14 Hazard and risk

This assessment considers the key hazards and risks that may arise from construction and operation of the proposed airport.

The analysis was based on a review of relevant project documentation including a number of studies conducted for the EIS and local and international aircraft safety data, a conceptual airspace risk model and a series of workshops with key project stakeholders.

Many aspects of the airport design are preliminary and a number of important considerations will be resolved during detailed design or closer to the commencement of operations. Certification of the aerodrome by the Civil Aviation Safety Authority will also be required before operations can commence, as well as implementation of the requirements of the existing regulatory framework.

Based on the design information currently available, no insurmountable construction or operational risks associated with the Stage 1 development are considered likely. Key issues that need to be finalised prior to operations include:

- resolution of potential offsite safety risks associated with jet fuel storage;
- work with relevant authorities to identify options for a pipeline corridor to secure future fuel supply by means other than road transport;
- additional bird and bat surveys to confirm the preliminary low strike risk identified to date;
- completion of a study to identify high velocity gaseous emissions in the proposed airspace which might pose a risk to aircraft; and
- implementation of development controls on public safety zones outside Commonwealth land.

Prior to operations commencing at the airport, a safety review would need to be undertaken in accordance with the requirements of the applicable work, health and safety legislation.

14.1 Introduction

As part of the development of the EIS, a hazard and risk review of the proposed airport was undertaken and is documented in detail in Appendix H (Volume 4).

The assessment of key risks associated with the construction and operation of the proposed airport adopted a precautionary approach, consistent with the provisions of the *Work Health and Safety Act 2011* (Cth) and *Work, Health and Safety Act 2011* (NSW). Due to the preliminary nature of the design, including indicative flight tracks, airspace and terminal design information, a comprehensive due diligence assessment of the proposed airport was not possible.

A review was therefore considered appropriate for the purposes of the EIS, given that a safety assessment to demonstrate due diligence in accordance with Work, Health and Safety (WHS) legislation would be required before the commencement of operations at the proposed airport. This chapter draws on that study and other work by the Australian Government agencies (such as Airservices Australia), as described in Chapter 7 (Volume 1).

14.2 Methodology

The study methodology comprised:

- documentation review – including the findings of the 1997–99 EIS risk study, current project design documentation, and national and international aviation safety statistics;
- legislative context review – to establish the legislative framework for the proposed airspace and ground operations at the proposed airport;
- development of a conceptual airspace risk model – to provide a framework for a systematic process to identify possible hazards and risks; and
- stakeholder workshops – to discuss identified risks and seek expert opinion on these and any other risks and treatments that should be considered for the proposed airport.

14.2.1 Document review

A number of background documents were reviewed as part of the hazard and risk assessment process, including:

- 1997–1999 Environmental Impact Statement: Technical Paper 10 – Hazards and Risks (PPK 1997);
- Western Sydney Airport: Preliminary Airspace Management Analysis (Airservices Australia 2015);
- Western Sydney Airport Climatological Review (Bureau of Meteorology 2015a);
- Western Sydney Airport Usability Report – Meteorological Impacts (Bureau of Meteorology 2015b); and
- Western Sydney Airport indicative airport layouts.

14.2.2 Legislative context

The following Commonwealth legislation applies to airports and aviation:

- *Civil Aviation Act 1988* (Civil Aviation Act)*;*
- Civil Aviation Regulations 1988;
- Civil Aviation Safety Regulations 1998*;*
- *Air Navigation Act 1920;*
- Airspace Regulations 2007;
- *Airports Act 1996* (the Airports Act)*;*
- Airports (Protection of Airspace) Regulations 1996 (APAR);
- Air Navigation Regulations 1947;
- Airport (Building Control) Regulations 1996;
- Airport (Environment Protection) Regulations 1997;
- Airports Regulations 1997;

- Airports (Control of On-Airports Activities) Regulations 1997;
- Airports (Ownership and Interests in Shares) Regulations 1996;
- *Aviation Transport Security Act 2004; and*
- Aviation Transport Security Regulations 2005.

The Civil Aviation Safety Authority (CASA) has primary responsibility for the safety regulation of civilian aircraft operations in Australia. The Civil Aviation Regulations 1988 and the Civil Aviation Safety Regulations 1998 provide the general regulatory controls for the safety of air navigation. The Regulations enable CASA to issue Manuals of Standards with detailed technical material, which support the regulations. The following Manuals of Standards are relevant to the proposed airport:

- Manual of Standards Part 139 – Aerodromes;
- Manual of Standards Part 139H – Standards Applicable to the Provision of Aerodrome Rescue and Fire Fighting Services;
- Manual of Standards Part 172 – Air Traffic Services;
- Manual of Standards Part 171 – Aeronautical Telecommunication and Radio Navigation Services; and
- Manual of Standards Part 173 – Standards Applicable to Instrument Flight Procedure Design.

Prior to the proposed airport commencing operations, CASA would need to be satisfied that appropriate operating procedures, and necessary infrastructure and personnel are in place to ensure the safety of aircraft operations in accordance with the Civil Aviation Act and the Civil Aviation Safety Regulations. Aircraft operations around the proposed airport would be controlled by the aviation-specific Commonwealth Acts and Regulations outlined above.

