

## **Question on notice no. 183**

### **Portfolio question number: 183**

#### **2019-20 Additional estimates**

#### **Rural and Regional Affairs and Transport Committee, Infrastructure, Transport, Regional Development and Communications Portfolio**

**Senator Mehreen Faruqi:** asked the Department of Infrastructure, Transport, Regional Development, Communications and the Arts on 2 March 2020—

With reference to answers given at last Senate Estimates Hearing (please see transcript below) : Why has the Department not published the Record of Meeting or meeting minutes for the FOWSA meeting in December 2019? Will the record of this meeting be made public? If not, why not? If yes, when? The Department of Infrastructure's response to the Report, which is entitled, "Assessment of measured aircraft noise levels under the existing flight paths of Sydney Kingsford Smith Airport with reference to Western Sydney Airport," was going to be presented to the FOWSA meeting on 6th of December 2019. Is the Department of Infrastructure's response to the report going to be made public? If so, when will it be? If not, why not? Does the Department of Infrastructure intend to issue a copy of their response to Dr Ancich and Mr Carter? If not, please provide reasons. Can the Department provide assurance that the copy of DoI's response will be the same as the one DoI provided to the 6th Dec FOWSA meeting or will it be an edited version, as alluded to by Mr. Yeaman's comments during Senate Estimates in October 2019? If the response will be edited, please explain why the Department feels there is a need to take anything out of their response and prevent the public from viewing the full DoI response? In the October Estimates Hearing Mr Yeaman stated; "Our expectation is that planes, at this stage, will be travelling at a higher altitude sooner after leaving the (WSA) airport than they would be at Kingsford Smith". Can DoI provide the committee with a detailed explanation to justify that comment? Why do you expect that the aircraft climb rate out of WSA will be different to KSA? The same kinds of aircraft will fly in and out of Western Sydney Airport that currently fly in and out of Sydney Airport. Why would they travel at a higher altitude, and make less noise, as the representative's statement implies, sooner after leaving Western Sydney Airport than Sydney Airport? Why wouldn't the aircraft noise levels and altitude of aircraft be the same for Western Sydney Airport as they are for Sydney Airport? We understand the Dec 6th FOWSA meeting discussed DoI's response to the Ancich/Carter WSA Noise Report. Why were Dr Ancich and Mr Carter refused the courtesy to attend the Dec 6th FOWSA meeting and put points forward on their own report? Since May 2017, only two of the 10 meetings held by FOWSA have been open to the public. Is this correct? If yes, why are FOWSA meetings not open to the public? Is there a plan to open up more of the future meetings to the public? Why hasn't FOWSA published the minutes for the meeting, which it held on the 6th of December 2019 when Dr Ancich and Mr Carter's independent noise study for Western Sydney Airport was considered along with the Department of Infrastructure's response? At the Senate Estimates 21.10.19 - Greens Senator, Mehreen Faruqi, asked the Department of Infrastructure (DoI) , a number of questions about an official response to the independent noise report for Western

