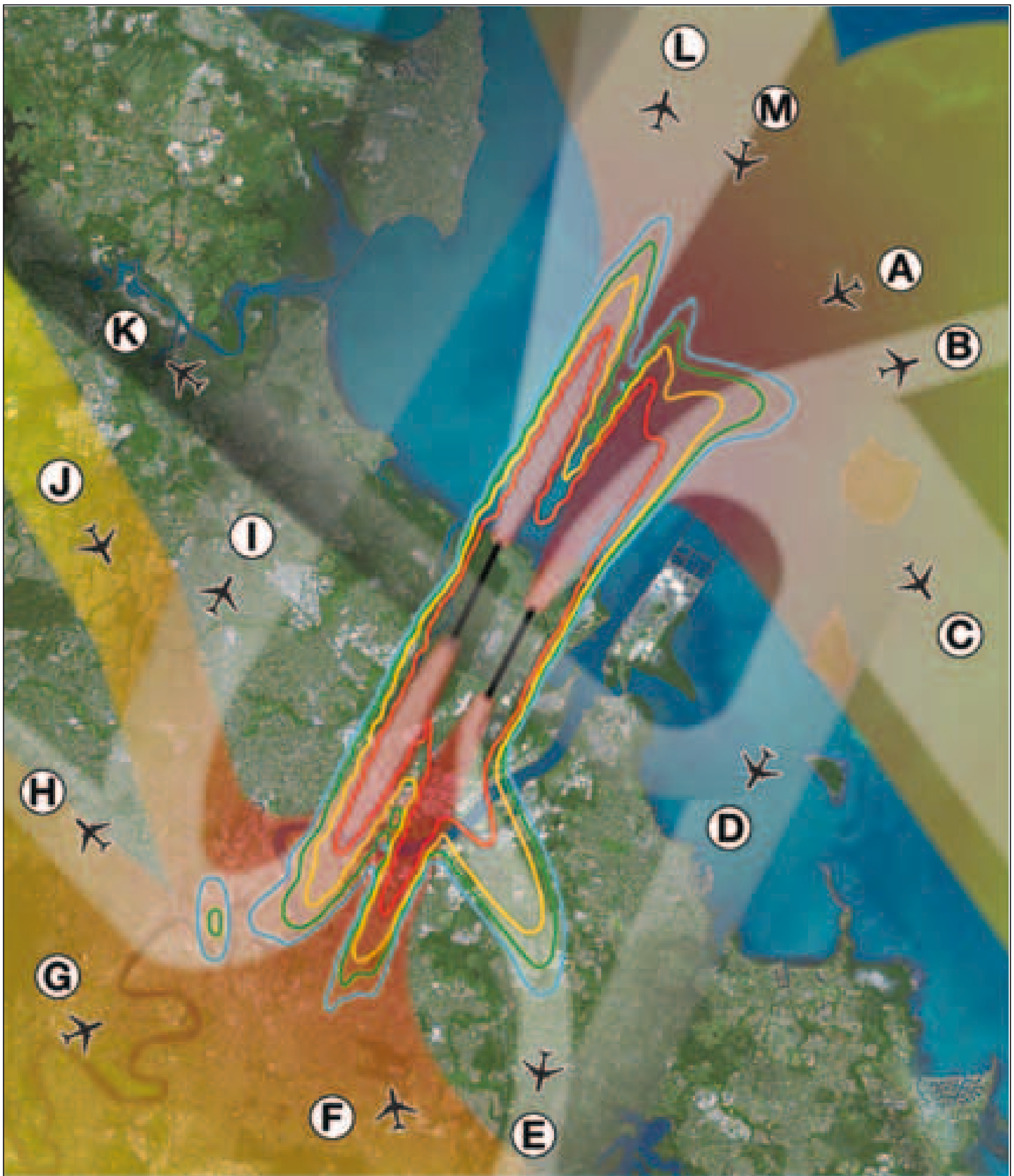



| Flight path | Flight path type | Average number of jet flights on flight path | Expected minimum and maximum numbers of jet flights on path | Percentage of Brisbane Airport's total jet flights on path | Percentage of days with no jet flights on path |
|---|---|---|---|---|---|
| A | Arrival | 1 | 0 - 10 | 4% | 76% |
| B | Departure | 4 | 0 - 5 | 11% | 3% |
| C | Departure | Inactive at this time | | | |
| D | Departure | 9 | 0 - 11 | 26% | 2% |
| E | Departure | 2 | 0 - 11 | 5% | 75% |
| F | Arrival | 1 | 0 - 6 | 2% | 76% |
| G | Arrival | 1 | 0 - 8 | 2% | 76% |
| H | Departure | <1 | 0 - 6 | 1% | 74% |
| I | Departure | 1 | 0 - 4 | 1% | 76% |
| J | Arrival | Inactive at this time | | | |
| K | Departure | 5 | 0 - 5 | 13% | 1% |
| L | Departure | <1 | 0 - 4 | 1% | 76% |
| M | Arrival | 11 | 0 - 14 | 32% | 1% |




*Individual values are rounded. Totals may not add to 100% due to rounding.*

***Figure 5.3g:*** *2035 NPR Flight Path Movement Chart – Summer Weekday Day.*




| Flight path | Flight path type | Average number of jet flights on flight path | Expected minimum and maximum numbers of jet flights on path | Percentage of Brisbane Airport's total jet flights on path | Percentage of days with no jet flights on path |
|---|---|---|---|---|---|
| A | Arrival | 107 | 0 – 215 | 18% | 19% |
| B | Departure | 8 | 0 – 16 | 1% | 25% |
| C | Departure | 6 | 0 – 13 | 1% | 29% |
| D | Departure | 88 | 0 – 184 | 15% | 25% |
| E | Departure | 104 | 0 – 199 | 17% | 19% |
| F | Arrival | 91 | 0 – 196 | 15% | 26% |
| G | Arrival | 13 | 0 – 133 | 2% | 26% |
| H | Departure | 14 | 0 – 29 | 2% | 20% |
| I | Departure | 38 | 0 – 76 | 6% | 20% |
| J | Arrival | 36 | 0 – 95 | 6% | 31% |
| K | Departure | 10 | 0 – 18 | 2% | 27% |
| L | Departure | 37 | 0 – 74 | 6% | 26% |
| M | Arrival | 49 | 0 – 95 | 8% | 20% |

**Altitude Key**

**Arrivals**

Mean Altitude

4,500 ft

0 ft

**Departures**

Mean Altitude

12,000 ft

0 ft

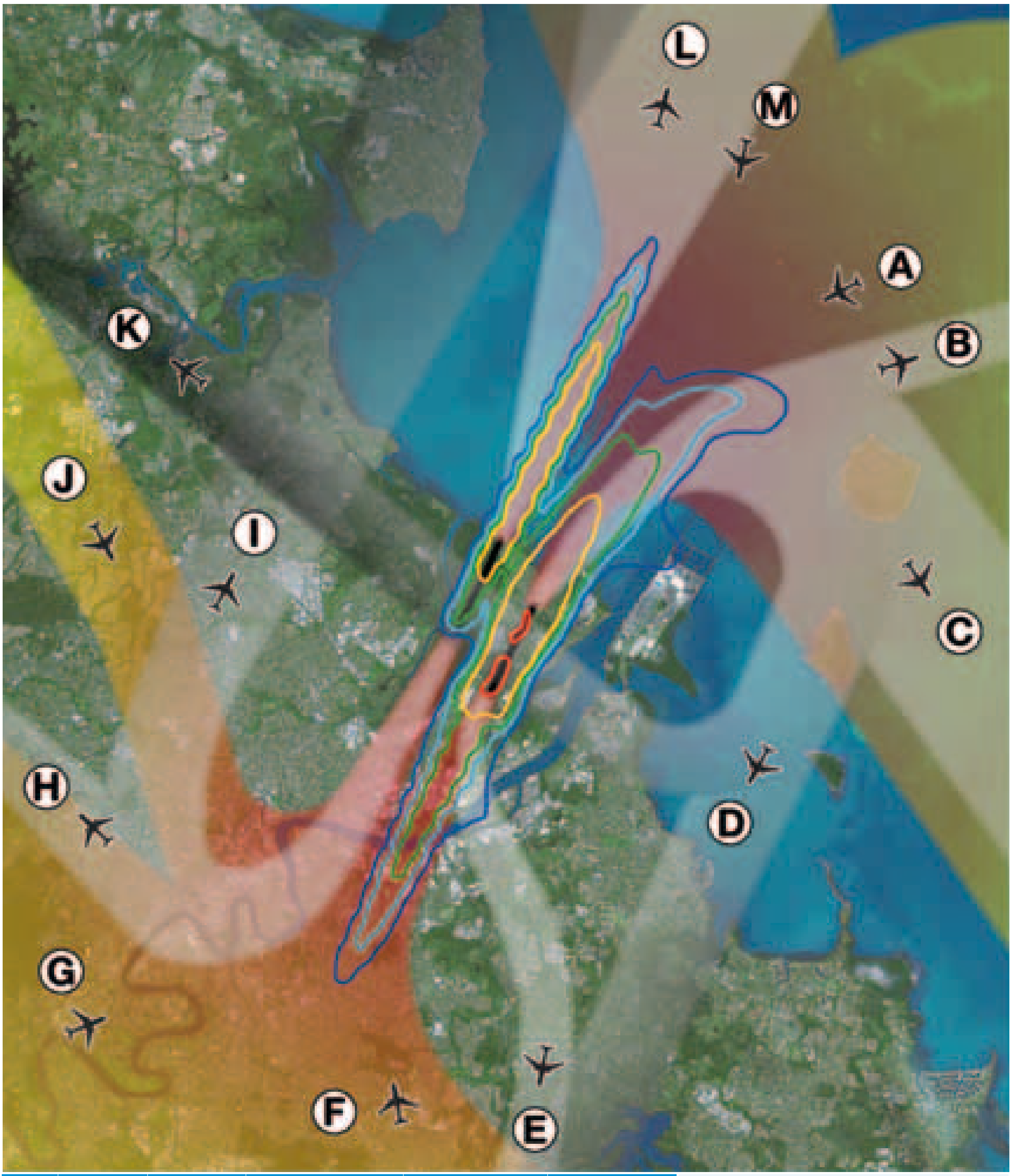
**Contour Key**

The number of overflights of 70dB(A) and above during the indicated time period

- 5 to 9 overflights
- 10 to 19 overflights
- 20 to 49 overflights
- 50 or more overflights

*Individual values are rounded. Totals may not add to 100% due to rounding.*

***Figure 5.3h:*** *2035 NPR Flight Path Movement Chart – Summer Weekday Night.*




| Flight path | Flight path type | Average number of jet flights on flight path | Expected minimum and maximum numbers of jet flights on path | Percentage of Brisbane Airport's total jet flights on path | Percentage of days with no jet flights on path |
|---|---|---|---|---|---|
| A | Arrival | 5 | 0 - 21 | 8% | 55% |
| B | Departure | 3 | 0 - 7 | 6% | 10% |
| C | Departure | Inactive at this time | | | |
| D | Departure | 12 | 0 - 16 | 20% | 5% |
| E | Departure | 4 | 0 - 16 | 6% | 56% |
| F | Arrival | 4 | 0 - 16 | 6% | 58% |
| G | Arrival | 3 | 0 - 14 | 5% | 59% |
| H | Departure | 2 | 0 - 9 | 4% | 55% |
| I | Departure | 2 | 0 - 6 | 3% | 56% |
| J | Arrival | Inactive at this time | | | |
| K | Departure | 6 | 0 - 8 | 10% | 6% |
| L | Departure | 1 | 0 - 6 | 2% | 60% |
| M | Arrival | 19 | 0 - 30 | 31% | 1% |

**Altitude Key**

**Arrivals**
Mean Altitude
4,500 ft
0 ft

**Departures**
Mean Altitude
12,000 ft
0 ft

**Contour Key**

The number of overflights of 70dB(A) and above during the indicated time period

- 2 to 4 overflights
- 5 to 9 overflights
- 10 to 19 overflights
- 20 to 49 overflights
- 50 or more overflights

*Individual values are rounded. Totals may not add to 100% due to rounding.*

### 5.3.2 Single Event Noise Level Contours

Whereas flight path movement charts indicate the number of aircraft operations over an area, but not their noise level, single-event noise contours indicate the noise level resulting from a single operation of a specific aircraft type on a specific track.

TNIP, supplied on CD as supporting material to the Draft EIS/MDP, also allows the user to generate single event contour figures for different aircraft types on different tracks.

Examples of single event noise contours are provided in **Figure 5.3i** to **Figure 5.3o**, showing areas where the maximum noise level due to a single aircraft operation would exceed 70 dBA and 75 dBA.

**Figure 5.3i** to **Figure 5.3l** shows approach and departure contours for a 737-800 aircraft, over land, for the existing runway configuration and the NPR configuration (note that contours for departures to southern destinations will be the same for both configurations, because there would be no change to these tracks). The 737-800 is the most common aircraft type predicted for year 2015, and is forecast to comprise approximately 40 percent of all jet operations in that year.

**Figure 5.3m** to **Figure 5.3o** shows similar contours for the 747-400 aircraft. This is likely to be the noisiest aircraft which would be operating in 2015, and comprises 2.5 percent of predicted jet operations in that year. For approaches from the north, the 747-400 is shown on a track which approximates the instrument approach path, as this is the most common track for these aircraft. For departures to the north with the NPR, the departure is performed from the existing runway, as this would be the normal runway for departures by heavy jets (section 5.2.1).

Note that the contours shown in **Figure 5.3i** to **Figure 5.3o** are for nominal tracks used in the modelling process. Actual aircraft tracks would be distributed across the flight zones as shown in section 5.3.1. The flight path movement charts shown in **Figure 5.3a** to **Figure 5.3h** also indicate the likely number of aircraft per day using tracks within the flight zone.

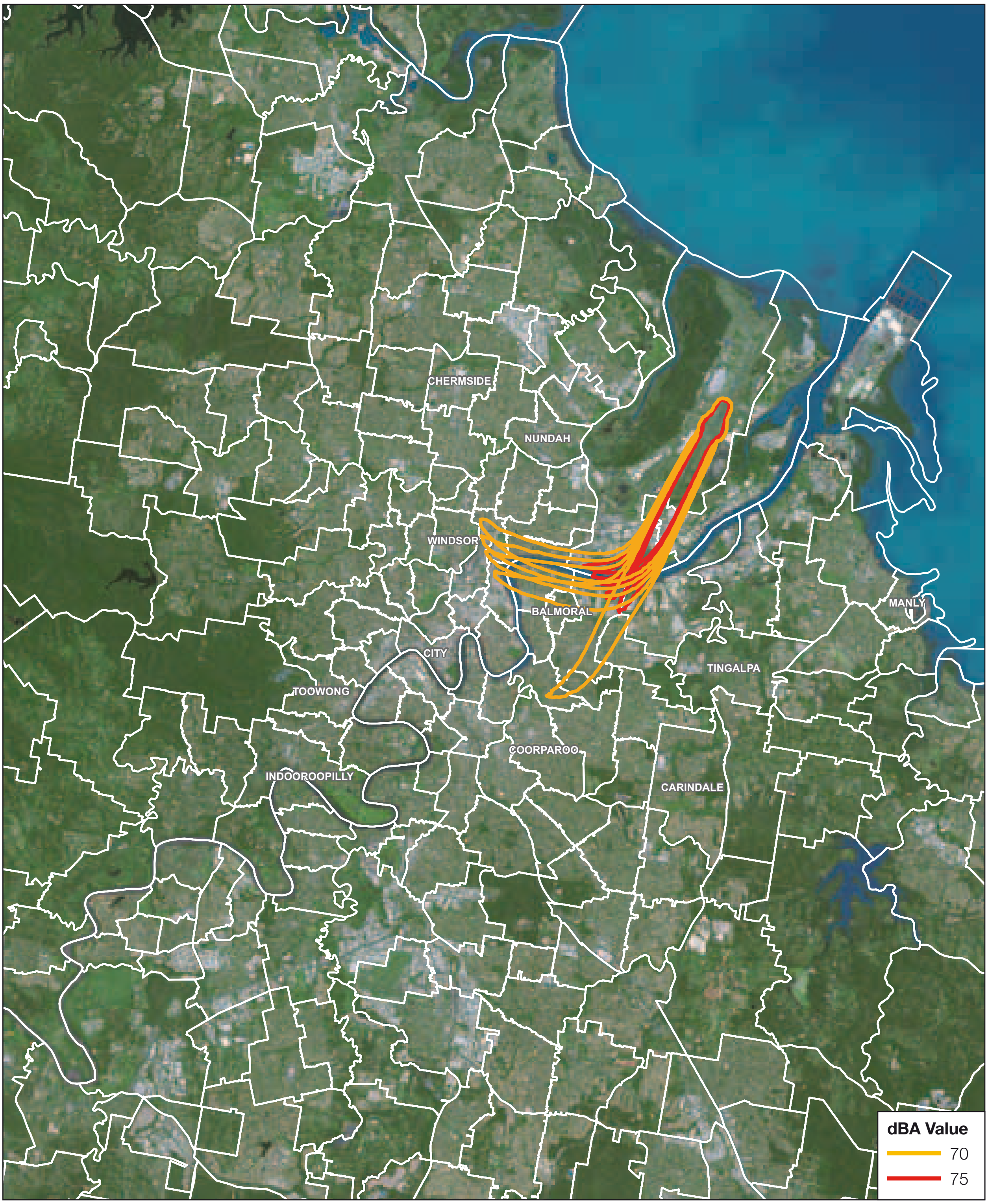
### 5.3.3 N70 Contours

N70 noise level contours represent the number of overflights per day which exceed 70 dBA, and are described in detail in Chapter D2. They combine information on the noise level from individual overflights and the number of such overflights per day, and have been found to be useful in understanding the extent and nature of aircraft noise exposure.

**Figure 5.3p** to **Figure 5.3aa** present N70 contours for the daytime (6am–6pm), evening (6pm–10pm) and night periods (10pm–6am), for the for same set of scenarios as presented in section 5.3.1, namely the Summer Weekday Day, Evening and Night periods in the 2005, 2015 Before NPR, 2015 NPR and 2035 NPR scenarios. The full suite of results is provided in Appendix D5, which shows calculated N70 contours for all periods – Summer and Winter, Weekday and Weekend, Day, Evening and Night – for all assessment scenarios.

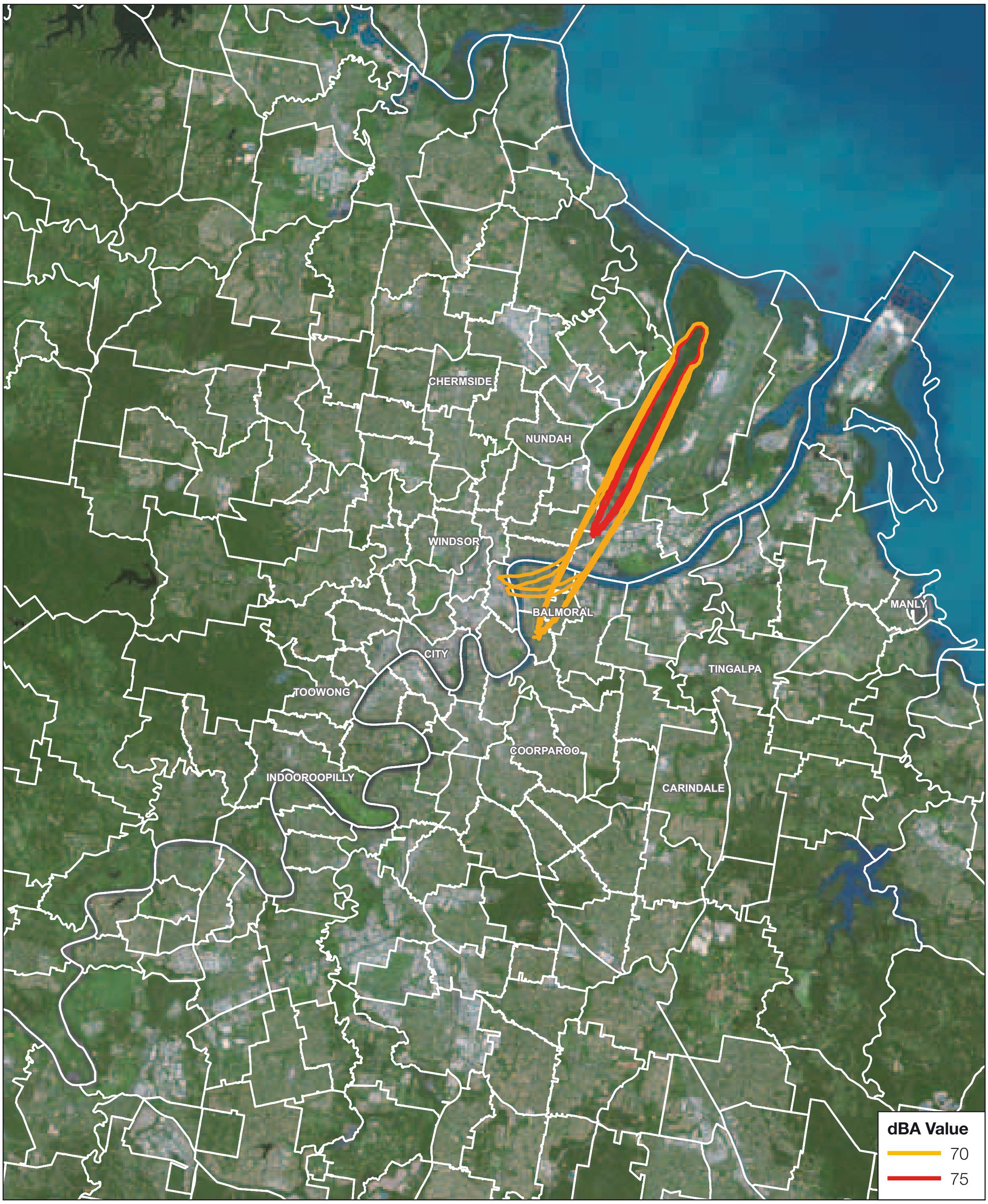
N70 contours can also be generated for each of the scenarios using the TNIP software provided with the Draft EIS/MDP.

