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Sydney Metro – Western Sydney Airport

EPBC Act Final Environmental Impact Assessment of on-airport proposed action (EPBC 2019/8541)

Certification page

Names, roles and qualifications (where relevant) of all persons involved in preparing the preliminary documentation must be provided.

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1 Introduction

This chapter provides a brief overview of Sydney Metro – Western Sydney Airport (the project) and its on-airport components (the proposed action) including key features and objectives. It provides the status of the on-airport planning approval process and identifies the purpose and structure of this Final Environmental Impact Assessment.

1.1 Project overview

Sydney Metro – Western Sydney Airport (the project) is identified in the *Greater Sydney Region Plan* (Greater Sydney Commission, 2018a) as a key element to delivering an integrated transport system for the Western Parkland City. The new railway line would become the city's transport spine, connecting communities and travellers with the rest of Sydney's public transport system with a fast, safe and easy metro service. The project would enable the realisation of the vision for Western Sydney and the Western Sydney Aerotropolis (hereafter referred to as the Aerotropolis), by connecting people to employment, education, shops, services and recreation facilities. The project would also provide important access to Western Sydney International (Nancy-Bird Walton) Airport (hereafter referred to as Western Sydney International) for airport workers and aviation travellers.

The project would provide a connection between the existing Sydney Trains suburban rail network at St Marys and six new metro stations, including two at Western Sydney International and one at the Aerotropolis. The stations would play a key role in the development of future precincts in the Western Parkland City.

The project is being delivered under the Western Sydney City Deal, a partnership between the Australian Government, NSW Government and eight Western Sydney local governments that aims to deliver the vision for the Western Parkland City. The Australian and NSW Governments are partners in funding the project and have a shared objective to connect rail to Western Sydney International when the airport opens for passenger services.

1.2 Key features of the project

The project involves the construction and operation of a metro rail line around 23 kilometres in length, between St Marys in the north and the Aerotropolis Core precinct in the south (the area to be called Bradfield), via Western Sydney International (see Figure 1-1). Station locations for the project would include:

- a new metro station connecting to, and providing interchange with, the existing Sydney Trains suburban rail network at St Marys, north of Western Sydney International
- two new metro stations between the existing Sydney Trains suburban rail network at St Marys and Western Sydney International; one at Orchard Hills and one at Luddenham within the Northern Gateway precinct
- two new metro stations within the Western Sydney International site; one at the Airport Terminal and one at the Airport Business Park
- a new metro station within the Aerotropolis Core precinct, south of Western Sydney International (the area to be called Bradfield).

The alignment of the new metro railway line would:

- include a combination of tunnel, surface and viaduct sections
- interface with key roads including the Great Western Highway, M4 Western Motorway, Luddenham Road, the future M12 Motorway, The Northern Road, Elizabeth Drive and Badgerys Creek Road, as well as key utilities such as the Warragamba to Prospect Water Supply Pipelines
- include waterway crossings of Blaxland Creek and Cosgroves Creek.

The project includes works required to support its construction and operation, including all operational systems and infrastructure.

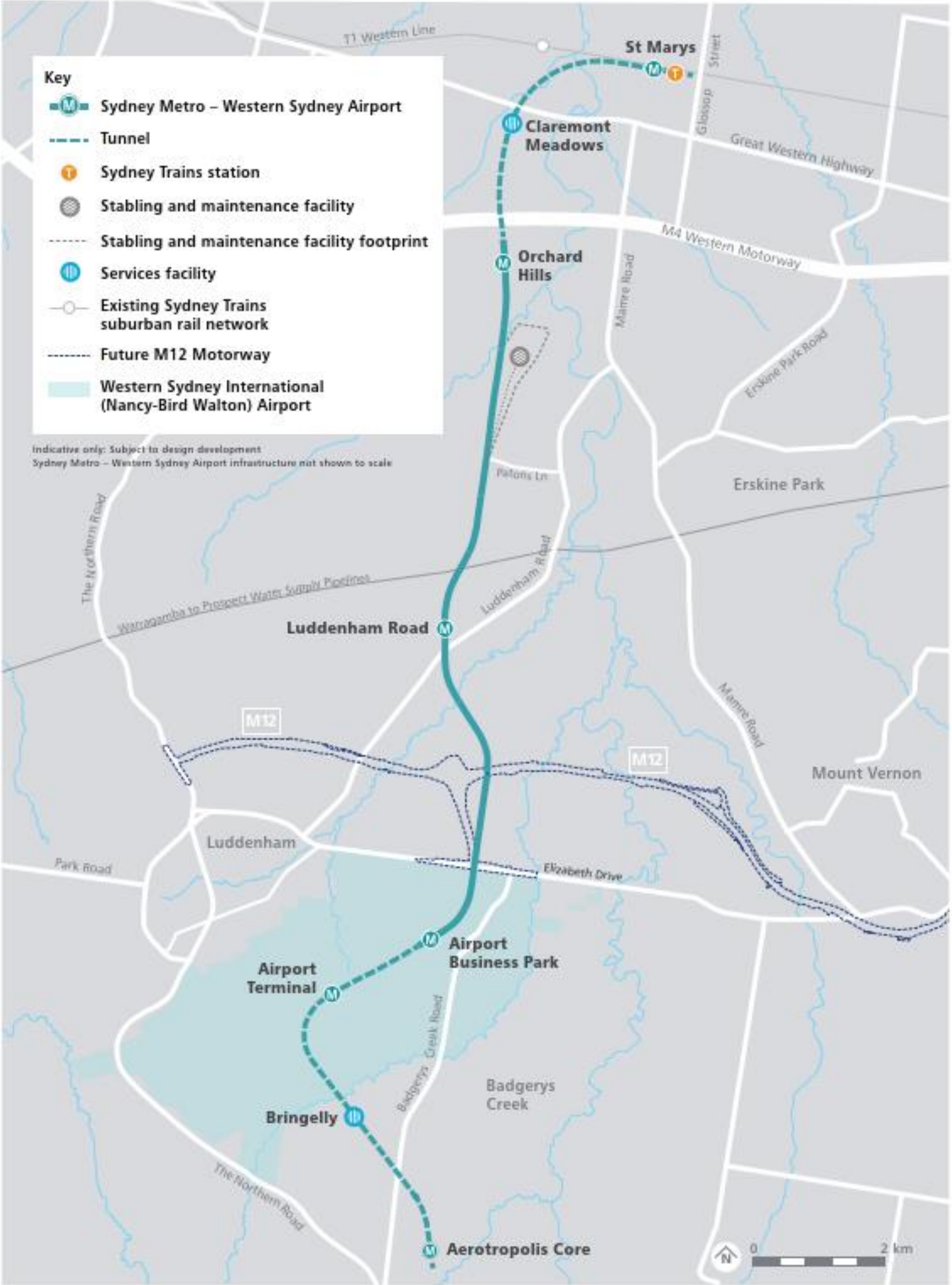


Figure 1-1 Overview of the project

A stabling and maintenance facility and operational control centre would be required to support operation of the project. The facility is proposed to be located in Orchard Hills, to the north of Western Sydney International.

Services facilities are proposed at Claremont Meadows and Bringelly for the St Marys to Orchard Hills tunnel and the Western Sydney International to Bringelly tunnel, respectively. The need for the Claremont Meadows services facility is subject to further investigation.

The project components that are located within Western Sydney International are hereafter defined as the on-airport proposed action (proposed action).

1.3 The development within Western Sydney International

The proposed action is located within Western Sydney International.

Western Sydney International is currently under construction, with operations scheduled to start in 2026. The new airport will support growth of the international and domestic passenger and freight markets, and the district's economy, by attracting visitors to the Western Parkland City.

The development of Stage 1 of the airport has been authorised by the *Western Sydney Airport – Airport Plan* (Airport Plan) (Department of Infrastructure and Regional Development, 2016a) determined by the then Commonwealth Minister for Urban Infrastructure on 5 December 2016, under the *Airports Act 1996* (Cth) (Airports Act). The Airport Plan sets out the vision for the development and operation of Western Sydney International (see Figure 1-2 for the airport site layout).

The construction of Stage 1 of the airport is scheduled to be completed in 2026 and will comprise a single runway, a terminal and other relevant facilities to accommodate around 10 million passengers annually as well as air freight traffic. A passenger rail corridor has been identified and protected on the airport site, as well as stations at the Airport Business Park and at the Airport Terminal, although these components are not authorised under the Airport Plan.

The Airport Plan contains conditions that govern the construction phase of Stage 1 of the airport including the requirement for a Construction Plan which describes construction activities and phases of construction, a series of Construction Environment Management Plans (CEMPs) and a Community and Stakeholder Engagement Plan. These plans incorporate relevant mitigation requirements and other matters from the *Western Sydney Airport - Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b) that was prepared for the airport prior to determination of the Airport Plan. The Airport Plan provides for CEMPs to be prepared on a phase by phase basis and to be updated for each new phase of work. These plans have been prepared and approved for the current phases of work and will be updated for new phases as they occur.

As demand grows over time and subject to future regulatory approvals, Western Sydney International is expected to include an expanded terminal, further supporting passenger and commercial facilities and ultimately a second runway. The proposed action would not preclude the subsequent development of Western Sydney International, including a second runway and other expanded airport facilities.

Rail access to Western Sydney International would support the success of the airport and the Western Parkland City, as it would support passengers' and workers' journeys, reduce road congestion and support the economic viability of the airport.

1.4 Key features of the proposed action

The proposed action involves the construction and operation of a metro rail link within Western Sydney International. The proposed action would include a combination of tunnel and surface sections of rail alignment and two new metro stations: Airport Business Park Station and Airport Terminal Station.

The proposed action comprises a surface rail alignment entering Western Sydney International from the north (see Figure 1-3). The line would then progress through Airport Business Park Station, before transitioning into a tunnel, through Airport Terminal Station and exiting the airport site beneath Badgerys Creek to the south.

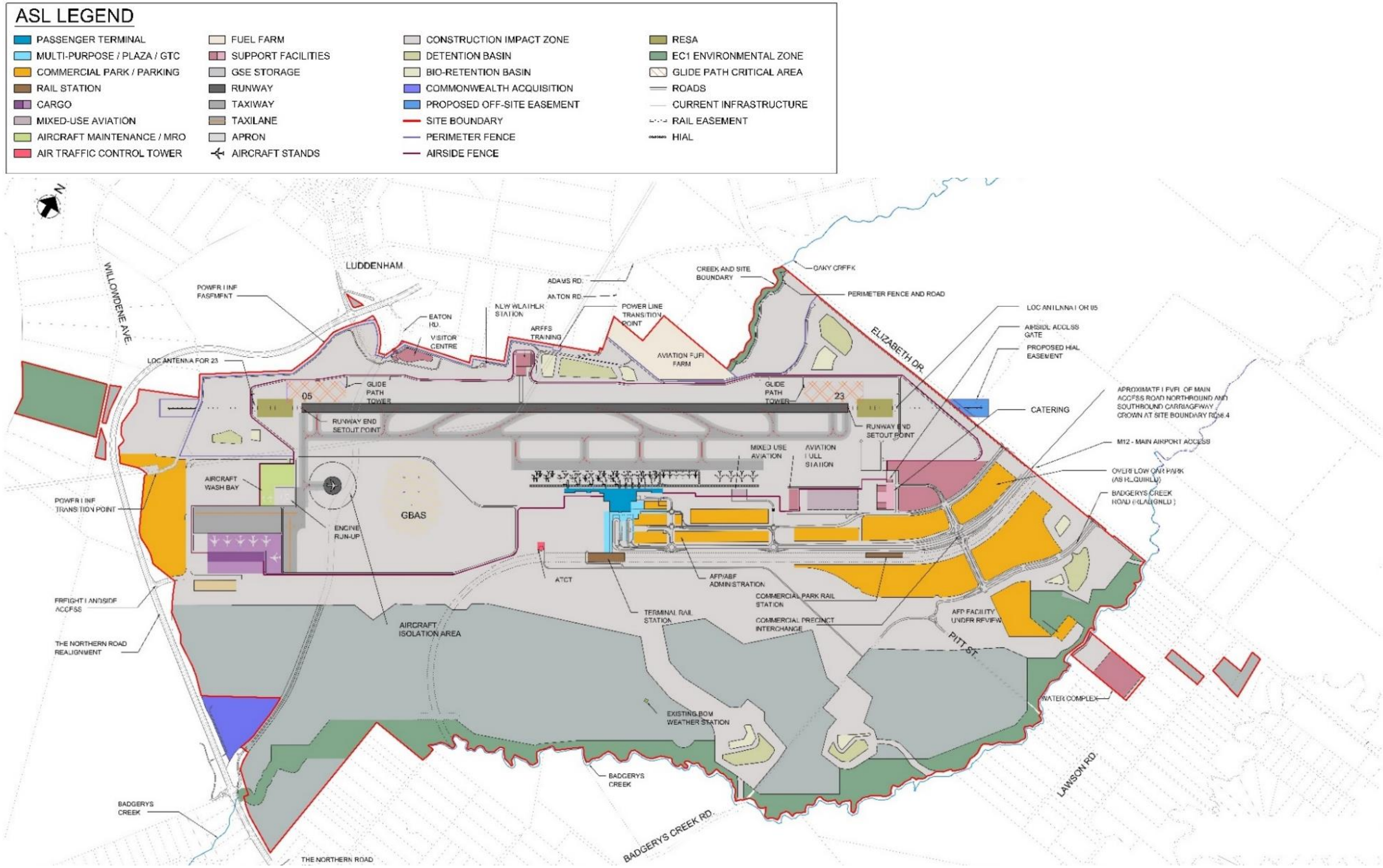
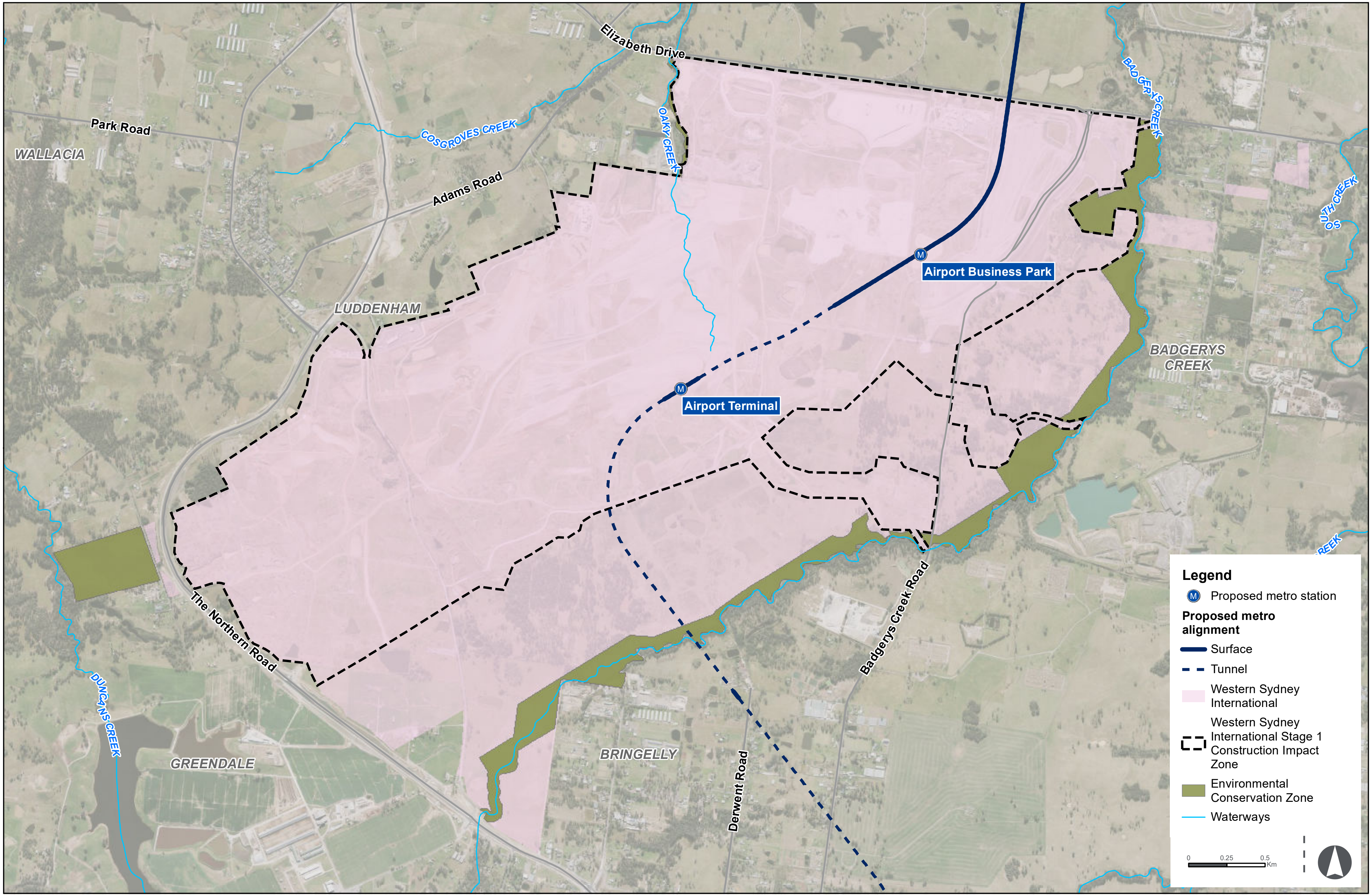


Figure 1-2 Western Sydney International Stage 1 airport layout (Western Sydney Airport, July 2019)



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Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

The proposed action within Western Sydney International

Figure 1-3

Airport Business Park Station would support an agglomeration of different industries associated with airport operations. The station precinct would offer opportunities to integrate office, retail, industrial, hotel and conference facilities within around 1.5 kilometres of the Airport Terminal. Airport Terminal Station would provide metro rail access to international and domestic passengers as well as staff and visitors. The stations would be designed to be consistent with the plans for the Airport Business Park and Airport Terminal areas.

As shown in Figure 1-3, the proposed action would be located both within and outside the footprint of the Stage 1 development of Western Sydney International (referred to in the Airport Plan as the Construction Impact Zone and hereafter as the Western Sydney International Stage 1 Construction Impact Zone). There is also an Environmental Conservation Zone located within and along the southeast boundary of the airport site (which generally corresponds to the riparian corridor for Badgerys Creek). There are additional areas of Environmental Conservation Zone in the north-west corner of the site along Oaky Creek, and to the south-west of the site. No works are proposed within the Environmental Conservation Zone and the proposed action would be located in tunnel beneath Badgerys Creek.

The proposed action includes works required to support its construction and operation including operational systems and infrastructure within Western Sydney International. Further detail is provided in Section 4.1. Construction aspects associated with the proposed action include tunnel and earthworks and station excavation. Further detail is provided in Section 4.2.

1.5 Project objectives

A robust set of objectives has been developed to represent the outcomes to be achieved by the project (see Figure 1-4). The objectives have underpinned the options evaluation process and guided decision-making during design development. The objectives will also be used to guide decision-making during future design development for the project.

Figure 1-4 Project objectives

The project is needed to:

- service a growing population in the Western Parkland City
- provide rail access to Western Sydney International and the Aerotropolis
- connect with the existing Sydney Trains suburban rail network at St Marys, providing a link to the Central River and Eastern Harbour cities
- open access to jobs and increase potential for jobs growth in the Western Economic Corridor (including the Aerotropolis and Western Sydney International) and in the Greater Penrith to Eastern Creek Growth Investigation Area

- facilitate the movement of workers and airline passengers westwards, helping to rebalance demand and supply across Greater Sydney
- support and shape the sustainable growth of the Western Parkland City by optimising land use around station precincts
- create opportunities for precinct planning that would improve liveability in and around station precincts
- support access to urban renewal and new land release areas including the Greater Penrith to Eastern Creek Growth Investigation Area and the Western Sydney Aerotropolis precincts.

The proponent for the project is Sydney Metro, a NSW Government agency which has the responsibility for developing and delivering metro railways and managing their operation.

1.6 Status of on-airport planning approvals

The proposed action traverses, and provides stations within, Western Sydney International, on land owned by the Commonwealth and currently leased to Western Sydney Airport (the airport site).

Assessment and approval of the proposed action is governed by the Airports Act. This would involve the Commonwealth Infrastructure Minister varying the Airport Plan, subject to seeking and considering advice from the Commonwealth Environment Minister. There are several steps to the process as outlined in Chapter 2 (Planning and assessment process).

In September 2019, Sydney Metro lodged a Scoping Report for on-airport works (the proposed action) with the Commonwealth Infrastructure Minister to refer to the Commonwealth Environment Minister. The referral (EPBC 2019/8541) comprised the Scoping Report for on-airport works that described the proposed action, outlined the planning and approval process, and summarised the key environmental issues associated with the proposed action.

The Commonwealth Environment Minister subsequently advised that the assessment approach to inform the proposed variation of the Airport Plan be in the form of preliminary documentation (Appendix A). The preliminary documentation requirements of the Commonwealth Environment Minister were provided as a request for further information (Appendix B).
The Commonwealth Environment Minister requirements comprised two parts, being:

- Part 1 – Final Environmental Impact Assessment (subject of this document)
- Part 2 – Draft variation to the Airport Plan. The draft variation to the Airport Plan does not form part of this Final Environmental Impact Assessment. A copy would be provided to the Commonwealth Environment Minister along with this final environmental assessment.

The Draft Environmental Impact Assessment for on-airport works was placed on public exhibition between 21 October and 18 November 2020 as Appendix J in *Sydney Metro – Western Sydney Airport Environmental Impact Statement* (Project Environmental Impact Statement) (Sydney Metro, 2020a) in accordance with the requirements under section 95A of the EPBC Act. Following exhibition, the document has been finalised to reflect minor changes to haul roads and potential permanent spoil placement areas, finalisation of the Revised Biodiversity Development Assessment Report (Appendix C) and consideration of feedback received during exhibition.

Further detail on the process to vary the Airport Plan is provided in Chapter 2 (Planning and assessment process).

1.7 Purpose and structure of this document

The purpose of this document is to respond to Part 1 of the Commonwealth requirements by providing a Final Environmental Impact Assessment of the proposed action. This Final Environmental Impact Assessment:

- builds on information provided by the Scoping Report and Draft Environmental Impact Assessment for on-airport works. This includes a description of the construction and operation of the proposed action, an assessment of its environmental impacts, and management and mitigation arrangements for construction and operation (including integration with the broader on-airport environmental management framework)

- includes the consideration of Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) Significant Impact Guidelines, particularly those relating to actions on, or impacting on, Commonwealth land (Significant Impact Guidelines 1.2) (Commonwealth of Australia 2013a and b)
- considers the existing conditions of approval in the Airport Plan as they currently apply to the airport in the formulation of identified mitigation and management measures
- is a stand-alone document for the purposes of on-airport Commonwealth statutory assessment.

The structure of this Final Environmental Impact Assessment reflects the Commonwealth Environment Minister's requirements (Appendix B), and includes:

- the main Final Environmental Impact Assessment containing chapters on:
  - introduction (Chapter 1)
  - planning and assessment process (Chapter 2)
  - consultation (Chapter 3)
  - description of the proposed action (Chapter 4)
  - avoidance of impacts during development of design (Chapter 5)
  - description of the existing environment (Chapter 6)
  - assessment of environmental impacts (Chapter 7)
  - environmental management and mitigation measures (Chapter 8)
  - offsets (Chapter 9)
  - environmental history of Sydney Metro (Chapter 10)
  - conclusion (Chapter 11)
  - references (Chapter 12)
- supporting Appendices.

The environmental management framework, performance outcomes and mitigation measures presented in Chapter 8 (Environmental management and mitigation) generally apply to the proposed action, except where otherwise specified.

The Commonwealth Environment Minister requirements and where this information is addressed in this Final Environmental Impact Assessment is provided in the checklist in Appendix B.

2 Planning and assessment process

This chapter provides an overview of the statutory schemes that govern the planning and assessment process for the project. It includes further guidance on the on-airport statutory scheme for the proposed action.

2.1 Principal statutory schemes

There are three principal statutory schemes that govern the planning and approvals process for the project:

- the on-airport proposed action (proposed action) (EPBC 2019/8541) which is the subject of this document: *Airports Act 1996* (Cth) (Airports Act), applies to works located within the boundary of Western Sydney International, discussed in Section 2.2
- the off-airport proposed action (EPBC 2020/8687): *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- the project off-airport: *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act), discussed in the Project Environmental Impact Statement.

The land to which the different statutory regimes apply is illustrated in Figure 2-1, and the approvals process is summarised in Figure 2-2.

2.2 Airports Act 1996 (Cth)

2.2.1 Airport Plan for Western Sydney Airport

The Airports Act regulates certain Commonwealth-owned airports, including the development of airport sites to the exclusion of State planning laws. The Airports Act contains a planning framework under which each airport is required to prepare a master plan for approval by the Commonwealth Infrastructure Minister. For major airport developments, a major development plan is also required to be prepared and approved. For Western Sydney International, a transitional planning instrument, the *Western Sydney Airport – Airport Plan* (Airport Plan) (Department of Infrastructure and Regional Development, 2016a) has been determined under the Airports Act to guide development on the site as a greenfield site until a masterplan is put in place (Part 2 of the Airport Plan - Concept Design) and also to authorise the first stage of airport development subject to conditions (Part 3 of the Airport Plan – Specific Developments).

The Airport Plan was determined by the Commonwealth Infrastructure Minister in December 2016 following preparation and exhibition of an Environmental Impact Statement, and incorporates the conditions specified by the Commonwealth Environment Minister. Those conditions include the requirement for preparation and approval of a Construction Plan and a number of Construction Environmental Management Plans (CEMPs) prior to commencement of main construction works. Initial versions of those plans have been prepared and approved and main construction work on the airport commenced in September 2018.

2.2.2 Airport Plan variation for the proposed action

The proposed action will be authorised through a variation of the Airport Plan made by the Commonwealth Infrastructure Minister, to include the rail development and conditions for the rail development taking account of advice from the Commonwealth Environment Minister. The variation of the Airport Plan is a step to which section 160 of the EPBC Act applies. Section 160 and following sections of the EPBC Act set out a process for the Commonwealth Environment Minister to provide advice, and include the referral of the proposed action and the assessment of environmental impacts.

If the existing conditions in the Airport Plan for the Stage 1 airport development are not consistent with the proposed variation to accommodate the rail development (such as the requirement to prepare CEMPs specific to the rail development), the agreement of the Commonwealth Environment Minister would also be required for any variation to those existing conditions. Approval of the rail development under Part 9 of the EPBC Act will not be required.

The steps required to vary the Airport Plan are identified in Figure 2-2.

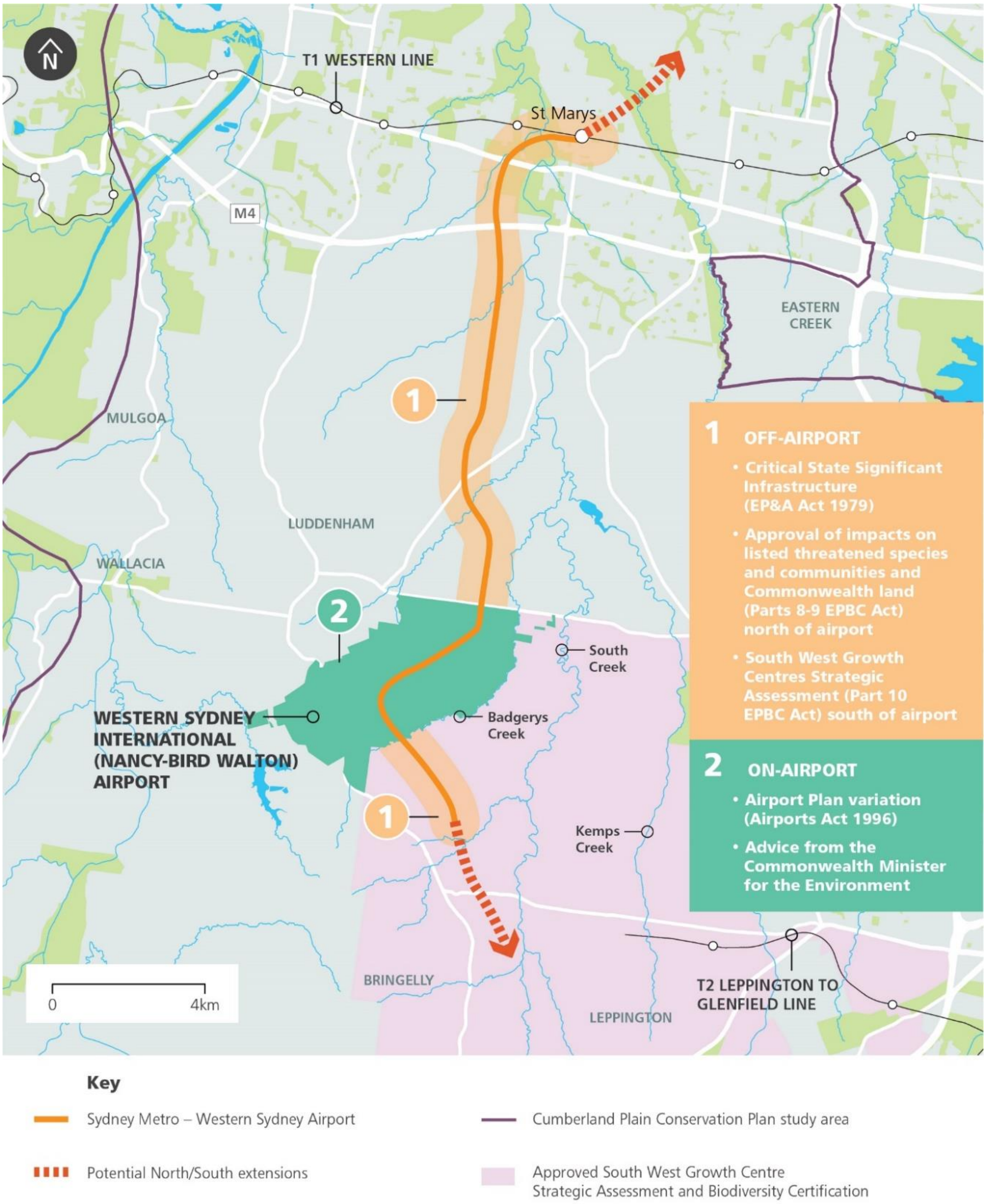


Figure 2-1 Planning approval context

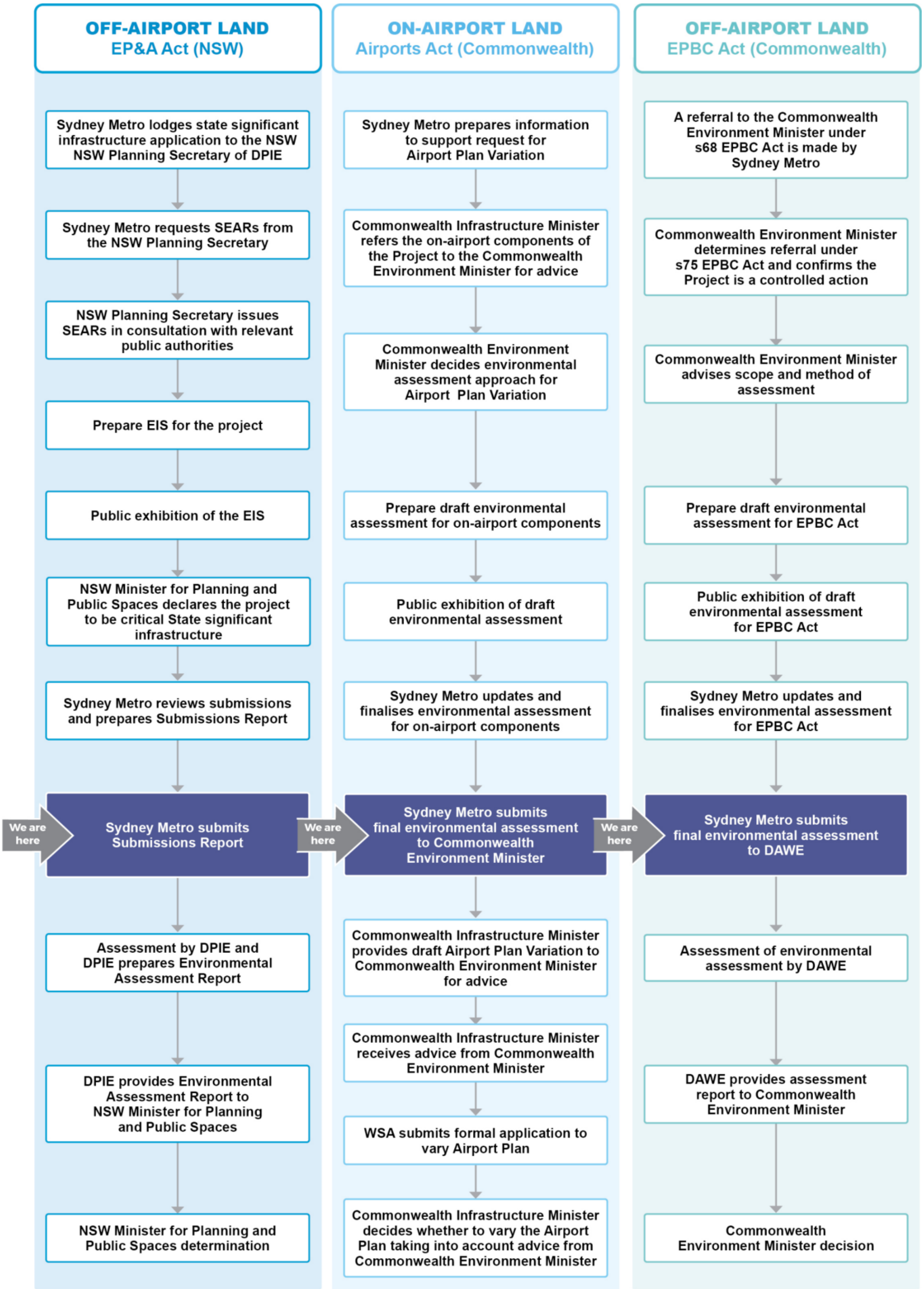


Figure 2-2 Summary of approvals process for the project

As discussed in Section 1.6 this environmental assessment is in the form of preliminary documentation in accordance with the requirements of the Commonwealth Environment Minister (Appendix B). The steps from here are:

- together with the response to Part 2 of the Commonwealth Environment Minister requirements, this Final Environmental Impact Assessment would enable the Commonwealth Environment Minister to provide informed advice to the Commonwealth Infrastructure Minister on the proposal to vary the Airport Plan to authorise the proposed action, together with what existing conditions should be modified (if any), and what new conditions (if any) should be attached to the Airport Plan variation to protect the environment, and any other matter relating to the protection of the environment from the proposed action
- the Commonwealth Infrastructure Minister would consider advice from the Commonwealth Environment Minister and decide whether to vary the Airport Plan.

2.3 Other approvals

Other permits and approvals would be required for the proposed action. These would include building approvals issued under the Airports (Building Control) Regulations 1996 (Cth) as well as (potentially) a permit under Part 13 of the EPBC Act.

3 Consultation

This chapter provides an overview of the consultation activities undertaken before and during the preparation of this Final Environmental Impact Assessment. It provides an overview of the stakeholder and community feedback received and how it has informed Sydney Metro – Western Sydney Airport, as well as future consultation and engagement planned for the proposed action.

3.1 Overview

Stakeholder and community consultation is integral to the development of the Sydney Metro – Western Sydney Airport project as well as informing and scoping investigations that have informed this document. Relevant stakeholder and community consultation undertaken for the proposed action has included that undertaken for Western Sydney International as well as consultation undertaken during the preparation and exhibition of the Draft Environmental Impact Assessment, and preparation of this Final Environmental Impact Assessment.

3.2 Engagement objectives

Community and stakeholder engagement is a priority for Sydney Metro. The Sydney Metro communication objectives are to:

- communicate the rationale for the project and broader benefits in delivering city-shaping rail that will support nationally significant growth in Western Sydney
- communicate the broader Sydney Metro product, projects and timing
- build community and key stakeholder relationships and maintain goodwill
- provide information about the planning approvals process and encourage community participation
- clearly communicate the corridor protection and property acquisition process.

The project team has developed a comprehensive community and stakeholder engagement program to proactively engage with local communities, key stakeholders and government agencies.

3.3 Consultation undertaken for Western Sydney International

3.3.1 Consultation undertaken

Consultation undertaken for the *Western Sydney Airport - Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b) and *Western Sydney Airport – Airport Plan* (Airport Plan) (Department of Infrastructure and Regional Development, 2016a) was undertaken in three phases:

- phase 1: preparation of the draft *Western Sydney Airport - Environmental Impact Statement* and draft Airport Plan, from September 2014 to October 2015
- phase 2: public exhibition of the draft *Western Sydney Airport - Environmental Impact Statement* and draft Airport Plan, from October 2015 to December 2015
- phase 3: the finalisation of the *Western Sydney Airport - Environmental Impact Statement* and preparation of the revised Draft Airport Plan from 19 December 2015 onwards, including consultation associated with publication of the finalised Environmental Impact Statement.

During the three phases, a number of community and stakeholder engagement activities were undertaken to raise awareness, provide further information and answer questions raised by community members about the project. Opportunities for engagement included information sessions and community information stalls held at locations across Western Sydney and the Blue Mountains. These were supported by a range of communications products including a series of fact sheets and the project website.

Separate communication and stakeholder management activities are being carried out in relation to Western Sydney International (including the construction of Stage 1), through the *Western Sydney Airport - Community and Stakeholder Engagement Plan* (Western Sydney Airport, 2019a) (Community and Stakeholder Engagement Plan). These include the quarterly Forum on Western Sydney Airport (FOWSA). FOWSA links the community, government and Western Sydney Airport during planning and construction of Western Sydney International and provides a consultative forum for the exchange of information and ideas. FOWSA members have a responsibility to inform their communities about planning and progress of the airport project, and to share information on a range of issues relating to the broader airport development. In turn, members will raise community concerns to be discussed at FOWSA meetings. A FOWSA meeting in September 2019 included discussion around rail development for Western Sydney International.

There would be ongoing consultation and coordination with Western Sydney International for areas surrounding the airport site.

3.3.2 Feedback received

Volume 5 (Submissions Report) of the *Western Sydney Airport - Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b) outlines concerns raised relating to the development of rail infrastructure on-airport, or cumulative impacts of the proposed action with the construction and operation of Western Sydney International. Table 3-1 outlines the key relevant feedback received and where these concerns are addressed in the Final Environmental Impact Assessment.

A large number of submissions expressed strong support for the planning and delivery of a multi-modal transport network to service the proposed airport. In particular, a rail link to the airport site was seen as necessary by the community to enhance economic and social benefits of the proposed airport, to minimise environmental impacts, and to support growth in the Western Parkland City.

Table 3-1 Relevant feedback received during Western Sydney Airport - Environmental Impact Statement 2016 consultation

Issues raised	Where considered in this EIA
Suggested options for the rail link, including: • continuing the South West Rail Link from Leppington to the airport site as a priority and continuing on to the Western Line near St Marys • establishment of a north–south rail connection between urban centres to the north and southwest connecting to the airport site • expansion of the Sydney Metro network by extending the Northwest line to the airport site, extending the Southwest line from Bankstown (potentially via Liverpool) to the airport site, or a combination of both.	The options considered for the project are discussed in Chapter 6 (Project development and alternatives) of the Project Environmental Impact Statement.
Concern that the Stage 1 development of the airport would not be able to commercially support the need for a rail link.	The need for the project is discussed in Section 1.5. Further information on the strategic context is provided in Chapter 2 (Strategic need and justification) of the Project Environmental Impact Statement.

Issues raised	Where considered in this EIA
Concern around the assessment of impacts of the airport and a rail link to better understand the difference in direct and cumulative impacts that would result, including impacts to traffic and transport, noise and vibration, air quality, social and economics, and planning and land use.	An assessment of cumulative impacts is provided in Section 7.16.
Requests for clarity and commitment to the timing of provision of rail services through the airport site.	An indicative construction program for the project, and further information regarding the estimated time of opening is outlined in Section 4.2.1.
Submissions called for coordinated planning of the airport and other transport infrastructure including the Outer Sydney Orbital corridor, M12 Motorway and various rail connections.	It is noted that a number of transport infrastructure projects are currently being carried out or proposed within Western Sydney. The development of this infrastructure is being coordinated using a whole of government approach to ensure that planning in this region is undertaken in an organised and efficient manner. An overview of how the proposed action interfaces with other existing and proposed major transport projects is provided in Section 7.16.

3.4 Consultation undertaken during preparation of the Draft Environmental Impact Assessment

3.4.1 Overview

Consultation for the proposed action was largely carried out as part of the preparation of the Draft Environmental Impact Assessment. Feedback received during this consultation from government agencies, non-government stakeholders and the community is provided in the following sections.

3.4.2 Consultation undertaken

Government agency and key stakeholder consultation

The Sydney Metro project team ensured that government agencies and key stakeholders were proactively engaged and informed about the proposed action during preparation of the project's Environmental Impact Statement. Regular briefings were held to keep stakeholders informed and to ensure key issues raised were addressed.

Key stakeholder meetings

Consultation has occurred and would continue to occur with the following stakeholders through regular meetings, presentations and phone calls.

- Australian Government:
  - Department of Infrastructure, Transport, Regional Development and Communications (DITRDC)
  - Department of Agriculture, Water and the Environment
  - Infrastructure Australia
- NSW Government:
  - Department of Planning, Industry and Environment (DPIE) (incorporating the Environmental Protection Authority (EPA) and Energy, Environment and Science Group)
  - Department of Premier and Cabinet (Heritage NSW)
  - Infrastructure NSW
  - Greater Sydney Commission

  - NSW Land and Housing Corporation
  - Transport for NSW
  - Western Sydney Planning Partnership
  - Western Parkland City Authority
  - Western Sydney City Deal Delivery Office
- local Government:
  - Penrith City and Liverpool City Councils
  - Other Western Sydney City Deal Councils (Wollondilly, Campbelltown, Fairfield, Hawkesbury, Camden, Blue Mountains)
  - Blacktown City Council
- other key stakeholders:
  - Western Sydney Airport
- utility providers:
  - Endeavour Energy
  - TransGrid
  - Jemena Gas
  - Sydney Water
  - WaterNSW
  - Telecommunications, including Telstra, Optus, NBNCo, Nextgen, AARNet, PIPE Networks.

Western Sydney City Deal partnership

Sydney Metro has worked collaboratively with government agencies and councils within the framework of the Western Sydney City Deal partnership. Through this partnership, representatives from local councils are embedded in the project team and are part of the process for land use planning and project development.

Industry consultation

An industry briefing session was held on 6 December 2018 at the Hilton Hotel, Sydney. The briefing detailed plans for Sydney Metro projects including an outline of the scope for Sydney Metro – Western Sydney Airport. The session was attended by approximately 700 industry representatives from Australian and international firms, who were provided with information on the process for industry to contribute to the project and take part in its delivery. Attendees received a copy of the booklet ‘Sydney Metro Industry Briefing, December 2018’ (NSW Government, 2018).

Targeted industry engagement

An initial targeted engagement with industry was undertaken in December 2018. The purpose of engagement was to obtain market information to inform the development of project requirements and a project definition for Sydney Metro – Western Sydney Airport. Project delivery options were explored with participants and will be further tested with industry in later stages of engagement.

Further industry engagement was undertaken in May and June 2019, to refine delivery and procurement strategies for the project. Participants across a broad section of relevant delivery market sectors were engaged during this process.

Design workshop

A design workshop facilitated by Sydney Metro was held on 5 and 6 February 2019 to workshop land use and precinct planning around the proposed project alignment. Participants included stakeholders from the DITRDC; Transport for NSW; NSW Land and Housing Corporation; DPIE; Greater Sydney

Commission; Western Sydney Planning Partnership and local councils (Blacktown, Campbelltown, Liverpool, Penrith and Camden).

Aboriginal stakeholder consultation

A program of Aboriginal community consultation is ongoing, in accordance with *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (Department of Environment, Climate Change and Water, 2010b). This has included identification, notification and registration of Aboriginal Parties who hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects and/or places in the study area.

During preparation of the Draft Environmental Impact Assessment, a total of 68 Registered Aboriginal Parties (RAPs) were provided with project information, along with the draft assessment methodology, for comment and feedback and an invitation to participate in field survey work.

During preparation of the Aboriginal cultural heritage assessment report that formed part of the Project Environmental Impact Statement the following feedback was received from the Aboriginal community regarding Aboriginal cultural heritage values:

- the entire study area would have been once occupied and inhabited by Aboriginal people in the past, and is still culturally significant to the Aboriginal community of today
- in the past Aboriginal people in this area walked the land, participated in ceremonies and dance, had camp sites and used fire for cooking in the hot coals, undertook burials in soft ground, marked trees to indicate culturally significant areas, fished in waterways and used them as a source of drinking water. The waterways and their tributaries that traverse the construction footprint hold cultural significance, and were used in the past for their abundant natural resources and as natural landform boundary markers
- landscape features such as waterways provide connections between known sites, and connections of continuity from the past landscape to the present environment for the contemporary Aboriginal community
- the waterways that cross the construction footprint have cultural significance as they were used as pathways and resource areas for Aboriginal people in the past
- previously identified Aboriginal sites are markers of the past providing direct links for the contemporary Aboriginal community to their ancestors
- there is the potential for further, as yet unidentified, sites to occur. Any such sites would have associated cultural values
- there are some cultural sites as yet unregistered on the Aboriginal Heritage Information Management System (AHIMS) known by the Aboriginal community to occur in the area surrounding the construction footprint. At this stage no known cultural sites as yet unregistered on AHIMS have been identified within the construction footprint
- all Aboriginal sites are considered to be of high cultural value to the Aboriginal community as they provide a tangible link to ancestors and are a physical marker in the landscape attesting to the long-term presence of Aboriginal people in this area
- cultural values identified thus far rest in the identified sites, potential sites and landscape features such as waterways
- evidence of past Aboriginal activity does not form bounded ‘sites’ for the Aboriginal community but rather is seen as one connected cultural landscape
- the cumulative impact of this project with other development proposed in the region (such as the Aerotropolis) is seen by the Aboriginal community as removing/destroying the remnant Aboriginal sites and associated cultural values across a larger area
- recommendations to undertake further investigations (survey and test excavation), including the proposed methodology for these investigations, are supported prior to impacts occurring.

Collaboration with Western Sydney Airport

Sydney Metro has participated in ongoing consultation with Western Sydney Airport regarding the project's interface with Western Sydney International. This has included sessions regarding the design of the project, construction program, construction impacts, and environmental management approach.

Project surveys

The community was invited to participate in two online project surveys, one in Quarter 1 and one in Quarter 3 of 2020.

The first survey was held between 17 February and 20 March 2020. The objective of this survey was to gather valuable community insights into transport priorities for Greater Western Sydney and to help shape future station precincts. The survey included a combination of multiple choice and open-ended questions, all of which are provided in Appendix D (Stakeholder and community engagement) of the Project Environmental Impact Statement.

This survey was published on the project website. A project flyer was letterbox dropped to around 16,000 properties between St Marys and Bringelly and an email was sent to about 2,500 people who had subscribed to the project email distribution list, promoting the survey.

Stakeholders were also informed about this survey through the City Deal Communications and Engagement sub-committee, which includes members of Australian and NSW government agencies and the eight councils of the Western Parkland City.

During the online community survey:

- 1,703 people responded including 885 people responding to open-ended questions
- 3,500 people visited the survey site
- 508 people subscribed to the email distribution list to receive further project updates.

A second survey was held between 8 July and 24 July 2020. The objective of the survey was to gather insight into how the community intends to use the new metro service, and how best to keep the community informed about potential construction impacts. The survey consisted of multiple choice questions.

This survey was published on the project website. A project flyer was letterbox dropped to around 3,300 properties between St Marys and Bringelly and an email was sent to about 4,000 people who had subscribed to the project email distribution list, promoting the survey.

Stakeholders were also informed about this survey through the City Deal Communications and Engagement sub-committee.

There were 326 responses received and survey feedback identified:

- 86 per cent live or work in Greater Western Sydney
- 18 per cent were local business owners largely in:
    - building and construction
    - administration and office support
    - education and training
    - information and technology
    - transport and logistics
    - retail and sales
- 43 per cent said their local metro station would be St Marys, followed by 29 per cent Orchard Hills, 11 per cent Aerotropolis, nine per cent Airport and eight per cent Luddenham.

3.4.3 Summary of feedback received

Feedback received throughout consultation with local, State and Australian government agencies, infrastructure and service providers, special interest groups, businesses and the community has been summarised in Table 3-2.

Table 3-2 Key issues raised during consultation

Issue category	Key issues raised	Where addressed
Station locations and future rail lines	• suggestions for desired station locations • support for or objections to known station locations • additional future metro stations at locations such as Marsden Park • safeguarding for future rail lines	• Chapter 6 (Project development and alternatives) of the Project Environmental Impact Statement provides a discussion on the station location option evaluation process and potential future extensions of the project
Precinct planning	• support for integrated precincts to be developed around metro stations • comments around public spaces at new metro stations	• Section 4.1 outlines proposed public spaces at the airport stations and integrated precincts • Chapter 7 (Project description – operation) of the Project Environmental Impact Statement provides a discussion regarding placemaking and the provision for potential future integrated station and precinct developments
Surrounding infrastructure	• ensuring sufficient surrounding infrastructure to support the new metro, including transport links such as buses and active transport • roads and existing public transport infrastructure insufficient to support new metro	• Section 7.1 provides an assessment of the impacts of the proposed action on the existing road network, including public transport
Accessibility	• ensuring that stations are accessible and consider vulnerable people and people with disability	• Chapter 7 (Project description – operation) of the Project Environmental Impact Statement provides a discussion regarding key metro characteristics, including accessibility
Timing of the project	• immediate need for the project to commence and be open prior to passenger services commencing at Western Sydney International	• Section 4.2 provides an indicative timeframe for the project
Integration with strategic planning documents	• integration with existing local Council and State strategic planning documents and guidelines	• Chapter 2 (Strategic context and project need) of the Project Environmental Impact Statement provides an overview of the strategic planning documents that have guided the project • Section 7.11 provides an assessment of the proposed action’s impact on existing and planned land use

Issue category	Key issues raised	Where addressed
Impacts during construction	• comments and concerns around potential temporary construction impacts (e.g. noise and vibration, traffic impacts, air quality, and cumulative impacts)	• potential temporary impacts of the proposed action during construction are assessed in Section 7.1 to Section 7.16
Impacts on transport	• congestion due to increased traffic • congestion on local streets due to commuters • consideration of active transport links to increase connectivity	• Section 7.1 provides an assessment of impacts on the road network during construction and operation of the proposed action
Impacts on parking	• ensuring there is sufficient parking at stations • concerns about on-street parking on residential streets	• Section 7.1 provides an assessment of the proposed action's impacts on parking
Impacts on property	• questions and uncertainty around property acquisition • damage to property during tunnelling work	• Section 7.11 provides an assessment of the proposed action's impact on land use and property • Section 7.13 provides an assessment of health and wellbeing impacts resulting from uncertainty caused by the proposed action • Section 7.7 provides an assessment of potential settlement impacts and damage to property
Social impacts	• comments and concerns around loss of rural lifestyles	• Section 7.13 provides an assessment of impacts on lifestyle during construction and operation of the proposed action
Impacts on flora and fauna	• comments and concerns regarding potential impacts on flora and fauna	• Section 7.3 provides an assessment of the proposed action's impact on flora and fauna
Impacts on utilities	• protection of the Warragamba to Prospect Water Supply Pipelines • coordination of utility services	• Section 4.2.2 provides a discussion on utility protection, adjustment and relocation
Integration with Western Sydney International	• integration of the on-airport stations with the Western Sydney International master plan • consideration of the operating hours for the project • site access issues during concurrent construction activities • discussion regarding the rail easement, the vertical and horizontal rail alignment, site drainage assumptions and remediation works on-airport land	• Section 5.2 and Section 6.3 provide a discussion on the integration of the proposed action with Western Sydney International • Section 4.1.6 outlines the hours of operation for the proposed action, the track and corridor alignment and drainage system • Section 4.2.9 describes construction traffic access and egress • Section 7.1.4 discusses construction traffic impacts • Section 6.10.4 and Section 7.8 discuss remediation works on airport land

3.5 Public exhibition of the Draft Environmental Impact Assessment

The Draft Environmental Impact Assessment was on public exhibition in accordance with the provisions of the EPBC Act between 21 October and 18 November 2020.

During this Commonwealth exhibition period, government agencies, project stakeholders and the community were able to review the Draft Environmental Impact Assessment and make a written submission via **sydneymetrosubmissions@transport.nsw.gov.au** or via post as part of the assessment of the proposed action.

Communication tools and channels that were implemented during public exhibition included:

- project overview book
- newsletter letterbox drop
- online Environmental Impact Statement portal for the Project Environmental Impact Statement featuring a virtual community drop-in session, interactive map, Environmental Impact Statement chapters and technical papers
- traditional and social media engagement
- videos with Subject Matter Experts
- a project webpage
- displays at local councils and libraries
- stakeholder meetings
- government stakeholder engagement.

At the completion of the Commonwealth exhibition period, two submissions were received in relation to the Draft Environmental Impact Assessment under the provisions of the EPBC Act. At the completion of the State exhibition period, submissions that raised Commonwealth issues were received under the provisions of the EP&A Act. These submissions are outlined in Section 3.6 and have been taken into consideration in the preparation of this Final Environmental Impact Assessment.

3.6 Response to submissions

3.6.1 Commonwealth exhibition process

Two submissions were received through the Commonwealth exhibition period – an individual and a submission from a consortium of landowners. No submissions were received from government agencies, local councils, or other key stakeholders. These submissions and the response from Sydney Metro are outlined in Table 3-3.

Table 3-3 Response to submissions

No.	Issue raised	Response
1	Suggestion for a fast metro line from Central Station to Western Sydney Airport with stations at Olympic Park and Parramatta.	Planning for Sydney Metro West is currently underway and involves a new 24-kilometre metro line that would connect Greater Parramatta with the Sydney CBD. Confirmed stations include Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Sydney CBD. The location of the Sydney CBD station will be determined following further investigations. As shown in the Sydney Metro network figure (Figure 1-5 of the Project Environmental Impact Statement), a future metro line has been identified to extend the Sydney Metro West line through to the Western Sydney International (Nancy-Bird Walton) Airport. The potential future East West Rail Link to connect Greater Sydney's three cities, will provide rail connectivity between the Western Parkland City, the Central River City and the Eastern Harbour City. The Sydney Metro – Western Sydney Airport project has been designed to allow for development of future rail lines, including the potential future East West Rail Link and extension of the existing South West Rail Link. This has included provision of space within the corridor, where the rail infrastructure is at surface, from north of Elizabeth Drive to the Aerotropolis Core to allow for development of these potential future rail links. The Airport Business Park, Airport Terminal and Aerotropolis Core stations have also been designed to allow for the future development of these potential rail links.
2	Full support of the project and the overall benefits of such a project	Sydney Metro notes the support expressed for the project.
	Suggestion for consideration of direct access for pedestrians and cyclists from the western boundary of the airport site to Airport Terminal Station. Such access would support the Agribusiness Precinct identified along the western boundary of the airport site and could be achieved (for example) by a tunnel under the western runway. The benefits of a proposal could include increased patronage of the Airport Terminal Station, direct connection to the Agribusiness Precinct and a fully integrated and connected Western Sydney Aerotropolis.	As noted in Section 6.3.1, pedestrian and cycle infrastructure is not currently provided within the airport site and is limited in the local area. Pedestrian and cycle facilities that would be provided as part of the project are outlined in Section 7.4 of the Project Environmental Impact Statement (for each station precinct). The pedestrian and cycle connections to be provided for the wider Western Sydney Aerotropolis are beyond the scope of the Project Environmental Impact Statement. Objectives and opportunities for active transport corridors for the Western Sydney Aerotropolis precincts are identified in the *Western Sydney Aerotropolis* Plan (NSW Government, 2020). An extension of Anton Road is identified as part of the principal regional cycle path network (off-road). An active transport connection will be provided from Elizabeth Drive to the Airport Terminal station via the Airport business park connecting to the wider active transport network.