Sydney Airport. Hansard of Senator Faruqi's questions about the independent noise study, and DoI's responses are below: "Senator FARUQI: My last question is about airport noise. I assume that you are aware of the report titled Assessment of measured aircraft noise levels under the existing flight paths of Sydney Kingsford Smith Airport with reference to Western Sydney Airport? The authors are Dr Ancich and Mr Carter. Mr Yeaman: Yes, we are. Senator FARUQI: As far as I understand it, that report disputes the findings of the EIS for Western Sydney Airport with respect to aircraft noise. I think their work indicates that aircraft noise levels will be three to four times higher across Western Sydney than the EIS predicts. I'm just wondering if you formally responded to that report? Ms Leeming: Yes, I have written to Dr Ancich and we have met with Dr Ancich and Mr Carter. We have also provided a copy of their report and our response-our assessment of that report-to FOWSA. FOWSA will discuss it at their next meeting in December. We are in touch with those two gentlemen. They also came to the open meeting. Our engagement with them has been constant. Senator FARUQI: Is there going to be a public copy of that response? Ms Leeming: It's a very technical report. We could consider some sort of response, but I wouldn't do that until after FOWSA, which is the appropriate forum, has had a look at it, and if they've got any particular concerns we'd need to respond to those. Senator FARUQI: Could you give the committee a copy of that response? Ms Leeming: Perhaps after the FOWSA meeting in December. Mr Yeaman: Yes, probably. I would want to double-check exactly what the content is and whether there is anything in there that would need to be taken out. In theory, yes, we're happy to do that. We have engaged very closely with them. If there's things in our modelling that are not up to scratch, we want to understand that. Our initial assessment of their work suggests that it doesn't invalidate the findings of the original EIS. There are differences in the way they've approached their work and how we approached ours, but there are some comparisons. For example, as a general rule for planes leaving Kingsford Smith essentially they said, 'If a plane is this far out, what's the measured noise from the aircraft for the community?' Our expectation is that planes, at this stage, will be travelling at a higher altitude sooner after leaving the airport than they would be at Kingsford Smith. Senator FARUQI: Are there different assumptions? Mr Yeaman: Different assumptions and different practical considerations on the ground between what we expect to occur and what they have measured. We're engaging very constructively with them on it and we take it seriously, but at this stage our view is that it doesn't invalidate the views of the EIS. We'll take that through FOWSA and discuss it in more detail."

**Answer —**

Answer attached

**Rural & Regional Affairs and Transport Legislation Committee**  
**ANSWERS TO QUESTIONS ON NOTICE**  
Additional Estimates 2019 - 2020  
**Infrastructure, Transport, Regional Development and Communications**

**Committee Question Number:** 183  
**Departmental Question Number:** SQ20-000181

**Program:** n/a  
**Division/Agency:** Western Sydney Unit  
**Topic:** Western Sydney Airport  
**Proof Hansard Page:** Written (25 March 2020)

**Senator Mehreen Faruqi asked:**

1. With reference to answers given at last Senate Estimates Hearing (please see transcript below): Why has the Department not published the Record of Meeting or meeting minutes for the FOWSA meeting in December 2019?
  - a. Will the record of this meeting be made public?
    - i. If not, why not?
    - ii. If yes, when?
2. The Department of Infrastructure's response to the Report, which is entitled, "Assessment of measured aircraft noise levels under the existing flight paths of Sydney Kingsford Smith Airport with reference to Western Sydney Airport," was going to be presented to the FOWSA meeting on 6<sup>th</sup> of December 2019.

Is the Department of Infrastructure's response to the report going to be made public?

  - a. If so, when will it be?
  - b. If not, why not?
3. Does the Department of Infrastructure intend to issue a copy of their response to Dr Ancich and Mr Carter? If not, please provide reasons.
4. Can the Department provide assurance that the copy of DoI's response will be the same as the one DoI provided to the 6th Dec FOWSA meeting or will it be an edited version, as alluded to by Mr. Yeaman's comments during Senate Estimates in October 2019?
  - a. If the response will be edited, please explain why the Department feels there is a need to take anything out of their response and prevent the public from viewing the full DoI response?
5. In the October Estimates Hearing Mr Yeaman stated; "Our expectation is that planes, at this stage, will be travelling at a higher altitude sooner after leaving the (WSA) airport than they would be at Kingsford Smith". Can DoI provide the committee with a detailed explanation to justify that comment?
  - a. Why do you expect that the aircraft climb rate out of WSA will be different to KSA?
  - b. The same kinds of aircraft will fly in and out of Western Sydney Airport that currently fly in and out of Sydney Airport. Why would they travel at a higher altitude, and make less noise, as the representative's statement implies, sooner after leaving Western Sydney Airport than Sydney Airport?
  - c. Why wouldn't the aircraft noise levels and altitude of aircraft be the same for Western Sydney Airport as they are for Sydney Airport?
6. We understand the Dec 6th FOWSA meeting discussed DoI's response to the Ancich/Carter WSA Noise Report. Why were Dr Ancich and Mr Carter refused the courtesy to attend the Dec 6th FOWSA meeting and put points forward on their own report?
7. Since May 2017, only two of the 10 meetings held by FOWSA have been open to the public. Is this correct?