**Figure 5.3i:** *737-800 Single Event Contours – Arrivals on Existing Runway System.*



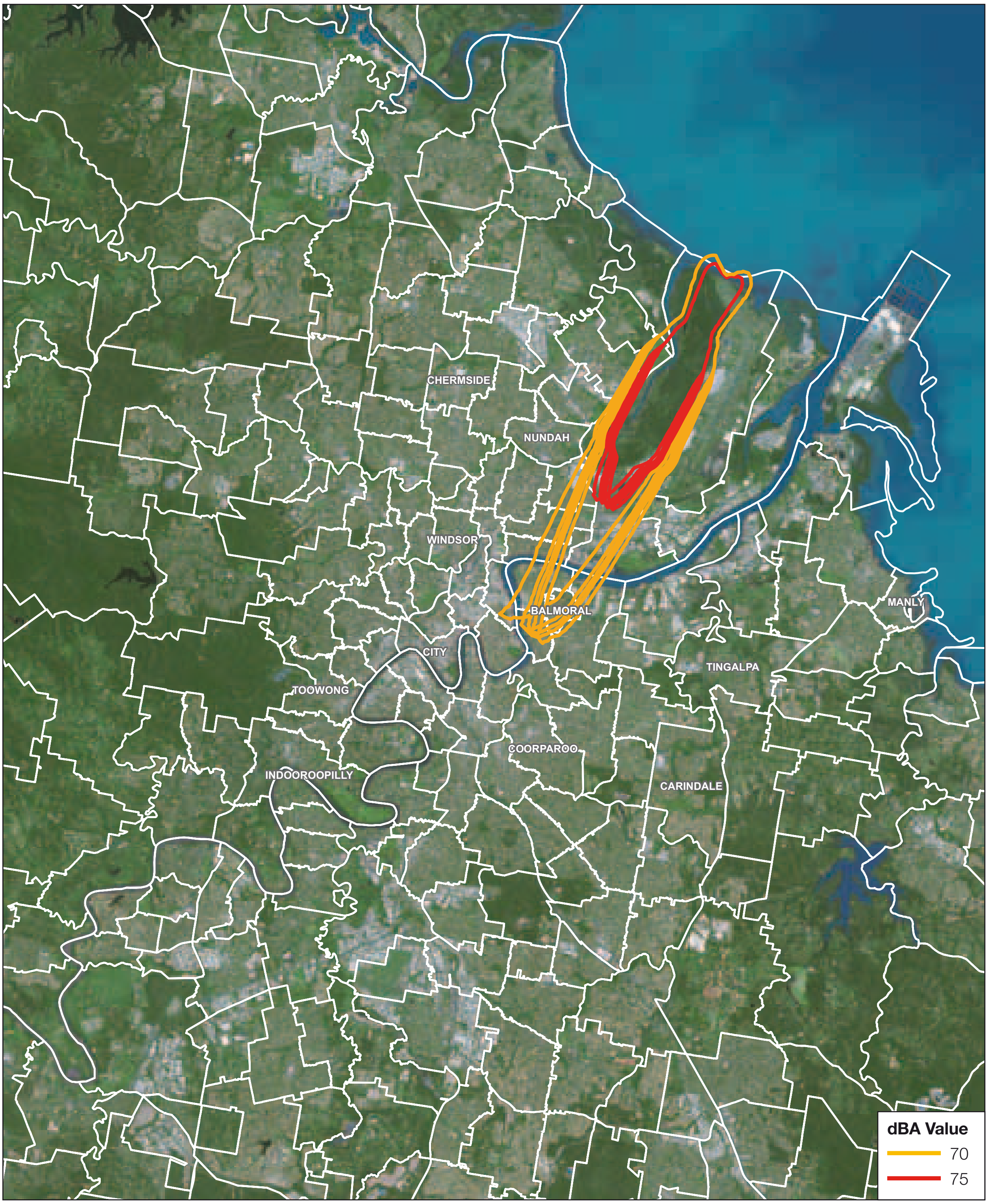

*Note: The multiple lines on the top contours represent a series of single event deviations from the main flight path.*

***Figure 5.3j:*** *737-800 Single Event Contours – Arrivals on NPR.*



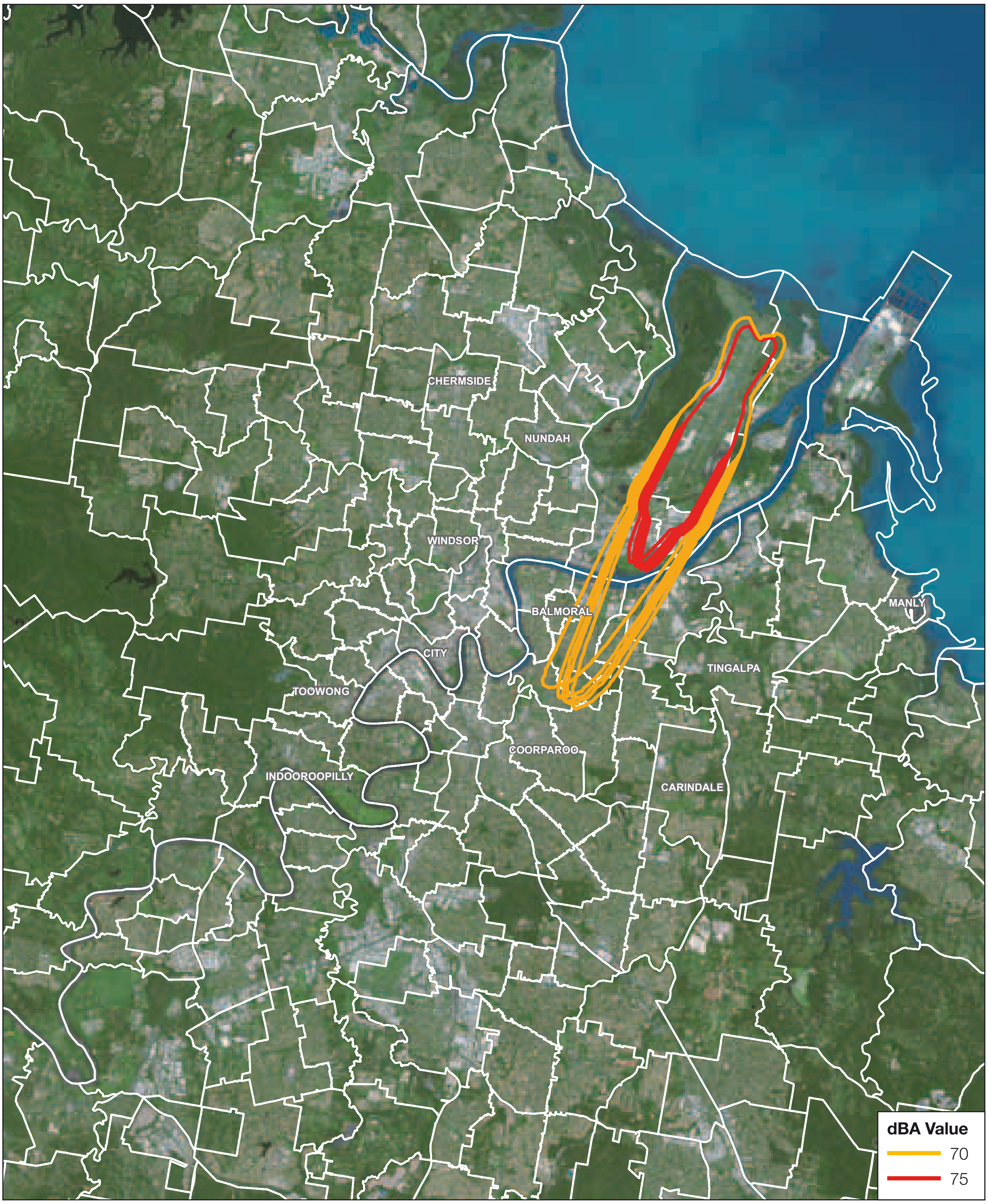

*Note: Multiple lines represent a series of single event deviations from the main flight path.*

***Figure 5.3k:*** *737-800 Stage 4 Single Event Contours – Departures on NPR.*



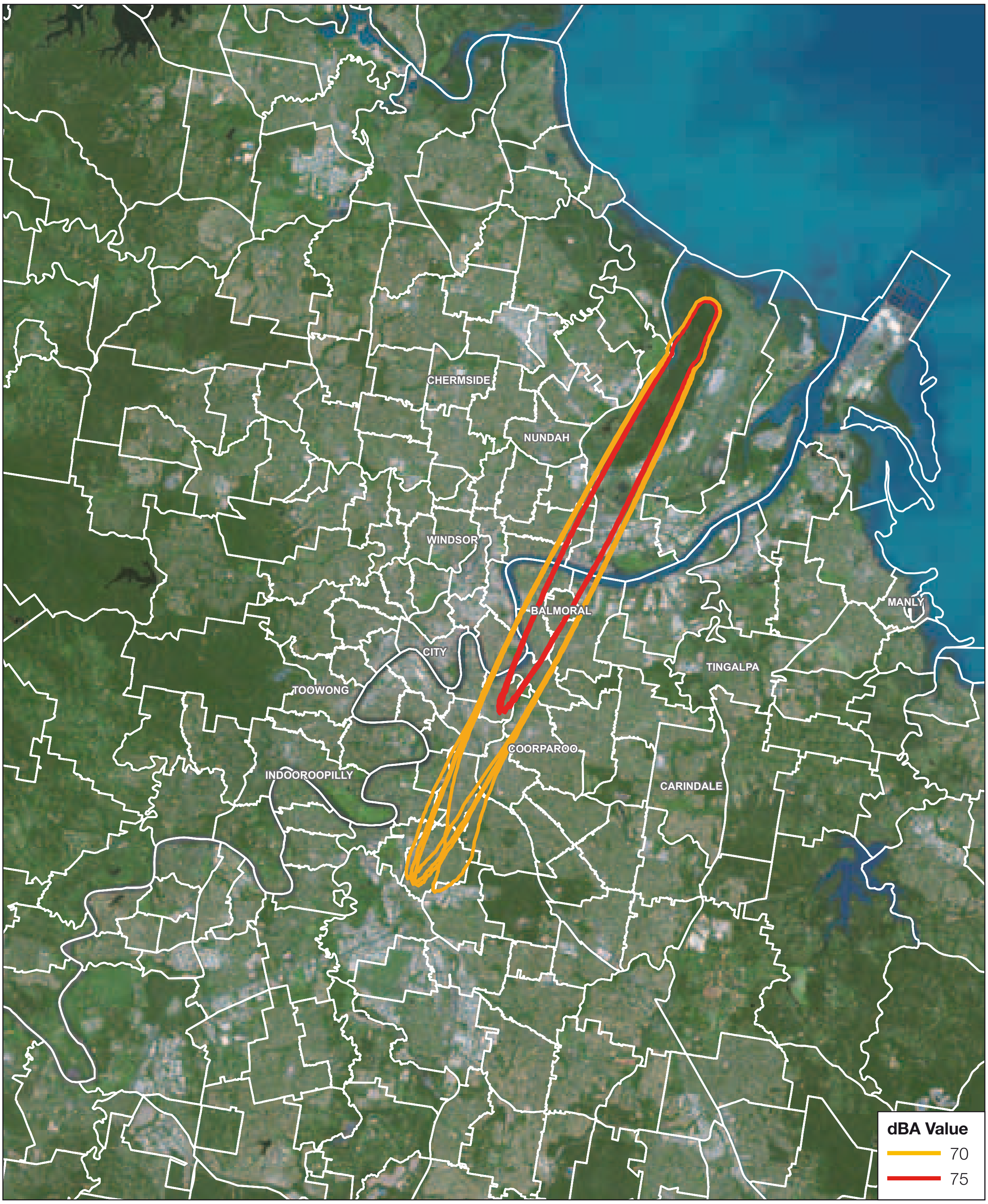

*Note: Multiple lines represent a series of single event deviations from the main flight path.*

***Figure 5.3l:*** *737-800 Stage 4 Single Event Contours – Departures on Existing Runway System.*



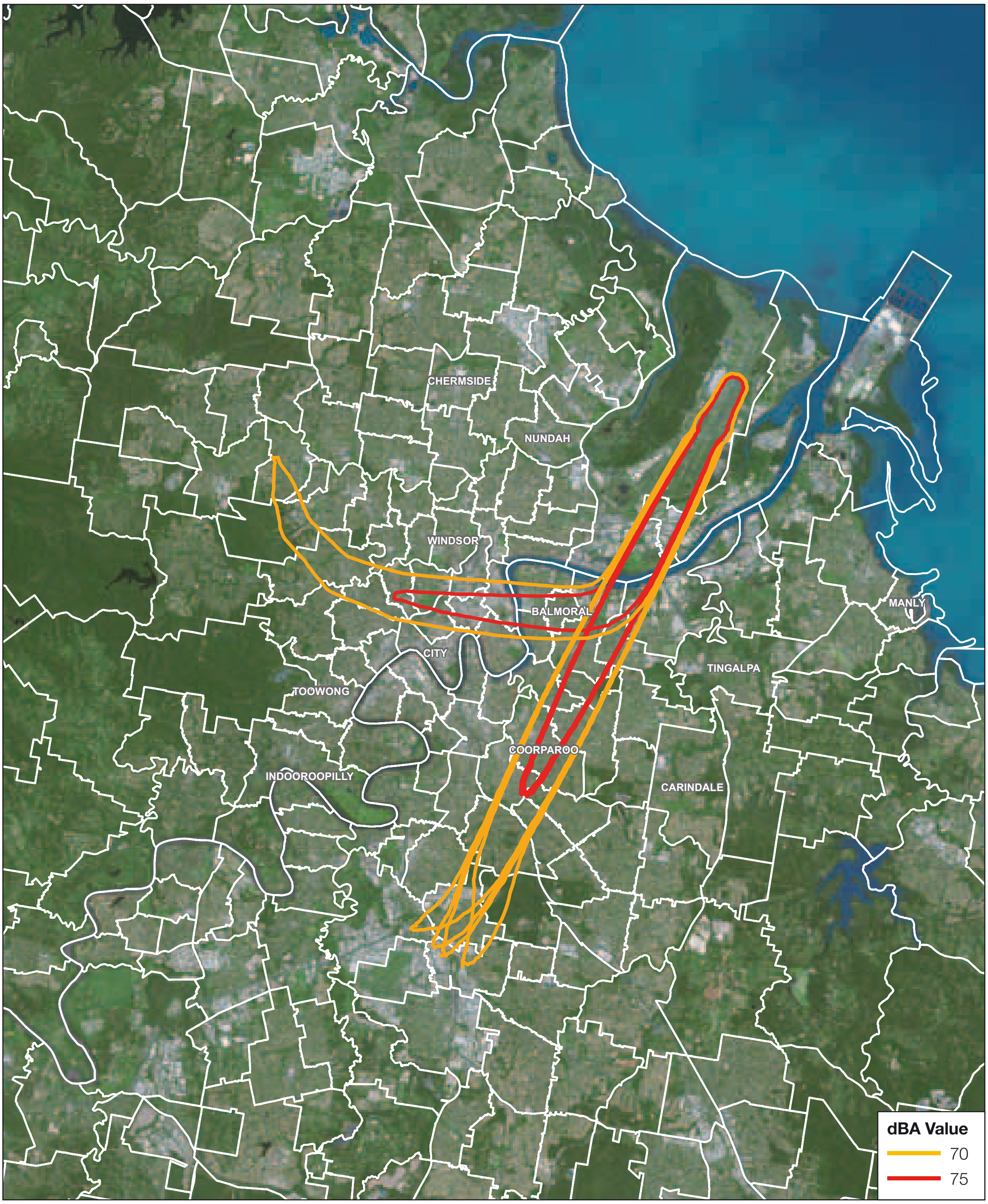

*Note: Multiple lines represent a series of single event deviations from the main flight path*

***Figure 5.3m:*** *747-400 Single Event Contours – Arrivals on NPR.*



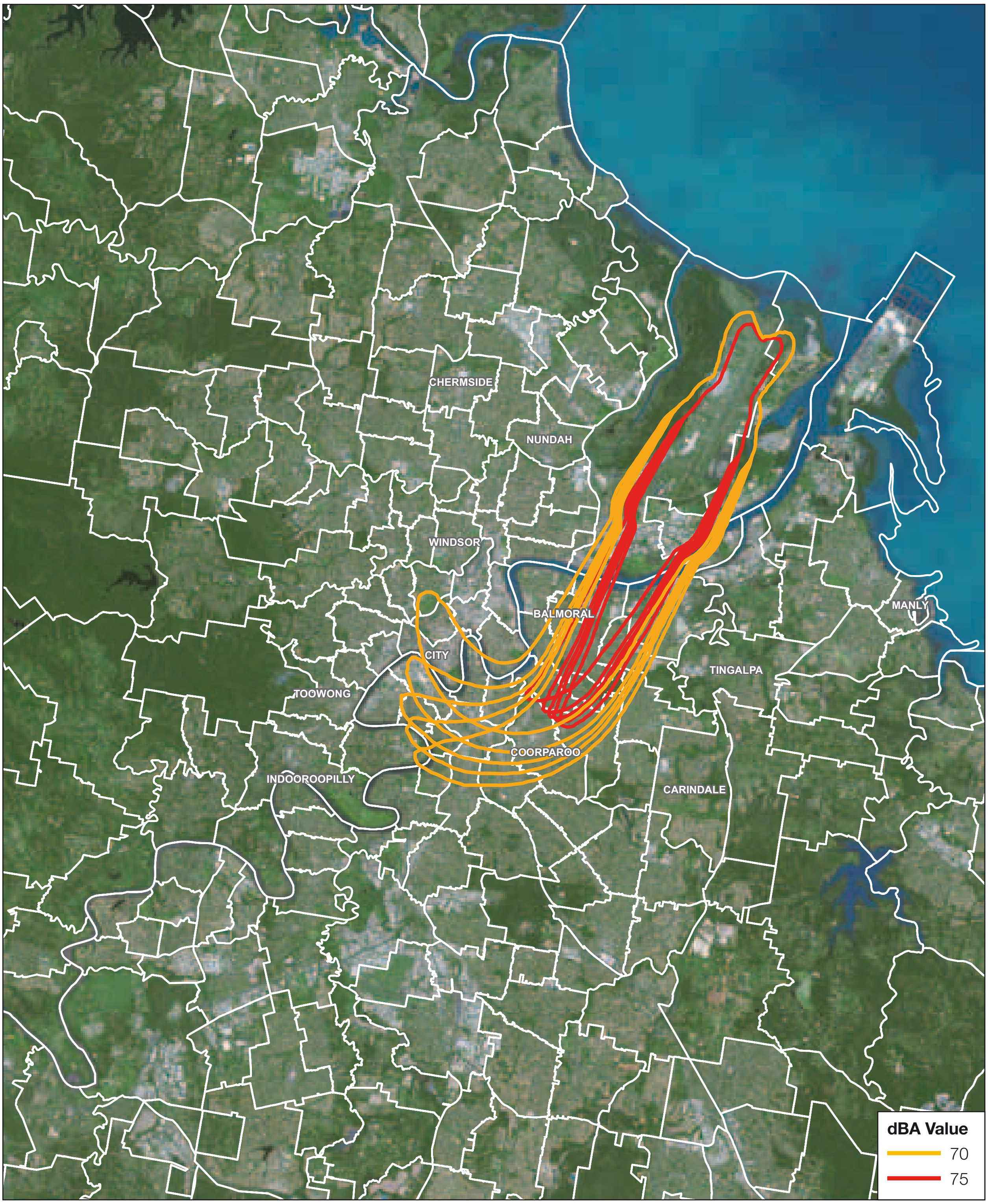

*Note: Multiple lines represent a series of single event deviations from the main flight path.*

***Figure 5.3n:*** *747-400 Single Event Contour – Arrivals on Existing Runway System.*




*Note: Multiple lines represent a series of single event deviations from the main flight path.*

***Figure 5.3o:*** *747-400 Stage 4 Single Event Contour – Departures off Existing Runway Before and After NPR.*




*Note: Multiple lines represent a series of single event deviations from the main flight path.*