14.2.2.1 Airspace protection

The airspace at and around airports is protected under Part 12 of the Airports Act and the APAR. The protected airspace is defined within international standards as the space above two sets of operational surfaces above the ground around an airport, namely the:

- Obstacle Limitation Surface (OLS); and
- Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) surfaces.

The OLS is intended to provide protection for aircraft flying into or out of the airport when the pilot is flying by sight. The PANS-OPS surfaces are intended to safeguard an aircraft from collision with obstacles when the aircraft's flight may be guided solely by instruments, in conditions of reduced visibility.

14.2.2.2 Control of development in the vicinity of airports

The National Airports Safeguarding Framework (NASF) is a national land use planning framework, agreed to by Commonwealth, State and Territory Ministers in 2012. The NASF recognises that responsibility for land use planning rests with State and local governments, but that a national approach can assist in improving planning outcomes near airports and under flight paths.

The NASF guidelines provide comprehensive information and recommendations relating to six airport safeguarding matters. The NASF guidelines are:

- Guideline A: Measures for Managing Impacts of Aircraft Noise;
- Guideline B: Managing the Risk of Building Generated Windshear and Turbulence at Airports;
- Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports;
- Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation;
- Guideline E: Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports; and
- Guideline F: Managing the Risk of Intrusions into the Protected Airspace of Airports.

The assessment of proposed development in the vicinity of airports is primarily the responsibility of local government, based on declared airspace arrangements. Once the airspace has been declared for the proposed airport, surrounding councils would be notified and OLS and PANS-OPS requirements would be incorporated into local planning instruments. Developments with the potential to exceed the OLS must be referred to the airport operator and the Department of Infrastructure and Regional Development for review prior to the development being approved to proceed. The OLS applies to both building obstacles (e.g. antennae, masts or tall buildings) and hot or high velocity air emission (e.g. smokestacks, cooling towers) which may cause a potential hazard to aircraft. In addition to OLS, civil aviation regulations also require approval from CASA for the installation of lighting which might cause a distraction, glare or confusion for pilots.

14.2.2.3 Dangerous goods

There is specific legislation related to the management of dangerous goods. NSW WorkCover is the responsible authority for the storage and handling of dangerous goods including jet fuel. Australian Standard *1940-2004: The storage and handling of flammable and combustible liquids* (AS 1940-2004) deals with flammable liquids of dangerous goods classified as Class 3 substances (flammable liquids) in the UN *Recommendations on the Transport of Dangerous Goods – Model Regulations.* The objective of AS 1940-2004 is to promote the safety of persons and property where flammable or combustible liquids are stored or handled, by providing requirements and recommendations that are based on industry best practices.

The NSW Environment Protection Authority (EPA) regulates the transport of dangerous goods under the provisions of the *Dangerous Goods (Road and Rail Transport) Act 2008* (NSW). The approval authority for a fuel pipeline would be the NSW Department of Trade and Investment (Resources and Energy) under the provisions of the *Pipelines Act 1967* (NSW).

14.2.2.4 Hazardous industries

The NSW Department of Planning and Environment also provides guidelines for the planning and development of hazardous industry in NSW which applies to land outside of the airport site. Relevant guidelines include the NSW *Hazardous Industry Planning and Advisory Paper* (HIPAP) series of guidelines:

- HIPAP 4 – Risk Criteria for Land Use Safety Planning (January 2011); and
- HIPAP 10 – Land Use Safety Planning (January 2011).

14.2.3 Conceptual airspace risk model

In conceptual terms, the airport airspace risk analysis approach considers risks in three parts: the entry (arrival and landing), exit (departure and take-off) and transit through the relevant airport airspace. There are a number of factors that add complexity to an airport's airspace, including:

- terrain and weather;
- the number and variety of airspace activities;
- multiple runway operations (where applicable);
- possible increased traffic density from nearby airspaces;
- potential runway intrusions including animals;
- public and other environmentally sensitive facilities and activities adjacent to the airport that may affect operations (e.g. population centres, especially schools and hospitals);
- speed differentials between aircraft at the airport; and
- pilot experience differentials.

These issues were tested in stakeholder workshops in order to systematically consider possible airspace risks at the proposed airport and identify, in a preliminary manner, existing regulatory and potential other risk treatments.

14.2.4 Stakeholder workshops

Workshops with representative key stakeholders were completed to identify credible risk issues that should be addressed by the hazard and risk assessment.

Workshops or meetings were undertaken with the following stakeholders:

- Department of Infrastructure and Regional Development;
- Civil Aviation Safety Authority, Office of Airspace Regulation;
- Airservices Australia;
- NSW Department of Planning and Environment;
- Australia Federal Police; and
- NSW Rural Fire Service.

14.3 Identified key risks

The risk review process identified a list of key credible hazards that were the subject of analysis and discussion with stakeholders. These can be broadly considered as either airspace or ground-based risks and are outlined in Table 14–1. It should be noted that while each of these risks has a different likelihood of occurrence, they were identified on the basis that each could potentially result in either injury or loss of life to members of the public, airport workers or airline staff.