3.6.2 State exhibition process – community submissions

A number of community submissions received through the State exhibition period raised issues that relate to the proposed action.

A summary of submissions and the response from Sydney Metro for on-airport works is outlined in Table 3-4. Detailed responses to all community submissions received during the State exhibition period are provided within the State Submissions Report.

3.6.3 State exhibition process - government and key stakeholder submissions

A number of government and key stakeholder submissions received through the State exhibition period raised issues that relate to the proposed action.

A summary of submissions and the response from Sydney Metro for on-airport works is outlined in Table 3-5. Detailed responses to all government and key stakeholder submissions received during the State exhibition period are provided within the State Submissions Report.

Table 3-4 Response to community submissions – State process

Issue category	Issue raised	Response
Consultation during construction and complaints handling	A submitter raised concern over how they would submit complaints during construction	A toll-free community information line (1800 717 703) is in place. This community information line provides an opportunity for the community to contact the Sydney Metro project team, ask questions and seek further information. All complaints handling would be conducted in accordance with the Construction Complaints Management System. As a requirement of the Overarching Community Communications Strategy (Appendix D), contractors would be required to adhere to a Construction Complaints Management System which would outline the framework for managing complaints, enquiries and escalation processes throughout the project lifecycle. The community contact and information points outlined in Table 3-6 would also continue to remain in place for the duration of the project.
Metro rail alignment	Submitters raised the following comments and suggestions about the vertical alignment of the project, including: • comment that the project includes an excessive amount of tunnel sections which increases the cost of the project • comment that tunnelling is unnecessary through relatively undeveloped land for the southern tunnel between Western Sydney International and Bringelly and that a shorter tunnel to the Airport Terminal Station would be more suitable	The vertical alignment options analysis for the project is summarised in Section 6.6.2 of the Project Environmental Impact Statement. A tunnel alignment was selected for the project in two locations to reduce community impacts, avoid substantial property acquisition, improve land use outcomes, provide additional flexibility for transport integration, and provide the opportunity for the development of a city centre well integrated with the stations. A tunnel alignment would also provide the opportunity to create a civic focus, a vibrant city heart and high-quality public domain for the public and pedestrians on arrival to the stations. A tunnel alignment allows for unimpeded public and pedestrian connection between the built urban fabric. The vertical alignment was developed to be in-tunnel between Western Sydney International and Bringelly to avoid a avoid a number of constraints including Badgerys Creek (and associated on-airport Environmental Conservation Zone), potential for flood impacts, areas of endangered ecological communities (including Cumberland Plain Woodland), local heritage items (including an area of Aboriginal archaeological heritage), private properties, potential difficulty in achieving safe and feasible road design at the interface with Derwent Road and Badgerys Creek Road, and ongoing development of master planning and land use outcomes for the future Aerotropolis Core precinct.

Issue category	Issue raised	Response
		Compared to a surface alignment, a tunnel through this section was also considered to provide an opportunity to optimise the alignment between the Airport Terminal Station and Aerotropolis Core Station, improving the journey time for customers.
Metro station design	Submitters raised the following issues about the design of metro stations: • queried whether stations would be designed to provide shade and weather protection • queried whether the project would provide wayfinding, tactile geographical indicator strips, ramps, audio described lifts with braille buttons, hearing loops, accessible toilets and parking • queried whether bicycle parking would be provided at stations • commented that the length of station platforms is not provided in the Project Environmental Impact Statement, and four-carriage station platforms would be sufficient with any added capacity in the future to be met by increased train frequency (rather than an increase in size of stations to cater for greater than four-carriage trains)	Section 7.4 of the Project Environmental Impact Statement provides an overview of the design drivers and key design elements for each of the proposed metro stations. Adequate shelter would be provided at the stations. The Design Guidelines (Appendix G) provide direction for station design, and in accordance with these guidelines, metro station entrance plazas would be sheltered from the weather so customers can travel to their destination comfortably. Indicative layouts, elevations and artists impressions in Section 4.1.3 of this Final Environmental Impact Assessment show that the stations are to be designed to provide protection from the sun and rain. The project would be designed to meet the operational performance outcomes for transport, which includes the requirement for stations and interchanges to be fully accessible and compliant with the *Disability Discrimination Act 1992* (Cth) (Disability Discrimination Act) and the *Disability Standards for Accessible Public Transport* (Australian Government, 2002). Accessible parking spaces would be provided for commuters in accordance with the Disability Discrimination Act and to meet the *Disability Standards for Accessible Public Transport.* Section 7.3.2 of the Project Environmental Impact Statement also details common station elements that would be incorporated to each of the proposed metro stations, which would include signage and wayfinding. As detailed in Section 4.1.6, the project is being designed for ultimate service capacity of up to four carriages per train, and a frequency of up to 20 trains per hour during peak periods, therefore the stations are proposed to be built for this length of train.

Issue category	Issue raised	Response
Metro operations	A submitter queried if persons travelling to and from the airport (with multiple luggage loads) will have control to delay the closing of metro train doors	Section 7.5.4 of the Project Environmental Impact Statement provides an overview of the signalling systems and train control for the project. The signalling system would control the stopping of trains at stations and the opening and closing of train and platform screen doors. The project will take into consideration passengers with luggage through suitable dwell times (the time the train remains with its doors open) at key locations such as St Marys Station and Airport Terminal Station.
Noise and vibration impacts during construction	Submitters raised concern about noise and vibration impacts during tunnelling construction works, including concerns about noise and vibration impacts from tunnelling works required for the Western Sydney International to Bringelly tunnel	Potential construction noise and vibration impacts are discussed in Section 7.2.4. The vibration levels from the Tunnel Boring Machine (TBM) have been predicted for each sensitive receiver and are presented in Figure 4-52 of *Sydney Metro – Western Sydney Airport, Noise and Vibration Assessment* (Sydney Metro, 2020c) for the Western Sydney International to Bringelly tunnel. No impacts on sensitive receivers are anticipated from ground-borne noise and vibration associated with tunnelling within Western Sydney International due to the limited duration of potential vibration target exceedances from tunnelling, and the distance and location of the closest sensitive receivers from the on-airport works. Construction noise and vibration impacts on sensitive receivers from on-airport works (including airborne noise and ground-borne noise and vibration) would be managed in accordance with the Construction Noise and Vibration Standard (Appendix F).

Issue category	Issue raised	Response
Flooding impacts	Submitter raised concerns about the potential flooding impacts of the project, including flooding impacts on rail tunnels during heavy rainfall events	Section 7.6 provides a summary of how the project has been designed to mitigate flooding impacts on-airport and an assessment of flooding impacts during construction and operation of the proposed action. The project would be designed to meet the performance outcomes for hydrology and flooding which require that critical infrastructure, including station entries and tunnel portals, are designed to have immunity against the probable maximum flood event. Further investigation and modelling would be carried out during design development and appropriate arrangements would be in place to manage any flood events should they occur during either construction or operation. Mitigation measure OHYD1 has been updated to require that the flood model for the project be updated with regard to flood modelling undertaken for the South Creek Sector Review (anticipated to be released in 2021) and would include updated calibration and validation.
Ground movement impacts during construction	Submitters raised concerns about ground movement impacts during construction, including that tunnelling works would result in ground disturbance during construction of the Western Sydney International to Bringelly tunnel	Section 7.7.4 provides an assessment of potential ground movement due to construction of Western Sydney International to Bringelly tunnel within the airport site using the Rankin (1988) risk classification. An assessment of potential impacts to existing buildings and structures within the airport site was not required as the surface environment is assumed to have been cleared. The preliminary assessment assumes that ground movements arising from the proposed action would occur prior to construction of the Airport Terminal building and associated civil works at the airport. Consultation with Western Sydney Airport will be ongoing in respect to the construction programs for both projects to understand the potential for ground movement impacts to proposed buildings and structures. For the Western Sydney International to Bringelly tunnel, the maximum predicted ground movement from construction of the twin tunnels south of Badgerys Creek is expected to be within the 5 to 10 millimetre range which is in the negligible risk category for buildings and structures using the Rankin (1988) risk classification.

Issue category	Issue raised	Response
Reuse and recycling targets	A submitter asked how much reused, recycled and recyclable products would be used for the project.	Potential project-wide sustainability objectives have been identified in Table 7-47 for inclusion in the project's Sustainability Plan. These sustainability objectives include targets and initiatives for reuse and recycling and would be integrated into the design, construction and operation of the project, following confirmation during further design development. Opportunities to use recycled products would be identified and prioritised during detailed design, where they are able to meet performance and durability requirements. The majority of materials that would be used for the project (concrete and steel) are for infrastructure with a more than a 100 year design life, and are readily recyclable. Examples of some reuse and recycling-related initiatives identified in this document include 100 per cent beneficial reuse of usable spoil generated by the project, in accordance with the project spoil management hierarchy and a target of 95 per cent construction and demolition waste recycling. The types and quantities of construction waste generated by the proposed action would be site specific and would vary throughout the stages of construction. The volumes of other construction wastes (i.e. apart from spoil) are expected to be comparable to other infrastructure projects of similar type and scale so were not estimated as part of the on-airport environmental impact assessment. These construction waste volumes are expected to be manageable through the application of standard waste management strategies (addressing waste generation, storage, disposal and reuse) and the project-specific sustainability initiatives documented in Section 7.9.3.
Bushfire risks	A submitter asked how the project would manage bushfire risks	Section 7.15.4 assesses the potential bushfire risks of the project during construction and operation. The project traverses bushfire prone land on-airport. Areas of vegetation within the Western Sydney International site will be removed as a result of the bulk earthworks associated with Stage 1 of the airport. It should also be noted that a significant length of the metro rail corridor through the Western Sydney International site will be in tunnel which reduces potential bushfire risk during operation. Mitigation measures HR2 and OHR2 require that a Bushfire Management Plan would be prepared and implemented to manage current bushfire risk and identify

Issue category	Issue raised	Response
		response actions during construction and operation of the project. The Plan would be prepared in consultation with the NSW Rural Fire Service and Western Sydney Airport. For project areas on-airport the Bushfire Management Plan would be prepared having regard to the existing *Western Sydney Airport Site at Badgerys Creek Bushfire Risk Management Plan* (Western Sydney Airport Corporation, 2019).
Cumulative land use and transport impacts	A submitter raised concerns about cumulative land use and construction transport impacts from the future M12 Motorway project and the project on their property	Potential cumulative transport and land use impacts from the construction and operation from Stage 1 of the Western Sydney Airport and the proposed action, and of the proposed action and surrounding developments (including the future M12 Motorway) are identified and assessed Section 7.16. An assessment of land use impacts is provided in Section 7.11. Cumulative land use impacts may occur during operation as the proposed action is located within Western Sydney International and is surrounded by areas subject to extensive land use change arising from other infrastructure projects (such as the future M12 Motorway and Western Sydney International) and broader strategic planning processes. Key potential cumulative transport impacts during construction include a temporary increase in construction vehicles on the road network, in particular north of Western Sydney International, and associated impacts as a result of overlapping construction activities from the future M12 Motorway and Western Sydney International which are due to be completed in 2025 and 2026 respectively. The project would be designed to meet the performance outcomes for potential cumulative impacts which includes the requirement for potential cumulative impacts to be managed through coordination of construction activities and communication processes with nearby projects (including Western Sydney International and future M12 Motorway). Mitigation measure CL1 requires that a Cumulative Construction Impacts Management Plan would be developed and would detail coordination and consultation requirements with the following stakeholders (as relevant), to manage the interface and potential impacts of projects under construction at the same time: • Western Sydney Airport

Issue category	Issue raised	Response
		• Transport for NSW • Western Parkland City Authority • Sydney Water • Emergency service providers • Utility providers. Coordination and consultation requirements with these stakeholders would be detailed in the plan to include: • provision of regular updates to the detailed construction program, construction sites and haul routes • identification of key interfaces with other construction projects • development of mitigation strategies to manage cumulative impacts associated with these interfaces.
Future metro extensions	Submitters raised the following about possible future extensions of the Sydney Metro network which is beyond the scope of the project: • comments about and requests for a potential northern extension of the project from St Marys to Tallawong (Metro North West Line in Rouse Hill) • queried whether stations in Macarthur and Oran Park would be provided as part of a southern extension of the project between Western Sydney Aerotropolis and Macarthur / Campbelltown • comments about and requests for a potential South-West Rail Link extension between	The project is the first stage of the recommended North South Rail Line Corridor and has been prioritised in order to provide rail access to Western Sydney International and an interchange with the existing Sydney Trains network. Planning is also underway to deliver: • a new metro line from Westmead to Western Sydney International • a new metro line from Western Sydney International to Macarthur • a new metro line from Bankstown to Liverpool • extending the Metro North West Line from Tallawong Station at Rouse Hill via Schofields to St Marys Station. As part of the Western Sydney City Deal, the NSW Government has committed to investigating a range of other transport connectivity initiatives to support the Western Parklands City. For example, *Future Transport 2056* prioritises rapid bus services from the metropolitan centres of Penrith, Liverpool and Campbelltown to the new airport and Aerotropolis, continued planning for a rail connection between Leppington and the new airport precinct, and additional road, cycling and walking connections to support access to jobs and services.

Issue category	Issue raised	Response
	Aerotropolis Core and Leppington • query whether metro rail would be extended to provide a connection between St Marys and Parramatta	
Concerns about Western Sydney International	Submitters raised comments about Western Sydney International which is beyond the scope of the project, including: • concerns about 24 hour operation of the airport • concerns about noise impacts from flight paths associated with the airport • comments that Western Sydney International is not needed, and that there is no justification for the project without a viable airport • suggestion that there should be a fully enclosed or underground pedestrian connection between the Airport Terminal Station and Western Sydney International • suggestion for active transport connections between the Airport Terminal Station and the western boundary of the site, and for cycle path access to	The need for and the operation of Western Sydney International is outside the scope of the Sydney Metro – Western Sydney Airport project and subject to separate approvals by the Australian government. Western Sydney International is currently under construction, with operations scheduled to start in 2026. The new airport will support growth of the international and domestic passenger and freight markets, and the district's economy, by attracting visitors to the Western Parkland City. Customer access between the Airport Terminal Station and the Airport Terminal would be weather protected and is currently being designed by Western Sydney Airport. The design of this access is beyond the scope of the Sydney Metro – Western Sydney Airport project and Project Environmental Impact Statement. Objectives and opportunities for active transport corridors for the Western Sydney Aerotropolis precincts are identified in the Draft Aerotropolis Precinct Plan (NSW Government, 2020). An extension of Anton Road is identified as part of the principal regional cycle path network (off-road). An active transport connection will be provided from Elizabeth Drive to Airport Terminal Station via the airport business park connecting to the wider active transport network.

Issue category	Issue raised	Response
	Western Sydney International at Anton Road support connectivity of the Agribusiness Precinct and wider Western Sydney Aerotropolis	

Table 3-5 Response to government and key stakeholder submissions – State process

Stakeholder	Issue category	Issue raised	Response
Liverpool City Council	Project description - operation	Council raised concern about the lack of detail surrounding the station precincts and associated business opportunities and noted that this information is required for Council to assess the potential economic impacts of the project.	At the on-airport stations, Sydney Metro would work with Western Sydney Airport to ensure the required transport integration elements are effectively delivered to support the project.
Liverpool City Council	Biodiversity	Council raised the following concerns: • There is limited detail detailing how he proposed permanent spoil placement area would avoid impacts on the Badgerys Creek Environmental Conservation Zone • On-airport impacts considered within the Revised Biodiversity Development Assessment Report (Appendix C) are restricted to the Stage 1 Construction Impact Zone and do not consider the adjacent Environmental Conservation Zone • Council requested that further details regarding activities associated with the permanent spoil placement area, potential impacts on the Environmental Conservation Zone, and proposed mitigation measures and recommends additional mitigation measures be included to support the conclusion of these assessments	The airport construction support site (which includes the potential permanent spoil placement areas) has been located outside of the Environmental Conservation Zone consistent with the intent of the Airport Plan and recognising the environmental values of Badgerys Creek and associated remnant native vegetation. In relation to protecting the Environmental Conservation Zone, a riparian buffer of 40 metres (measured from top of bank) was identified consistent with the NSW waterway guidelines and NSW Biodiversity Assessment Method (BAM) and reflecting that that Badgerys Creek is a 4th order waterway. In addition, to further minimise edge effects and indirect impacts associated with noise, light and weeds on surrounding biodiversity values, a 20 metre buffer was identified around the outer limit of

Stakeholder	Issue category	Issue raised	Response
			remnant native vegetation adjacent to Badgerys Creek, including vegetation that lay outside the 40 metre riparian buffer already identified. These buffers are shown on Figure 4-21. In some instances, parts of the proposed riparian buffer and the proposed remnant native vegetation buffer extend into the airport construction support site. The layout of the airport construction support site (which accommodates the permanent spoil placement areas and related activities, as well as associated environmental protection control features such as sedimentation ponds, has been altered to ensure these buffers are not impacted. The known locations of threatened flora are noted, however direct or indirect impacts are not considered to occur on any threatened species not already considered within the Revised Biodiversity Development Assessment Report (Appendix C). The Revised Biodiversity Development Assessment Report has assessed impacts within the construction footprint outside the Stage 1 Construction Impact Zone including indirect impacts on Environmental Conservation Zone. Mitigation measure FF6 applies to the on-airport construction support site (potential permanent spoil placement area) which is located adjacent to the Environmental Conservation Zone. Mitigation measures FF1, FF6, and WQ1 would manage potential indirect biodiversity impacts of the project, including water quality impacts on

Stakeholder	Issue category	Issue raised	Response
			adjacent vegetation, reduced viability of habitat due to edge effects, loss of shade and shelter and loss of breeding habitats and managing shading and artificial light impacts to remnant bushland in intact condition. Additional mitigation measures to manage these potential impacts are provided in the Construction Environmental Management Framework (Appendix H) .
Liverpool City Council	Biodiversity	Council recommended replanting an equal or greater quantity of Cumberland Plain Woodland species within the vicinity of where the endangered ecological community is proposed to be removed from	A new mitigation measure (OLV7) has been included which requires the landscape design for the project to use native species from the relevant native vegetation communities within the local area for tree planting programs. While native species would be used for landscaping, the species may not include Cumberland Plain Woodland. A new mitigation measure (FF11) has also been included which outlines that a native vegetation seed collection and salvage program would be developed prior to the commencement of construction and implemented during construction. The seed collection and salvage program would target native species prioritising the Cumberland Plain Woodland species to be utilised in landscaping for the project where possible. Opportunities for use of collected and salvaged seed outside of the project would also be investigated. The biodiversity offsets and credit report for the project is detailed in Section 12 of the Revised Biodiversity Development Assessment Report (Appendix C). The residual impacts of the project on Cumberland Plain Woodland that are not able to be managed through mitigation

Stakeholder	Issue category	Issue raised	Response
			would be offset in accordance with the BAM and the biodiversity offset strategy described in Section 9.2.4. The project is committed to meeting its credit requirements for Cumberland Plain Woodland which would ensure the management and protection of Cumberland Plain Woodland in accordance with the BAM.
Department of Planning, Industry and Environment (Environment, Energy and Science) (EES)	Biodiversity	EES raised the following comments: • clarification is required as to whether the site of the previously recorded (2013) *Marsdenia viridiflora ssp viridiflora* species on Badgerys Creek Road was found during on-airport surveys • Table 6.5 of Technical Paper 3 – Biodiversity Development Assessment Report that formed part of the Project Environmental Impact Statement refers to Figure 8 of an expert report undertaken as part of the Cumberland Plain Conservation Plan for *Dillwynia tenuifolia*, but the figure in this expert report does not include the on-airport area	The majority of the *Marsdenia viridiflora ssp viridiflora* records identified on Badgerys Creek Road, including the record mentioned in the EES submission are within the Western Sydney International Stage 1 Construction Impact Zone where vegetation is to be cleared and earthworks undertaken to enable development of the airport. These records are not located within the Sydney Metro construction footprint. As a result, they have not been assessed by the Revised Biodiversity Development Assessment Report (Appendix C), as summarised in Section 6.5 and Section 7.3. Reference to the expert report has been removed, noting it does not show the on-airport area, and the Revised Biodiversity Development Assessment Report includes more recent and appropriate references to rounds of surveys conducted on-airport for this species.

Stakeholder	Issue category	Issue raised	Response
Department of Primary Industries (DPI Fisheries)	Biodiversity	DPI Fisheries recommended project approval be subject to the following conditions: • all final designs and construction of waterway crossings allow for suitable fish passage • any stream realignment be constructed to ensure habitat values are included	The project has been designed to minimise impacts on Key Fish Habitat through use of the tunnel beneath Badgerys Creek and the associated on-airport Environmental Conservation Zone. The mobilisation of sediments would be contained within the construction footprint and managed in accordance with mitigation measure OWQ3. The alignment is to be in tunnel under Badgerys Creek and buffer distances are proposed between the potential permanent spoil placement areas and Badgerys Creek and remnant native vegetation adjacent to the creek (refer to Section 4.2.3). No works are proposed within the Environmental Conservation Zone along Badgerys Creek.

Stakeholder	Issue category	Issue raised	Response
Environment Protection Authority	Noise and vibration	EPA raised the comment that the on-airport and off-airport noise objectives should be harmonised in accordance with the more conservative off-airport noise objectives	The Airports (Environment Protection) Regulations 1997 (Cth) (Airports (Environment Protection) Regulations) provides specific criteria to be met at sensitive receivers from construction noise and operational rail traffic noise generated on airport land. The Airports Regulations provide higher allowances for noise generating activities which generally relate to noise generated by aircraft. The noise and vibration impact assessment undertook an assessment of construction noise against both the Airports (Environment Protection) Regulations and the *Interim Construction Noise Guideline* (ICNG) (DECCW, 2009a), noting that the ICNG is more stringent. The assessment was undertaken in accordance with the relevant regulatory frameworks that apply off-airport and on-airport. If the project is approved, Sydney Metro would undertake the construction and operation of the project in accordance with the applicable regulatory framework.
Environment Protection Authority	Flooding, hydrology and water quality	EPA also identified a range of issues related to guideline values that were described within *Sydney Metro – Western Sydney Airport, Flooding, Hydrology and Water Quality Assessment* (Sydney Metro 2020e), including: • the accuracy of guideline values for chlorophyll-a, total phosphorus, total nitrogen and pH • a recommendation that the appropriate Australian and New Zealand Guidelines (ANZG) (2018) guideline values for slightly	The project would be designed to achieve the water quality performance outcomes outlined in Table 8-2 to ensure that all water discharged from the project would: • contribute towards achieving ANZECC guideline water quality trigger values for physical and chemical stressors for slightly disturbed ecosystems in lowland rivers in southeast NSW, or • meet any water quality criteria determined in consultation with the NSW Environment Protection Authority (off-airport) where an

Stakeholder	Issue category	Issue raised	Response
		to moderately disturbed ecosystems be adopted • the Project Environmental Impact Statement incorrectly states that for on-airport waterways, the Airports (Environment Protection) Regulations water quality limits are more stringent than the ANZECC(2000)/ANZG (2018) guidelines; however, the EPA notes several Airports (Environment Protection) Regulations limits (arsenic, chromium, copper and nickel) exceed the ANZG (2018) trigger levels for 95 percent species protection • a recommendation that the appropriate ANZG (2018) guideline values for slightly to moderately disturbed ecosystems be adopted • a recommendation that where Airports (Environment Protection) Regulations water quality limits are higher than the ANZG (2018) guideline values, that the more conservative ANZG (2018) values be adopted • a recommendation that if site-specific guideline values are developed, these should be derived consistent with ANZG for Fresh and Marine Water Quality, including being based on the 80th percentile of 24 months of data from an appropriate slightly disturbed reference site.	EPL is required, or in consultation with Western Sydney Airport in accordance with the Airports (Environment Protection) Regulations (on-airport). Basin design would be confirmed during design development and detailed construction planning. The ANZECC guideline values included within *Sydn*ey Metro – Western Sydney Airport, Flooding, Hydrology and Water Quality Assessment (Sydney Metro 2020e) have been updated in Table 6-24. The correct guideline values are chlorophyll-a 0.003mg/L, total phosphorus 0.025mg/L, total nitrogen 0.35mg/L and pH 6.5 – 8.5. The protection of 95 percent of species in slightly disturbed to moderately disturbed ecosystems is appropriate for the toxicants that do not bioaccumulate. Sydney Metro notes that guidelines require 99 per cent species protection to be adopted for toxicants that do bioaccumulate (such as mercury, organochlorine pesticides, polychlorinated biphenyls and dioxins). As outlined in the new mitigation measure WQ2, Sydney Metro is committed to water treatment plants being designed so that wastewater is treated to a level that is compliant with the ANZECC/ ARMCANZ (2000), ANZG (2018) and draft ANZG (2020) default guidelines for 95 per cent species protection and 99 per cent species protection level for toxicants that bioaccumulate, unless other discharge criteria are agreed with relevant authorities. Consistent with the

Stakeholder	Issue category	Issue raised	Response
			requirements of the Construction Environmental Management Framework (Appendix H), detailed procedures for the treatment, testing and discharge of groundwater from the site would be included in a Groundwater Management Plan (or equivalent). The assessment has been undertaken in accordance with the relevant regulatory frameworks that apply off-airport and on-airport. If the project is approved, Sydney Metro would undertake the construction and operation of the project in accordance with the applicable regulatory framework. Mitigation measure WQ1 requires that a surface water monitoring program would be developed in consultation with EPA and other relevant stakeholders. Mitigation measures GW5 and GW6 require the development and implementation of a groundwater monitoring program to inform development of the detailed groundwater model and preparation of a Groundwater Management Plan to manage potential construction impacts, including target criteria for discharge, trigger values and corrective actions.
Environment Protection Authority	Flooding, hydrology and water quality	EPA recommended the following additional information be provided: • clarification on how temporary spoil stockpiles, permanent spoil placement areas and associated leachate and runoff would be managed to ensure appropriate management and mitigation measures are implemented to avoid polluting waters	Section 7.8 identifies potential risks of generating saline or contaminated runoff and leachate from the potential permanent spoil placement areas at Western Sydney International. Any contaminated groundwater intercepted during construction would be treated in water treatment plants before discharge to ensure that works meet the requirements under

Stakeholder	Issue category	Issue raised	Response
			Schedule 2 of the Airports (Environment Protection) Regulations. On-site detention basins, including water quality treatment basins, would be implemented along the project construction footprint for surface construction areas. The Soil and Water Management Plan would contain management measures for contaminated material (including water) and a contingency plan to be implemented in the case of unanticipated discovery of contaminated material during construction. The Construction Environmental Management Framework (Appendix H) describes the approach to environmental management, monitoring and reporting during construction, including a requirement to develop and implement a Spoil Management Plan that would incorporate procedures and methodologies for storage and stockpiling arrangements, including those for virgin excavated natural material, contaminated and unsuitable material. Additional contamination investigations are being progressively undertaken. The data from these additional investigations would inform detailed design and construction, with relevant information to be included in management plans and monitoring programs. In accordance with mitigation measure SC1, the Soil and Water Construction Environmental Management Plan would incorporate: • for low risk areas of environmental concern, worker health and safety measures, waste management and

Stakeholder	Issue category	Issue raised	Response
			tracking for contamination would be outlined • for medium and high risk areas of environmental concern, detailed site investigations and review of further available information would be undertaken prior to the start of construction.
Sydney Water	Western Sydney International flooding impacts	Sydney Water raised concern that flooding impacts resulting from construction of the Western Sydney International need to be understood to manage emerging equity issues for landholders	Flooding impacts as a result of the operation of Western Sydney International are beyond the scope of the Sydney Metro – Western Sydney Airport project. The final landform within the Western Sydney International site will be determined by the airport development. Potential on-airport flooding impacts of the project are based on the modelling completed for the *Western Sydney Airport Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b) and the project. This assessment is included in Section 7.6.
Sydney Water	Public utilities	Sydney Water recommended an extension of the existing Interface Deed agreement between Sydney Water and Transport for NSW to cover the project at Western Sydney International	Further consultation with Sydney Water would occur via a utilities coordination manager and include consideration of impacts to Sydney Water assets. The role of the utilities coordination manager is discussed in Section 8.9.11 of the Project Environmental Impact Statement. Sydney Metro would continue to work with Sydney Water to ensure they are informed about the project and that potential impacts to Sydney Water assets are managed appropriately.

3.7 Consultation to support the Final Environmental Impact Assessment

Western Sydney Airport, DITRDC and Sydney Metro have been working collaboratively on design development and construction staging of the Western Sydney International airport and Sydney Metro – Western Sydney Airport projects. Consultation has occurred through ongoing working group meetings and constructability/delivery workshops.

No further Aboriginal consultation has been required in relation to the proposed action since the preparation of the Aboriginal cultural heritage assessment report that formed part of the Project Environmental Impact Statement.

3.8 Ongoing consultation and engagement

Sydney Metro would continue to work with stakeholders and the community to ensure they are informed about the proposed action, should it be authorised, and have opportunities to provide feedback to the project team.

The community contact and information points outlined in Table 3-6 were in place while the Draft Environmental Impact Assessment was on exhibition and will remain in place for the remainder of the planning and approval process.

Table 3-6 Community contact and information points

Community contact method	Contact details / information points
Community information line (toll free)	1800 717 703 (24 hours a day)
Community email address	sydneymetrowsa@transport.nsw.gov.au
Website	**www.sydneymetro.info**
Postal address	Sydney Metro – Western Sydney Airport PO Box K659, Haymarket, NSW 1240

An Overarching Community Communications Strategy (OCCS) has been prepared for the project (Appendix D and Section 3.8.2) which will guide Sydney Metro's approach to engagement with communities, stakeholders and businesses. The strategy includes the approach for managing ongoing consultation and coordination with Western Sydney Airport regarding activities within Western Sydney International.

A list of activities that would be undertaken for the project and their timing is provided in Table 3-7.

Table 3-7 Ongoing and future engagement

Activity	Design	Delivery	Operation
Project overview document		●	
Media releases		●	
Community information sessions	●		
Traditional and social media engagement	●	●	●
Doorknocks with neighbouring properties	●	●	●
Newsletter letterbox drop	●	●	●
Project website and online forums	●	●	●
Newsletter advertising	●	●	●
Stakeholder meetings	●	●	●
Local business engagement	●	●	●
Local Aboriginal Land Councils and Aboriginal stakeholder engagement	●	●	●
Goverment stakeholder engagement	●	●	●

3.8.1 Consultation during construction and complaints handling

Should the proposed action be authorised under a variation to the Airport Plan, the project team would continue to consult with the community and key stakeholders during construction. In general, this consultation would occur as part of the broader project and involve:

- ongoing consultation liaising with key stakeholders, local councils and other government agencies on relevant environmental issues (and meetings or project briefings where required)
- provision of regular updates to the nearby community
- development and implementation of a community complaints and response management system. This system would be developed in consultation with Western Sydney Airport to ensure that there is a consistent approach to managing community complaints within Western Sydney International.

3.8.2 Overarching Community Communications Strategy

The OCCS (Appendix D) will guide the approach to stakeholder and community consultation to be adopted during construction. The OCCS:

- identifies relevant communities, individuals or organisations to be consulted during construction
- identifies procedures for the regular distribution of information
- identifies procedures for the community to provide feedback and to resolve issues.

The OCCS comprises a consolidated document to be implemented for the construction of proposed action, off-airport proposed action and project off-airport works. For the works associated with the proposed action, the OCCS would be implemented in coordination with Western Sydney Airport. This would ensure that cumulative impacts are considered in communication and engagement and there is a seamless process for complaint and enquiry management across both projects.

4 Proposed action

This chapter provides a detailed description of the operation and construction of the proposed action, including changes to haul roads and potential permanent spoil placement areas which have occurred since exhibition of the Draft Environmental Impact Assessment.

4.1 Operation

This section provides a description of the key elements of the proposed action, including the location of the track alignment, proposed stations, and other ancillary infrastructure. This section also outlines how the proposed action would operate and how customers would use Sydney Metro – Western Sydney Airport.

The description of the proposed action presented in this section is indicative and based on the current level of design. Some design elements would continue to be refined as part of the project design development process. This refinement would also be subject to ongoing consultation with Western Sydney Airport.

4.1.1 Key features

Key operational features of the proposed action would include:

- around two kilometres of surface rail alignment
- around 3.3 kilometres of twin rail tunnels (including tunnel portal with in-cutting)
- two new metro stations:
  - Airport Business Park
  - Airport Terminal
- all operational systems and infrastructure such as tunnel ventilation systems, crossovers, signalling, communications, overhead wiring, power supply, lighting, fencing, security and access tracks/paths
- environmental protection measures including on-site water detention, water quality treatment basins and other drainage works.

The key operational features of the proposed action within Western Sydney International are shown on Figure 4-1.

4.1.2 Metro alignment and track infrastructure

Track and corridor alignment

The proposed action would be located within a dedicated and restricted access rail corridor. The track alignment for the proposed action would involve:

- a track designed with fit-for-purpose horizontal and vertical alignment that consists of a combination of twin rail tunnels, surface and in-cutting
- twin standard gauge tracks to allow two-way rail movements.

The alignment has been designed to meet the functional requirements of a metro system including the need to:

- provide a maximum vertical grade of 4.5 per cent
- locate station platforms along a straight and level (i.e. a zero per cent grade) section of track
- provide appropriate curvature to accommodate proposed train operating speeds.

The alignment of the proposed action was predominantly determined by the corridor identified in the Construction Plan and has been refined as part of design development. The proposed horizontal and vertical alignment for the proposed action is shown in Figure 4-1 and would continue to be refined as part of design development.

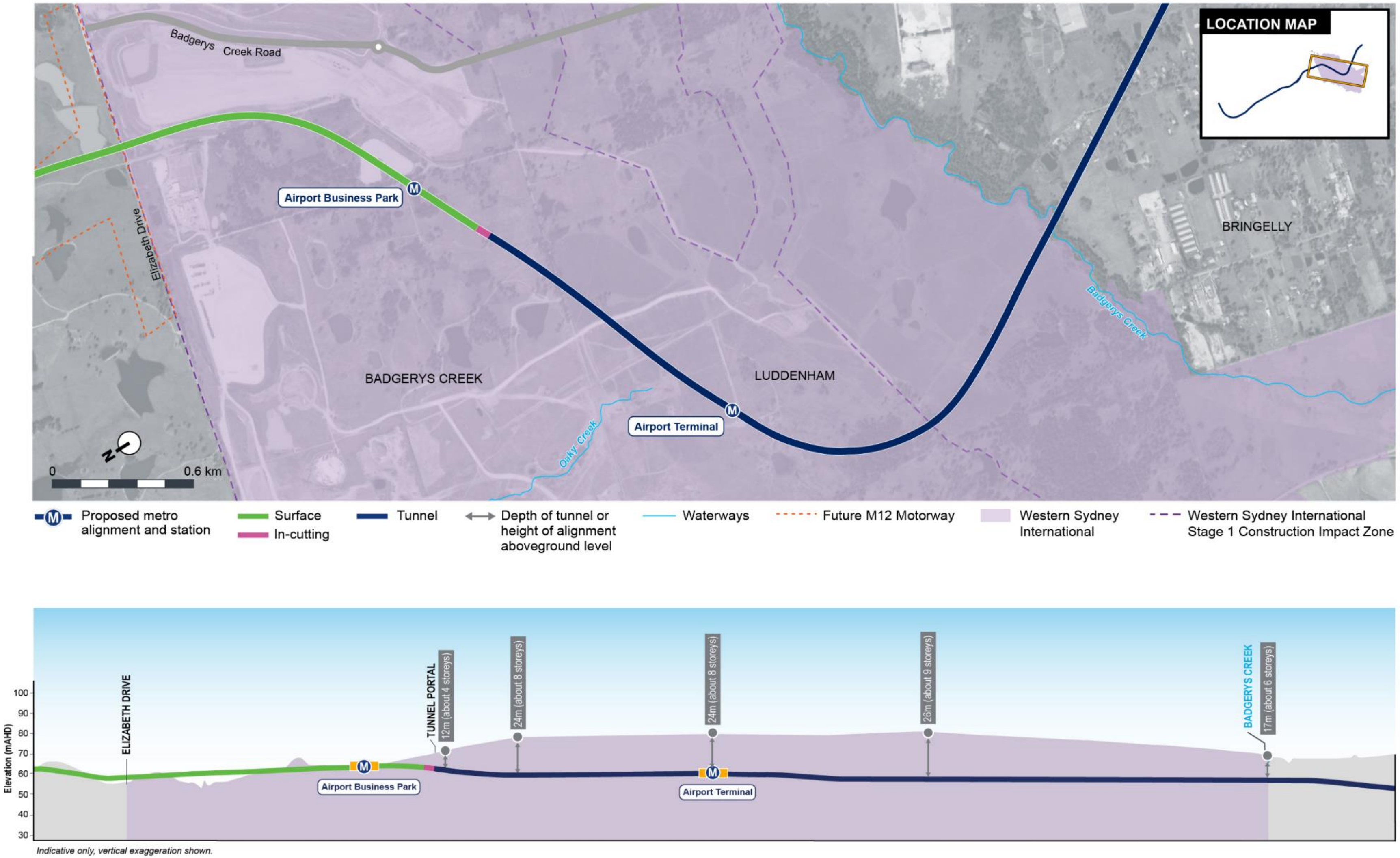


Figure 4-1 Proposed action infrastructure and alignment

Tunnels and underground track features

Metro rail tunnels

The proposed action would transition from surface into twin rail tunnels (the Western Sydney International to Bringelly tunnel) around 400 metres southwest of Airport Business Park Station at the Western Sydney International tunnel portal. The twin rail tunnels would comprise two single tunnels generally running parallel to each other.

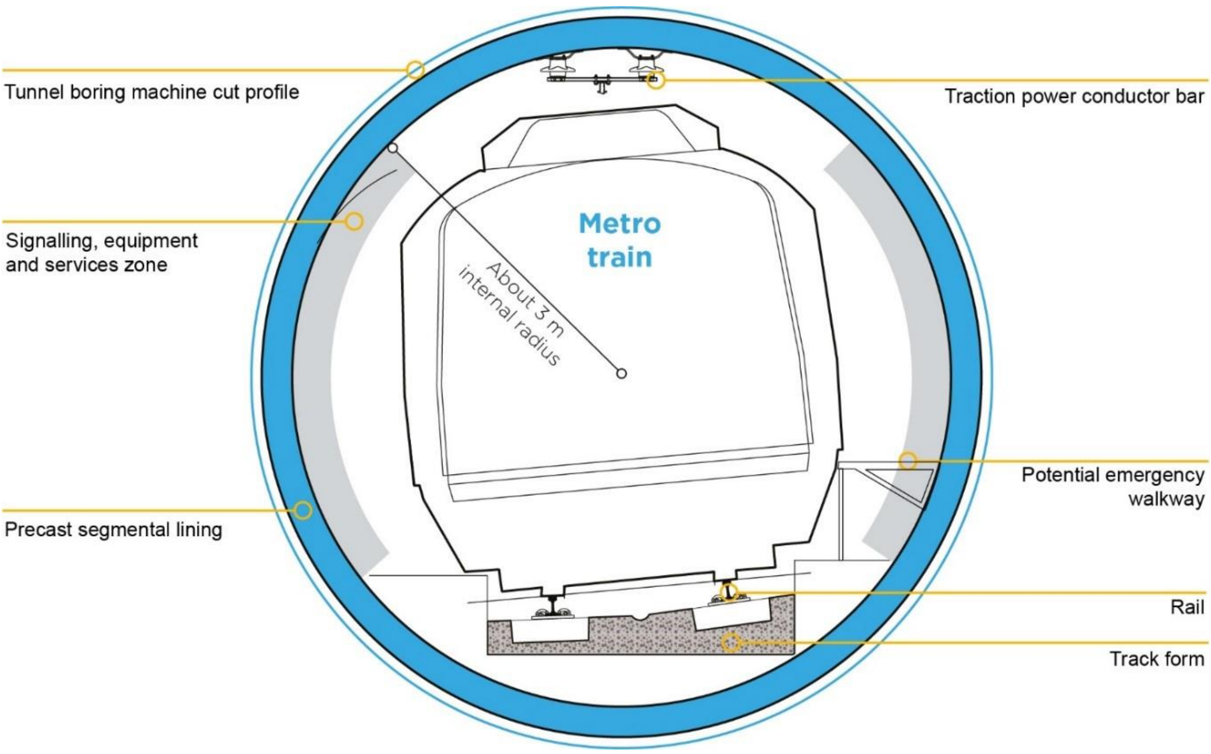
The length of the twin rail tunnels to the southwest boundary of the Western Sydney International would be approximately 3.3 kilometres. The tunnels would then extend for a further three kilometres south of the Western Sydney International boundary to Aerotropolis Core Station (the southern extent of the project).

The Western Sydney International to Bringelly tunnel would typically be between 12 and 30 metres below the finished surface level of the airport. Indicative tunnel depths below the finished surface level of the airport at various locations along this section of the alignment are shown on Figure 4-1.

Variations in the tunnel depth may be required to accommodate geotechnical conditions, hydrogeological environments, drainage, surface/subsurface infrastructure and operational design requirements and would be confirmed during ongoing design development.

The metro rail tunnels would have a circular cross-section with a clear internal lined diameter of about six metres to accommodate a typical metro train.

An indicative cross-section of the underground tunnel is shown in Figure 4-2. The tunnels would be lined with pre-cast concrete segments to ensure the long-term life of the tunnels and to minimise groundwater ingress. The tunnels would provide space for the trains and tracks, and for other equipment and services including rail signalling, controls and communication, overhead traction power, fresh air ventilation, fire and life safety systems, lighting and drainage.



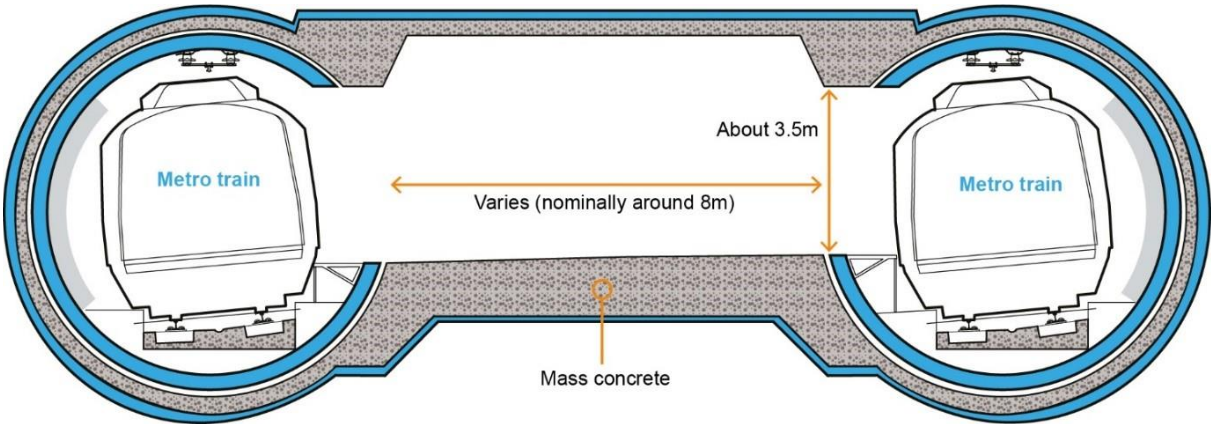
Note: Indicative only, subject to design development

Figure 4-2 Indicative cross section of one of the tunnel alignments

The track in tunnel would consist of a fixed concrete slab combined with a continuously welded rail. Typically, the tunnel track centrelines would be about 16 metres apart; however, variations to this tunnel spacing would occur at a number of locations to overcome geotechnical, and other subsurface constraints, surface infrastructure and operational design requirements.

Raised walkways could be provided throughout the tunnel sections of the alignment to provide for emergency access and exit. If provided, these walkways would be the same height as the floor of the train carriage so customers could evacuate in an emergency. To facilitate emergency access and exit between the two tunnels, cross-passages would be provided at intervals of about 240 metres.

Figure 4-3 shows an indicative section of a typical cross-passage.



Note: Indicative only, subject to design development

Figure 4-3 Indicative section of a tunnel cross-passage

Tunnel portal

Tunnel portals are the transition points for the rail track from below ground to surface. The Western Sydney International tunnel portal would be located around 400 metres southwest of Airport Business Park Station as part of the Western Sydney International to Bringelly tunnel.

The tunnel portal would be designed to be protected from the probable maximum flood level to avoid floodwater flowing into the tunnels (refer to Section 7.6). Fire protection walls would be installed along the entire length of the structure to provide separation between the two metro tracks. A tunnel services building, including ventilation facility, to support operations would also be provided at the tunnel portal.

The proposed tunnels and tunnel portal would be designed to minimise water ingress. Appropriate drainage systems would collect runoff from the open sections of the tunnel portal and groundwater seepage into the tunnel and direct it to the tunnel low points. The water would be treated to a standard suitable for discharge into the surrounding drainage network (see Section 4.1.4).

Surface track features

Surface tracks refer to the components of the project alignment that are at the same level as the existing surface, in addition to sections in cuttings or located on embankments. The surface sections of track would generally consist of a slab track construction with concrete sleepers. The track type would be confirmed as part of design development and would consider areas where noise mitigation may be required.

The spacing (track centres) between the metro tracks would typically be between about five and six metres.

Where the project crosses Elizabeth Drive (at the northern boundary of Western Sydney International) and becomes the proposed action, it would be at surface level under a new elevated alignment of Elizabeth Drive. This elevated structure is proposed to be delivered as part of the future M12 Motorway project. The surface sections of the track within Western Sydney International are shown in Figure 4-1.

4.1.3 Overview of metro stations

The on-airport stations would be designed to be consistent with the design and layout being developed for the station precincts within Western Sydney International, in consultation with Western Sydney Airport. The broader precincts associated with the two stations within Western Sydney International would be delivered by others as part of the overall development of Western Sydney International.

This section describes the two metro stations that are part of the proposed action.

Airport Business Park Station

The proposed catchment for Airport Business Park Station would be the future business park precinct that, as part of the Airport Plan, is proposed to be a major employment precinct and services hub.

Airport Business Park Station would be located between the southern and northern airport business park precincts and would directly adjoin the southern business park area. Airport Business Park Station would also be located adjacent to the main vehicular entry road to the precinct.

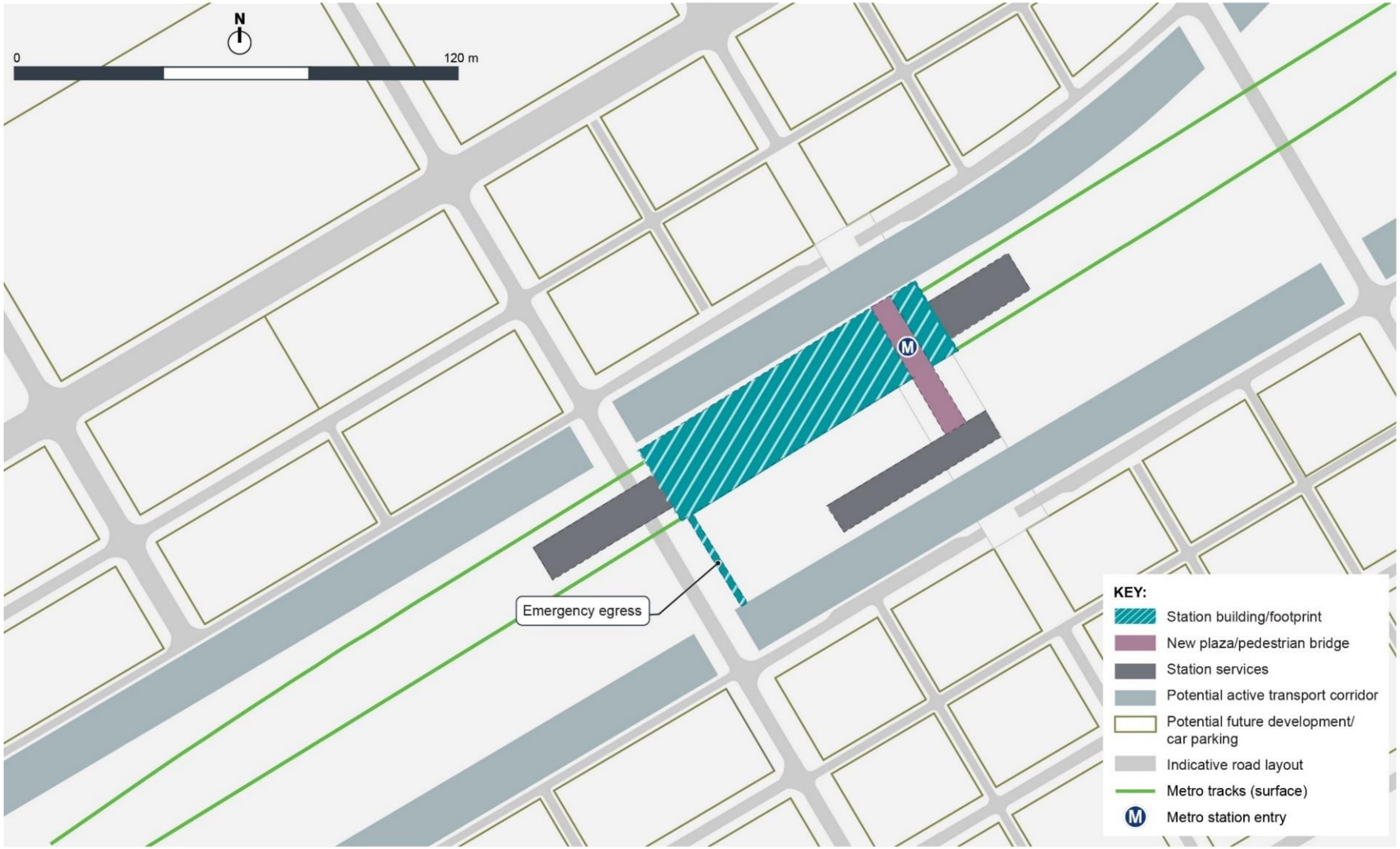
The station drivers for Airport Business Park Station are to:

- support easy and efficient interchange with local and rapid bus services and a potential future East-West Rail Link to Parramatta
- integrate and support the Airport Plan outcomes for the airport precinct
- maintain flexibility for long-term airport development
- provide easy, efficient and safe cross-corridor active transport access into the north and south Airport Business Park precinct from day one and design to accommodate future widening to create a high amenity public domain
- safeguard for a future rail connection from the east.

Airport Business Park Station would consist of a surface level (shallow cutting) station with an island platform and a small cutting on one side of the station. Areas for station services and utilities would be provided at both the eastern and western ends of the station platform. A roof canopy would be provided to cover the majority of the length of the station platform.

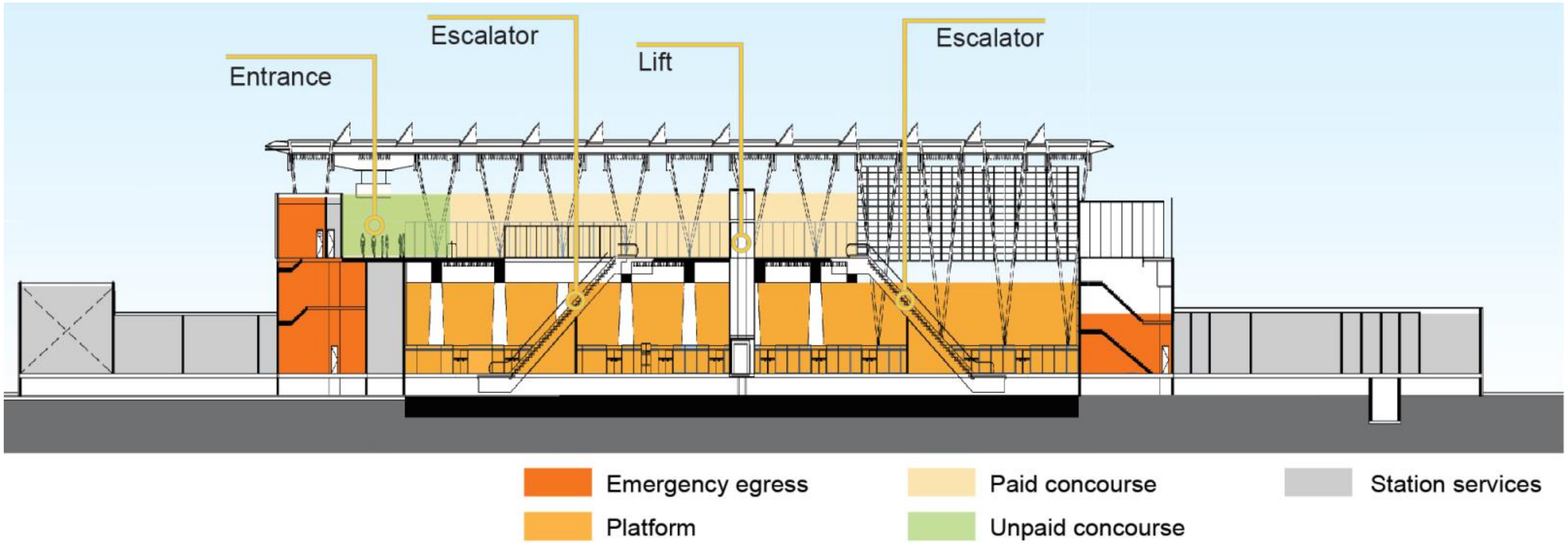
The precinct and interchange facilities for Airport Business Park Station would be provided as part of the wider development of Western Sydney International (to be provided by others). As part of the proposed action, Sydney Metro would provide a pedestrian bridge between the station and the future business park precinct.

An indicative layout of Airport Business Park Station is shown in Figure 4-4, with an elevation and cross-section shown in Figure 4-5 and Figure 4-6 respectively. An artist’s impression is provided in Figure 4-7.



