Chapter 20 Human health

This chapter describes the assessment that has been undertaken to evaluate the potential community health impacts from the project. This assessment has focused on community health impacts resulting from changes in air quality, noise and other hazards and risks associated with the operation of aircraft from WSI. Based on the assessment undertaken, with consideration of the population located in the community surrounding WSI, the following is concluded in relation to potential impacts on community health:

Changes in air quality

The assessment undertaken has not identified any risk issues of concern in relation to impacts on community health in the local study area. More specifically the assessment has identified the following:

- impacts on community health as a result of exposure to fine particulates (as $PM_{2.5}$) are low
- impacts on community health as a result of exposure to nitrogen dioxide (NO_2) are considered to be low. While there may be the potential for elevated exposures to occur close to WSI, further review of these impacts indicates that the potential impact on respiratory health is considered to be low. It is noted that the areas where elevated exposures are identified are expected to be rezoned such that residential use is no longer relevant
- impacts on community health as a result of exposure to carbon monoxide (CO) are low, and essentially negligible
- impacts on community health as a result of exposure to sulfur dioxide (SO_2) are low, and essentially negligible
- impacts on community health as a result of exposure to individual volatile organic compounds (VOC) derived from aircraft emissions are low, and essentially negligible
- emissions to air derived from the operation of aircraft would have a negligible impact on water quality in Prospect Reservoir or rainwater tanks in the community. Potential impacts on these water supplies would be so low they would not be measured.

In addition to the above, no risk issues of concern in relation to community health has been identified in relation to changes in regional air quality.

Changes in noise

This assessment has addressed potential impacts on community health associated with aircraft noise derived from the operation of the project. The assessment has identified that there is the potential for noise from the project to result in potentially significant increases in sleep disturbance, noise annoyance (and therefore complaints) and, to a lesser extent, cognitive impairment for children (as learning delays). These impacts have been identified at a number of receivers located close to the runway as well as beneath the approaches and take off routes away from the runway. However, not all the locations identified as being potentially significant are used for residences, schools or childcare centres and have been used as an indicator of where issues may arise.

Most of the impacts on community health that are considered to be potentially significant are located within the existing or predicted Australian Noise Exposure Concept (ANEC) 20 contours. Existing land use planning controls are in place to prevent future noise sensitive development from occurring with the ANEC 20 contours, including new residential development, childcare centres and schools. The Department of Infrastructure, Transport Regional Development, Communications and the Arts (DITRDCA) and WSA Co will continue to liaise with State and local government agencies to ensure applicable environmental planning instruments have regard to ANEC forecasts produced for the project, where differences occur with the predicted ANEC as presented in this EIS.

By 2055 there would be some additional locations, outside of the modelled ANEC 20 contours where impacts on community health may be of significance. Changes in noise as a result of operations between 2033 and 2055 would be expected to be gradual, and hence the significance of the impacts identified may be influenced by community adjustment to the presence of aircraft noise in the environment. These changes, however, may remain of significance to some members of the community.

For existing residential properties located in the existing ANEC 20 contours, there is the potential for the community in these areas to experience increased and significant levels of annoyance and sleep disturbance.

Changes in hazard and risks

A range of hazards and risks have been identified that relate to the operation of aircraft in the airspace above and around WSI and within the Sydney Basin. A range of mitigation measures have been identified to manage these hazards and risks, consistent with the way such risks are managed for all aircraft and airports. Where these are implemented, risks to community safety and health would be considered low and acceptable.

Refinements to the project

The key health impact related to night-time noise is sleep disturbance. The introduction of the RRO noise abatement procedure (RRO-NAP) and the reallocation of jet aircraft from Runway 23 Departure Northeast Night (RRO) to the Runway 23 Departure Southeast Night (RRO) flight path would result in a change in noise impacts at night. This change in night-time noise impacts would result in some sensitive receivers no longer exceeding thresholds for L_{max} or L_{night}, or very small changes in the percentage of the population that is highly sleep disturbed. Overall, the changes are small and do not result in changes to the conclusions presented in the Draft EIS in terms of sleep disturbance. For the other refinements to the preliminary flight paths, these generally do not occur over populated areas and/or further increase the distance to or altitude above populated areas. Further detail is provided in Section G2.12 of Appendix G (Assessment of the refinements to the project) of the EIS.

20.1 Introduction

This chapter considers the potential human health impacts of the project at a local and regional scale. It considers the noise and air emissions resulting from the project as well as other hazards and risks associated with the project that could impact the health and wellbeing of the community. The full human health impact assessment is provided in Technical paper 12: Human health (Technical paper 12).

The health impact assessment considers the baseline human health profile of the region and identifies key health risks from the operation of the proposed airspace and flight paths. The implementation of mitigation measures associated with noise and air quality described in the relevant chapters of this EIS would reduce the predicted risks.

20.2 Legislative and policy context

The human health impact assessment was carried out in accordance with national and international guidance that is endorsed or accepted by Australian health and environmental authorities.

Guidance used for the assessment of human health impacts include the following:

- *National Environmental Protection (Air Toxics) Measure, Impact Statement for the National Environment Protection (Air Toxics) Measure, 2003* (National Environment Protection Council (NEPC), 2003)
- *National Environmental Protection (Ambient Air Quality) Measure 2021* (NEPC, 2021)
- *Schedule B8 Guideline on Community Engagement and Risk Communication, National Environment Protection (Assessment of Site Contamination) Measure, 1999* (NEPC, 2013)
- *Health Impact Assessment Guidelines* (Environmental Health Committee, 2017)

- *State Environmental Planning Policy (SEPP) (Resilience and Hazards) 2021* (NSW Government, 2021)
- *Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards, 2012* (Environmental Health Committee, 2012)
- *Health Impact Assessment: A Practical Guide, Centre for Health Equity Training, Research and Evaluation* (CHETRE) (Harris et al. 2007).

In addition, there are a range of more specific guidance relevant to the assessment of health impacts from changes in air quality and noise, in particular, that are available from Australian and key international organisations or reviews. These include the following:

- NEPC reviews on the health effects of air pollution (*Exposure Assessment and Risk Characterisation for the Development of a PM2.5 Standard* (Burgers and Walsh, 2002))
- World Health Organization (WHO) reviews on the health effects of air pollution (*Outdoor Air Pollution: Assessing the environmental burden of disease at national and local levels* (Ostro, 2004))
- USEPA reviews on the health effects of NO_2 and particulates
- guidance on the assessment of environmental noise, including *Environmental Noise Guidelines for the European Region* (WHO, 2018).

20.3 Methodology

20.3.1 Impact assessment approach

The methodology for the human health impact assessment is aimed at assessing impacts and risks to human health from the operation of the project. The human health assessment has focused on health-related impacts associated with key air quality, noise, and hazard and risk aspects. The human health impact assessment for the project has been undertaken as a desktop assessment.

Broadly, the methodology and legislative requirements to assess health impacts/risks follow a standard risk assessment and management-type approach, shown in Figure 20.1.