Table 14–1 Identified key risks

Airspace	Ground-based
Bat and bird strike	Aircraft fire (on the ground)
Drone and model aircraft strike	Building fire
Airspace obstruction	Fuelling fire
Mid-air collision with other aircraft	Grass fire
Military and emergency services operations	Fuel storage fire
High velocity air discharge	Contaminated land (during construction)
Adverse meteorology	Transport of dangerous goods
Aircraft crashes into critical infrastructure	Site flooding
Falling aircraft	Railway safety
Terrorism incidents	Bushfire

For the purposes of the hazard and risk assessment process, these risks were considered separately, as they may have different causes, and mitigation measures would be specific to each risk. For the purposes of the summary below, they have been grouped into broad categories for more general discussion.

14.4 Airspace risk overview

Australia has a good aviation safety record, comparable to other developed countries such as the United States, Canada and the United Kingdom. Statistics collected by the Australian Transport Safety Bureau (ATSB) indicate that the number of reported safety incidents in Australia has risen significantly over the past decade. However, not all incidents result in a physical accident and the growth in incidents reported needs to be considered in light of the continuing increase in aircraft movements. In 2013, among 3.3 million departures of high capacity public transport aircraft, there were 23 serious incidents (occurrences nearly leading to an accident) and two accidents in which serious injury or damage to an aircraft or person occurred.

The 23 aircraft involved in serious incidents in 2013 was the highest rate for this operation type in more than 10 years (ATSB 2014). The most common occurrences reported were wildlife strikes, adverse weather and aircraft system problems. Most accidents and serious incidents involved reduced aircraft separation distance, engine malfunction, or runway excursions.

No fatalities involving high capacity commercial aircraft operations similar to the type assessed for the proposed airport have occurred since 1975 and the number of reported fatal accidents and fatalities declined significantly from 1990 to 2005 to a level considered very low (ATSB 2006a).

14.4.1 Flight paths

Indicative flight paths have been developed by the Airservices Australia to model and assess the impacts of aircraft operations in the EIS. The indicative concept designs demonstrate that the Stage 1 Western Sydney Airport and Sydney Airport could safely operate independently as high capacity airports. A formal flight path design process design process will commence after the Airport Plan is determined. Chapter 7 (Volume 1) provides further detail on the indicative flight path design and the formal flight path design process. However, these indicative flight paths would avoid key infrastructure locations such as Defence Establishment Orchard Hills, the Warragamba Dam wall and Prospect Reservoir.

Commencement of operations of the second runway at the proposed airport would introduce additional complexity to airspace arrangements. Current analysis shows a broader reconfiguration of the Sydney basin airspace would likely be required. However, changes in land and improved navigation technology over time would influence the extent of future reconfiguration necessary.

A rigorous process of airspace design and approval would need to be undertaken prior to commissioning of a second runway. This two runway scenario at the proposed airport is discussed in Chapter 34 (Volume 3).

14.4.2 Navigation systems and air traffic management procedures

A variety of satellite and ground-based navigational aids would provide necessary safety for aircraft approaches and departures in reduced visibility conditions. The required accuracy, operation and availability of these facilities are strictly controlled under the Civil Aviation Safety Regulations. All aircraft that would operate at the proposed airport in reduced visibility conditions would need to be suitably equipped to use the available navigational aids. Radar services would assist air traffic control to manage air traffic in the controlled airspace surrounding the proposed airport under the Civil Aviation Safety Regulations.

A satellite assisted precision landing system, known as a ground based augmentation system (GBAS) is proposed for the airport. The system uses GPS signals to provide aircraft with very precise positioning guidance during the final stages of an approach and landing. Airservices Australia and the International Civil Aviation Organization (ICAO) recognise GBAS as a potential future replacement for current instrument landing systems and adoption of this technology is considered to be a critical component of next-generation air traffic management infrastructure. Each GBAS can precisely guide up to 26 approach flight paths simultaneously from up to 42 kilometres from the runway. The proposed airport would likely include two GBAS – one for each runway.

Another example of emerging technology in the aviation sector is the adoption of automatic dependent surveillance-broadcast for all instrument flight rules (IFR) aircraft. This system allows aircraft to broadcast their position, velocity and other flight details in real time for flight tracking. The technology is currently being rolled out in the Sydney basin. It is anticipated that the proposed airport would similarly adopt emerging technology and that future incidents would decrease.

14.4.3 Bat and bird strike

Birds are attracted to large, open grassed areas which are often found at airports. Such areas provide feeding, resting and nesting areas for many types of birds. Short grass provides protection against predators such as snakes, cats and foxes but may also attract predatory birds in search of rodents and other food sources. Water lying in drains and dams on the airport site may also provide habitat for birds. Large open hangars and other flat roofed buildings can also provide nesting areas for small birds.

The environment surrounding airports can also attract birds. These may be natural habitat areas (e.g. wetlands) or urban features such as landfills. Birds and flying foxes can transit across airports and flight paths while travelling between nesting, roosting and feeding sites.

Modern aircraft engines are designed to deal with bird or bat strike. The key issue is the size and flocking habits of the species in and around an airport. While in the worst case, bird or bat strike can lead to serious aircraft incidents, the more likely consequence is damage to aircraft and associated inconvenience to the travelling public.