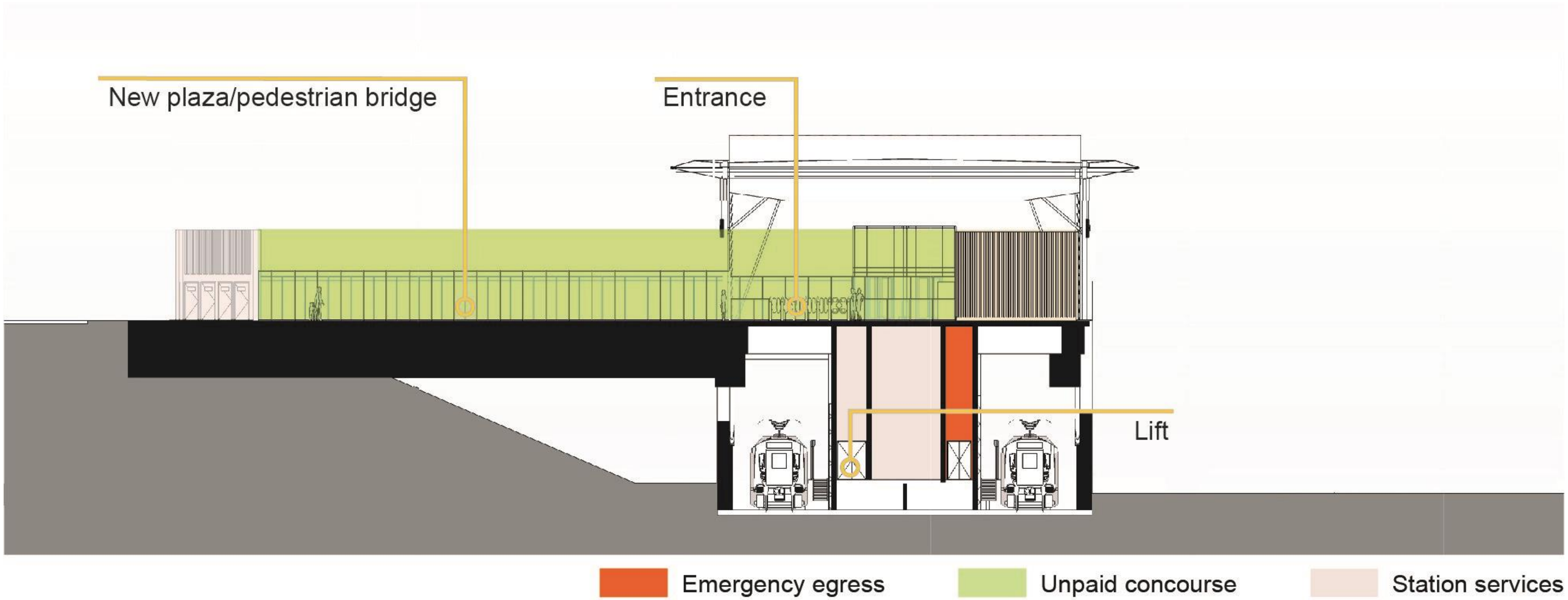
Note: Indicative only, subject to design development

Figure 4-4 Airport Business Park Station – indicative layout and key design elements



Note: Indicative only, subject to design development

Figure 4-5 Airport Business Park Station – indicative station elevation



Note: Indicative only, subject to design development

Figure 4-6 Airport Business Park Station – indicative station cross-section

Note: Indicative only, subject to design development

Figure 4-7 Airport Business Park Station – artist's impression

Airport Terminal Station

Airport Terminal Station would provide access to the future airport terminals and would be located adjacent to the proposed Ground Transportation Centre, a facility within the airport where customers are transferred between transport modes. The proposed catchment for Airport Terminal Station has considered customers accessing flights, employment and other services associated with Western Sydney International.

As the gateway for Western Sydney International for both domestic and international travellers, the station's primary purpose would be to serve the needs of aviation customers. The station drivers for Airport Terminal Station are to:

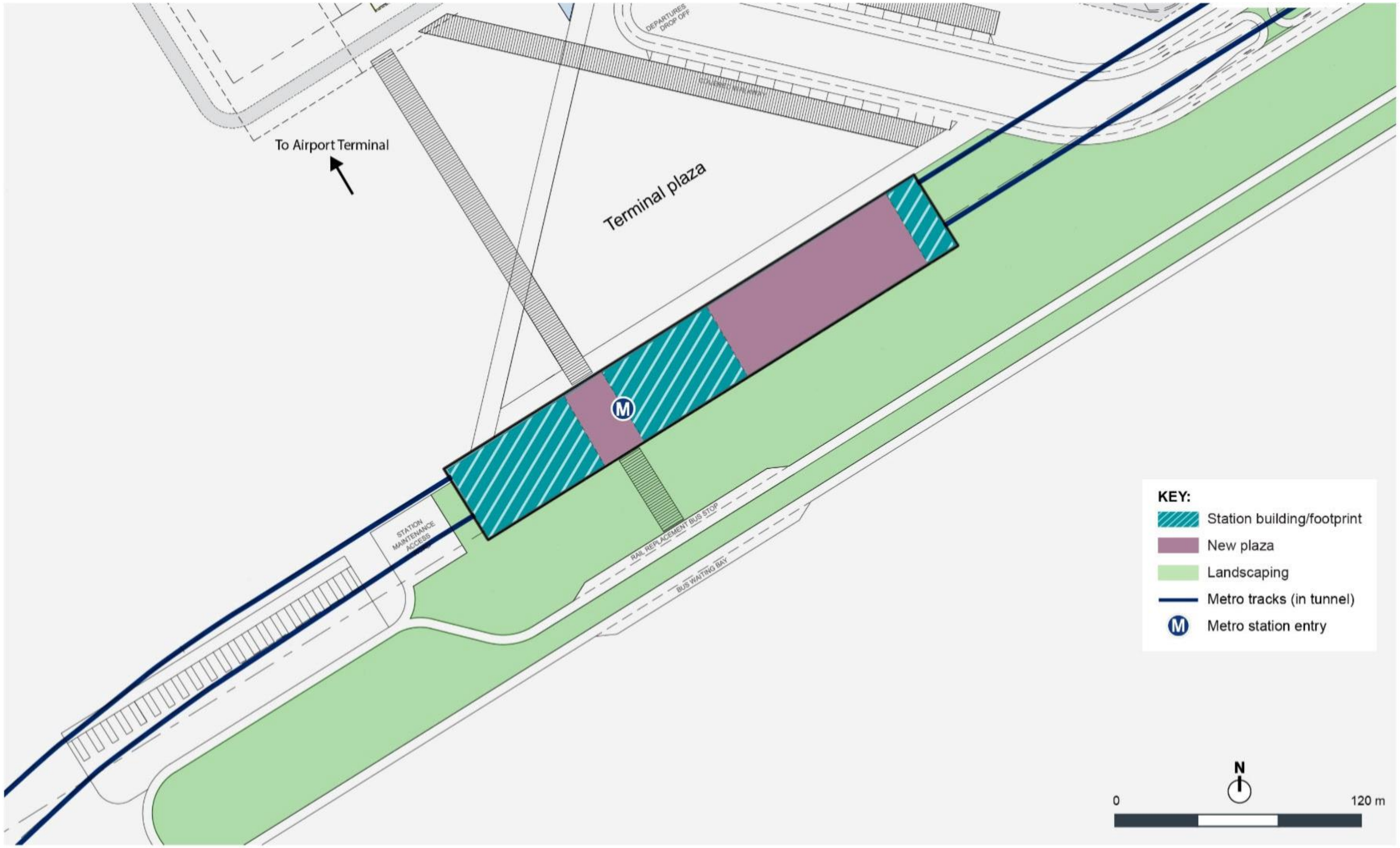
- enable easy, efficient, safe, comfortable and intuitive customer access to the airport terminal/s for day one of airport opening and safeguard for ultimate design
- integrate into and support the design outcomes for the airport
- maintain flexibility for long-term airport development
- safeguard for a future rail connection from the east.

Airport Terminal Station would consist of an underground (cut-and-cover station) below the anticipated Western Sydney International finished surface level. The metro station would include an island platform configuration.

Customer access would primarily be provided via an airport terminal connection with Western Sydney International (to be provided by others). The design of the station would provide natural light and ventilation. Areas for station services and utilities would also be provided at both ends of the station platform.

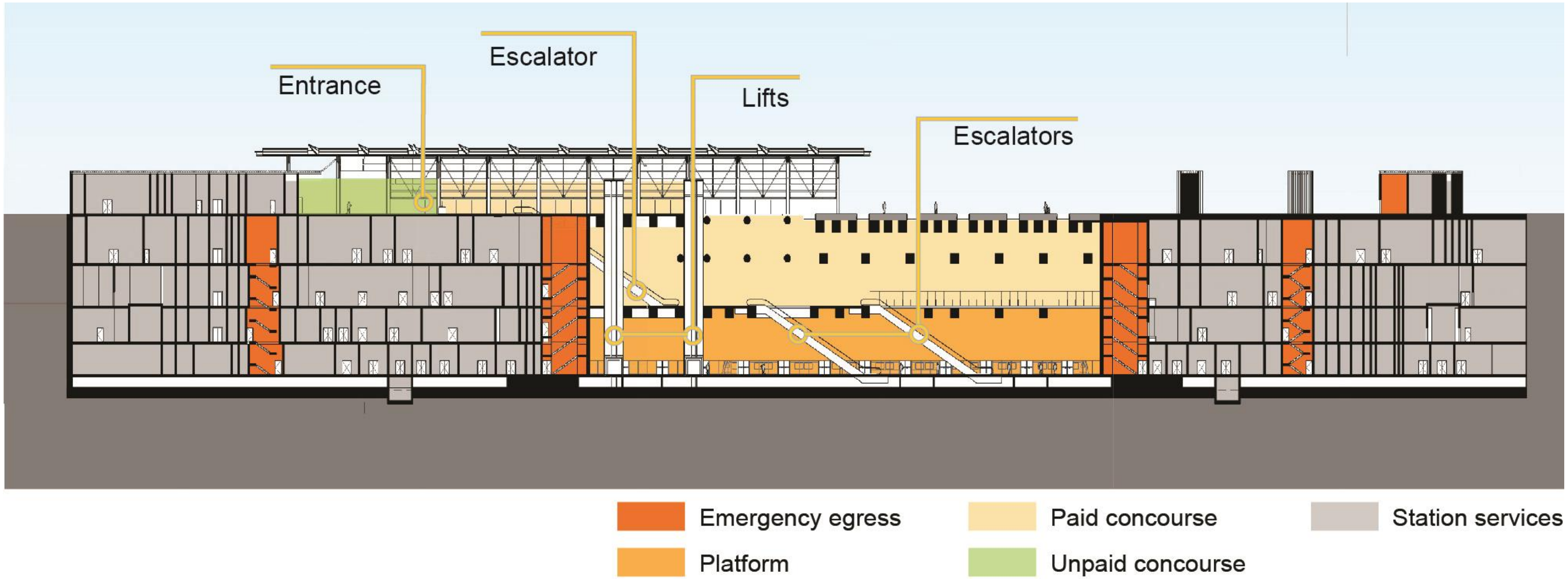
Airport Terminal Station would be the main connection between the metro rail and the airport terminal. Other interchange opportunities for the airport terminal including bus stops would be provided by others as part of the wider development of the precinct.

An indicative layout of Airport Terminal Station is shown in Figure 4-8, with an elevation shown in Figure 4-9 and a cross-section in Figure 4-10. An artist's impression is provided in Figure 4-11.



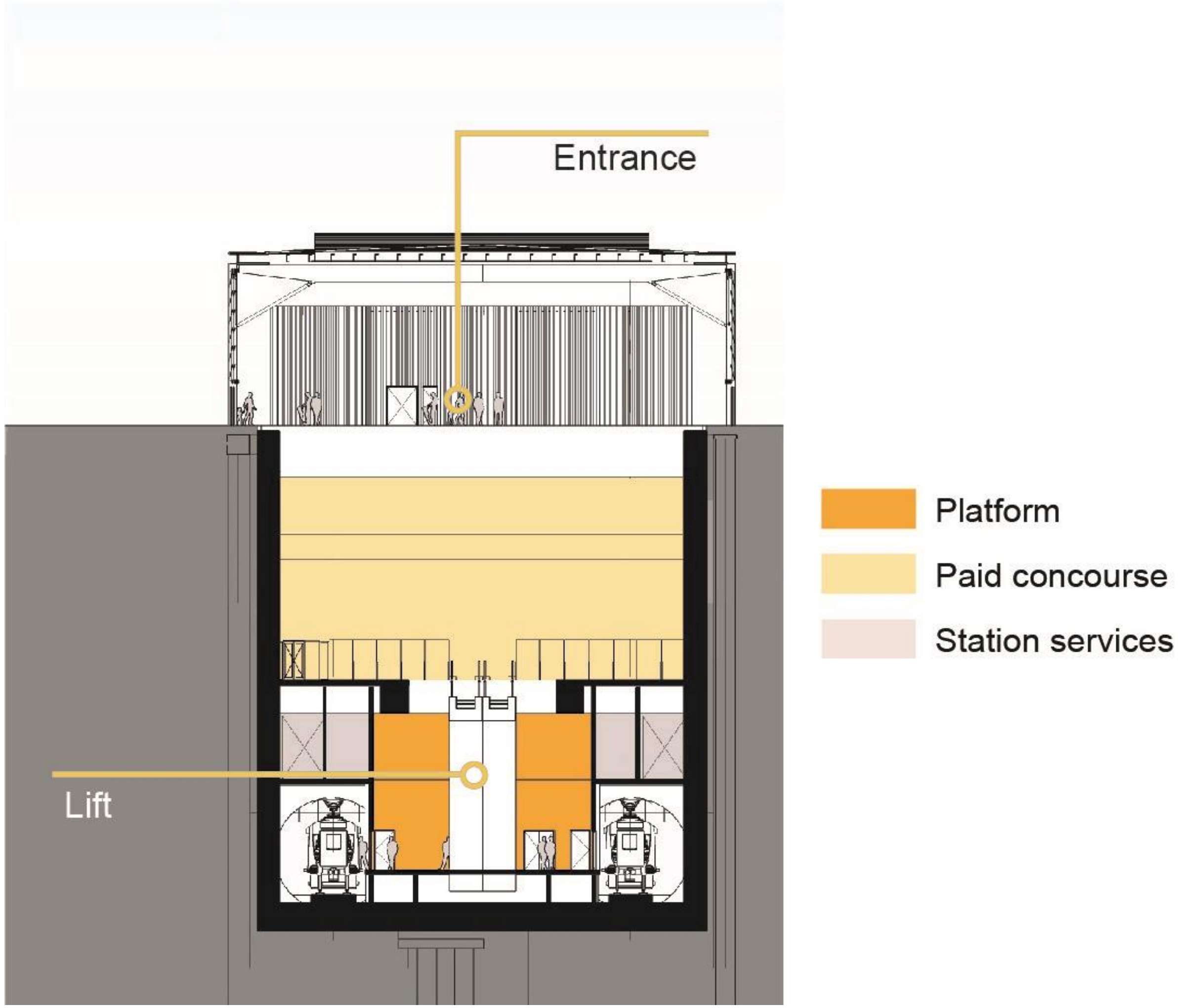
Note: Indicative only, subject to design development

Figure 4-8 Airport Terminal Station – indicative layout and key design elements



Note: Indicative only, subject to design development

Figure 4-9 Airport Terminal Station – indicative elevation



Note: Indicative only, subject to design development

Figure 4-10 Airport Terminal Station – indicative cross-section

Note: Indicative only, subject to design development

Figure 4-11 Airport Terminal Station – artist's impression

4.1.4 Ancillary operational infrastructure

Tunnel ventilation system and services facility

A tunnel ventilation system would be provided for the tunnel portal, Airport Terminal Station and tunnelled sections of the proposed action to allow for a range of ventilation requirements including station ventilation and ventilation for fire and life safety and operational scenarios (such as heat build-up). The tunnel ventilation system would be designed to comply with the *National Airports Safeguarding Framework* (Department of Infrastructure, Transport, Cities and Regional Development, 2018) to ensure no risk to aviation associated with plume rise.

In addition to the tunnel ventilation, a services facility is also proposed at Bringelly for the Western Sydney International to Bringelly tunnel. The Bringelly services facility would be located near the northern end of Derwent Road in Bringelly. This facility does not form part of the proposed action as it is located outside of the airport site, however it has been identified here for completeness of describing how the proposed action would operate.

Metro rail systems

Signalling and train control

Similar to the operation of the Metro North West Line, the proposed action would use advanced signalling technology to support safe operations and control the way trains accelerate and brake at stations to enable more trains to operate along the line. The signalling system would keep each train within a safe braking distance of the train ahead, control speed between stations and the opening and closing of train doors.

The signalling and train control system would consist of:

- automatic train protection which would provide train spacing and speed monitoring and control functionality
- automatic train regulation which would monitor and adjust train speeds and station dwell times to maintain timetable and spacing between trains
- automatic train operation providing automated train driving functionality.

The signalling system would control the stopping of trains at stations, ensure trains stop at the correct location on the platform (including lining trains up with platform screen doors), control train speed between stations, and initiate the opening and closing of doors on the correct side of the train.

The signalling system would allow for bi-directional operation (i.e. trains would run in either direction on either track) in special circumstances. This would provide functionality to respond to a range of incidents to support continuity of service. All control systems would be integrated with rail systems to provide consistent performance and high levels of safety. The signalling system for the project would be linked via dedicated fibre optic cable and network to the operations control centre within the stabling and maintenance facility.

Communications

The proposed action would include an integrated information and digital communication system. This would allow communication between customers and metro staff via audio and visual links at each station and on all trains. The communications equipment would be within the designated services area at each station and within the proposed tunnels.

Power supply

The power supply for the project (including the proposed action) has been designed to operate as an independent standalone system. The electrical power supply network would be provided and monitored from outside Western Sydney International as part of the overall project.

The proposed network would operate using an overhead wiring system for the section outside of tunnels, with overhead conductor rails proposed to be used for sections within tunnels.

A combined services route containing both high voltage, low voltage and communications and signalling cabling would also be provided along the length of the proposed alignment.

Traction power supply would be provided through dedicated traction substations and supporting feeder line cables. These would be co-located with other infrastructure (such as at each station) wherever possible.

Drainage

Track drainage

The proposed track drainage system would include new drainage infrastructure for tunnels and surface sections of the proposed alignment. The drainage infrastructure would consist of trunk stormwater drainage, track drainage, on-site detention and various discharge points. Once constructed the stations and the tunnel portal would generally comprise undrained structures (which prevent groundwater from entering the structure but do not actively drain groundwater).

The design of the drainage for surface sections of the proposed alignment would be developed to safely collect and convey runoff (including rainwater, groundwater and firefighting generated flows) to an appropriate point of discharge. The drainage system would be designed to collect and convey flows for up to a 1 in 100-year event (one per cent annual exceedance probability). The drainage system would typically consist of a combination of pit and pipe, open channel and subsurface drains.

Within the tunnel, drainage depressions would be incorporated into the concrete slabs that form the base for the rail track. The tunnel portal would be designed to be above the Probable Maximum Flood level.

Water treatment plant

The proposed drainage system for the proposed action would also include an operational water quality treatment plant to manage stormwater and groundwater within the proposed tunnels and tunnel portal. As part of the project, a water quality treatment plant is proposed to be provided off-airport at the Bringelly services facility. The water quality treatment plant would treat wastewater pumped from the tunnels and other below ground facilities as a result of stormwater entering the tunnel portal or ingress of groundwater. The water treatment plant building would include chemical treatment tanks, water storage tanks, and filters. Treated water would then be discharged into the local stormwater network at Bringelly. This facility does not form part of the proposed action and has been assessed as part of the project, however it has been identified here for completeness of describing how the proposed action would operate.

The final location and design of the water treatment system would be confirmed during design development and construction planning.

4.1.5 Maintenance and emergency access

During operation, vehicular access along and across the metro corridor would be required to allow for maintenance and emergency access. Access to the proposed metro corridor within and south of Western Sydney International would be via a dedicated access point within Western Sydney International northeast of Airport Business Park Station. The final location of proposed access points would be determined during design development and construction planning.

For each of the twin rail tunnels, access would be restricted to emergency pedestrian access.

4.1.6 Metro operations

The project would operate independently of existing suburban and intercity rail network, and independently of the Metro North West Line, Sydney Metro City & Southwest and Sydney Metro West. All operations would be controlled and monitored from the proposed operations control centre at the stabling and maintenance facility (which is located to the north of the airport site and outside the scope of the proposed action).

Service frequency and reliability

As with the broader Sydney Metro network, the project would deliver a ‘turn up and go’ service consistent with customer expectations and the needs of the Western Sydney International. It is expected that the end-to-end journey time for the wider Sydney Metro – Western Sydney Airport, between St Marys Station and Aerotropolis Core Station would be around 20 minutes. The journey time from St Marys Station to Airport Terminal Station would be around 15 minutes.

It is anticipated that the project would initially operate up to three carriages per train with a service frequency of up to 12 trains per hour in the peak. The design for the ultimate service caters for up to four carriages per train and a frequency of 20 trains per hour. The ultimate number of train movements may further increase should future extensions to the north of St Marys Station and to the south of Aerotropolis Core Station become operational.

The proposed service frequency for the project is shown below for both the opening (day one initial services) and expected ultimate service capacity:

- opening (day one initial services) operations:
  - *peak periods* (between 6am and 9am and between 3pm and 6pm) – a metro train every five minutes (up to 12 trains per hour)
  - *non-peak periods* – metro train every 10 minutes (up to six trains per hour)
- future (ultimate service) operations:
  - *peak periods* (between 6am and 9am and between 3pm and 6pm) – a metro train every three minutes (up to 20 trains per hour)
  - *non-peak periods* – metro train every six minutes (up to 10 trains per hour).

Special events

The project would be capable of extending operating hours to cater for special events. Examples of events that would be considered for special event operations relate to peak Western Sydney Airport passenger demand and include city-wide events and heavy passenger demand days such as New Year's Eve and ANZAC Day. Details for special event operations would be determined during the design development process.

Hours of operation

Sydney Metro – Western Sydney Airport has the ability to operate as a 24-hour service. It is anticipated that the project would generally operate from early morning to late at night. The final operating hours would be determined as part of the development of the services schedules for the project, taking into account customer and maintenance access requirements.

When the metro service is not operating (for example, outside of operating hours, during maintenance activities or in the event of an emergency) alternative services would be provided.

The operation of the metro service combined with alternative services where required, would ensure there is a 24-hour transport service to respond to the operational requirements of Western Sydney International.

Train types and ticketing

An outline of train types is provided in Chapter 7 (Project description – operation) of the Project Environmental Impact Statement.

The key features of these trains include:

- an average operating speed of around 70 kilometres per hour (up to a maximum of 100 kilometres per hour)
- level access between the platform and train
- a mixture of seating arrangements and provision for customers in wheelchairs
- heated and air-conditioned carriages
- multiple doors per side per carriage, allowing fast boarding and alighting
- priority seating for mobility impaired, the elderly and people with prams
- allocated multi-purpose areas on each train for prams, bicycles and customers travelling with luggage.

Photographs of the indicative type of trains proposed are provided in Figure 4-12 (internal) and Figure 4-13 (at a station).

Source: Sydney Metro

Figure 4-12 Photograph of an internal metro train carriage

Source: Sydney Metro

Figure 4-13 Photograph of a train at an underground station on the Metro North West Line

The project would be integrated with the existing Opal electronic ticketing system, which will allow for a ticketing system integrated with all other modes of public transport (Sydney Trains operated trains, buses, ferries, and light rail services). The system would be installed at all stations, including those identified as part of the proposed action.

Fares for Sydney Metro would be set by the NSW Government. Ticket pricing for all transport in NSW is determined by the Independent Pricing and Regulatory Tribunal of New South Wales (IPART), and by NSW Government policy. The NSW Government reviews this pricing annually and may consider a change to the Opal policy at any time. Sydney Metro service pricing would be reviewed in line with the pricing review process for other forms of transport.

Infrastructure maintenance

Maintenance planning would generally allow routine and major periodic maintenance of infrastructure to be carried out with a view to maximising service availability and minimising impacts on customers. Scheduled maintenance would either occur during planned weekend maintenance periods, when train services would not be in operation on parts of the line, or overnight during the no service period.

4.2 Construction

This section provides a description of the indicative construction approach and methodology for the proposed action and includes the indicative construction staging, strategy and program for the project. The section also provides information on the proposed construction sites required to support the proposed action; construction traffic and access; spoil and water management; equipment and materials required; and proposed construction hours.

The construction approach and methodology presented in this chapter is indicative and would be refined as design and construction planning progresses. A final construction methodology and program would be developed by the construction contractor(s) when appointed. There would be continued consultation between Sydney Metro and Western Sydney Airport as part of the ongoing development of the construction approach for the two projects.

The construction methodology for the proposed action would be confirmed in the Construction (Rail) Plan which would be prepared following the approval of the project. Refer to Chapter 8 (Environmental management and mitigation) for further information.

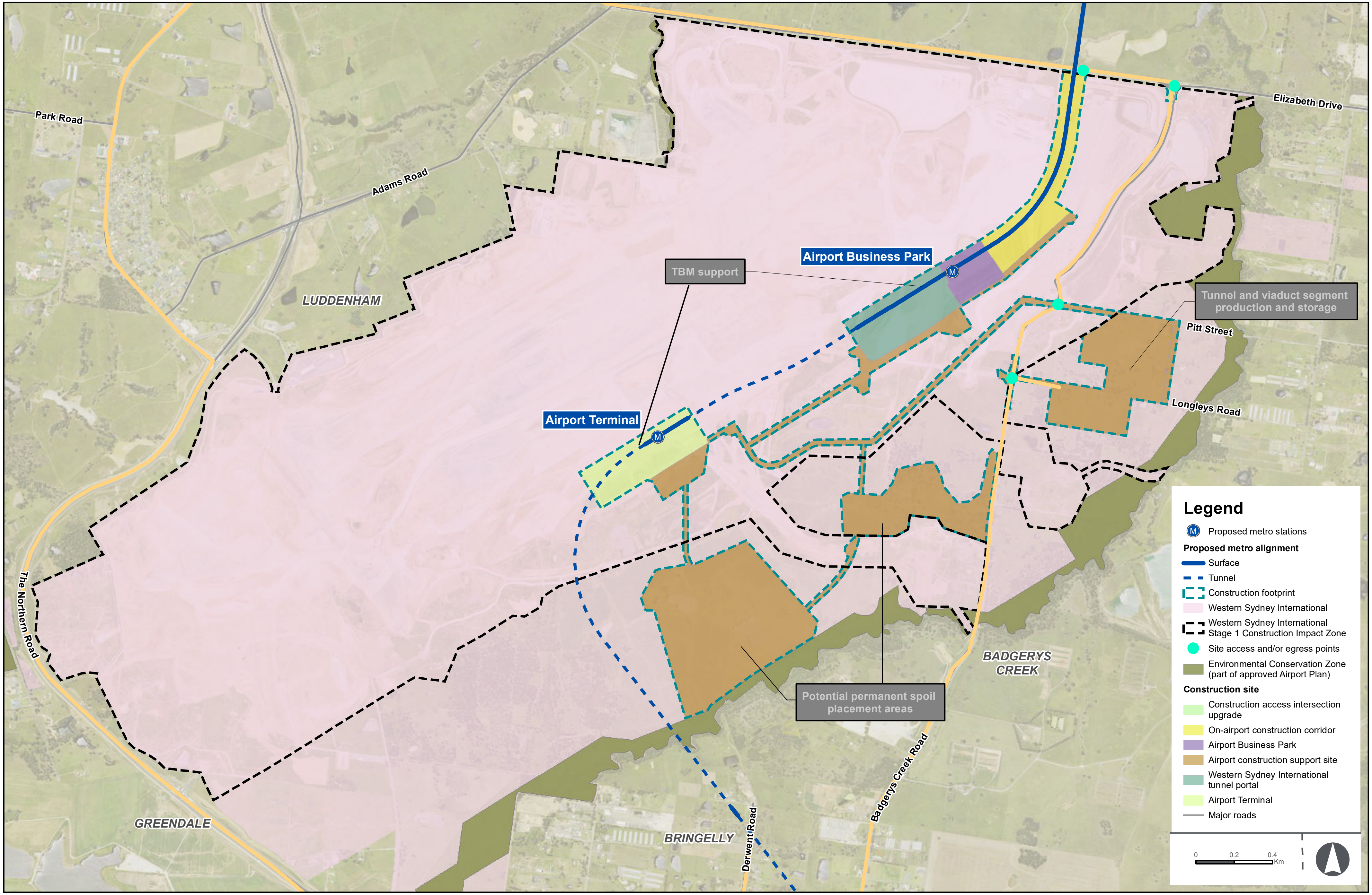
4.2.1 Overview

The proposed construction activities that would be undertaken for the proposed action include:

- preparatory activities (see Section 4.2.2)
- main construction works including:
  - tunnelling and associated works (see Section 4.2.4)
  - corridor and associated works (see Section 4.2.5)
  - stations and associated works (see Section 4.2.6)
- rail systems fitout (see Section 4.2.7)
- activities required for tunnel and viaduct segment manufacture and storage and temporary haulage roads
- finishing works and testing and commissioning (see Section 4.2.10).

The proposed action would also include the potential permanent placement of spoil at two sites to support the development of future stages of the airport.

The construction footprint and key construction sites proposed for use during the construction of the proposed action are shown in Figure 4-14. This figure also indicates the Western Sydney International Stage 1 Construction Impact Zone and the Environmental Conservation Zone within Western Sydney International.



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Proposed action construction footprint

Figure 4-14

The indicative timeframe for the project is for main construction works to commence in 2021 and take about five years to complete, subject to planning approval, with project opening anticipated to align with when Western Sydney International opens for passenger services. An indicative main construction program for the project is shown in Figure 4-15.

Figure 4-15 Indicative main construction program for the project

4.2.2 Preparatory activities

Preparatory activities for the proposed action are required to establish key construction sites and facilitate construction activities.

The majority of the preparatory activities are expected to commence in advance of main construction works, such as tunnelling and station excavation, while some preparatory activities would continue concurrently with the main construction works. Preparatory activities would include:

- detailed site investigations and subsequent clearance works
- provision of construction haul roads
- relocating, adjusting and protecting utilities and services affected by the proposed action
- supplying power, water and other utilities to construction sites and other areas within the construction footprint
- vegetation clearance (as required)
- establishment of construction sites.

4.2.3 Construction sites

Construction activities would be carried out within and to the south of the Western Sydney International Stage 1 Construction Impact Zone. The indicative works at proposed construction sites required for the construction of the proposed action are shown in Figure 4-17 to Figure 4-20. The construction sites would be confirmed by the construction contractor(s) when appointed in consultation with Western Sydney Airport.

Location	Preparatory activities	TBM launch	TBM support	TBM retrieval	Spoil handling and removal	Roadheader launch/support	Ancillary facility construction	Stabling and maintenance facility construction	Major earthworks	Bridge and viaduct construction	General civil works	Concrete batch plant	Equipment and material laydown	Rail system fitout	Site offices and worker amenities	Water treatment plant	Potential acoustic shed	Vehicle parking
On-airport																		
On-airport construction corridor	✓				✓		✓		✓	✓	✓		✓	✓	✓			✓
Airport Business Park	✓				✓		✓		✓		✓		✓	✓	✓			✓
Western Sydney International tunnel portal	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
Airport Terminal	✓		✓		✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
Airport construction support site	✓				✓				✓		✓	✓	✓	✓	✓			✓

Note: TBM retrieval would occur outside the proposed action at the Aerotropolis Core Station site

Figure 4-16 Indicative construction activities at proposed action construction sites

On-airport construction corridor

The on-airport construction corridor is located within the Western Sydney International Stage 1 Construction Impact Zone and consists of the rail corridor between Elizabeth Drive and Airport Business Park Station. The site would support the construction and fit-out of this section of the alignment within Western Sydney International.

A temporary crossing of the Western Sydney International drainage swale may be required to support work within the on-airport construction corridor.

The on-airport construction corridor is shown in Figure 4-14.

Airport Business Park

The Airport Business Park construction site is located within the Western Sydney International Stage 1 Construction Impact Zone. The site would support the construction of Airport Business Park Station. Key construction works would include:

- construction of the rail alignment including earthworks for the transition of the rail alignment from surface to in-cutting
- construction of an access road to Airport Business Park Station from Badgerys Creek Road
- construction of Airport Business Park Station structures, finishes and fitout.

The location and an indicative layout of the construction site, including vehicle access/egress is provided in Figure 4-17.

Western Sydney International tunnel portal

The Western Sydney International tunnel portal construction site is located within the Western Sydney International Stage 1 Construction Impact Zone, southwest of the Airport Business Park construction site.

Key construction works would include:

- construction of the rail alignment including earthworks for the transition of the rail alignment from in-cutting to in-tunnel
- tunnel boring machine (TBM) launch
- TBM support including spoil handling
- construction of the tunnel portal
- finishing works.

The location and an indicative layout of the construction site, including vehicle access/egress is provided in Figure 4-18.

Airport Terminal

The Airport Terminal construction site is located within the Western Sydney International Stage 1 Construction Impact Zone. The site would effectively be separated into two sites, one supporting the construction of Airport Terminal Station and the other supporting tunnelling activities for the Western Sydney International to Bringelly tunnel. Key construction works would include:

- earthworks to accommodate the station and tunnelling activities
- TBM maintenance and relaunch
- TBM support including spoil handling
- construction of Airport Terminal Station structures, finishes and fitout.

The location and an indicative layout of the construction site, including vehicle access/egress is provided in Figure 4-19.

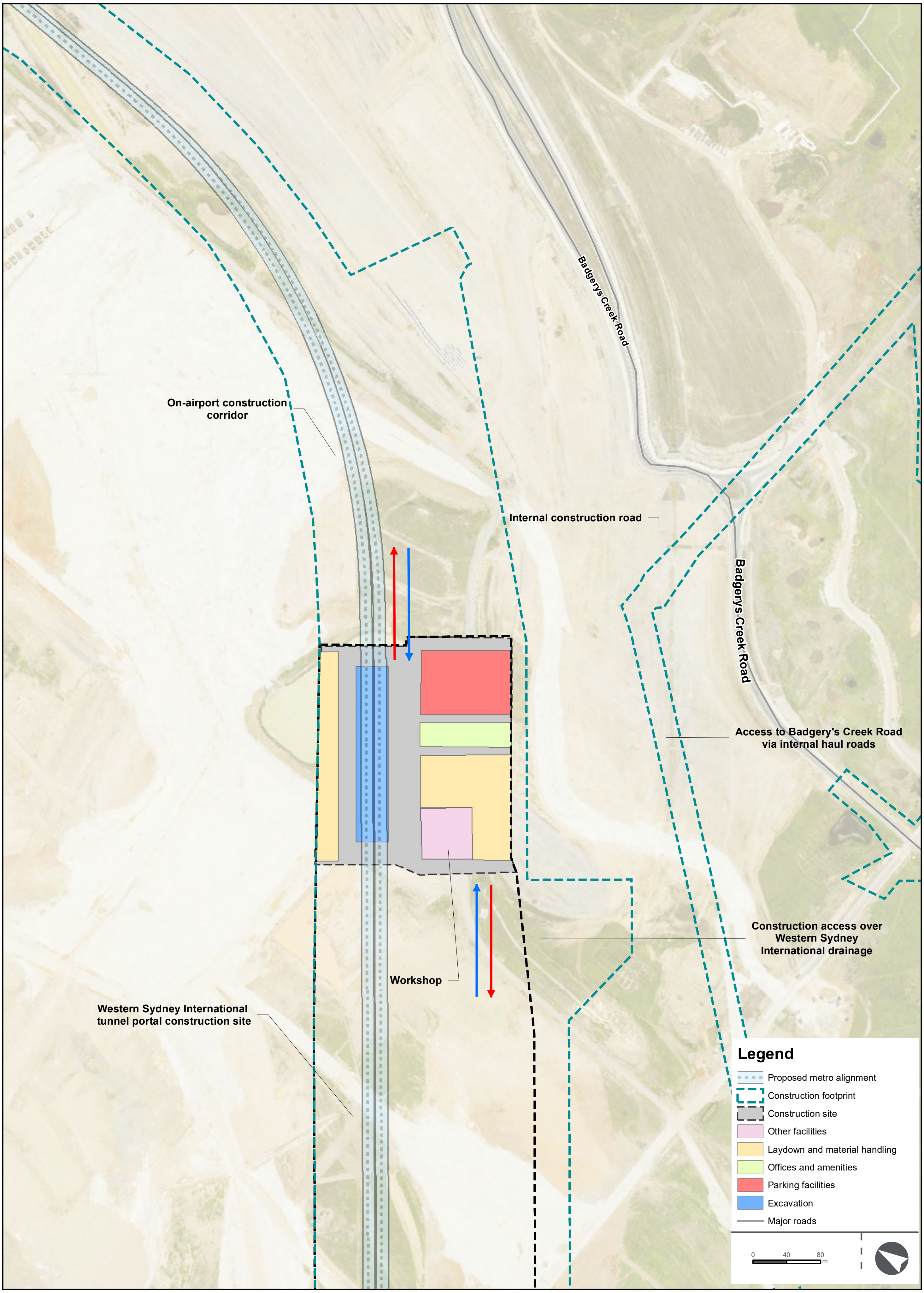
Airport construction support site

The airport construction support site sits across both the Western Sydney International Stage 1 Construction Impact Zone and the area located outside of the Western Sydney International Stage 1 Construction Impact Zone (refer to Figure 1-2 for the boundary between these two areas). The airport construction support site comprises multiple ancillary areas where the key construction activities would include:

- construction and use of haulage roads to support the construction of the proposed action
- activities required for the production and storage of viaduct and tunnel segments, including concrete batching, site offices and construction worker car parking
- potential permanent placement of spoil.

The combination of sites would support construction activities at all proposed action construction sites as well as the production of viaduct and tunnel segments to be transported and used both for proposed action and project off-airport construction sites as appropriate.

The location and an indicative layout of the tunnel and viaduct segment production and storage area, including vehicle access/egress is provided in Figure 4-20.

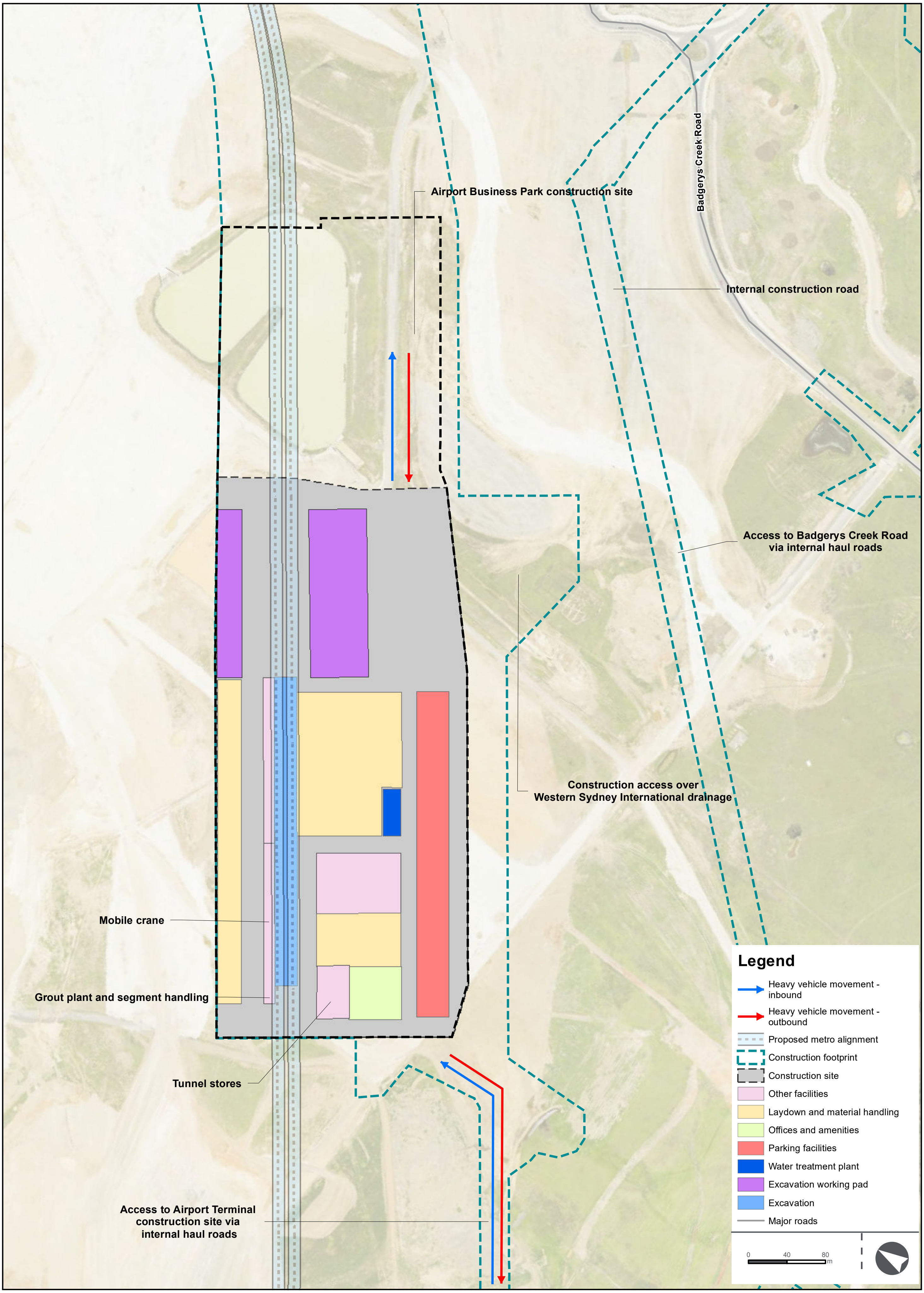


Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Airport Business Park indicative construction site layout

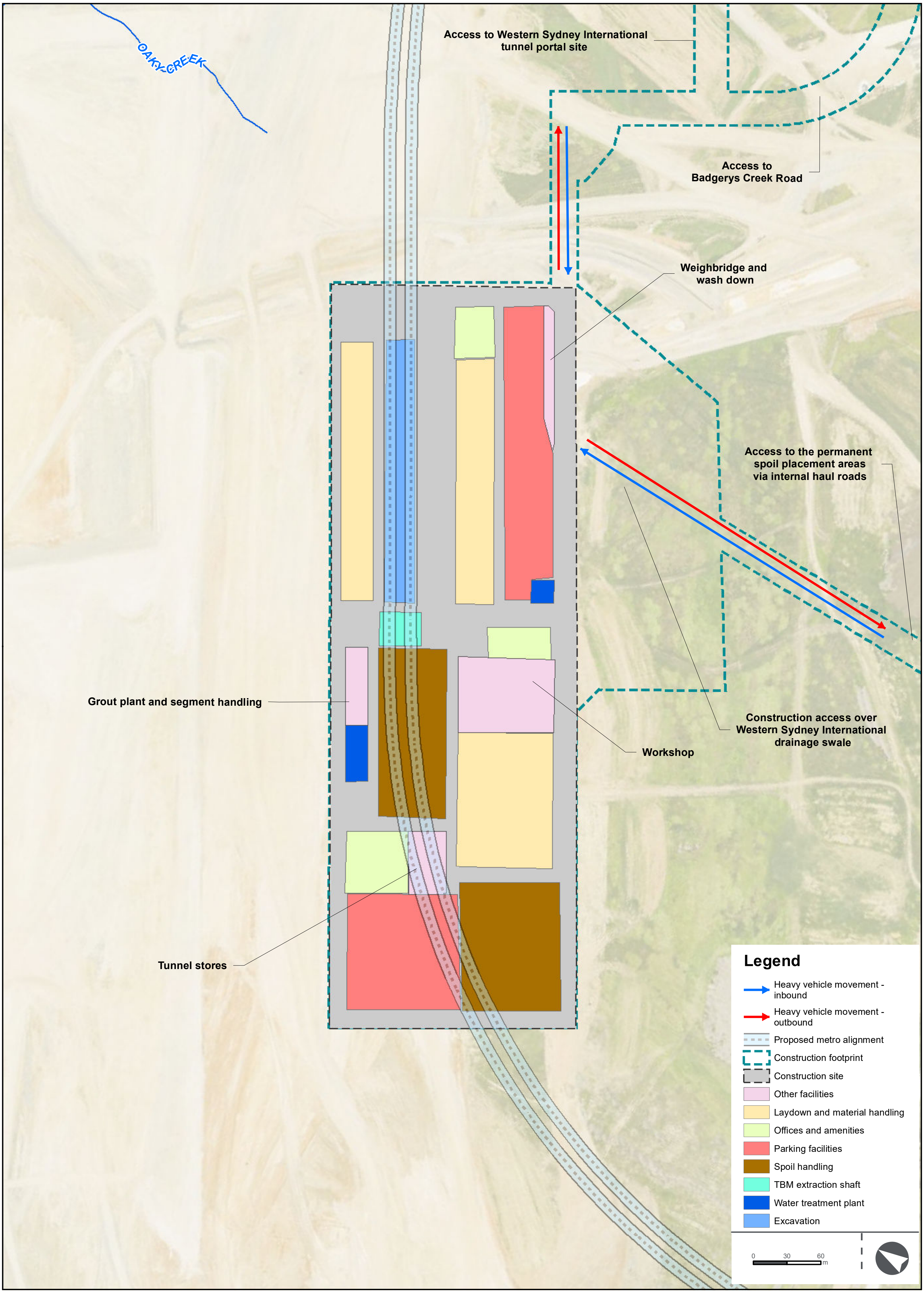
Figure 4-17



Western Sydney International tunnel portal indicative construction site layout

Figure 4-18

Indicative only, subject to design development

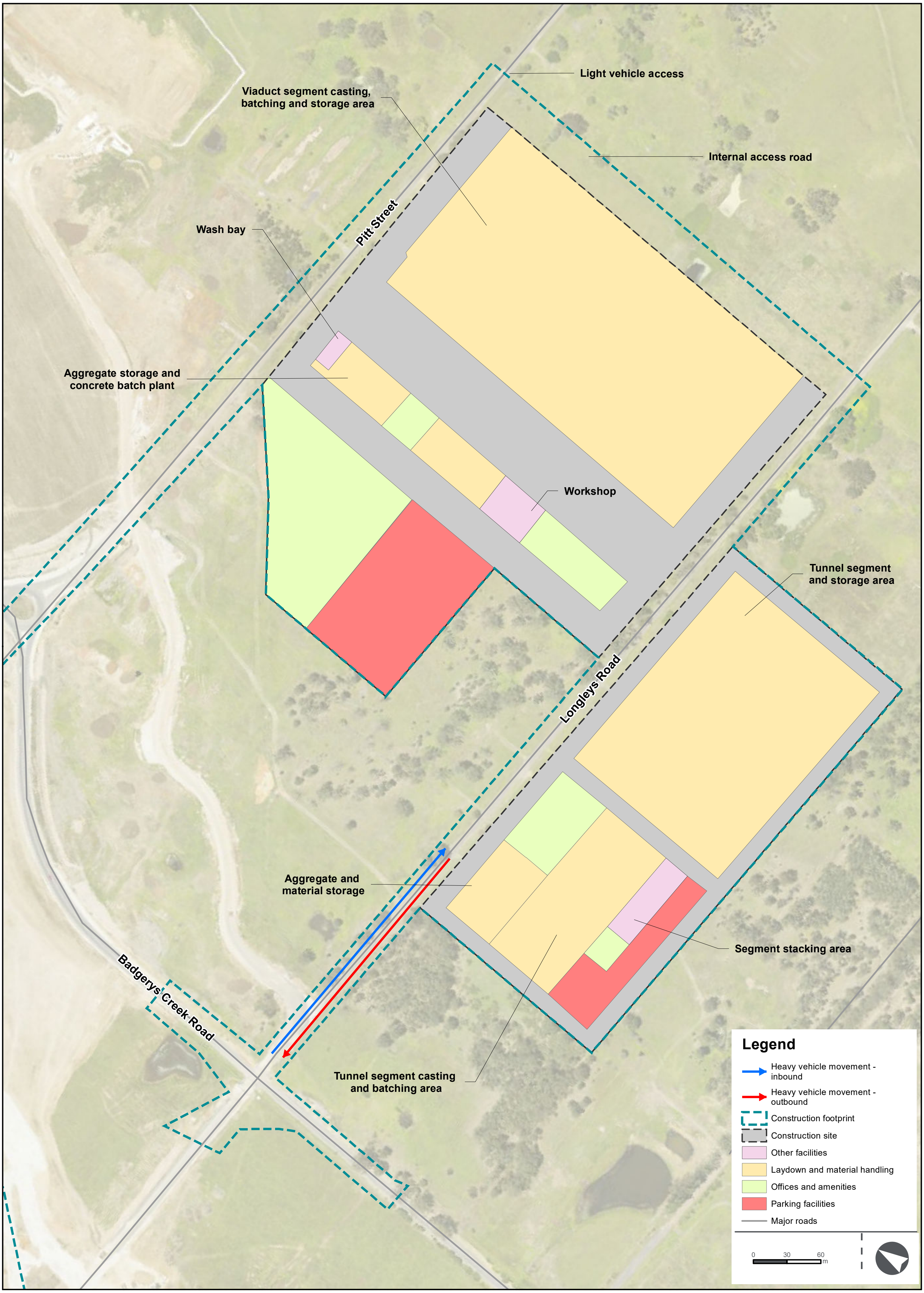


Sydney Metro – Western Sydney Airport

Airport Terminal indicative construction site layout

Figure 4-19

Indicative only, subject to design development



Sydney Metro – Western Sydney Airport

Tunnel and viaduct segment production and storage indicative construction site layout

Figure 4-20

Indicative only, subject to design development

Potential permanent spoil placement areas

An opportunity has been identified to reuse material from the project as fill material for future development at Western Sydney International. Subject to relevant approvals and agreement with Western Sydney Airport, spoil from both within and outside of the airport site could be placed at permanent spoil placement areas.

The potential permanent spoil placement areas form part of the airport construction support site. Up to 1.9 million cubic metres of spoil could be permanently placed on-airport. Further design work and consideration of compaction levels has determined that 1.9 million cubic metres of spoil cannot be wholly accommodated at the permanent spoil placement area identified within the Draft Environmental Impact Assessment so a second area has been identified, in consultation with Western Sydney Airport (refer to Figure 4-21).

The extent to which the potential permanent spoil placement areas are used would be confirmed during design development and construction planning in agreement with Western Sydney Airport. The placement of spoil would avoid the Environmental Conservation Zone along Badgerys Creek (discussed further below). The potential permanent spoil placement areas will be accessed from the proposed construction haul road network within the airport site.

The proposed potential permanent spoil placement areas are located outside of the Western Sydney International Stage 1 Construction Impact Zone (refer to Figure 4-21). The location of these areas has been determined in consultation with Western Sydney Airport to align with future development needs. Authorisation for the long-term management of the permanent spoil placement areas would be the responsibility of Western Sydney Airport.

Management of the Environmental Conservation Zone buffer

The airport construction support site has been located outside of the Environmental Conservation Zone consistent with the intent of the Airport Plan and recognising the environmental values of Badgerys Creek and associated remnant native vegetation.

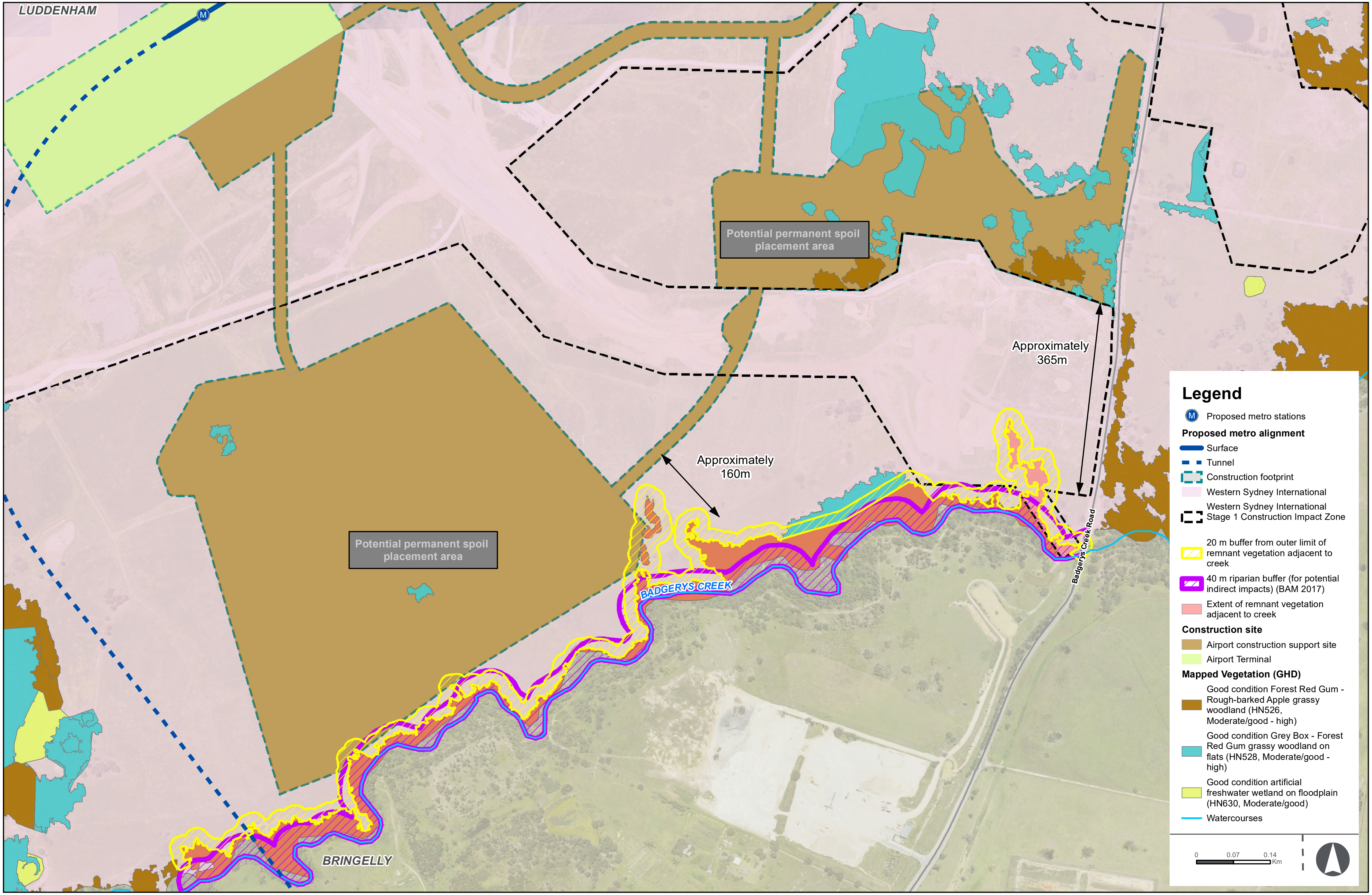
Acknowledging that Badgerys Creek is a 4th order waterway, a riparian buffer of 40 metres (measured from top of bank) was identified, consistent with the NSW waterway guidelines and NSW Biodiversity Assessment Method (BAM). In addition, to further minimise edge effects and indirect impacts associated with noise, light and weeds on surrounding biodiversity values, a 20 metre buffer was identified around the outer limit of remnant native vegetation adjacent to Badgerys Creek, including vegetation that lay outside the 40 metre riparian buffer already identified. These buffers are shown on Figure 4-21. In some instances, parts of the proposed riparian buffer and the proposed remnant native vegetation buffer extend into the airport construction support site.

The layout of the construction footprint within the airport construction support site (which accommodates the potential permanent spoil placement areas and related activities, as well as associated environmental protection control features such as sedimentation ponds) has been altered to ensure these buffers are not impacted.

Given the Western Sydney International setting is within a predominately cleared agricultural landscape already subject to a wide range of disturbances, the maintenance of these prescribed buffer distances and the associated distances are considered suitable to minimise edge effects and indirect impacts on surrounding environmental values.

Tunnel and viaduct segment production and storage

Isolated remnant native vegetation is present in the area to the south and southeast of this construction site. Vegetation outside of the construction footprint for this site would not be disturbed. To minimise edge effects and indirect impacts associated with noise, light and weeds on surrounding biodiversity values, a 20 metre buffer was identified around the outer limit of the south and south west boundaries of this site to protect the nearby remnant native vegetation in moderate to good condition (refer to Figure 4-22).