Figure 20.1 Approach to assessing human health impacts and benefits

This assessment of impacts on human health has been undertaken in accordance with the guidelines outlined in Section 20.2 and consideration of the impacts identified in other relevant technical studies.

20.3.1.1 Health impact assessment approach

Broadly, the impact assessment of health impacts consisted of:

- the identification of risk issues of concern
- assessment of the potential significance of community exposures (or the benefits of the project) on health outcomes
- identification of measures to manage impacts or enhance benefits and review risks and benefits with the implementation of these measures.

The assessment considered a wide range of factors with the potential to affect human health, both direct and indirect factors that affect community health and wellbeing.

To inform the assessment of potential health impacts, relevant information on the community or population in areas surrounding the project was reviewed. Information reviewed regarding the existing environment included:

- community profile(s), which comprises information on the population that may be impacted by the project, specifically the demographics, lifestyle factors and baseline health, and the social environment that have the potential to determine the vulnerability of various aspects of the community to impacts form the project
- existing conditions of key environments in which the community reside that affect and are of importance for the human health impact assessment, including existing air quality and noise.

Figure 20.2 provides an overview of the key aspects that are considered in the assessment of impacts on community health.

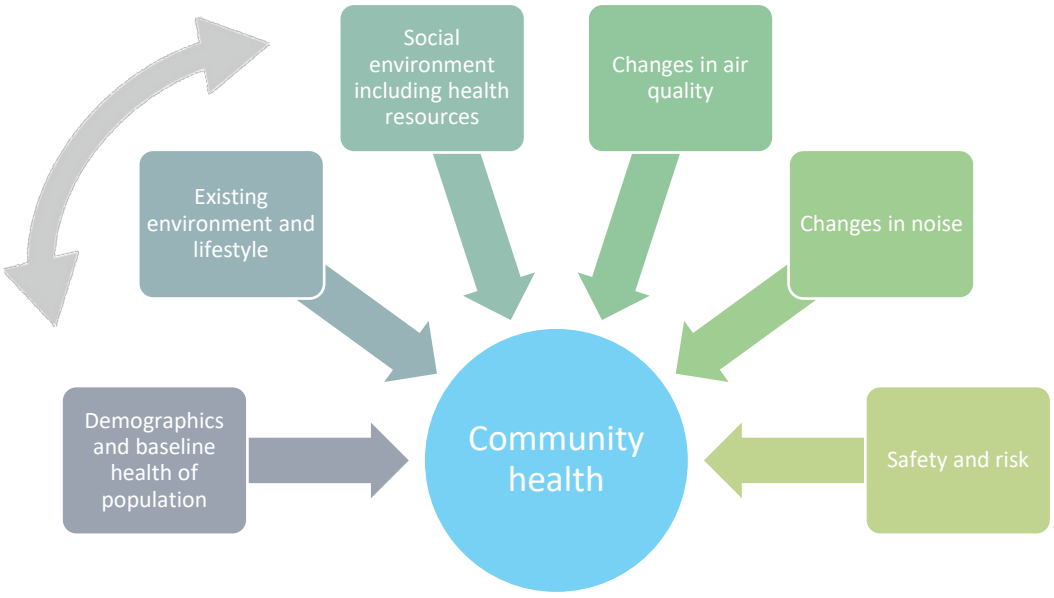

Figure 20.2 Key aspects relevant to the conduct of the health impact assessment

20.3.1.2 Characterising health impacts

The assessment of health impacts involved a combination of quantitative and qualitative approaches.

Where a quantitative assessment was undertaken, the following terminology has been used:

- **No health impacts of concern or negligible.** This means that all exposure levels or concentrations quantified are below guidelines that are protective of all adverse health effects in the community or are so low that they are effectively considered to be indistinguishable from zero
- **Low.** Exposure levels or concentrations quantified are equal to guidelines that are protective of all adverse health effects in the community or at a level that may result in some amenity impacts but no health impacts (e.g., visible dust deposition).

Where exposure levels or concentrations are not described as above, they are considered to be elevated and potentially unacceptable.

Where a qualitative assessment is undertaken, the following terminology has been used:

- **No health impacts of concern or negligible.** Impacts evaluated or considered would not result in a health effect that would be different to the variability typically experienced within normal urban or suburban environments.
- **Low.** Impacts evaluated or considered may be noticeable or result in a short-term increase in stress and anxiety, however the level of impact can be managed through normal daily coping mechanisms just as are common when there is a change in our normal environment, e.g., new building works occurs nearby or a common travel route change.

Where impacts have the potential to result in the development of or exacerbation of disease or result in levels of stress and anxiety that cannot be managed through normal daily coping mechanisms, they are considered to be elevated and potentially unacceptable.

20.3.2 Dependencies and interactions with other technical papers

This report has been informed by the technical reports identified in Table 20.1. The health impact assessment has drawn on information provided in these reports and, in some areas, provides a summary of key (and relevant) aspects.

Table 20.1 Dependencies and interactions with other technical papers

Technical paper	Relevance
Technical paper 1: Aircraft noise	The assessment methodology for health impacts related to aircraft noise involved: • review of Technical paper 1 including identification of sensitive receivers within potentially impacted communities surrounding the project, and modelled noise impacts relevant to the project • assessment of potential human health impacts from noise during operation of the project. Additional assessment of project refinements was also completed based on a review of Addendum Technical paper 1: Aircraft noise.
Technical paper 2: Air quality	The assessment methodology for health impacts related to air quality involved: • review of Technical paper 2 including identification of sensitive receivers within potentially impacted communities surrounding the project, and modelled air quality impacts relevant to the project • assessment of potential human health impacts from key pollutants during operation of the project.
Technical paper 3: Greenhouse gas emissions	The assessment methodology for health impacts related to air quality involved: • review of Technical paper 3 including review of the assumptions and methodology and the establishment of the greenhouse gas (GHG) emissions assessment boundary for aircraft operating along WSI's flight paths • assessment of potential human health impacts from key pollutants during operation of the project.
Technical paper 4: Hazard and risk	The assessment methodology for health impacts related to hazards and risks involved: • review of Technical paper 4 and assessment of potential human health impacts from identified hazards and risks associated with operation of the project.

Technical paper	Relevance
Technical paper 10: Social	The assessment methodology for health impacts related to social aspects involved: • review of all available information relevant to the assessment including: – Technical paper 10 – data from the Australian Bureau of Statistics (ABS) – information relevant to local government areas (LGAs) and health districts (in particular Sydney Local Health District and Northern Sydney Local Health District) • identification of sensitive receivers within potentially impacted communities surrounding the project, and assessment of the current health metrics for those communities • assessment of potential human health impacts associated with visual amenity, and stress and anxiety issues during operation of the project, including short-term and long-term impacts.

20.4 Existing environment

This section outlines the existing environment as it relates to human health including:

- potentially impacted receivers within the communities surrounding the project
- the current health status of these communities.

The existing environment for air quality, noise, hazard and risks, and social aspects are detailed in the following chapters:

- Chapter 11 (Aircraft noise)
- Chapter 12 (Air quality and greenhouse gas)
- Chapter 13 (Aircraft hazard and risk)
- Chapter 18 (Social).