**Rural & Regional Affairs and Transport Legislation Committee**  
**ANSWERS TO QUESTIONS ON NOTICE**  
Additional Estimates 2019 - 2020  
**Infrastructure, Transport, Regional Development and Communications**

- a. If yes, why are FOWSA meetings not open to the public?
  - b. Is there a plan to open up more of the future meetings to the public?
8. Why hasn't FOWSA published the minutes for the meeting, which it held on the 6<sup>th</sup> of December 2019 when Dr Ancich and Mr Carter's independent noise study for Western Sydney Airport was considered along with the Department of Infrastructure's response?

At the Senate Estimates 21.10.19 – Greens Senator, Mehreen Faruqi, asked the Department of Infrastructure (DoI), a number of questions about an official response to the independent noise report for Western Sydney Airport.

Hansard of Senator Faruqi's questions about the independent noise study, and DoI's responses are below:

**“Senator FARUQI:** My last question is about airport noise. I assume that you are aware of the report titled Assessment of measured aircraft noise levels under the existing flight paths of Sydney Kingsford Smith Airport with reference to Western Sydney Airport? The authors are Dr Ancich and Mr Carter.

**Mr Yeaman:** Yes, we are.

**Senator FARUQI:** As far as I understand it, that report disputes the findings of the EIS for Western Sydney Airport with respect to aircraft noise. I think their work indicates that aircraft noise levels will be three to four times higher across Western Sydney than the EIS predicts. I'm just wondering if you formally responded to that report?

**Ms Leeming:** Yes, I have written to Dr Ancich and we have met with Dr Ancich and Mr Carter. We have also provided a copy of their report and our response—our assessment of that report—to FOWSA. FOWSA will discuss it at their next meeting in December. We are in touch with those two gentlemen. They also came to the open meeting. Our engagement with them has been constant.

**Senator FARUQI:** Is there going to be a public copy of that response?

**Ms Leeming:** It's a very technical report. We could consider some sort of response, but I wouldn't do that until after FOWSA, which is the appropriate forum, has had a look at it, and if they've got any particular concerns we'd need to respond to those.

**Senator FARUQI:** Could you give the committee a copy of that response?

**Ms Leeming:** Perhaps after the FOWSA meeting in December.

**Mr Yeaman:** Yes, probably. I would want to double-check exactly what the content is and whether there is anything in there that would need to be taken out. In theory, yes, we're happy to do that. We have engaged

very closely with them. If there's things in our modelling that are not up to scratch, we want to understand that. Our initial assessment of their work suggests that it doesn't invalidate the findings of the original EIS.

There are differences in the way they've approached their work and how we approached ours, but there are some comparisons. For example, as a general rule for planes leaving Kingsford Smith essentially they said,

'If a plane is this far out, what's the measured noise from the aircraft for the community?' Our expectation is that planes, at this stage, will be travelling at a higher altitude sooner after leaving the airport than they would be at Kingsford Smith.

**Senator FARUQI:** Are there different assumptions?

**Mr Yeaman:** Different assumptions and different practical considerations on the ground between what we expect to occur and what they have measured. We're engaging very constructively with them on it and we take it seriously, but at this stage our view is that it doesn't invalidate the views of the EIS. We'll take that through FOWSA and discuss it in more detail.”

**Answer:**

1. The record of the December 2019 meeting of the Forum on Western Sydney Airport can be found at [www.westernsydneyairport.gov.au/community-partners/forum](http://www.westernsydneyairport.gov.au/community-partners/forum).