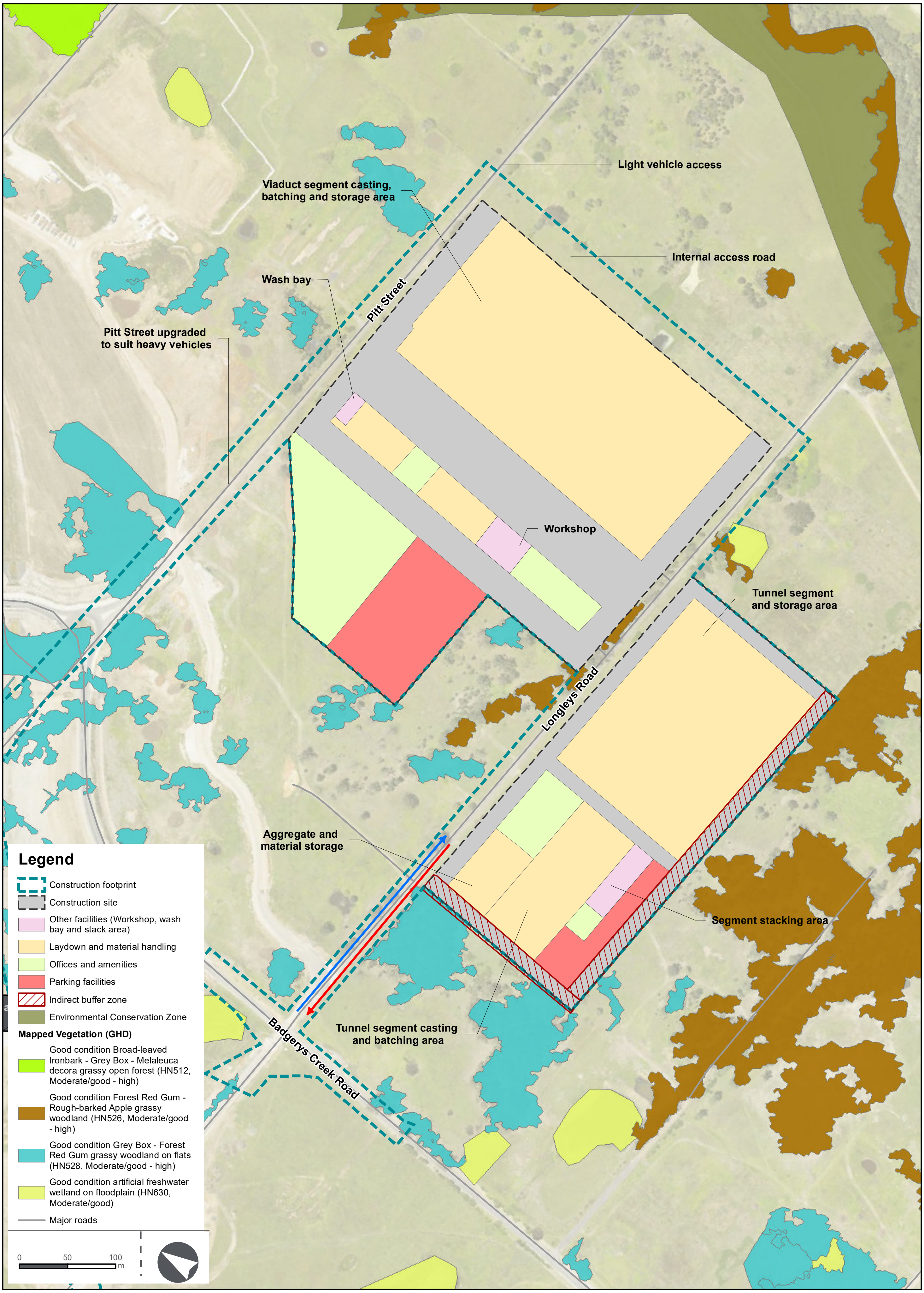


Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Potential permanent spoil placement areas - buffer zones

Figure 4-21



Sydney Metro – Western Sydney Airport

Tunnel and viaduct segment production and storage construction site - buffer zones

Figure 4-22

Indicative only, subject to design development

4.2.4 Tunnelling and associated works

The tunnel and excavation method would be driven by ground conditions likely to be encountered during construction, the project design and program. Based on the current understanding of the existing ground conditions, the proposed methodology for the proposed action is to utilise a bored tunnel approach. The methodology described below is indicative and would be developed by the construction contractor(s) when appointed and will be detailed in the Construction (Rail) Plan (refer to Chapter 8 (Environmental management and mitigation)).

A summary of this indicative construction methodology is provided below.

Bored tunnel construction methodology

A TBM typically consists of a shielded cutting head and trailing backup support services and mechanisms. At the front of the shield is a rotating cutter head (shown in Figure 4-23), and behind the cutter head is a chamber where the excavated spoil would be collected and transferred via a conveyor or slurry pipe back to the TBM launch site or other retrieval point as required. The TBM would be propelled forward by hydraulic jacks pushing off the previously excavated sections of rock. Gaps between the excavated tunnel wall and the tunnel lining would be filled with cement-based grout.

It is anticipated that two TBMs would be required for the Western Sydney International to Bringelly tunnel.

The lining for the tunnel would be assembled from precast concrete segments and installed progressively as the TBM moves forward. The precast concrete tunnel segments, would be manufactured using concrete from a dedicated concrete batching plant and stored at a tunnel segment precast facility, located at the airport construction support site (see Section 4.2.3 and example in Figure 4-24). The precast facility would produce about 300 tunnel lining ring segments per day. The segments would be transported via trucks within Western Sydney International for the proposed action. Precast concrete tunnel segments would also be manufactured at this facility for use in sections of the tunnel located outside of the airport site. The tunnel segments would be transported from the facility on the surrounding road network to their required destination.

The estimated rate of tunnel advance by the TBMs would be around 100 metres per week.

Figure 4-23 Photo of a tunnel boring machine at Epping Station on the Metro North West Line

Figure 4-24 **Photo of the tunnel segment storage area at Marrickville for the Sydney Metro City & Southwest project (indicative example of the proposed facility within Western Sydney International)**

Tunnel boring machine launch and retrieval

The indicative strategy for launch and retrieval of the two TBMs for the Western Sydney International to Bringelly tunnel is as follows:

- both TBMs would be launched from the Western Sydney International tunnel portal construction site and driven south-west towards the Airport Terminal construction site. TBM support activities would be carried out at the Western Sydney International tunnel portal construction site until the TBM reaches the Airport Terminal construction site
- the TBMs would receive maintenance west of the Airport Terminal station box before being relaunched to the southeast towards the Bringelly services facility. At this time, relevant infrastructure to support TBM operations including grout plant(s) and ventilation fans would be relocated (as required) from the Western Sydney International tunnel portal construction site to the Airport Terminal construction site. TBM support activities (including spoil handling) would commence from this location and continue until tunnelling is completed
- at the Bringelly services facility (see Section 4.1.4), the TBMs would receive maintenance before being relaunched southeast towards the Aerotropolis Core construction site
- on completion of tunnelling, the TBMs would be disassembled and retrieved from a temporary shaft excavated at the Aerotropolis Core construction site. The shaft would be decommissioned and backfilled following the retrieval of the TBMs.

Tunnel spoil would be removed from the Western Sydney International tunnel portal and Airport Terminal construction sites. See Section 4.2.9 for further information regarding spoil management.

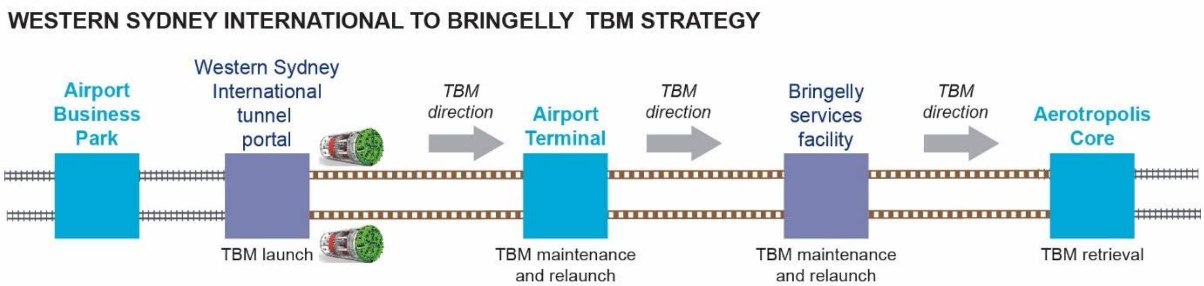


Figure 4-25 **Indicative Western Sydney International to Bringelly TBM strategy**

Tunnel boring machine support activities

TBM operations require surface construction areas for logistics support and material handling including:

- TBM delivery, assembly and commissioning
- high voltage power supply
- fresh air ventilation (fresh air ventilation fans would operate 24 hours per day, seven days per week during tunnelling)
- water supply
- drainage and water treatment plant
- grout plants
- spoil handling, stockpiling and removal facilities
- workforce facilities
- acoustic shed if required to mitigate environmental impacts.

TBM support activities would primarily be carried out at the following construction sites:

- Western Sydney International tunnel portal site
- Airport Terminal construction site.

Tunnel portal construction

A tunnel portal would be constructed about 400 metres southwest of Airport Business Park Station (the northern extent of the Western Sydney International to Bringelly tunnel). A dive structure would be constructed at the tunnel portal to transition the rail track from surface to in-tunnel through the portal.

Construction of the dive structure and tunnel portal would generally involve:

- piling along the edge of the dive structure to form the walls
- excavating below proposed track level
- placing of precast and cast in-situ concrete for the cut-and-cover section and to form the tunnel portal.

A tunnel ventilation facility would also be provided as part of the tunnel portal (see Section 4.1.4).

Other tunnel excavations

Cross-passages would be excavated between bored twin tunnels roughly every 240 metres using small roadheaders (specialised excavation machines) and/or excavators with rock hammers. Additionally, rooms would be excavated with rock hammers at various points along the bored twin tunnels for rail systems services.

4.2.5 Corridor and associated works

Earthworks (for example, cuttings and embankments) would be required in the On-airport construction corridor (see Figure 4-14) to achieve required levels for the surface track alignment. Sections of cut and embankment batters would not typically require structural support; however, where necessary structural support can be provided by retaining walls, piles and soil nails.

Earthworks would also be required along the proposed action alignment for drainage structures and water quality basins.

The general sequence for earthworks would be as follows:

- ground stabilisation works as required
- construction of bored pile wall or similar infrastructure where required
- earthworks cut and fill to design levels

- construction of retaining structures and drainage elements where required as the earthworks progresses.

4.2.6 Stations and associated works

Two stations are proposed as part of the proposed action. The construction method for the stations is summarised in Table 4-1 with further detail provided below. The methodology described below is indicative and would be confirmed by the construction contractor(s) when appointed.

The construction of the stations would consist of structural works (for the station box) and station fitout works. Station fitout works are generally similar for the two stations and the methodology for these works is described in Section 4.2.7.

Table 4-1 Indicative station construction method

Station	Vertical alignment	Construction method (structural works)
Airport Business Park	Surface (shallow cutting)	Surface
Airport Terminal	Underground	Cut-and-cover box

Where the design and site conditions allow, stations would be constructed using modular design elements to minimise the construction timeframes. This approach involves the installation of structures (for example, station buildings and canopies) comprising modularised components.

Surface station construction method

Surface station construction is proposed at Airport Business Park Station. At this location the rail track transitions from surface to in-cutting. The station would be constructed at the surface level (or slightly below) relative to the finished surface level at Western Sydney International. The excavation method for the surface station would be consistent with typical minor excavation and levelling works.

Structural works for the surface level station would involve the construction of:

- support columns and foundations for vertical transport structures and the station buildings
- the platform structure
- vertical transport structure and the pedestrian accesses
- the platform canopy
- the emergency egress stairs
- the station buildings.

The structures outlined above would be constructed using a combination of:

- conventional formwork and cast in situ concrete
- precast concrete elements
- pre-fabricated steel structures and
- standard blockwork and/or steel framing.

The construction of the station buildings would occur concurrently with the station construction.

Cut-and-cover station construction method

Cut-and-cover construction is proposed for Airport Terminal Station. A typical construction method for cut-and-cover station excavation would involve excavating the station from the surface and using pile walls to support the surrounding soil and rock.

Structural works for the underground stations would involve the construction of:

- platforms
- vertical supports

- mezzanine levels and rooms
- roof slabs (covering the station box).

The structures outlined above would be constructed using a combination of:

- conventional formwork and cast in situ concrete
- precast concrete elements
- pre-fabricated steel structures and
- pre-fabricated platform canopy components.

Station fitout, precinct and transport integration works

The mechanical and electrical fitout of the stations consists of two major elements, the rail systems located at the stations and the services required for the function of the stations. For the underground Airport Terminal Station, the initial fitout of mechanical and electrical services would occur concurrently with the structural works via openings left in the floors and roof structure. This would include the installation of large equipment such as ventilation fans. The final fitout of mechanical and electrical services would occur after the completion of structural works and concurrently with the architectural fitout.

The architectural fitout of the stations would occur on completion of the station structural works and involves the final finishes for the stations, such as glazing, wall and ceiling cladding, and floor finishes.

The precinct and transport interchange works for Airport Business Park Station and Airport Terminal Station would be provided as part of the wider development of Western Sydney International. The elements to be constructed at each station is detailed in Section 4.1.3.

4.2.7 Rail systems fitout

The rail systems fitout works are described in Table 4-2. Indicative access points for the rail systems fitout would be via the construction sites described in Section 4.2.3. Access points would be confirmed by the construction contractor(s) when appointed

Table 4-2 Rail systems fitout

Item	Work
Ventilation	The majority of tunnel ventilation equipment for the proposed action would be located at the tunnel portal facility, stations and services facility (the latter to be constructed as part of the project off-airport).
Track slab and rail fastening	The track slab would be formed by mass concrete pours with rail fasteners incorporated into the pours. Rail fasteners would be designed to mitigate operational noise and vibration where required. Ballast track form may also be used for surface sections of track.
Rail track installation, fixing and welding	Rail track would be delivered to the access points at each of the construction sites. Where there is surface access to the tunnels (i.e. the tunnel portal), rail track sections would be welded together in lengths and then transported underground. Where there is no surface access to the tunnel, standard rail lengths would be delivered and lowered down via access shafts such as at the Airport Terminal construction site. For the surface rail, rail would be delivered to site and welded or pre-welded in the casting yard and delivered to site and welded into position.

Item	Work
Cable and equipment installation	Dedicated cable routes would be provided within the tunnel environment for signalling, communications and electricity and surface sections. Signal equipment rooms would be provided at each station and alongside the surface alignment as required. Communication rooms would also be provided at each station. Galvanised steel troughs and poles and masts for communications systems and lighting would also be provided.
Overhead wiring	For the tunnels, overhead wiring would be installed at regular intervals on the track. For surface rail, overhead wiring structures would be installed into the track subgrade.

4.2.8 Western Sydney International Stage 1 project interface

Construction of the proposed action within the Western Sydney International Stage 1 Construction Impact Zone is likely to begin on a cleared and level site.

Ongoing consultation with Western Sydney Airport has ensured the design of temporary proposed action infrastructure also considers the temporary infrastructure required for construction of the Western Sydney International Stage 1 project. In addition, construction planning for the proposed action has taken into consideration the Western Sydney Airport Construction Plan.

Construction activities and infrastructure for the proposed action that would occur outside the Western Sydney International Stage 1 Construction Impact Zone (wholly or partially) would include:

- activities required for tunnel and viaduct segment manufacture and storage
- potential permanent spoil placement areas
- upgrade at the intersection of Longleys Road and Badgerys Creek Road
- temporary haulage roads
- site offices and construction worker car parking.

Refer Figure 4-14 for further information.

A number of internal roads are being delivered in this area as part of the Western Sydney International project. Internal vehicle access arrangements for the proposed action have been developed to utilise these roads where possible. Temporary haulage roads for the proposed action would be constructed to connect the Western Sydney International internal roads to construction infrastructure for the proposed action.

Construction planning for the proposed action has considered the initial design of the intersection (roundabout) with Elizabeth Drive and the realigned Badgerys Creek Road and would deliver an additional northbound exit for the intersection to facilitate construction vehicle access to the off-airport construction corridor as well as a separate new access to the west to access the on-airport construction corridor. This is not part of the proposed action but is provided for context.

There would be continued consultation between Sydney Metro and Western Sydney Airport as part of the ongoing development of the construction approach for the two projects. Opportunities for the construction of the proposed action to integrate with construction activities for Western Sydney International would be developed as the project design and construction planning is refined.

4.2.9 Other construction elements

Site investigations and subsequent works

Detailed investigations would be required before the start of main construction works. Detailed investigations that would be carried out as preparatory activities would include:

- site survey

- utility investigations
- geotechnical investigations including groundwater monitoring
- contamination investigations and subsequent remediation works (if required).

Vegetation clearing

For the purposes of this Final Environmental Impact Assessment it has been assumed that all vegetation within the Western Sydney International Stage 1 Construction Impact Zone has already been cleared as part of the Stage 1 airport development.

As part of the proposed action additional vegetation clearing will be required in some areas outside of the Western Sydney International Stage 1 Construction Impact Zone. The construction footprint has been located to minimise the need for vegetation clearing in these areas, where possible. No vegetation clearing is proposed within the Environmental Conservation Zone (ECZ) along Badgerys Creek. A Part 13 permit may be required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to enable clearing of listed threatened species and ecological communities to occur.

Spoil

Indicative cut and fill volumes along the proposed action alignment are summarised in Table 4-3. The volumes include earthworks required to achieve required ground surface levels for surface (shallow cut and embankment) and in-cutting sections as well as the construction of the bored twin tunnels and the excavation of station boxes.

Table 4-3 Indicative cut and fill volumes

Location	Cut volume (m3)	Fill volume (m3)
Western Sydney International - Elizabeth Drive to Airport Business Park	130,000	75,000
Airport Business Park	25,000	15,000
Airport construction support site	65,000	65,000
Airport Business Park to Aerotropolis Core (including Airport Terminal and Western Sydney International to Bringelly tunnel)	1,065,000	75,000
Total	**1,285,000**	**230,000**
Balance	**1,055,000 surplus**	

The estimates are based on the assumption that cut material can be used as fill for the project, which may not be the case if unsuitable material is encountered during earthworks. Fill volumes do not include reuse opportunities beyond the project which would reduce surplus volumes. Spoil volumes would be confirmed by the construction contractor(s) when appointed.

As discussed in Section 4.2.3, up to 1.9 million cubic metres of spoil could be permanently placed on-airport within the potential permanent spoil placement areas at the airport construction support site.

The reuse of spoil at this location would reduce potential impacts that would otherwise be associated with the movement of this spoil to other reuse locations via the public road network. Reuse of spoil within Western Sydney International would be performed in accordance with the Airport Plan, Construction Plan and any relevant CEMPs, including any subsequent variations to those plans. Other opportunities to reuse spoil would also continue to be investigated as the project design progresses. This could involve use of spoil as fill material elsewhere within the proposed action construction footprint, within the project construction footprint outside of the airport site or possibly by other projects in the area, such as the future M12 Motorway project.

Temporary stockpiling sites would be established as required throughout the construction footprint for the proposed action. This would include stockpiling sites to stockpile material excavated from the tunnel as well as other sources of excavated material from the proposed action.

Spoil removal from construction sites would be via trucks on the road network. Refer to Section 7.1 for details on haulage routes and Section 7.10 for further information regarding spoil management.

Construction hours

The majority of the station fitout and other above ground construction activities would be carried out during standard construction hours, as defined by the *Interim Construction Noise Guideline* and the *Western Sydney Airport Noise and Vibration Construction Environmental Management Plan* (Western Sydney Airport, 2019f):

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturdays
- no works on Sundays or public holidays.

Activities resulting in impulsive or tonal noise emissions would generally be limited to these hours.

Activities that may be carried out outside the standard construction hours would include:

- tunnelling works and other underground works
- works within acoustic sheds
- tunnel fitout and associated works
- underground station fitout works
- spoil haulage, deliveries and TBM activities at Western Sydney International tunnel portal and the Airport Terminal
- spoil haulage associated with placement of material at the potential permanent spoil placement areas within the airport construction support site
- activities at the tunnel segment precast facility within the airport construction support site, including transport of material to support segment production and segment deliveries
- the delivery of oversized materials or materials outside approved hours as required by the NSW Police or other authorities for safety reasons
- emergency situations where it is required to avoid the loss of lives and property and/or to prevent environmental harm
- testing and commissioning
- other works (e.g. utility works).

With the exception of emergencies, activities would not take place outside standard construction hours without prior notification of Western Sydney Airport and the affected community.

In relation to on-airport out-of-hours work, this would be undertaken in accordance with the existing Western Sydney Airport out-of-hours work procedure.

Construction traffic and access

Haulage routes for vehicles accessing the proposed action construction footprint are provided in Figure 4-14. Additional or revised construction haulage routes and refinements to the construction sites and potential permanent spoil placement areas within Western Sydney International may be required during design development and construction planning, subject to agreement with Western Sydney Airport.

The proposed indicative access to the construction sites once inside the airport boundary are shown in the site layout figures in Figure 4-17 to Figure 4-20.

The indicative temporary access and egress to constructions sites would be subject to confirmation by the construction contractor(s) and Western Sydney Airport.

Further information relating to construction traffic impacts is provided in Section 7.1.

For the proposed action, indicative road network adjustments are anticipated to include:

- minor modification to a Western Sydney International internal access road to connect to temporary haulage roads (located within the on-airport construction corridor)

- upgrade to sections of Longleys Road and Badgerys Creek Road, including intersection works where Longleys Road and Badgerys Creek Road intersect to provide heavy vehicle access
- an additional haulage route accessing the potential permanent spoil placement areas from Badgerys Creek Road is subject to further design development and is being considered to minimise spoil haulage distances and to reduce the number of heavy vehicles accessing the on-airport haulage roads from the intersection of Badgerys Creek Road and Longleys Road.

Measures to manage potential traffic impacts associated with temporary road modifications are described in Section 8.4.

Construction water management

Treated water discharge

The excavation of the tunnels and Airport Terminal Station and shaft are likely to intercept groundwater, resulting in the need to capture, treat and reuse or discharge water. Treated water would be re-circulated to the tunnel cutting face and used for surface dust suppression.

Treated water that cannot be recirculated would be discharged from the sites via construction water treatment plants (refer to Table 4-4). The reuse of treated water would be maximised during the construction works. Where surplus treated water needs to be discharged from the sites, subject to the relevant performance outcomes and mitigation measures in Chapter 8 (Environmental management and mitigation), it may be discharged to Badgerys Creek via Western Sydney International swale.

Other reuse options including Sydney Water trade waste agreement(s) and use of treated water at Western Sydney International and other nearby projects (such as the future M12 Motorway) would be investigated during construction planning.

Table 4-4 Treated water discharge from construction water treatment plants

Location	Discharge point	Indicative discharge volume when discharging (litres per second)
Western Sydney International tunnel portal	Badgerys Creek via Western Sydney International swale	10
Airport Terminal	Badgerys Creek via Western Sydney International swale	10

Surface water management

Surface water management at the construction sites would be managed through the implementation of standard erosion and sediment control mitigation measures in accordance with Chapter 8 (Environmental management and mitigation).

Within Western Sydney International, construction water would be pumped to water quality basins, treated and then reused or discharged via constructed swales to Badgerys Creek or left to evaporate in the surrounding landscape.

Opportunities would be considered to maximise the reuse of construction water (refer to Section 7.9 for further information).

Construction equipment, resources and materials

The indicative plant and equipment expected to be used during construction of the proposed action is summarised in Figure 4-26. The actual plant and equipment used at each work site would be confirmed by the construction contractor(s).

Location	Bulldozer	Compressor	Concrete pump	Concrete truck	Roadheader	Concrete saw	Crusher	Excavator	Generator	Gantry crane	Hand tools	Jackhammer	Mobile crane	Pile boring rig	TBM	Vibratory roller	Water cart
On-airport																	
On-airport construction corridor	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓		✓		✓	✓
Airport Business Park	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
Western Sydney International| tunnel portal site	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Airport Terminal	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Airport construction support site	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓			✓	✓

Figure 4-26 Plant and equipment at proposed construction sites

Water requirements

A combination of recycled and potable water would be used during construction for activities such as tunnelling, earthworks, site facilities, dust suppression, concreting and landscaping. Water would be sourced from water treatment plants, sedimentation basins and rainwater tanks where feasible.

Power supply

High voltage construction power would likely be provided to the Western Sydney International tunnel portal construction site to support tunnelling activities via a new connection from the existing Kemps Creek substation located at Devonshire Road, Kemps Creek (to the east of Western Sydney International). Generators may be used for construction power before the mains power supply becoming available.

The construction power route would primarily be constructed in areas outside of the airport site with only a small section of the route proposed to be constructed within Western Sydney International. The extent of the indicative construction power supply route within Western Sydney International would generally follow internal Western Sydney International roads or temporary haulage roads for the proposed action. The construction power route is expected to enter the airport site from the east along Pitt Street.

Utility protection, adjustment and relocation

There are a number of active and disused utilities within the construction footprint of the proposed action. Utilities that are located both above ground and below ground have the potential to be affected by construction of the proposed action.

The locations of utilities have been identified based on Dial Before You Dig searches and a review of utility data, including as-built surveys, and agency and council records. The utility provider within the airport site is Western Sydney Airport (power, communications and stormwater infrastructure).

Where an existing utility conflicts with the proposed action, it may be necessary to:

- provide physical protection for the utility, where the utility is not directly affected but may be indirectly affected by vibration or accidental impact
- modify construction methods to avoid impacting a nearby utility
- divert the utility around the construction footprint.

4.2.10 Finishing works and testing and commissioning

Finishing works

Following the completion of the main construction works, the contractor would remove construction equipment from the construction sites. Where relevant, sites that were occupied temporarily and do not form part of the operational footprint for the proposed action would be returned in a condition agreed to with Western Sydney Airport.

Any landscaping works required would be consistent with the Airport Plan and with Western Sydney Airport's intentions for these locations.

Testing and commissioning

Testing and commissioning of the rail line and communication/signalling systems would be carried out to ensure that all systems and infrastructure have been installed and are operating according to Sydney Metro's operational requirements.

Once all services are installed, testing and commissioning of the whole system would occur.

During the final stages of commissioning, test trains would run on the line to test the signalling system and controls and the traction power supply.

4.2.11 Approach to identifying and selecting additional construction related elements

While every endeavour has been made to identify and quantify the likely land requirements for construction of the proposed action, the construction contractor or Western Sydney Airport may require changes to elements of construction. This may include:

- additional or revised construction haulage routes and refinements to the construction sites and potential permanent spoil placement areas
- changes to water quality and detention basins
- additional utility works (or other minor construction works) outside of the construction footprint.

Any changes to the works would be managed through construction planning, consultation with Western Sydney Airport and detailed in the Western Sydney Airport Construction (Rail) Plan.

5 Avoidance of impacts during development of the proposed action

This chapter provides an overview of the on-airport design considerations to date, including alignment options. It also outlines the future design development process.

5.1 Design refinements for impact minimisation

The design and development of Sydney Metro – Western Sydney Airport has been influenced by factors including environmental and transport constraints.

Key environmental aspects that have influenced the proposed action, together with how the design has been refined to avoid and/or minimise potential environmental impacts, are summarised in Table 5-1. Ongoing project planning would continue to be undertaken to ensure these outcomes would be retained in design development where possible.

Table 5-1 Environmental considerations during design refinements

Environmental aspect	Design refinements
Biodiversity	• vertical and horizontal alignment optimisation has resulted in improved fauna connectivity, due to provision of tunnel alignments (such as the crossing under Badgerys Creek) • reduced impacts to Cumberland Plain Woodland and the Environmental Conservation Zone along Badgerys Creek have resulted from the proposed tunnel alignment from Western Sydney International to the airport site boundary (and beyond off-airport to Aerotropolis Core) (refer to Section 7.3) • refinement of the proposed action construction footprint to minimise impacts on biodiversity, where possible • use of internal roads that are being delivered as part of the Western Sydney International project for construction vehicle access where possible thereby minimising the need for new haulage roads which impact on biodiversity.
Construction traffic and transport	• by producing and storing tunnel segments and viaduct segments at Western Sydney International, the proposed action would reduce traffic movements associated with trucking these materials from a remote location to the proposed action • the project is continuing to investigate spoil management options, including potential permanent spoil placement areas within Western Sydney International and spoil reuse in areas close to the project alignment (for example use by the future M12 Motorway project) to minimise road-based spoil haulage (refer to Section 7.10).
Aboriginal heritage	• optimisation of the vertical alignment has resulted in longer sections of tunnel (including for the on-airport section of the alignment), substantially reducing the extent of potential impacts on areas of Aboriginal archaeological sensitivity.
Property and land use	• improved land use and development outcomes at Western Sydney International due to the introduction of a tunnel alignment and design optimisation in consultation with Western Sydney Airport.
Visual and landscape	• optimisation of the vertical alignment has resulted in longer sections of tunnel (including for the on-airport section of the alignment) reducing the extent of potential visual and landscape impacts.
Hydrology and flooding	• avoid the need for a viaduct over Badgerys Creek and reduced potential for flood impacts due to the on-airport tunnel alignment.

Environmental aspect	Design refinements
Waste management and resource use	• selection of tunnel boring machines to excavate the twin tunnels because these cut the ideal circular profile for a rail tunnel, thereby minimising spoil generation • identifying potential permanent spoil placement areas within Western Sydney International that could minimise resource use (i.e. fuel etc) (refer to Section 7.10).

During future design development, opportunities to avoid and/or further minimise potential impacts of the proposed action would continue to be identified.

5.2 Design development process

The design of the project, including stations, will be further developed following any variation of the Airport Plan in consultation with relevant stakeholders.

The design development process will be guided by a suite of documents which include the following:

- Sydney Metro design objectives
- Design Quality Framework
- Sydney Metro – Western Sydney Airport Design Guidelines (Appendix G).

These documents, along with community and stakeholder engagement and the establishment of a Design Advisory Panel (prior to project approval) and a Design Review Panel (once project approval is obtained), will allow for high quality standards throughout the whole design process. At relevant stages in the design process, the design would be reviewed against the Design Guidelines and design objectives.

Sydney Metro has engaged with relevant stakeholders regarding the project design and would continue to engage these stakeholders throughout design development. In addition, submissions made during the statutory exhibition of the Draft Environmental Impact Assessment or as part of ongoing community involvement and consultation to date have been considered during design development (refer to Chapter 3 (Consultation)).

Integration with Western Sydney International

The design would also continue to consider the integration of the proposed action with Western Sydney International. It is expected that Sydney Metro and Western Sydney Airport would participate in a formal design review process to identify and resolve design integration issues. Many of the key metro characteristics for the Sydney Metro network are relevant for passengers travelling to and from Western Sydney International. The key characteristics of the Sydney Metro network of being a ‘fast and reliable service’ and ‘highly legible’ would ensure sufficient frequency that passengers can ‘turn up and go’ to Western Sydney International with sufficient time to connect to flights.

The design for the project would further consider the movement of passengers to and from Western Sydney International, including those with luggage. The metro trains would provide suitable storage areas for both carry-on and larger sized luggage for customers accessing Western Sydney International.

As part of further design development, the project would also consider and respond to requirements relating to airport operations, for example including lighting and ventilation design, to comply with applicable requirements of the Airports (Protection of Airspace) Regulations 1996 (Cth) and the *National Airports Safeguarding Framework* (Department of Infrastructure, Transport, Cities and Regional Development, 2018), as well as other relevant regulations and guidelines.

6 Description of the existing environment

This chapter describes the airport setting and focuses on the environment affected by the construction and operation of the proposed action. This includes the affected environment both within the airport boundary and for some issues, the environment beyond the airport boundary.

6.1 Overview of the airport environment

6.1.1 Location

The project is located within the Penrith and Liverpool Local Government Areas (LGAs), between the T1 Western Line at St Marys in the north and the Aerotropolis Core precinct in the south, via Western Sydney International. Western Sydney International is located in the suburbs of Luddenham and Bringelly and comprises approximately 1,780 hectares of land adjacent to Badgerys Creek (refer to Figure 1-3). This section describes the key aspects of the setting.

6.1.2 Biophysical setting

The on-airport environment is historically typified by a gently undulating landform within a highly modified landscape. The overall landscape character has been open and rural, with expansive views possible from surrounding hill tops and higher elevations to the west. Previous land uses in the affected area included rural residential, agricultural, community and extractive industry.

The on-airport environment is located in the South Creek sub-catchment. The South Creek sub-catchment encompasses the majority of the Cumberland Plain of Western Sydney. Watercourses and low-lying floodplain areas are primarily associated with South Creek and its tributaries. South Creek is a 400-square kilometre creek system that has its headwaters in the Camden area and flows 70 kilometres north to the Hawkesbury River. Tributaries of South Creek within the affected area include Cosgroves Creek and Badgerys Creek.

Construction of Stage 1 of Western Sydney International has commenced and is impacting around 60 percent of the airport site within the Western Sydney International Stage 1 Construction Impact Zone. There are significant earthworks underway to prepare the site for the airport development. These earthworks have removed the historical land uses within the site and transformed much of the landscape into a construction site. Construction on the residual area located within the on-airport environment but outside of the Western Sydney International Stage 1 Construction Impact Zone has not yet commenced and this area remains undeveloped. This residual area consists primarily of cleared land and vegetation around Badgerys Creek.

There is an Environmental Conservation Zone located along the southeast boundary of the airport site which generally corresponds to the riparian corridor for Badgerys Creek. There are additional areas of Environmental Conservation Zone in the north-west corner of the site along Oaky Creek, and to the south-west of the site. The Environmental Conservation Zone makes up around seven per cent of the airport site. Badgerys Creek is the primary watercourse in the affected area, with a number of tributaries and dams located generally to the west and north of the creek. The local topography of the affected environment gently undulates and slopes towards Badgerys Creek.

The environment outside the Western Sydney International Stage 1 Construction Impact Zone consists of remnant patches of grassy woodland and narrow corridors of riparian forest around Badgerys Creek with extensive areas of derived grassland, cropland, cleared and developed land. The condition of native vegetation is generally poor and there is moderate to severe weed infestation. However, within the Environmental Conservation Zone there is some vulnerable and endangered vegetation listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth) and the *Biodiversity Conservation Act 2016* (BC Act) (NSW).

Geologically, the airport site is located on Bringelly Shale bedrock overlain by Quaternary alluvial soils (younger sedimentary unit) in creek channels and older, historic river beds. The Quaternary alluvial deposits represent active and historical stream deposits and are associated with the active drainage channels in the area, including Badgerys Creek. The Hawkesbury Sandstone aquifer sits beneath the Bringelly Shale which acts as a barrier between the aquifer and the surficial alluvial soils.

The groundwater quality and yield (amount able to be extracted) across the region is variable, and dependent on the rock unit. The Bringelly Shale provides small amounts of near saline water.

The Badgerys Creek riparian corridor and immediate surrounds including the airport site have Aboriginal heritage significance including a number of recorded Aboriginal heritage sites as discussed in Section 6.7. All areas of non-Aboriginal heritage have been cleared as part of preparatory works for Western Sydney International Stage 1.

6.1.3 Socio-cultural setting

Western Sydney International is located within the suburbs of Badgerys Creek and Bringelly. The land in and around Badgerys Creek and Bringelly is primarily rural residential with large lots, and some agricultural and rural industries, including construction-related businesses. North of Elizabeth Drive, a substantial amount of land is occupied by the CSIRO Research Station, the University of Sydney McGarvie-Smith Veterinary Farm, and a landfill depot.

Sensitive receivers located near the airport environment are limited to rural residential receivers adjacent to the airport site north of Elizabeth Drive, to the east and south east of Badgerys Creek, to the west along Adams Road and to south of Northern Road.

6.1.4 Future setting

Western Sydney International would be developed in stages in response to demand and include planning for services and amenities that are easily expandable over time, providing scalable capacity for aircraft, passengers, cargo and vehicle movements. Stage 1 comprises a single runway, a terminal and other relevant facilities, to accommodate approximately 10 million annual passengers as well as freight traffic. Stage 1 of Western Sydney International is planned to open in 2026 (refer to Figure 1-2).

Following the completion of construction of Western Sydney International Stage 1, the environment would be characterised by permanent airport infrastructure including a runway, taxi areas, car parking and buildings for terminal support and business development. Overflights would also represent a new visual and noise element for the site and the surrounding environment.

Sources of night lighting would be introduced throughout the on-airport environment for the illumination of runways and security lighting around airport buildings and other infrastructure.

Western Sydney International is anticipated to bring significant benefits to the people and economy of Western Sydney in relation to economic development and employment opportunities for a variety of workers. Western Sydney International is anticipated to stimulate further development in existing and future regional and local centres within and outside the on-airport environment. It is anticipated this would contribute to the provision of better quality social infrastructure such as shops, health services, and recreation and leisure services.

The operation of Stage 1 of Western Sydney International (at day of opening) is expected to create thousands of direct onsite jobs and generate additional onsite jobs within the Airport Business Park. The airport is anticipated to generate around $77 million in added value for Western Sydney and around $145 million in added value for the rest of Greater Sydney (Department of Infrastructure and Regional Development, 2016b).

As part of the Northern Gateway Precinct of the *Western Sydney Aerotropolis Plan* (WSAP) (NSW Government, 2020), the area to the north of Western Sydney International is intended to transition from a semi-rural landscape to more intensive urban development primarily accommodating employment generating land uses.

The area to the southeast of Western Sydney International including Badgerys Creek and Bringelly is identified for further development under the WSAP, and forms part of the Aerotropolis Core precinct. The Aerotropolis is expected to comprise mixed use and flexible employment zones in Bringelly and Badgerys Creek. These areas will attract globally significant defence and aerospace activities and have significant freight and logistics strengths. The development of the Aerotropolis will have the potential to agglomerate the economic activities of the Western Parkland City.

The future M12 Motorway will run to the north of Western Sydney International connecting the M7 Motorway with Western Sydney International and The Northern Road. The NSW government is also investigating improvements to Elizabeth Drive between the M7 Motorway and The Northern Road to provide increased capacity for future growth.

6.2 Integration with Western Sydney International

The Western Sydney International Stage 1 Construction Impact Zone is shown in Figure 1-2. Construction activities for the proposed action would be carried out within and outside of the Western Sydney International Stage 1 Construction Impact Zone.

Construction activities for Western Sydney International Stage 1 are being carried out in three major phases:

- site preparation activities including clearing and earthworks
- aviation infrastructure activities including construction of the runway and internal road network
- site commissioning activities at the completion of the aviation infrastructure activities in readiness for the operation of the airport.

Preparatory activities including clearing and earthworks for Western Sydney International would generally be completed or almost completed when construction activities for the proposed action commence in 2021. To the extent required, all vegetation would be removed from the Western Sydney International Stage 1 Construction Impact Zone.

Construction activities for the proposed action would primarily overlap with construction of aviation infrastructure at Western Sydney International. Construction of the proposed action within the Western Sydney International Stage 1 Construction Impact Zone would therefore commence in the context of a cleared and level site during the construction of permanent aviation infrastructure.

Outside the Western Sydney International Stage 1 Construction Impact Zone, the land would be cleared of buildings as part of the airport development prior to construction of the proposed action; however, existing road infrastructure and vegetation would remain.

Construction planning for the proposed action has involved consultation with Western Sydney Airport to avoid construction conflicts where possible and to minimise cumulative construction impacts. Consultation would be ongoing through to the project's detailed design and construction phases (refer to Chapter 3 (Consultation).

The layout of permanent airport infrastructure has been considered in the ongoing design development and construction planning of the project to ensure integration with the airport. The two stations within Western Sydney International would be designed to be consistent with the agreed transport corridor and design intention for the Airport Business Park and Airport Terminal areas.

The following sections provide further information on the existing environment for relevant environmental issues.

6.3 Transport

This section outlines the existing transport environment, including the public and active transport environments, the traffic conditions and the existing road network performance on the key roads surrounding the airport site. Planned transport upgrades are also outlined.

6.3.1 Existing transport network

Transport interactions due to the proposed action would occur both on and off-airport.

Key roads

There are limited publicly accessible roads within the airport site (such as Badgerys Creek Road).

The key roads surrounding the airport site are illustrated in Figure 1-1 and Figure 1-3 and include:

- **Luddenham Road** –a collector road in a rural environment connecting Elizabeth Drive at Luddenham in the south to Mamre Road in the north

- **Elizabeth Drive** – an arterial road Elizabeth Drive that connects The Northern Road at its western end and Liverpool via crossings of the M7 and Cowpasture Road at its eastern end. The northern boundary of Western Sydney International adjoins Elizabeth Drive. The intersection of Elizabeth Drive and Badgerys Creek has been upgraded to a roundabout as part of the realignment of Badgerys Creek and the construction works at Western Sydney International. Transport for NSW has allocated funding to investigate improvements to Elizabeth Drive between the M7 Motorway and The Northern Road
- **Adams Road** – Adams Road is a collector road to the west of Western Sydney International connecting Luddenham in the south to Elizabeth Drive in the north, with a future signalised interchange with the upgraded The Northern Road at its midpoint (due to open in 2021-2022)
- **Mamre Road** –an arterial road which connects the Great Western Highway in St Marys in the north to Elizabeth Drive in the south
- **Badgerys Creek Road** –a collector road in a rural environment which connects The Northern Road at a roundabout to the south through Western Sydney International to Elizabeth Drive in the north. As part of preparatory works for Western Sydney International, the existing Badgerys Creek Road has been realigned for the section between Elizabeth Drive and Longleys Road and the intersection of Badgerys Creek and Elizabeth Drive has been upgraded to a roundabout. This section of the road was opened to traffic in February 2020
- **The Northern Road** – an arterial road that connects Narellan in the south west to the Great Western Highway in Penrith. The Northern Road is being upgraded in stages as part of the *Western Sydney Infrastructure Plan* (Department of Infrastructure and Regional Development, 2018c). The realigned section of The Northern Road to the west of the Western Sydney International was opened in April 2020.

The roads in Luddenham, Badgerys Creek and Bringelly are predominantly characterised by unsealed road shoulders, with poor pedestrian and cycle facilities. It is however expected that these facilities would be improved in the long term, as urban development occurs with the Western Sydney Aerotropolis precinct.

Road network performance

An assessment of existing weekday AM peak and PM peak hour traffic volumes was completed based on traffic survey data to determine the general performance of the current road network configuration of these key roads.

Most sections of road within the transport study area operate within their theoretical capacity, however:

- the current configuration of Elizabeth Drive (east of Badgerys Creek Road) operates close to its theoretical capacity
- The Northern Road (east of Badgerys Creek Road) operates above its theoretical capacity during both peak hours.

Assessment of the intersections within the transport study area indicated that all intersections analysed currently operate satisfactorily at Level of Service D or better (refer to Section 7.1.3) with spare capacity.

Parking

There is limited demand for on-street car parking along Luddenham Road, Elizabeth Drive and Badgerys Creek Road. This is due to the surrounding land uses predominantly consisting of undeveloped lands and rural and agricultural lands. Existing car parking in the study area south of the M4 Western Motorway primarily consists of informal parking, with no off-street parking facilities provided.

Public transport

Overall, the area has generally limited public transport services due to the current low population density and consequent low demand for public transport services. The existing train lines include:

- T2 Inner West and Leppington Line – Leppington interchange

- T5 Cumberland Line – Leppington interchange.

Leppington interchange is included as it is adjacent to the study area and the proposed South West Rail Link would connect the project to Leppington Station. The South West Rail Link Extension would lengthen the existing passenger rail line from Leppington Station to the Aerotropolis and providing a direct link to the Western Sydney Aerotropolis and the surrounding business.

The area is serviced by two bus routes:

- Route 801 Badgerys Creek to Liverpool, which includes Badgerys Creek Road and Elizabeth Drive, and is operated by Transit Systems
- Route 856 Bringelly to Liverpool, which includes The Northern Road and Bringelly Road and is operated by Interline bus services.

These bus services primarily provide local coverage and generally operate at low frequency (typically between one and five services in the morning or afternoon peak).

Pedestrian and cycle infrastructure

Pedestrian and cycle infrastructure is not currently provided within the airport site and is limited in the local area. However, it is assumed that pedestrian and cycle pathways would be provided as part of the airport development.

6.3.2 Proposed transport upgrades

As part of the broader development of the Western Parkland City including Western Sydney International, the Australian and NSW Governments are currently undertaking investigations for proposed public transport, road and active transport projects. Proposed transport upgrades of relevance to the proposed action include:

- **Future M12 Motorway** –a new motorway is being delivered between the M7 Motorway, Cecil Hills and The Northern Road in Luddenham over a distance of about 16 kilometres. Construction of the project is expected to start in 2022 and be open to traffic before the opening of the Western Sydney International Airport in 2026
- **Mamre Road** – Stage 1 of the upgrade includes the section of road between the M4 Motorway in St Clair and Erskine Park Road in Erskine Park, while Stage 2 includes the section of the road from Erskine Park Road to Kerrs Road in Kemps Creek. The NSW Government has committed $220 million to Stage 1, Investigations to inform the concept design are currently underway
- **The Northern Road** – consisting of upgrade of a 35-kilometre section of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway in Glenmore Park. The Northern Road upgrades are being delivered in stages with some stages completed and the final stages having started construction in 2019
- **Badgerys Creek Road** – Badgerys Creek Road has been realigned as part of the early earthworks for Western Sydney International. The realigned section of the road was completed in February 2020 and constitutes the first major piece of infrastructure for the Western Sydney International, which is now ready for traffic. Early earthworks for this project have now been completed with the northern section having been realigned providing a new connection point to Elizabeth Drive. By opening of the project in 2026. The intersection of Badgerys Creek Road and Elizabeth Drive will be signalised as part of the M12 Motorway/Elizabeth Drive works
- **Elizabeth Drive** – consisting of an upgrade of Elizabeth Drive directly in front of the Airport. Elizabeth Drive will be upgraded and grade separated over the Metro and M12 Motorway entry to Western Sydney International
- potential public transport upgrades including the potential future extensions of the project to the north and south, and the potential future East West Rail Link and South West Rail Link Extensions
- additional rapid and suburban bus routes within Western Sydney

- pedestrian and cyclist upgrades including walking and cycling infrastructure as part of Western Sydney International, future M12 Motorway project, The Northern Road, Elizabeth Drive and Bringelly Road upgrades.

6.4 Noise and vibration

6.4.1 Existing noise environment

The noise environment is characteristic of a semi-rural landscape. The background noise environment is characterised by natural sounds, with most of the area having little road traffic noise, and generally characterised by moderately low background noise levels. Traffic along sub-arterial roads such as Luddenham Road and Elizabeth Drive, and arterial roads such as The Northern Road, are the main noise sources within this area.

Construction work is currently being undertaken at Western Sydney International. Noise generated by these works has been observed to have little impact on the existing noise environment at the nearest sensitive receivers. This observation is consistent with the predicted impacts from the construction noise assessment for Western Sydney International as part of the *Western Sydney Airport - Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b), which suggests that due to the large size of the site, construction noise experienced off-airport is anticipated to be localised to the areas adjacent to where bulk earthworks occur.

During construction, there are two sensitive receivers within the Western Sydney International; the Airport Experience Centre and Western Sydney Airport site offices. No residential receivers currently exist within Western Sydney International. In the future (during operation), the on-airport sensitive receivers would broadly consist of the new airport terminal and ancillary buildings, air traffic control tower, and the proposed business park.

Noise Catchment Areas

Noise Catchment Areas (NCAs) are groups of sensitive receivers that are likely to experience similar impacts from the proposed action. Predicted impacts for each NCA are considered to represent typical noise and vibration impacts at each individual receiver within that NCA. Table 6-1 describes the location of the NCAs adopted for the proposed action which are also presented in Figure 6-1.

The NCAs are delineated by landmark features, such as roads, to encompass groupings of houses with similar background noise environments. These NCAs contain sensitive receivers approximately two kilometres around the proposed action.

Table 6-1 Noise Catchment Areas

NCA	Indicative number of receiver buildings assessed in NCA	Description
NCA10	378	Open farmland with low density single storey and multi-storey residential dwellings within the Twin Creeks area north of the proposed action, and scattered residential dwellings along Luddenham Road.
NCA11	70	Predominantly Western Sydney International land, including the Airport Experience Centre and Western Sydney Airport site offices. Low density residential dwellings along Lawson Road and Martin Road to the east of the proposed action. Medium density residential dwellings at Luddenham to the west of the proposed action.
NCA12	396	Predominantly scattered low density single-storey residential dwellings, located south of the proposed action. Ambient noise conditions are dominated by traffic along The Northern Road.

Background noise monitoring locations

Four noise monitoring locations were used to characterise the existing noise environment in the areas surrounding the proposed action and sensitive receivers potentially impacted by the proposed action. Noise monitoring was undertaken at locations where site access was granted by the resident/occupant. The noise monitoring locations selected for the assessment were considered to be representative of the existing background noise environment in each NCA. The weather conditions at the time of monitoring were recorded by Bureau of Meteorology weather stations located at Badgerys Creek (Station ID: 67108). The locations of the attended and unattended monitoring are presented in Table 6-2 and shown in Figure 6-1.

Table 6-2 Noise monitoring locations

Noise monitoring location	NCA	Start date	End date	Address
NM10	NCA10	17-02-20	25-02-20	27 Halmstad Boulevard, Luddenham
NM12	NCA11	17-02-20	25-02-20	5 Jamison Street, Luddenham
NM13	NCA12	27-02-20	09-03-20	80 Mersey Road, Bringelly
NM20	NCA11	27-02-20	09-03-20	25 Lawson Road, Badgerys Creek

Unattended noise survey results

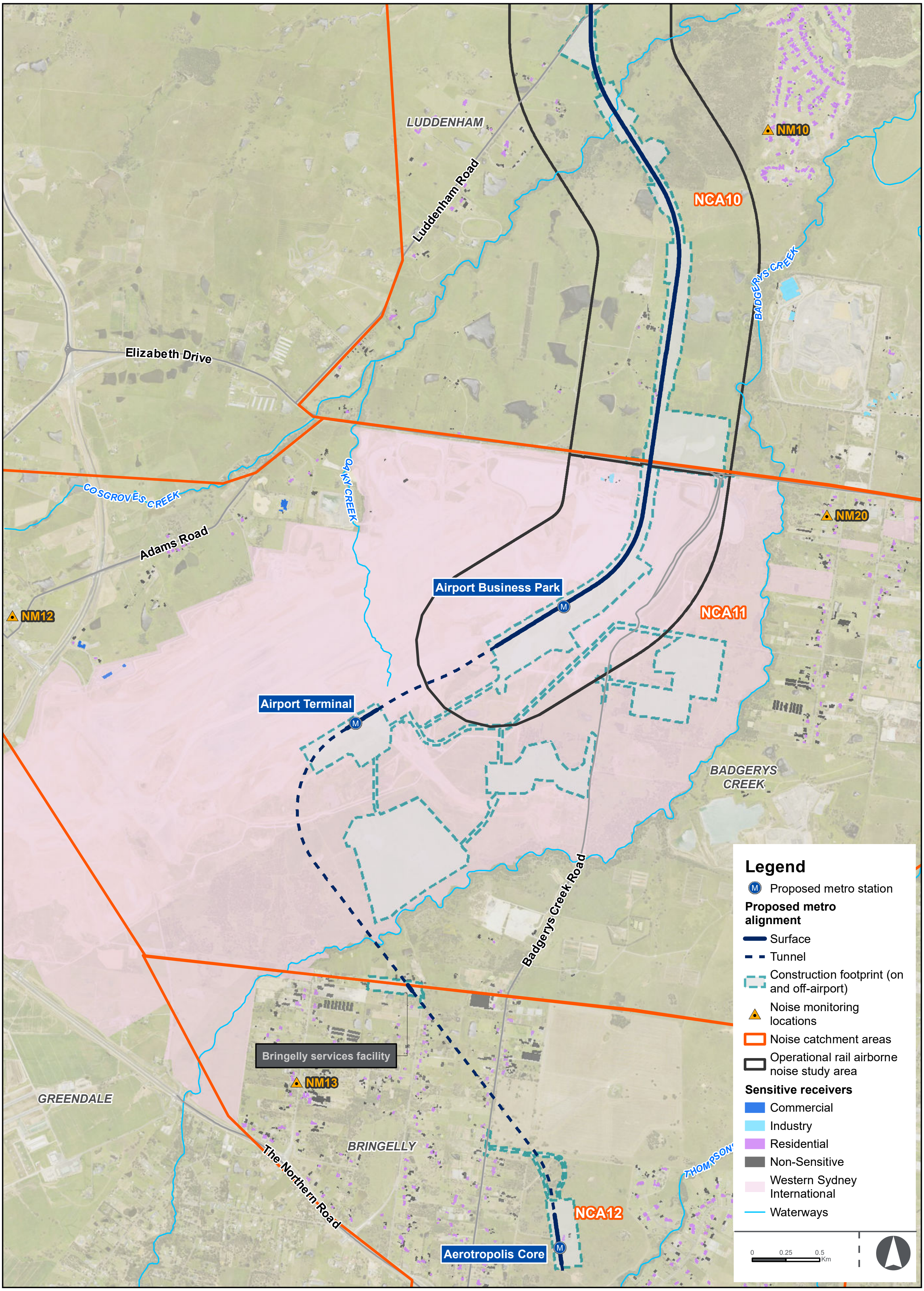
Unattended noise monitoring was carried out by M2A between 17th February 2020 and 9th March 2020.

The measured Rating Background Levels (RBLs) and ambient noise levels are summarised in Table 6-3.

Table 6-3 Summary of unattended noise monitoring results

Location	Rating Background Level (RBL) dBA[1]			Ambient noise level dBA[1] $L_{eq\ 15\ minute}$		
	Day	Evening	Night	Day	Evening	Night
NM10	(30) 35[2]	30	30	47	42	37
NM12	(34) 35[2]	32	(24) 30[2]	58	60	48
NM13	38	35	34	58	52	51
NM20	39	37	(28) 30[2]	49	47	42

1. Time periods defined as – Day: 7am to 6pm Monday to Saturday, 8am to 6pm Sunday; Evening, 6pm to 10pm; Night 10pm to 7am Monday to Saturday, 10pm to 8am Sunday
2. Where background levels are below the minimum assumed rating background noise levels outlined in the NPfI, they have been adjusted to 35dBA during the day period, and 30 dBA during the evening and night periods in accordance with the NPfI



Noise catchment areas and sensitive receiver locations

Figure 6-1

Indicative only, subject to design development

Operator attended noise survey

M2A carried out operator attended noise surveys to characterise the noise environment and identify the contributors to the acoustic environment. The results of the attended noise surveys and observations are detailed in Table 6-4.

Table 6-4 Summary of attended noise measurement results

Location	Date	Time	dBA $L_{eq(15min)}$	dBA $L_{90(15min)}$	Observations
NM10	17/02/2020	11:15	37	27	The ambient noise environment was generally characterised by natural sounds such as birds, insects, or wind through trees. Occasional car passbys on Halmstad Boulevarde were audible but uncommon.
NM12	17/02/2020	10:30	43	37	The ambient noise environment was generally characterised by natural sounds (e.g. birds and insects), as well as distant traffic along The Northern Road. The ambient noise environment was occasionally punctuated by events such as car or truck passbys along Adam Road, the occasional dog bark, and plane flyovers.
NM13	27/02/2020	10:30	57	38	The background noise environment was dominated by natural noise including cicadas. Semi-frequent truck passbys along Mersey Street, and fixed wing aircraft flyovers noted during measurements.
NM20	27/02/2020	13:15	48	43	The background noise environment was dominated by natural sounds and road traffic along Elizabeth Drive. Natural sounds were audible.

6.4.2 Future noise environment

Western Sydney is a fast growing area which is planned to support significant residential and employment generating development. Projects either currently approved or planned, such as the Western Sydney International, Western Sydney Aerotropolis and the future M12 Motorway project, together with this project, will substantially change the existing semi-rural noise environment.

The future noise environment will consist of noise generated from the construction of infrastructure (including transport), proposed residential and commercial development, operation of transport infrastructure (road and rail), and eventually aircraft noise during the day, evening and night.