20.4.1 Population profile and health status of the community

The health of the community is influenced by a complex range of interacting factors including age, socio-economic status, social networks, behaviours, beliefs and lifestyle, life experiences, country of origin, genetic predisposition and access to health and social care. Information in relation to health-related behaviours (that are linked to poorer health status and chronic disease including cardiovascular and respiratory diseases, cancer, and other conditions that account for much of the burden of morbidity and mortality in later life) is available for the larger populations within the local area health services in Sydney and NSW.

It is important to understand the demographics of the population in the study area to determine if the population has the potential to be more or less vulnerable to environmental stressors relevant to the project. The relevant statistics relate to the age distribution of the population, housing, unemployment rate, level of socioeconomic disadvantage, availability of economic resources and cultural and linguistic diversity of the population.

In terms of the key statistics presented for the human health study area the following is:

- There are some populations that have a higher proportion of young children or older individuals, that also include a higher proportion of social housing and/or are under rental or mortgage stress. These areas include Blacktown, Camden, Liverpool and Penrith LGAs; and Austral, Badgerys Creek, Bringelly, Cecil Park, Glenmore Park, Horsley Park, Kemps Creek, Orchard Hills, Rossmore, Silverdale and Warragamba suburbs and localities. These populations can typically be more vulnerable to environmental stressors than other populations. Conversely, there are also some populations in the study areas that may be less vulnerable, where there is a smaller proportion of the population that comprises young children or older individuals and there are lower levels of rental and/or mortgage stress. These areas include Mount Vernon and Luddenham.

- Factors such as socio-economic disadvantage, the availability of economic resources and availability of education and employment are important factors in relation to community health and wellbeing. The available data indicates that:
  - Fairfield LGA is considered more disadvantaged in terms of socio-economic disadvantage or availability of economic resources and availability of education and occupation resources, and also has a higher rate of unemployment. The populations in Blue Mountains, Camden and Hawkesbury LGAs and the suburbs and localities of Cobbitty, Luddenham, Mulgoa, Mount Vernon and Silverdale are considered the least disadvantaged
  - much of the population in the study area are in locations with lower rates of unemployment, with only populations in Blacktown LGA and Greendale reporting higher rates of unemployment (noting that unemployment is a key determinant in evaluating community health and wellbeing and is linked with socio economic disadvantage and the availability of resources).
- With respect to population health:
  - changes in air quality and noise within an environment can result in impacts on community health. For the key air pollutants considered (derived from aircraft emissions) and noise sources (aircraft), there are numerous other sources in urban areas that include these emissions
  - the rate of mortality in the study area is generally similar to that of NSW. Higher rates of mortality from cardiovascular disease has been reported in South Western Sydney Local Health District and higher rates of mortality including respiratory and cardiovascular causes presented in the Nepean Blue Mountains Local Health District
  - the rate of hospitalisations in the study area is generally similar to that of NSW for respiratory and cardiovascular disease, however the rate of respiratory hospitalisations is higher in the South Western Sydney and Nepean Blue Mountains Local Health Districts.

Further information regarding statistics relevant to the study area are summarised in Section 4.1 to Section 4.5 of Technical paper 12.

20.4.2 Potentially impacted communities

The study area applicable to the assessment of health impacts and consideration of potentially impacted communities has been established to align with the study areas identified and evaluated in relation to changes in air quality, noise, hazard and risk, and social impacts. More specifically the study area considered in the assessment of health impacts is consistent with the social impact assessment, which has divided the study area into a local area and regional area, with the State of NSW and the Greater Sydney area adopted as points of comparison.

The potentially impacted communities considered in the assessment have been divided into 2 areas consisting of a local study area and a regional study area. The local study area showcases the communities most likely to be most affected by impacts of the project, including changes to noise, air quality and visual impacts. The regional study area showcases the communities that would possibly be affected by visual and noise impacts of the project. The human health impact assessment study area is an amalgamation of these study areas.

A local study area was defined to include ABS suburb and localities within 10 km from the centre of the runway, and a regional study area was defined to include LGAs in which residential areas were predicted to be intersected by N60 and N70 noise contours (as identified in Chapter 11 (Aircraft noise) and Technical paper 1). Overall, the total study area included areas contained within a total of 8 LGAs including Liverpool, Camden, Blacktown, Penrith, Blue Mountains, Hawkesbury, Fairfield and Wollondilly. The extents of the local and regional study areas are shown in Figure 4.1 and 4.2 respectively within Technical paper 12.

20.4.2.1 Sensitive receivers

Within the study area, the air quality and aircraft noise impact assessments have identified and evaluated impacts at specific residential and community receiver locations where sensitive members of the community are more likely to be present. In terms of evaluating health impacts sensitive groups include infants and young children, the elderly and individuals who are unwell or with health conditions. Hence residential homes, childcare centres, schools, hospitals and aged care facilities are considered to be sensitive receiver locations. Other sensitive receiver locations may include recreational areas and religious premises. Details of the sensitive or community receivers included in the assessment are consistent with those identified for the air quality assessment as previously identified in Chapter 12 (Air quality and greenhouse gas) and Technical paper 2.

20.5 Assessment of impacts

Impacts on human health as a result of the operation of the preliminary flight paths have been assessed in relation to the following:

- health impacts resulting from changes in air quality
- health impacts resulting from changes in noise
- health impacts resulting from changes to existing hazards and risks.

20.5.1 Health related air quality impacts

Emissions to air from the operation of aircraft have been summarised in Chapter 12 (Air quality and greenhouse gas). The assessment to the community focused on key pollutants relevant to aircraft emissions, as follows:

- particulates, as fine particulates PM_{10} and $PM_{2.5}$
- oxides of nitrogen, with NO_2 of key importance for the assessment of health
- CO
- SO_2
- VOCs, with the key individual VOCs identified as benzene, toluene, xylenes and formaldehyde.

This assessment has assessed potential community exposures to these key pollutants with a summary of each presented below. Further details of the potential health impacts resulting from changes in air quality associated with the project, and the metrics used to determine the potential impacts, is provided in Section 5.5 of Technical paper 12.

20.5.1.1 Potential for exposure

The key air pollutants identified and assessed in relation to the operation of aircraft within the air space are either vapours/gases or fine particulates that would be expected to behave as a gas, as is the case for $PM_{2.5}$. For PM_{10}, which includes some slightly larger, but still very fine, particulates, most of these particulates would stay suspended in air. The potential for these particles to deposit to the ground is very small. Therefore, the key pathway of exposure relevant to the community exposed to aircraft emissions would be through inhalation.

20.5.1.2 Particulates

Dust or particulate matter (PM) is a widespread air pollutant (that has and will always be present in air) with a mixture of physical and chemical characteristics that vary by location (and source). The assessment assessed potential impacts on community health on the basis of an assessment of cumulative exposures (i.e. project plus background) and incremental exposures (i.e. from the project alone) from increases in PM.