A preliminary bird and bat strike report (see Appendix I (Volume 4)) identifies the type and number of species that would be likely in the vicinity of the proposed airport. It concludes that the risk at the proposed airport is comparably low relative to many other Australian airports that are situated in coastal areas where flocking birds are more likely to exist. Standard activities and procedures throughout the design, construction and operational phases including additional surveys and monitoring would be undertaken to confirm these preliminary results and reduce areas of potential habitat of various species before airport operations commence. This would include measures to be adopted both on and off-site, in accordance with the requirements of applicable regulations such as NASF, CASA Advisory Circular 139-26(0) and ICAO requirements.

14.4.4 Airspace obstructions

Airspace obstructions and distractions (e.g. lighting and glare) can be a threat to navigation, but these are controlled through CASA standards and guidelines and through development control procedures of local government. Additional hazards include hot air from discharge points such as smokestacks and cooling towers. Emissions above certain velocities, or chimneys above specified heights, are considered potential hazards in accordance with the APAR.

A preliminary survey for obstacles in and around the proposed airport was undertaken based on the anticipated OLS for both the northern and second runways. Before the start of airport operations, a survey would be required to identify existing industrial emissions that may pose a hazard to aircraft. Any future industrial developments within the declared airspace would need to be referred to the Department of Infrastructure and Regional Development and the Airport Lessee Company for comment prior to the development proceeding.

14.4.5 Adverse meteorology

In aviation terms, adverse meteorology refers to the following conditions:

- aircraft icing (freezing fog);
- crosswind (especially gusts);
- cyclones/tornados;
- fog (visibility);
- lightning (thunderstorm); and
- windshear (especially in the vicinity of the runway threshold).

The likely occurrence of these meteorological conditions at the airport site was investigated by the Bureau of Meteorology (see Appendix D (Volume 4)) and the outcomes are summarised in Chapter 7 (Volume 1). No unusual conditions are likely to exist at the site that would routinely interfere with safe operation of the proposed airport. An on-site automatic weather station would collect comprehensive baseline data of local weather conditions before the start of operations to support further analysis. Provided that appropriate airport operating parameters are established and complied with, operational safety concerns associated with adverse meteorology at the airport would be satisfactorily managed.

14.4.6 Aircraft accidents

Australia has a good aviation safety record comparable to other developed countries. No fatalities involving high capacity commercial aircraft operations similar to the type assessed for the proposed airport have occurred since 1975. The number of reported fatal accidents and fatalities declined significantly from 1990 to 2005 to a level considered to be very low (ATSB 2006a).

Aircraft accidents involving multiple fatalities are a rare occurrence in Australia and worldwide (ATSB 2006b). Figure 14–1 provides a summary of commercial jet aircraft operations, specific to the USA and Canada and the rest of the World combined, between 1959 and 2013 and indicates that over the 54 years of analysis, the annual fatal accident rate has reduced from 40 (1959) to less than 0.5 (2013) per million departures (Boeing 2014).

The Sydney Basin Aeronautical Study undertaken by CASA (CASA 2015) reported an improving safety trend in total airspace related incidents in the Sydney region. An airspace ‘incident’ includes events such as operational non-compliance with an air traffic control instruction, a missed approach and ‘go-around’, airspace infringements and non-compliance with aircraft separation standards. The rate of airspace incidents in relation to total recorded basin movements declined consistently over the five-year period between 2008 and 2013. The number of airspace related incidents more than halved (a reduction of 56.4 per cent) over this period.

Compared to other Australian capital city airports including Melbourne, Brisbane, Adelaide and Perth, Sydney has experienced the largest reduction in the rate of airspace incidents per 1,000 aircraft movements. The data indicate that despite increasing traffic at Sydney, airspace related safety has improved in the past six years.