6.5 Biodiversity

The *Western Sydney Airport – Airport Plan* (Airport Plan) (Department of Infrastructure and Regional Development, 2016a) provides authorisation for the clearing of biodiversity values within the Western Sydney International Stage 1 Construction Impact Zone. As such, this section describes the existing environment of the study area outside of the Western Sydney International Stage 1 Construction Impact Zone and within the construction footprint.

6.5.1 Landscape and site context

The study area encompasses a highly fragmented landscape. Generally, habitat connectivity is limited to riparian corridors around Badgerys Creek. All riparian corridors have been subject to varying levels of clearing and disturbance.

An assessment of native vegetation cover and patch size has been undertaken to determine site context as required by section 4.3 of the NSW Biodiversity Assessment Method (BAM) (Office of Environment and Heritage, 2017a). This assessment is provided in Table 6-5 and Table 6-6 respectively.

Table 6-5 Native vegetation cover

Project location	Assessment area	Total assessment area (hectares)	Area of native vegetation cover (hectares)	Native vegetation percentage cover (per cent)
On-airport	500 metres along each side of the centre line of the proposed construction footprint	1068	369	35

Table 6-6 Patch size classes for each vegetation zone

Plant Community Type (PCT) (condition)	Condition	Patch size class (hectares)
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	25-100
	Thinned	25-100
	Scattered Trees	-
	Low	25-100
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	25-100
	Thinned	-
	Scattered Trees	25-100
	Low	>100
PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	25-100

6.5.2 Vegetation and threatened ecological communities

Native vegetation

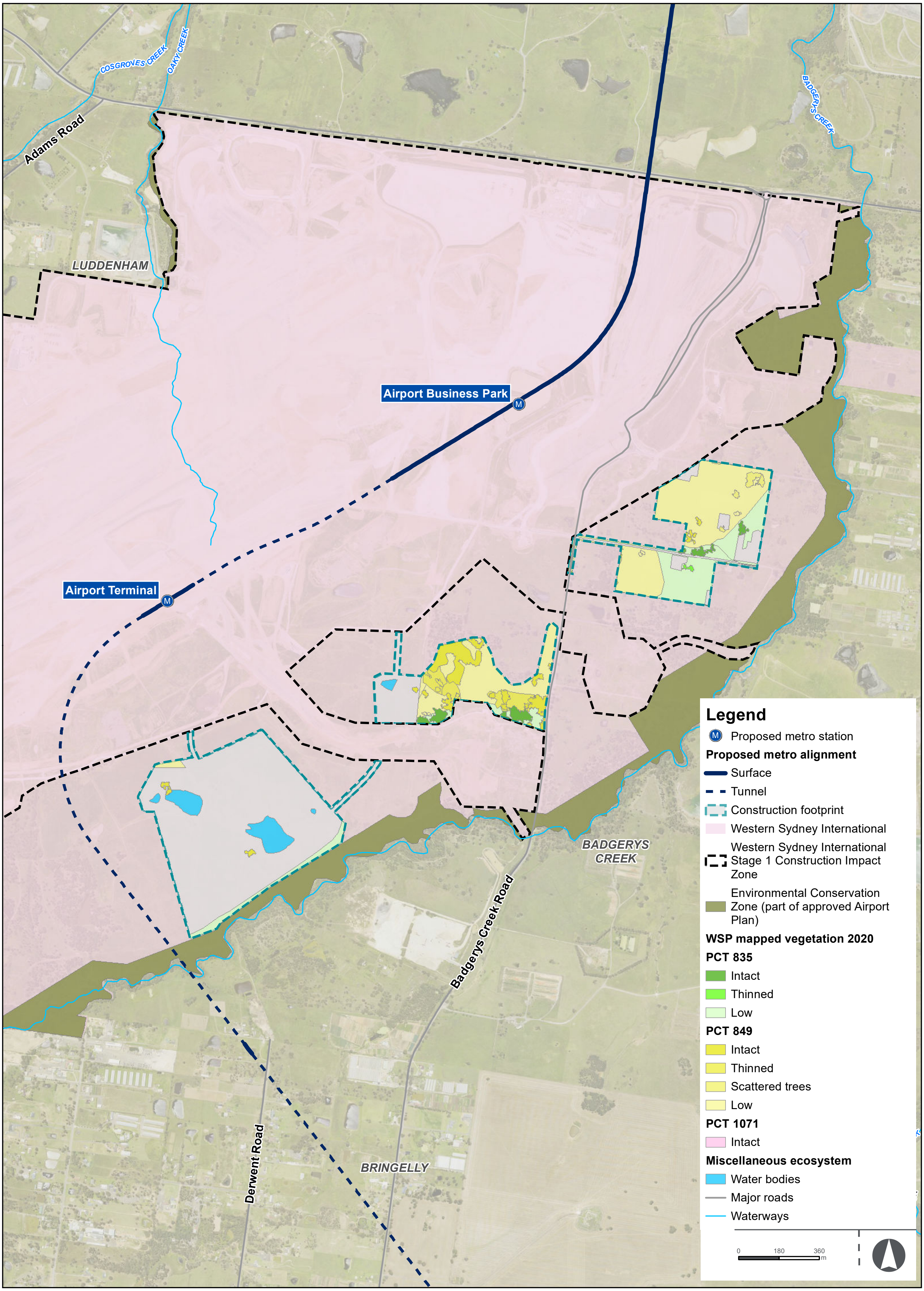
Three Plant Community Types (PCTs) were recorded in the study area, as summarised in Table 6-7. These native vegetation types were assigned to discrete vegetation zones based on broad vegetation condition class criteria outlined in Section 6.5.1.

The three PCTs meet the relevant criteria for two threatened ecological communities (TECs) listed under the BC Act and EPBC Act. A summary of each TEC, associated PCT and listing is provided as follows:

- Cumberland Plain Woodland listed as Critically Endangered under BC Act (PCT 849) and Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest listed as Critically Endangered under EPBC Act (PCT 849)
- River-Flat Eucalypt Forest listed as Endangered under the BC Act (PCT 835).

A summary of PCTs and associated vegetation zones is presented in Table 6-7 with detailed descriptions and selection justification for each PCT and vegetation zone provided in the sections following.

The extent and distribution of each vegetation type and zone is shown in Figure 6-2.



Indicative only, subject to design development

Vegetation types (PCTs) within the study area

Figure 6-2

Table 6-7 Overview of native vegetation types and zones

Vegetation type	Vegetation formation	Vegetation class	PCT % cleared	Condition	Threatened ecological community (BC Act)	Threatened ecological community (EPBC Act)	Patch size (hectares)	Vegetation integrity score[3]	Extent on-airport land (hectares)
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Forested Wetlands	Coastal Floodplain Wetlands	93	Intact	River-Flat Eucalypt Forest[1]	-	25-100	65.9*	1.53
				Thinned			25-100	71.2	0.09
				Low			25-100	2.4*	10.21
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	Coastal Valley Grassy Woodlands	93	Intact	Cumberland Plain Woodland[2]	Cumberland Plain Woodland[2]	25-100	67.8	4.05
				Scattered Trees		-	25-100	20.3	2.32
				Low		-	>100	7.8	23.79
PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands	Coastal Freshwater Lagoons	75	Intact	Not listed	-	25-100	57.4	0.01
Total									**42.00**

1. River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
2. Cumberland Plain Woodland in the Sydney Basin Bioregion
3. Vegetation integrity was calculated based on a single plot (Q2) that was sampled during drought

* Vegetation Integrity Scores were calculated using an average of attributes collected during field survey

PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

The occurrence of this vegetation type within the study area is illustrated in Figure 6-2. A profile of PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion is provided in Table 6-8.

Table 6-8 Summary of PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion			
Vegetation formation	Forested Wetlands		
Vegetation class	Coastal Floodplain Wetlands		
Conservation status	BC Act: forms part of the River-flat Eucalypt Forest on Coastal Floodplain on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions which is listed as Endangered. Aligns to River-flat Eucalypt Forest on Coastal Floodplain listed as Critically Endangered under the EPBC Act.		
SAII entity	No		
Percent cleared	93 per cent		
Vegetation condition	Intact	Thinned	Low
Patch size class	25-100 hectares	25-100 hectares	25-100 hectares
Vegetation integrity plots	Q2	Q10, Q23	Q8, Q9
Composition condition score	63.3	52.1	48.2
Structure condition score	78.3	82.2	23.6
Function condition score	57.7	84.3	0
Vegetation Integrity score	65.9* plot recorded during drought	71.2	2.4
Extent	1.53	0.09	10.21
PCT justification			
Landscape position	This vegetation occurred on alluvial soils which drained Wianamatta shale soils in riparian and floodplain areas.		
Dominant canopy species	Dominated by *Eucalyptus tereticornis* (Forest Red Gum) and *Angophora subvelutina* (Broad-leaved Apple) with scattered occurrences of *Eucalyptus moluccana* (Grey Box) and *Casuarina glauca* (Swamp Oak)		
Characteristic midstorey species	Shrubs were present at varying densities and included species such as *Acacia decurrens* (Green Wattle), *Bursaria spinosa* (Native Blackthorn), *Grevillea juniperina subsp. juniperina* (Juniper-leaved Grevillea) and *Melaleuca decora* (White Feather Myrtle). Exotic species *Olea europaea** (African Olive) was sub-dominant in some patches.		
Characteristic ground cover species	Ground cover was generally grassy and dominated by *Microlaena stipoides* (Weeping Grass) and *Echinopogon caespitosus* (Tufted Hedgehog Grass) with a range of other native herbs and grasses included *Asperula conferta* (Common Woodruff), *Brunoniella australis* (Blue Trumpet), *Chloris ventricosa* (Tall Chloris),		

PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	
	Dichondra repens (Kidney Weed*), Desmodium gunnii* (Slender Tick Trefoil), *Glycine tabacina, Hypericum gramineum* (Small St John's Wort) and *Sporobolus creber* (Slender Rats Tail Grass). Dominant exotic species included *Conyza sumatrensis** (Fleabane), *Rubus fruticosus agg. ** (Blackberry), *Senecio madagascarensis** (Fireweed) and *Solanum sisymbriifolium** (Viscid Nightshade).
Other diagnostic features	Alluvial soils subject to periodic inundation during heavy rainfall and flooding events
PCT quantitative analysis	Justification for PCT 835 recorded within the study area was based on a quantitative analysis of vegetation integrity plot data (Q2, Q23) using the Plant Community Identification tool (EES, 2020) in accordance with section 5.2.1.12 of the BAM. Plot data from intact and thinned condition vegetation was considered the most representative of the floristics and dominant species were entered in the Plant Community Identification tool from each stratum along with IBRA region, vegetation formation and field observations. The following PCTs which are classified as forested wetlands were identified: PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (8 matches) The distinguishing feature of this vegetation type is the prominent stands of *Casuarina glauca* (Swamp Oak) found along or near streams. Often these are relatively young trees, swarming amongst a mix of old and young eucalypts such as *Angophora floribunda* (Rough-barked Apple), *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus moluccana* (Grey Box) (EES, 2020). Vegetation was not dominated by *Casuarina glauca* (Swamp Oak) which featured as scattered occurrences only. • PCT 85 River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion (5 matches) This vegetation type occurs on gravels, sands and loams on various substrates along major watercourses in the NSW South-western Slopes Bioregion and western edge of the South-East Highlands Bioregion and is not known from the study area (Sydney Basin Bioregion). • PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (5 matches) The vegetation type is an open eucalypt forest situated on broad alluvial flats of the Hawkesbury and Nepean river systems and typically the canopy includes one of either *Angophora floribunda* (Rough-barked Apple) or *Angophora subvelutina* (Broad-leaved apple) and one or both of *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus amplifolia* (Cabbage Gum) (EES, 2020). This vegetation description is consistent with vegetation recorded within the study area. A review of existing vegetation mapping identified that PCT 835 has been mapped previously by Open Lines and Biosis (2020), Tozer *et al.* (2010) and GHD (2017). Based on floristic, geographic and geological characteristics, this vegetation is considered consistent with the scientific description and distribution information outlined for PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (EES, 2020).

PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

The occurrence of this vegetation type within the study area is illustrated in Figure 6-2. A profile of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion is provided in Table 6-9.

Table 6-9 PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion			
Vegetation formation	Grassy Woodlands		
Vegetation class	Coastal Valley Grassy Woodlands		
Conservation status	Aligns to Cumberland Plain Woodland listed as Critically Endangered under the BC Act and EPBC Act.		
SAII entity	Yes		
Percent cleared	93 per cent		
Vegetation condition	Intact	Scattered Trees	Low
Patch size class	25-100 hectares	25-100 hectares	>100 hectares
Vegetation integrity plots	Q1, Q4, Q6, Q16	Q5, Q15, Q18	Q11, Q12, Q13, Q14, Q17, Q28, Q31, Q32
Composition condition score	70.5	27.9	24.7
Structure condition score	71.4	17.7	17.1
Function condition score	61.9	16.8	1.1
Vegetation Integrity score	67.8	20.3	7.8
Extent	4.05	2.32	23.79
PCT justification			
Landscape position	This PCT was recorded on a flat and/or undulating landscape and graded into PCT 1800 or PCT 835 downslope in areas associated with streams/watercourses.		
Dominant canopy species	*Eucalyptus moluccana* (Grey Box) was the dominant canopy species occurring with *Eucalyptus tereticornis* (Forest Red Gum) either as a co-dominant or sub-dominant and scattered occurrences of *Eucalyptus fibrosa* (Red Ironbark).		
Characteristic midstorey species	Shrub cover varied between patches however often displayed wattles *Acacia decurrens* (Green Wattle) and *Acacia falcata* along with *Bursaria spinosa* (Native Blackthorn). Less commonly occurring shrubs species included *Dodonaea viscosa subsp. cuneata, Exocarpos cupressiformis* (Native Cherry), *Ozothamnus diosmifolius* (Dogwood) and exotic species *Olea europaea** (African Olive).		

PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	
Characteristic ground cover species	Ground cover was dominated by native grasses including *Aristida vagans* (Three Awn Speargrass), *Eragrostis brownii* (Browns Love Grass), *Microlaena stipoides var. stipoides* (Weeping grass), *Paspalidium distans, Themeda triandra (Kangaroo Grass)* and exotic *Eragrostis curvula** (African Love Grass). Forb and fern species included *Arthropodium milleflorum* (Vanilla Lily), *Brunoniella australis* (Blue Trumpet), *Cheilanthes sieberi subsp. sieberi* (Mulga Fern), *Desmodium gunnii* (Slender Tick Trefoil), *Einadia hastata* (Berry Saltbush), *Glycine tabacina, Lomandra filiformis subsp. filiformis, Opercularia varia* (Variable Stinkweed), *Oxalis perennans, Solanum prinophyllum* (Forest Nightshade),
Other diagnostic features	This vegetation was recorded as a grassy woodland on Wianamatta shale/clay soils.
PCT quantitative analysis	A quantitative analysis was undertaken for plots which sampled Intact vegetation (Q1, Q4, Q6 and Q16) within the study area as this condition class best represented the PCT. A total of eighteen search criteria including IBRA region, dominant species in the canopy, middle and ground stratum were entered in the Plant Community Identification Tool (EES, 2020). PCT 849 has the most number of matches (12) and was considered most the most representative PCT. A review of existing vegetation mapping identified that PCT 849 has been mapped previously by Open Lines and Biosis (2020), Tozer *et al.* (2010) and GHD (2017). Based on floristic, geographic and geological characteristics, this vegetation type is considered consistent with the scientific description and distribution information outlined for PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (EES, 2020).

PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

The occurrence of this vegetation type within the study area is illustrated in Figure 6-2. A profile of PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion is provided in Table 6-10.

Table 6-10 Summary of PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion

PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Freshwater Lagoons
Conservation status	Does not form part of Freshwater Wetlands on Coastal Floodplains, listed as Endangered under the BC Act, due to this community occurring because of human influence (see Section 5.6).
SAII entity	No
Percent cleared	75 per cent
Vegetation condition	Intact
Patch size class	25-100 hectares
Vegetation integrity plots	Q3
Composition condition score	67.3

<table>
<tr><th colspan="2">PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion</th></tr>
<tr><td>Structure condition score</td><td>49</td></tr>
<tr><td>Function condition score</td><td>N/A</td></tr>
<tr><td>Vegetation Integrity score</td><td>57.4</td></tr>
<tr><td>Extent</td><td>0.01</td></tr>
<tr><td colspan="2">PCT justification</td></tr>
<tr><td>Landscape position</td><td>Vegetation was recorded in a man-made waterbody (agricultural farm dam)</td></tr>
<tr><td>Dominant canopy species</td><td>Absent</td></tr>
<tr><td>Characteristic midstorey species</td><td>Absent</td></tr>
<tr><td>Characteristic ground cover species</td><td>Eleocharis sphacelata (Tall Spike Rush), Juncus usitatus (Common Rush), Marselea drummondii (Common Nardoo), Persicaria decipiens (Slender Knotweed), Philydrum lanuginosum (Frogsmouth), Senecio madagascariensis* (Fireweed), Typha orientalis (Broad-leaved Cumbungi)</td></tr>
<tr><td>Other diagnostic features</td><td>Occurs in areas subject to periodic or semi-permanent inundation by freshwater.</td></tr>
<tr><td>PCT quantitative analysis</td><td>Justification for PCT 1071 recorded within the study area was based on a quantitative analysis of vegetation integrity plot data (Q3) using the Plant Community Identification tool (EES, 2020) in accordance with 5.2.1.12 of the BAM. The IBRA region, vegetation formation and dominant species were used as search criteria. Freshwater wetlands in the vegetation class ‘coastal freshwater lagoons’ were considered further. Due to the low species diversity recorded, six PCTs were identified during the search and have been considered further:

1. PCT 783 Coastal freshwater swamps of the Sydney Basin Bioregion

This vegetation type is restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplains and is not considered further

2. PCT 1736 Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter and PCT 1740 Tall Spike Rush freshwater wetland

This vegetation type occurs outside of the locality (Cumberland Plain) and are not considered further.

3. PCT 1742 Jointed Twig-rush sedgeland

This vegetation type is dominated by Baumea occasionally with Melaleuca emergent. No Baumea species were recorded, this vegetation type is not considered further.

4. PCT 781 Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion

PCT 781 was dismissed based on the absence of a freshwater or brackish coastal lagoons below 10 metre in elevation as described in the PCT vegetation description.

5. PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

This vegetation type is known to occur in or near artificially made waterbodies across a range of environments and is dominated by</td></tr>
</table>

PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	
	Phragmites australis and *Typha orientalis*. Vegetation within the study area was recorded in a constructed waterbody and was dominated by *Typha orientalis*. A review of existing vegetation mapping identified that PCT 1071 has been mapped previously by GHD (2017). Based on floristic, geographic and landscape characteristics, this vegetation is considered consistent with the scientific description and distribution information outlined for PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (EES, 2020).

Non-native vegetation types

A summary of the non-native vegetation types recorded in the study area is outlined in Table 6-11.

Table 6-11 Summary of non-native vegetation types

Non-native vegetation types	Description	Area (hectares)
Miscellaneous ecosystem – non-native	Highly disturbed areas within no or limited native vegetation was recorded in areas where exotic perennial grasses dominated the understorey and covered more than 50 per cent of total plant foliage cover. Overstorey vegetation was absent due to historic clearing. Within the study area, this vegetation type was recorded in paddocks used for agriculture and in disturbed areas such as roadsides.	45.14
Miscellaneous ecosystem - water bodies, rivers, lakes, streams (not wetlands)	Water bodies, rivers, lakes, streams (not wetlands) were recorded predominately as man-made features (i.e. agricultural dams) that were void of native vegetation. These areas occurred throughout the study area.	3.48

Priority weeds and Weeds of National Significance

During field surveys, exotic species listed as High Threat weeds under the BC Act*, Priority Weeds for the Greater Sydney region under the Biosecurity Act 2015* (Department of Primary Industries, 2019) and *Weeds of National Significance* (WoNS) (Australian Weeds Committee, 2020) were noted in the study area. Each species is outlined in Table 6-12.

Table 6-12 Priority weeds identified within the study area

Scientific name	Common name	BAM	Priority weed listing	WONS
*Araujia sericifera**	Moth Vine	HT	General Biosecurity Duty	No
*Eragrostis curvula**	African Love Grass	HT	General Biosecurity Duty	No
*Cestrum parqui**	Green Cestrum	HT	General Biosecurity Duty Regional Recommended Measure	No
*Lantana camara**	Lantana	HT	General Biosecurity Duty Prohibition on dealings	Yes
*Ligustrum sinense**	Small-leaved Privet	HT	General Biosecurity Duty	No
*Ligustrum lucidum**	Broad-leaved Privet	-	General Biosecurity Duty	No
*Lycium ferocissimum**	African Box Thorn	HT	General Biosecurity Duty Prohibition on dealings	Yes
*Olea europaea**	African Olive	HT	General Biosecurity Duty Regional Recommended Measure	No
*Opunita sp.**	Prickly Pear		General Biosecurity Duty Prohibition on dealings	Yes
*Ricinus communis**	Castor Oil Plant		General Biosecurity Duty	No

Scientific name	Common name	BAM	Priority weed listing	WONS
*Rubus fruticosus complex**	Blackberry	HT	General Biosecurity Duty Prohibition on dealings	Yes
*Senecio madagascariensis**	Fireweed	HT	General Biosecurity Duty Prohibition on dealings	Yes

NSW threatened ecological communities

A total of two TECs listed under the BC Act were recorded within the study area, being:

- Cumberland Plain Woodland in the Sydney Basin Bioregion
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

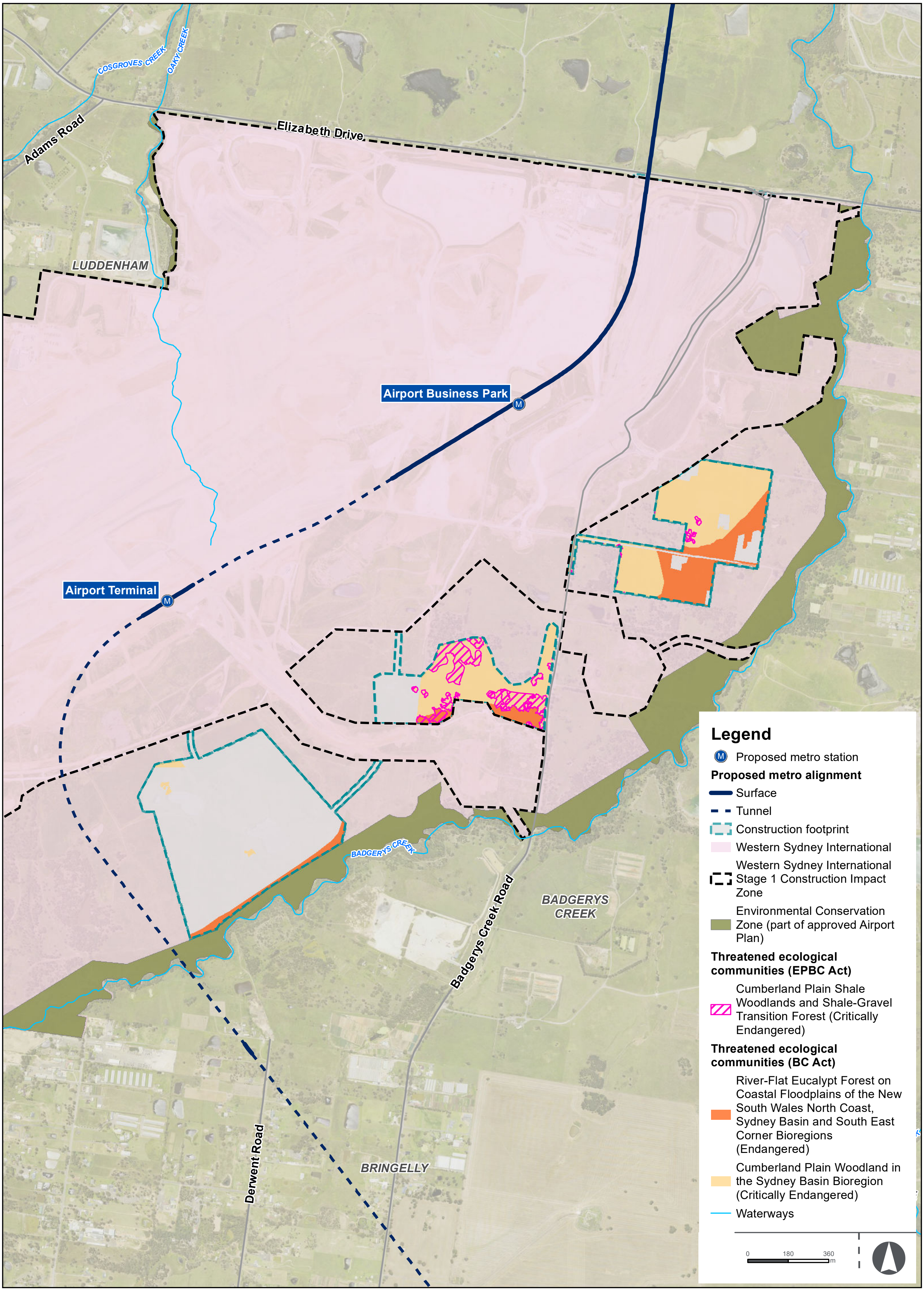
A summary of each TEC, associated PCT and extent within the study area is presented in Table 6-13.

The location of the TECs in relation to the study area is shown in Figure 6-3.

An additional TEC, Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions was considered as a candidate based on associated PCT although this vegetation type did not meet listing advice for the TEC.

Table 6-13 Summary of BC Act threatened ecological communities within the study area

TEC	BC Act Status	Associated PCT within the study area	Condition	Extent (hectares)
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	4.05
			Thinned	Does not occur
			Scattered Trees	2.32
			Low	23.79
Total area of Cumberland Plain Woodland in the Sydney Basin Bioregion				**30.16**
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	1.53
			Thinned	0.09
			Scattered Trees	Does not occur
			Low	10.21
Total area of River-Flat Eucalypt Forest on Coastal Floodplains				**11.83**



Threatened ecological communities within the study area

Figure 6-3

Indicative only, subject to design development

Groundwater dependant ecosystems

Groundwater dependent ecosystems (GDEs) are defined as ecosystems that require access to groundwater to meet all or some of their water requirements to maintain their communities of plants and animals, ecological processes and ecosystem services' (Department of Planning, Industry and Environment, 2020).

Ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater may include native plant communities. GDEs which are surface expressions of groundwater within the locality of the study area (<10 kilometres) include South Creek and associated tributaries. Other GDEs which are reliant on subsurface groundwater in the study area include:

- Cumberland Plain Woodland in the Sydney Basin Bioregion
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Potential impacts on GDEs resulting from the project include groundwater drawdown. Although the majority of groundwater drawdown with the potential to affect GDEs is predicted to occur within the project's construction footprint, potential impacts outside of the construction footprint have been considered. Groundwater drawdown is not expected to impact the GDEs listed above located within the study area.

6.5.3 Threatened species

This section addresses section 6 of the BAM and provides information on assessing the habitat suitability for threatened species within the study area. The *Biodiversity Assessment Calculator* (OEH, 2017) was used to derive the list of ecosystem credit (predicted species) and species credit species (candidate species) for the study area.

All threatened species were subject to habitat suitability assessments.

Ecosystem credit species

Ecosystem credit species are those that can be predicted by vegetation surrogates and landscape features or are those species for which targeted survey has a low probability of detection. Targeted survey is not required for ecosystem credit species. Ecosystem credit threatened species were assessed using information about site context, PCTs and vegetation integrity attributes collected during the field surveys, and data from the *Threatened Biodiversity Data Collection* (EES, 2020) as required by sections 6.1.1.3 and 6.2.1.2 of the BAM (see Section 7.3.2).

The Biodiversity Assessment Calculator was used to generate a list of the predicted threatened species for the study area. One species, the Blue-billed Duck was added to the Biodiversity Assessment Calculator as a predicted species and considered further for assessment. The initial list of predicted ecosystem credit species is provided in Table 6-14.

Once the initial list of ecosystem credit species had been generated, the geographic limitations of each species were assessed and where the study area was outside of the geographic limitation described for a species it was removed from the assessment. The habitat assessments and vegetation integrity surveys conducted during the field survey allowed for the identification of any specific habitat constraints or presence absence of suitable microhabitats within the study area. Habitat suitability assessment in accordance with section 6.2 of the BAM was completed to support the inclusion or exclusion of ecosystem credit species from the assessment. A summary of predicted threatened species is presented in Table 6-15.

Table 6-14 Summary of predicted ecosystem credit species that were predicted by the BAM calculator

Species name	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	PCT associations
Anthochaera phrygia	Regent Honeyeater	CE	CE	High	PCT 835; PCT 849;
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Moderate	PCT 835; PCT 849; PCT 1071
Botaurus poiciloptilus	Australasian Bittern	E	CE	Moderate	PCT 835; PCT 1071
Calidris ferruginea	Curlew Sandpiper	E	-	High	PCT 1071
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Moderate	PCT 835; PCT 849
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	High	No associated habitat recorded.
Chthonicola sagittata	Speckled Warbler	V	-	High	PCT 835; PCT 849
Circus assimilis	Spotted Harrier	V	-	Moderate	PCT 849; PCT 1071
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	High	PCT 835; PCT 849
Daphoenositta chrysoptera	Varied Sittella	V	-	Moderate	PCT 835; PCT 849
Dasyurus maculatus	Spotted-tailed Quoll	V	E	High	PCT 835; PCT 849; PCT 1071
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Moderate	PCT 1071
Epthianura albifrons	White-fronted Chat	E	-	Moderate	PCT 1071
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	High	PCT 835; PCT 849
Glossopsitta pusilla	Little Lorikeet	V	-	High	PCT 835; PCT 849
Grantiella picta	Painted Honeyeater	V	V	Moderate	PCT 835; PCT 849
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	M	High	PCT 835; PCT 849; PCT 1071
Hieraaetus morphnoides	Little Eagle	V	-	Moderate	PCT 835; PCT 849; PCT 1071
Irediparra gallinacea	Comb-crested Jacana	V	-	Moderate	PCT 1071
Ixobrychus flavicollis	Black Bittern	V	-	Moderate	PCT 835; PCT 1071
Lathamus discolor	Swift Parrot	E	-	Moderate	PCT 835; PCT 849
Limicola falcinellus	Broad-billed Sandpiper	V	-	High	PCT 1071
Limosa limosa	Black-tailed Godwit	V	-	High	PCT 1071
Lophoictinia isura	Square-tailed Kite	V	-	Moderate	PCT 835; PCT 849; PCT 1071

Species name	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	PCT associations
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Moderate	PCT 835; PCT 849
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Moderate	PCT 835; PCT 849
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	High	PCT 835; PCT 849; PCT 1071
Miniopterus australis	Little Bent-winged Bat	V	-	High	PCT 835; PCT 849; PCT 1071
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	High	PCT 835; PCT 849; PCT 1071
Neophema pulchella	Turquoise Parrot	V	-	High	PCT 835; PCT 849
Ninox connivens	Barking Owl	V	-	High	PCT 835; PCT 849
Ninox strenua	Powerful Owl	V	-	High	PCT 835; PCT 849
Oxyura australis	Blue-billed Duck	V	-	Moderate	PCT 1071
Pandion cristatus	Eastern Osprey	V	-	Moderate	PCT 835
Petaurus australis	Yellow-bellied Glider	V	-	High	PCT 849
Petroica boodang	Scarlet Robin	V	-	Moderate	PCT 835; PCT 849
Petroica phoenicea	Flame Robin	V	-	Moderate	PCT 835; PCT 849
Phascolarctos cinereus	Koala	V	V	High	PCT 835; PCT 849
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	High	PCT 835; PCT 849
Rostratula australis	Australian Painted Snipe	E	E	Moderate	PCT 1071
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	High	PCT 835; PCT 849
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	High	PCT 835; PCT 849; PCT 1071
Stagonopleura guttata	Diamond Firetail	V	-	Moderate	PCT 835; PCT 849
Stictonetta naevosa	Freckled Duck	V	-	Moderate	PCT 1071
Tyto novaehollandiae	Masked Owl	V	-	High	PCT 835; PCT 849

1. V = Vulnerable, E = Endangered, CE = Critically Endangered under the NSW BC Act or Commonwealth EPBC Act. M= Migratory/Marine under the Commonwealth EPBC Act

Table 6-15 Summary of predicted ecosystem credit species that were assessed

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion
Anthochaera phrygia	Regent Honeyeater	CE	CE	No key breeding areas or other breeding areas identified in the National Recovery Plan occur within the study area. Preferred foraging habitat (Spotted Gum, Swamp Mahogany, Mugga Ironbark) not present within study area. Excluded
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Foraging habitat present in study area **Included as an ecosystem credit**
Botaurus poiciloptilus	Australasian Bittern	E	E	Marginal, degraded habitat occurs within the study area. Most of the artificial wetlands lack dense aquatic vegetation which is preferred by the species. Excluded
Calidris ferruginea	Curlew Sandpiper	E	CE	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Preferred habitat of mature/old growth eucalypt forest not present Marginal foraging and breeding habitat within the study area. Excluded
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Preferred foraging habitat not present within the study area. Excluded
Chthonicola sagittata	Speckled Warbler	V	-	Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited. Excluded
Circus assimilis	Spotted Harrier	V	-	No large inland wetlands within study area. Some marginal foraging habitat present so could occasionally forage within the vicinity of the study area. Excluded
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	Preferred habitat not within study area. Excluded
Daphoenositta chrysoptera	Varied Sittella	V	-	Suitable foraging habitat recorded within the study area. Likely to be non-breeding migrant to the study area. **Included as an ecosystem credit**
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Preferred habitat is not present. Excluded

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Outside usual range for this species and preferred habitat not within study area. Excluded
Epthianura albifrons	White-fronted Chat	E	-	Preferred habitat not within study area Excluded
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Glossopsitta pusilla	Little Lorikeet	V	-	Suitable foraging habitat present within the study area. **Included as an ecosystem credit**
Grantiella picta	Painted Honeyeater	V	V	Large patches of woodland with Mistletoe generally absent in study area. Rare or intermittent occurrences cannot be discounted. Excluded
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	M	Living and dead trees and paddock trees present within the study area. Would forage within study area as part of a larger home range. **Included as an ecosystem credit**
Hieraaetus morphnoides	Little Eagle	V	-	Suitable foraging and breeding habitat present within the study area. **Included as an ecosystem credit**
Ixobrychus flavicollis	Black Bittern	V	-	Habitat within the study area is degraded and limited to farm dams without emergent vegetation. Recorded on airport land by Department of Infrastructure and Regional Development 2016e. **Included as an ecosystem credit**
Lathamus discolor	Swift Parrot	E	CE	May occur over the study area intermittently during seasonal migration movements. Winter-flowering resources (e.g. Spotted Gum) absent from the study area. No recent records within the vicinity of the study area. Excluded
Lophoictinia isura	Square-tailed Kite	V	-	Living and dead trees and paddock trees present within the study area. Would forage within study area as part of a larger home range. **Included as an ecosystem credit**
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area. Excluded

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Large patches of woodland generally absent on study area. Rare or intermittent occurrences cannot be discounted. Excluded
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	Potential roosting and foraging habitat available within the study area. Recorded in study area (Department of Infrastructure and Regional Development, 2016e) **Included as an ecosystem credit**
Miniopterus australis	Little Bent-winged Bat	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Neophema pulchella	Turquoise Parrot	V	-	Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited. Excluded
Ninox connivens	Barking Owl	V	-	Moderate - Suitable foraging and breeding habitat (hollows >20 centimetres in diameter and 4 metres above ground) recorded within the study area. **Included as an ecosystem credit**
Ninox strenua	Powerful Owl	V	-	Suitable foraging and breeding habitat recorded within the study area. **Included as an ecosystem credit**
Pandion cristatus	Eastern Osprey	V	-	Preferred habitat not within study area. Excluded
Petaurus australis	Yellow-bellied Glider	V	-	Preferred habitat not within study area. Excluded
Petroica boodang	Scarlet Robin	V	-	Suitable foraging habitat recorded within the study area. Likely to be non-breeding migrant to the study area. **Included as an ecosystem credit**
Petroica phoenicea	Flame Robin	V	-	Habitat within study area is degraded. Some potential foraging habitat within study area, but patches fallen timber and woody debris are limited. Excluded

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion
Phascolarctos cinereus	Koala	V	V	Habitat degraded and unlikely to be considered important habitat. Excluded
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Foraging habitat present within the study area. No known roost sites or established camps within the study area. **Included as an ecosystem credit**
Rostratula australis	Australian Painted Snipe	E	E	Habitat within the study area is degraded and limited to farm dams without emergent vegetation Excluded
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Stagonopleura guttata	Diamond Firetail	V	-	No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area. Excluded
Stictonetta naevosa	Freckled Duck	V	-	Several degraded farm dams present in study area that this species may use on occasion (e.g. during periods of drought). Excluded
Tyto novaehollandiae	Masked Owl	V	-	Suitable foraging and breeding habitat (hollows >20 centimetres in diameter and 4 metres above ground) recorded within the study area. **Included as an ecosystem credit**
Varanus rosenbergi	Rosenberg's Goanna	V	-	Preferred habitat not within study area Excluded

1. V = Vulnerable, E = Endangered, CE = Critically Endangered under the NSW BC Act or Commonwealth EPBC Act. M = Marine/Migratory under the Commonwealth EPBC Act

In summary, a total of 18 predicted ecosystem credit species were assessed for offsetting purposes.

Species credit species

Species credit species are those species that cannot be confidently predicted to occur based on habitat surrogates and landscape features. These species can also be reliably detected by survey. Species credit species were assessed using information about site context, PCTs and vegetation integrity attributes collected during the field surveys, and data from the Threatened Biodiversity Data Collection as required by section 6.3.1.1 of the BAM in conjunction with a habitat assessment.

The Biodiversity Assessment Calculator was used to generate a list of the candidate species for the study area.

Where appropriate, a combination of available expert reports, vegetation mapping and survey results from off-airport lands (prepared for the *Draft Cumberland Plain Assessment Report* (Open Lines and Biosis, 2020) have been used. The initial list of species credit species as returned from the Biodiversity Assessment Calculator is provided in Table 6-16.

Table 6-16 Summary of candidate threatened species credit species returned by the Biodiversity Assessment Calculator

Species	Common name	BC Act [1]	EPBC Act[1]	Sensitivity to gain class
Plants				
Acacia bynoeana	Bynoe's Wattle	E	V	High
Acacia pubescens	Downy Wattle	V	V	High
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Moderate
Callistemon linearifolius	Netted Bottle Brush	V	-	Moderate
Commersonia prostrata	Dwarf Kerrawang	E	E	High
Cynanchum elegans	White-flowered Wax Plant	E	E	High
Dillwynia tenuifolia - Endangered population	Dillwynia tenuifolia, Kemps Creek	E	-	High
Dillwynia tenuifolia	Dillwynia tenuifolia	V	-	Moderate
Eucalyptus benthamii	Camden White Gum	V	V	High
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V	-	Moderate
Haloragis exalata subsp. exalata	Square Raspwort	V	V	Moderate
Hibbertia sp. Bankstown	Hibbertia sp. Bankstown	CE	CE	High
Marsdenia viridiflora subsp. viridiflora - endangered population	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E	-	Moderate
Maundia triglochinoides	Maundia triglochinoides	V	-	High
Melaleuca biconvexa	Biconvex Paperbark	V	V	High
Persicaria elatior	Tall Knotweed	V	V	High
Persoonia bargoensis	Bargo Geebung	E	V	High
Persoonia hirsuta	Hairy Geebung	E	E	High
Pilularia novae-hollandiae	Austral Pillwort	E	-	High
Pimelea curviflora var. curviflora	Pimelea curviflora var. curviflora	V	V	High
Pimelea spicata	Spiked Rice-flower	E	E	High
Pomaderris brunnea	Brown Pomaderris	E	V	High
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Moderate
Pultenaea parviflora	Pultenaea parviflora	E	V	Moderate

Species	Common name	BC Act [1]	EPBC Act[1]	Sensitivity to gain class
Pultenaea pedunculata	Matted Bush-pea	E	-	High
Thesium australe	Austral Toadflax	V	V	Moderate
Wahlenbergia multicaulis - endangered population	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E	-	High
Zannichellia palustris	Zannichellia palustris	E	-	High
Animals				
Anthochaera phrygia	Regent Honeyeater	CE	CE	High
Burhinus grallarius	Bush Stone-curlew	E	-	High
Calidris ferruginea	Curlew Sandpiper	E	CE	High
Callocephalon fimbriatum - endangered population	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	E	-	High
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	High
Cercartetus nanus	Eastern Pygmy-possum	V	-	High
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Very High
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	M	High
Heleioporus australiacus	Giant Burrowing Frog	V	V	Moderate
Hieraaetus morphnoides	Little Eagle	V	-	Moderate
Lathamus discolor	Swift Parrot	E	CE	Moderate
Limicola falcinellus	Broad-billed Sandpiper	V	-	High
Limosa limosa	Black-tailed Godwit	V	-	High
Litoria aurea	Green and Golden Bell Frog	E	V	High
Lophoictinia isura	Square-tailed Kite	V	-	Moderate
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	High
Miniopterus australis	Little Bent-winged Bat	V	-	Very High
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Very High
Myotis macropus	Southern Myotis	V	-	High
Ninox connivens	Barking Owl	V	-	High
Ninox strenua	Powerful Owl	V	-	High
Pandion cristatus	Eastern Osprey	V	-	Moderate
Petaurus norfolcensis	Squirrel Glider	V	-	High
Phascolarctos cinereus	Koala	V	V	High
Pommerhelix duralensis	Dural Land Snail	E	E	High

Species	Common name	BC Act [1]	EPBC Act[1]	Sensitivity to gain class
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	High
Tyto novaehollandiae	Masked Owl	V	-	High

4. V = Vulnerable, E = Endangered, CE = Critically Endangered under the BC Act or Commonwealth EPBC Act. M Marine/Migratory

Once the initial list of predicted candidate species credit species was generated, the geographic limitations of each species were examined and where the study area is not within the geographic limitation described for a species, the species was removed from the assessment (see section 6.4.1.9 – 6.4.1.16 of the BAM).

The habitat assessments and vegetation integrity surveys conducted during the field survey allowed for the identification of any specific habitat constraints or presence or absence of suitable microhabitats within the study area. Species were excluded from the assessment if the habitat was degraded or if the species is a vagrant (section 6.4.1.17 – 6.4.1.19 of the BAM).

A species was also excluded from the assessment based on the advice provided in expert reports prepared for the Draft Cumberland Plain Assessment Report (section 6.5.2 of the BAM).

The candidate species excluded from the assessment on geographic or habitat constraints are outlined in Table 6-17. A conservative approach has been taken for the Cumberland Plain Land Snail as the expert report predicts the species would potentially be found in any remaining intact PCTs 724 and 849 especially if there is a well-developed leaf litter layer, plenty of woody debris on the ground and few exotic/invasive species (Clarke, 2018). The species has therefore been assumed present in any intact areas of PCT 849 in the study area.

Table 6-17 Candidate threatened species excluded from assessment

Species	Common Name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion
Plants					
Caladenia tessellata	Thick Lip Spider Orchid	E	V	-	Though associated vegetation type PCT 849 was recorded, all *Caladenia tessellata* records occur to the east of Prospect Reservoir.
Callistemon linearifolius	Netted Bottle Brush	V	-	-	Scattered records in Western and South-Western Sydney area with majority of the western records being centred around Bankstown. Though associated vegetation type, PCT 835, was recorded this species is considered unlikely to occur.
Commersonia prostrata	Dwarf Kerrawang	E	E	-	Preferred habitat, sandy/peaty soils and associated species not recorded within the study area.
Dillwynia tenuifolia - endangered population	Dillwynia tenuifolia, Kemps Creek	E	-	Bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool LGA	Study area does not occur within geographic limitations of species.
Eucalyptus benthamii	Camden White Gum	V	V	-	This species is known to occur on the alluvial flats of the Nepean River and its tributaries with all historic records to the west of the alignment. Associated vegetation types PCT 835 and 849 were recorded within the study area. Although unlikely based on known distributional limits.
Haloragis exalata subsp. exalata	Square Raspwort	V	V	Waterbodies: Edges of coastal lakes after flooding has removed other vegetation, creek banks within flood zone, areas close to these features subject to human disturbance including road verges and powerline easements or within 100 metres	This species is known from four disjunct populations, none of which are known to occur within locality of the study area.

Species	Common Name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion
Hibbertia sp. Bankstown	Hibbertia sp. Bankstown	CE	CE	-	Though associated vegetation type PCT 835 was recorded within the study area, this species is known from one population at Bankstown Airport.
Maundia triglochinoides	Maundia triglochinoides	V	-	Riparian areas/drainage lines, water ponding, man-made dams and drainage channels, shallow swamps, waterbodies up to 1 metres deep or semi-permanent/ephemeral wet areas	Though associated vegetation type, PCT 1800, was recorded, this species is restriction to coastal NSW with Sydney populations considered to be extinct.
Melaleuca biconvexa	Biconvex Paperbark	V	V	-	This species is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.
Persoonia bargoensis	Bargo Geebung	E	V	-	This species is not known to occur on the Cumberland Plain with the nearest population being recorded south of Picton.
Persoonia hirsuta	Hairy Geebung	E	E	-	Preferred habitat, sandy soils and sandstone geologies, not recorded within the study area. Though associated vegetation type, PCT 835, was recorded, this species is generally not recorded on the Cumberland Plain. Within locality of the study area, historic records generally restricted to the east of M7 Motorway and in Windsor Downs Nature Reserve.
Pilularia novae-hollandiae	Austral Pillwort	E	-	-	Though associated vegetation types, PCT 835 and 1800, were recorded, preferred habitats being shallow swamps and waterways, were limited within the study area. This species has one record within locality, near Bungarribee, from 1966.

Species	Common Name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion
Pultenaea pedunculata	Matted Bush-pea	E	-	-	Though associated vegetation types, PCT 849 was recorded within the study area, this species distribution is generally restricted to the Liverpool area and South of Menangle with one record (2015) from Cobbitty.
Wahlenbergia multicaulis - endangered population	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E	-	Auburn (Cumberland Council), Bankstown and Canterbury (City of Canterbury – Bankstown), Baulkham Hills (The Hills Shire Council), Hornsby, Parramatta and Strathfield Local Government Areas	The study area does occur within geographic limitations.
Zannichellia palustris	Zannichellia palustris	E	-	Waterbodies: Freshwater or slightly brackish estuarine areas (10 per cent)	Though potential habitat was recorded within the study area, this species is not known to occur within locality of with one small population being recorded at Sydney Olympic Park.
Animals					
Anthochaera phrygia	Regent Honeyeater (mapped important areas)	CE	CE	As per mapped areas	No key breeding areas or other breeding areas mapped in the National Recovery Plan occur within the study area. Preferred foraging habitat (Spotted Gum, Swamp Mahogany, Mugga Ironbark) not present within study area. Excluded from further assessment
Burhinus grallarius	Bush Stone-curlew	E	-	Fallen/standing dead timber including logs	Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited. Excluded from further assessment

Species	Common Name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion
Calidris ferruginea	Curlew Sandpiper (Breeding habitat)	E	CE	-	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded from further assessment
Callocephalon fimbriatum - endangered population	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	E	-	Hollow bearing trees: Eucalypt tree species with hollows greater than 9 centimetres diameter; Hornsby and Ku-ring-gai LGAs	Oustide of LGAs Excluded from further assessment
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding habitat)	V	-	-	Preferred habitat of mature/old growth eucalypt forest not present Marginal foraging and breeding habitat within the study area. Excluded from further assessment
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding habitat)	V	-	Hollow bearing trees Living or dead tree with hollows greater than 15 centimetre diameter and greater than 5 metres above ground	Preferred foraging habitat not present within the study area. Excluded from further assessment
Cercartetus nanus	Eastern Pygmy-possum	V	-	-	Preferred habitat not within study area. Excluded from further assessment
Heleioporus australiacus	Giant Burrowing Frog	V	V	-	Sandstone geology not recorded. Habitat requirements not recorded within the study area. Excluded from further assessment.

Species	Common Name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion
Lathamus discolor	Swift Parrot (mapped important areas)	E	CE	As per mapped areas	The Swift Parrot only breeds in Tasmania. It may fly over the study area intermittently during seasonal migration movements. Winter-flowering resources (e.g. Spotted Gum) generally absent from the study area. No recent records within the vicinity of the study area. Excluded from further assessment
Limicola falcinellus	Broad-billed Sandpiper (Breeding habitat)	V	-	-	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded from further assessment
Limosa limosa	Black-tailed Godwit (Breeding habitat)	V	-	-	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded from further assessment
Litoria aurea	Green and Golden Bell Frog	E	V	Semi-permanent/ephemeral wet areas- within 1 kilometre of wet areas Swamps - within 1 kilometre of swamp Waterbodies - within 1 kilometre of waterbody	Potential habitat for this species within the study area is heavily degraded. Farm dams are polluted and contain the predatory Mosquito Fish (*Gambusia holbrooki*). A low number of OEH records occur within the locality, and the study area contains no known historic populations. Excluded from further assessment
Miniopterus australis	Little Bent-wing bat (Breeding habitat)	V	-	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in Bionet with microhabitat code '1C – in cave', observation type code 'E- nest roost', with numbers of individuals >500 or from the scientific literature	Preferred breeding habitat not within study area. The habitat constraints for breeding as identified in the Threatened Biodiversity Data Collection are not met for this species. Excluded from further assessment

Species	Common Name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion
Miniopterus orianae oceanensis	Large Bent-wing Bat (Breeding habitat)	V	-	Caves - Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in Bionet with microhabitat code ‘1C – in cave’, observation type code ‘E- nest roost’, with numbers of individuals >500 or from the scientific literature	Breeding habitat for the Large Bent-winged Bat is highly specific to their territorial range (Churchill 2008; Lumsden and Jemison, 2015). In late spring, pregnant females disperse from Sydney and migrate to one of three known maternity roosts in NSW: Willi caves near Kempsey, Church Cave at Wee Jasper and Drum Cave near Bungonia (Hamilton Smith and Dwyer, 1965; Hoye and Spence, 2004). These maternity roosts are at least 200 kilometres from the study area. They roost in known overwintering roost sites within Sydney include disused military tunnels at Henry’s Head and Malabar Headland (White, 2011), Balls Head Coal Loader, Gore Cove and Tunks Park (Gonslaves and Law, 2018). Hoye and Spence (2004) report on all current roost sites within the Sydney Basin and none of those structures are buildings, only caves, military or railway tunnels and very large stormwater drains. These structures are absent from the study area. The habitat constraints for breeding as identified in the Threatened Biodiversity Data Collection are not present for this species in the study area. Excluded from further assessment.
Ninox strenua	Powerful Owl (Breeding habitat)	V	-	Hollow bearing trees Living or dead trees with hollow greater than 20 centimetre diameter	Marginal foraging habitat within the study area. Excluded from further assessment

Species	Common Name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion
Pandion cristatus	Eastern Osprey (Breeding habitat)	V	-	Other Presence of stick-nests in living and dead trees (>15 metres) or artificial structures within 100 metres of a floodplain for nesting)	The habitat constraints for breeding as identified in the Threatened Biodiversity Data Collection are not met for this species. Excluded from further assessment
Petaurus norfolcensis	Squirrel Glider (Breeding habitat)	V	-	-	Preferred habitat not within study area. Excluded from further assessment
Phascolarctos cinereus	Koala (Breeding habitat)	V	V	Areas identified via survey as important habitat (see comments)	Habitat degraded and unlikely to be considered important habitat. Excluded from further assessment
Pommerhelix duralensis	Dural Land Snail	E	E	Other Leaf litter and shed bark or within 50 metres of litter or bark| Rocky areas Rocks or within 50 metres of rocks| Fallen/standing dead timber including logs Including logs and bark or within 50 metres of logs or bark	Study area is outside distribution Excluded from further assessment
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Camp	A breeding camp was not recorded within study area. The habitat constraints for breeding as identified in the Threatened Biodiversity Data Collection are not met for this species. Excluded from further assessment
Tyto novaehollandiae	Masked Owl (Breeding habitat)	V	-	Hollow bearing trees Living or dead trees with hollows greater than 20 centimetre diameter	Marginal foraging habitat within the study area. Excluded from further assessment

1. V = Vulnerable, E = Endangered, CE = Critically Endangered under the BC Act and EPBC Act

NSW threatened flora

Threatened species survey results from the *Western Sydney Airport Environmental Impact Statement Biodiversity Assessment* (Department of Infrastructure and Regional Development, 2016e), Biodiversity Assessment Report for land outside Stage 1 Development (Department of Infrastructure and Regional Development, 2018b) and Environmental field survey of Commonwealth land at Badgerys Creek (SMEC, 2014) were used to inform this assessment.

Candidate threatened flora species subject to further assessment in accordance with 6.4.1.21 of the BAM for the study area are outlined in Table 6-18.

Table 6-18 Candidate threatened flora species

Scientific name	Common name	Presence	Affected?
Acacia pubescens	Downy Wattle	No (surveyed)	No. This species was not recorded despite multiple rounds of targeted field surveys within recommended survey months (all year) (Department of Infrastructure and Regional Development, 2016e; WSP, 2020).
Cynanchum elegans	White-flowered Wax Plant	No (surveyed)	No. This species was subject to multiple rounds of targeted field surveys within recommended survey months (All year) and was not recorded (Department of Infrastructure and Regional Development, 2016e; WSP, 2020).
Dillwynia tenuifolia	Dillwynia tenuifolia	No (surveyed)	No. This species was not recorded despite multiple rounds of targeted field surveys (Department of Infrastructure and Regional Development, 2016e; Department of Infrastructure and Regional Development, 2018; WSP, 2020).
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	No (surveyed)	No. This species was subject to multiple rounds of targeted field surveys within recommended survey months (All year) and was not recorded (Department of Infrastructure and Regional Development, 2016e; SMEC 2014; WSP 2020). An expert report for this species outlines that the present of this species in the Western Sydney Aerotropolis growth area appears to be marginal with one observational record occurring outside of the study area (Weston, 2019). This species is not considered affected.
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	No (surveyed)	No. Department of Infrastructure and Regional Development, 2016e conducted surveys for this species between February and June 2016. At this time, the BioBanking Credit Calculator identified optimal survey months for this species to be all year. August to November is now acknowledged as the optimal survey period due to flowering. No *Grevillea parviflora* subsp. *parviflora* individuals were recorded during targeted seasonal surveys. SMEC (2014) conducted targeted surveys in September and did not record this species. As such, this species is not considered likely to be affected.
Hibbertia fumana	Hibbertia fumana	No (expert report)	No. An expert report was prepared for this species as part of the Cumberland Plain Conservation Plan (Miller, 2018a). This report identified no areas of study area as containing likely habitat for this species.