The size of particulates is important as it determines how far from an emission source the particulates may be present in air (with larger particulates settling out close to the source and smaller particles remaining airborne for greater distances) and also the potential for adverse effects to occur as a result of exposure (how far the particles can infiltrate into the respiratory system). Only particulates that are small enough can penetrate into the lungs where there is the potential for effects to occur. If the particles are too large, they will be captured high up in the respiratory tract, trapped and flushed out and eventually swallowed. Typically, $PM_{2.5}$ and smaller are the particle size that may reach the lower parts of the respiratory tract (the smaller bronchioles and alveoli). This is the area of the lungs where gaseous exchange takes place and the area that may be impacted by fine particles.

In relation to exposure to PM, effects are primarily related to the respiratory and cardiovascular system and include:

- aggravation of existing respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits)
- changes in cardiovascular risk factors such as blood pressure
- changes in lung function and increased respiratory symptoms (including asthma)
- changes to lung tissues and structure
- altered respiratory defence mechanisms.

Assessment of cumulative exposure impacts

The assessment of cumulative exposures to $PM_{2.5}$ is based on a comparison of the cumulative concentrations predicted with the current air quality standards and goals presented in the NEPC(Ambient Air Quality) Measure (NEPM) (NEPC, 2021), and have been adopted in NSW (NSW EPA, 2022). These standards and goals are total concentrations in ambient air, within the community, that are based on the most current science in relation to health effects.

A review of cumulative exposure to $PM_{2.5}$ indicates that the maximum predicted 24-hour average air concentration, including the project would remain below the NEPC air standard. In relation to the annual average air concentrations, impacts predicted in 2033 would not result in exceedance of the NEPC air standard, however the cumulative concentration predicted in 2055 may exceed the NEPC air standard in some locations. This would occur at the most impacted residential receiver (at a location near the northern boundary of the Airport Site) and the assessment has assumed background air quality, which dominates the impacts identified, remains unchanged in 2055. The impact of emissions from aircraft is very low, comprising around 4 percent of the NEPM air standard.

Assessment of incremental exposures (changes in air quality)

The assessment of incremental impacts associated with exposure to $PM_{2.5}$ has evaluated the maximum increase in annual average $PM_{2.5}$ predicted from community receivers evaluated each of the suburbs and localities in the local study area. Assessment of incremental impacts considered the attributable cases relevant to increased exposure to $PM_{2.5}$ from aircraft emissions to the following primary and secondary indicators:

- primary indicators:
  - mortality – all causes, long-term
  - hospitalisations – cardiovascular, short-term
  - hospitalisations – respiratory, short-term
- secondary indicators:
  - mortality – all causes, short-term
  - mortality – cardiovascular, short-term
  - mortality – respiratory, short-term
  - morbidity – asthma Emergency Department (ED) admissions, short-term.

The predicted number of attributable cases, relevant to all indicators is considered to be very low, well below one case per year. Assuming the maximum impacts always occurred each year, and the population was at that same location all day every day for a lifetime, the number of cases may be up to around 2 attributable cases over a 100-year period, within the whole population evaluated. For Luddenham, the most impacted suburb, the calculations presented indicate the number of cases may be up to around one attributable case over a 100-year period. Such a low level of impact would be negligible in relation to the health statistics relevant to the study area.

On the basis of the calculations presented in terms of cumulative and incremental impacts of exposure to $PM_{2.5}$, there are no health risk issues of concern in relation to $PM_{2.5}$ derived from the operation of aircraft associated with the project.

20.5.1.3 Oxides of nitrogen

Nitrogen oxides (NOx) refer to a collection of highly reactive gases containing nitrogen and oxygen, most of which are colourless and odourless. Nitrogen oxide (NOx) gases form when fuel is burnt including when residual waste is used as fuel. Motor vehicles, along with industrial, commercial and residential (e.g., gas heating or cooking) combustion sources, are primary producers of NOx. This assessment considered the potential impacts of exposure to NO_2 from aircraft emissions on community health on the basis of an assessment of cumulative exposures (i.e. project plus background) and incremental exposures (i.e. from the project alone).

In terms of health effects, NO_2 is considered to be the only oxide of nitrogen that may be of concern (WHO, 2000). Nitrogen dioxide (NO_2) can cause inflammation of the respiratory system and increase susceptibility to respiratory infection. Exposure to elevated levels of NO_2 has also been associated with increased mortality, particularly related to respiratory disease, and with increased hospital admissions for asthma and heart disease patients.

Assessment of cumulative impacts

Review of the NO_2 impacts predicted from the project (and summarised in Chapter 12 (Air quality and greenhouse gas)) indicates that, in relation to the assessment of short-term exposures, the maximum 1-hour average concentrations predicted in 2055 are anticipated to exceed the NEPC standard (predicting a cumulative maximum 1-hour average (residential) range of around 201 to 254 $\mu g/m^3$ compared to the NEPC standard of 164 $\mu g/m^3$). In relation to the assessment, the review indicates the following:

- the predicted levels of NO_2 are likely to be conservative (i.e., potentially overstated), due to:
  - the modelling has used a conservative approach for assessing chemical transformations to predict NO_2 levels
  - the modelling assumes the worst-case scenario occurs for every hour of the year
  - the modelling does not take into account future improvements in emissions due to better fuel or engine emission controls
- as a result, the predicted impacts detailed above are unlikely to actually occur
- the impacts identified relate to a few hours of the year and only at a few locations close to the WSI, specifically a residential receiver at a location near the northern boundary of the Airport Site in Luddenham
- the next highest impact is at a second receiver in Luddenham where the maximum 24-hour average concentration of NO_2 is below the NEPC standard.

The residential receiver in Luddenham is located north-west of the Airport Site. This is in an area that has been rezoned by the State Government as per the planning initiatives for Aerotropolis. Specifically, the area of this receiver is now zoned for agribusiness, which includes restrictions on the intensification of residential development. Where the area assessed associated with this receiver is no longer used for residential purposes, but is redeveloped for business purposes, that does not include childcare uses, the potential for impact on respiratory health is low.

Assessment of incremental impacts

The predicted number of attributable cases, relevant to all scenarios is low, below one case per year. Assuming the maximum impacts always occurred each year, and the population was at that same location all day every day for a lifetime, the number of cases may be up to 40 over a 100-year period. This is considered to be overly conservative particularly within Luddenham, where the calculated health incidence is dominated by the maximum impact identified at the residential receiver in Luddenham. Where the land use of this area is changed, consistent with the rezoning of the land adjacent to the Aerotropolis (excluding childcare uses) the potential health impacts would be significantly lower.

As detailed in Chapter 12 (Air quality and greenhouse gas) and Technical paper 2, the incremental impacts identified at the residential receiver in Luddenham only occur for a few hours each year, under worst-case assumptions. Review of the hourly concentrations predicted indicates only a few hours where an hourly-average concentration between 200 µg/m^3 and 240 µg/m^3 may occur. These concentrations are below a level at which respiratory effects, including asthma, would be expected to occur within the population. Hence the potential for health impacts to occur as a result of these predicted worst-case limited, short duration elevated NO_2 concentrations is considered to be negligible.