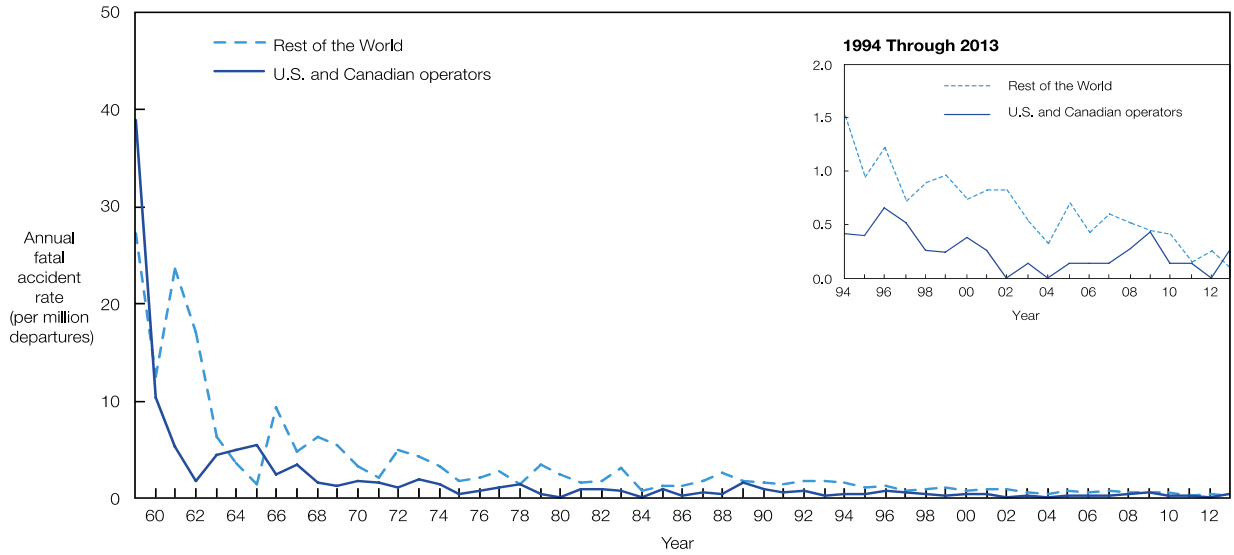
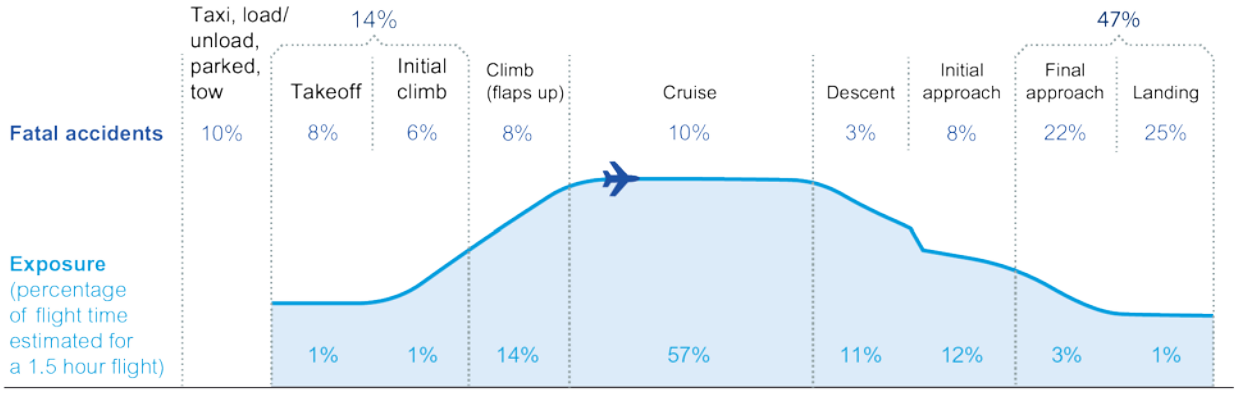


Figure 14–1 Summary of annual fatal accident rate between 1959 and 2013

Figure 14–2 summarises the percentage of fatal accidents by stage of flight which indicates that:

- 10 per cent are likely to occur on the ground during taxiing, loading/unloading, when the plane is being parked or towed;
- 14 per cent are during take-off or initial climb to cruising altitude;
- 10 per cent are during level flight at cruising altitude;
- 11 per cent are during descent and on initial approach to landing; and
- 47 per cent are during final approach or landing.



Note: Percentages may not sum precisely due to numerical rounding

Source: Boeing Commercial Services, 2014

Figure 14–2 Percentage of fatal accidents by flight stage

ICAO reports that most aircraft crashes occur within 1,000 metres of landing and 500 metres of take-off (ICAO 2014). The Australian Government is working with the states and territory governments on the development of a national standard for public safety zones to be incorporated into the NASF. Public safety zones are areas of land at the ends of runways within which development may be restricted in order to control the number of people on the ground at risk of injury or death in the event of an aircraft accident on take-off or landing. While Australia has an excellent aviation safety record, there will always be an inherent risk associated with flying and operation of aircraft at or around airports. The use of public safety zones can further reduce the already low risk of an air transport accident affecting people near airport runways. In the absence of any nationally agreed guidance, a nominal 1,000 metre trapezoid-shaped clearance at the end of the runway threshold has been provided in the proposed airport concept.

An estimate of the likely risk of plane crashes resulting from the proposed airport has been undertaken based on the most recent year of accident data available. In 2013, Boeing reported five major accidents occurred worldwide in their fleet as a result of 25 million departures that year. This equates to an accident likelihood of 0.0000002 per cent per departure. Table 14–2 shows the likelihood of an accident for the proposed Stage 1 development based on forecast total annual air traffic movements and the 2013 accident statistics.

Table 14–2 Predicted likelihood of an accident for Stage 1 development

Total annual air traffic movements (passenger and freight)	Departures (per year)	Likelihood of major accident per departure	Major accidents per year	Years between major accidents	Years between major accidents on final approach or runway
63,000	31,500	0.0000002	0.0063	159	317

As indicated in the table, the accident rate for aircraft assessed for the proposed airport would be in the order of 1 in 150 years for all stages of flight. It should be noted that this estimate is based on forecast air traffic movements at the airport and an accident rate based on current aviation technology and practices around the world. As outlined in Section 14.4.2, aviation procedures and technology are continually improving, particularly in response to ongoing incident investigations, and therefore it is reasonable to expect that improved safety performance would occur with time.

14.4.7 Terrorism

At this preliminary design stage, no specific issues or precautions beyond those in use at Sydney Airport or other similar international facilities are envisaged for the proposed airport. The detailed design of the proposed airport facilities would be reviewed by security experts to ensure that adequate space for security facilities and personnel is provided and additionally, that the design minimises potential vulnerabilities.