Scientific name	Common name	Presence	Affected?
Marsdenia viridiflora subsp. viridiflora - endangered population	Marsdenia viridiflora subsp. viridiflora	No (surveyed)	No. Not recorded during targeted field surveys within on-airport study area undertaken by WSP for the project. This species was recorded by Department of Infrastructure and Regional Development, 2016e during targeted seasonal surveys within recommended survey months (Nov-Feb). A total of 145 stems were recorded none of which occurred within the study area.
Pimelea spicata	Spiked Rice-flower	No (surveyed)	No. This species was not recorded despite multiple rounds of targeted surveys within recommended survey months (all year) (Department of Infrastructure and Regional Development, 2016e; WSP, 2020).
Pomaderris brunnea	Brown Pomaderris	No (surveyed)	No. Department of Infrastructure and Regional Development 2016e conducted surveys for this species between March and May, 2016. The BioBanking Credit Calculator identifies the optimal survey months for this species to be all year. August to October is not acknowledged as the optimal survey period due to flowering. No *Pomaderris* individuals were recorded during targeted seasonal surveys or in sampling plots by Department of Infrastructure and Regional Development, 2016e or WSP (2019/20). This species is not considered likely to be affected.
Pterostylis saxicola	Sydney Plains Greenhood	No (expert report)	No. An expert report was prepared for this species as part of the draft Cumberland Plain Conservation Plan (Weston, 2019). This report identified no areas of study area as containing likely habitat for this species.
Pultenaea parviflora	Pultenaea parviflora	No (surveyed)	No. This species was subject to targeted survey outside of optimal months (Sept-Nov) (Department of Infrastructure and Regional Development, 2016e). Despite this, four individuals were recorded within the Western Sydney International land. None of these individuals occur within the study area. This species is not considered affected.
Thesium australe	Austral Toadflax	No (surveyed)	No. This species was not recorded despite multiple rounds of targeted surveys with recommended survey months (Nov-Feb) (Department of Infrastructure and Regional Development, 2016e).

NSW threatened fauna

Detailed targeted fauna field surveys were undertaken for all threatened fauna species within the study area.

The Southern Myotis is assumed to be present within suitable habitat of the study area. The Southern Myotis was recorded on-airport by Department of Infrastructure and Regional Development (2016e) at Badgerys Creek. Foraging habitat is present within several farms dams across the study area. Some potential roosting or breeding habitat is present in dead trees, but this species is most likely to use larger, under-road structures such as concrete culverts and bridges. Potential impacts to the habitat for the Southern Myotis are outlined in Section 7.3. In accordance with section 6.4 of the BAM, species polygon boundaries for the Southern Myotis are aligned with PCTs that are within 200 metres of mapped waterbodies including Badgerys Creek, Blaxland Creek and farm dams within the study area.

The Cumberland Plain Land Snail was recorded by Department of Infrastructure and Regional Development (2016e) within woodland vegetation in the study area. A conservative approach has been taken for the Cumberland Plain Land Snail as the expert report for the Cumberland Plain Assessment Report predicts the species would potentially be found in any intact remnant especially if there is a well-developed leaf litter layer, plenty of woody debris on the ground and few exotic/invasive species (Clarke, 2018). The species has therefore been assumed present within intact areas of PCT 849 and PCT 835 in the study area. Potential impacts to the habitat for the Cumberland Plain Land Snail are outlined in Section 7.3.

The species polygons for the Southern Myotis and Cumberland Plain Land Snail on-airport land is estimated at 0.05 and 5.57 hectares respectively and are shown in Figure 6-4.

An additional threatened fauna species recorded during the field surveys included the Eastern False Pipistrelle (*Falsistrellus tasmanianesis*) which is listed as Vulnerable under the BC Act and considered in this assessment as an ecosystem credit species.

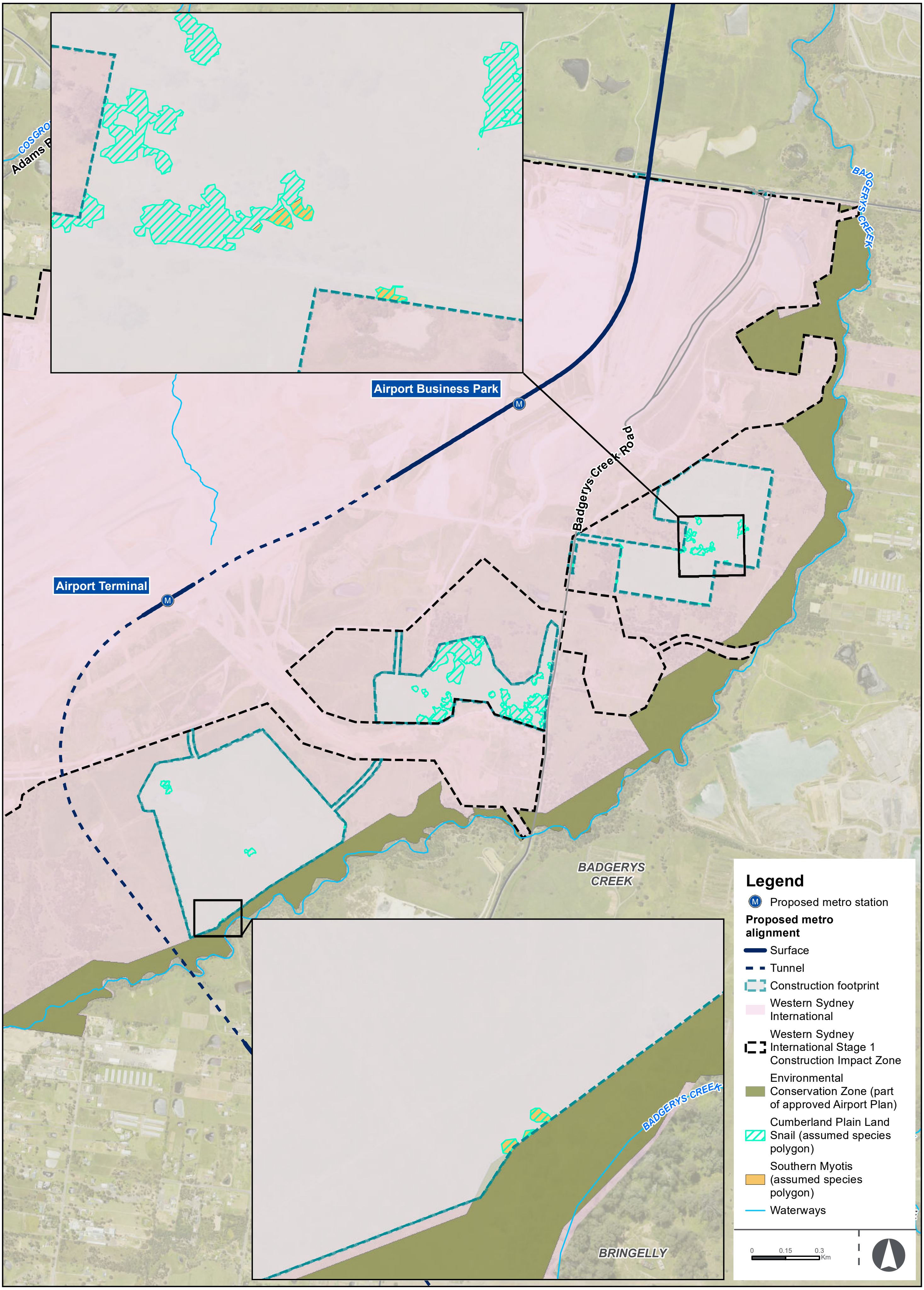
Candidate threatened fauna species subject to further assessment in accordance with 6.4.1.21 of the BAM for on-airport land are outlined in Table 6-19.

Table 6-19 Candidate NSW threatened fauna

Scientific name	Common name	Affected? (Department of Infrastructure and Regional Development, 2016e)	Outcome
Hieraaetus morphnoides	Little Eagle	No (surveyed) This species was recorded during targeted surveys mid-flight above the on-airport lands. No nest trees were observed.	Excluded from further assessment
Meridolum corneovirens	Cumberland Plain Land Snail	Yes (surveyed) Targeted surveys were carried out for this species during recommended survey months. CPLS was recorded in larger remnant patches of Cumberland Plain Woodland with deep leaf litter. River Flat Eucalypt Forest ecotonal areas considered potential habitat.	**Considered further for offset obligations**
Myotis macropus	Southern Myotis	Yes (surveyed) Colony of bats observed under the bridge over Badgerys Creek (Badgerys Creek Road) is likely to include breeding individuals. Hollow-bearing trees recorded within 200 metres of riparian areas.	**Considered further for offset obligations**

Scientific name	Common name	Affected? (Department of Infrastructure and Regional Development, 2016e)	Outcome
Ninox connivens	Barking Owl	No (surveyed) Though breeding habitat was recorded within the subject Land, observations required to confirm the utilisation of breeding habitat were not made despite targeted surveys undertaken.	Excluded from further assessment
Ninox strenua	Powerful Owl	No (surveyed) Though breeding habitat was recorded within the subject Land, observations required to confirm the utilisation of breeding habitat were not made despite targeted surveys undertaken.	Excluded from further assessment
Tyto novaehollandiae	Masked Owl	No (surveyed) Though breeding habitat was recorded within the subject Land, observations required to confirm the utilisation of breeding habitat were not made despite targeted surveys undertaken.	Excluded from further assessment

In summary, a total of two NSW threatened fauna species (Cumberland Plain Land Snail and Southern Myotis) were recorded or assumed present within the on-airport study area and have been assigned to species credit calculations for offsetting purposes.



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Threatened fauna species polygons

Figure 6-4

6.5.4 Aquatic ecology

The study area is located entirely within the South Creek catchment within the larger Hawkesbury catchment. The study area crosses a number of smaller intermittent unnamed drainage lines and depressions. The Airport Plan designates an Environmental Conservation Zone (ECZ) which is predominantly associated with the riparian vegetation along Badgerys Creek. The project has been designed to avoid impact upon the ECZ by being located in tunnel at this location.

The study area also contains the catchment areas (but does not cross the main channel) for Oaky Creek (within the Western Sydney International site, to the west of the project) and a tributary of Duncans Creek (within the Western Sydney International site and to the southwest of the project). South Creek is the receiving waterway for creeks within the study area.

The catchment is highly impacted due to a mix of rural and urban land uses and major infrastructure and has been altered from its natural state. Aquatic habitats in the study area are shown in Figure 6-5.

Fish habitat and waterway classification

Badgerys Creek is mapped as Key Fish Habitat by the NSW Department of Primary Industries and would be classified as Type 2 (moderately sensitive key fish habitat) for habitat sensitivity (NSW Department of Primary Industries, 2013).

In terms of waterway classification for fish passage, Badgerys Creek would generally be classified as Class 2 (moderate fish habitat) (Fairfull and Witheridge, 2003).

The unnamed tributary of Badgerys Creek within the study area would be classified as ‘Class 4’ for fish passage waterway classification (unlikely fish habitat) (Fairfull and Witheridge, 2003).

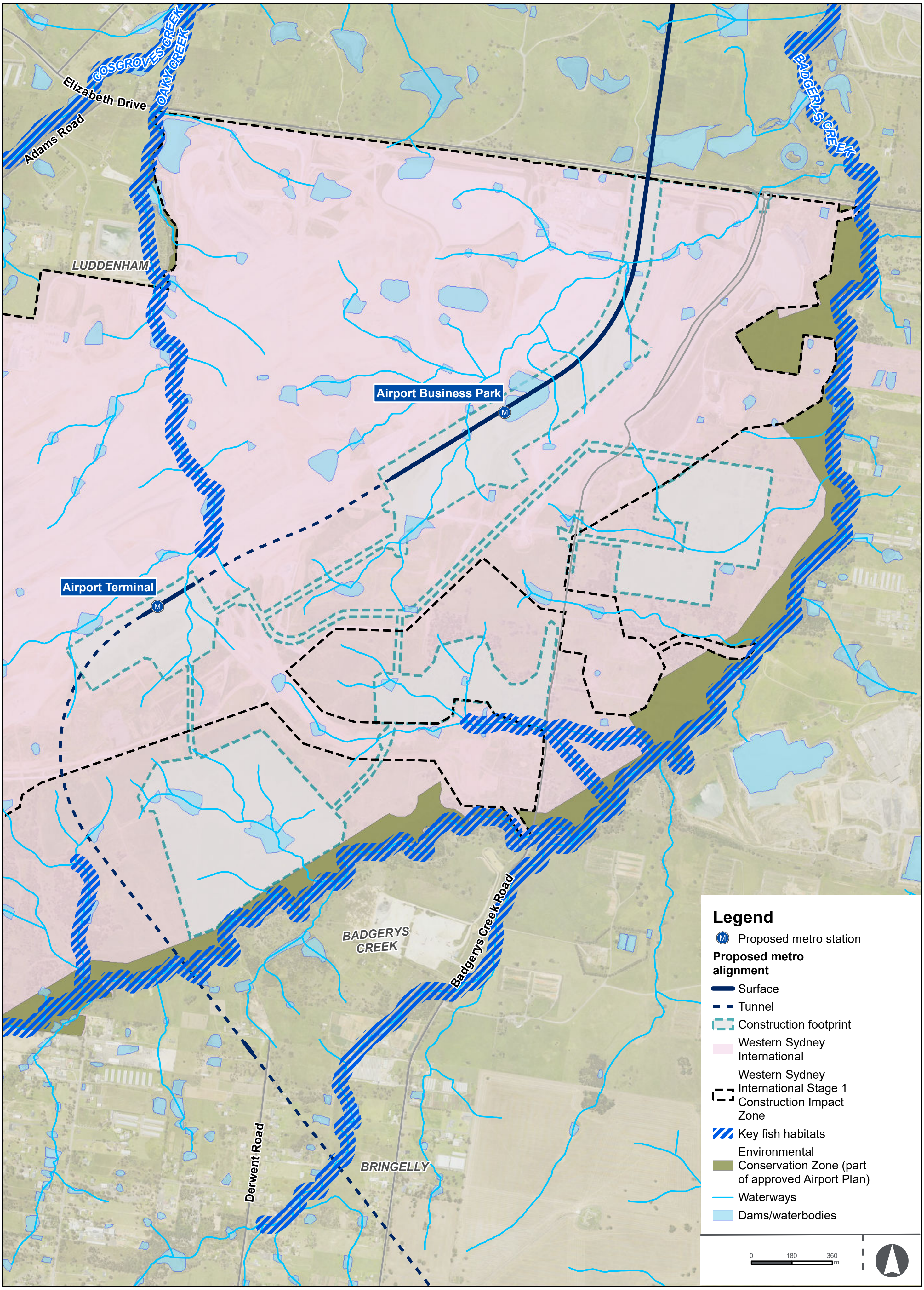
Aquatic biota

The fish communities within on-airport land and in upstream and downstream habitats are indicative of disturbed habitats (Department of Infrastructure and Regional Development, 2016e). Eight fish species were caught during surveys for the Western Sydney Airport Environmental Impact Statement - Biodiversity Assessment. Five native fish species – Long-finned Eel, Firetail Gudgeon, Western Carp Gudgeon, an unidentified Gudgeon species and Australian Smelt – were recorded, along with exotic species including Goldfish, Common Carp, and Eastern Gambusia (Department of Infrastructure and Regional Development, 2016e).

Given these results the macroinvertebrate and fish communities are likely to be similar to those assessed for the Western Sydney Airport Environmental Impact Statement Biodiversity Assessment.

Threatened aquatic species

The intermittent nature of the waterways is likely a natural inhibitor to threatened species occurrence and the habitat disturbance that has occurred with the associated flow on effects of erosion, poor water quality, and high abundance of exotic species suggest that the habitat quality for threatened species is poor (Department of Infrastructure and Regional Development, 2016e).



Aquatic ecology - watercourses and drainage lines across the airport site

Figure 6-5

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6.5.5 Commonwealth Matters of National Environmental Significance

Wetlands of international importance

No wetlands of international importance occur within the study area or broader locality.

Listed threatened species and communities

Commonwealth threatened ecological communities

The protected matters search undertaken for this project identified nine predicted TECs as potentially occurring within the locality. Of these, one TEC meeting the criteria for listing under the EPBC Act was recorded during field surveys, the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (hereafter referred to as CPW).

It should be noted that River-flat eucalypt forest on coastal floodplains of NSW was under EPBC Act listing assessment at the time the Commonwealth Environment Minister advised that the assessment approach to inform the proposed variation of the Airport Plan be in the form of preliminary documentation on 19 December 2019 (Appendix A).

On the 15 December 2020, the Minister of the Environment approved the listing assessment of *'River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria'*. As of this date, this community is now listed as Critically Endangered under the EPBC Act.

As this community was not listed prior to the decision by the Commonwealth Environment Minister on 19 December 2019, it has not been considered further as an MNES in this assessment.

For vegetation to be commensurate with the EPBC-listing for CPW, both key diagnostic features and condition thresholds must be met. An assessment of PCT and condition class against the relevant criteria has been undertaken for CPW. A summary of the TEC, associated PCT and extent within the study area which is commensurate with EPBC listing is summarised in Table 6-20.

Table 6-20 Summary of EPBC-listed TECs

TEC	Status	Associated PCT recorded	Condition	Extent (hectares)
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	3.89
			Thinned	0.05
			Scattered Trees	Not commensurate
			Low	Not commensurate
Total area for EPBC-listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest				**3.94**

CPW is listed as critically endangered under the EPBC Act.

Within the study area, one native plant community type recorded was considered a candidate to from part of this TEC:

- PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.

To be considered to form part of this community, both the key diagnostic characteristics and condition thresholds outlined in the Approved Conservation Advice (Department of the Environment, 2015) must be met.

A comparison of candidate CPW patches and recorded condition class against condition thresholds is provided in Table 6-21.

Table 6-21 Candidate patches for Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest

Construction site	Approx. location	PCT/condition	Threshold/ Reasoning	Outcome
Airport construction support site	Tunnel and viaduct segment production and storage	PCT 849 - Intact	A. Minimum patch size is ≥0.5ha; ≥50per cent of the perennial understorey vegetation cover is made up of native species	Meets patch threshold (3.94 hectares)
		PTC 849 – Thinned	A. Minimum patch size is ≥0.5ha; ≥50per cent of the perennial understorey vegetation cover is made up of native species	
		PCT 849 – Scattered Trees	<30per cent of perennial understorey is made up of native species	Threshold not met. Not considered further
Total area				**3.94 hectares of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest**

Provisional list of EPBC Act listed species and vegetation communities following 2019-2020 bushfires

On 11 February 2020, DAWE released a provisional list of species that have been identified as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia (DAWE, 2020b).

The Critically-endangered CPW was listed as having less than 10 per cent of its estimated distribution affected by bushfire and is therefore not identified in the initial list of highest priority threatened ecological communities by the Department (DAWE, 2020c). Furthermore, CPW is a dry sclerophyll eucalypt forest that are relatively resilient to the impacts of wildfires and burning if fire intervals of greater than 4-12 years are maintained. The areas of this community that were subject to the recent bushfires are considered likely to recover in time, further mitigating the fires' impacts.

No CPW within 10 kilometres of the project has been affected by recent bushfires. Therefore, following consideration of the recent bushfire impacts to CPW, the project is considered unlikely to significantly impact upon this threatened ecological community.

Commonwealth threatened flora

There is no Commonwealth listed threatened flora with potential habitat within the airport site.

Commonwealth threatened fauna

Twenty-four fauna species threatened under the EPBC Act were predicted to occur in the Predicted Matters Search Tool. Of these, one fauna species, the Grey-headed Flying-fox was recorded foraging in the study area. As there are no roosting camps within the study area it has been considered further as an ecosystem credit species.

As part of DAWEs provisional list of species that have been identified as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia (DAWE, 2020b), the Grey-headed Flying-fox has been 'provisionally included as a high priority whilst more information is gathered' (DAWE, 2020c).

An assessment of the potential impacts to Grey-headed Flying-fox habitat is included in Section 7.3.

Migratory species

Eighteen species listed as Migratory under the Commonwealth EPBC Act were predicted to occur in the Predicted Matters Search Tool (PMST). Of these, four migratory species were considered to have suitable foraging habitat within the study area:

- Latham's Snipe (Gallinago hardwickii)
- White-bellied Sea-eagle (*Haliaeetus leucogaster*)
- White-throated Needletail (*Hirundapus caudacutus*)
- Satin Fly-catcher (*Myiagra cyanoleuca*).

The White-bellied Sea-eagle was recorded flying over the study area. In addition to the detail provided above, Department of Infrastructure and Regional Development (2016e) recorded Latham's Snipe in a large, vegetated farm dam within the on-airport lands (but not within the study area).

Commonwealth land

The study area comprises Commonwealth Land for Western Sydney International (Australian Government Property Register ID: AGPR 4877) which would be impacted by the project. Impacts to biodiversity on this land are considered in this assessment.

6.6 Non-Aboriginal heritage

The Airport Plan authorises the demolition of all heritage structures on the airport site, including areas within and outside the Western Sydney International Stage 1 Construction Impact Zone. Listed and potential heritage items within Western Sydney International have been or would be removed and managed in accordance with the *Western Sydney Airport European and Other Heritage Construction Environmental Management Plan* (Western Sydney Airport, 2019e) and the Airport Plan.

6.7 Aboriginal heritage

6.7.1 Landscape and archaeological context

Western Sydney International and surrounding land generally comprises flat to undulating topography, with floodplains, watercourses and their tributaries. South Creek and its tributaries including Cosgroves Creek, Oaky Creek and Badgerys Creek would have been an important resource for past Aboriginal groups in this area.

Historic land use practices such as vegetation clearing, damming, and flood mitigation works in this area have resulted in the likely disturbance of any pre-existing Aboriginal sites and deposits.

Previous assessments undertaken across this region have identified the presence of surface and subsurface Aboriginal artefacts. These are commonly artefact sites and have generally been found near water sources and areas that have been subject to low levels of past disturbance.

Consultation with Registered Aboriginal Parties has identified that cultural values are present within the study area in association with the previously identified sites within the study area. These values can be interpreted as physical markers indicating the long-term presence of Aboriginal people in this region, and the waterways which connect the larger features of the landscape and the sites across it.

6.7.2 Recorded Aboriginal sites

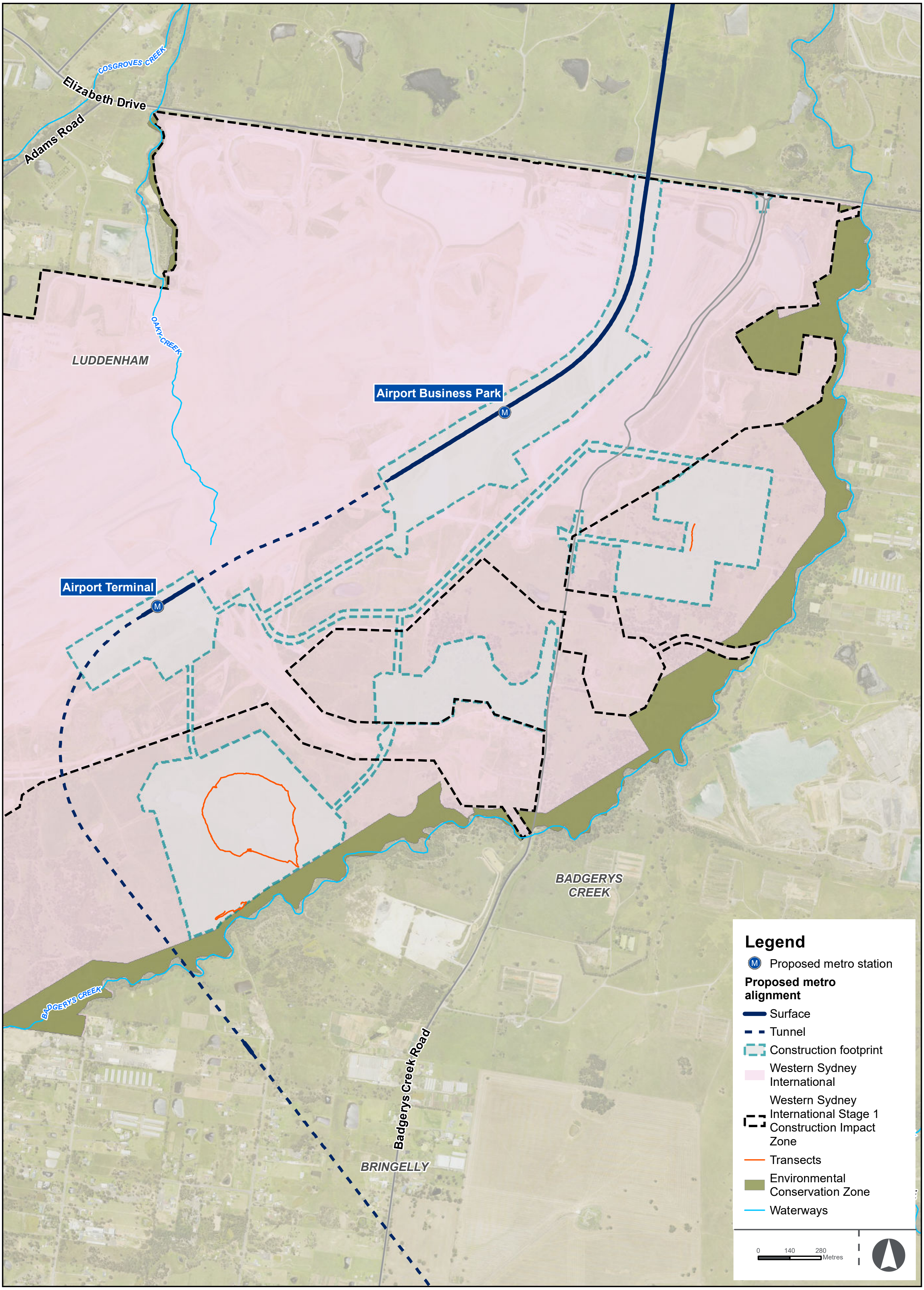
An AHIMS search was conducted and identified ten sites within the proposed action construction footprint as outlined in Table 6-22. The location of AHIMS sites are not shown in this Final Environmental Impact Assessment. The areas where field investigations were undertaken (transects) for this Final Environmental Impact Assessment are shown on Figure 6-6.

Table 6-22 AHIMS sites within the on-airport construction footprint

Site ID	Site name	Site type	On-airport construction site
45-5-2637	B5	Artefact scatter	Airport construction support site
45-5-2665	B88	Artefact scatter	On-airport construction corridor
45-5-2586	B3	Isolated artefact	Airport construction support site
45-5-2687	B71	Artefact scatter	Airport Terminal
45-5-5068	B131	Isolated artefact	On-airport construction corridor

Site ID	Site name	Site type	On-airport construction site
45-5-5078	B136	Isolated artefact	Airport construction support site
45-5-5085	B162	Artefact scatter	Airport construction support site
45-5-5089	B163	Artefact scatter	On-airport construction corridor
45-5-5094	B154	Artefact scatter	On-airport construction corridor
45-5-5100	B147	Artefact scatter	Airport construction support site

Of the ten sites listed above, three sites (listed as 45-5-5078, 45-5-2637 and 45-5-2586) are located outside of the Western Sydney International Stage 1 Construction Impact Zone. Only one of these sites was able to be found during archaeological field investigations (listed as 45-5-5078).



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Aboriginal heritage transects (AHIMS sites redacted)

Figure 6-6

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6.8 Flooding, hydrology and water quality

The proposed action lies entirely within the South Creek Catchment, in the upper reaches of the Badgerys Creek, Cosgroves Creek, and Oaky Creek catchments. A western section of the airport site lies within Duncans Creek catchment (see Figure 6-7).

Badgerys Creek forms the south eastern boundary of Western Sydney International. There are several overland flow paths with multiple natural basins within the Western Sydney International boundary that contribute flows to Badgerys Creek.

The headwaters of Oaky Creek are located on the airport site and the creek flows to the northwest for around two kilometres before it reaches the western boundary of the site. A number of unnamed tributaries of Duncans Creek are located on the airport site and flow in a westerly direction. The proposed action does not directly impact the Duncans Creek catchment.

The Western Sydney International Stage 1 works include preparatory activities including clearing and earthworks. The earthworks include relocation of around 1.9 million cubic metres of topsoil and 22 million cubic metres of subsoil and rock to create a level site. A number of detention basins to mitigate increases in peak runoff across the site and the addition of low flow culvert outlets underneath Elizabeth Drive to maintain low flow in Badgerys Creek are also incorporated as part of the Western Sydney International Stage 1 works. Following site preparation activities, the airport site would be developed with hardstand areas and buildings.

These activities would result in major modification to the existing flow paths and catchment boundaries within the Western Sydney Airport Stage 1 Construction Impact Zone and increase runoff levels and the velocity of surface water flows.

6.8.1 Flooding

The existing flooding environment is described in Table 6-23 and the one per cent Annual Exceedance Probability (AEP) event is shown in Figure 6-8. This understanding of flood behaviour is based on the modelling completed for the Western Sydney Airport - Environmental Impact Statement and the project, and assumes the Western Sydney International Stage 1 construction works are underway. The flood model was undertaken for the project as a whole, with applicable results for the on-airport environment detailed below. The one per cent AEP flood event is appropriate because it can be directly related to other flood planning controls.

Table 6-23 Existing on-airport flooding environment

Flood aspect	Existing environment
Peak flood level	For the 0.2 exceedances per year (EY) event, the overland flows paths have depths of less than 0.1 metres, with isolated areas of 0.5 metres at the basins throughout the site. The main Badgerys Creek channel is predicted to have depths of around one metre. For the one per cent AEP event, overland flow paths are still shallow and close to 0.1 metres deep; however, the basin depths are over 0.5 metres. The main Badgerys Creek channel is predicted to have flood depths over one metre. In the probable maximum flood (PMF) event, all flood liable land is inundated by more than one metre, as predicted by the flood models.

Flood aspect	Existing environment
Peak flood velocity	For the 0.2 EY event, the overland flow paths and Badgerys Creek floodplain have flood velocities generally less than 0.5 metres per second. The main channel is predicted to have flood velocities of up to one metre per second. For the one per cent AEP event flood velocities are similar to the 0.2 EY event for the overland flows paths and floodplain and are up to two metres per second in the main channel. For the PMF event, some of the upper reaches of the overland flow paths still have peak velocities of 0.5 metres per second, but the remainder of the floodplain has velocities between 0.5 and one metre per second, with up to two metres per second in the main channel.
Flood duration	The main Badgerys Creek channel has a duration of inundation between 18 and 24 hours for the full range of flood events, with the overland flow paths being less than six hours. The detention basins are predicted to have durations between 12 and 24 hours.
Flood hazard	Flood prone areas are generally classified as H1 and are safe for people, vehicles and buildings with the exception of the basins where the deep water results in higher hazard and would be unsafe for people and vehicles in some areas (generally H3 with some basins classified as H4).

6.8.2 Hydrology

The Western Sydney Airport – Environmental Impact Statement identified that through Western Sydney International, Badgerys Creek, Oaky Creek and Duncans Creek display evidence of path and ongoing bed degradation (Department of Infrastructure and Regional Development, 2016b). The creeks have a vegetated riparian zone and are considered to be in a moderate geomorphic condition. As a result of past clearing, the construction of farm dams along the watercourses and ongoing agricultural activities, tributaries of Badgerys Creek and Cosgroves Creek across Western Sydney International are also considered to be in a moderate state of geomorphic condition.

The construction activities for the Stage 1 development of Western Sydney International will result in increasing runoff levels and the velocity of surface water flows across the airport site and would be continuing during construction of the proposed action. As part of the Stage 1 development of Western International, detention basins were to be established adjacent to Badgerys Creek and elsewhere within the airport site to mitigate the increase in runoff.

6.8.3 Water quality

Water quality monitoring in the vicinity of the proposed action has been carried out for a number of assessments at Western Sydney International over the last 20 years and is ongoing. Monitoring locations are shown in Figure 6-7. Water quality monitoring data from the Western Sydney Airport - Environmental Impact Statement is shown in Table 6-24.

Table 6-24 Water quality monitoring data from the *Western Sydney Airport Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b) compared to Airports (Environment Protection) Regulations limits

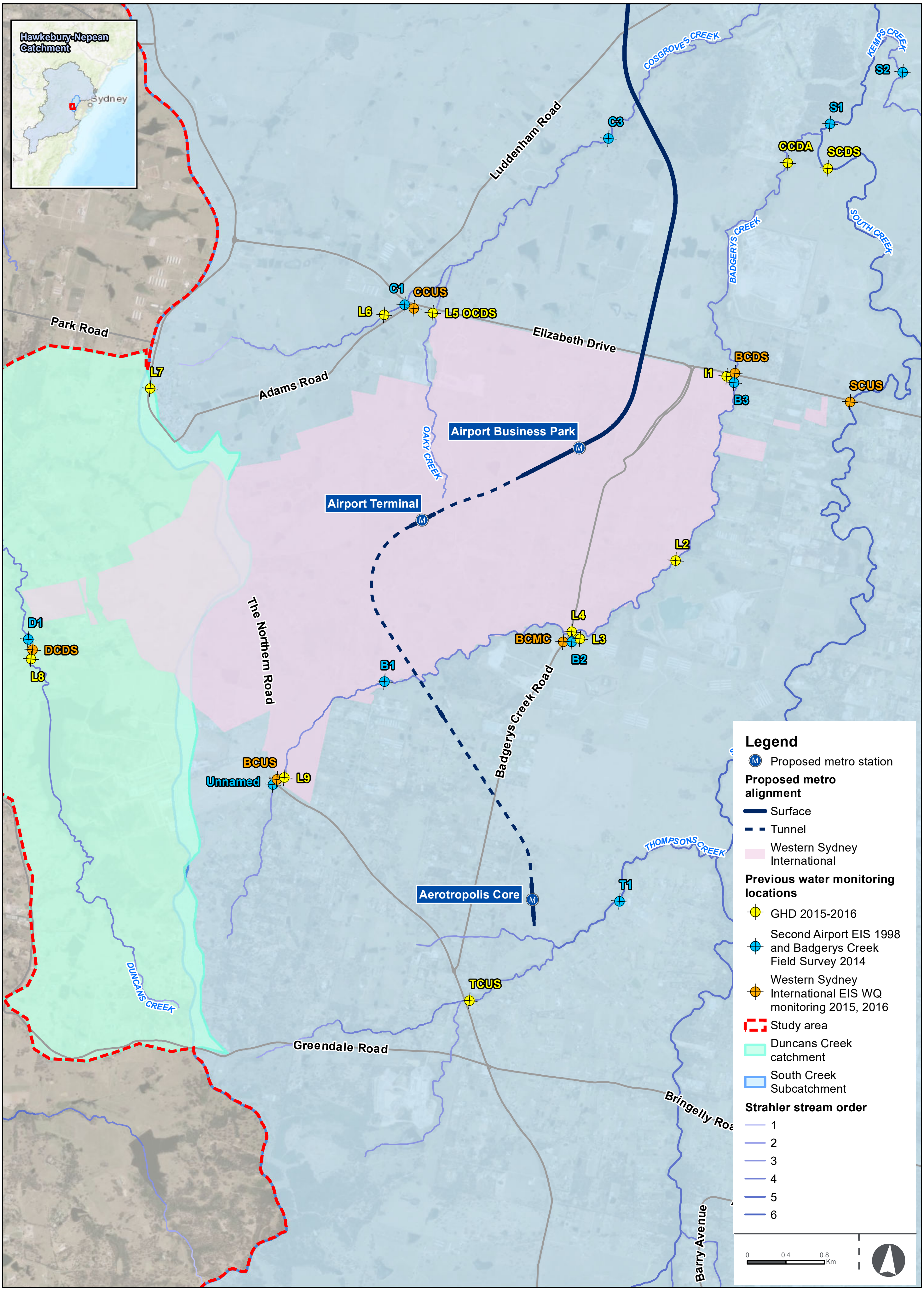
	DO %s	EC (mS/cm)	pH	Turbidity NTU	TSS mg/L	TN mg/L	TP mg/L
Airports Regulations limits	80%	125-2,200	6.5-9	<10%	<10%	0.1	0.01
ANZECC guideline	85-110%	125-2,200	6.5-8.5	6-50	<40	0.35	0.025
Location							
Badgerys BCUS	21.3	2710	n/a	12	23	6.2	0.42
Badgerys BCMS	36	3100	n/a	7.71	5	18.5	0.31
Badgerys BCDS	8.6	3050	n/a	13	5	2.3	1
Cosgroves COCDS	55.4	4320	n/a	19	1.2	0.05	-
Duncans DCDS	52.5	847	n/a	89.2	14	0.9	0.06

Notes:
1. BCUS: Badgerys Creek upstream (of airport)
2. BCMS: Badgerys Creek middle of Site
3. BCDS: Badgerys Creek downstream (of airport)
4. CCDS: Cosgroves Creek downstream (of airport)
5. DCDS: Duncans Creek downstream (of airport)

The monitoring indicated that:

- values were generally above the Airports Regulations limits and the relevant ANZECC guideline values for nutrient loads and below the limits for dissolved oxygen
- total suspended solids (TSS) loads were generally low and achieved the relevant ANZECC guideline values
- conductivity levels were above those for typical lowland rivers
- heavy metals, hydrocarbons and pesticides were generally below detectable limits with the exception of chromium, copper and zinc.

Overall, the data showed that both Western Sydney International and downstream catchments are degraded, particularly in terms of nutrients. The existing water quality is not compliant with the Airports Regulations limits or the ANZECC guideline values for protection of aquatic ecosystems, primary and secondary contact recreation and irrigation water used for food and non-food crops.



Sydney Metro – Western Sydney Airport

Catchments, watercourses and monitoring locations within the study area

Figure 6-7

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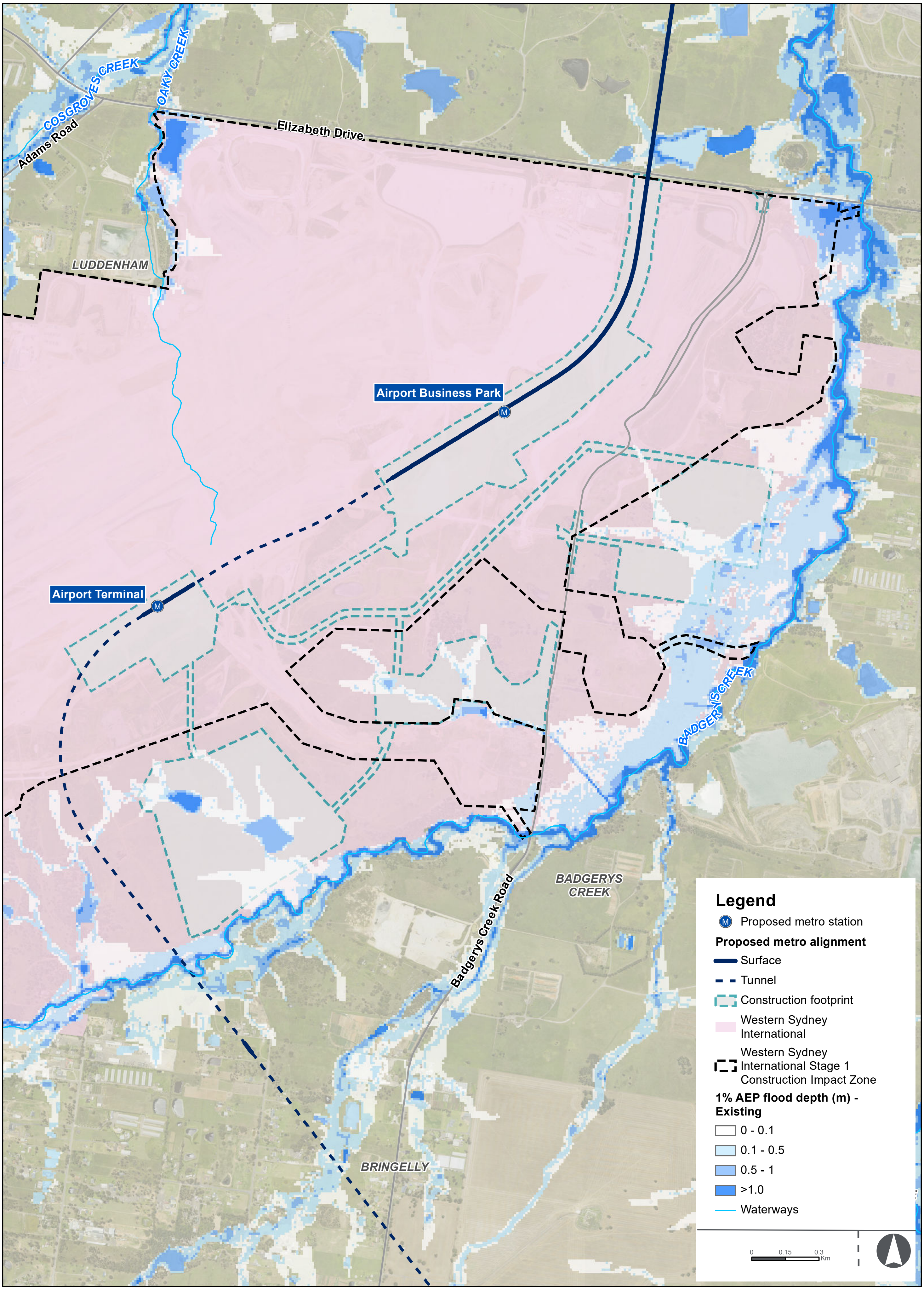

Existing modelled peak flood levels – one per cent AEP event across the airport site

Figure 6-8

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6.9 Groundwater and geology

Groundwater is relatively consistent across a regional scale and this section describes the regional geology and groundwater setting.

6.9.1 Regional geology and groundwater context

Regional geology

The proposed action is located within the Cumberland Basin, forming part of the Sydney Basin, which is the southernmost part of the Sydney-Bowen Basin, a major structural basin which extends from Durras Lake near Batemans Bay to central coastal Queensland. The Western Sydney area is characterised by the Middle Triassic-aged sedimentary rocks of the Wianamatta Group. The Wianamatta Group (from oldest to youngest) consists of the Ashfield Shale, the Minchinbury Sandstone and the Bringelly Shale. Only the Bringelly Shale is expected to be present within the study area.

The Bringelly Shale bedrock is overlain by Quaternary alluvial soils (younger sedimentary unit) in creek channels and older, historic riverbeds. The Quaternary alluvial deposits represent active and historical stream deposits and are associated with the active drainage channels in the area, including South Creek, Blaxland Creek, Cosgroves Creek and Badgerys Creek. The Quaternary alluvial deposits are variable in nature but were found to be predominantly cohesive, comprising silts and clays with fine to coarse sand and trace fine gravel.

In addition to these natural soils, fill is also likely to be encountered in some areas along the alignment, in particular around built up areas, and areas associated with existing infrastructure and around farm dams.

Figure 6-9 provides an overview map of the surface geology for the region and indicates the distribution of Bringelly Shale and overlying Quaternary alluvial deposits across the airport site.

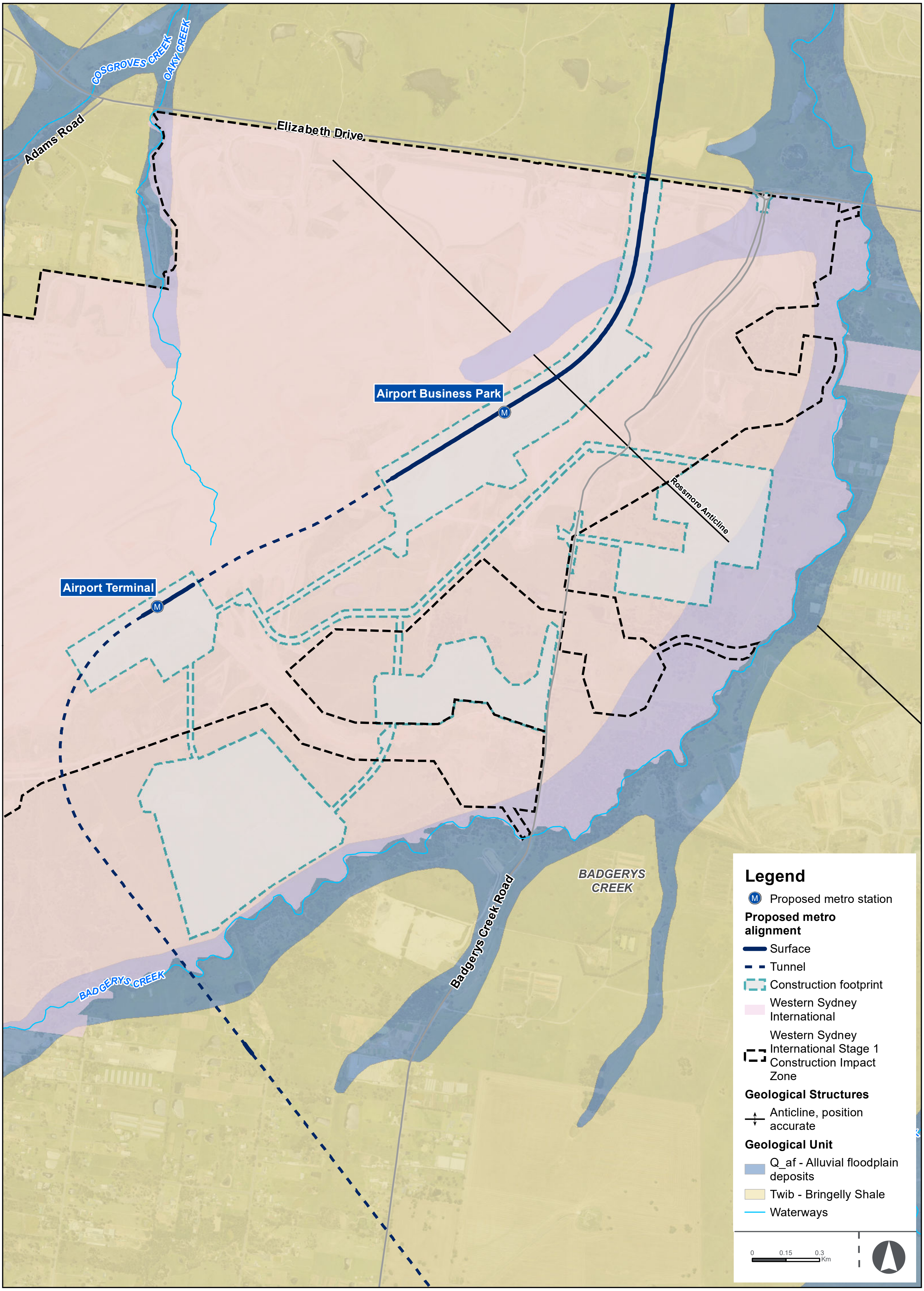
Regional groundwater setting

The groundwater quality and yield (amount able to be extracted) is variable, and dependent on the rock unit, with the Hawkesbury Sandstone providing abundant clean water and the Bringelly Shale providing small amounts of near saline water.

The Hawkesbury Sandstone aquifer is used for some irrigation and local water supply purposes, due to the water quality and the ability for the water to move (conductivity). This aquifer sits beneath the Bringelly Shale, which acts as a barrier between the aquifer and the surficial alluvial soils.

The bedrock units (Hawkesbury Sandstone and Bringelly Shale) form ‘heterogenous fractured rock aquifers’ where groundwater flow occurs within defects within the rock. The ability for water to move within the rock mass is dependent on the number and connectedness of the cracks and faults within the rock. In the Bringelly Shale, vertical movement of groundwater is restricted because of the subhorizontal rock bedding.

Groundwater within the Quaternary alluvial deposits is generally variable in flow, as a result of the mixed nature of the deposits. The aquifer has some connection to the groundwater systems within the bedrock, with creek lines acting either as discharge points for the aquifers or as sources of supplemental recharge into the underlying aquifers.



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Regional geology across the airport site

Figure 6-9

6.9.2 Groundwater levels

A summary of the groundwater monitoring data within Western Sydney International is presented in Table 6-25.

Table 6-25 Summary groundwater level information

Location	Groundwater level (metres below existing ground level)	Groundwater level (relative to final surface level)	Groundwater elevation (m AHD)
Western Sydney International to Bringelly tunnel (within Western Sydney International)	2 to 9	2m to 11m below	67 to 80
Western Sydney International tunnel portal	0.5 to 3	3m below to 2m above[1]	57 to 67
Airport Terminal Station	0.5 to 3.5	8m to 9m below	74 to 76

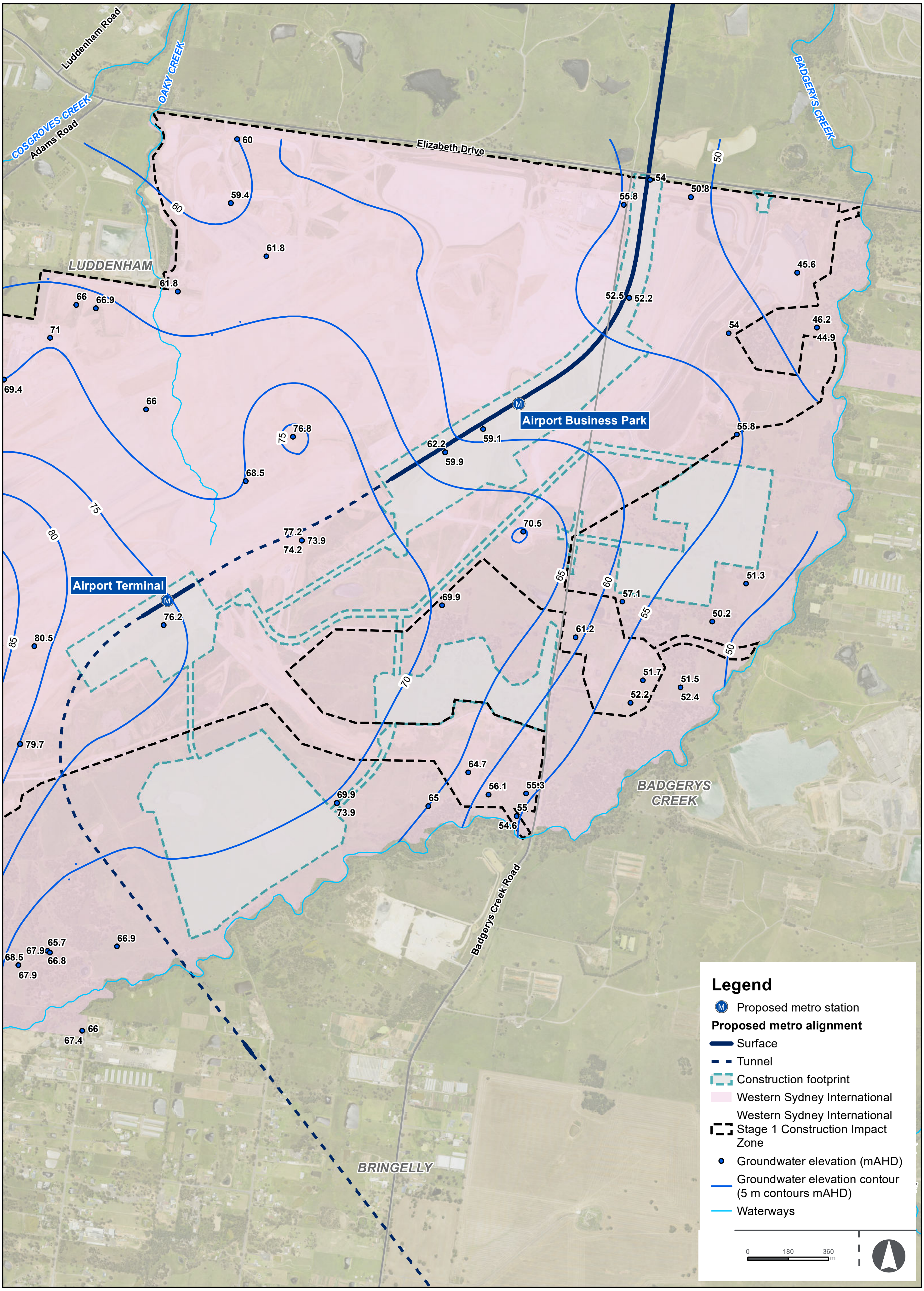
Note: Areas of cut at Western Sydney International mean that existing groundwater levels are above the final surface level

Groundwater monitoring bores were installed during the groundwater assessment undertaken for the Western Sydney Airport - Environmental Impact Statement. The bores show that the groundwater gradients (i.e. the slope of the water table within the rock layers) within the Bringelly Shale appear to be relatively shallow, at around one per cent gradient. Flow directions are generally in a northerly and easterly direction towards Cosgroves Creek, and in a southerly and easterly direction towards Badgerys Creek and South Creek. To the west groundwater appears to flow westwards towards Duncans Creek.

Groundwater flow within the Bringelly Shale is anticipated to be slow and total flow rates are likely to be small due to the low hydraulic conductivity of the residual soils and Bringelly Shale bedrock.

Figure 6-10 shows relative groundwater levels at Western Sydney International. The contours indicate that groundwater broadly follows the existing topography of the site.

The groundwater monitoring network for the project is being expanded and additional monitoring is being undertaken. This additional monitoring data will be used to inform the development of the hydrogeological and geotechnical model for the project (see mitigation measure GW5) and preparation of the Groundwater Management Plan (see mitigation measure GW6) during the design development phase.



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Western Sydney International Bringelly Shale groundwater contour plot

Figure 6-10

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6.9.3 Groundwater quality

Contaminant testing of groundwater quality was undertaken at 15 sampling locations across Western Sydney International between April 2018 and April 2019. While none of the groundwater samples collected were located directly within the proposed action alignment, it is reasonable to infer a consistency of conditions across the site, so that groundwater quality at the sampling locations is likely to be consistent with groundwater that would be encountered during construction and operation of the proposed action.

Table 6-26 provides a summary of test results compared to the ANZECC freshwater ecosystem guidelines (95 per cent).

Table 6-26 Summary of Western Sydney International groundwater quality (contamination) test results

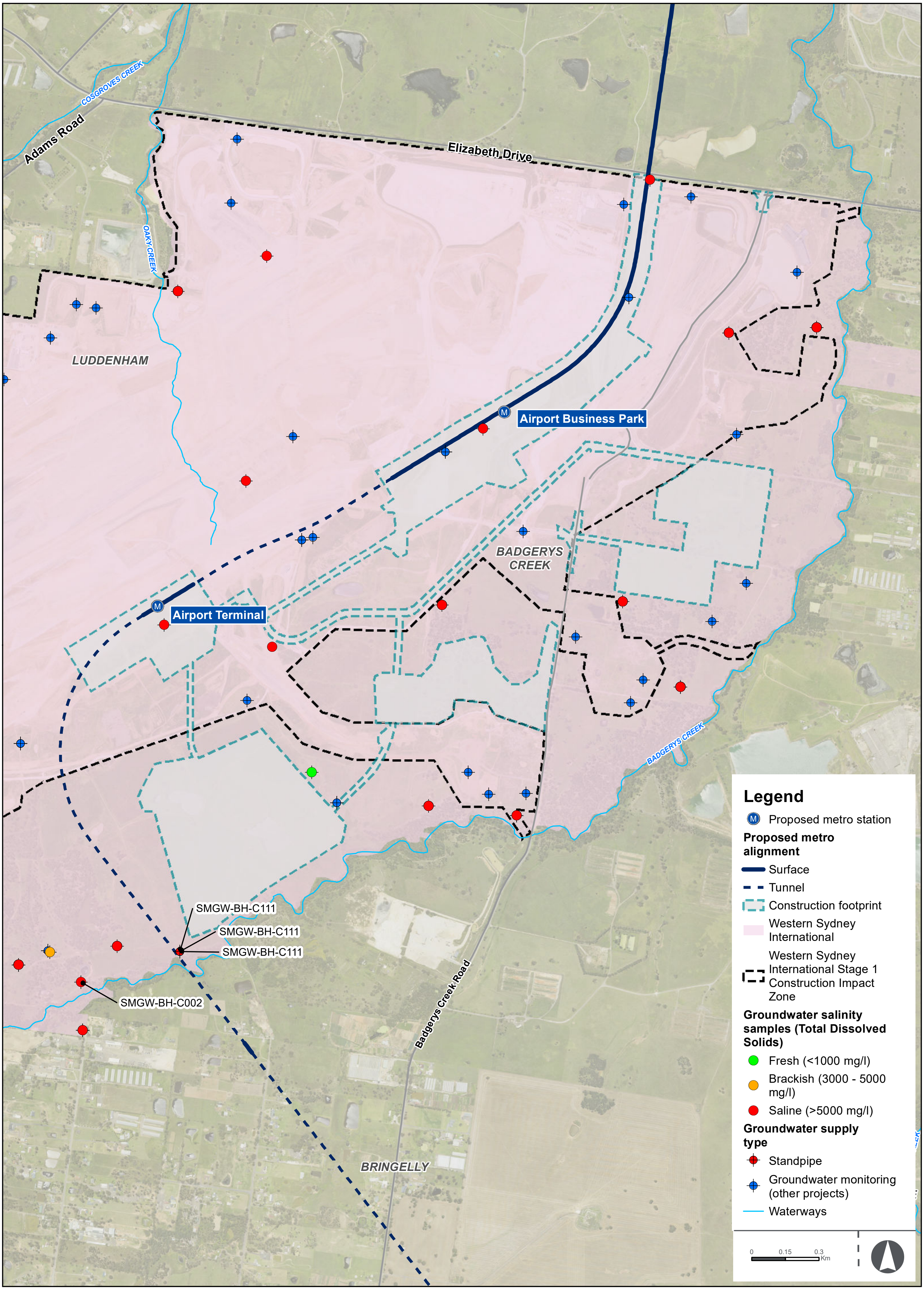
Parameter [1]	ANZECC freshwater ecosystem guidelines (95%)	Test Results [2]		
		Minimum	Maximum	No of tests (exceedances)
pH Value [3]	6.5 – 8.5 (lowland rivers – NSW)	5.0	7.5	78 (8)
Electrical conductivity @ 25°C (μS/cm) [2]	125 – 2,200 (lowland rivers – NSW)	590	40,800	80 (77)
Nitrogen	500	<0.2	2,300	16 (7)
Phosphorous	50	20	1,000	70 (45)
Ammonia as N	900	<10	7,800	71 (39)
Cobalt	1	< 1	26	6 (4)
Copper	1.4	<1	87	71 (48)
Lead	1	<1	8	71 (1)
Manganese	1,900	1	4,550	6 (2)
Nickel	11	<1	93	73 (20)
Toluene	180	< 2	426	2 (1)
Zinc	8	<5	90	71 (59)

Notes:
1. All units mg/l unless otherwise stated. < indicates limit of detection of analysis method
2. Table only includes parameters which exceed the 95% for freshwater ecosystem criteria
3. Includes recorded field measurements

The testing identified trace metals, nutrient parameters organic hydrocarbons and pesticides; however, these were not consistently detected across the monitoring period. In addition, the results showed that the groundwater has background concentrations of copper, lead, nickel and zinc above the 95 per cent ANZECC freshwater criteria.