***Figure 5.3p:*** *2005 Existing Runway System N70 – Summer Weekday Day.*

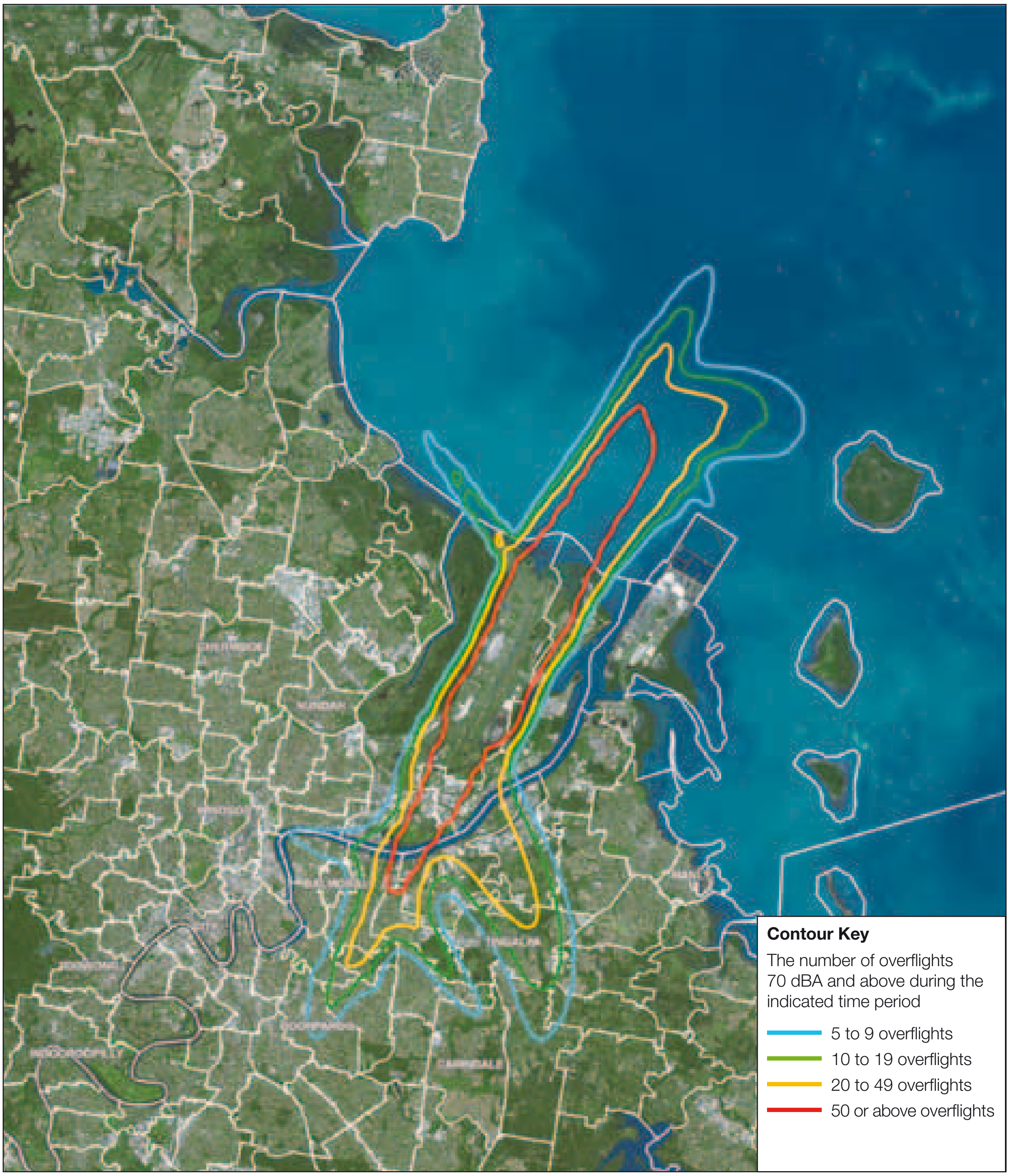


***Figure 5.3q:*** *2005 Existing Runway System N70 – Summer Weekday Evening.*

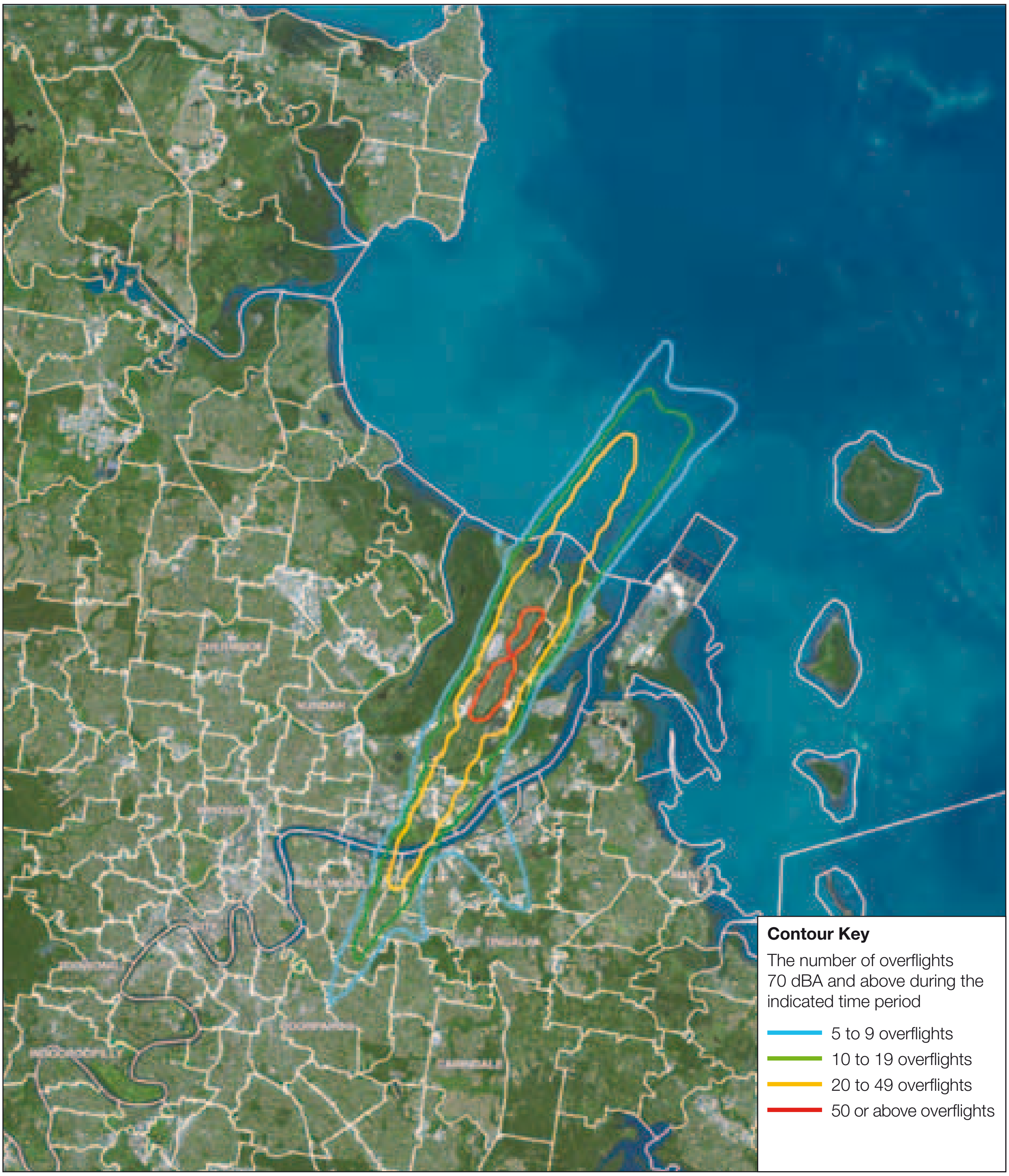


***Figure 5.3r:*** *2005 Existing Runway System N70 – Summer Weekday Night.*

*Figure 5.3s:* *2015 Existing Runway System N70 – Summer Weekday Day.*

***Figure 5.3t:*** *2015 Existing Runway System N70 – Summer Weekday Evening.*

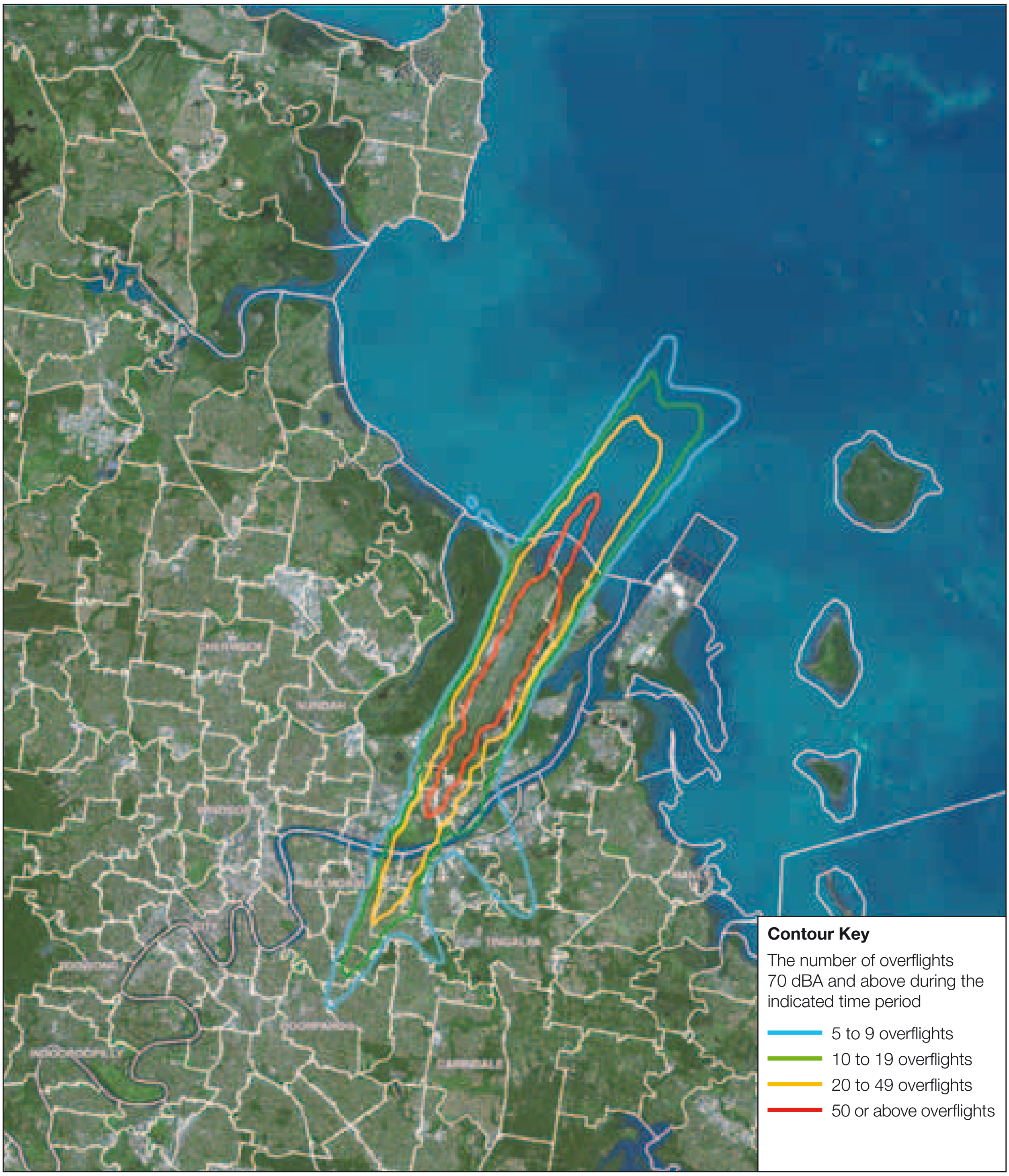


**Figure 5.3u:** *2015 Existing Runway System N70 – Summer Weekday Night.*

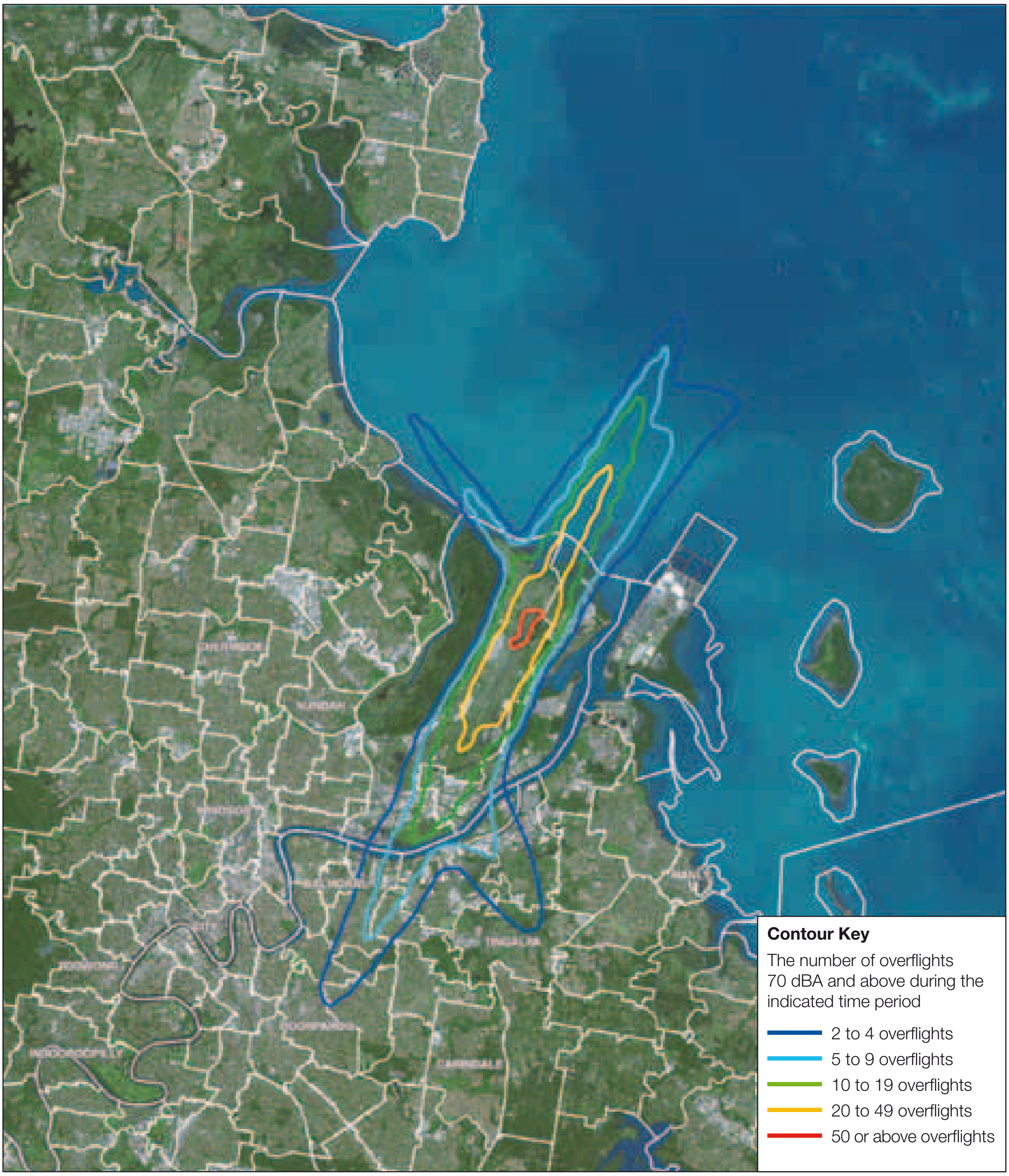
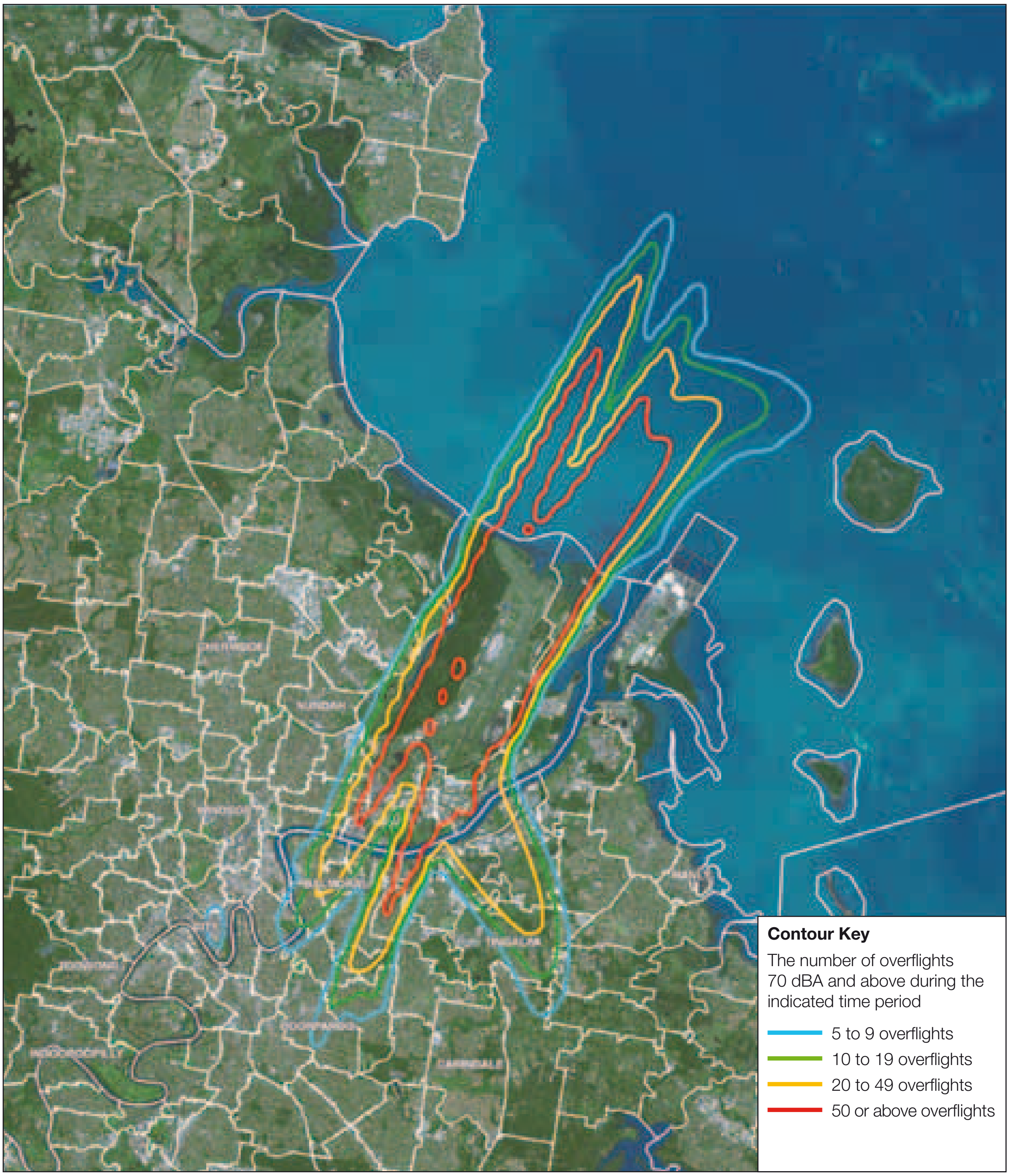


**Figure 5.3v:** *2015 NPR N70 – Summer Weekday Day.*




*Note: The Isolated blue contour above the City represents where two flight paths cross in the model.*

***Figure 5.3w:*** *2015 NPR N70 – Summer Weekday Evening.*

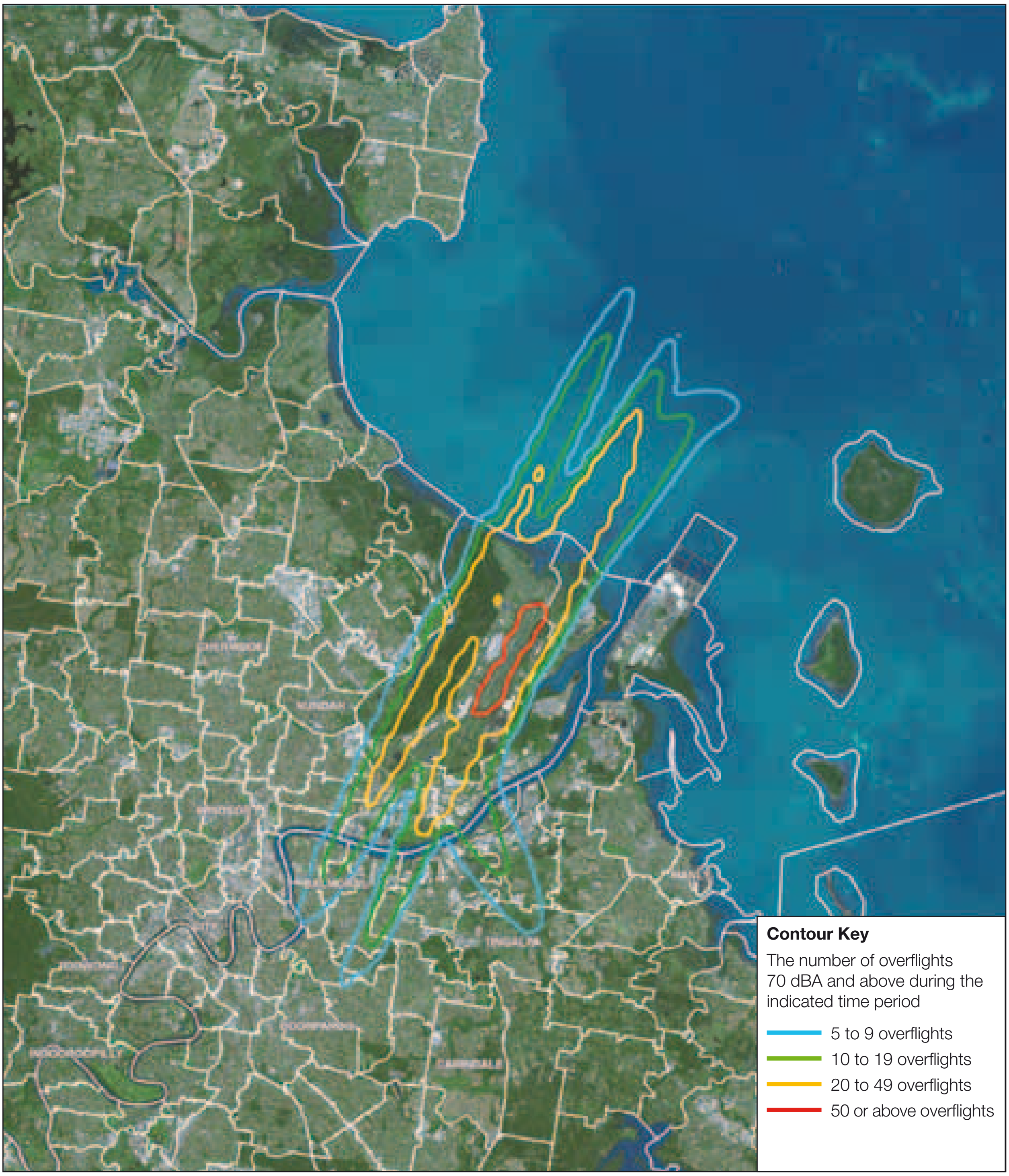


***Figure 5.3x:*** *2015 NPR N70 – Summer Weekday Night.*

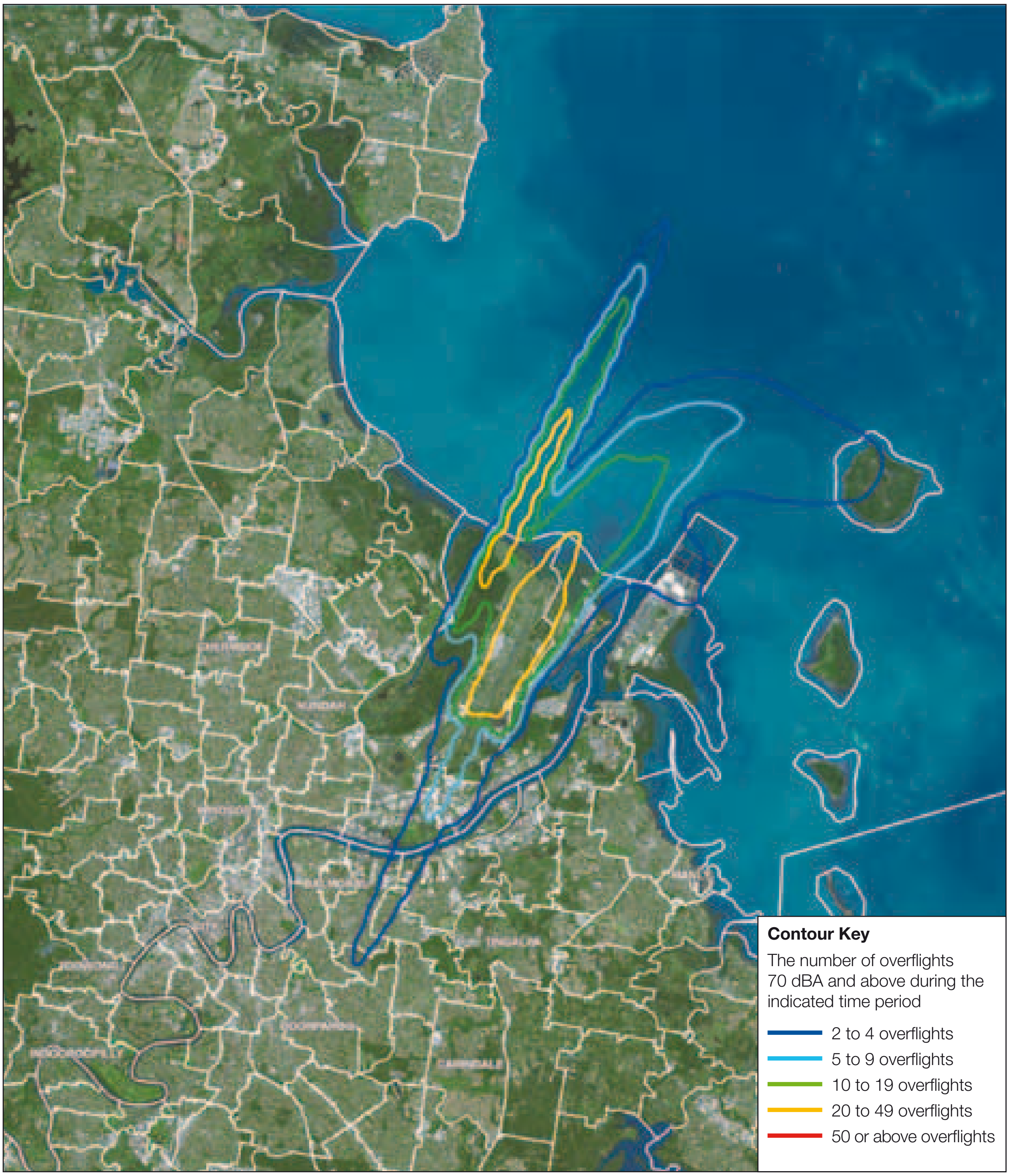
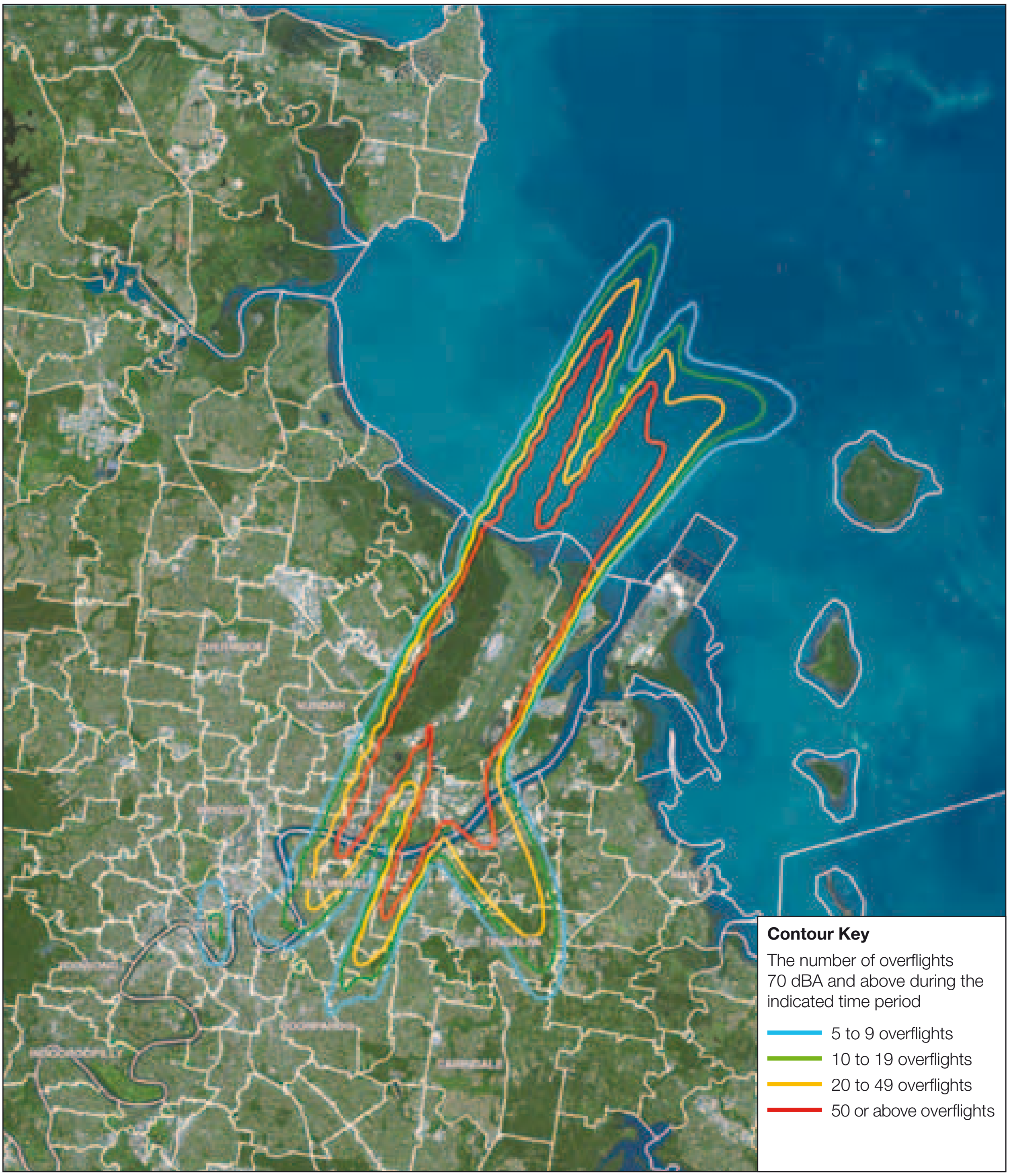


***Figure 5.3y:*** *2035 NPR N70 – Summer Weekday Day.*




*Note: The Isolated blue contour above the City represents where two flight paths cross in the model.*