20.5.1.4 Carbon monoxide

Carbon monoxide (CO) is produced during combustion when there is a limited supply of oxygen. This includes combustion engines in vehicles. The sorts of effects that can be expected due to exposure to CO are those linked with carboxyhaemoglobin in blood (where CO replaces oxygen in the blood preventing oxygen from being transported around the body). In addition, association between exposure to CO and cardiovascular hospital admissions and mortality, especially in the elderly for cardiac failure, myocardial infarction and ischemic heart disease; and some birth outcomes (such as low birth weights) have been identified (NEPC, 2010).

All concentrations of CO predicted in the local study area are well below the relevant air standards. Hence there are no health risk issues of concern in relation to CO emissions from the operation of aircraft associated with the project.

20.5.1.5 Sulfur dioxide

Sulfur oxides are formed during combustion when chemicals present in fuels (such as coal, gas, petrol etc) containing sulfur react with oxygen to form sulfur oxides. Sulfur dioxide (SO_2) is the main sulfur oxide that can have impacts on people. Exposure to elevated levels can result in irritation of the respiratory system and can make breathing difficult. The most affected by exposure to these chemicals are people with asthma.

All concentrations of SO_2 predicted as a result of the project are well below the relevant air standards. Hence there are no health risk issues of concern in relation to SO_2 emissions from the operation of aircraft associated with the project.

20.5.1.6 Volatile organic compounds

As described in Chapter 12 (Air quality and greenhouse gas) VOCs can comprise a large number of individual chemicals. The key individual VOCs related to aircraft emissions, namely benzene, toluene, xylenes and formaldehyde. Health risk issues of concern in relation to VOCs can include increased risk of cancer (specifically leukaemia), respiratory and neurological symptoms and other carcinogenic-type effects.

Overall, impacts on community health as a result of exposure to individual VOCs derived from aircraft emissions are considered to be low to essentially negligible.

20.5.1.7 Impacts on drinking water quality

In terms of drinking water supplies, Prospect Reservoir is the closest potable water reservoir to the site. The concentration of pollutants in Prospect Reservoir depends on the deposition rate of dust onto the surface of the water and onto the surrounding catchment, the volume of the reservoir and the volume of rainfall each year.

Fine particles as $PM_{2.5}$ (and PM_{10}) and gases would remain in the atmosphere and would not deposit to the ground. However, concern has been raised in relation to aircraft emissions impacting on drinking water supplies and hence for the purpose of this assessment it has been assumed that deposition does occur. Where this occurs, these pollutants may deposit to the ground or to roof areas, where impacts on drinking water quality in drinking water catchments and rainwater tanks may occur. Impacts on drinking water quality, where such water may be used as potable water by the community has also been considered in this assessment. It is noted that advice from NSW Health indicates that rainwater tanks in urban areas, which includes the local and regional study areas, should not be used as potable water supply. The study area is supplied with reticulated water, from Sydney Water, and hence rainwater tanks would not be expected to be used for potable water. Other non-potable uses such as toilet flushing, filling swimming pools, garden watering, washing cars and firefighting may occur.

As detailed above, it has been conservatively assumed that key chemicals such as benzene, toluene, xylenes and formaldehyde that may occur as a result of the aircraft utilising WSI will be absorbed to particulates in the air, and these will be large enough to deposit to the ground. While in fact such chemicals are not expected to deposit at all (as they are formed from vapours and would typically degrade in air), a highly conservative approach has been adopted to predict concentrations that may be present in Prospect Reservoir and in residential rainwater tanks.

Based on the assessment (refer to Section 5.5.7 of Technical paper 12 for details), emissions to air derived from the operation of aircraft would have a negligible impact on water quality in Prospect Reservoir or rainwater tanks in the community. Potential impacts on these water supplies would be so low they would not be measurable.

20.5.2 Health related noise impacts

A detailed assessment of noise impacts associated with the project are presented in Chapter 11 (Aircraft noise). Sound is a natural phenomenon that only becomes noise when it has some undesirable effect on people or animals. Noise and vibration can potentially have both short-term and long-term adverse effects on people. These health effects can include:

- hearing impairment
- sleep disturbance (sleep fragmentation that can affect psychomotor performance, memory consolidation, creativity, risk-taking behaviour and risk of accidents)
- annoyance (which can be a major consideration because it reflects the community's dislike of noise and their concerns about the full range of potential negative effects from a project. It also affects the greatest number of people in the population)
- cognitive impairment in children (effects on reading and oral comprehension, short and long-term memory deficits, attention deficit)
- cardiovascular health
- interference with speech and other daily activities.

Other potential effects which may occur, but for which the evidence is weaker, include:

- effects on mental health (usually in the form of exacerbation of existing issues for vulnerable populations rather than direct effects)
- some evidence of indirect effects such as impacts on the immune system.

This assessment has assessed potential community exposures to these key noise-related impacts with a summary of the key issues presented below. Further details of the potential health impacts resulting from changes in noise associated with the project, and the metrics used to determine the potential impacts, is provided in Section 6.5 of Technical paper 12.

20.5.2.1 Hearing impairment

Where significantly elevated levels of noise are present, there is the potential for such noise levels to result in hearing impairment. Review of the predicted noise levels from aircraft operations against WHO thresholds relevant to hearing impairment indicates the following:

- L_{max}: there are no predicted maximum levels of noise for all scenarios evaluated in 2055 at any of the noise sensitive receivers that exceed the threshold of 110 dB(A)
- L_{day}, $L_{evening}$ or L_{night}: there are no L_{Aeq} levels of noise for all scenarios evaluated in 2033 and 2055 at any of the noise sensitive receivers that exceed the threshold of 70 dB(A).

On the basis of the above, noise derived from aircraft operations would not be expected to result in hearing impairment in any of the areas surrounding the WSI.

20.5.2.2 Sleep disturbance

Sleep serves to facilitate vital functions in our body. It is relatively well-established that night time noise exposure can have an impact on sleep (Environmental Health Committee, 2018; WHO, 2009; WHO, 2011). Noise can cause difficulty in falling asleep, awakening and alterations to the depth of sleep, especially a reduction in the proportion of healthy rapid eye movement sleep. Other primary physiological effects induced by noise during sleep can include changes in glucose metabolism and appetite regulation, impaired memory consolidation and a dysfunction in blood vessels. Long-term sleep disturbance can also lead to cardiovascular health issues (WHO, 2011; WHO, 2018).

Exposure to night-time noise also may induce secondary effects, or so-called after-effects. These are effects that can be measured the day following exposure, while the individual is awake, and include increased fatigue, depression and reduced performance.

Assessment of potential sleep disturbance impacts associated with aircraft noise have been assessed on the basis of calculating the percentage of populations located in specific areas that are highly sleep disturbed. The assessment has identified areas, as suburbs and localities, where sleep disturbance as a result of aircraft noise is considered to be of potential significance. This is where the calculated percentage of the population in the area as a result of aircraft noise is 3 per cent or more higher than the percentage of people highly sleep disturbed from existing environmental noise. Utilising this approach, the assessment identified that the areas of highest potential for increases in sleep disturbance impacts would occur in areas closest to WSI being Luddenham, Greendale, Silverdale, Wallacia and Kemps Creek. The maximum percentage of these populations that are highly sleep disturbed as a result of aircraft noise ranged from between around 19 per cent in Kemps Creek (in 2033) to 40 per cent in Luddenham (by 2055).