**Rural & Regional Affairs and Transport Legislation Committee**  
**ANSWERS TO QUESTIONS ON NOTICE**  
Additional Estimates 2019 - 2020  
**Infrastructure, Transport, Regional Development and Communications**

2. A copy of the Department's technical response to "*Assessment of measured aircraft noise levels under the existing flight paths of Sydney Kingsford Smith Airport with reference to Western Sydney Airport*" (the Report) is at **Attachment A**, as requested by the Committee.
3. The Department's response was provided to the Report's authors, Dr Ancich and Mr Carter, on 2 August 2019.
4. Yes. It is the same as that provided at the 6 December 2019 FOWSA meeting.
5.
  - a. Departure flight rules at Western Sydney International (WSI) Airport will be designed to manage community noise issues at that particular airport, and will adopt advanced satellite-based navigation technologies to avoid residential areas and noise-sensitive facilities to the maximum extent possible (in accordance with the airspace design principles in the Airport Plan 2016). These technologies and procedures are not all able to be employed at Sydney (Kingsford Smith) Airport (KSA).
  - b. In addition to the point above, airspace and flight path designs at WSI will seek to maximise the application of continuous descent approaches (in accordance with the Airport Plan), noting that these are proven to reduce aircraft noise emissions when compared to other approach methodologies. Continuous descent approaches are not employed at KSA.
  - c. Existing arrivals into KSA are typically at a stable height, or in the process of commencing their final descent, as they enter the KSA terminal management area. The process of maintaining stable height, and of transitioning to final descent, involves additional noise owing to the required thrust and flap settings, and therefore noise levels tend to be higher than may otherwise be the case. This is in contrast to the continuous descent approach procedures that were applied and modelled for all arrivals into WSI (refer EIS Volume 4, Appendix E, 2.9) and that are a requirement (where possible) under the Airport Plan specifically in order to reduce aircraft arrival noise.
6. Dr Ancich and Mr Carter attended the FOWSA drop-in community information session and open FOWSA meeting on 7 September 2019 and discussed their report with the FOWSA Chair.
7. Yes. As per the FOWSA Terms of Reference, meetings are not generally open to the public. The practice has been to hold one open meeting every year.
8. See answer to question 1.

**Attachments**

- A: Copy of the Department's technical response to the report authored by Dr Ancich and Mr Carter.



# Review of the report ‘Assessment of Measured Aircraft Noise Levels under the Existing Flight Paths of Sydney Kingsford Smith Airport with Reference to Western Sydney Airport’, Report No. 9173 – R1, Eric, J. Ancich

---

August 2019

## Purpose

To provide a summary of the matters raised by the report *Assessment of Measured Aircraft Noise Levels under the Existing Flight Paths of Sydney Kingsford Smith Airport with Reference to Western Sydney Airport*, Report No. 9173 – R1, Eric, J. Ancich (the Report), in the context of aircraft noise measurement and reporting in the *Western Sydney Airport Environmental Impact Assessment 2016* (the WSA EIS) and present the outcomes of a technical review of these claims.

## Background

In early May 2019 the department received correspondence (from Mr Don Carter) stating that “... there was a lack of correlation between the noise predictions in the EIS for Western Sydney Airport and the noise monitoring I (he) had carried out on real aircraft using a professional noise meter”. Further, Mr Carter stated that he “and Dr Eric Ancich ..., both retired Engineers, have carried out a noise study of real aircraft arriving and departing from Kingsford Smith Airport as compared the noise levels predicted in the WSA EIS.... The results are alarming and have major implications for residents that will be impacted by noise generated by WSA airport.”

On request to Dr Ancich, the Department of Infrastructure, Transport, Cities and Regional Development (the Department) was provided with a copy of the Report. The conclusion of the Report is that “*measurement of noise generated by aircraft in flight has demonstrated that variability in height of aircraft will result in a wide range of receiver noise levels. This variability in height and the commensurate variability in noise levels will increase the noise impact over Blacktown and the Lower Blue Mountains compared to that predicted in the WSA EIS. The study raises questions as to the reliability of noise level predictions in the WSA EIS for aircraft noise impacts on other areas affected by the WSA as it appears that the variability in height of arriving and departing aircraft was not considered in the WSA EIS.*”

Further to the above, the Report also notes that variability in aircraft height results in the noise levels recorded being a perceived loudness increase of up to 3 to 4 times louder than those predicted in the WSA EIS for particular locations (refer the Report, Table 1 and Table 2).