***Figure 5.3z:*** *2035 NPR N70 – Summer Weekday Evening.*

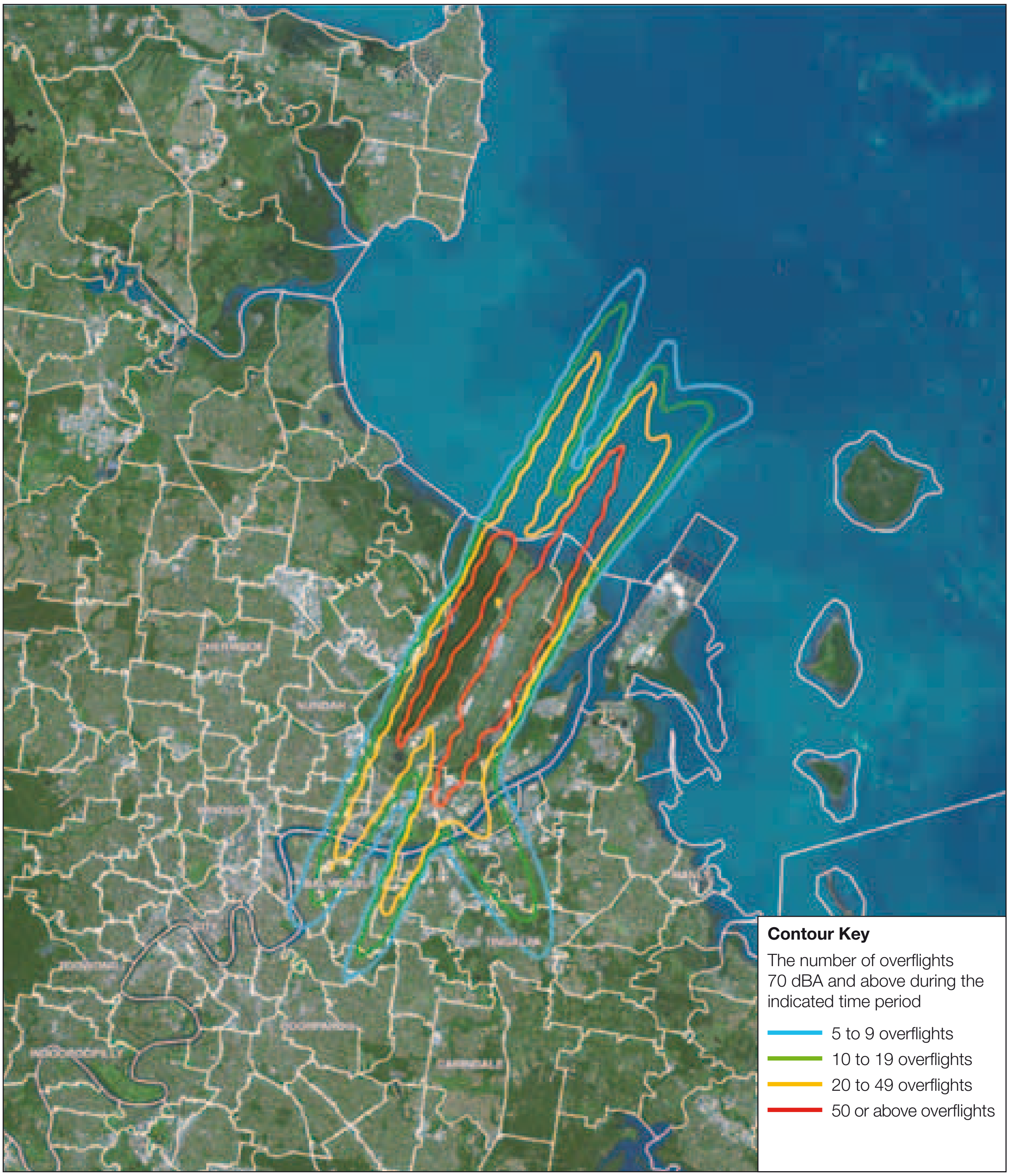
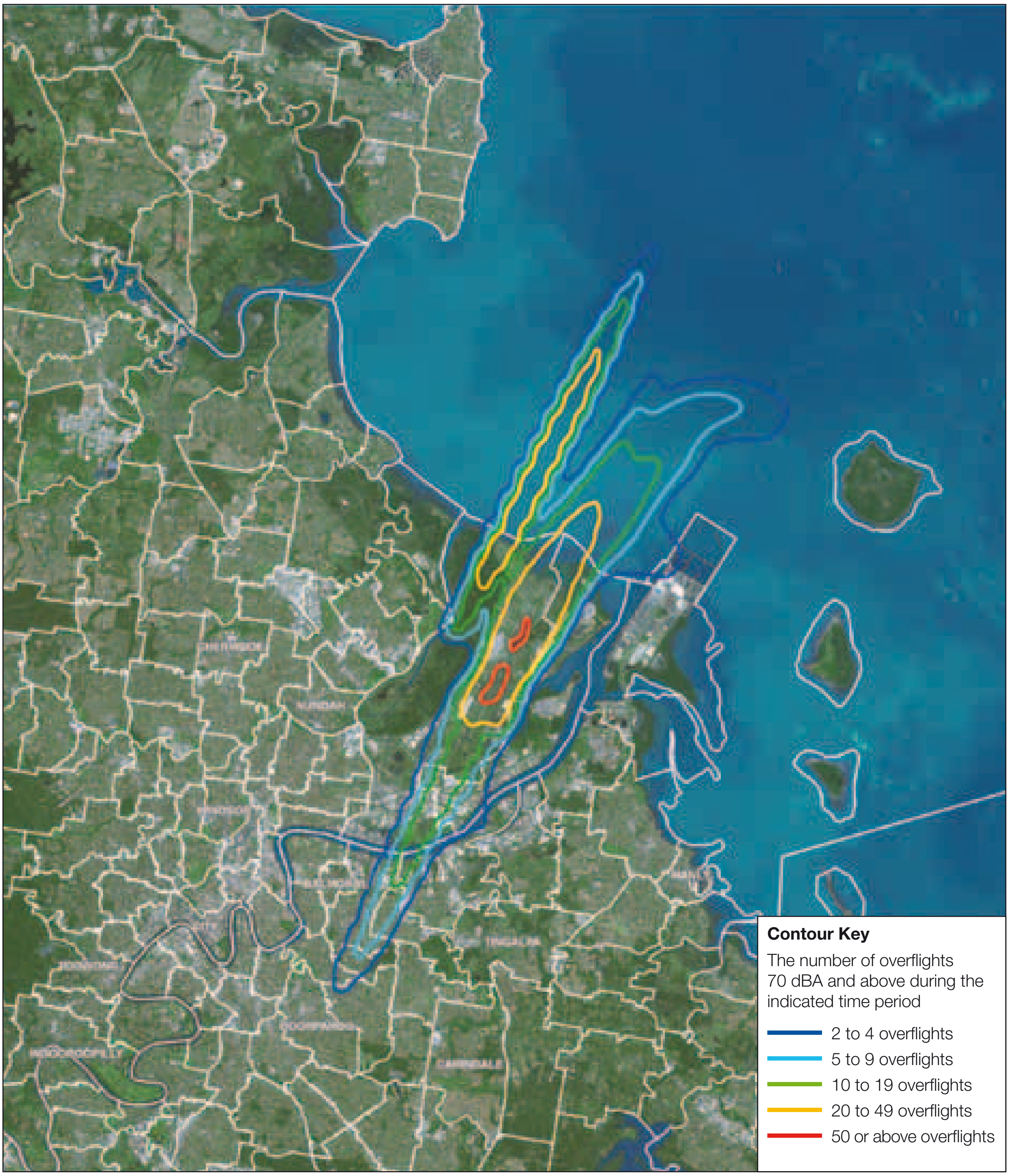


***Figure 5.3aa:*** *2035 NPR N70 – Summer Weekday Night.*



### 5.3.4 ANEC Contours

The most important use of Australian Noise Exposure Concept (ANEC) contours is in land use planning around airports, using the principles set out in Australian Standard 2021. The ANEC contour is a measure of total aircraft noise exposure at a point for a given set of procedures.

An Australian Noise Exposure Forecast (ANEF) chart is an ANEC chart(s) produced for a specific future year, which are required to be endorsed by AsA. It is the officially recognised forecast of noise exposure for that Airport. The chart is updated every five years as part of the Master Plan review.

Land use planning advice in Australian Standard 2021 is expressed in terms of ANEF zones and is described in more detail in Chapter D2.

**Figure 5.3ab** and **Figure 5.3ac** represent the ANEC contours calculated for year 2015 and 2035, with the NPR. Appendix D5 contains the full suite of ANEC contours for the 2015 and 2035 years and runway scenarios. The TNIP software provided with the Draft EIS/MDP will also allow generation of ANEC contours for each scenario 2015 ERS, 2015 NPR and 2035 NPR.

Note that because officially endorsed ANEF charts are required to use the INM prediction program, the noise level corrections applied to INM predictions to produce N70s (as described in Chapter 4) were not included in calculating the ANEC figures. This also allows more accurate comparison of the ANECs with previous ANECs and ANEFs. The corrections are, in any case, irrelevant when considering noise levels from future aircraft types which may be operating in 2035.

The Australian Government currently has a policy that noise insulation should be provided for all residences with aircraft noise exposure exceeding 30 ANEF[7]. The predicted ANEC 30 contour for year 2035 does not include any residences, and hence no such insulation program is required under this Policy at Brisbane Airport. This is to be expected because of Brisbane Airport's buffer zone and the distance from both runway thresholds to the nearest residences.

[7] *Adelaide and Sydney Airports are the only airports in Australia where this insulation policy is currently applied.*

*__Figure 5.3ab:__ 2015 NPR ANEC.*

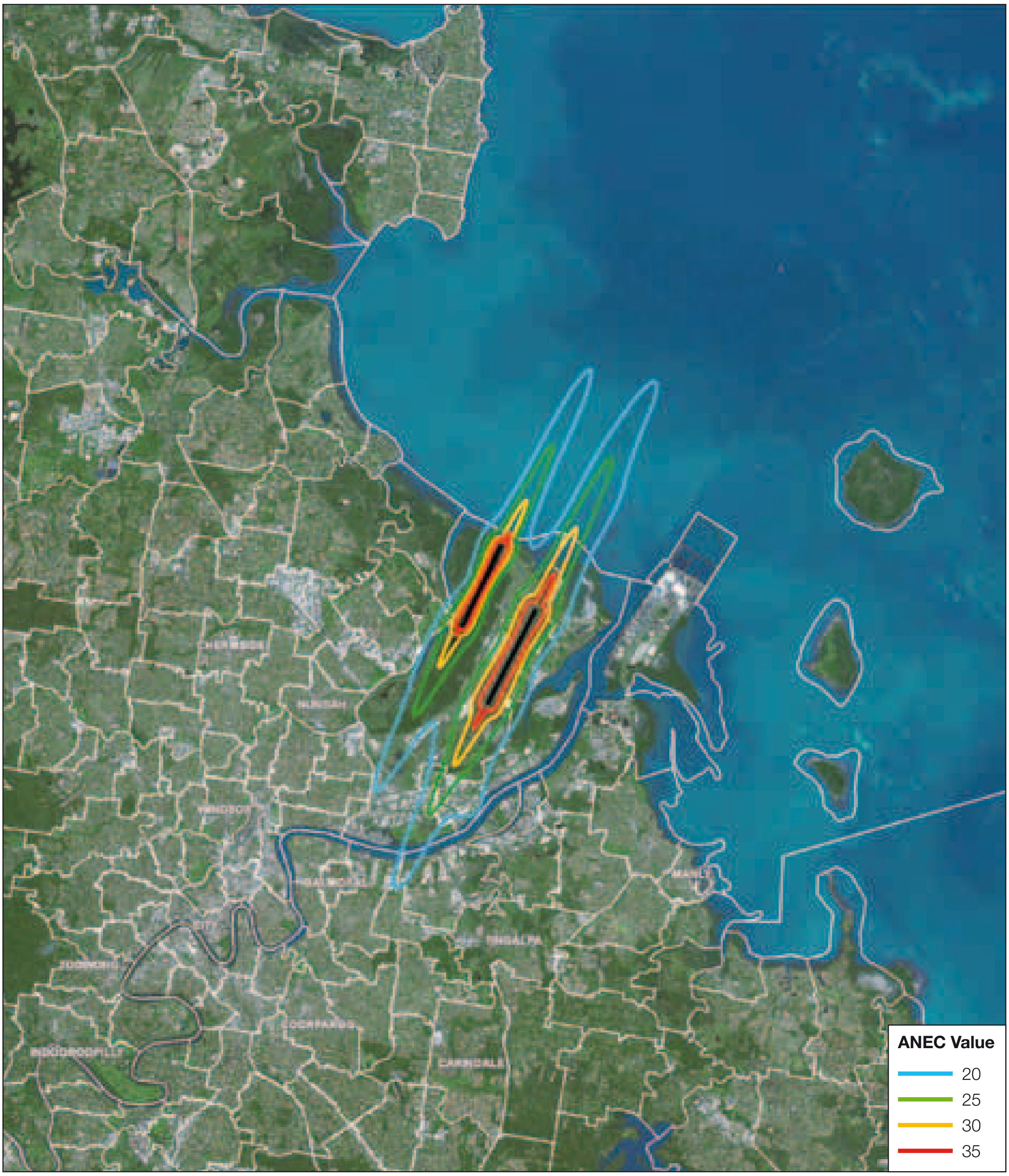
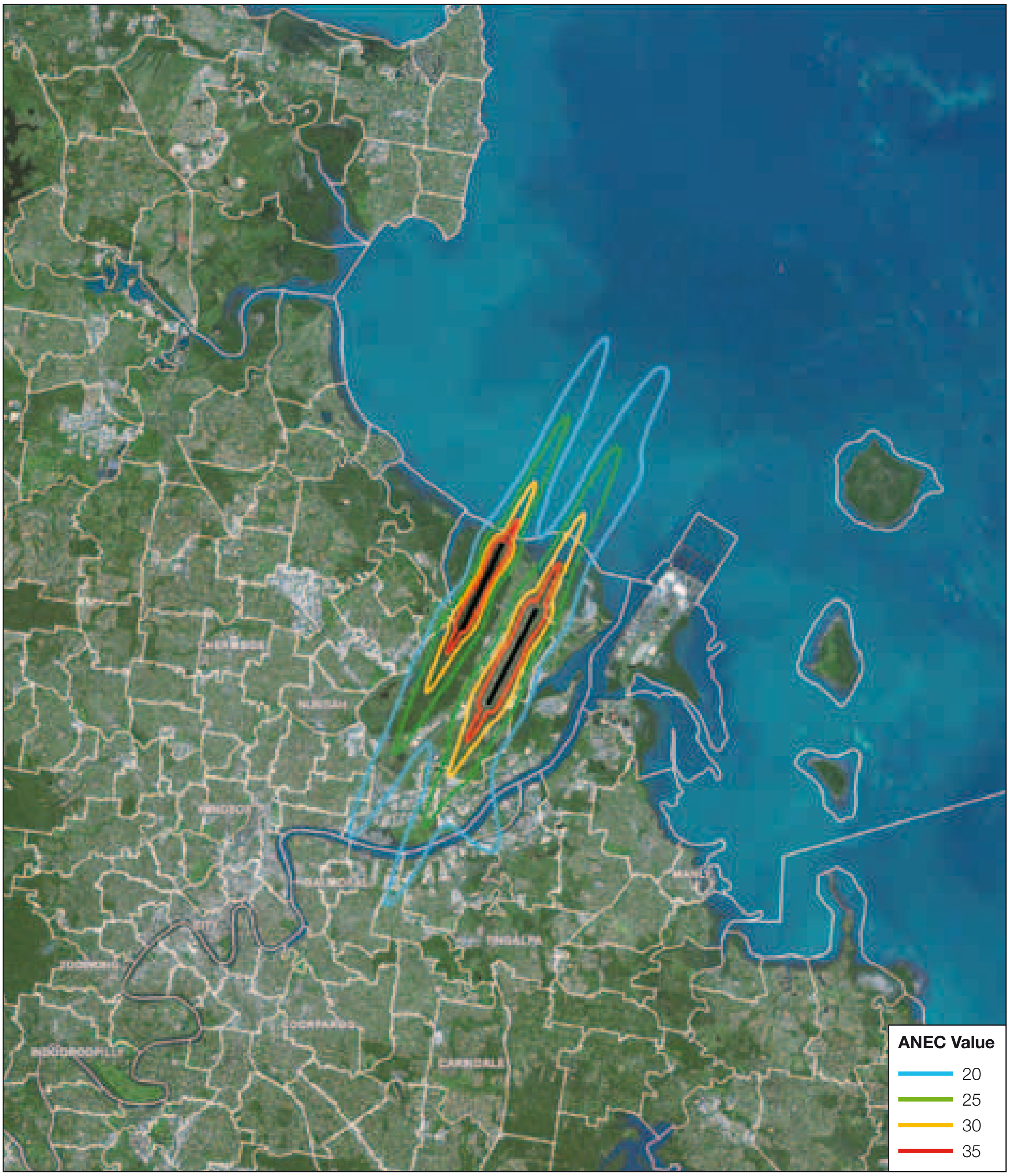


***Figure 5.3ac:*** *2035 NPR ANEC.*



## 5.4 Assessment of Impacts – Day and Evening Operations

The impact of the proposed NPR in terms of noise exposure in the day (6am–6pm) and evening (6pm–10pm) periods is most clearly seen by considering the areas experiencing specified N70 values. In this section, the change in N70 values, and in the number of residences and other noise-sensitive receivers experiencing certain noise levels, is considered in detail.

The full suite of noise modelling results is provided in **Appendix D5**, which shows calculated N70 contours for all periods – Summer and Winter, Weekday and Weekend, Day, Evening and Night, for all assessment scenarios as discussed in the previous section. However, changes during the Summer Weekday Day period are representative of the trends in all day and evening periods so have been presented in this section.

**Figure 5.4a** indicates the likely change in N70 contours with time, assuming that the NPR project proceeds. It shows N70 contours representing five or more overflights for the Summer Weekday Day period with:

- Current operations in 2005;
- Operations in 2015 before opening of the NPR;
- Operations in 2015 immediately after the NPR is operational; and
- Operations in 2035 with the NPR in place.

**Figure 5.4b** shows comparative contours for the 'No Build' case in years 2015 and 2035 (with constrained movement numbers).

Noise exposure grows gradually from 2005 to 2015 as a result of increasing numbers of overflights. Changes related to the introduction of additional jet movements on the cross runway have little impact on the overall noise exposure at any point. There is not a proportional increase in noise in relation to aircraft traffic growth, as older noisier aircraft are replaced by newer quieter aircraft.

In 2015 with the opening of the NPR there is a re-distribution of noise exposure. Areas close to the existing runway, and areas beneath some existing approach paths, experience a reduction in noise exposure, while areas close to the new runway and beneath new approach paths experience an increase.

In the 'no build' case, the pattern of exposure in 2015 would be very similar to that immediately before opening of the NPR, but would not grow substantially after that time, as the runway system would put severe constraints on the possible number of movements after 2015.

The suburb level results for 2015 with and without the NPR are provided in **Table 5.4** and illustrated in the difference contours shown in **Figure 5.4c** and **Figure 5.4d**. The table discusses noise exposure in relation to:

- The range of the average number of overflights predicted to occur at each suburb. This is provided for with and without NPR; and
- The number of residences that will likely be subject to an increase or decrease of a defined number of overflights within each suburb as a result of operating the NPR.

A large proportion of the suburbs (approximately 70 percent) included in the table are forecast to experience a change in the number of overflights. However, the residences in these suburbs are forecast to experience a change of less than 10 overflights in the day, five overflights in the evening and two overflights at night. These suburbs are generally not discussed in any further detail.

The operations of the NPR generally reduces the number of overflights experienced by suburbs to the south of the existing runway with other suburbs to the south and south-west of the airport experiencing increased or new overflights as a result of the approach and departure flight paths to the new runway over the city, as shown in **Table 5.4**.

***Table 5.4:*** *Range of N70 Overflights and Change in Residences Overflown for Suburbs with a Change With NPR/Without NPR in 2015.*

| Suburb | Summer Weekday Day | | | | | | Summer Weekday Evening | | | | | | Summer Weekday Night | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 Without NPR | 2015 With NPR | | | | | 2015 Without NPR | 2015 With NPR | | | | | 2015 Without NPR | 2015 With NPR | | |
| | Range of N70 Flights within Suburb | Range of N70 Flights within Suburb | No. Residences Experiencing | | | | Range of N70 Flights within Suburb | Range of N70 Flights within Suburb | No. Residences Experiencing | | | | Range of N70 Flights within Suburb | Range of N70 Flights within Suburb | No. Residences Experiencing | |
| | | | Increase of 20 flights or more (% of Suburb) | Decrease of 20 flights or more (% of Suburb) | Increase of 10 flights or more (% of Suburb) | Decrease of 10 flights or more (% of Suburb) | | | Increase of 10 flights or more (% of Suburb) | Decrease of 10 flights or more (% of Suburb) | Increase of 5 flights or more (% of Suburb) | Decrease of 5 flights or more (% of Suburb) | | | Increase of 2 flights or more (% of Suburb) | Decrease of 2 flights or more (% of Suburb) |
| Albion | 1 – 5 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Annerley | 0 - 2 | 0 - 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Ascot | 0 – 2 | 0 – 55 | 547 (21.0%) | 0 (0%) | 1,001 (38.0%) | 0 (0%) | 0 | 0 - 22 | 453 (17.0%) | 0 (0%) | 933 (35.0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Balmoral | 1 – 20 | 5 - 31 | 626 (40.0%) | 0 (0%) | 1,226 (79.0%) | 0 (0%) | 0 – 7 | 2 – 12 | 197 (13.0%) | 0 (0%) | 1,271 (82.0%) | 0 (0%) | 0 – 3 | 0 – 1 | 0 (0%) | 0 (0%) |
| Banyo | 0 – 1 | 0 - 28 | 0 (0%) | 0 (0%) | 3 (0.0%) | 0 (0%) | 0 | 0 - 12 | 0 (0%) | 0 (0%) | 3 (0.0%) | 0 (0%) | 0 - 1 | 0 - 1 | 0 (0%) | 0 (0%) |
| Belmont | 1 – 10 | 0 – 9 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 -1 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Bowen Hills | 0 – 4 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Bulimba | 1 – 12 | 1 - 37 | 234 (9.0%) | 0 (0%) | 898 (35.0%) | 0 (0%) | 0 – 3 | 0 - 16 | 172 (7.0%) | 0 (0%) | 908 (35.0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Camp Hill | 0 – 20 | 1 – 16 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 8 | 0 – 5 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 3 | 0 – 1 | 0 (0%) | 73 (2.0%) |
| Cannon Hill | 3 – 80 | 0 – 62 | 0 (0%) | 306 (17.0%) | 9 (0.0%) | 1,124 (61.0%) | 0 – 29 | 0 – 16 | 0 (0%) | 115 (6.0%) | 0 (0%) | 1,173 (64.0%) | 0 – 7 | 0 – 3 | 0 (0%) | 1,223 (66.0%) |
| Carina | 0 – 21 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 277 (7.0%) | 0 – 6 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 2 (0.0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Carindale | 0 - 7 | 0 - 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 2 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Chandler | 0 – 2 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| City | 0 – 3 | 1 – 5 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 - 1 | 0 | 0 (0%) | 0 (0%) |
| Coorparoo | 0 – 15 | 1 – 10 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 6 | 0 – 3 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 3 | 0 – 1 | 0 (0%) | 0 (0%) |
| Dutton Park | 2 – 5 | 1 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Eagle Farm | 0 - 327 | 1 - 214 | 0 (0%) | 20 (16.0%) | 0 (0%) | 28 (23.0%) | 0 -106 | 0 – 62 | 0 (0%) | 7 (6.0%) | 0 (0%) | 20 (16.0%) | 0 – 56 | 0 – 37 | 0 (0%) | 122 (100.0%) |
| East Brisbane | 1 – 5 | 2 - 5 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Fairfield | 0 - 3 | 0 - 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Fortitude Valley | 0 – 0 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Gordon Park | 0 -2 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Greenslopes | 0 – 4 | 0 – 4 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Gumdale | 0 – 8 | 0 – 7 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Hamilton | 1 – 10 | 0 – 44 | 623 (24.0%) | 0 (0%) | 778 (30.0%) | 0 (0%) | 0 – 2 | 0 - 16 | 576 (22.0%) | 0 (0%) | 807 (31.0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Hawthorne | 0 – 5 | 4 - 21 | 5 (0.0%) | 0 (0%) | 1,121 (56.0%) | 0 (0%) | 0 – 1 | 1 – 9 | 0 (0%) | 0 (0%) | 1,013 (51.0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Hemmant | 0 -47 | 0 – 43 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 9 | 0 – 12 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 6 | 0 – 1 | 0 (0%) | 630 (66.0%) |
| Hendra | 0 – 2 | 0 – 55 | 102 (5.0%) | 0 (0%) | 363 (19.0%) | 0 (0%) | 0 | 0 - 21 | 82 (4.0%) | 0 (0%) | 308 (16.0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Herston | 0 – 1 | 0 – 3 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Highgate Hill | 1 – 5 | 1 - 3 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Holland Park | 0 – 2 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Kangaroo Point | 0 – 3 | 2 – 3 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Lutwyche | 0 -2 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Morningside | 5 – 111 | 3 - 55 | 0 (0%) | 153 (4.0%) | 25 (1.0%) | 1,892 (44.0%) | 1 – 40 | 1 - 18 | 0 (0%) | 43 (1.0%) | 24 (1.0%) | 1,485 (34.0%) | 1 – 9 | 0 – 4 | 0 (0%) | 2,713 (63.0%) |
| Murarrie | 3 – 111 | 0 – 57 | 0 (0%) | 343 (22.0%) | 0 (0%) | 853 (55.0%) | 1 – 40 | 1 – 18 | 0 (0%) | 0 (0%) | 0 (0%) | 548 (35.0%) | 0 – 9 | 0 – 4 | 0 (0%) | 468 (30.0%) |
| New Farm | 0 – 1 | 2 – 12 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 1 – 5 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Newstead | 0 – 6 | 0 – 8 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 – 4 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Norman Park | 1 – 27 | 2 - 20 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 - 11 | 0 – 5 | 0 (0%) | 0 (0%) | 0 (0%) | 1 (0.0%) | 0 – 4 | 0 – 2 | 0 (0%) | 599 (24.0%) |

| Suburb | Summer Weekday Day | | | | | | Summer Weekday Evening | | | | | | Summer Weekday Night | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 Without NPR | 2015 With NPR | | | | | 2015 Without NPR | 2015 With NPR | | | | | 2015 Without NPR | 2015 With NPR | | |
| | Range of N70 Flights within Suburb | Range of N70 Flights within Suburb | No. Residences Experiencing | | | | Range of N70 Flights within Suburb | Range of N70 Flights within Suburb | No. Residences Experiencing | | | | Range of N70 Flights within Suburb | Range of N70 Flights within Suburb | No. Residences Experiencing | |
| | | | Increase of 20 flights or more (% of Suburb) | Decrease of 20 flights or more (% of Suburb) | Increase of 10 flights or more (% of Suburb) | Decrease of 10 flights or more (% of Suburb) | | | Increase of 10 flights or more (% of Suburb) | Decrease of 10 flights or more (% of Suburb) | Increase of 5 flights or more (% of Suburb) | Decrease of 5 flights or more (% of Suburb) | | | Increase of 2 flights or more (% of Suburb) | Decrease of 2 flights or more (% of Suburb) |
| Northgate | 0 – 1 | 0 - 18 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 - 7 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Nudgee | 0 | 0 - 110 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 - 12 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 - 8 | 0 (0%) | 0 (0%) |
| Nudgee Beach | 0 – 10 | 0 - 110 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 - 3 | 0 - 37 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 - 3 | 0 - 8 | 0 (0%) | 0 (0%) |
| Nundah | 0 – 1 | 0 - 10 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 - 5 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Pinkenba | 0 – 224 | 0 – 161 | 0 (0%) | 80 (48.0%) | 0 (0%) | 159 (95.0%) | 0 -63 | 0 – 45 | 0 (0%) | 7 (4.0%) | 0 (0%) | 16 (10.0%) | 0 – 29 | 0 – 23 | 4 (2.0%) | 150 (90.0%) |
| Seven Hills | 2 – 37 | 1 – 30 | 0 (0%) | 0 (0%) | 0 (0%) | 237 (29.0%) | 1 – 15 | 0 – 9 | 0 (0%) | 0 (0%) | 0 (0%) | 236 (29.0%) | 0 – 5 | 0 – 3 | 0 (0%) | 571 (71.0%) |
| South Brisbane | 0 – 5 | 1 – 5 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Spring Hill | 0 – 1 | 1 – 5 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| St Lucia | 0 - 3 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 1 | 0 | 0 (0%) | 0 (0%) |
| Tarragindi | 0 – 2 | 0 – 2 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Tingalpa | 3 – 31 | 0 – 32 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 6 | 0 – 8 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 – 3 | 0 – 1 | 0 (0%) | 1 (0.0%) |
| West End | 0 -1 | 0 - 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |
| Windsor | 0 – 3 | 0 – 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 | 0 | 0 (0%) | 0 (0%) |