20.5.2.3 Annoyance

Annoyance is a feeling of displeasure associated with any agent or condition known or believed by an individual or group to adversely affect them. It is one of the most prevalent responses to noise, and it is described as a stress reaction that encompasses a wide range of negative feelings, including disturbance, dissatisfaction, distress, displeasure, irritation and nuisance. The individual response to noise depends not only on exposure levels but also on contextual, situational and personal factors. It can initiate physiological stress reactions that, if long-term, could trigger the development of cardiovascular disease.

The assessment of annoyance requires some consideration of what may be of concern in terms of health, and complaints. Where noise levels change, community reaction to these changes can vary. For example, reaction to a newly introduced noise source (such as new aircraft noise) may be considerably higher than a source that has been present for a long time. There are no specific guidelines available for determining what would be an acceptable, or unacceptable increase in annoyance from a specific project. Most health-based noise guidelines are set at a level that corresponds with 10 per cent of the residents highly annoyed (NSW, DECCW 2011; WHO, 2018), however, when evaluating noise annoyance in an urban environment, where there are a number of existing sources, the application of a total 10 per cent highly annoyed criteria is not considered appropriate. As such, criteria that may be considered for evaluating noise annoyance identified a change of 5 dB as a level that would be considered an acceptable change in noise levels in a residential home. A change in noise level of 5 dB results in 5 per cent of the population being highly annoyed. On this basis, significant levels of the population considered highly annoyed as a result of the project are identified as the

calculated percentage of people highly annoyed that is 5 percent or higher than existing levels of noise annoyance in the community (from existing/background levels of noise).

Utilising this assessment criteria, the assessment identified that the areas of highest potential for increases in noise generating high annoyance would (similar to sleep disturbance) occur in areas closest to the WSI being Luddenham, Greendale, Silverdale and Wallacia. Increases in the percentage of these population areas ranged from between around 34 per cent in Silverdale and Wallacia (in 2033) to 58 per cent in Luddenham (in 2055).

20.5.2.4 Cognitive impairment

Noise in classrooms can affect children in many ways, including lowering their motivation, reducing speech intelligibility, listening comprehension and concentration, producing annoyance and disturbance, and increasing restlessness. As a result, children exposed to noise at school may experience poorer reading ability, memory and performance. Cognitive impairment could also be linked to noise exposure at home during night-time hours, which can cause low mood, fatigue and impaired task performance the next day. Noise at home may also be linked to hyperactivity and inattention problems, which can cause lower academic performance (EEA, 2020). This assessment has assessed cognitive impairment on the basis of an exposure-response relationship established for long-term delays in reading and oral comprehension in children at the end of primary school as a result of chronic exposure to aircraft noise. The calculated delays in learning have been assumed to apply at the end of childhood learning, and more specifically (and conservatively) at the end of each developmental/learning phase, i.e., at the end of pre-school/childcare, primary school or high school.

The assessment of cognitive impairment/learning delays requires consideration of what may be of concern in terms of health and long-term outcomes (as delays in childhood can have an impact later in life). There are no specific guidelines available for determining what would be an acceptable, or unacceptable level of learning delays in a community from a specific project. The WHO (2018) has identified that a one-month delay (i.e. 30 days) in reading and oral comprehension should be adopted as the level of cognitive impairment for the purpose of establishing guideline levels for noise. Hence for this assessment, where the calculated learning delay is 30 days or more, and this differs from existing/background, the impacts from the project have been considered to be of potential significance.

The calculated learning delays in these areas is variable, with the highest levels (across the whole of the identified suburbs) estimated in Luddenham, Greendale, Silverdale, Wallacia and Kemps Creek. The more significant impacts typically relate to longer term operations (i.e. from 2055) and have been identified as potentially impacting the following representative existing facilities:

- Childcare centres:
  - Mamre After School and Vacation Care, Kemps Creek (between one and 11 days delay in 2055)
  - Little Smarties Childcare Centre, Kemps Creek (between one and 11 days delay in 2055)
  - Schoolies at Mulgoa, Luddenham (between 4 and 5 days delay in 2055).
- Schools:
  - Mamre Anglican School, Kemps Creek (between 2 and 11 days delay in 2055)
  - Luddenham Public School, Luddenham (between 18 and 24 days delay in 2055)
  - Holy Family Catholic Primary and Church, Luddenham (between 4 and 5 days delay in 2055).

Review of the potential impacts identified above indicates that for the schools and childcare centres located in the key suburbs and localities where learning delays may be of potential significance, none of the noise impacts associated with the project at these locations are high enough to be of concern in relation to community health (i.e. learning delays are all less than 30 days).

20.5.2.5 Cardiovascular health

Noise is an important risk factor for chronic diseases. Noise exposure activates stress reactions in the body, leading to increases in blood pressure, a changing heart rate and a release of stress hormones. Cardiovascular diseases are the class of diseases that involve the heart or blood vessels, both arteries and veins. Strokes reflecting cerebrovascular events and ischaemic heart disease or coronary heart disease are the most common representation of cardiovascular disease. High-quality epidemiological evidence on cardiovascular and metabolic effects of environmental noise indicates that exposure to environmental noise, including aircraft noise increases the risk of ischaemic heart disease.

Overall, the predicted number of attributable cases associated with the project is considered to be generally low. Assuming the predicted noise impacts always occurred each year, and the population was at that same location all day every day for a lifetime, the number of cases attributable to the project may be up to 270 over a 100-year period. Interpretation of this value should also consider the incidence of ischaemic heart disease in the same population, based on existing/background noise levels. For the same suburbs and localities evaluated, this is calculated to be 2.5 per year, which is up to 250 cases over a 100-year period. It should be noted that the calculated impacts from aircraft operations are not additive to the background, however the impacts on the incidence of ischaemic heart disease are similar. Therefore, it can be considered that the impact of the operation of the project on the incidence of ischaemic heart disease from project-related noise is considered to be low and/or similar to existing/background rates of ischaemic heart disease in the community.

20.5.2.6 Consideration of existing land use controls on health related noise impacts

The assessment has identified the potential for significant impacts on community health as a result of exposure to noise from the project, specifically in relation to sleep disturbance, noise annoyance and potentially cognitive impairment (as learning delays in children). These impacts are highest close to the ends of the runways, with other impacts identified in areas beneath departure and approach flight paths close to WSI. The assessment presented provides indicative locations where there is the potential for these impacts to be considered to be of significance, due to a range of uncertainties associated with the identification of potential health impacts. The potential for significant impacts is consistent with the conclusions of Technical paper 1, where significant and unavoidable levels of noise exposure have been identified.

Review of these impacts have been considered in the context of land use planning protections that are already in place. The indicative ANEC for WSI provided in the Airport Plan and NSW State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (Western Parkland City SEPP) was generated based on the runway direction, dual runway operations and indicative flight paths as presented in the 2016 EIS.