The elevated levels of heavy metals, ammonia and nitrogen are likely attributable to historic agricultural land use or natural background concentrations rather than a specific point source of contamination.

Known areas of groundwater salinity within the airport site are shown on Figure 6-11. Groundwater salinity for the airport site varied between 600 and 41,000 μS/cm, mostly well above the criteria for lowland rivers. Around half of the samples tested for ammonia exceeded the 95 per cent guideline value for freshwater ecosystems. Around half the samples also had concentrations of nitrogen in excess of the threshold for lowland rivers.



Sydney Metro – Western Sydney Airport

Groundwater salinity distribution across the airport site

Figure 6-11

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6.9.4 Groundwater dependent ecosystems

Vegetation mapping (see Figure 6-2) indicates that the predominant vegetation communities on Western Sydney International are Cumberland Plain Woodland and Cumberland River Flat Forest (both of which are identified as potential GDEs).

The River Flat Forest is located adjacent to the main drainage channels of Badgerys Creek as well as other minor creek lines within Western Sydney International. Reliance on groundwater in these areas is likely to be from alluvial groundwater, connected to creek flow. A small area of Shale Gravel Transition Forest is located to the far east of the airport site. Native vegetation would be cleared from areas within the Western Sydney International Stage 1 Construction Impact Zone during construction of the airport.

No other GDEs (including Ramsar wetlands or aquatic, subterranean or wetland GDEs) were identified within the airport site.

6.9.5 Groundwater users

No existing registered groundwater users were identified within Western Sydney International.

6.10 Soils and contamination

6.10.1 Soil landscapes

Soils within the airport environment consist primarily of the Blacktown and South Creek soil landscapes. These soils are primarily comprised of residual clays with areas of alluvial gravels, sands, silts and clays associated with Badgerys Creek. There are no areas of disturbed terrain mapped within the airport environment; however, significant earthworks are currently being undertaken within the Western Sydney International Stage 1 Construction Impact Zone which have altered the soil landscapes and ground levels.

6.10.2 Salinity

Known areas of soil salinity within the airport site include Oaky Creek in the central portion and Badgerys Creek in the southern portion (see Figure 6-12). Some areas of the airport site are mapped as high salinity potential.

6.10.3 Acid sulfate soils

The airport environment is located outside coastal areas and is considered to have ‘no known occurrence’ of acid sulfate soil (ASS) materials associated with coastal processes. The airport environment may contain potential isolated areas of inland ASS which have not been previously identified. Inland ASS form within saline waterlogged soils with high quantities of organic matter. These may occur in dams, drainage channels, riparian zones and wetlands. The areas mapped as high potential or known salinity risk on Figure 6-12 also have the potential for areas of inland ASS.

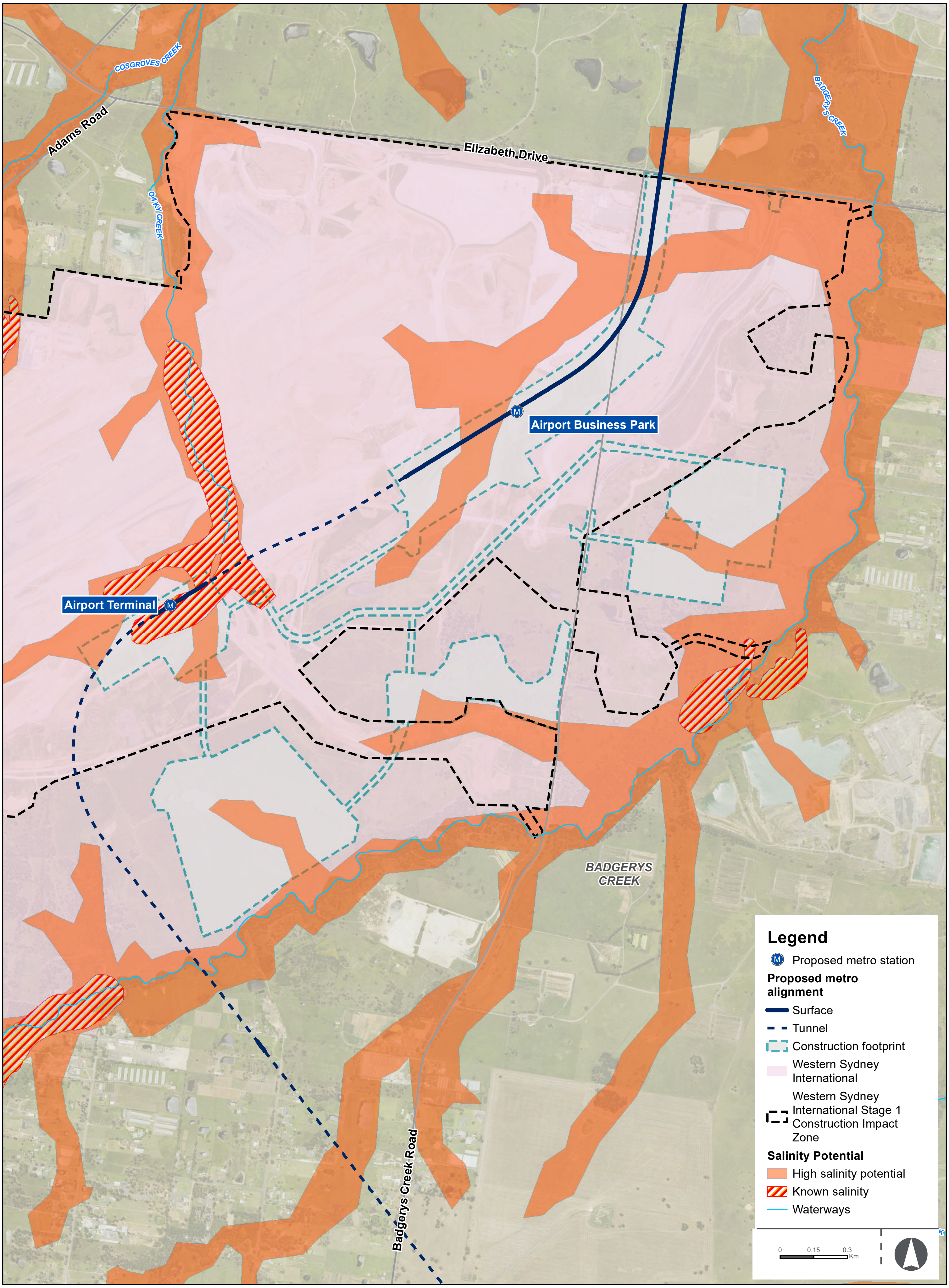
The Western Sydney Airport - Environmental Impact Statement reported that field testing undertaken during geotechnical investigations indicated isolated ASS may be present, but not to an extent requiring mitigation measures.

6.10.4 Contamination

Remediation within the Western Sydney International Stage 1 Construction Impact Zone, as described in the *Western Sydney Airport Remediation Action Plan* (Department of Infrastructure and Regional Development, 2019), is anticipated to be complete prior to the proposed action commencing. However, given that the proposed action would involve construction activities and construction depths that may vary from those associated with Western Sydney International, Sydney Metro would develop a project-specific Remediation Action Plan (Sydney Metro Remediation Action Plan).

Preliminary site investigations (Department of Infrastructure and Regional Development, 2016c) identified extensive waste dumping and stockpiling as the main source of potential contamination. The properties that were assessed as having a high potential of contamination based on the desktop assessment were inspected. The specific types and sources of potential contaminants were identified as:

- asbestos from demolished buildings, dumped, buried and stockpiled asbestos containing materials
- fuels and lubricants from farming, landfill, dumped waste and industry
- solvents, acids and fuels from chemical storage
- heavy metals from farming, dumped waste, cemeteries and industry
- ash from landfill, dumped waste and industry
- farm chemicals (pesticides and herbicides) from market gardening, poultry farming and grazing
- pathogens (bacteria and faecal coliforms) from sewage, farming, landfill and cemetery
- inert waste from rural/residential, farming, dumping, industry and landfill.



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High salinity potential and known salinity risk areas

Figure 6-12

6.11 Land use and property

6.11.1 Existing land uses

Commonwealth land on-airport consists of Western Sydney International Stage 1 and associated land uses, which are currently under construction. Planning on the airport site is controlled under the Airports Act.

Western Sydney International is expected to be developed in stages to match demand and include planning for services and amenities that are easily expandable over time, providing scalable capacity for aircraft, passengers, cargo and vehicle movements. The land use plan for the Stage 1 development of the airport site as presented in the Airport Plan is shown in Figure 6-13.

The Airport Plan sets the land use plan for the airport and identifies the vision for the development and operation of Western Sydney International, in addition to providing authorisation for Stage 1 of the airport. At the time of commencement of operation of the proposed action, Stage 1 of Western Sydney International is being developed consistent with the land use plan.

The land immediately surrounding Western Sydney International comprises of the following land use zones under the *State Environmental Planning Policy (Western Sydney Aerotropolis) 2020*: Environment and Recreation, Enterprise, Agribusiness and Infrastructure – Airport, MIC (*State Environmental Planning Policy (Major Infrastructure Corridors) 2020.*

The area to the north of Western Sydney International, includes the suburbs of Luddenham, Badgerys Creek and Kemps Creek, located to the north and east of Western Sydney International. The land uses in this area include large rural properties with some semi-rural residential properties bordering Luddenham Road within an open, rural landscape. The area also includes a number of agricultural uses including equine and poultry facilities and market gardens. There is a waste management facility on the eastern side of Badgerys Creek.

The University of Sydney owns and operates two commercial farms in Badgerys Creek and Kemps Creek that provide agricultural teaching and learning opportunities.

To the south of Badgerys Creek and Western Sydney International are the suburbs of Bringelly and Rossmore. Existing land uses in this area comprise a mixture of rural industries and rural-residential properties. Land use to the west of South Creek is predominantly rural, with a rural-residential subdivision at Kelvin Park.

6.11.2 Planned land uses

For the commencement of operation of the project, Stage 1 of Western Sydney International is expected to be completed consistent with the land use plan and include a single 3.7 kilometre runway located in the north western portion of the airport site, a terminal and other support facilities to provide for the anticipated operational capacity. Construction on the land outside of the Western Sydney International Stage 1 Construction Impact Zone has not yet commenced.

As demand grows over time and subject to future regulatory approvals, Western Sydney International is expected to include an expanded terminal, further supporting passenger and commercial facilities and ultimately a second runway. A rail corridor has also been preserved through the airport site in developing the airport site layout. An Environmental Conservation Zone is also located along the south eastern boundary of the airport site (which would be retained as part of the development of the airport) on land outside of the Western Sydney International Stage 1 Construction Impact Zone. An indicative long-term land use plan for the airport site is shown in Figure 6-14.

A 'passenger transport facility' is defined in the Airport Plan as permissible use in the following zones:

- AD2 – Terminal and Support Services,
- BD1 – Business Development
- BD2 – Business Development (Reservation).

As part of the Northern Gateway Precinct of the WSAP, the area to the north of Elizabeth Drive is intended to transition from a semi-rural landscape to more intensive urban development. The area around Luddenham is intended to comprise flexible employment and mixed flexible employment and urban land.

Other significant transport infrastructure is also planned as part of the Northern Gateway Precinct, including the future M12 Motorway.

To the southeast of the airport site, the Aerotropolis Core Precinct identified within the WSAP will be centred around the new Aerotropolis Core Station and be supported by retail, creative industries, civil and cultural facilities, and public open spaces.

Within the Aerotropolis Core Precinct, land use will transition from its current semi-rural landscape to a city centre. The Aerotropolis Core Precinct is planned to comprise land uses including advanced manufacturing, defence and aerospace, research, business and creative hubs, as well as residential to create a new city centre. Within the Western Sydney Aerotropolis Precinct, the Wianamatta–South Creek corridor is proposed to create a new ‘green spine’ network which will be integrated with local services, retail and commercial development.

Anticipated forecasts of future aircraft noise are being developed using the Australian Noise Exposure Concept (ANEC) as part of the airspace design process in accordance with the Airport Plan. This is to ensure that aircraft noise impacts associated with the development of Western Sydney International are taken into account in strategic planning and individual development proposals in areas impacted by the ANEC contours. New residential development will be located outside the ANEC 20 and above contours.

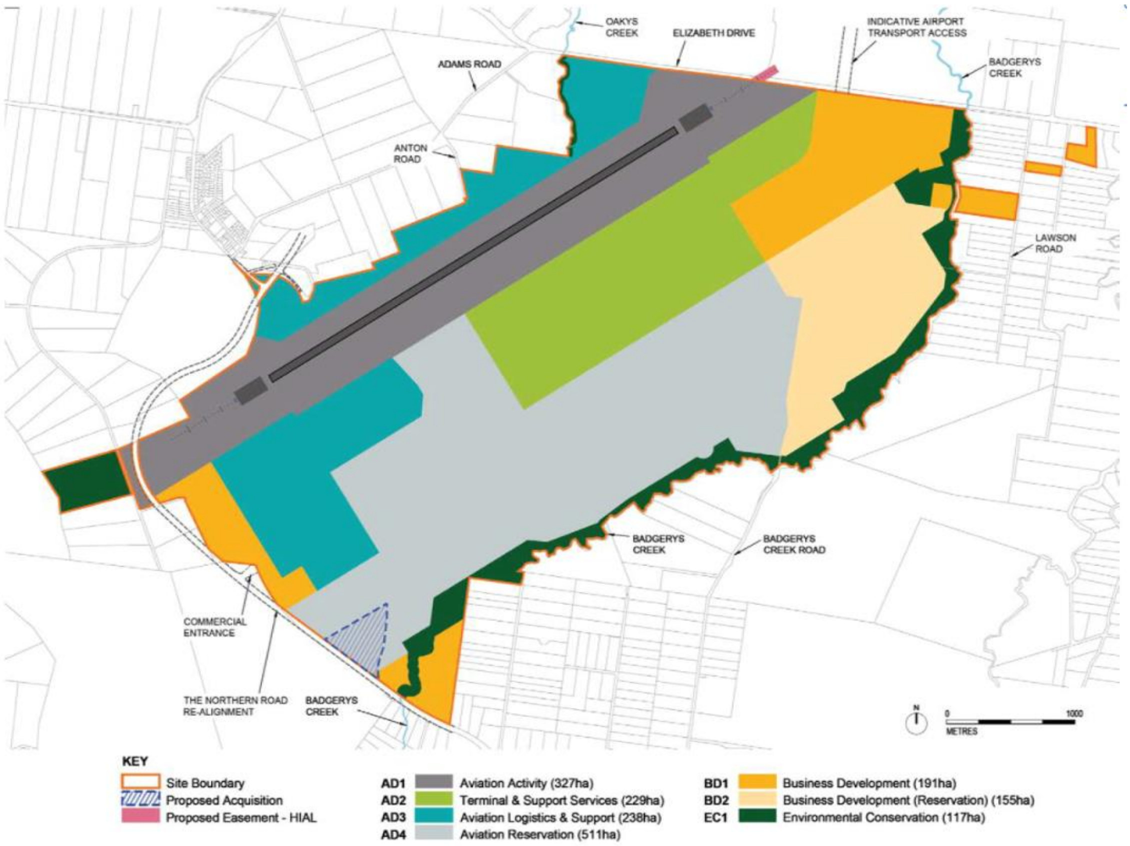


Figure 6-13 Western Sydney International land use zones (Stage 1) (Airport Plan)

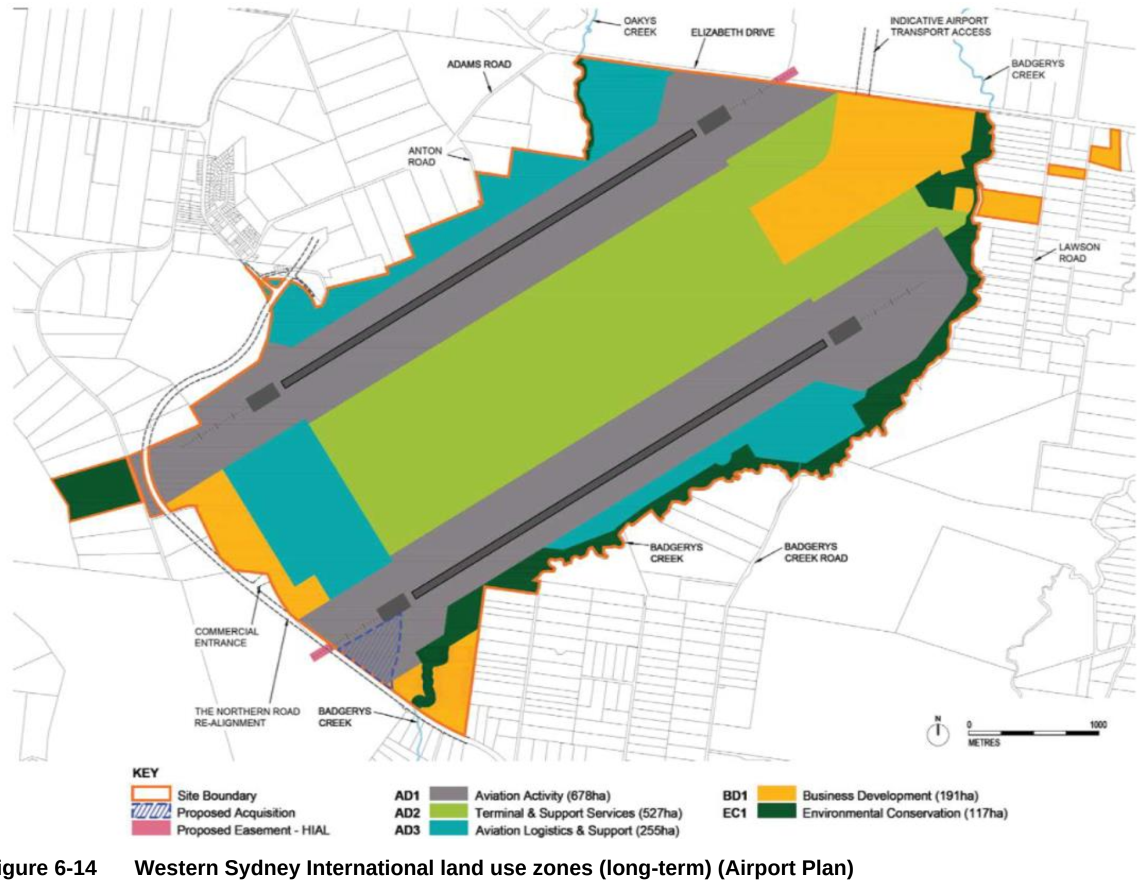


Figure 6-14 Western Sydney International land use zones (long-term) (Airport Plan)

6.12 Landscape and visual

As part of the construction of Stage 1 of Western Sydney International, substantial earthworks on the airport will transform the existing undulating landform of the site to a newly formed flat landscape to accommodate the airport infrastructure. While the majority of earthworks would be completed before construction of the proposed action, construction of airport infrastructure will be occurring when construction for the proposed action commences, subject to approval.

The future setting of Western Sydney International will be the environment of the airport site upon completion of construction (see Section 6.1.4).

There are currently broad panoramic views across the airport site from the Western Sydney International Airport Experience Centre and views to Badgerys Creek from rural areas to the south in Bringelly.

Outside of the airport site the landscape character can be divided into the area of Luddenham to the north of Elizabeth Drive and the area of Bringelly to the south east of Badgerys Creek.

Around Luddenham, the landscape is characterised by broad open rural grazing areas located on undulating terrain with patches of bushland and includes South Creek, Badgerys Creek, Cosgroves Creek and Oakey Creek. Key existing features include Luddenham Road, Twin Creeks residential estate, Elizabeth Drive and local heritage property McGarvie-Smith Farm.

South Creek and its tributaries are recognised as an important regional corridor for the proposed Western Parkland City under the *Greater Sydney Region Plan* and *Western City District Plan* and would be of regional landscape sensitivity.

Future development in this area includes the proposed transition from a rural landscape to intensive urban development and would include the future M12 Motorway, the Northern Gateway precinct which will provide future employment, research and knowledge-based employment.

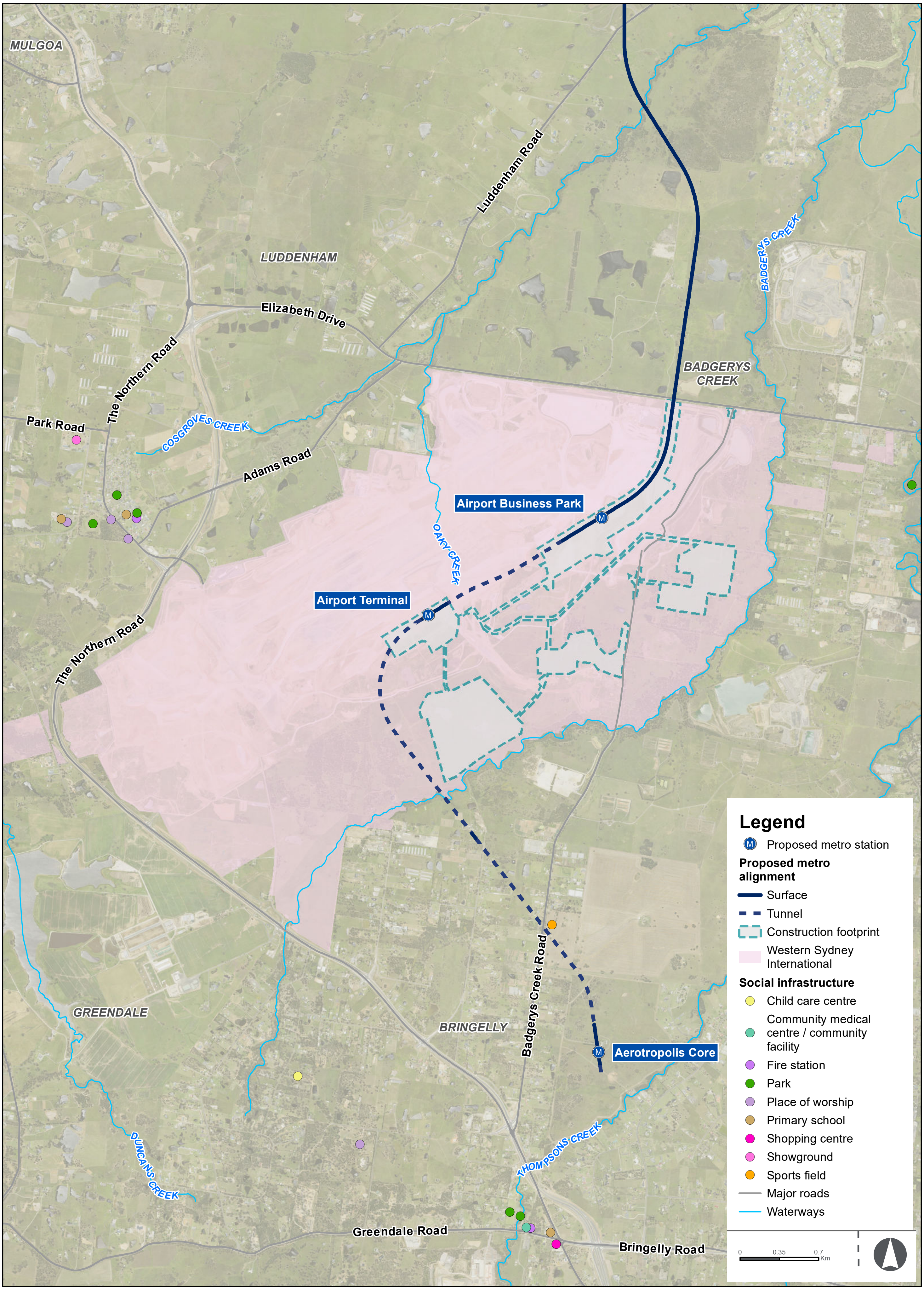
Around Bringelly, the landscape character area comprises mainly rural land with patches of mature bushland, detached dwellings and pockets of intensive agriculture. The Northern Road connects the southern areas of the City of Liverpool with the M4 Western Motorway and Penrith to the north and is currently being upgraded. Heritage listed properties located off-airport include the Kelvin Park Group property and the former Overseas Telecommunications Radio Station Complex.

The Bringelly landscape character area is intended to transition from a semi-rural landscape to intensive urban development to form part of the Aerotropolis Core precinct under the WSAP, with South Creek, Badgerys Creek and Thompsons Creek identified as part of the major open space network. The Bringelly landscape character area is intended to transition from a semi-rural landscape to intensive urban development to form part of the Aerotropolis Core precinct under the WSAP, with South Creek, Badgerys Creek and Thompsons Creek identified as part of the major open space network.

6.13 Social and economic

While Western Sydney International historically comprised a dispersed rural residential community, the land was vacated prior to commencement of airport construction, and as such there is currently no on-airport community. The proposed action would have broader social and economic effects on the future airport, associated future land uses within the airport site as well as areas beyond the airport site boundary (as described in Section 6.11). The social infrastructure surrounding the airport site is presented in Figure 6-15.

The northern portion of the airport site along Elizabeth Drive and Bringelly Road is currently undergoing extensive preparatory works associated with the construction of Stage 1 of Western Sydney International. There is also land outside of the Western Sydney International Stage 1 Construction Impact Zone which has not been cleared of vegetation, as well as an Environmental Conservation Zone along Badgerys Creek.



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Social infrastructure in the study area

Figure 6-15

The suburbs surrounding the airport (Luddenham, Bringelly and Badgerys Creek) are predominantly comprised of rural residential with large lots, and some agricultural and rural industries, including construction-related businesses. Sensitive receivers located near the airport environment are limited to rural residential receivers adjacent to the airport site north of Elizabeth Drive, to the east and south east of Badgerys Creek, to the west along Adams Road and to south of Northern Road.

The wider area surrounding the on-airport proposed action would be subject to urban growth and development as part of strategic planning for the Western Parkland City, including for the Western Sydney Aerotropolis and Greater Penrith to Eastern Creek Growth Investigation Area.

6.14 Air quality

The closest ambient air quality monitoring station in proximity to Western Sydney International is located at Bringelly (around three kilometres south east of the airport boundary). Given the proximity of the proposed action to the Bringelly monitoring station, the air quality in the existing airport environment is expected to be generally consistent with the existing conditions at this monitoring station as described below. Air quality monitoring is being undertaken by Western Sydney Airport in accordance with the *Western Sydney Airport Air Quality Construction Environmental Management Plan* (Western Sydney Airport, 2019c).

6.14.1 Meteorology

Seasonal wind patterns for Bringelly show predominantly south-southwest winds for autumn and winter, increased levels of wind from the east during spring and predominant stronger easterly winds during summer. The high proportion of calm winds suggests the potential for significant periods throughout the year where the ability of local winds to disperse particulates and other air pollutants is poor.

An analysis of the intraday wind patterns was undertaken by examining the wind roses for the 2014-2019 data for the time periods of 9am to 3pm, midnight to 7am, and 7am to 5pm (typical workday). The analysis showed the following:

- very high percentages of calm wind speed at night with calm percentages of approximately 45 per cent. This was very high compared to the daytime percentages which showed calm winds at Bringelly of 12 per cent respectively
- night-time wind direction was predominantly from a south to south-westerly direction, which is consistent with the expected wind direction at night due to the topography sloping down toward the north in the area
- winter and autumn patterns were broadly similar to the patterns observed during summer and spring with northerly, south-westerly and easterly winds dominating the wind patterns
- 9am and 3pm wind roses showed a similar pattern to the overall night-time and day-time calm percentages with approximately 20 per cent calm winds at 9am and very low calm wind percentages (less than five per cent) observed at 3pm.

6.14.2 Terrain

The project is situated within the Sydney basin approximately nine kilometres east of the Blue Mountains. The terrain is generally flat with minor topographical undulation along the length of the project alignment. Although the local relief surrounding the broader project area is minor and is not expected to influence the broad scale meteorology in the region, there are localised topographical effects that may influence low wind speed conditions. There is a decrease in elevation as the alignment moves north toward St Marys. This topographical feature has the potential to affect the area under low wind speed conditions with cool air following the low-lying topography toward the north.

6.14.3 Particulate matter

Annual air quality data for the period 2014-2019 (Office of Environment and Heritage, 2014-2019) indicates that annual average particulate matter $(PM)_{10}$ concentration around Bringelly ranges between 15.1 and 21.2 micrograms per cubic metre (see Table 6-27). There are a number of recorded exceedances of the 50 micrograms per cubic metre maximum 24-hour concentration criterion, however the exceedances are generally due to exceptional events related to bushfires, hazard reduction burns and dust storms.

Annual air quality data for the period 2016-2019 (Office of Environment and Heritage, 2016-2019) indicates that annual average $PM_{2.5}$ concentration around Bringelly is around 8 micrograms per cubic metre (see Table 6-28). There are a number of recorded $PM_{2.5}$ exceedances of the 25 micrograms per cubic metre maximum 24-hour concentration criterion. As with PM_{10} concentrations however, the $PM_{2.5}$ exceedances were generally due to exceptional events related to bushfires, hazard reduction burns and dust storms.

Particulate data from 2019 is heavily skewed by the bushfires that occurred across NSW in November and December 2019. Data from 2019 does not represent normal long-term air quality conditions in the Sydney basin.

Table 6-27 Bringelly monitoring location ambient PM_{10} concentrations (2014-2019)

Statistic	24-hour average PM_{10} concentration - $\mu g/m^3$						
	Criteria	2014	2015	2016	2017	2018	2019
Maximum 24-hour concentration	50	42.6	57.0	61.6	83.7	92.9	134.0
24-hour exceedance count	-	0	1	3	6	8	24
Statistic	**Annual average PM_{10} concentration - $\mu g/m^3$**						
	Criteria	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Annual Average	25	16.6	15.8	17.0	19.8	21.2	23.6

Table 6-28 Bringelly monitoring location ambient $PM_{2.5}$ concentrations (2016-2019)

Statistic	24-hour average $PM_{2.5}$ concentration - $\mu g/m^3$				
	Criteria	2016	2017	2018	2019
Maximum 24-hour concentration	25	21.6	52.5	55.6	178.0
24-hour exceedance count	-	0	2	4	27
Statistic	**Annual average PM_{10} concentration - $\mu g/m^3$**				
	Criteria	**2016**	**2017**	**2018**	**2019**
Annual Average	8	7.6	7.5	8.0	11.3

6.14.4 Existing and future air pollution sources

Existing air pollution sources include:

- emissions from vehicles using the surrounding road network including Elizabeth Drive and The Northern Road
- semi-rural industries
- various small scale agricultural activities.

Ongoing earthworks for Western Sydney International Stage 1 would influence the local air quality environment, as would the ongoing and planned large scale construction projects surrounding the airport site including The Northern Road and the future M12 Motorway (refer to Section 7.16).

The Western Sydney Airport - Environmental Impact Statement identified that during earthworks, predicted dust impacts would be at or below the project air quality assessment criteria. In relation to the future ambient air quality environment relevant to the proposed action, the operation of Western Sydney International would significantly influence the on-airport air quality environment.

The operation of aircraft at Western Sydney International would result in emissions of nitrogen dioxide, particulate matter, carbon monoxide, sulfur dioxide and other pollutants and would impact both the on-airport and off-airport environment. Western Sydney International Stage 1 would provide capacity for around 63,000 annual air traffic movements. Emissions would generally be within relevant criteria and an air quality monitoring would be undertaken as part of airport operations (Department of Infrastructure and Regional Development, 2016b).

6.14.5 Sensitive receivers

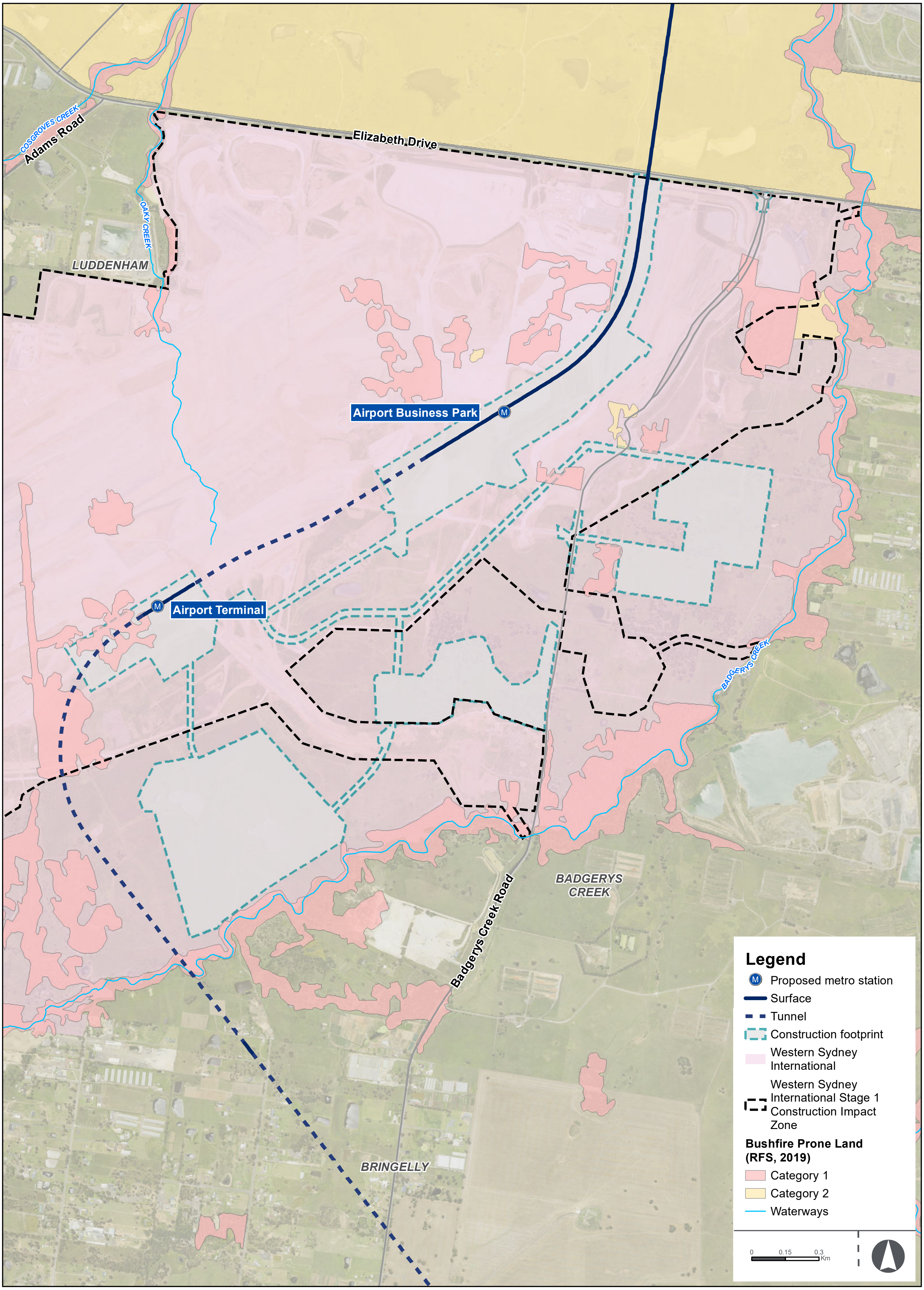
There are no sensitive residential receptors within the on-airport environment and limited sensitive receptors within the study area outside the on-airport environment. Air quality sensitive receivers are currently limited to semi-rural residential properties outside of the airport site.

Once operational, on-airport air quality sensitive receivers would be limited to commercial receivers (including employees and passengers) at the Airport Terminal and Airport Business Park.

6.15 Hazard and risk

The following potential hazards and risks are located within the airport environment:

- bushfire prone land is mapped within the airport site and broader area beyond the airport site as shown in Figure 6-16. This indicates that there are areas within Western Sydney International that are Category 1 (higher risk). The development of Western Sydney Airport Stage 1 would remove all vegetation within Western Sydney International Stage 1 Construction Impact Zone.
- power, communications and stormwater infrastructure
- contaminants associated with prior rural, commercial and light industrial land uses have been identified to be present at Western Sydney International (see Section 6.9.4) including asbestos in soil and localised areas of petroleum hydrocarbon and heavy metal contamination in soil
- health impacts (air and noise) and road safety hazards would be present in the context of existing construction activities at Western Sydney International. These are currently being managed in accordance with the relevant CEMPs (air quality, noise/vibration, traffic) for the development of Western Sydney International Stage 1
- operational hazards and risks at Western Sydney International which will be managed through the Airports Act, Airports (Protection of Airspace) Regulations 1996 (Cth) and *National Airports Safeguarding Framework*.



Bushfire prone land across the airport site

Figure 6-16

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7 Impact assessment

This chapter provides the assessment of potential impacts of the proposed action on each component of the environment described in Chapter 6 (Description of the existing environment).

The Commonwealth Environment Minister's environmental assessment requirements (Appendix B) does not prescribe any specific scope or methodology requirements in relation to assessment of the suggested components of the environment. Each section therefore describes the legislative framework, information sources and methodology used to inform the assessment.

7.1 Transport

This section assesses the potential impact on transport during the construction and operation of the proposed action. It identifies the potential nature and extent of impacts to transport services as a result of the proposed action. The transport assessment for the project is provided in *Sydney Metro – Western Sydney Airport, Transport Assessment* (Sydney Metro, 2020b).

7.1.1 Overview

Potential transport and traffic impacts of the project have been avoided and minimised, primarily by tunnelling underneath or bridging over key roads such as Luddenham Road, Elizabeth Drive and Badgerys Creek Road, identifying the most efficient haul route to the arterial road network and minimising movements during existing network peak periods. The management of construction traffic would be in accordance with the Construction Traffic Management Framework (refer Appendix E) and site specific mitigation measures. This includes measures to manage pedestrian, cyclist and motorist safety around construction sites.

There may be some potential temporary impacts to traffic performance on the road network due to the temporary addition of construction vehicles and temporary road closures as a result of the project. In general, most of the network near Western Sydney International would continue to perform at an acceptable level of service.

Cumulative temporary transport impacts may also be experienced where the same haul routes are concurrently used for the construction of the future M12 Motorway and Western Sydney International. Sydney Metro would consult with these projects to ensure these cumulative impacts are effectively managed.

Once operational, the Airport Terminal and Airport Business Park Stations would integrate seamlessly with the surrounding precincts within the airport. At the airport stations, walking and cycling networks would be developed as part of Western Sydney International. As part of the *Western Sydney City Deal* (NSW Government, 2018), the Australian and NSW Governments have committed to delivering new rapid bus routes to link the metropolitan centres of Penrith, Liverpool and Campbelltown to the Western Sydney Aerotropolis and Western Sydney International.

The combined effects of the provision of the metro service, increases in the number of bus services and enhancements to the walking and cycling facilities are likely to reduce car dependency and minimise the impacts to the study area road network.

7.1.2 Legislative and policy context

Relevant legislation, policy, guidelines and standards that were considered in the traffic assessment included:

- *Airports Act 1996* (Cth) (Airports Act)
- *Western Sydney Airport – Airport Plan* (Airport Plan) (Department of Infrastructure and Regional Development, 2016a)
- Australian Standards 2009, AS1742.3 Traffic Control for works on roads
- Austroads 2017, Guide to Traffic Management Part 3: Traffic Studies and Analysis

- Traffic Modelling Guidelines (Transport for NSW, 2013)
- Traffic control at work sites manual (Transport for NSW, 2018)
- Construction Traffic Management Framework (Appendix E)
- Western Sydney Airport Traffic and Access Construction Environmental Management Plan (Western Sydney Airport, 2019h).

7.1.3 Assessment methodology

Study area

For the purpose of the transport assessment, a transport study area (see Figure 7-1) was determined based on the potential impacts of the proposed action on the existing and future road and public transport network in the areas within and surrounding the airport site during the construction and operational phases of the proposed action. These roads include Elizabeth Drive, Badgerys Creek Road, The Northern Road, Luddenham Road and Adams Road.

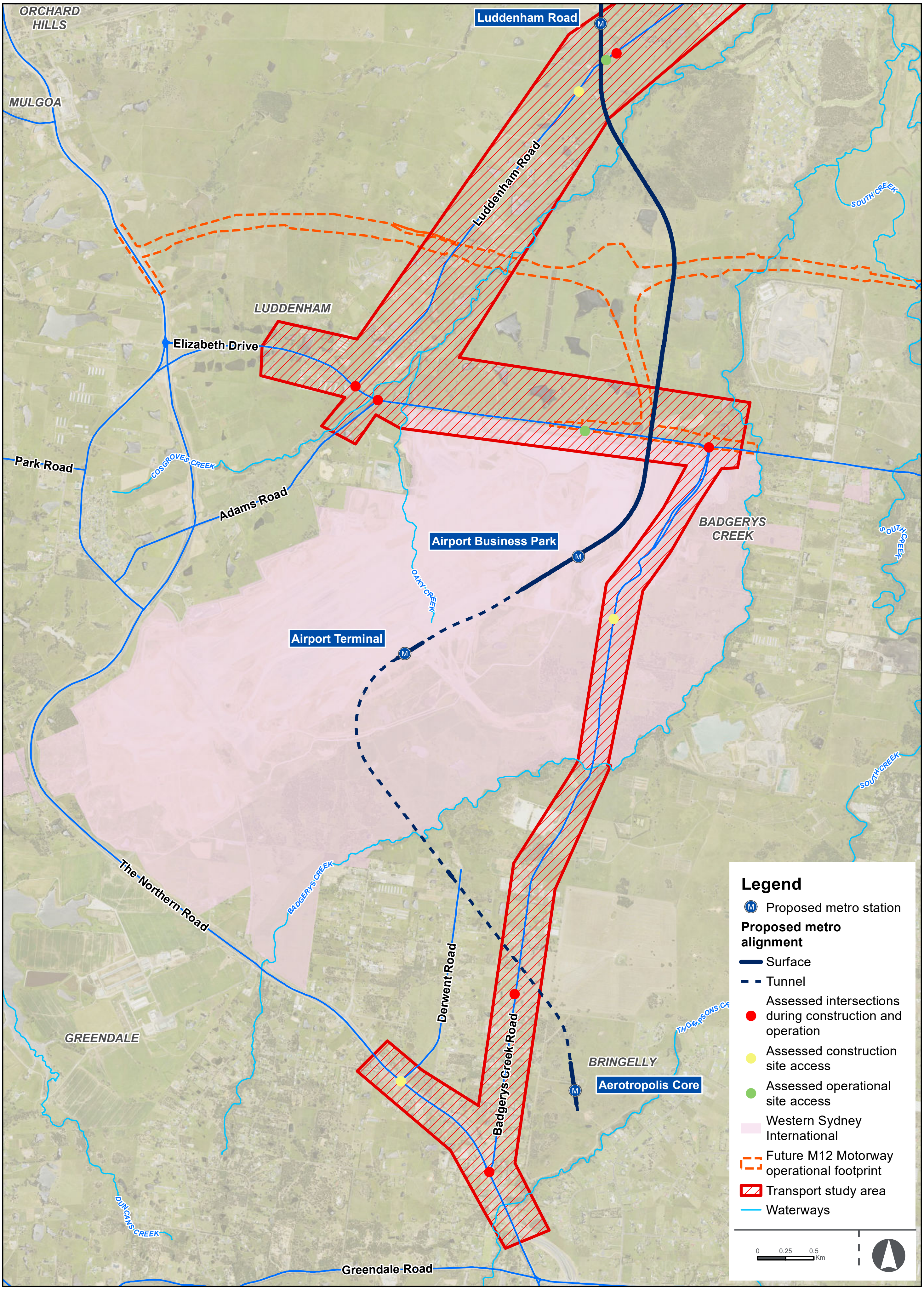
Figure 7-1 also indicates the locations of the intersections that were modelled as part of the transport environment.

General methodology

The assessment considered the impact on the road network from combined traffic generated by the on-airport and off-airport components of the project during both the construction and operational phases.

The assessment of potential transport impacts involved:

- reviewing the project design (including proposed indicative construction methodology)
- reviewing existing road features, traffic, transport services, pedestrian and cyclist facilities, and available traffic data
- identification of the existing traffic and transport conditions in the study area
- assessment of the potential road-based impacts on public transport and general traffic caused by the construction and operational scenarios. The assessment included consideration of potential cumulative construction impacts from other major infrastructure projects being delivered in the study area. The assessment also included a review of the forecast road-based public transport mode share at the proposed station precincts and its potential impacts on the capacity of the future network
- a qualitative assessment of potential impacts to the pedestrian and cycling transport network during the construction and operational scenarios. The assessment also included a review of transport integration at each station and assessment of the potential transport impacts during the operational scenarios
- identification of performance outcomes and mitigation measures to manage the potential impacts on transport.



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Traffic, transport access study area and local context

Figure 7-1

Assessment scenarios

Base year scenario

A 2019 network base year peak hour was adopted for the base year assessment scenario.

Construction scenarios

Assessment of the potential transport and traffic impacts during construction considered two scenarios:

- 2023/2024 without construction traffic
- 2023/2024 with construction traffic.

The assessment of the 2023/2024 without construction traffic scenario was informed by outputs from the WestConnex Road Toll Model (WRTM) prepared for the Environmental Impact Statement for the future M12 Motorway.

Construction traffic from the future M12 Motorway and Western Sydney International have also been considered as part of the cumulative impact assessment (refer to Section 7.16).

Operational scenarios

Assessment of the potential transport impacts during operation of the project considered future scenarios for 2026 and 2036 with and without the project. Consistent with the methodology used to assess the construction impacts, the assessment of the future operational years without the project was informed by outputs from the WRTM modelling.

The distribution of light vehicles arriving and departing at each proposed station precinct was guided by the existing traffic distribution, precinct location, proposed future developments and the proposed location of transport facilities. These road-based traffic volumes included park and ride, kiss-and-ride, point-to-point services and bus movements.

The transport operational assessment includes the integration of the project with the proposed station precincts including walking and cycling facilities proposed by others.

The assessment of the 2026 and 2036 future year with and without the project scenarios considers future road upgrades as well as the operation of Western Sydney International, future M12 Motorway and other projects within the transport study area. As a result, this assessment also represents the cumulative operational assessment.

An overview of the modelling methodology and scenarios considered is provided in Figure 7-2.

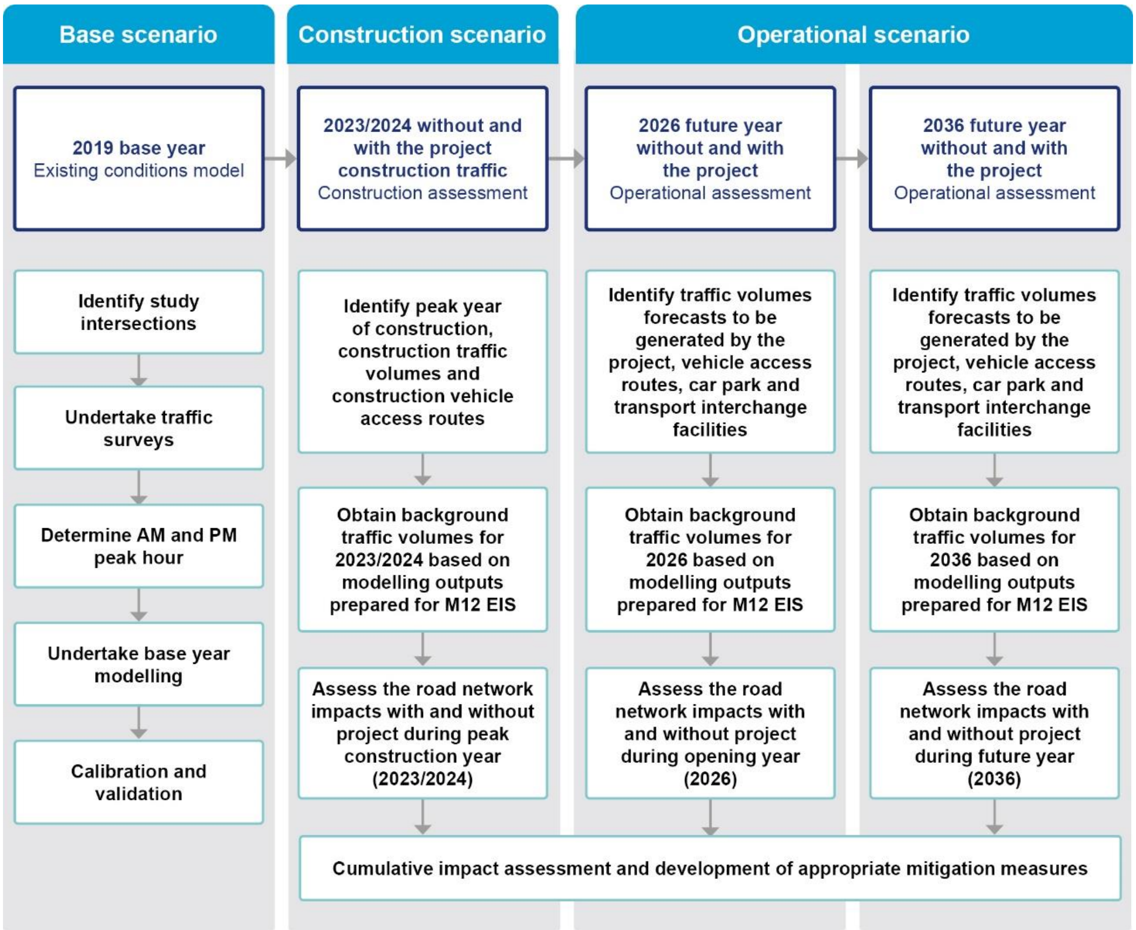


Figure 7-2 Summary of modelling methodology and assessment scenarios

Assessment criteria

Performance of the road network can be assessed in several ways, including at a mid-block level, showing the changes in traffic volumes or to travel routes, or at an intersection level, showing changes to the performance of an intersection.

Mid-block performance

Analysis of mid-block Level of Service (LoS) was conducted based on criteria set out for arterial and collector roads by the *Austroads Guide to Traffic Management – Part* 3. LoS may range from LoS A to LoS F. LoS A refers to primarily free flow operations at average travel speeds. Vehicles are completely unimpeded in their ability to manoeuvre within the traffic stream. LoS C is generally considered satisfactory and LoS F is an interrupted flow with urban street flow at extremely low speeds, with high delays, high volumes and extensive queuing. For the assessment of mid-block performance, LoS E is close to capacity and LoS F is considered at or above capacity.

Intersection performance

The operation of the key intersections within the study area was assessed using Signalised & unsignalised Intersection Design and Research Aid (SIDRA) INTERSECTION 8, a computer-based modelling package that calculates intersection performance. The commonly used measure of intersection performance, as defined by Transport for NSW, is vehicle delay. SIDRA INTERSECTION 8 determines the average delay that vehicles encounter and provides a measure of the LoS.

Similar to mid-block performance, intersection performance may range from LoS A indicating good operation to LoS F indicating an intersection that is over capacity involving extreme delays. For the assessment of intersection performance, LoS E is generally considered close to or at capacity and LoS F as operating above capacity.

7.1.4 Potential impacts – construction

Potential temporary construction impacts of the proposed action on the road network, pedestrian and cycling networks and the public transport network are described in the following sections.

Road network performance

Internal construction vehicle movements to/from the construction sites within Western Sydney International would be managed in coordination with Western Sydney Airport, Transport for NSW and their respective contractors for the development of the Western Sydney International and the future M12 Motorway. Some construction trucks would require the use of internal construction routes also used for the construction of Western Sydney International. As such traffic management measures would need to be developed in consultation with Western Sydney Airport to manage access to construction sites as well as the cumulative construction impacts.

During the peak construction scenario in 2023/2024, construction works for the airport would still be progressing. As such, public access to the airport would be restricted, and potential transport related impacts would be limited.

It is expected that construction vehicle movements would be planned in conjunction with the airport construction works as per the guidelines included in the Construction Traffic Management Framework (CTMF) (Appendix E).

The Traffic and Transport Liaison Group (TTLG) would be established to coordinate, manage and minimise transport impacts during construction and would include Western Sydney Airport, Transport for NSW, local councils, emergency services and other stakeholders. Development of the traffic management measures will be carried out in consultation with the TTLG.

Construction traffic movements within Western Sydney International would also affect the performance of the surrounding road network and intersections located off-airport. This includes roads such as Elizabeth Drive, Badgerys Creek Road, The Northern Road, Luddenham Road and Adams Road. The impacts due to construction activities proposed were assessed by looking at both mid-block and intersection performance.

Mid-block performance

An assessment of the weekday AM peak and PM peak hour traffic volumes was completed to determine the general performance of the road network during the peak construction year without and with project construction. The findings of this assessment are summarised in Table 7-1.

In summary, the assessment indicates that the sections of Luddenham Road and Elizabeth Drive are forecast to operate at or above theoretical capacity during the peak construction year without the addition of construction traffic generated by the project.

The following sections of the road network are forecast to operate at or above theoretical capacity due to the temporary addition of construction traffic to be generated by the project:

- Luddenham Road north of Elizabeth Drive (southbound) would change from LoS E to LoS F during the PM peak
- Elizabeth Drive west of Badgerys Creek Road (westbound) would change from LoS D to LoS E during the PM peak
- Elizabeth Drive east of Badgerys Creek Road (eastbound) would change from LoS D during the AM peak and LoS C during the PM peak to LoS E during the AM and PM peaks
- Badgerys Creek Road north of The Northern Road would change from LoS C (northbound) during AM peak and LoS C (southbound) during the PM peak to LoS F (northbound) during the AM peak and (southbound) during the PM peak
- The Northern Road east of Badgerys Creek Road would change from LoS D (northbound) during the AM peak and LoS C (southbound) during the PM peak to LoS F during those times.