14.5 Ground-based issues

14.5.1 Transport of dangerous goods

It is expected that jet fuel would initially be transported to the airport site by B-Double road tankers. Approximately five years after opening, the expected fuel demand would require approximately 43 B-Double fuel deliveries per day. This is not a large number of trucks, relative to road capacity or existing heavy vehicle volumes. This number of deliveries is expected to rise in line with the increased aircraft movements at the airport. However, the actual volumes of fuel required onsite to support aircraft operations will be largely determined by the airlines as a result of aircraft scheduling.

Although it is not currently possible to identify the specific traffic routes likely to be used for fuel deliveries, it is expected the majority of the trip would be by high capacity, arterial roads and/or motorways. It is anticipated that fuel truck movements would comply with relevant legislation and that transportation routes will avoid tunnels in accordance with existing industry practice.

It is expected that a fuel supply pipeline would replace road tanker deliveries, likely before the operation of the second runway. A route for a fuel pipeline will be determined by the entity or organisation responsible for providing fuel to the airport and likely, in consultation with the NSW Government. Arrangements for access to the fuel pipeline, which may involve an easement, would be required along the pipeline corridor alignment for emergency response, maintenance and as a public safety measure. Ensuring such access may require planning controls including restricting development on, and adjacent to, the pipeline.

14.5.2 Fuel storage and other fires

A fuel farm will be located near the north-western boundary of the airport, off Anton Road. During the Stage 1 development, the fuel farm will include up to four fuel tanks providing volume for three days' supply. The design of the fuel storage will include protection bunds and safety buffers.

For the purposes of investigating potential off-site risks from the fuel storage, ignition of a 100 x 100 metre bunded fuel storage area was modelled in a fire dynamics simulation with 20 knot winds blowing towards off-site areas. The assessment was considered worst case given that winds exceeding 20 knots are rare at Badgerys Creek (BOM 2015a).

The results of the simulation are presented in Figure 14–3. The vertical coloured bar on the right hand side indicates the heat at different distances from the simulated fire.

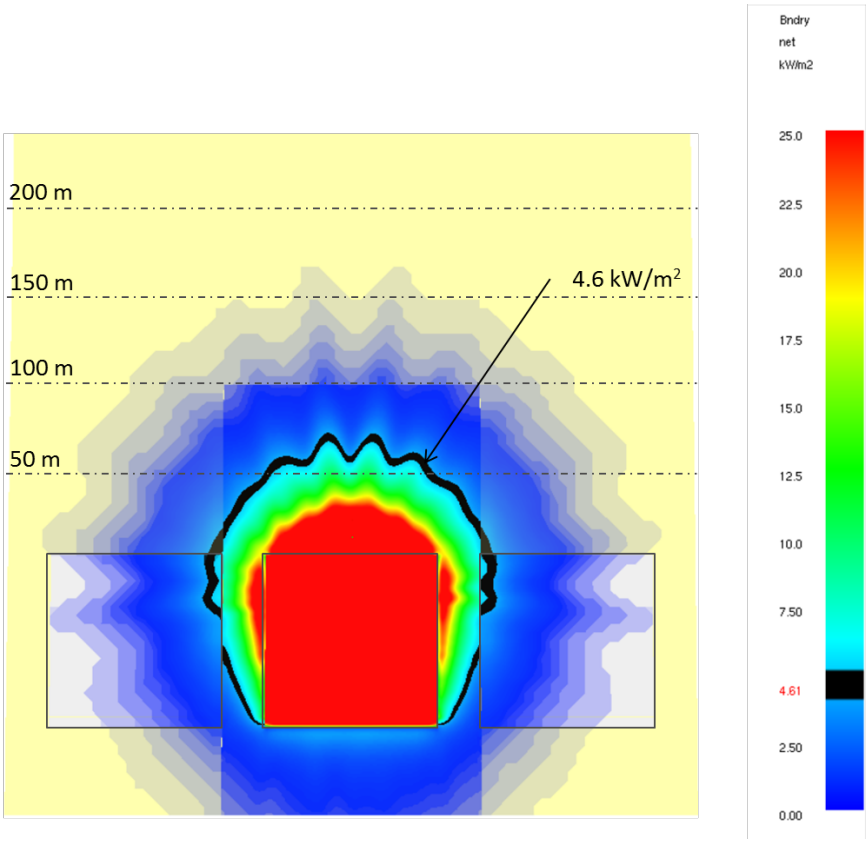


Figure 14–3 Fire dynamic simulation model for a kerosene fire with 20 knot winds

Hazardous Industry Planning Advisory Paper (HIPAP) 4 (Department of Planning and Environment 2011a) outlines the potential consequences of varying levels of heat flux on structures and people, noting that the ultimate effect would depend on the duration of exposure. In general terms, buildings should be located outside of a heat flux level of 12.6 kilowatts per square metre (kW/m^2) which is the point at which timber can ignite after prolonged heat exposure and insulated steel can buckle. Buildings outside the 2.1 kW/m^2 heat flux level would not typically require special fire protection measures to be adopted.