In the lead up to WSI becoming operational, a formalised Australian Noise Exposure Forecast (ANEF) (as a more refined ANEC) would be generated for WSI based on the final approved single-runway flight path design and longer-term dual runway operations. The ANEC 20 contour defined in the Airport Plan and Western Parkland City SEPP, and updates based on the assessment of noise impacts for this project, is used for the purpose of managing land use in the vicinity of WSI, in areas where noise impacts may be of significance.

This includes the following:

- existing residential land uses can continue, however developments such as dual occupancies, secondary dwellings and subdivision of land for sensitive uses not already approved would not be permitted
- no new noise sensitive development can be developed (including residential, schools and childcare centres) if a development site is found to be 'conditionally acceptable' this means that any proposed buildings would be required to be designed to result in a reduced noise level indoors in accordance with *AS2021:2015 Acoustics – Aircraft noise intrusion – building siting and construction* (AS 2021: 2015) (Standards Australia, 2015).

With consideration of the above, the following provides further discussion in relation to the predicted impacts of noise on community health presented in sections 20.5.2.2 to 20.5.2.4. Further details are provided in Section 6.5.7 of Technical paper 12.

Sleep disturbance

With respect to sleep disturbance:

- the most significant health impact identified, where there is the highest number of receivers potentially impacted, is sleep disturbance
- the potential for sleep disturbance impacts would depend on the sensitivity of individuals in the community
- the majority of the locations identified where sleep disturbance is of potential significance in 2055 sit within the existing Western Parkland City SEPP ANEC 20 contour and 2055 ANEC 20 contour. However, not all the locations identified as being potentially significant are used for residences, schools or childcare centres and have been used as an indicator of where issues may arise. These are all areas where existing planning controls limit future developments including residential developments. The exceptions are as follows:
  - 2 areas located to the north-west, one of which is located outside of all the ANEC contours, and the other located outside of the 2033 and 2055 ANEC 20 composite contours
  - a group of receivers located in Wallacia to the north-west of the runway, and further distant from all the ANEC contours.

These additional locations were not identified as potentially significant, in terms of sleep disturbance, for the 2033 period. It is expected that by 2055 the presence of aircraft noise in the local study area would have been present for a significant period of time, where some members of community may have adjusted to the presence of aircraft noise at night. In addition, changes in night time noise levels between 2033 and 2055 would be gradual and hence it is expected that the community would adjust to these changes over time.

Annoyance

With respect to annoyance:

- receivers where annoyance, as percentage of the population considered highly annoyed, has been identified as of potential significance are a subset of those identified for sleep disturbance
- increased levels of noise annoyance is expected to result in increased levels of noise complaints from the community
- the majority of the locations identified, where the percentage of high annoyance is of potential significance in 2055 sit within the existing Western Parkland City SEPP ANEC 20 contour and 2055 ANEC 20 contour. However, not all the locations identified as being potentially significant are used for residences, schools or childcare centres and have been used as an indicator of where issues may arise. These are all areas where existing planning controls limit future developments including sensitive developments, noting that DITRDCA and WSA Co will continue to liaise with State and local government agencies to ensure applicable environmental planning instruments have regard to ANEC forecasts produced for the project. The exception is one location in Wallacia to the north-west just outside of the ANEC contours. This location is not identified as potentially significantly impacted, in the 2033 period.

It is expected that by 2055 the presence of aircraft noise in the local study area would have been present for a significant period of time, where some members of the community may have adjusted to the presence of aircraft noise in the environment. In addition, the change in noise levels between 2033 and 2055 would be expected to be gradual where adjustment to changes in noise levels would be expected to occur.

Changes in percentage of the population considered highly annoyed between 2033 and 2055 may not be considered significant given the uncertainty in relation to assessing changes in background/ambient noise and predicting impacts on sleep disturbance. However, the assessment undertaken suggest that by 2055 some additional residential areas adjacent close to the existing ANEC contours may experience aircraft noise at levels that are considered highly annoying.

For existing residential homes in the area of the ANEC 20 contours, there is the potential for a higher proportion of the population to be considered highly annoyed by noise.

Changes in the levels of highly annoyed members of the community are expected to result in a higher level of noise complaints, particularly at the start of the project where aircraft noise was a new source of noise in the environment.

Cognitive impairment (children)

With respect to sleep disturbance:

- sensitive receivers where cognitive impairment (in children) has been identified as of potential significance are a further smaller subset of both sleep disturbance and annoyance
- while there are no impacts that are considered to be significant at existing childcare centres and schools in the community, it is important to evaluate whether the existing ANEC 20 contours that define planning controls surrounding WSI are sufficient
- it is also important to note that both Luddenham Public School (Primary) and Mamre Anglican Schools are either located within the Western Parkland City SEPP ANEC 20 contour or the predicted 2055 ANEC 20 contour. In terms of cognitive impairment, the impacts predicted at these schools is not considered to be of significance and these schools would be expected to continue to operate due to 'existing use rights' under the *Environmental Planning and Assessment Act 1979* (NSW). However future developments at these schools would require approval of the relevant consent authority and consideration of the indoor sound requirements relevant to these areas
- the majority of the locations identified where cognitive impairment is of potential significance in 2055 sit within the existing Western Parkland City SEPP ANEC 20 contour and 2055 ANEC 20 contour. However, not all the locations identified as being potentially significant are used for residences, schools or childcare centres and have been used as an indicator of where issues may arise. These are all areas where existing planning controls limit future developments including sensitive developments, such as future childcare and schools, noting that DITRDCA and WSA Co will continue to liaise with State and local government agencies to ensure applicable environmental planning instruments have regard to ANEC forecasts produced for the project. The exception is one location in Wallacia to the north-west just outside of the ANEC contours. This location is not identified as potentially significantly impacted, in relation to cognitive impairment, in 2033.

Based on the above the existing planning controls, existing and proposed ANEC 20 contours would prevent the development of new childcare centres and schools in areas where impacts on children's learning would be of significance – the exception to this being a location just outside of the 2055 ANEC 20 contour where the development of any new childcare centre or school should be considered in more detail at the time using measured noise levels from the operation of the project. As identified above, DITRDCA and WSA Co will continue to liaise with State and local government agencies to ensure applicable environmental planning instruments have regard to ANEC forecasts produced for the project.

20.5.3 Health related hazard and risk impacts

Chapter 13 (Aircraft hazard and risk) provides a summary of the potential hazards and risks related to the operation of the airspace. This section provides an overview of the outcomes of the hazard and risk assessment, with specific reference to impacts on community health.

The assessment considered any potential hazards that have the potential to result in injury or death, damage to health infrastructure and contamination of the environment such that the community may be exposed to elevated levels of contamination. The assessment evaluated individual risks as well as societal or community risks.

Based on the detailed assessment presented in Technical paper 4 (Hazard and risk), a summary of the potential hazards identified and assessed relevant to community health and safety is provided in Table 20.2.