*Notes :*

1) *Range of N70 overflights is for the whole suburb and may not relate to only residential areas.*
2) *The number of residences experiencing a change is related as a percentage of the total residences within a suburb.*
3) *Residences experiencing a change may or may not the same in the day (6am to 6 pm), evening (6pm to 10pm) and night (10pm to 6am) periods.*
4) *10 to 20 overflights in the day period and 5 to 10 overflights in the evening period equates to approximately 1 to 2 overflights per hour on average.*


NEW PARALLEL RUNWAY DRAFT EIS/MDP
FOR PUBLIC COMMENT

**Figure 5.4a:** *5 Overflight N70s for 2005 ERS, 2015 ERS, 2015 NPR and 2035 NPR – Summer Weekday Day.*

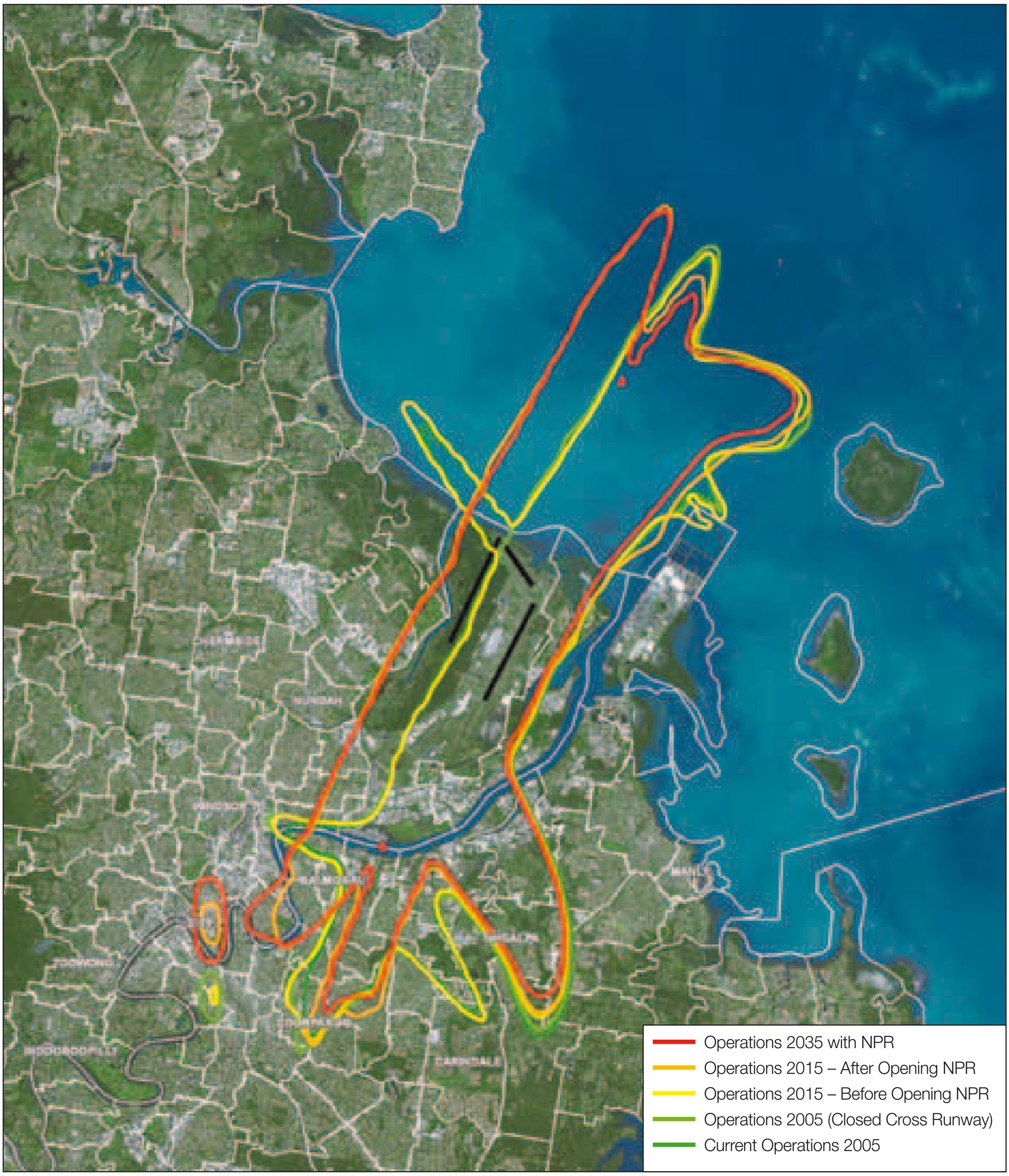


***Figure 5.4b:*** *5 Overflight N70s for 2015 and 2035 ERS 'No Build' – Summer Weekday Day.*

***Figure 5.4c:*** *N70 Differences for 2015 With/Without NPR – Summer Weekday Day.*

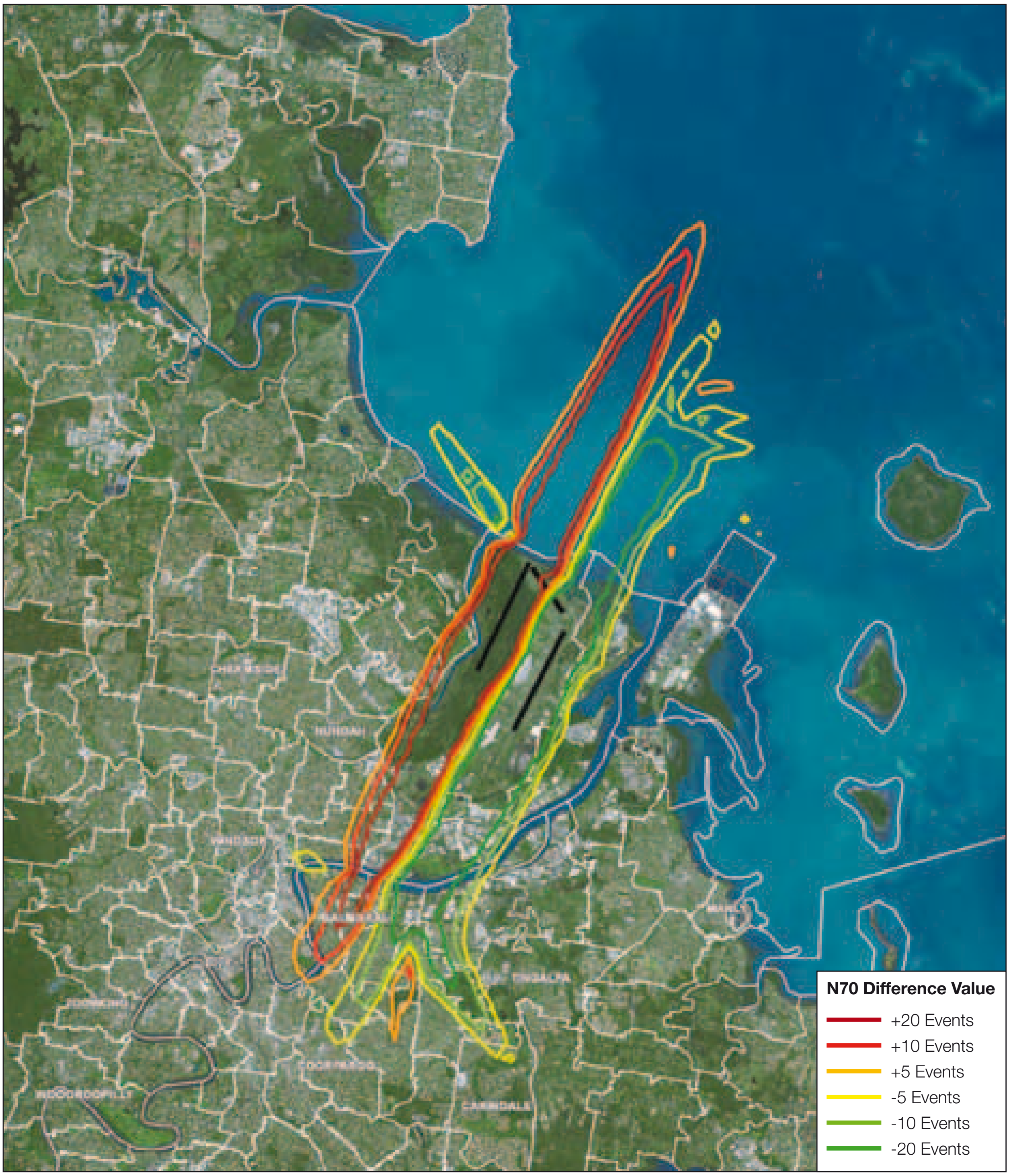
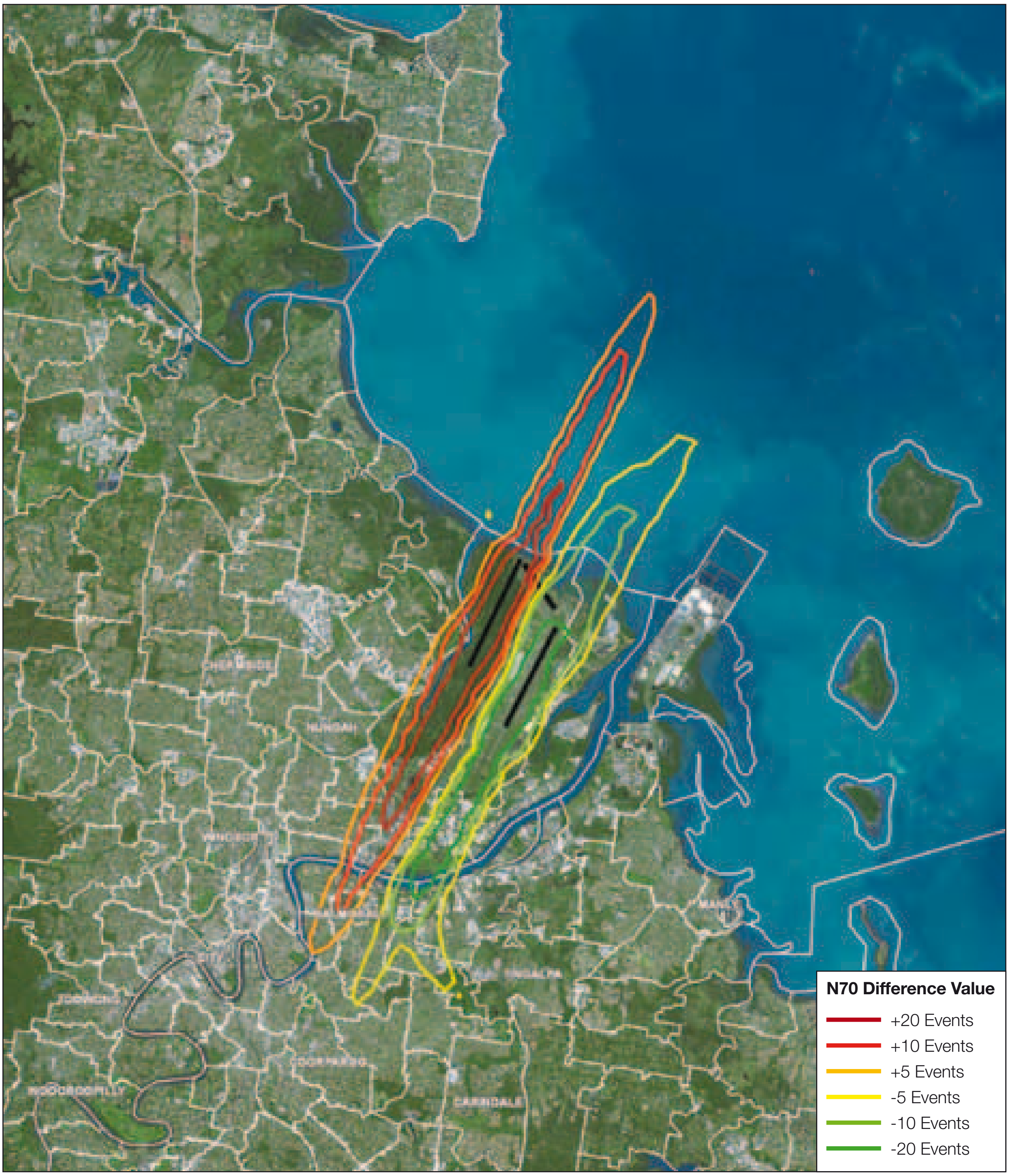


***Figure 5.4d:*** *N70 Differences for 2015 With/Without NPR – Summer Weekday Evening.*



The suburbs of Banyo, Northgate, Nudgee, Nudgee Beach and Nundah in the immediate vicinity and to the west of the airport experience an increased number of overflights, but only a few residences experience a 10 or more overflight increase in the day or evening.

The effects of the operations on the new runway become more apparent moving to the south of the above suburbs towards the southern boundary of the airport. Ascot, Hamilton and Hendra experience the following increases in the number of overflights:

- Between 100 and 600 residences (between approximately five percent and 25 percent of all residences in the suburb) experience an average increase of 20 overflights or more in the day;
- Between 350 and 1,000 residences (between approximately 20 percent and 40 percent of all residences in the suburb) experience an average increase of 10 overflights or more in the day;
- Between 100 and 500 residences (between approximately five percent and 20 percent of all residences in the suburb) experience an average increase of 10 overflights or more in the evening; and
- Between 300 and 900 residences (between approximately 15 percent and 35 percent of all residences in the suburb) experience an average increase of five overflights or more in the evening.

On the south of the river, Balmoral, Bulimba and Hawthorne are forecast to experience a similar number of residences affected by the new runway operations. This is summarised as follows:

- Between zero and 600 residences (between approximately zero percent and 40 percent of all residences in the suburb) experience an average increase of 20 overflights or more in the day;
- Between 900 and 1,200 residences (between approximately 35 percent and 80 percent of all residences in the suburb) experience an average increase of 10 overflights or more in the day;
- Between zero and 200 residences (between approximately zero percent and 15 percent of all residences in the suburb) experience an average increase of 10 overflights or more in the evening; and
- Between 900 and 1300 residences (between approximately 35 percent and 85 percent of all residences in the suburb) experience an average increase of five overflights or more in the evening.

Moving east towards the approach and departure flight paths to the existing runway over the city, Cannon Hill, Morningside and Murarrie all experience decreases in overflights. These are summarised as follows:

- Between 150 and 350 residences (between approximately five percent and 20 percent of all residences in the suburb) experience an average decrease of 20 overflights or more in the day;
- Between 850 and 1,900 residences (between approximately 45 percent and 60 percent of all residences in the suburb) experience an average decrease of 10 overflights or more in the day;
- Between zero and 100 residences (between approximately zero percent and five percent of all residences in the suburb) experience an average decrease of 10 overflights or more in the evening; and
- Between 900 and 1,300 residences (between approximately 35 percent and 85 percent of all residences in the suburb) experience an average decrease of five overflights or more in the evening.

In Seven Hills, around 250 residences experience a decrease of 10 overflights in the day and five overflights in the evening. In Carina around 250 residences experience an average decrease of 10 overflights or more in the day.

New Farm is identified as experiencing an increase in overflights, although there are no residences identified to be affected by more than 10 overflights in the day or five overflights in the evening. It is noted that approximately 1,400 residences (approximately 20 percent of all residences in the suburb) are forecast to experience an increase of five overflights or more in the day.

## 5.5 Assessment of Impacts – Night Operations

Noise exposure at Brisbane Airport in the night time period is very seasonal, being higher in the summer than the winter. This is due to a combination of meteorological factors (notably wind speed) which mitigate against the use of the over bay DODPROPS or SODPROPS modes in summer, and the effect of daylight saving in other states, which means that there is a departure peak in the 5am–6am time period when daylight saving is in operation. The large number of presenting aircraft may require that DODPROPS mode be abandoned for a mode in which aircraft arrive or depart over land. The latter effect is predicted to increase as the number of aircraft operations increases.

This seasonality is shown in **Figure 5.5a**, which shows the proportion of night time aircraft operations occurring over land between January 2003 and December 2005. (Note that in this case 'night' is defined as 11pm–6am rather than 10pm–6am as generally in this report, because this is the period over which data are directly available from AsA publications). The figure also indicates a trend toward an increasing proportion of these operations occurring over land in the summer period, due to the increasing number of departures in the hour 5am–6am.

**Figure 5.5b** and **Figure 5.5c** show night time N70 contours (summer weekday) for the same set of scenarios as **Figure 5.4a** and **Figure 5.4b**. Once again, the full suite of results for all periods and scenarios is provided in **Appendix D5**. Note that these figures assume the use of special night time operating modes as described in section 5.2.5.

For night time exposure, **Figure 5.5b** indicates a general increase in exposure with increasing aircraft movements, as for the day and evening periods.

However, the opening of the NPR sees a decrease in the area exposed to more then two overflights per night above 70 dBA. This is largely because the introduction of SODPROPS mode allows for a higher capacity than DODPROPS mode, and can be used in the 5am–6am period at times when DODPROPS mode could not. Use of the special night time operating modes further reduces night time exposure in potentially-affected areas.

The use of these modes of operation allow for final approach and take offs to be over Moreton Bay. The suburb level results for 2015 with and without the NPR are provided in **Table 5.4** and illustrated in the difference contours shown in **Figure 5.5d**. The outcome of these operations with NPR is forecast to be:

- Over 2,500 residences (approximately 60 percent of all residences in the suburb) in Morningside experience a reduction of two overflights;
- Over 1,200 residences (approximately 65 percent of all residences in the suburb) in Cannon Hill experience a reduction of two overflights;
- Approximately 500 residences experience a reduction of two overflights in Hemmant, Murarrie, Norman Park and Seven Hills;
- Up to 150 residences experience a reduction of two overflights in Camp Hill, Eagle Farm and Pinkenba;

Refer to Chapters D2 and D3 for further explanation of modes of operation and flight paths.

**Figure 5.5a:** *Current Proportion of Night Time Operations (11pm–6am) Occurring Over Land (from AsA NFPMS Data – refer www.airservicesaustralia.com.au).*

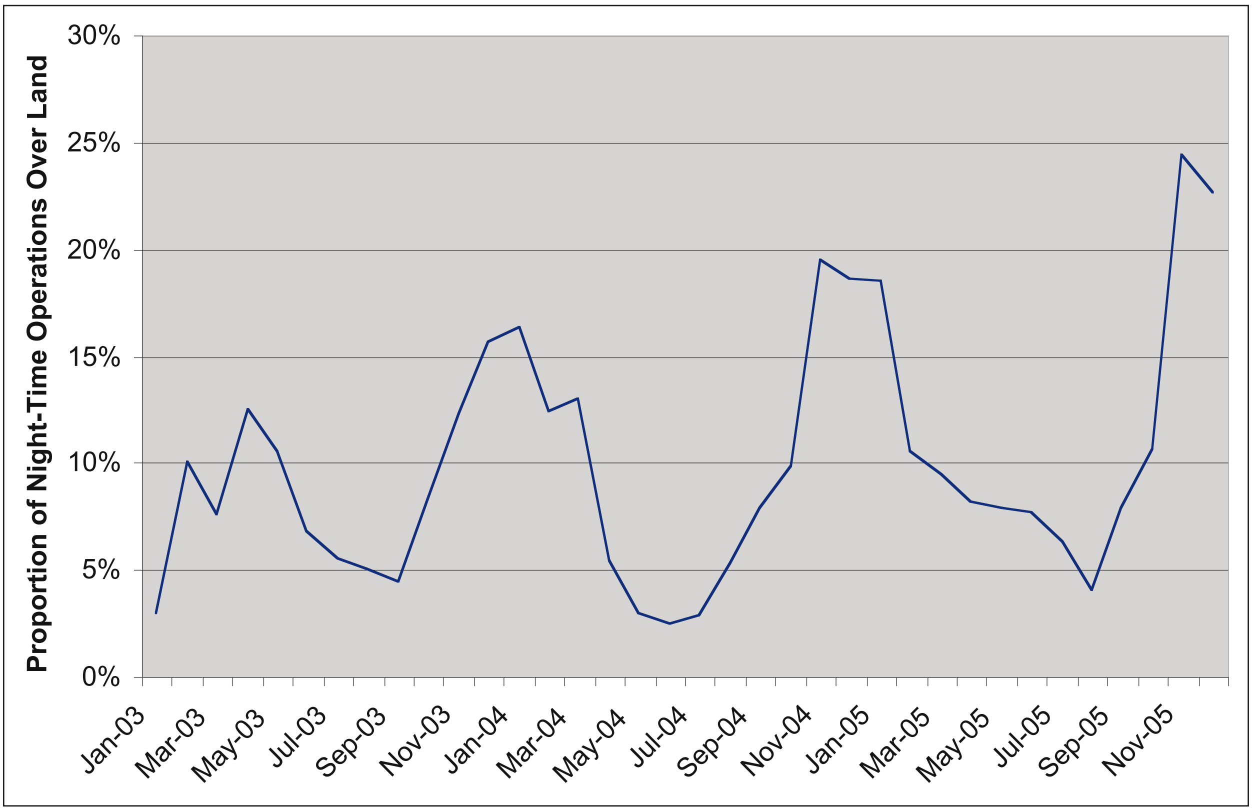


***Figure 5.5b:*** *2 Overflight N70s for 2005 ERS, 2008 Existing Runway System (ERS), 2015 ERS, 2015 NPR and 2035 NPR – Summer Weekday Night.*