**Note:** a doubling of perceived loudness is generally accepted to be experienced for every 10 dBA increase.

Following an internal review by the Department in June 2019, the Report was referred to Wilkinson Murray Acoustical Consultants, (who undertook the aircraft noise assessment and modelling for the 2015 WSA EIS). Wilkinson Murray Acoustical Consultants were asked to review the Report and provide advice to the Department.

## Present consideration

In July 2019, the Department received advice from Wilkinson Murray Acoustical Consultants on the data and analysis presented in the Report. The advice noted four significant issues relating to the methodology employed in data collection, processing, and reporting:

### 1. Instrumentation settings (Chapter 3.0)

**Issue:** Noise measurement instrumentation was set to “Fast” time constant. Australian Standard 2021:2015 (and other standard references) indicate that maximum noise levels should be measured using “Slow” time constant.

**Outcome:** The “Fast” time constant setting tends to increase the measured noise results. Dependent upon the aircraft movement type, this could have the effect of increasing the predicted aircraft noise level by 3-5dB.

### 2. Application of ‘maximum noise levels’ for individual aircraft (Chapter 4.0)

**Issue:** Many of the reported maximum noise levels are the highest level measured. Standard procedures for reporting maximum aircraft noise levels apply the mean (average) of the maximum noise levels for overflights (Australian Standard AS2021:2015: Section 1.5.2 of this standard defines “aircraft noise level” as: *‘The arithmetic average of the maximum sound levels occurring during a series of flyovers by a specific aircraft type and load conditions ...’*)

**Outcome:** Use of the maximum highest level, rather than the mean level, may result in the reported level being a significant overestimate, by up to 5-10dB, depending on the range of measured levels.

### 3. Nominated Noise Logger sites (Chapter 4.0)

**Issue:** The selected noise logger sites for aircraft arrivals into Sydney Airport may not be capturing data that is representative of the flight procedures into Western Sydney Airport at similar distances from the runway threshold. Existing arrivals into Sydney Airport are typically at a stable height, or in the process of commencing their final descent. The process of maintaining stable height, and of transitioning to final descent, involves additional noise due to required thrust and flap settings. Noise levels at this distance from the airport therefore tend to be higher than may otherwise be the case. This is in contrast to the “continuous descent approach” procedures that were applied and modelled for all arrivals in the WSA EIS (refer EIS Volume 4, Appendix E, 2.9) and that are a requirement (where possible) under the provisions of Airport Plan ‘Future airspace design principle’ No. 5 for future use at Western Sydney Airport, specifically in order to reduce aircraft arrival noise.

## Conclusion

- The noise measurements presented in the Report do not invalidate the noise exposure levels reported in the context of the indicative flight paths presented in the WSA EIS – which are reliable and correct for forecast aircraft operations at Western Sydney Airport under the assumptions that applied at the time of preparation of that assessment.

**Note:** current work on airspace and flight path design for WSA will change the predicted noise levels presented in the WSA EIS, and this is the subject of ongoing work (*refer Environmental Assessment 2021 information on the Department's website*).

- It is noted that the future environmental assessment of potential aircraft noise at Western Sydney Airport will benefit from:
  - Clear understanding of existing ambient noise conditions under potential future flight paths (potential for noise data loggers in advance of airport operations).
  - Detailed attention to the modelling of forecast aircraft altitude (having regard to the potential variance in altitude above and below nominated tracks – in order to take account of potential height variation following implementation).
  - Noise modelling that clearly specifies flight procedure assumptions (including altitude and flight mode).



**Outcome:** noise levels measured for Sydney Airport (as reported in the Report) may be over-estimates of those at the future Western Sydney Airport.

#### **4. Noise measurement using unattended noise loggers.**

**Issue:** The Report has indicated that noise loggers were left unattended in position for a number of days. At the significant distances from the airport, where measurements were carried out, the influence of extraneous noise may be significant. This effect would be exacerbated when the 'Fast' time constant is used (as opposed to the 'Slow' time constant). Simply aligning a recorded maximum noise level in time with an aircraft overflight does not guarantee that the recorded noise was due to the aircraft.

**Outcome:** It is possible that some of the recorded noise levels attributed to aircraft overflight were in fact caused by sources other than aircraft.