The preliminary fire modelling shows that a buffer of at least 50 metres is required from the edge of the storage bund to all airport site boundaries to avoid a heat flux level of 12.6 kW/m^2. The current conceptual design of the fuel storage facility at the proposed airport would satisfy this requirement by incorporating an 80 metre buffer to the airport site boundary.

The current land use zoning of property neighbouring the fuel storage allows for the development of residential dwellings. However, rezoning of the surrounding area is expected to occur as a result of the airport. In consideration of potential injury to people in these locations, HIPAP 10 indicates that a heat flux level of 4.7 kW/m^2 should not be exceeded at a frequency of more than 50 chances in a million per year. This level represents the possibility of injury for people who are exposed for more than 30 seconds and are unable to be evacuated or seek shelter.

As shown in Figure 14–3, this heat flux level would only be achieved beyond approximately 80 metres from the edge of the storage bund. Therefore, further risk calculations may be required to determine the frequency of such an event to meet the NSW DP&E off-site risk criteria.

Other fires associated with tanker truck discharge, fires in terminal buildings or other areas or aircraft are also possible, but would likely to be smaller. Standard design precautions would be adopted for all infrastructure. Additionally, an aviation rescue fire-fighting station is proposed for the Stage 1 development. A mutual aid agreement with the NSW Rural Fire Service would also be put in place before airport operations commence.

14.5.3 Flooding

The potential for flooding at the proposed airport is assessed in detail in Chapter 18. The concept design for the proposed airport includes a drainage strategy for the site. The airport infrastructure is located outside the 100-year average recurrence interval (ARI) flood extent of Badgerys Creek, Duncans Creek and Oaky Creek. Existing creeks at the airport site would be removed and replaced with an extensive stormwater drainage network including a series of detention basins. These would be created during the construction stage and remain in use during airport operation.

The airport infrastructure has been designed in accordance with the Stormwater Drainage Design Manual, which identifies standards for aerodromes and is consistent with current industry practice. The manual sets minimum flood immunity requirements for airport infrastructure as shown in Table 14–3. Consideration has also been given to Australian Rainfall and Runoff (Engineers Australia 1987) recommendations, including the need to make appropriate allowances in the design for blockage of stormwater structures.

The table shows that, for key infrastructure such as runways and taxiways, flood immunity would be required for a 50 year ARI event as a minimum, with additional restrictions on the duration for which any water can pond nearby.

During construction, the effects of changes to the site topography would be mitigated by a network of flood detention basins. A detailed Soil and Water Construction Environmental Management Plan would be developed to manage the impacts of on-site flooding during the construction period.

Table 14–3 Typical flood criteria for aerodromes

Aerodrome Area	Criterion	Annual recurrence interval
Pavements		
Runways	No ponding	50 years
Taxiways	No ponding	50 years
Apron	No ponding	10 years
Other paved areas	No ponding within 30 metres of buildings	50 years
Grassed areas		
Runway strip	Ponding within 75 metres of runway centreline not to exceed 12 hours	5 years
Taxiway strip and apron flanks	Ponding within 15 metres of pavement edge not to exceed 12 hours	5 years

14.5.4 Railway safety

The Australian Government and NSW Governments are undertaking a Joint Scoping Study on the rail needs for Western Sydney, which includes the proposed airport. The study will consider the best options for future rail links, including decisions about timing and rail service options, both directly to the airport site and within the Western Sydney region.

A specific alignment or station location for the airport rail link is yet to be confirmed, however planning for the airport preserves flexibility to accommodate several possible rail alignments. This would be resolved as part of the future design and planning for the proposed airport in conjunction with Transport for NSW and DP&E. Any such work is expected to be subject to a separate approval process.

Underground trains and stations have special safety and operational considerations which would be taken into account in the railway design and approvals process.

14.5.5 Bushfire

A bushfire risk assessment was conducted as part of the design development of the proposed airport. The proposed airport would be a significant commercial asset, located in a landscape that contains vegetation and landscape features that may represent a bushfire risk. It is noted that over time this risk may reduce as a function of the broader urbanisation of Western Sydney.

The most likely scenario for fire at the airport site would be from a large grass fire starting to the west of the site under hot, dry north-westerly, westerly or south-westerly winds. Construction and operation of the proposed airport also has the potential to provide sources of ignition that, under adverse winds, could allow a fire to escape off site.

A Bushfire Management Plan for the Commonwealth owned land at Badgerys Creek has been prepared and implemented to manage current bushfire risk and identify response actions. The existing plan will be revised and updated by the Department of Infrastructure and Regional Development prior to Main Construction Works for the airport and would contain procedures for how site personnel should respond in the event of a bushfire occurring within or threatening the site. The plans would be prepared in consultation with the NSW Rural Fire Service.

14.5.6 Contaminated land

A range of contaminants associated with prior land uses may be present at the airport site. Previous and current land uses at the airport site that may potentially result in contamination include agriculture, light commercial and building demolition works. Contaminants of potential concern evidenced at the airport site include fuels, lubricants, solvents, acids, asbestos, heavy metals, ash, herbicides, pesticides and pathogens. Furthermore, about half the properties at the airport site are considered to present at least moderate risk of asbestos contamination.