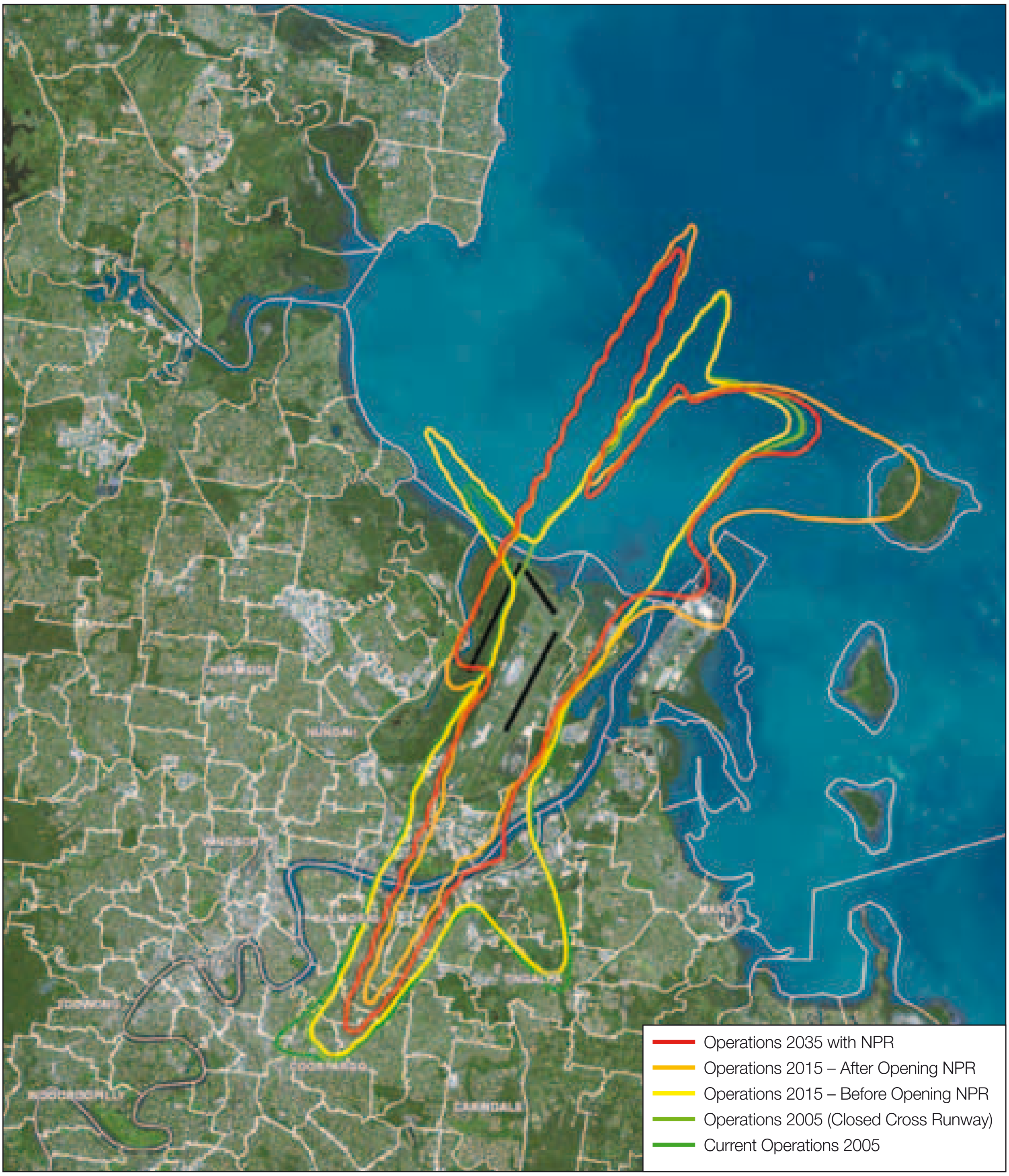
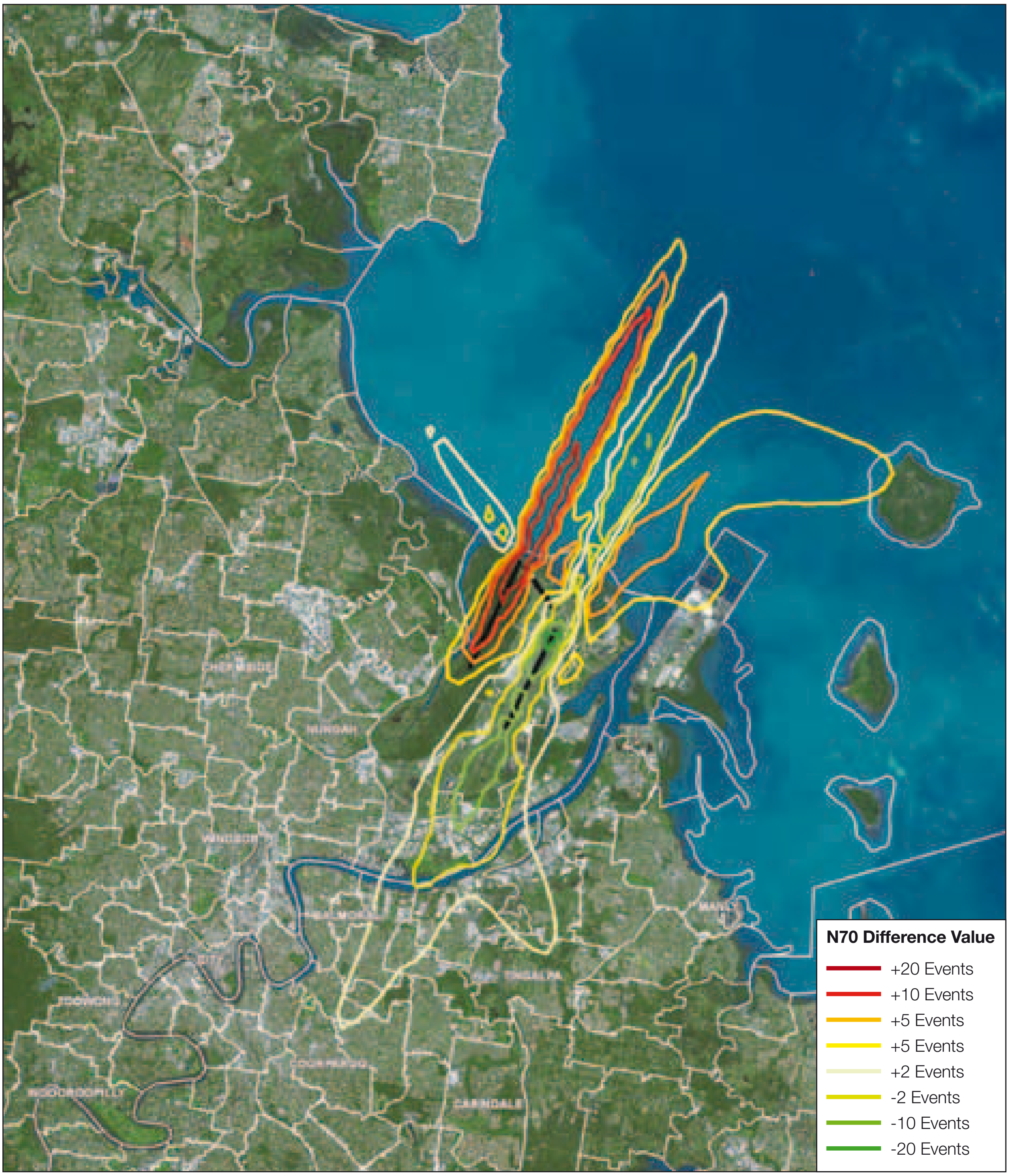


**Figure 5.5c:** *2 Overflight N70s for 2015 and 2035 ERS – Summer Weekday Night.*

***Figure 5.5d:*** *N70 Differences for 2015 With/Without NPR – Summer Weekday Night.*



## 5.6 Residence and Population Counts

### 5.6.1 Determining Residence and Population Counts within Noise Contours

The count of residences and populations was completed using the ArcGIS system to interrogate various data sets obtained from government agencies. The process is summarised below:

- Cadastral data covering the Brisbane Local Government Area (LGA) was obtained from the Department of Natural Resources and Water (DNRW) current to June 2006. This provides the location of lot/plan numbers, but does not identify whether there is a building located on the lot;
- Brisbane City Council (BCC) supplied a subset of their rates database containing lot/plan number and the property description field;
- The DNRW and BCC data sets were merged to provide a single data set that identified the presence of residential buildings at a property level. Of the rates categories, properties with the following description codes were deemed residential:
    a) Single unit dwelling (dwelling house);
    b) Non owner-occupier residential;
    c) Multiple dwelling;
    d) Mixed residential;
    e) Group titles;
    f) Combined multiple dwelling and shops; and
    g) Community title scheme.
- A second subset of the BCC rates database was supplied containing numbers of units or flats on a parcel of land. This was also integrated into the combined cadastral dataset.

  The unit/flat count subset of the BCC rates database does not take into account instances where more than one dwelling may be present on a parcel, but receives only one rates notice. These included multiple dwelling, combined multiple dwelling and shops and mixed residential. To account for this, the average of known units per ABS Statistical Local Area (SLA) was calculated and applied to the unknown parcels. In the cases where no known unit counts were available for an SLA, the BCC LGA average of 10 (rounded up from 9.6) was applied.

  Additionally, the rates database data supplied did not take into account situations where a residence was situated upon multiple lots (i.e. because the holder pays rates on each lot). A property holdings GIS layer was obtained from BCC and used to aggregate residential lots in these circumstances.
- To assign a population to each dwelling, BCC BSTM (Brisbane Strategic Transport Model) data supplied for the surface transport modelling for the project was used. Occupancy rates for detached and attached dwellings were assigned to each residence based on the BSTM zoning.

All residence and population information presented in this report is based on the above 2006 data. section 5.6.2 provides a discussion on how changes to future land use may affect these counts.

### 5.6.2 Effects of Future Land Use on Residences within Noise Contours

The South East Queensland Regional Plan anticipates that Brisbane City will need to accommodate an additional 145,000 new dwellings by 2026. This will be achieved through both infill development and development of greenfield sites.

The South East Queensland Regional Plan requires each local government to prepare a Local Growth Management Strategy (LGMS) to identify the areas that will accommodate future growth. BCC has not yet completed their LGMS, however, the work undertaken to date has identified a need to increase residential densities in certain locations including areas that are:

- Adjacent to centres;
- In close proximity to public transport, especially rail;
- Along major roads; and
- Located in the inner city.

The current City Plan was adopted in 2000, and subsequently does not reflect many legislative changes required by the *Integrated Planning Act 1997* (IPA). The City Plan is currently under review. It is expected that the existing City Plan will be amended to reflect the South East Queensland Regional Plan as required by IPA.

Under the current City Plan, the predominant form of residential growth in proximity to the Brisbane Airport will be by irregular infill development, as there are limited greenfield sites. Currently, infill development is only likely to occur where there are brownfield sites that provide opportunities for demolition and reconstruction.

It is not expected that land use in proximity to the Brisbane Airport will change significantly to 2035, with the exception to an overall increase in residential density in existing residential areas.

**Table 5.6a** to **Table 5.6c** contain suburbs that are affected by the N70 contours. An assessment has been made, based on best practice, on whether significant growth in population is likely to occur in these suburbs to 2035.

**Table 5.6a** contains the suburbs likely to experience significant growth in population to 2035, as they:

- Are identified by the City Plan for medium to higher density development;
- Have the opportunity for transit oriented development; or
- Contain a number of greenfield or brownfield sites that have the potential for residential development and are expected to be redeveloped by 2035.

**Table 5.6b** contains the suburbs that are generally designated for residential development, and are likely to experience relatively lower levels of growth from infill development or development of greenfield sites to 2035 than those identified in **Table 5.6a**.

**Table 5.6c** contains the suburbs that are unlikely to grow significantly by 2035, as they are either:

- Predominantly designated for industrial development and unlikely to be subject to significant change in the land use profile; or
- Contain a high proportion of land designated for industry adjacent to land designated for low density residential development, where the residential area is predominantly developed and unlikely to experience significant infill development in the future.

**Table 5.6a:** Suburbs Likely to Experience Significant Growth to 2035.

| |
|---|
| Albion |
| Ascot (Doomben Racecourse) |
| Banyo (several non-residential brownfield sites are currently experiencing pressure for redevelopment for residential uses) |
| Bulimba (Northern Logistics Group Site and adjacent to Oxford Street commercial precinct) |
| Camp Hill |
| Coorparoo |
| Eagle Farm (particularly the Northshore Hamilton Redevelopment Site) |
| Hawthorne |
| Highgate Hill |
| Newstead |

**Table 5.6b:** Suburbs Unlikely to Experience Significant Growth to 2035.

| | |
|---|---|
| Annerley | Greenslopes |
| Balmoral | Gumdale |
| Belmont | Kangaroo Point |
| Cannon Hill | Norman Park |
| Carina | Northgate |
| Carindale | Seven Hills |
| City | South Brisbane |
| East Brisbane | Spring Hill |
| Fairfield | Tingalpa |
| Fortitude Valley | |

**Table 5.6c:** Predominantly Industrial Suburbs Unlikely to Experience Significant Growth to 2035.

| |
|---|
| Hendra |
| Hemmant |
| Morningside |
| Murarrie |
| Pinkenba |

##### *5.6.2.1 Conclusion*

As discussed in the above section, the suburbs affected by the N70 contours that are likely to experience significant residential growth to 2035 are contained in **Table 5.6a**. The planned extent of this growth will be confirmed in BCC's LGMS, once completed and available to the public in mid-2007.

The suburbs contained in **Table 5.6b** are likely to experience minimal growth to 2035 from infill development, and the suburbs contained in **Table 5.6c**, which are predominantly industrial in nature, are not likely to experience significant growth to 2035.

The ANEC is contained within the ultimate capacity ANEF as shown in BAC's 2003 Master Plan. Therefore there is no change to future land use planning over and above that required as a result of the 2003 Master Plan. Future land use planning will continue to be managed through the ANEF contours, the Airport Master Plan, and the continued co-operation between BAC, Local Government and State Government.

## 5.7 Flight Path and Noise Information Booklet

The Flight Path and Noise Information Booklet (FPNIB) has been prepared as a separate document to complement this Volume of the Draft EIS/MDP. It contains additional information and figures important to understanding flight paths, the changes in aircraft overflights following the opening of the NPR and the likely noise exposure associated with those overflights on the suburbs in Brisbane.

The FPNIB can be viewed and read as a stand alone document. It includes a summary of the background information described in this Volume about aircraft types, weather conditions, traffic forecast and flight path allocation as well as explanatory notes for interpreting the flight path charts provided in the document. A hard copy of the FPNIB, will be supplied with each hard copy of the Draft EIS/MDP Summary of Major Findings document, as well as an electronic copy on CD with the Draft EIS/MDP.

The booklet includes a comprehensive range of illustrated Flight Path and Noise Charts, examples of which have been provided in the previous sections of this Chapter. The booklet also includes a transparent overlay with the boundaries of Brisbane suburbs, which can be held over each Flight Path and Noise Chart, so you can more clearly see where a suburb is located in relation to the flight path.

The booklet also provides a detailed explanation on how the flight path zones were developed. It is important to note that these flight path zones represent the area in which an aircraft overflight may be experienced. In most cases, on any given day, the number of movements may be greater in some areas than another within the same flight path zone, or may be evenly spread across the zone with a slight concentration closer to the centre of the flight path zone.

In addition to the information in the FPNIB, all the flight path and noise information modelled is available electronically in **Appendix D5** where further additional information can be obtained, should the reader require.

## 5.8 Lateral Noise – Reverse Thrust, Take-Off and Taxi Operations

### 5.8.1 Assessment and Calculation Procedures

This section deals specifically with noise from aircraft which are:

- Performing reverse thrust after landing;
- On take-off roll, but still on the runway; or
- Taxiing.

These noise sources constitute aircraft operational noise, and are assessed in the same way as the operational noise considered in the previous sections. In particular, the N70 value, representing the number of events per day exceeding 70 dBA, is considered to provide a valid and useful description of noise impacts associated with these operations. (ANEC values for noise from these sources are well below relevant land use planning criteria at all potentially-affected locations, and are not considered in this Chapter).

The lateral noise assessment in this section is in addition to the Brisbane Airport Lateral Noise Study (May 2005) undertaken by Parsons Brinkerhoff on behalf of BAC, which looked at the difference in noise for different runway separation distances only.

The noise impacts in the previous sections have been calculated using the INM (Integrated Noise Model) noise prediction model. This model is used throughout the world to predict aircraft operational noise, but it was not originally designed to take account of details of surface topography, barriers, meteorology and ground effects, all of which have a significant impact on noise levels for sources which are within a few metres of the ground. These effects are particularly relevant for assessment of noise from the sources considered in this section.

The most recent version of INM allows some of the above factors to be included, but the algorithms have not been tested over a long period under Australian conditions. Other ground-based propagation models, in particular the ENM (Environmental Noise Model), are considered to provide more reliable estimates of noise levels from sources close to the ground. In addition, in some cases the noise emission levels from aircraft performing the above operations are quite site-specific, and require validation against measured noise levels.

For this reason, the present section provides a specific assessment of noise from aircraft performing the above operations, calculated using the ENM model and using measured noise levels and local topographical and meteorological information.

### 5.8.2 Measurement Procedures

To determine noise emission levels from the above aircraft operations, field noise measurements (attended by a field officer) were undertaken at Brisbane Airport between 5 and 10 November, 2005. Over this period, noise from reverse thrusts and during take-off was measured at fixed locations close to the airport perimeter fence, while noise emission from aircraft while taxiing was measured close to the source, within the airport grounds.

Noise levels were measured with a Bruel & Kjaer Type 2231 (B&K 2231) Sound Level Meter, which conforms to Australian Standard 1259 "Acoustics – Sound Level Meters" as a Type 1 Precision Sound Level Meter, having an accuracy suitable for laboratory use. The A-weighting filter was selected and the time weighting was set to 'fast'. The meter was field calibrated both before and after the measurements with a Bruel & Kjaer Sound Level Calibrator Type 4230 (B&K 4230). No significant system drift was noted.

The B&K 2231 and B&K 4230 have been laboratory calibrated within the previous two years in accordance with Wilkinson Murray Quality Assurance procedures.

### 5.8.3 Results from Fixed Measurement Locations

The three fixed locations used for measurement of reverse thrust and take-off noise are shown in **Figure 5.8a**. Noise from these events was recorded on three days – 7, 9 and 10 November 2005. Apart from a brief period on 7 November, all operations during this time were on runway 01. The aircraft type for each event was noted on site, and checked from AsA records by matching the times of recorded airport operations.

For each measurable event, the maximum noise level ($L_{AMax}$) and the Sound Exposure Level (SEL) were recorded. The SEL represents the sound energy contained in a noise event, and takes account of the event's duration as well as its maximum noise level.

$L_{Amax}$ and SEL noise levels from each measurable noise event are shown in **Appendix B11**.

Although three measurement sites were used, for operations on runway 01 it was found that site CC gave results which were more reliable and less affected by extraneous noise than the others. This site is closer to the point at which reverse thrust is typically applied, and the maximum level during take-offs is experienced when the aircraft is still on the ground. Hence measurement time was concentrated at this site. A total of 149 measurable events were recorded at site CC, compared with five at site AA and six at site BB. For this reason, the analysis below is restricted to events measured at site CC, which are all on runway 01.

### 5.8.4 Effect of Meteorological Conditions

The first point which can be noted from these results is the effect of wind speed and direction on the measured noise levels. Wind conditions on the three days, as determined from the Bureau of Meteorology station on the airport site, were relatively stable over long time periods, and can be characterised as shown in **Table 5.8a**. In particular, on 7 November there was significant wind in the receiver-to-source direction.

**Figure 5.8b** and **Figure 5.8c** show energy-mean recorded $L_{Amax}$ values from reverse thrusts and take-offs of 737-400, 737-700 and 737-800 aircraft on each measurement day. The effect of differences in wind conditions is obvious, with levels recorded on 7 November being approximately 10–15 dBA lower than on the other days (note that results for 737-800 are more reliable as there are more events included in the energy-mean).

An estimate of noise emission levels from reverse thrusts and take-offs can be gained by considering the energy-mean measured $L_{Amax}$ levels from events measured on 9 and 10 November. **Figure 5.8d** and **Figure 5.8e** show these energy-mean levels for all aircraft types with at least two recorded events. The variation in noise levels between types is within the expected range for these aircraft types, given the fact that emission levels from aircraft on the ground are not necessarily well correlated with those from the same aircraft heard in the air.

**Table 5.8a:** Wind Conditions During Measurements.

| Date | Time Period | Wind Speed, m/sec | Wind Direction, degrees (mag) | Approximate Wind Component in Source – Receiver Direction, m/sec | |
|---|---|---|---|---|---|
| | | | | Reverse Thrust | Take-off |
| 7 November | 12:00–15:30 | 6.1 | 110 | -6.1 | -4.8 |
| 7 November | 15:30–17:30 | 5.0 | 110 | -5.0 | -3.9 |
| 9 November | 14:00–18:30 | 7.2 | 10 | 2.1 | 5.4 |
| 10 November | 9:30–10:30 | 5.8 | 10 | 1.7 | 4.3 |
| 10 November | 10:30–18:30 | 9.2 | 10 | 2.7 | 6.8 |