Table 20.2 Summary of community impacts – hazard and risk

Hazard evaluated	Potential consequence – community health	Outcomes in terms of community health
Airspace conflicts	Airspace conflicts relates to the safety of the whole airspace and the potential for mid-air collisions.	The broader Sydney Basin airspace has been redesigned to meet operational needs and provide an acceptable level of safety for the community.
Off-airport crash risks		
Off-airport crash risks, which may impact:	Whilst aircraft crashes are rare events, the majority occur during take-off and landing operations such that crash risks are more concentrated along flight paths close to runway ends. Accordingly, people and critical infrastructure located in the vicinity of airports can be expected to be exposed to an elevated risk.	
• People	Aircraft crashes can cause significant injury and fatalities within the community.	A limited number of people reside close to the runway ends. The overall risks (as individual and societal) are considered negligible for most of the study area, however close to the runway ends the risk increases to slight, but are considered as low as reasonably practicable.
• Critical infrastructure, (e.g. hospitals and water reservoirs supplying drinking water)	Incidents that impacts on critical health facilities (such as hospitals) and drinking water reservoirs are of particular relevance.	Overall, taking further account of the low event frequencies, the risk associated with these scenarios can be considered to be low and acceptable when assessed against the available societal risk criteria.
Other hazards		
Aircraft fuel jettisoning	Where fuel jettisoning occurs over a populated area, there is the potential for fuel exposures and contamination to occur. Such events are rare and when conducted in accordance with procedures (that recommend controlled jettison of fuel at altitude) do not impact the community. Relevant procedures include the Aeronautical Information Publication Australia, Part 2 – En Route (AIP ENR). (Airservices Australia, 2022a).	Potential risks to land from such incidents, principally related to take-off and climbing were evaluated, in conjunction with historical incident data and the likelihood that fuel would reach or impact the ground during such events. The risk assessment did not identify any significant impacts to land from such incidents. Hence risks to community health are considered low and acceptable.

Hazard evaluated	Potential consequence – community health	Outcomes in terms of community health
Objects falling from aircraft	This relates to objects falling from airborne aircraft and causing injury or fatalities to individuals on the ground.	The historical incident record shows that occurrences involving objects falling from aircraft are uncommon and typically involve small objects with limited hazard potential. Taking account of the relative size of the objects concerned and frequency of these occurrences compared with aircraft crashes, it may readily be concluded that the risks to people and sites on the ground are very small compared with the risks associated with aircraft crashes. Given that the risks associated with aircraft crashes have been shown to be low and acceptable, it may be concluded that the lesser risks associated with objects falling from aircraft can similarly be considered to be low and acceptable.
Aircraft wake vortex strikes	This relates to vortices from the wingtips that, during landing when aircraft are close to the ground, shortly before touchdown, can reach the ground and have sufficient power to cause damage to buildings (roof structures/tiles in particular).	There are a limited number of buildings in areas where wake vortex damage may be a possibility and given the type of roof construction and the low probability of impacts. Risk of damage is considered to be low, and with the potential for injury to people being much lower, risks to community safety are expected to be negligible.
Local meteorological hazards	This relates to events such as windshear, lightning strike, unforeseen weather and icing that have the potential to result in accidents, with injury and fatalities occurring.	While there is the potential for turbulence, windshear and thunderstorm activity to occur, the historical evidence indicates the threat to aircraft safety is limited. Measures to avoid adverse weather conditions are applied in the aviation industry to limit safety risks. An Automated Thunderstorm Alert Service is proposed to be implemented to improve the accuracy of thunderstorm forecasting for WSI. No significant weather related risks were identified for WSI operations where appropriate mitigation measures were implemented. Where this occurs risks to the community would be low and acceptable.
Wildlife hazards	This particularly relates to bird strike that may result in aircraft damage and incidents, potentially resulting in injury or fatality.	Risks posed by wildlife has been assessed in detail in the Chapter 16 (Biodiversity). Where wildlife strike risk mitigation for WSI is implemented, an acceptable level of safety can be achieved. Where risks are managed, the potential impact on community safety is considered low and acceptable.

Further details of the potential health impacts resulting from changes in hazards and risks associated with the project is provided in Chapter 7 of Technical paper 12.

20.5.4 Refinements to the project

The introduction of the RRO noise abatement procedure (RRO-NAP) and the reallocation of jet aircraft from Runway 23 Departure Northeast Night (RRO) to the Runway 23 Departure Southeast Night (RRO) flight path would result in a change in noise impacts at night. The assessment of potential changes to sleep disturbance impacts was completed based on the predicted noise levels at modelled sensitive receivers as presented in the Addendum Technical paper 1: Noise. The health assessment considered the maximum noise level during the night-time period (L_{max}), L_{night} and change in the percentage of the population that is highly sleep disturbed (%HSD) for the Prefer Runway 05 and Prefer Runway 23 scenarios in 2055. These scenarios include the use of the RRO mode of operation and the RRO-NAP.

This assessment found that the change would:

- not result in any additional sensitive receivers exceeding the 40 dB(A) threshold for L_{night} or the 52 dB(A) threshold for L_{max}. Five (5) sensitive receivers would no longer exceed these thresholds
- the %HSD would essentially remain unchanged from the assessment presented in the Draft EIS and the extent where %HSD is of potential significance would not change. A very small increase in the average %HSD is noted for Greendale and Silverdale, and a very small decrease in the average %HSD is noted for Mulgoa and Wallacia. These changes are small and are not considered to be significant.

For the other refinements to the preliminary flight paths, these generally do not occur over populated areas and/or increase the distance to or altitude above populated areas.

Further detail is provided in Section G2.12 of Appendix G (Assessment of the refinements to the project) of the EIS.

20.6 Mitigation and management

20.6.1 Existing management

Future development in areas where potential noise impacts may be significant will include planning protections to prevent noise sensitive development.

Existing strategic planning in the vicinity of WSI has considered and incorporated the operational needs of WSI into land use planning in accordance with guidance provided in the National Airports Safeguarding Framework (NASF). This has been ongoing for over a decade in conjunction with planning for WSI and is well established in existing planning instruments. The NSW Department of Planning and Environment's *Aviation Safeguarding Guidelines – Western Sydney Aerotropolis and surrounding areas* (NSW DPE, 2022a) were also developed with input from DITRDCA and seek to ensure planning authorities consider WSI operations when undertaking land use planning for the Aerotropolis and surrounding areas of influence. Current planning provisions for land associated with the Aerotropolis has been developed in conjunction with the NASF specifically to support the operation of WSI and limit potential restrictions on surrounding land uses (and therefore risks to third parties or surrounding development). Protections are also included in the existing Airport Plan and Western Parkland City SEPP and revisions are expected to be made based on this project, with a formalised ANEF (as a more refined ANEC) chart generated and implemented. The Airport Plan is expected to be replaced by a Master Plan.

20.6.2 Project specific mitigation measures

There are no project specific mitigations related to human health. Mitigation measures related to aircraft noise are presented in Chapter 11 (Aircraft noise) and mitigations related to aircraft hazards and risk are presented in Chapter 13 (Aircraft hazard and risk).