In addition to the above, Wilkinson Murray Acoustical Consultants also responded to two detailed claims in the Report:

#### **1. EIS Predicted Noise Contours**

Wilkinson Murray Acoustical Consultants have undertaken a systematic review of the Report claims regarding predicted noise levels presented in the WSA EIS. It has been found that the claims made are not supported once data is adjusted to account for the factors outlined in 1-4 above. Wilkinson Murray Acoustical Consultants maintain that the WSA EIS predicted noise contours are valid (including for all nominated aircraft types: arrivals and departures). It has also been noted that the Report references WSA 'EIS prediction' data that is at the lower end of predicted noise levels (i.e. Table 2 "Noise level 747D" reads 60 dBA but EIS indicates 60-65 dBA: reference WSA EIS Volume 4 Fig. 3.3). **Note:** details of the aircraft noise model specification (INM) and methodology applied in the preparation of the WSA EIS acoustic studies are at [Attachment A](#) below.

#### **2. Aircraft Heights**

The Report claims that the height of aircraft results in variability in noise levels, and that the variability in height of arriving and departing aircraft was not considered in the WSA EIS. This was not the case (*refer WSA EIS Volume 4, Appendix E, Ch. 2*). Wilkinson Murray Acoustical Consultants refute these claims, noting that aircraft noise levels for both arrivals and departures depend upon power and flap settings, and the procedure being flown. Further, details of flight levels for indicative flight path arrivals and departures below 10,000ft were presented in the WSA EIS (*refer WSA EIS Volume 2a Stage 1 Development, 26-4, 26-6, 26-7, 2015*). **Note:** details of the aircraft noise model specification (INM) and methodology applied in the preparation of the WSA EIS acoustic studies are at [Attachment A](#) below.

**Note:** the aircraft heights reported in the Report (relating to the operation of existing Sydney Airport flight paths) have been compared with Airservices Australia data for the nominated locations and dates, and are accepted by Wilkinson Murray Acoustical Consultants as generally correct – noting that aircraft on these routes may not be flying continuous descent approaches, or departure flight rules similar to those that may be proposed at WSA to manage community noise issues.

## Extracts from the Western Sydney Airport EIS 2016

WESTERN SYDNEY AIRPORT EIS

PAGE 19

AIRCRAFT OVERFLIGHT &amp; OPERATIONAL NOISE

REPORT NO. 14168 VERSION E

### **2.3 Aircraft Noise Calculation Procedures**

Detailed calculation of future aircraft overflight noise levels at any airport requires estimates of the number of future aircraft operations, broken down by:

- aircraft type (as defined in the INM noise calculation program);
- flight track (including several flight tracks for arrivals and departures on each runway);
- stage length for departures (representing distance to destination); and
- time of day at which the operation occurs.

The number and mix of operations on each flight track will be different for each scenario considered. Given the above information, values of all the above noise descriptors can be calculated, either at specific points or in terms of contours, using noise levels calculated using the industry-standard INM calculation program (version 7d).

The INM is a computer model that evaluates aircraft noise impacts in the vicinity of airports. It was developed based on the algorithm and framework from the SAE AIR 1845 standard, which used noise-power-distance (NPD) data to estimate noise accounting for specific operation mode, thrust setting, and source-receiver geometry, acoustic directivity, and other environmental factors. The INM can output either noise contours for an area or noise level at pre-selected locations. The noise output can be exposure-based, maximum-level-based, or time-based.

The INM focusses mainly on aircraft overflight noise, but also includes departure noise and landing and reverse thrust noise when the aircraft is on the runway.

It is noted that the US Federal Aviation Administration, which developed the INM, has recently superseded the INM with the Aviation Environmental Design Tool (AEDT). At the time of writing of this report, AEDT had not been evaluated for Australian conditions. On this basis the INM was selected for the aircraft noise predictions in the current assessment. It is noted that the calculation and prediction algorithms relating to aircraft noise are understood to be equivalent in both calculation programs.