***Figure 5.8a:*** *Fixed Locations for Monitoring of On-Airport Noise Sources.*

**Figure 5.8b:** *Energy-Mean Recorded $L_{Amax}$ Values for 737-400, 737-700 and 737-800 Aircraft – Reverse Thrusts.*

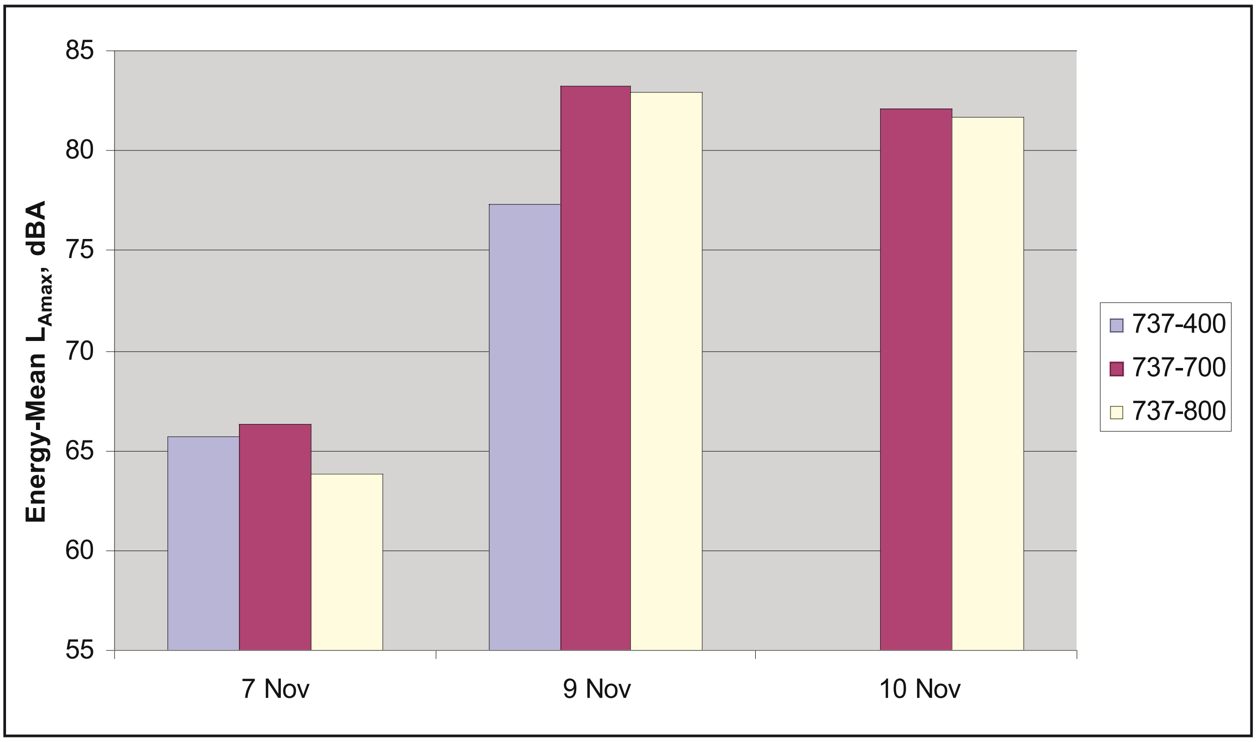



**Figure 5.8c:** *Energy-Mean Recorded $L_{Amax}$ Values for 737-400, 737-700 and 737-800 Aircraft – Take-Offs.*

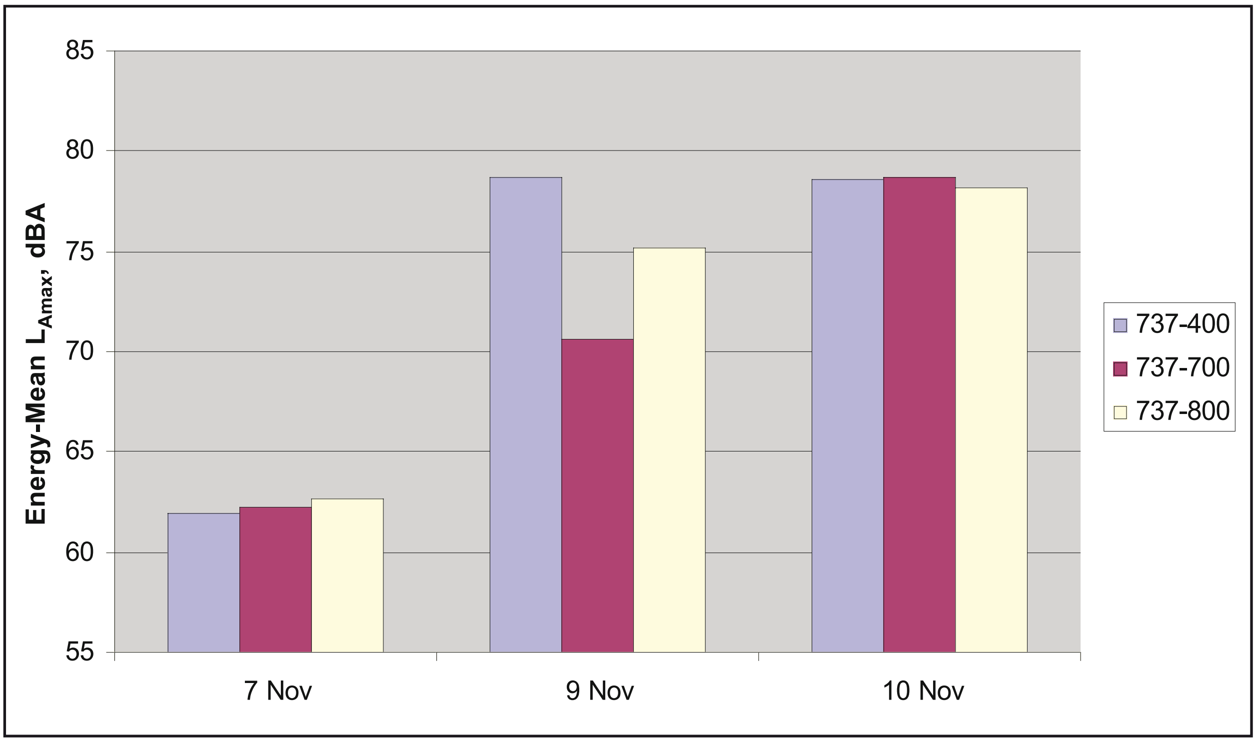


**Figure 5.8d:** *Energy-Mean Recorded $L_{Amax}$ Values for Reverse Thrusts – Events on 9 and 10 November.*

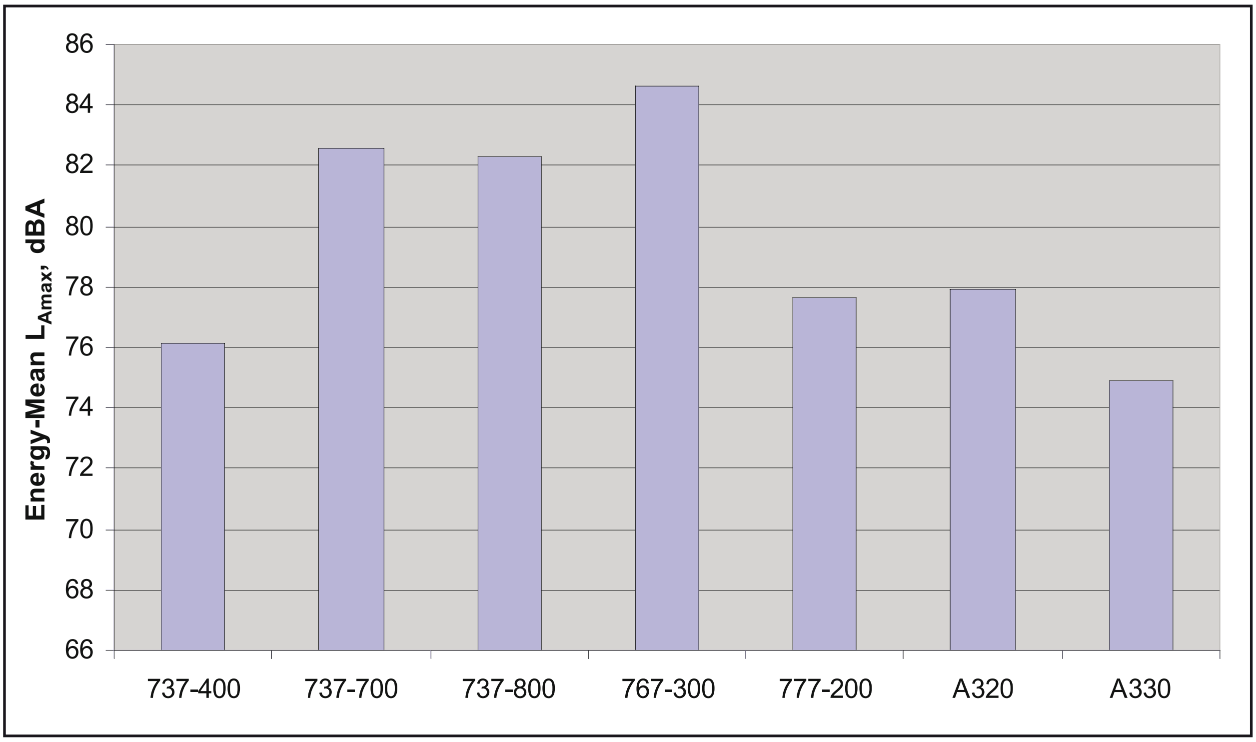
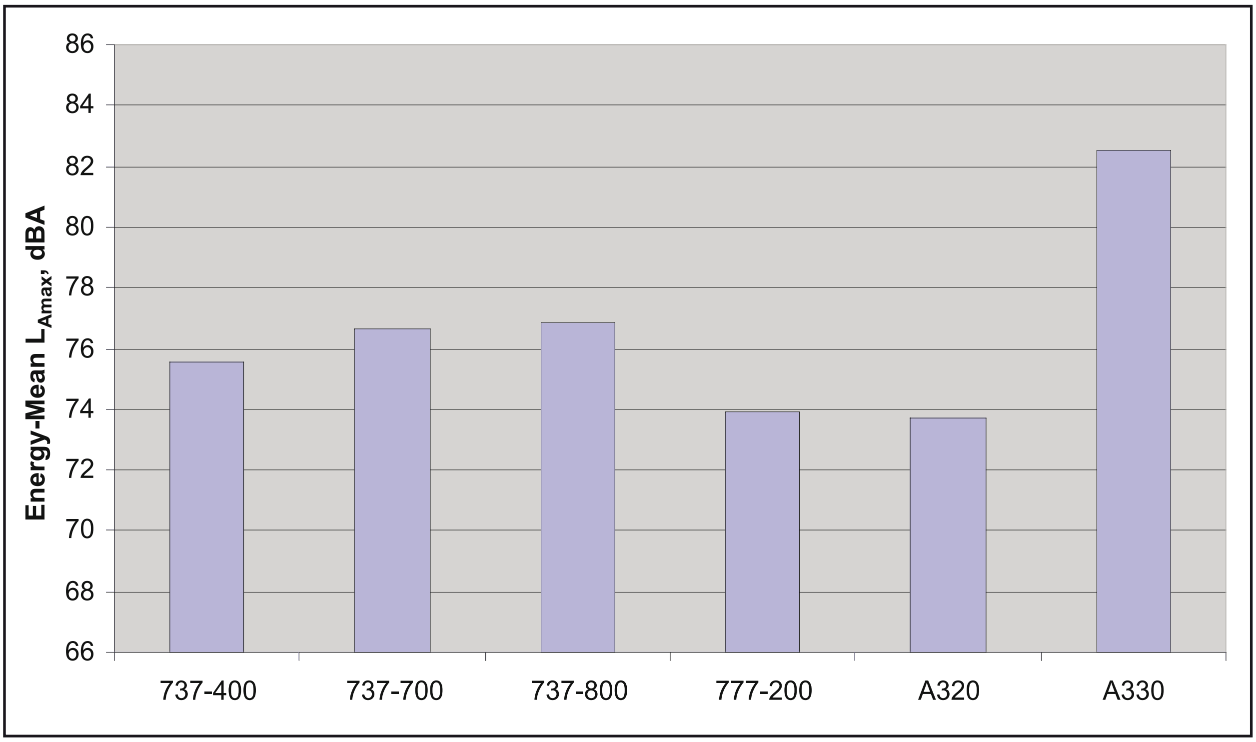



**Figure 5.8e:** *Energy-Mean Recorded $L_{Amax}$ Values for Take-Offs – Events on 9 and 10 November.*



### 5.8.5 Calculation of Sound Power Levels – Reverse Thrusts

To calculate noise levels at other locations, the measured $L_{Amax}$ values must be converted to sound power levels, which represent the sound energy emitted by the source. These sound power levels can then be input into the ENM model to predict noise levels at other locations and under other meteorological conditions.

In the case of reverse thrusts, the noise event can be considered to occur at a relatively well-defined source location, and to last for the duration of application of the thrust. In this case the maximum sound power level can be deduced by using the ENM model to predict measured $L_{Amax}$ levels at the receiver location due to a stationary source, taking account of ground and meteorological conditions at the time of the measurements, and back-calculating the required value of sound power level in order to give the measured $L_{Amax}$ values. The sound spectra used in calculations are taken from standard spectra for the relevant aircraft type, as used by the INM program.

**Table 5.8b** shows A-weighted values of maximum sound power level for each measured aircraft type, calculated in this way.

**Table 5.8b:** Maximum Sound Power Level – Reverse Thrusts.

| Aircraft Type | Maximum Sound Power Level (Energy-Mean), dBA | Number of Events on which Estimate is Based |
|---|---|---|
| 737-400 | 147 | 4 |
| 737-700 | 154 | 11 |
| 737-800 | 153 | 19 |
| 767-300 | 155 | 3 |
| 777-200 | 148 | 4 |
| A320 | 148 | 7 |
| A330 | 146 | 2 |

For normal take-off and landing operations, noise levels from A320 aircraft would be expected to be similar to those from 737-400 aircraft, with 767 aircraft somewhat louder. **Table 5.8b** and **Table 5.8c** indicate that noise levels during reverse thrust operations are reasonably well correlated with expected levels during normal take-off and landing, but there may be differences. In calculations, a sound power level of 154 dBA, as measured for a 737-700 aircraft, was adopted as a reasonable estimate of the typical sound power level from a reverse thrust by a large jet aircraft arriving at Brisbane.

### 5.8.6 Calculation of Sound Power Levels – Take-Offs

In the case of an aircraft take-off, this represents moving directional noise source, with maximum sound power typically emitted at an angle of approximately 135° to the direction of travel. Hence, the maximum level heard at any point on the ground will be slightly lower than it would be from a source emitting the same sound power omnidirectionally. To a first approximation this difference can be taken as 3 dB. To calculate the maximum noise level, such a source can be approximated by an omnidirectional point source at the closest point to a receiver, with a sound power level 3 dB lower than the actual maximum level emitted in any direction.

The procedure described above was used to find the maximum sound power level emitted during a take-off, based on measured maximum levels and the estimated distance to the point of maximum noise emission. Results are shown in **Table 5.8c**.

**Table 5.8c:** Sound Power Level Emitted During Take-Off at Angle of Maximum Emission (Aircraft on Runway).

| Aircraft Type | Maximum Sound Power Level (Energy-Mean), dBA | Number of Events on which Estimate is Based |
|---|---|---|
| 737-400 | 151 | 8 |
| 737-700 | 151 | 8 |
| 737-800 | 151 | 15 |
| 777-200 | 147 | 3 |
| A320 | 147 | 3 |
| A330 | 157 | 2 |

The high measured sound power level from an A330 take-off is surprising. However, it should be noted that this is based on only two recorded events, and is therefore relatively unreliable. A sound power level of 151 dBA, as measured for a number of aircraft types, was adopted as a reasonable estimate of the typical sound power level from a large jet aircraft on take-off roll at Brisbane Airport.

### 5.8.7 Results from On-Airport Measurements

Measurements of noise from aircraft taxing were performed under normal operating conditions, with the measured aircraft and operating conditions being dependent on conditions applying at the time of the measurements. **Table 5.8d** shows the measured noise emission levels for each aircraft. These are expressed as sound power level, which is calculated from the measured $L_{Amax}$ level as an aircraft passes the measurement point and the distance at which the event was recorded. These distances ranged from 40 to 200 metres.

**Table 5.8d:** Sound Power Level for Taxiing.

| Aircraft Type | Sound Power Level per Metre, dBA | |
|---|---|---|
| | Individual Measurements | Energy-Mean |
| 747 (all types) | 137, 134, 136, 142 | 138 |
| 737 (all types) | 126, 126, 139 | 135 |
| 717 | 120 | 120 |
| A330 | 129 | 129 |
| 777 | 132 | 132 |

Noise levels emitted during taxiing vary significantly depending on the thrust setting in use at the time, but at least for 747 and 737 aircraft, the energy-mean values in **Table 5.8d** give an indication of typical values.

The values of sound power level in **Table 5.8d** can be directly compared with those in **Table 5.8c** for aircraft during take-off. For example, for a 737 aircraft the maximum noise emission during take-off is approximately 151 dBA, while during taxiing it is approximately 135 dBA. This is consistent with expectations for this aircraft type, and confirms that in comparison with noise from take-off operations, noise from taxiing represents a relatively minor contribution to the total emission from on-airport sources.

### 5.8.8 Calculated Noise Levels

The ENM noise prediction model was used to predict noise levels from a typical aircraft (737-700) performing a reverse thrust, take-off and taxi operation at the nearest point to each of the three receiver locations shown in **Figure 5.8f**, on the existing runway and on the NPR. The three locations represent the three residential locations which are potentially most affected by these operations.

Calculations were performed under the range of meteorological conditions applying for summer and winter day, evening and night periods. These conditions include wind speed and direction, as well as temperature inversion conditions.

These calculated noise levels were then used to derive 10 percent exceedance values – the noise level which would be exceeded for 10 percent of the time during a particular season and time period. Results from this analysis are shown in **Table 5.8e**.

As expected, **Table 5.8e** indicates that at receivers A, B and C all these events will be louder for operations on the NPR than on the existing runway. The difference is predicted to be between 4 and 13 dBA, and may be noticeable depending on what other activities are occurring in the area, in particular at locations B and C.

Predicted noise levels from taxiing on the NPR are relatively low, although the predicted night time level of up to 56 dBA at location B would be audible. However, if the buildings at this location are air-conditioned, then with windows closed maximum internal noise levels are likely to be 36 dBA or lower, which is unlikely to result in disturbance.

In the analysis in section 5.3, noise from aircraft operations was considered in the assessment when it exceeded a maximum level of 70 dBA.

***Figure 5.8f:*** Receiver Locations for Noise Level Calculations.


**Table 5.8e** indicates that this value is exceeded, on a 10 percent basis, only for reverse thrust operations at locations B and C during some evening and night time periods.

Location C represents a theological college, and although this includes residential accommodation, the residential buildings are in a more shielded location than the assessment position. In practice, noise levels greater than 70 dBA due to reverse thrusts are predicted to occur only rarely at the residential buildings, although once again reverse thrusts would nevertheless be audible.

Residences at location B are part of an aged care facility which has a clear line of sight to the NPR. More detailed analysis indicates that at this location a level of 70 dBA could be exceeded for reverse thrusts for approximately 25 percent of the time during winter evenings, 40 percent of the time during summer nights and 45 percent of the time during winter nights. It should be noted that these have not been identified in the N70 diagrams because of the limitations of INM model with respect to lateral noise as discussed in section 5.8.1.

TFI projections are that there would be approximately 11 arrivals by larger jet aircraft per summer weekday night in 2015, and 16 per winter weekday night. Almost all of these would occur on the NPR. Location B could therefore be predicted to experience a night time N70 value from four to seven aircraft landings due to movements on the NPR.

As noted above, if buildings in the facility are air-conditioned, then predicted noise levels will be up to 20 dB lower and therefore less audible. However, this level of impact may still not be negligible, so additional measures to ameliorate it will be considered.

One measure would be to place limitations on the use of reverse thrust for night time operations. This measure is used at other airports for aircraft arriving during the night period.

Standard data, and results from the measurements described above, confirm that noise levels from an aircraft landing without reverse thrust are at least 10 dB below those for a landing with reverse thrust. If the use of reverse thrust can be limited during the night time period, noise levels from aircraft landing on the NPR are predicted to be below 70 dBA at all times, and at all residential locations, during the night period.

Another possible control measure would be the use of the existing runway wherever possible at night. In particular, at times when DODPROPS and SODPROPS modes are unavailable it would often be possible to use only the existing runway for both arrivals and departures, thereby reducing the impact of noise from both landings and take-offs on adjacent areas (the same as existing single runway reciprocal operations). This would have less effect than restricting the use of reverse thrust, but would provide some benefit for adjacent residences.

**Table 5.8e:** Calculated $L_{Amax}$ Noise Levels Exceeded for 10% of Specified Time Period (737-700 Aircraft).

| Receiver | Season | NPR | | | Existing Runway | | |
|---|---|---|---|---|---|---|---|
| | | Day | Evening | Night | Day | Evening | Night |
| **Noise Source – Take-Off** | | | | | | | |
| A | Summer | 43 | 43 | 47 | 32 | 32 | 39 |
| | Winter | 43 | 46 | 49 | 32 | 38 | 41 |
| B | Summer | 64 | 64 | 69 | 51 | 51 | 59 |
| | Winter | 64 | 68 | 69 | 51 | 56 | 58 |
| C | Summer | 59 | 59 | 63 | 55 | 55 | 62 |
| | Winter | 59 | 65 | 67 | 55 | 61 | 63 |
| **Noise Source – Reverse Thrust** | | | | | | | |
| A | Summer | 49 | 49 | 53 | 38 | 38 | 45 |
| | Winter | 49 | 52 | 55 | 38 | 44 | 47 |
| B | Summer | 70 | 70 | 75 | 57 | 57 | 65 |
| | Winter | 70 | 74 | 75 | 57 | 62 | 64 |
| C | Summer | 65 | 65 | 69 | 61 | 61 | 68 |
| | Winter | 65 | 71 | 73 | 61 | 67 | 69 |
| **Noise Source – Taxi** | | | | | | | |
| A | Summer | 36 | 36 | 40 | 19 | 19 | 26 |
| | Winter | 36 | 39 | 42 | 19 | 25 | 28 |
| B | Summer | 51 | 51 | 56 | 38 | 38 | 46 |
| | Winter | 51 | 55 | 56 | 38 | 43 | 45 |
| C | Summer | 46 | 46 | 50 | 42 | 42 | 49 |
| | Winter | 46 | 52 | 54 | 42 | 48 | 50 |

## 5.9 Noise-Induced Vibration

At high noise levels, the low frequency components of aircraft noise can result in vibration of loose elements in buildings, notably windows. Even at the highest expected noise levels, the levels of vibration due to low frequency noise are well below those which may cause structural damage to buildings. However, they can result in secondary radiation from loose windows and other building elements.

This effect is distinct from that of vibration from wake vortices, which result from aerodynamic turbulence caused by the aircraft as it passes through the air. Brisbane Airport's large buffer zone (refer to Chapter A1), means that wake turbulence from aircraft will have no impact on existing residential areas in Brisbane.

With typical light building structures, noise induced vibration may begin to occur where the maximum external noise level reaches approximately 90 dBA. The effect is more common on take-offs than for landings, since the noise spectrum for a take-off close to the airport has stronger low frequency components.

**Figure 5.9a** and **Figure 5.9b** show 90 dBA noise level contours for a 747-400 aircraft departure (maximum stage length) and a 747-400 arrival, on the existing runway. The contours are almost entirely contained within the Airport bounds, and do not cover any existing residences. The same is true for equivalent contours on the NPR, although in this case the maximum noise level on departure would be lower because long-range departures by heavy aircraft would not occur on this runway.

From the above it is clear that there is currently negligible impact from noise-induced vibration associated with the airport as a whole, and this would not change with the introduction of the NPR.

***Figure 5.9a:*** *90 dB Noise Level Contours – 747-400 Aircraft Departing, Stage 7 (Long-Range).*

*Figure 5.9b: 90 dB Noise Level Contours – 747-400 Aircraft Arriving.*


## 5.10 Future Technology Improvements

### 5.10.1 Implications of Navigation Technology Improvements

It is assumed that the NPR system will continue to be serviced by an Instrument Landing System (ILS) as the main precision navigation approach aid. However, improvements in aviation navigation technology and procedures are being developed and trialled at Brisbane Airport and other airports around the world. Some of the technologies currently being trialled include Required Navigation Performance (RNP) procedures and Continuous Descent Approaches (CDA).

It is possible these procedures will be available by the time the NPR is commissioned and, as a consequence, the existing approach and departure procedures may vary at Brisbane Airport. Current navigational procedures applicable to parallel runway operations and the relevant traffic management requirements have been used in the noise assessment in this Volume.

Some potential changes, such as RNP, have been considered by AsA in the development of the NPR flight paths and airspace so that the future flight paths may accommodate possible changes. Any changes that will occur prior to the opening of the NPR will be included in the additional full and detailed Safety Case and Environmental Assessment that will need to be undertaken by the Airspace and Navigation Service Provider (ANSP), which is currently AsA, closer to the opening of the NPR.

### *5.10.1.1 Continuous Descent Approach (CDA)*

During landing substantial noise in manoeuvring and the deployment of slats, flaps and landing gear is generated compared with a clean configuration (i.e. slats, flaps and landing gear retracted). Exposure to this noise from landing aircraft can be reduced noticeably by changing the arrival procedure, such that if manoeuvres could be carried out further away from the airport to get the aircraft on course for its final approach, descent could be performed slowly with little or no corrections. CDA is a method following these principles. The optimal arrival configuration with slats, flaps and landing gear retracted, and throttle setting just above idle, provides minimum fuel burn and low noise and engine emissions.

CDA starts at an altitude of about 6000 ft (approximately 1830 m) where the aircraft continuously descends at 3º instead of short descents to cleared altitudes and joining the 3º glide slope as typically required by Air Traffic Control. It intercepts the ILS slope without using level flight.

Additional benefits can be achieved by flying in clean configuration as long as possible, consistent with safety requirements. Noise reduction using CDA is primarily obtained because aircraft are flying at a higher speed for a longer period of time, meaning the deployment of landing gear and high-lift devices is delayed.

Louisville International Airport in the USA conducted initial CDA trials in 2002 and 2004. This trial showed that the application of CDA reduces community noise on average by about 4 dB to 6 dB. Some other benefits of CDA observed were a reduction in engine emissions, less fuel burn and slightly shorter flights.

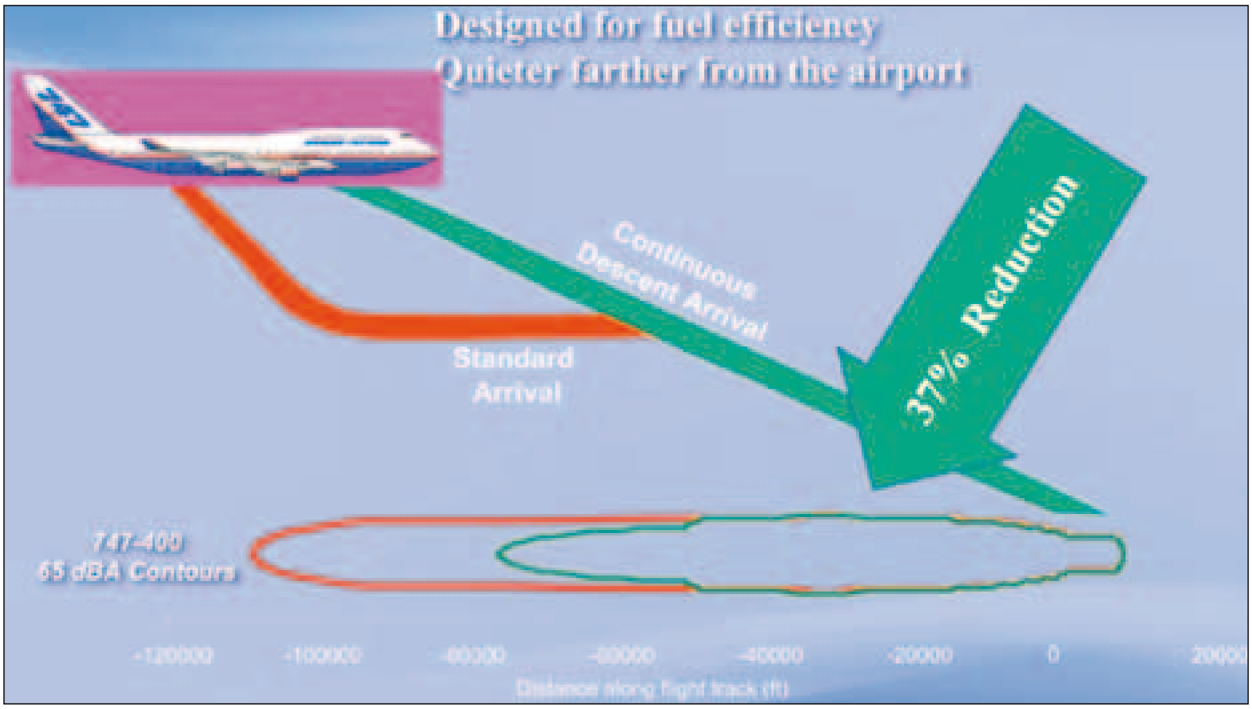
Schiphol Airport in the Netherlands also conducted a trial of CDAs with two airlines using three aircraft types (B737-800, MD-11 and A320) to perform a total of 192 CDAs. Some fuel burn and time comparisons of the B737-800 used in the trial are given in **Table 5.10a**.

**Table 5.10a:** Comparisons of CDA Trial at Schiphol Airport for Fuel Burn and Flight Time of a B737-800 (Figures from Boeing and LVNL).

| | Fuel (kg) | Time (mins) | Distance (m) |
|---|---|---|---|
| Daytime Baseline Profile | 549 | 28.4 | 139.5 |
| Daytime CDA Profile | 440 | 25.9 | 139.5 |
| Savings | 109 | 2.5 | 0 |
| | | | |
| Nighttime Baseline Profile | 602 | 29.7 | 147 |
| Nighttime CDA Profile | 481 | 26.9 | 147 |
| Savings | 121 | 2.8 | 0 |

A comparison between the noise footprints obtained from Boeing of a B747-400 performing a standard arrival and a CDA is depicted in **Figure 5.10a**.

***Figure 5.10a:*** *Noise Contour Comparison Between Standard Arrival and CDA for a B747-400 (Courtesy of Boeing).*



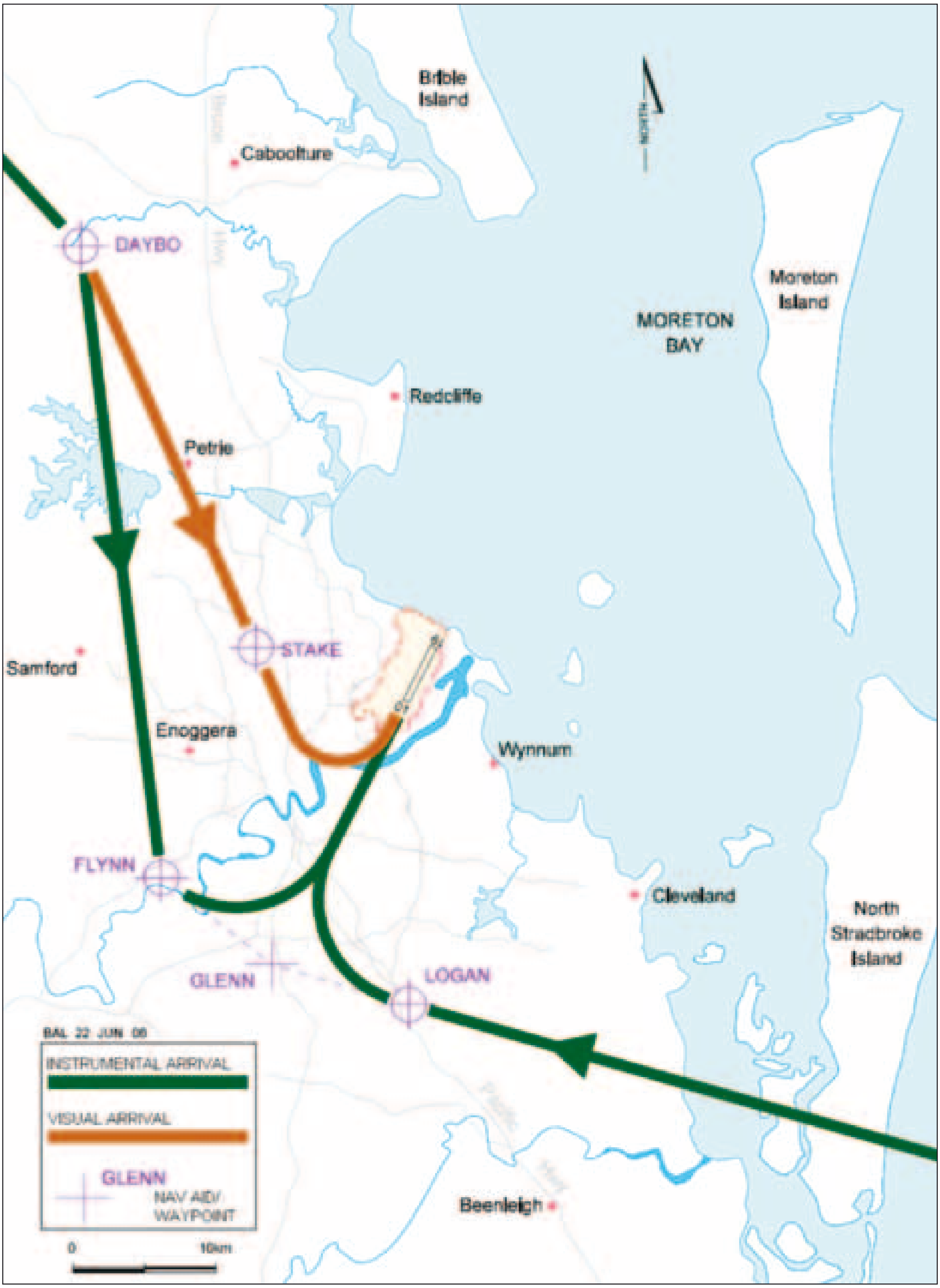

### *5.10.1.2 Required Navigation Performance*

Another method of reducing aircraft noise is the use of RNP technology, which includes cockpit fitted state-of-the-art GPS navigation equipment in new generation aircraft (such as the B737-700, B737-800 and A320 aircraft). This means that these aircraft can use visual arrival tracks in instrument conditions, requiring only a two mile arrival clearance. It is anticipated that this technology should be available in most aircraft by 2015.