A contaminated land assessment was undertaken at the airport site including a desktop assessment and site investigation. A number of mitigation and management measures are proposed to control risks associated with contamination including an asbestos management plan, remedial action plan and unexpected finds protocol. The assessment and associated mitigation and management measures is documented in Chapter 17.

14.6 Mitigation and management measures

While a number of potential risk issues were identified and analysed by the hazards and risk study, the majority:

- could be satisfactorily resolved through further design and regulatory processes or studies already underway;
- would not require the adoption of project-specific measures or measures that are not already required by existing industry legislation and standards; or
- would be the responsibility of other statutory authorities to implement, in consultation with the Department of Infrastructure and Regional Development and the future Airport Lessee Company.

These issues and the responsible parties are summarised in Table 14–4.

The key remaining mitigation and management measures to be resolved in future design stages are provided in Table 14–5.

Table 14–4 Identified issues and responsible parties

Responsible organisation	Identified risk	Considerations
Department of Infrastructure and Regional Development	Future formal flight path design process	• avoidance of military and emergency services operations from surrounding airfields, existing airspace obstacles, surrounding critical infrastructure and site-specific meteorology; and • consideration of possible future flight paths associated with the long term development and proposed second runway so that changes in surrounding land use over the intervening period can be appropriately managed.
Civil Aviation Safety Authority	Safe operation of aircraft	• aerodrome certification of the proposed airport facilities and equipment are in accordance with the applicable standards and operating procedures make satisfactory provision for the safety of aircraft operations; • regulation of drone and model aircraft; and • specification of new technology/procedures as demonstrated to be effective.

Responsible organisation	Identified risk	Considerations
Airport Lessee Company	Appropriate design and safe operation of the proposed airport and facilities	• preparation of an aerodrome manual; • installation and operation of automatic weather station in consultation with the Bureau of Meteorology; • compliance/adoption of new technology/ procedures specified by CASA; • detailed design of the proposed airport and facilities in accordance with industry standards and regulations e.g. terminal, railway and fuel storage; • provision of necessary safety and contingency procedures and facilities in accordance with guidelines; • ongoing management of wildlife at the airport in accordance with CASA Manuals of Standards and operational management plan; • preparation of an airport master plan in accordance with the Airports Act; • participate in planning coordination forums and community aviation consultation groups; and • conduct a risk and safety study prior to operation of the Stage 1 development in accordance with the requirements of WHS legislation.
Aircraft manufacturers and airline operators	Fuel exhaustion Mechanical failure Pilot error Inflight fire	• continuous improvement and response to identified issues
Local councils	Airspace intrusion	• refer potential conflicts to the Airport Lessee Company and Department of Infrastructure and Regional Development.

A biodiversity land and safety Operational Environment Management Plan (OEMP) detailed in Chapter 28 (Volume 2b) will incorporate these mitigation and management measures in Table 14–5. A biodiversity OEMP will be approved prior to commencement of operation of the proposed airport.

Table 14–5 Mitigation measures to be resolved in future design stages

Issue	Mitigation and management measure	Timing
Wildlife hazard management plan	To manage the risk of fauna hazard and bird and bat strike a wildlife hazard management plan will be developed and implemented. The plan will include the following measures: • the conduct of additional surveys to study and monitor for changes in species and movement patterns. The surveys will be conducted in accordance with relevant Commonwealth and State guidelines and standards including any recovery plans for threatened species; • the review of detailed design documentation to identify potential bird and bat attractants; • liaison with local government in relation to plans for proposed developments within 13 kilometres of the airport site that are likely to increase the bird and bat strike risk; • active management of bird and bat presence at the airport site six months prior to the commencement of airport operations; and • the outcomes of bird and bat strike monitoring will be reviewed by a wildlife strike expert and the results taken into account in any audit of the airport's impacts on wildlife in and around the airport site.	Pre-operation Operation

Issue	Mitigation and management measure	Timing
Fauna hazard	To minimise bird and bat strike risk and terrestrial fauna strike risk, the design of the proposed airport will seek to minimise the attractiveness of the airport site to fauna. To achieve this, the following measures will be incorporated into the detailed design process: • drains, water basins and other airfield components that minimise the availability and attractiveness of water and other potential roosting, nesting or foraging habitat; • an appropriate fence to restrict terrestrial animal access to the airfield; and • airside access roads to facilitate active wildlife management.	Pre-operation
Fuel storage	To reduce the risk of hazardous incidents and ensure compliance with relevant offsite risk criteria the fuel farm will be managed having regard to any further hazard investigations undertaken and operating procedures establish during detailed design.	Pre-operation Operation

14.7 Conclusion

At this preliminary design stage of the proposed airport, adequate precautions have been identified to resolve safety and risk issues. Ongoing design processes would further consider these issues and future regulatory approvals would need to be achieved before operations could commence. This includes the future formal airspace design process to be led by the Department of Infrastructure and Regional Development in close collaboration with Airservices Australia and CASA, the detailed design of the airport in accordance with the approved Airport Plan (including any conditions in the Airport Plan arising out of the EIS and made by the Environment Minister) and the aerodrome certificate from CASA.

The recommended mitigation measures would reduce hazards and risk during construction and operation of the airport, both for airspace and ground-based activities.