## **2.9 Calculation of Aircraft Noise Levels**

The INM aircraft noise prediction program, produced by the U.S. Federal Aviation Administration, was used to predict noise levels from each of the 22 aircraft types on each of the 346 flight tracks (245 tracks for the initial development and 101 tracks for the long term development). INM Version 7d was used, as this was the latest available version at the time of performing the calculations.

Parameters used in the calculations are:

- temperature: 20 °C (reasonable and conservative value for most operations at the site);
- atmospheric pressure: 1017.2 hPa (standard, and typical);
- average headwind: 0 kts. This conservative setting was determined based on low average headwinds at the site, meaning that on most occasions, the actual headwind would be determined by the airport's mode priority; and
- topography: 10 m contours covering the area of interest – at least 25 NM to the north, east, south and west of the airport centre.

Predicted noise levels are not very sensitive to any of the above parameters – for example, reducing the temperature to 10 °C, increasing atmospheric pressure to 1030 hPa or increasing the average headwind to 5 kts all result in a change of less than 1 dB in the calculated noise level from typical operations.

The INM model does not allow for calculation of the effect of atmospheric conditions such as wind and temperature inversions on sound propagation. These factors are known to have a strong influence on noise generated at ground level. However, for sources that are significantly elevated, such as an aircraft in flight, their influence on sound propagation is much lower, and has not been as thoroughly studied. In many cases, the major impact of adverse wind and temperature gradient conditions on noise from ground level sources comes through the removal of intervening barriers. This can result in very significant enhancement of noise at the receiver location. However, this effect is obviously not relevant for noise from a source such as an aircraft in flight.

As described in Section 2.3, INM's "standard" height-vs-distance profiles were used for all departures, while a "continuous descent approach" was used for all arrivals. Departures by most aircraft types are defined for several "stage lengths", representing different distances to the destination, and hence different assumed fuel loads. Noise levels on departure were initially calculated for all possible stage lengths for each aircraft type.

For each aircraft type, each track and (for departures) each possible stage length, custom-designed software was used to control INM's operation, calculating noise levels at each point on a grid of size 185 m x 185 m, covering the area of interest. The unit that was calculated is  $L_{Amax}$  – the maximum noise level during the overflight in dBA, which is used in calculating N70 and similar units. The results from this calculation form the "library of noise levels" referred to in Figure 2-2.

For N70 and similar units, this library is then interrogated to determine the number of events at each grid point exceeding the relevant  $L_{Amax}$  threshold, and the results used to produce contours using standard procedures.

Unlike N70 and similar units, both ANEC and units derived from  $L_{Aeq}$  can be calculated directly in INM. These descriptors were calculated in this way, based on the average number of events per day during the relevant time periods, calculated as described above.

## **2.10 Sensitive Receivers & Noise Exposure Calculation**

Noise-sensitive receivers in the area around the proposed airport include residences, schools and other educational facilities, and hospitals and other health care facilities. In this report, the potential impact of the proposal on these receivers is assessed in terms of a number of descriptors of noise exposure, as set out in Section 2.1. One indicator of impact is the number of receivers experiencing a given level of noise exposure, measured by the various descriptors.

Existing and forecast population estimates were developed by GHD, based on the September 2014 release of the NSW Bureau of Transport Statistics population forecasts. These forecasts take into account metropolitan planning development forecasts for future land use in Sydney as well as NSW Department of Planning and Environment population forecasts. The limit of these forecasts is currently 2041; therefore, in order to project to 2063 and beyond, Series B population growth rates estimates used by the Australian Bureau of Statistics in their long-term population forecasts were applied.

The forecast of existing and future populations potentially exposed to different levels of noise from the proposed airport utilised GIS databases and was developed by GHD. The databases were developed based on the above population forecasts and address point data provided by NSW Land and Property Information.

The address point dataset provided a set of co-ordinates for each registered address point within the area covered by the data and was therefore used to represent the spatial distribution of population. The address point data was then divided into subareas based on statistical local area (SLA) boundaries developed for the Census. By matching the population estimates and address points to a common SLA, a population per SLA and average population per address point was calculated.

The noise contours generated by this study were then overlaid with the address point population for each forecast year enabling a count of future population potentially affected by each airport operational scenario.