This procedure has an additional benefit of saving of fuel (up to 104 litres for a typical B737-800 because of a one to three minute reduction in flight time). Burning less fuel in the air will also reduce the greenhouse gas emissions by a substantial amount if every B737 or A320 aircraft flying at Brisbane saves three minutes of time in the air.

AsA plans to start an RNP trial at Brisbane Airport in November 2006 for at least six months. The trial will be applied on three visual tracks. One track is the STAKE visual track form the north, saving almost three minutes of time in the air compared to flying the ILS approach track. The difference in distance can be seen in **Figure 5.10b**.

***Figure 5.10b:*** *RNP at Brisbane Airport: Visual STAR (River Track) and Instrument STAR.*



#### *5.10.1.3 RNAV Area Navigation*

Another advanced operational procedure is the tailored arrival, designed to lessen the workload of pilots and air traffic controllers. A tailored arrival is a customised RNAV arrival created to provide the optimal descent trajectory while reducing fuel-burn, noise and engine emissions. RNAV refers to area navigation, which is a method of navigation that enables aircraft to fly on any desired flight path within the coverage of referenced navigation aids or within the limits of the capability of self-contained systems, or a combination of these capabilities.

New aircraft can be programmed for flight profile and thrust management so that optimised noise abatement flight profiles can be tailored for individual airports and runways without excessive pilot workload. Actively coupled systems could provide for minimum noise impact on surrounding communities. The arrival phase of the flight could be flown as a CDA with throttle settings at just above idle.

Boeing Air Traffic Management, Air Traffic Alliance, Qantas and AsA agreed to participate in a tailored arrival trial that took place at Melbourne and Sydney airports recently. Qantas released some figures about fuel savings using CDA during a tailored arrival. At Sydney airport, CDA offers annual savings of 6,115 tonnes of fuel over current descent profiles (based on an extrapolation of one month's data).

### 5.10.2 Implications of Aircraft Technology Improvements

The first civil subsonic aircraft, such as the B707 and DC-8, came into service in the 1960s and were powered by noisy turbojet engines. Aircraft noise was dominated by the engine's high velocity jet exhaust. When civil aviation started to grow, aircraft noise became an issue and alternative engines were looked for. The replacement of the turbojet engine by the turbofan engine was the first step in the process of aircraft noise reduction.

The first turbofan engine had a low bypass ratio. To reduce its engine noise, high bypass ratios were introduced and as a direct result, airframe noise became a dominant noise source during landing. For this reason, both engine noise and airframe noise have to be considered when reducing aircraft noise. **Figure 5.10c** gives an overview of the noise footprint reduction over the last couple of decades for different aircraft types.

NASA (National Aeronautics and Space Administration), in cooperation with the aerospace industry, is researching all possible solutions to aircraft noise reduction. NASA initiated a noise reduction program in 1992 and started in 1994 with its first program, Advanced Subsonic Technology (AST). AST was divided into three parts: engine, nacelle[6] and airframe noise reduction. After eight years the program was finished and an 8 dB noise reduction was obtained relative to 1992 technology.

A subsequent noise reduction program started in 2001, the Quiet Aircraft Technology (QAT), with the intention to reduce aircraft noise by 10 dB within 10 years and by 20 dB within 25 years relative to 1997 technology. To give an idea of the NASA goal of the two programs, a noise reduction trend is given in **Figure 5.10d**.

Current noise reduction research is being undertaken on engine and airframe noise. Engine noise reduction techniques include reducing jet exhaust noise by applying high bypass ratios and using modified engine nozzles. The nozzle modifications are called chevrons and are triangular cut-outs. These cut-outs reduce the jet exhaust noise by lowering the turbulent mixing of the hot high-velocity jet exhaust and the surrounding air.

Airframe noise is dominated by deployed high-lift devices and landing gear. Some studies of airframe noise have examined the physical principles of a flying owl. Although the owl is a small bird and has a low flight speed compared to an aircraft, the owl flies at a high angle of attack similar to a landing aircraft. Using special feathers on its wing and legs, the owl flies stable and quiet at a high angle of attack. Engineers are now trying to learn from the aerodynamic principles in owls' feathers to make aircraft quieter.

[6] *A nacelle is the covered housing of the engine.*

The principle in reducing airframe noise is to make the wing as smooth as possible, with high-lift devices deployed. Reducing the gaps between slats and main wing, and main wing and flaps, and moving small rods of the landing gear behind larger parts, make the flow around the wing and landing gear more laminar, reducing airframe noise.

New aircraft such as the A380 and the B787 incorporate new technologies to lower the aircraft noise. The A380, which will replace the B747-400 by some airlines, has noise related aerodynamic improvements such as wing tip device optimisation and high-lift system modifications. The engine has nacelle improvements, additional acoustical treatment and an increased fan diameter. This leads to an overall noise reduction which can be seen in **Figure 5.10e**.

The B787, known as the Dreamliner, is Boeing's replacement for the B767. Half of the aircraft is made out of composites, making it much lighter than an aluminium aircraft. Some engine improvements include a high bypass ratio, chevrons at the nozzle and laminar flow nacelles. Airframe noise reduction is obtained by applying quiet flaps and slats and a low-noise landing gear. The noise footprint will be 60 per cent smaller than the footprint of the B767 (see **Figure 5.10f**). This implies a noise reduction of about 8 dB. **Figure 5.10g** provides the expected noise levels of the B787 compared to its competitors.

The three major Australian airlines flying at Brisbane Airport are Qantas Airways, Virgin Blue and Jetstar. The latter two started their operations in August 2000 and May 2004 respectively, and have a new aircraft fleet. Virgin Blue's fleet consists of B737-700 and B737-800 aircraft, and are new generation Boeing aircraft. Jetstar has B717-200 and A320-200 in their fleet, but will replace all their B717s by A320s by the end of 2006.

***Figure 5.10c:*** *Noise Contour Reduction.*

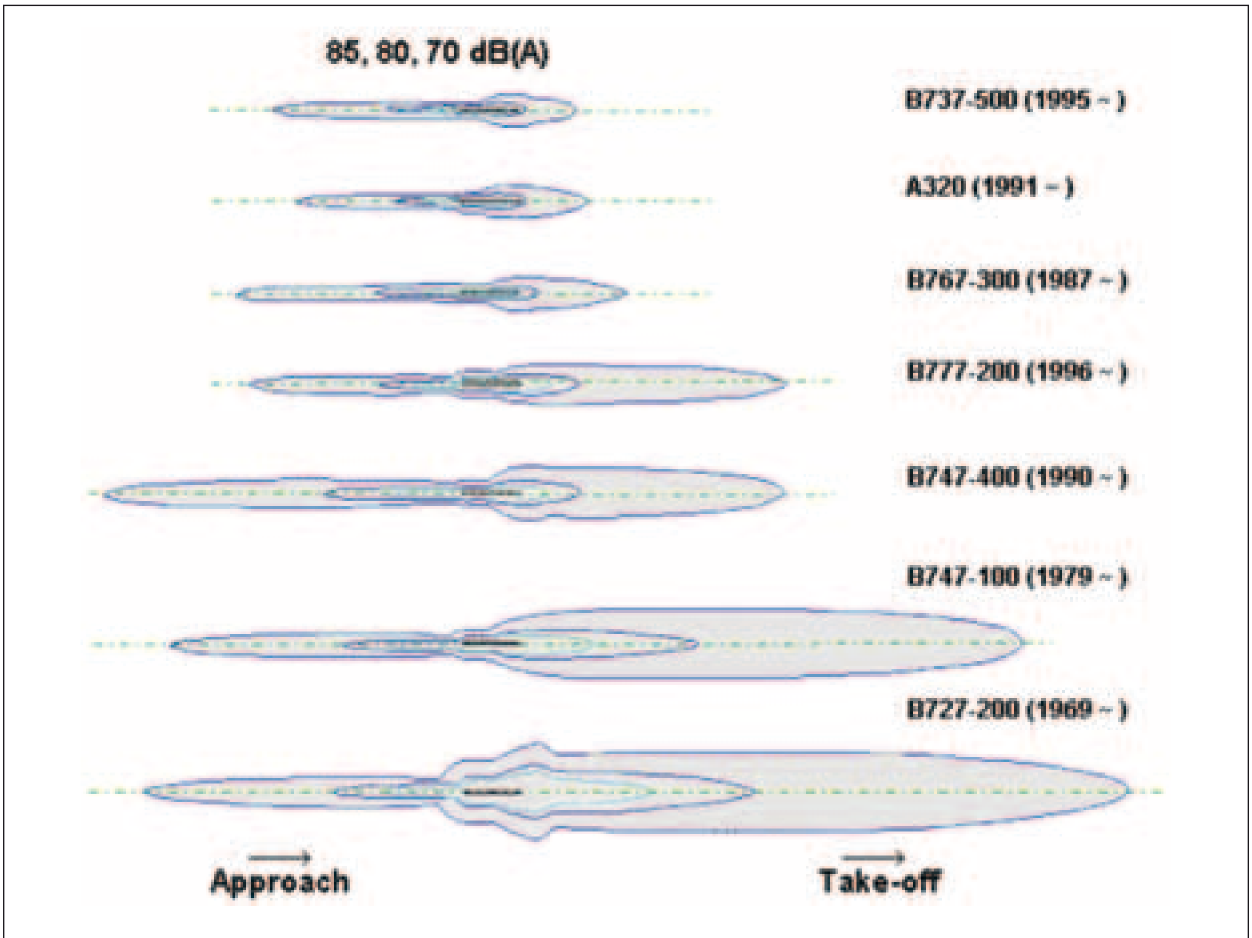


**Figure 5.10d:** *Noise Reduction Trend Compared to Chapter 3 Requirements[7] (Courtesy of Pratt & Whitney).*

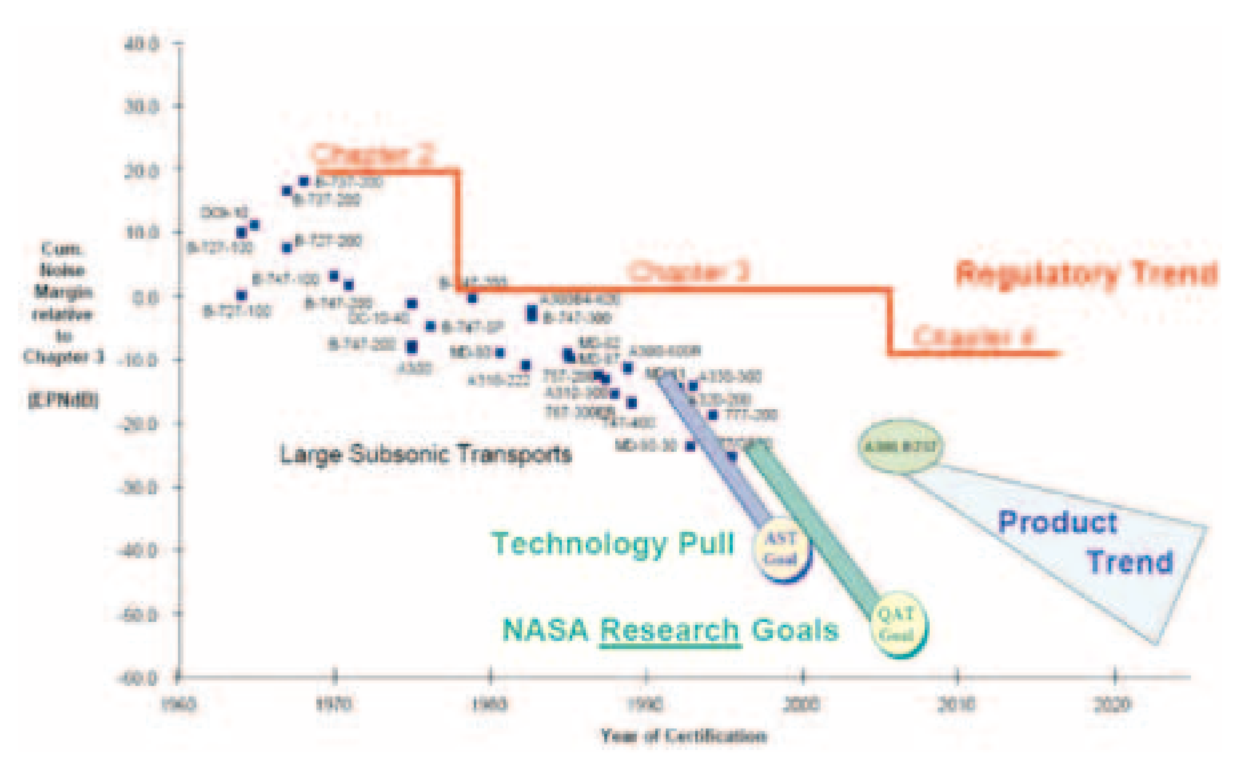
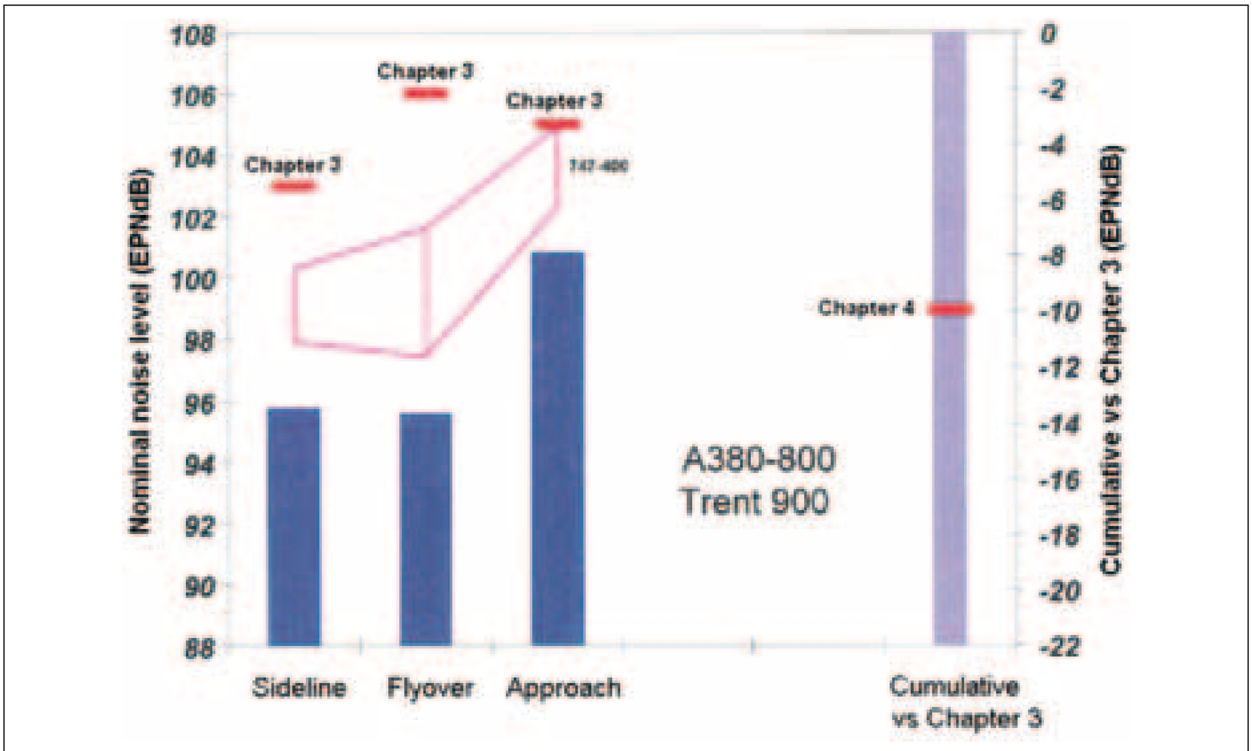



**Figure 5.10e:** *A380 Noise Levels Compared to Chapter 3 Noise Limits and B747-400 Noise Levels.*




[7] *Noise regulations for civil aircraft are described in ICAO Annex 16 Volume I Chapter 2-4. Chapter 2 aircraft are phased-out in Australia because they are too noisy, Chapter 3 aircraft are all current aircraft and Chapter 4 aircraft are aircraft which will be certified as from 1 January 2006. It is interesting to know that most aircraft flying at Brisbane Airport are already in compliance with Chapter 4 requirements.*

*Figure 5.10f:* *Noise Footprint of B787 Compared to B767 and B777 (Courtesy of Boeing).*

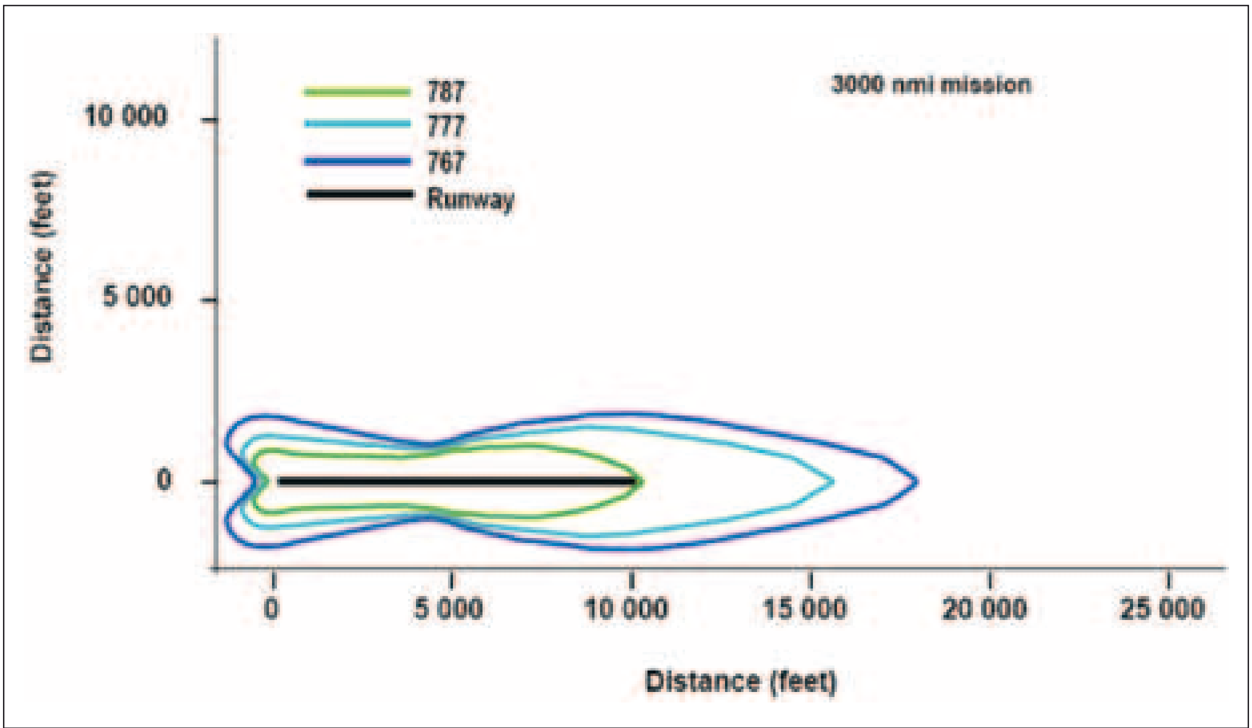
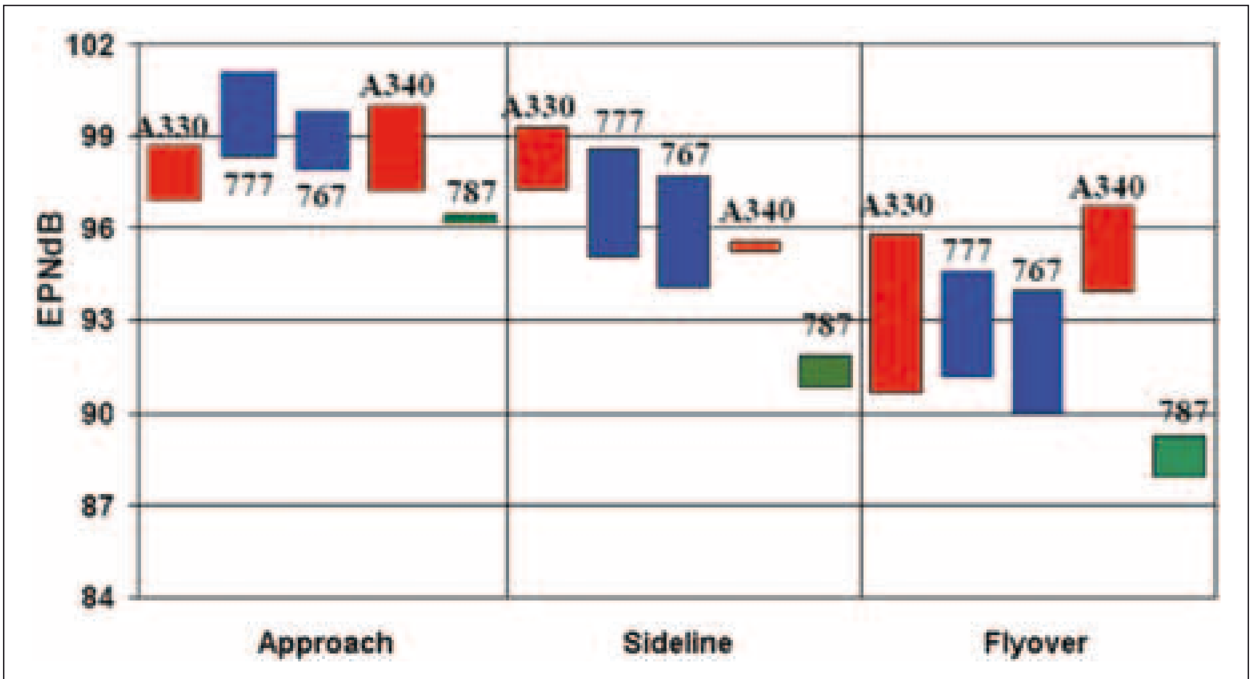



*Figure 5.10g:* *B787 Noise Levels Compared to Noise Levels of its Competitors (Courtesy of Boeing).*



As can be seen in **Table 5.10b**, Qantas' current fleet consists for the most part of Chapter 4 aircraft. Qantas also plans to replace its B767s by B787s and has ordered sixty-five B787s with an option of fifty more. It is anticipated Qantas will begin to take delivery of B787s in mid to late 2008. Besides this, Qantas also ordered twelve A380 with an option of 10 more. The first A380 aircraft are also expected to be delivered in 2008.

Also the low-cost airline, Jetstar, will commence operations with an interim fleet of four A330-200 aircraft and transition as quickly as possible to a fleet of 10 new B787 aircraft, with delivery of Jetstar's first B787 scheduled for August 2008.

Regional airlines, such as Qantaslink, operate turboprop aircraft. A new aircraft type in this category is the Bombardier Q400 which offers community noise levels well below FAR 36 and ICAO Annex 16 Chapter 3 requirements.

**Table 5.10b:** Qantas' Aircraft Fleet[8] in May 2006.

| Aircraft Type | Service Entry | Noise Chapter | Approach Noise Level (dB) | Departure Noise Level (dB) |
|---|---|---|---|---|
| A330-200 | 2002 | Chapter 4 | 98.6 | 89 |
| A330-300 | 2003 | Chapter 4 | 98.6 | 92.1 |
| B737-400 | 1990 | Chapter 4 | 98.6 | 85.9 |
| B737-800 | 2002 | Chapter 4 | 96.3 | 86.4 |
| B747-300[9] | 1984 | Chapter 3 | 104.9 | 104.1 |
| B747SP[9] | 1981 | Chapter 3 | 105 | 103 |
| B747-400 | 1989 | Chapter 4 | 103.8 | 99.1 |
| B747-400ER | 2002 | Chapter 4 | 103.8 | 97.8 |
| B767-300 | 1988 | Chapter 4 | 98.4 | 89.2 |

[8] *Information obtained from Qantas Environmental Aircraft Operations department.*
[9] *These aircraft are not flying at Brisbane Airport.*

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