The potential impacts forecast along these roads are temporary and due to construction vehicle movements accessing both the on-airport and off-airport construction sites. A conservative assessment has been undertaken whereby all tunnel and other spoil generated by the proposed action is expected to be transported by road to disposal sites located outside the airport site. However, it is anticipated that the use of the potential permanent spoil placement areas within Western Sydney International to reuse up to 1.9 million cubic metres of tunnel spoil is likely to reduce impacts on the road network.

Intersection performance

Construction traffic movements within Western Sydney International would temporarily affect the intersection performance of surrounding intersections located off-airport. A summary of the performance of intersections within the transport study area in the peak periods during the peak construction year and with construction traffic is summarised in Table 7-2.

The assessment identified that all intersections expected to be impacted by the on-airport construction activities are forecast to perform satisfactorily with acceptable delays and spare capacity during future year conditions in 2024 without construction. During the peak year with construction scenario, intersections likely to be temporarily impacted by the construction activities planned in the on-airport environment are forecast to operate at a LoS D or better.

Pedestrian and active transport impacts

During the peak year of construction of the project, the airport is forecast to be under construction and as such active transport links are not anticipated to exist within Western Sydney International. No impacts to pedestrian and active transport networks are therefore expected within and adjacent to the on-airport environment during construction.

Public transport impacts

During the peak year of construction of the project, the airport is forecast to be under construction and as such public transport services are not forecast to be operational within the on-airport environment. No impacts to public transport networks are therefore expected within the airport site during construction.

Outside of the airport site the road-based public transport modes are likely to be impacted in the same way as general traffic.

Table 7-1 2023/2024 peak construction year mid-block performance

Location	Direction	Theoretical capacity (pcu/h)	AM Peak				PM Peak			
			Future year without construction scenario		Future year with construction scenario		Future year without construction scenario		Future year with construction scenario	
			Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS
Luddenham Road (north of Elizabeth Drive)	NB	900	1080	F	1280	F	590	C	660	C
	SB	900	300	A	370	**B**	860	E	1070	**F**
Elizabeth Drive (west of Badgerys Creek Road)	EB	900	560	C	720	**D**	580	C	680	**D**
	WB	900	690	D	790	D	730	D	880	**E**
Elizabeth Drive (east of Badgerys Creek Road)	EB	900	770	D	840	**E**	620	C	850	**E**
	WB	900	930	F	1160	F	1000	F	1070	F
Badgerys Creek Road (south of Elizabeth Drive)	NB	900	420	B	510	**C**	380	B	690	**D**
	SB	900	440	B	750	**D**	610	C	710	**D**
Badgerys Creek Road (north of The Northern Road)	NB	900	500	C	1320	**F**	340	B	440	B
	SB	900	280	A	400	**B**	550	C	1370	**F**
The Northern Road (west of Badgerys Creek Road)	NB	1900	880	B	960	**C**	770	B	840	B
	SB	1900	1100	C	1170	C	1100	C	1180	C
The Northern Road (east of Badgerys Creek Road)	NB	1900	1550	D	2330	**F**	1380	C	1440	**D**
	SB	1900	1110	C	1180	C	1260	C	2040	**F**

Notes:

1. Assessments have been undertaken using SIDRA INTERSECTION 8.
2. Traffic volumes have been rounded to the nearest 10.
3. Peak hour construction traffic forecast to be generated by the project from each construction site have been distributed as per assumptions stated above and added to the forecast future year network traffic without the project.

Table 7-2 2023/2024 peak construction year intersection performance

Intersection	AM Peak				PM Peak			
	Future year without construction scenario		Future year with construction scenario		Future year without construction scenario		Future year with construction scenario	
	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)
Luddenham Road/Station Site Access West (P)	-	-	42	C	-	-	34	C
Luddenham Road/Station Site Access East (P)	-	-	50	D	-	-	47	D
Luddenham Road/Elizabeth Drive (P)	10	A	15	**B**	12	A	16	**B**
Elizabeth Drive/Adams Road (P)	9	A	13	A	16	B	32	**C**
Elizabeth Drive/Badgerys Creek Road (R)	13	A	17	**B**	14	A	28	**B**
Badgerys Creek Road/Badgerys Creek Site Access (R)	-	-	33	C	-	-	36	C
Badgerys Creek Road/Aerotropolis Site Access (P)	-	-	43	D	-	-	42	C
Badgerys Creek Road/The Northern Road (S)	34	C	53	**D**	28	B	32	**C**
The Northern Road/Derwent Road (S)	6	A	7	A	6	A	6	A

Notes:

1. Assessments have been undertaken using SIDRA INTERSECTION 8.
2. Peak construction traffic likely to be generated in 2023 by the construction sites north of Elizabeth Drive have been used for the assessments. For all other construction sites, peak construction traffic forecast in 2024 have been used for the assessments.
3. For traffic signals, the average movement delay and level of service over all movements is used. For roundabouts and priority control intersections (with stop and give way signs), the critical movement for level of service assessment with the worst movement delay is used.
4. The intersection of Kent Road/Lansdowne Road experiences the worst movement delay for through traffic approaching from the west on Lansdowne Road during the 2023 base scenario due to low traffic volumes (less than 5 veh/hr). However, the delay is not representative of the overall intersection performance. Therefore, the movement that corresponds to the next highest delay is reported here to provide an indication of the intersection performance.
5. Dashes indicate new construction site accesses that would only be constructed and used by construction vehicles and hence would not exist during the future year scenario without construction.
6. Intersection control type as indicated against each (P: Priority-controlled, R: Roundabout, S: Signalised)

7.1.5 Potential impacts – operation

Integration with other transport modes

The operational assessment for the on-airport station precincts was based on the demands, characteristics, access modes and station and precinct design plans for each of the planned stations.

The modal access hierarchy for the Airport Business Park Station would include all modes. A pedestrian bridge would link the station to the future road network of the business park (to be provided as part of the airport construction).

The Airport Terminal Station would be the main connection between the Project and the future airport terminal. Customer access would primarily be provided via an airport terminal connection with Western Sydney International (to be provided as part of the airport construction). Other interchange opportunities including bus stops would be provided by others as part of the wider development of the precinct and are outside the scope of this Project.

The forecast mode shares for point-to-point services, park and ride and kiss and ride are low for the Airport Business Park Station, as these modes would be provided as part of the development of Western Sydney International and the business park. The Airport Terminal station is not expected to have mode shares associated with private car-based trips accessing the station. As such, these stations are expected to introduce limited traffic demand once operational.

Future year 2026 with the project

The potential impacts on the transport network within the airport for the future year 2026 are forecast to be minimal as the majority of the passengers using the proposed stations within the on-airport environment are expected to be generated by Western Sydney International or the Airport Business Park (and are therefore not arriving at the stations by car).

During the future year 2026 with the project scenario, the transport movements generated by the project within the on-airport environment are considered to be negligible compared to the future background traffic without the project. The forecast mode shares for point-to-point services, park and ride and kiss-and-ride provided at the on-airport sites in 2026 are limited. As such, these stations are expected to generate limited traffic once operational.

Operational traffic movements generated from within Western Sydney International would also affect the performance of the road network and surrounding intersections located off-airport. This includes roads such as Elizabeth Drive, Badgerys Creek Road, The Northern Road, Luddenham Road and Adams Road. These impacts are discussed below.

Road network performance

<u>Mid-block performance</u>

An assessment of the weekday AM and PM peak hour traffic volumes was completed to determine the general performance of the in the vicinity of Western Sydney International in the 2026 future year. This includes roads such as Luddenham Road, Elizabeth Drive, Badgerys Creek Road and The Northern Road. The findings of this assessment are summarised in Table 7-3.

During the without project scenario in 2026, a number of roads are forecast to operate near or at the theoretical capacity including Luddenham Road north of Elizabeth Drive, Elizabeth Drive east of Badgerys Creek Road and The Northern Road east of Badgerys Creek Road.

During the with project scenario, the following roads are forecast to operate near or at the theoretical capacity in 2026:

- Luddenham Road north of Elizabeth Drive at a LoS F (northbound) during the AM peak and LoS F (northbound and southbound) during the PM peak (no change in LoS with and without project)
- Elizabeth Drive east of Badgerys Creek Road (westbound) at a LoS F during the AM and PM peak (no change in LoS with and without project)
- The Northern Road, east of Badgerys Creek Road (northbound) at a LoS E during the AM peak. (no change in LoS with and without project)

The assessment indicates that the project scenario is not forecast to cause significant impacts to the study area road network compared with the without project scenario.

The combined effects of the provision of the metro service, increases in the number of bus services and enhancements to the walking and cycling facilities are likely to reduce car dependency and minimise the impacts to the study area road network.

Intersection performance

A summary of the performance of the intersections within the transport study area during the AM and PM peak hours during the future year 2026 with the project scenario is outlined in Table 7-4.

For the without project scenario, the majority of the intersections operate at a LoS D or better, except for the intersection of Badgerys Creek Road/The Northern Road which operates at LoS F in the AM peak.

During the with project scenario in 2026, Table 7-4 indicates that all intersections are forecast to maintain their operational performance with the addition of project generated traffic. The Badgerys Creek/The Northern Road intersection continues to operate at LoS F, with a minor increase in delay (about three seconds). This indicates that the project would not cause any additional impacts to this intersection during the future year 2026.

Pedestrian and cyclist impacts

The active transport network within the airport site for the future year 2026 is proposed to be developed by Western Sydney Airport. It is envisaged that safe, convenient and direct active transport connections would be provided within Western Sydney International including to the Airport Terminal and Airport Business Park stations (to be developed by others).

The active transport network outside of the airport site for the future year 2026 is expected to include pedestrian and cycling infrastructure proposed as part of the future M12 Motorway and The Northern Road and Bringelly Road upgrade projects. Transport for NSW also proposes to provide walking and cycling links along Elizabeth Drive as part of proposed upgrades. These active transport links would significantly improve the walking and cycling environment in the vicinity of Western Sydney International, therefore increasing the active transport mode share to the airport.

Public transport impacts

The road-based public transport modes are likely to be impacted in the same way as general traffic.

As part of the Western Sydney City Deal, the Australian and NSW Governments have committed to delivering new rapid bus routes to link the metropolitan centres of Penrith, Liverpool and Campbelltown to the Western Sydney Aerotropolis and Western Sydney International.

Table 7-3 Future year 2026 mid-block performance

Location	Direction	Theoretical capacity (pcu/h)	AM Peak				PM Peak			
			Without project		With project		Without project		With project	
			Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS
Luddenham Road (north of Elizabeth Drive)	NB	900	1310	F	1340	F	730	D	760	D
	SB	900	340	B	380	B	980	F	1000	F
Elizabeth Drive (west of Badgerys Creek Road)	EB	2800	490	A	510	A	610	A	630	A
	WB	2800	730	A	760	A	730	A	750	A
Elizabeth Drive (east of Badgerys Creek Road)	EB	900	690	D	720	D	640	C	700	**D**
	WB	900	1030	F	1100	F	1030	F	1050	F
Badgerys Creek Road (south of Elizabeth Drive)	NB	1900	410	A	440	A	430	A	490	A
	SB	1900	510	A	580	A	700	B	730	B
Badgerys Creek Road (north of The Northern Road)	NB	900	550	C	610	C	390	B	430	B
	SB	900	300	A	350	**B**	610	C	680	**D**
The Northern Road (west of Badgerys Creek Road)	NB	1900	1340	C	1350	C	1290	C	1320	C
	SB	1900	750	B	780	B	720	B	720	B
The Northern Road (east of Badgerys Creek Road)	NB	1900	1840	E	1880	E	1600	D	1610	D
	SB	1900	1000	C	1010	C	1260	C	1260	C

Note: Traffic volumes rounded to the nearest 10
Source: Traffic volumes used for the assessments was informed by the outputs of the WRTM modelling developed for the M12 Motorway Environmental Impact Statement

Table 7-4 Future year 2026 intersection performance

Intersection	AM Peak				PM Peak			
	Without project		With project		Without project		With project	
	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)
Luddenham Road/Station Access (North) (S)	-	-	11	A	-	-	11	A
Luddenham Road/Station Access (South) (S)	-	-	11	A	-	-	9	A
Luddenham Road Station Car park Access (P)	-	-	6	A	-	-	6	A
Luddenham Road/Elizabeth Drive/Adams Road (S)	29	C	29	C	52	D	54	D
Elizabeth Drive/Western Sydney International Access (S)	15	B	15	B	16	B	13	B
Elizabeth Drive/Badgerys Creek Road (S)	13	B	13	B	13	B	16	B
Badgerys Creek Road/Aerotropolis Core Station Access (S)	-	-	13	A	-	-	12	A
Aerotropolis Car park Access (P)	-	-	6	A	-	-	6	A
Badgerys Creek Road/The Northern Road (S)	>100	F	>100	F	28	B	28	B

Notes:

1. Assessments have been undertaken using SIDRA INTERSECTION 8.
2. For traffic signals, the average movement delay and level of service over all movements is used. For roundabouts and priority control intersections (with stop and give way signs), the critical movement for level of service assessment with the worst movement delay is used.
3. The intersection of Kent Road/Lansdowne Road experiences the worst movement delay for through traffic approaching from the west on Lansdowne Road during the without project scenario due to low traffic volumes (less than 5 veh/hr). However, the delay is not representative of the overall intersection performance. Therefore, the movement that corresponds to the next highest delay is reported here to provide an indication of the intersection performance.
4. Dashes indicate new operational site accesses that would only be used once the project is operational and hence would not exist during the future year 2026 without the project scenario.
5. Intersection control type as indicated against each (P: Priority-controlled, R: Roundabout, S: Signalised)

Future year 2036 with the project

The potential impacts of the project on the transport network within the airport for the future year 2036 are forecast to be minimal as the majority of the passengers using the proposed stations within the on-airport environment are expected to be generated by Western Sydney International or the Airport Business Park (and are therefore not arriving at the stations by car).

During the future year 2036, the transport movements generated by the project within the on-airport environment are negligible compared to the future background traffic without the project. The forecast mode shares for point-to-point services, park and ride and kiss-and-ride provided at the on-airport sites in 2036 are limited. As such, these stations are expected to generate limited car traffic demand once operational. As a result, the project is not forecast to have an impact on the proposed transport network within the on-airport environment.

Operational traffic movements generated from within Western Sydney International would also affect the performance of the road network and surrounding intersections located off-airport. This includes roads such as Elizabeth Drive, Badgerys Creek Road, The Northern Road, Luddenham Road and Adams Road. These impacts are discussed below.

Road network performance

<u>Mid-block performance</u>

An assessment of the weekday AM peak and PM peak hour traffic volumes was completed to determine the general performance of the road network in the vicinity of Western Sydney International in the 2036 future year. This includes roads such as Luddenham Road, Elizabeth Drive, Badgerys Creek Road and The Northern Road. The findings of this assessment are summarised in Table 7-5.

During the without project scenario in 2036, a number of roads are forecast to operate near or at the theoretical capacity including:

- Luddenham Road north of Elizabeth Drive
- Elizabeth Drive east of Badgerys Creek Road, and The Northern Road both west and east of Badgerys Creek Road.

A number of road infrastructure projects are being delivered and proposed under the *Western Sydney Infrastructure* Plan (Department of Infrastructure and Regional Development, 2018c) that aim to address road congestion in the study area and are discussed in Section 7.16.

Table 7-5 indicates that the following roads are forecast to operate near or at the theoretical capacity during the with project scenario in 2026 as follows:

- Luddenham Road north of Elizabeth Drive at a LoS F and LoS E (northbound and southbound respectively) during the AM peak and LoS E and LoS F (northbound and southbound respectively) during the PM peak (the intersection would be at or near capacity during without project scenario).
- Elizabeth Drive east of Badgerys Creek Road (eastbound and westbound) at a LoS F during both peak hours (no change in LoS with and without the project)
- The Northern Road west of Badgerys Creek Road (northbound) at a LoS F during the AM peak (no change in LoS with and without the project)
- The Northern Road east of Badgerys Creek Road (southbound) at a LoS E during the PM peak (no change in LoS with and without the project).

During the 2036 future year with project scenario, these roads continue to operate in a similar manner to the without the project scenario, at or above their theoretical capacity and in a similar manner to the future year 2026 without project scenario.

<u>Intersection performance</u>

A summary of the performance of the intersections within the transport study area in the peak hours during the future year 2036 is outlined in Table 7-6.

Table 7-6 indicates that during the future year 2036 without project scenario, intersections generally operate at a LoS D or better, except for the intersection of Badgerys Creek Road/The Northern Road which operates at LoS F in the AM peak.

The assessment indicates that this intersection is forecast to operate at or above capacity in 2036 due to the forecast growth in background traffic within the transport study area. This is likely to result in significant delays and queuing at this intersection during the AM peak.

During the with project scenario in 2036, all intersections within the vicinity of Western Sydney International are forecast to operate at LoS D or better. This indicates that the addition of traffic forecast to be generated by the project is not forecast to significantly impact the transport study area intersections.

The only exception is the intersection of Badgerys Creek Road/The Northern Road which is forecast to operate at LoS F in the AM peak, similar to the without project scenario. The increase in average delay at this intersection due to the addition of traffic generated by the project is forecast to be around 10 seconds.

Active transport impacts

The on-airport active transport network for the future year 2036 with project scenario is proposed to be developed by Western Sydney Airport. It is envisaged that safe, convenient and direct active transport connections would be provided within Western Sydney International including to the Airport Terminal and Airport Business Park stations (both to be developed by others).

Public transport impacts

The road-based public transport modes are likely to be impacted in the same way as general traffic.

As part of the Western Sydney City Deal, the Australian and NSW Governments have committed to delivering new rapid bus routes to link the metropolitan centres of Penrith, Liverpool and Campbelltown to the Western Sydney Aerotropolis and Western Sydney International.

Table 7-5 Future year 2036 mid-block performance

Location	Direction	Theoretical capacity (pcu/h)	AM Peak				PM Peak			
			Without project		With project		Without project		With project	
			Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS	Volumes (pcu/h)	LoS
Luddenham Road (north of Elizabeth Drive)	NB	900	930	F	990	F	810	E	850	E
	SB	900	780	D	850	**E**	1020	F	1080	F
Elizabeth Drive (west of Badgerys Creek Road)	EB	2800	1430	C	1470	C	1280	B	1320	B
	WB	2800	1020	B	1070	B	1690	C	1740	C
Elizabeth Drive (east of Badgerys Creek Road)	EB	900	1450	F	1520	F	1440	F	1560	F
	WB	900	1280	F	1410	F	1760	F	1830	F
Badgerys Creek Road (south of Elizabeth Drive)	NB	1900	140	A	220	A	330	A	450	A
	SB	1900	370	A	510	A	230	A	300	A
Badgerys Creek Road (north of The Northern Road)	NB	900	120	A	260	A	220	A	270	A
	SB	900	230	A	310	A	370	B	500	**C**
The Northern Road (west of Badgerys Creek Road)	NB	1900	2090	F	2130	F	1210	C	1280	C
	SB	1900	920	B	990	**C**	1590	D	1590	D
The Northern Road (east of Badgerys Creek Road)	NB	1900	1230	C	1300	C	940	B	980	**C**
	SB	1900	1180	C	1220	C	1840	E	1840	E

Note: Traffic volumes rounded to the nearest 10

Table 7-6 Future year 2036 intersection performance

Intersection	AM Peak				PM Peak			
	Without project		With project		Without project		With project	
	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)	Average Delay (sec)	Level of Service (LoS)
Luddenham Road/Station Access (North) (S)	-	-	12	A	-	-	13	A
Luddenham Road/Station Access (South) (S)	-	-	12	A	-	-	12	A
Luddenham Road Station Car park Access (P)	-	-	6	A	-	-	6	A
Luddenham Road/Elizabeth Drive/Adams Road (S)	30	C	31	C	54	D	49	D
Elizabeth Drive/Western Sydney International Access (S)	13	B	13	B	18	B	19	B
Elizabeth Drive/Badgerys Creek Road (S)	11	B	13	B	15	B	18	B
Badgerys Creek Road/Aerotropolis Core Station Access (S)	-	-	21	B	-	-	19	B
Aerotropolis Car park Access (P)	-	-	6	A	-	-	6	A
Badgerys Creek Road/The Northern Road (S)	>100	F	>100	F	34	C	35	C

Notes:

1. Assessments have been undertaken using SIDRA INTERSECTION 8.
2. For traffic signals, the average movement delay and level of service over all movements is used. For roundabouts and priority control intersections (with stop and give way signs), the critical movement for level of service assessment with the worst movement delay is used.
3. Dashes indicate new operational site accesses that would only be used once the project is operational and hence would not exist during the future year 2036 without the project scenario.
4. Intersection control type as indicated against each (P: Priority-controlled, R: Roundabout, S: Signalised).
5. The intersection of Kent Road/Lansdowne Road is a priority controlled intersection during without the project scenario. During with the project, this intersection is proposed to be upgraded to a signalised intersection

7.2 Noise and vibration

This section assesses the potential noise and vibration impacts during the construction and operation of the proposed action. The noise and vibration assessment for the project is provided in *Sydney Metro – Western Sydney Airport, Noise and Vibration Assessment* (Sydney Metro, 2020c).

7.2.1 Overview

Construction noise and vibration would be managed in accordance with the Construction Noise and Vibration Standard (Appendix F) which provides standard mitigation measures and additional mitigation measures for certain noise and vibration impact levels. Site specific mitigation measures have also been identified to reduce noise and vibration impacts, including potential for acoustic sheds to be installed. An Operational Noise and Vibration Review would be undertaken as the design develops to ensure that the proposed action does not result in significant operational noise and vibration impacts.

The environment in areas surrounding the airport site is undergoing substantial planned urban growth associated with the Western Sydney Aerotropolis and broader Western Parkland City. Projects either currently approved or planned, such as the Western Sydney International and the future M12 Motorway, together with the proposed action (and broader Sydney Metro-Western Sydney Airport project), will substantially change the existing noise environment. Changes to the noise environment from these projects would include increased road and rail transport, aircraft noise and residential and other urban development.

Where receivers are close to construction sites or where the existing background noise levels are low (such as at the rural environments of Luddenham and Bringelly), the noise impacts during some of the works are expected to temporarily be ‘high’, particularly where noise intensive equipment such as concrete saws, concrete vibrators or hydraulic hammers are in use close to receivers.

Realistic worst-case and typical scenarios for noise emissions from construction have been assessed. The realistic worst-case scenarios include noisiest equipment working within the equipment work area, operating at 100 per cent duty for the 15 minute assessment period. The typical case scenarios include all equipment assessed as working within the equipment work area, operating over a proportion of the 15 minute assessment period based on the expected utilisation.

During construction, construction noise levels could significantly impact the closest receivers, predominantly during standard hours, with limited exceedances during out-of-hours works. These impacts include exceedance of noise management levels (NMLs), and potential sleep disturbance and awakening. Where exceedances have been predicted to occur during the worst case 15 minute periods (when all machinery is operating at full utilisation), these impacts are indicative of highest likely noise levels that may occur. Typical construction noise levels would be expected throughout most of the construction and would be lower than the worst case periods. There are predicted to be nine highly noise affected receivers within noise catchment area 12 (NCA12) during worst case for excavation and earthworks (Scenario 4).

The main potential sources of construction ground-borne noise and vibration are associated with the use of tunnel boring machines during tunnelling. The worse-case predicted ground-borne noise impacts are generally compliant with the management levels or result in only ‘minor’ impacts for most receivers. ‘Moderate’ or ‘high’ impacts are however predicted above the Western Sydney International to Bringelly tunnel either due to the tunnel being shallow at this location, or sensitive receivers being near the station shaft excavation works. However, these impacts will be transient at any individual receiver as tunnelling progresses.

There would also be minor construction or operational traffic noise impacts to receivers near a number of roads including Badgerys Creek Road and The Northern Road. Many of the roads utilised by traffic associated with construction or operation of the project already exceed the noise criteria without the project due to existing traffic movements.

7.2.2 Legislative and policy context

The legislation, assessment guidelines, standards and policies considered in the preparation of the noise and vibration impact assessment include:

- Airports (Environment Protection) Regulations 1997 (Cth) (Airports (Environment Protection) Regulations)
- *Australian Standard AS 1055: Description and measurement of environmental noise*
- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009a)
- *Rail Infrastructure Noise Guideline* (RING) (EPA, 2013)
- *Noise Policy for Industry* (NPI) (EPA, 2017)
- *NSW Road Noise Policy* (RNP) (DECCW, 2011)
- *Assessing Vibration a technical guideline* (DECC, 2006)
- *ISO 14837-1 2005 Mechanical vibration – Ground-borne noise and vibration arising from rail systems – Part 1: General Guidance*
- *German Standard DIN 4150-3: Structural Vibration – effects of vibration on structures*
- *US Federal Transit Administration Manual* (*Federal Transit Administration*, 2018)
- *Construction Noise and Vibration Standard* (Appendix F)
- *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP).

Schedule 4 of the Airports (Environment Protection) Regulations sets out indicators of noise that are considered to be excessive including for construction noise and operational rail traffic noise generated on airport land. Under the Airports (Environment Protection) Regulations excessive noise, in itself, is not an offence but is one of a number of factors which need to be considered in determining whether the noise offensively intrudes on amenity.

7.2.3 Assessment methodology

General methodology

The assessment methodology for construction and operational noise and vibration impacts involved:

- identifying and classifying sensitive receivers (note that the Airports (Environment Protection) Regulations uses the term ‘sensitive receptors’ rather than ‘sensitive receivers’ although the two terms have similar meanings. For the purposes of consistency in approach across the on-airport and off-airport assessments for the project the term ‘sensitive receivers’ has been used)
- characterising the existing noise environment based on attended and unattended noise measurements at specific locations across the study area
- determining noise and vibration management levels in accordance with relevant guidelines
- modelling to quantify the potential construction and operational noise and vibration levels for key project elements including:
  - ground-borne noise and vibration from metro trains operating within tunnels
  - airborne noise from metro trains operating on the surface
  - airborne noise from mechanical plant and tunnel ventilation systems at stations, services facilities and other ancillary facilities
- assessing the significance of potential impacts identified
- examining the proposed construction methodologies and identifying mitigation measures that are likely to be required to minimise construction noise and vibration impacts
- preparing and documenting reasonable and feasible performance outcomes and mitigation measures.

Study area

The study area for the proposed action is shown in Figure 7-3 and is made up of a series distances from the main track alignment correlating to various aspects of the noise assessment as follows:

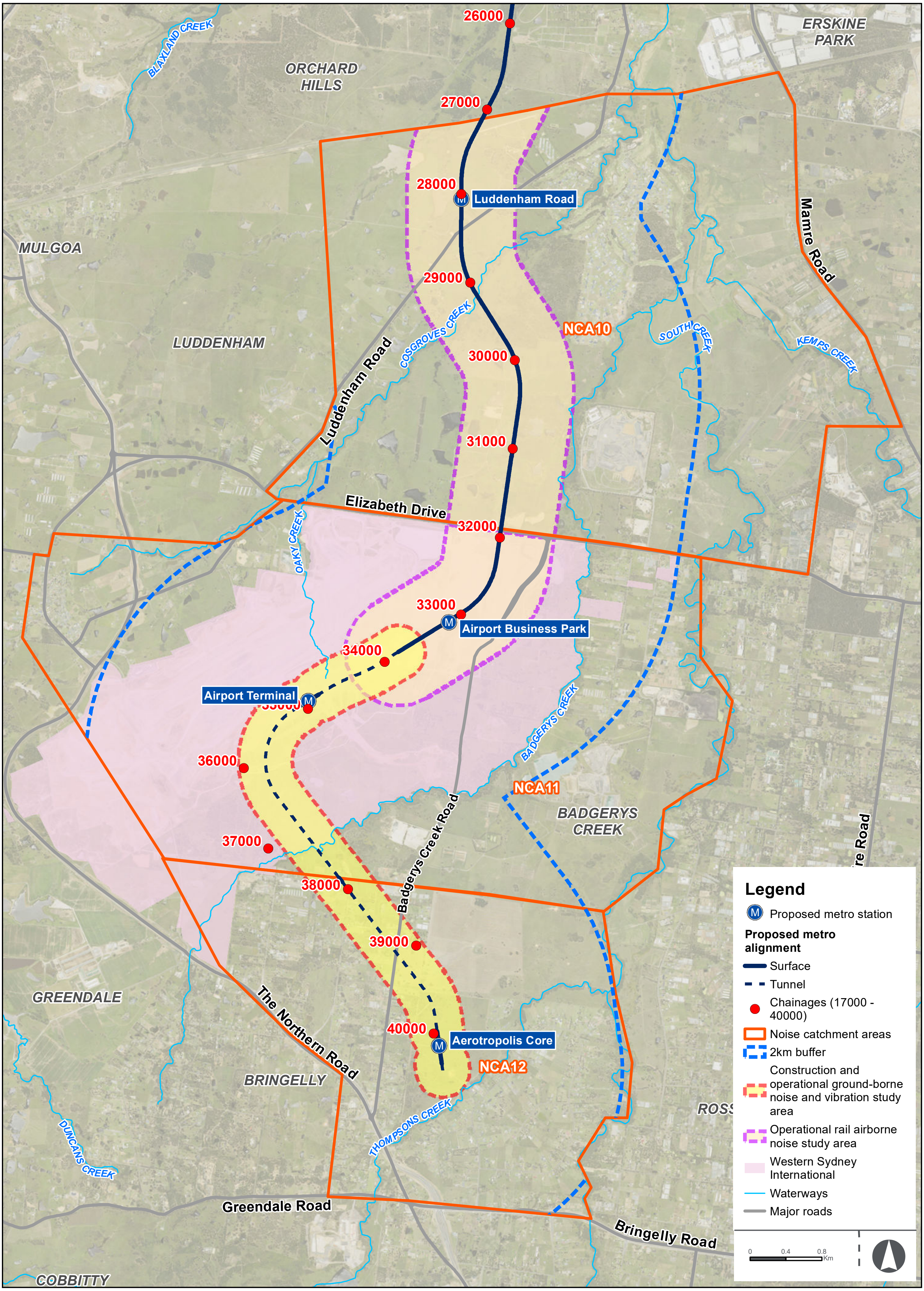
- construction assessment:
  - airborne noise: two kilometres
  - ground-borne noise and vibration: 300 metres
- operation assessment:
  - airborne noise: 600 metres
  - ground-borne noise and vibration: 300 metres.

The distances are intended to incorporate the extent of area potentially impacted, taking into consideration guidance provided by the assessment framework documents detailed in Section 7.2.2 above.

Application of the study area to the proposed action

The study area for the proposed action comprises the extent of the study area as defined above, but only as applied to NCA10 (immediately north of the airport boundary), NCA11 (generally covering the airport site) and NCA12 (immediately south of the airport site). The extent of these NCAs is presented in Figure 7-3

This approach ensures that the study area includes consideration of on-airport receivers, and also off-airport receivers that could potentially be impacted by on-airport works. Further, while receivers at the northern extent of NCA10 and the southern extent of NCA12 are beyond the area likely to be affected by the proposed action, there would be little practical benefit in further delineating impacts generated on and off-airport, given the proposed simultaneous construction of the project as a whole.



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Noise and vibration assessment study area

Figure 7-3

Representative construction scenarios

Representative construction scenarios have been developed to assess the likely impacts from the various construction phases for the proposed action with an indicative construction program provided in Section 4.3.3 and descriptions of the scenarios provided in Section 4.3.4 of *Sydney Metro – Western Sydney Airport, Noise and Vibration Assessment* (Sydney Metro, 2020c). These scenario descriptions are summarised below for on-airport works. The scenarios were developed to address construction of the Sydney Metro – Western Sydney Airport project as a whole and in some cases are not applicable to the proposed action. These instances are identified below.

Scenario 1 (SC01) – Enabling works

Key noise generating construction activities undertaken as part of the assessed preparatory activities scenario would include transport network adjustments to facilitate construction vehicle access and establishing construction compounds and work sites.

High noise generating plant utilised as part of these activities include:

- use of dozers (~80 per cent utilisation per shift) during site establishment at the Western Sydney International tunnel portal.

Scenario 2 (SC02) - Tunnelling and associated works

Key noise generating construction activities undertaken as part of the assessed tunnelling and associated works scenario would include:

- Western Sydney International to Bringelly tunnel (tunnel boring machine (TBM) tunnels) and associated tunnel spoil handling (including haulage), including TBM tunnelling, excavation and demobilisation.
- other techniques including the use of road-headers or excavators to excavate non-standard sections of tunnels including cross-passages and tunnel stubs.
- tunnelling support activities (including tunnel section segment manufacture and storage, material handling and grout batching).

High noise generating plant utilised as part of these activities includes use of multiple hydraulic hammers (~30 per cent utilisation per shift) during station box excavation works at Western Sydney International tunnel portal, and the Airport Terminal.

Scenario 3 (SC03) – Bridge and viaduct construction (viaduct segment casting)

Key noise generating construction activities undertaken as part of the assessed viaduct construction works scenario would include high noise generating plant such as the use of concrete vibrators (~20 per cent utilisation per shift) during viaduct segment casting at the Airport construction support site.

Scenario 4 (SC04) - Earthworks and excavation

Key noise generating construction activities undertaken as part of the assessed earthworks and excavation works scenario would include earthworks and/or excavation and station excavation.

High noise generating plant utilised as part of these activities include:

- use of hydraulic hammers (~30 per cent utilisation per shift) during station excavation works at the Airport Terminal and Airport Business Park sites.

Scenario 5 (SC05) – Station construction

Key noise generating construction activities undertaken as part of the assessed station construction works scenario would include above ground structural works at the two airport stations such as support columns and foundations for vertical transport structures and the station buildings.

Scenario 6 (SC06) – Construction of stabling and maintenance and other ancillary facilities

Not applicable to the proposed action.

Scenario 7 (SC07) – Rail systems fitout

Key noise generating construction activities undertaken as part of the assessed rail systems fitout works scenario would include fitout of mechanical and electrical ventilation and track slab and rail fastening.

Scenario 8 (SC08) – Station fitout, precinct and transport integration works

Key noise generating construction activities undertaken as part of the assessed station fitout, precinct and transport integration works scenario would include architectural fitout of the stations.

Scenario 9 (SC09) – Finishing works

Key noise generating construction activities undertaken as part of the assessed finishing works scenario would include site reinstatement and rehabilitation carried out progressively during the works, including demobilising site compounds and facilities and removing materials, waste and redundant structures from the works sites.

High noise generating plant utilised as part of these activities include:

- use of hydraulic hammers (~30 per cent utilisation per shift) during site demobilisation works at Western Sydney International (including the Airport construction support site.

Construction noise metrics and emission scenarios

Construction assessment scenarios include use of the noisiest available plant and equipment and the assessment is therefore considered to represent the worst-case construction noise impacts. As detailed construction planning continues, construction-related noise and vibration impacts and mitigation would be managed in accordance with the Construction Noise and Vibration Standard (Appendix F).

Noise metrics most relevant to construction noise are described below and were evaluated for daytime (7am-6pm), evening (6-10pm) and night-time (10pm-7am) periods:

- rating background level (RBL) or $L_{A90\ (period)}$ – the background noise level in the absence of proposed construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods and is used to set the $L_{Aeq(15\ minute)}$ noise management levels (NMLs) for residential receivers
- $L_{Aeq\ (period)}$ – the 'energy average noise level' evaluated over a defined measurement period (typically 15 minutes for construction noise or the relevant daytime, evening or night-time period for ambient noise monitoring)
- L_{Amax} – the 'maximum noise level' for an event, used in the assessment of potential sleep disturbance during night-time periods.

Realistic worst-case and typical scenarios for noise emissions from construction have been assessed as follows:

- realistic worst-case – noisiest equipment are assessed as working within the equipment work area, operating at 100 per cent duty for the 15 minute assessment period
- typical case – all equipment are assessed as working within the equipment work area, operating over a proportion of the 15 minute assessment period based on the expected utilisation.

Construction airborne noise guidelines

The ICNG requires the development of NMLs and a comparison of predicted construction noise levels with the NMLs. The 'worst-case' noise levels from construction of a project are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact of the proposed action.

Table 7-7 sets out the application of the management levels for noise at residences.

Table 7-7 ICNG noise management levels for residential receivers

Time of Day	NML, dBA $L_{eq,\ 15\ min}$	Application
Recommended standard hours: • Monday to Friday 7am to 6pm • Saturday 8am to 1pm • No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{eq,15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that certain activities can occur, taking into account times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences).
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would be required for works undertaken outside of the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should consult with the community.

NMLs have been derived for the identified land uses, and representative RBLs for residential receivers have been based on noise monitoring of the existing environment.

Table 7-8 presents the NMLs for non-residential sensitive receivers associated with the proposed action.

Table 7-8 Noise management levels for non-residential sensitive receivers

Land use	Noise management level (dBA $L_{eq,\ 15\ min}$)
Educational	55 dBA [1] (Internal noise level 45 dBA)
Commercial (offices, retail outlets)	70 dBA (external noise level)
Commercial (industrial)	75 dBA (external noise level)

Land use	Noise management level (dBA $L_{eq,\ 15\ min}$)
Active recreation	65 dBA (external noise level)
Passive recreation	60 dBA (external noise level)
Place of worship	55 dBA [1] (Internal noise level 45 dBA)
Child care centres	55 dBA [1] (Internal noise level 45 dBA)

1. An internal to external correction of +10 dB has been applied as per the ICNG

Construction ground-borne noise guidelines

Ground-borne noise is generated by vibration transmitted through the ground and into a structure when vibration intensive equipment is in use, such as during tunnelling works using tunnel boring machines, roadheaders or rockbreakers. The Construction Noise and Vibration Standard (Appendix F) refers to guidance in the ICNG, which specifies evening and night-time ground-borne noise management levels for residences and commercial. The ICNG management levels indicate when management actions should be implemented. These are presented in Table 7-9.

Table 7-9 Ground-borne noise management levels for residential and commercial receivers

Time of day	Ground-borne noise management level ($L_{eq,15min}$)
Daytime 7am-6pm	45 dBA at residences; 50 dBA at commercial receivers
Evening 6-10pm	40 dBA at residences
Night-time 10pm-7am	35 dBA at residences

These levels would apply only when ground-borne noise levels are higher than airborne noise levels (generally for tunnelling works). These levels are to be assessed at the centre of the most affected habitable room.

Construction vibration guidelines

The effects of vibration in buildings are described in the following sections:

Human comfort

The Construction Noise and Vibration Standard (Appendix F) requires the assessment of vibration impacts on human comfort in accordance with *Assessing Vibration – A technical guideline* (DEC, 2006) (AVTG). AVTG presents preferred and maximum vibration values, above which there is considered to be a risk that the amenity and comfort of people occupying buildings would be adversely affected. The preferred vibration values are not mandatory limits but should be sought to be achieved through application of all feasible and reasonable mitigation measures.

The applicable vibration dose values (VDV) for intermittent vibration are shown in Table 7-10.

Table 7-10 Vibration dose values for human exposure from intermittent vibration

Location	Assessment period	Vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residences	Daytime	0.2	0.4
	Night	0.13	0.26
Offices, schools, educational institutions, and places of worship	Anytime	0.4	0.8
Workshops	Anytime	0.8	1.6

Note: Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am

The vibration guideline also presents values for continuous and impulsive vibration. These values are detailed in Table 4-5 of *Sydney Metro – Western Sydney Airport, Noise and Vibration Assessment* (Sydney Metro, 2020c).

When short-term works such as piling, demolition and construction give rise to impulsive vibrations, strict restrictions on allowable vibration values (levels) may significantly prolong these operations and result in greater annoyance. Where work is short term, feasible and reasonable mitigation measures have been applied, then higher vibration values may apply.

Cosmetic building damage

Vibration screening levels (Peak Particle Velocity (PPV)) for cosmetic building damage are provided for intermittent vibration sources in Table 7-11.

Table 7-11 Recommended vibration limits for cosmetic damage

Type of building	Peak component particle velocity (PPV)
Reinforced or framed structures	10 mm/s
Unreinforced or light framed structures	5 mm/s

At locations where the predicted (or measured) vibration levels are greater than those in Table 7-11, monitoring would be undertaken during construction.

Other vibration sensitive structures and utilities

Construction of the project could potentially affect other utilities and assets which may be particularly sensitive to vibration. Examples include pipelines, tunnels, fibre optic cables and high-pressure gas pipelines.

The vibration criteria applicable to utilities and assets is outlined in Table 7-12.

Table 7-12 Guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework

Pipe material	Guideline values for velocity at the pipe
Steel (including welded pipes)	100 mm/s
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80 mm/s
Masonry, plastic	50 mm/s

Construction road traffic noise guidelines

Road traffic noise criteria

The Construction Noise and Vibration Standard (Appendix F) states that ‘an initial screening test should first be applied by evaluating whether noise levels will increase by more than 2 dBA due to construction traffic or a temporary reroute due to a road closure. Where increases are 2 dBA or less then no further assessment is required’.

Therefore, if the road traffic noise levels increase by more than 2 dBA as a result of the proposed construction traffic, and the criteria in Table 7-13 are exceeded, investigation of mitigation options would be required.

Table 7-13 Road traffic noise criteria for residential receivers on existing roads affected by additional traffic from land use developments

Road type	Road traffic noise criteria	
	Day (7am to 10pm)	Night (10pm to 7am)
Freeway/Arterial/Sub-arterial	60 $L_{eq,15hr}$ dBA	55 $L_{eq,9hr}$ dBA
Local	55 $L_{eq,15hr}$ dBA	50 $L_{eq,1hr}$ dBA

Sleep disturbance and awakening

Construction noise during the night (10pm to 7am Monday to Saturday, 10pm to 8am Sunday) has the potential to awaken residents from sleep. The CNVS refers to the Road Traffic Authority's (RTA) 'Environmental Noise Management Manual' (ENMM) (RTA, 2001) and DECCW's *Environmental Criteria for Road Traffic Noise* (ECRTN) (RTA, 1999) for guidance relevant to the assessment of sleep disturbance and awakening. These guidelines have been superseded by the Road Noise Policy (RNP) (DECCW,2011), including that the typical maximum noise level should not exceed the background noise level (i.e. RBL) + 15 dB.

Specifically, the guidance within the RNP indicates that at levels above 55 dBA L_{max}, sleep awakening would be considered likely. Assuming receivers may have windows partially open for ventilation, a +10 dB inside to outside correction has been adopted as indicated in the ICNG. This + 10 dB correction indicates noise difference from outside to inside from a building façade with windows partially open.

Therefore, sleep disturbance and awakening external noise level screening levels of RBL+15 dB and L_{max} 65 dBA, whichever is most conservative (lowest) within each NCA, have been adopted.

On-airport construction noise management guidelines

The Airports (Environment Protection) Regulations designates a sound pressure level of $L_{A10,\ 15\ min}$ of 75 dB, from noise generated by the construction, maintenance, or demolition of a structure, to be met at the site of any sensitive receiver. For commercial receivers, the time of day, duration, characteristics of noise, background noise level, and nature of the business conducted at the site should be considered when determining whether noise is excessive.

Commonwealth legislation contains no criteria in relation to the assessment of construction groundborne noise and vibration impacts. In the absence of suitable criteria, NSW guidelines and standards have been adopted. Therefore, a consistent approach to the assessment of ground-borne noise and vibration impacts would be undertaken across both on-airport and off-airport construction sites.

The Western Sydney Airport Noise and Vibration Construction Environmental Management Plan (Western Sydney Airport, 2019) is also used to manage noise and vibration impacts associated with construction works for Western Sydney International.

Operational rail noise management guidelines

Airborne operational rail noise guidelines

The RING states that noise trigger levels (a level that, if exceeded, would indicate a potential noise impact on the community, and so trigger a management response) should be assessed for the opening year and for a design year, typically 10 years after opening of the project.

The following years have been assessed in rail noise modelling:

- 2026 – represents the expected opening year for the project
- 2036 – represents the typical design year as required by the RING.

Noise trigger levels for residential land uses outside the airport site (but affected by the proposed action) are provided in Table 7-14. Noise trigger levels for non-residential receivers are provided in Table 7-15. The alignment is considered a new rail line development for the purpose of the operational noise assessment.

Table 7-14 Airborne noise trigger levels for residential land uses

Type of development	Noise trigger level, dBA (external)	
	Day 7am-10pm	Night 10pm-7am
New rail line development	Predicted rail noise levels exceed:	
	60 $L_{eq,15hr}$ or 80 L_{Fmax}	60 $L_{eq,15hr}$ or 80 L_{Fmax}

Table 7-15 Airborne noise trigger levels for sensitive land uses other than residential

Other sensitive land uses	Noise trigger level, dBA (when in use)
	New rail line development
	Resulting rail noise levels exceed:
Schools, educational institutions and childcare centres	40 $L_{eq,1hr}$ internal
Places of worship	40 $L_{eq,1hr}$ internal
Hospital wards	35 $L_{eq,1hr}$ internal
Hospitals other uses	60 $L_{eq,1hr}$ external
Open space – passive use (e.g. parkland, bush reserves)	60 $L_{eq,15hr}$ external
Open space – active use (e.g. sports field, golf course)	65 $L_{eq,15hr}$ external

Commercial receivers such as offices or industrial receivers are not considered as noise sensitive receivers within the RING and were not assessed for noise from the operational rail.

In relation to on-airport receivers, the Airports (Environment Protection) Regulations specify that noise generated from rail traffic operated at an airport and measured at the receiver should not exceed:

- L_{max} 87 dBA, calculated as the average maximum A-weighted sound pressure level for a period of at least 15 minutes measurement
- $L_{eq,24\ hr}$ 60 dBA, calculated as the equivalent continuous A-weighted sound pressure level for a 24 hour period of measurement
- $L_{eq,8hr}$ 55 dBA, from 10pm on a particular day to 6am on the following day.

For commercial receivers, the time of day, duration, characteristics of noise, background noise level, and nature of the business conducted at the site should also be considered when determining whether noise is excessive

Ground-borne operational rail noise and vibration

The RING provides guidance on the assessment and management of ground-borne noise and vibration impacts generated by railways. The RING provides the following trigger levels for ground-borne noise as outlined in Table 7-16.

Table 7-16 Ground-borne noise trigger levels for heavy or light rail projects

Sensitive land use	Time of day	Internal noise trigger levels dBA[1]
Residential	Day (7am-10pm)	40 L_{Smax}
	Night (10pm-7am)	35 L_{Smax}
Schools, educational institutions, places of worship	When in use	40-45 L_{Smax}

1. L_{Smax} refers to the maximum noise level not exceeded for 95 per cent of rail pass-by events and is measured using the 'slow' (S) response setting on a sound-level meter.

For the assessment of ground-borne vibration, the RING suggests use of AVTG. The AVTG recommends the use of the VDV for assessment of intermittent vibration. Acceptable VDV values are outlined in Table 7-17.

Table 7-17 Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1. Daytime is 7.00am to 10.00pm and night-time is 10.00pm to 7.00am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas

Stations and ancillary facilities noise trigger levels

The relevant operational noise sources associated with ancillary facilities at each station are summarised in Table 7-18, along with relevant limiting criteria and offsets to nearest sensitive receivers.

Table 7-18 Noise sources and criteria for stations, service facilities and ancillary facilities

Station	NCA (NM)[2]	Nearest receiver type	PNTL[1]
Airport Business Park	NCA11 (NM20)	Residential	35
	NCA11 (NM20)	Residential	35
	NCA11 (NM20)	Commercial	65
Airport Terminal	NCA11 (NM12)	Commercial	65

1. Project noise trigger level (PNTL) - night-time intrusive criteria adopted as most stringent criteria over a 24 hour period. Intrusiveness criteria apply to residential receivers only. Criteria for non-residential receiver are applicable when in use.
2. Reference to noise monitoring locations shown in Figure 6-1.

Road operational traffic noise

Applicable noise criteria for each road type are presented in Table 7-13. Where the criteria are exceeded, the RNP states that feasible and reasonable mitigation measures would be investigated.

The RNP (which applies to the off-airport assessment only) states that where land use developments have potential to generate additional traffic on existing roads, an assessment of the increase in total traffic noise level is required. The RNP states that following the consideration of feasible and reasonable mitigation, ‘any increase in the total traffic noise level as a result of the development should be limited to 2 dBA above that of the noise level without the development’. This applies for both day and night periods, and for the purpose of local roads is assumed to apply to the one-hour peak period.

7.2.4 Potential impacts – construction

Airborne noise - overview

The predicted noise levels for each of the nine construction work scenarios for on-airport works are presented in Table 7-19. Maps showing the predicted noise levels for residential receivers potentially impacted by construction of the proposed action are presented in Appendix B of *Sydney Metro – Western Sydney Airport, Noise and Vibration Assessment* (Sydney Metro, 2020c).

The predicted noise levels for on-airport works show that no on-airport and off-airport sensitive receivers are predicted to experience noise levels that exceed the Airports (Environment Protection) Regulations specified noise limits. Limits outlined in the Airports (Environment Protection) Regulations generally align with highly noise affected NMLs (applicable during standard hours) as outlined in the ICNG. No receivers have been identified as highly noise affected within Western Sydney International.

The on-airport construction noise levels, when compared against ICNG NMLs, indicate that construction noise levels may be higher at sensitive receivers closest to the airport boundary. The levels may, in some cases, be higher than sleep disturbance screening levels. Where exceedances have been predicted to occur during the worst-case 15-minute periods (when all machinery is operating at full utilisation), these are indicative of the highest likely noise levels that may occur. Typical construction noise levels would be expected throughout most of the construction period and would be lower than the worst-case periods.

Table 7-19 outlines the highest noise level experienced at a residential receiver in each NCA for each on-airport activity based on ICNG levels for on-airport construction works. NCA10 is located north of the airport site, NCA11 includes the airport site and areas immediately to the east and west and NCA12 is predominantly located south of the airport site. NCA10, NCA11 and NCA12 are considered in this section as receivers are adjacent to the Western Sydney International and may be impacted by on-airport works.

The predicted noise levels are representative of the ‘typical’ expected noise levels. The predicted noise levels representative of the ‘worst-case’ expected noise levels are presented in brackets in Table 7-19.

During standard hours, NCA10 to NCA12 are predicted to experience exceedances of NMLs during all construction work scenarios, with the exception of bridge and viaduct works, and construction of ancillary facilities (Scenarios 3 and 6) in NCA12. During out-of-hours works, exceedances of NMLs and sleep disturbance and awakening screening levels are predicted to occur during tunnelling and associated works, bridge and viaduct works, rail systems fitout works, and station fitout works (Scenarios 2, 3, 7, and 8) at all NCAs, with the exception of bridge and viaduct works in NCA12.

Exceedances within each NCA are predominantly located in the following areas:

- NCA10: receivers located to the north of the airport site along Elizabeth Drive
- NCA11: receivers located to the east of the airport site along Lawson Road
- NCA12: receivers located to the south of the airport site along Badgerys Creek Road, Derwent Road and the northern end of Mersey Road.

The construction noise impacts predicted for receivers in NCA10, 11 and 12 are based on the construction works which are proposed within the airport site. They do not consider the cumulative noise impacts potentially arising from construction works occurring both on-airport and off-airport at the same time.

A limited number of receivers located in areas proximate to the airport site boundary may be potentially impacted by cumulative noise levels associated with both on-airport and off-airport construction works. In most cases the cumulative noise impact experienced at these receivers will be equivalent to the highest construction noise level in each area, or in worst case scenarios up to 2 dBA higher than the highest noise level. Only a small number of receivers are likely to experience cumulative impacts and for limited periods of time when the highest noise generating construction activities in each area are occurring simultaneously.

Noise and vibration impacts and mitigation would be managed through the conventional methods as outlined in the Construction Noise and Vibration Standard (Appendix F).

Table 7-19 Number of residential receivers exceeding ICNG NMLs for on-airport works – typical and (worst-case)

NCA	Period	NML	Highest predicted noise level (dB)								
			SC01	SC02	SC03	SC04	SC05	SC06	SC07	SC08	SC09
NCA10 – (378 noise sensitive (residential) receivers assessed)	SH	45	55 (59)	57 (62)	54 (59)	63 (68)	53 (60)	50 (57)	50 (57)	47 (51)	58 (63)
	OOH - D	40	N/A	55 (60)	54 (59)	N/A	N/A	N/A	47 (50)	N/A	40 (49)
	OOH - E	35	N/A	55 (60)	54 (59)	N/A	N/A	N/A	47 (50)	N/A	40 (49)
	OOH - N	35	N/A	55 (60)	54 (59)	N/A	N/A	N/A	47 (50)	N/A	40 (49)
NCA11 – (68 noise sensitive (residential) receivers assessed)	SH	49	62 (65)	62 (67)	61 (66)	64 (69)	53 (60)	57 (64)	49 (55)	46 (51)	64 (67)
	OOH - D	44	N/A	62 (66)	61 (66)	N/A	N/A	N/A	48 (53)	N/A	48 (53)
	OOH - E	42	N/A	62 (66)	61 (66)	N/A	N/A	N/A	48 (53)	N/A	48 (53)
	OOH - N	35	N/A	62 (66)	61 (66)	N/A	N/A	N/A	48 (53)	N/A	48 (53)
NCA12 - (396 noise sensitive (residential) receivers assessed)	SH	48	61 (64)	61 (62)	N/A	59 (64)	51 (58)	N/A	48 (53)	45 (49)	48 (53)
	OOH - D	43	N/A	61 (62)	N/A	N/A	N/A	N/A	48 (53)	N/A	47 (52)
	OOH - E	40	N/A	61 (62)	N/A	N/A	N/A	N/A	48 (53)	N/A	47 (52)
	OOH - N	39	N/A	61 (62)	N/A	N/A	N/A	N/A	48 (53)	N/A	47 (52)

Notes:
1. ICNG standard hours includes Monday to Friday 7am to 6pm and Saturday 8 am to 1pm, Out of Hours Day any time within 1pm to 6pm Saturday and 8am to 6pm Sunday, and outside standard hours, Out of Hours – Evening any time from 6pm to 10pm & Out of Hours – Night at all other times
2. Yellow cells indicate an exceedance of NMLs between 0 and 10 dB for typical construction works; Orange cells indicate an exceedance of NMLs between 10 and 20 dB for typical construction works; Red cells indicate an exceedance of NMLs >20dB for typical construction works;
3. Results in brackets indicate noise level predictions assuming full utilisation of plant (i.e. realistic worst case).
4. N/A refers to no works for that scenario within that NCA.
5. Where more exceedances of NMLs are predicted in an exceedance range (e.g. 0-10 dB) during typical scenarios over worst-case, this is because predicted worst case impacts are higher than the typical impacts at a receiver, and therefore some number of receivers may move up into the higher exceedance ranges

Airborne noise – catchment assessment

A summary of the main findings for the construction noise assessment of on-airport works for each catchment area is provided below.

NCA10 (Luddenham, between the Warragamba to Prospect Water Supply Pipelines and north of Elizabeth Drive)

A total of 378 noise sensitive receivers were assessed for NCA10 which is located to the north of the airport site. The following potential airborne noise levels were predicted for NCA10:

- during standard hours, residential receivers are predicted to be most affected along Elizabeth Drive by earthworks and excavation works (Scenario 4). Predicted noise levels are most influenced by excavators during rail embankment works along the on-airport construction corridor, and hydraulic hammers at the Airport business park, exceeding NMLs by up to 18 dB to 23 dB. These excavators may be used over a period of around 12 months, and hydraulic hammers may be used over a period of around six months
- during out-of-hours works, residential receivers are predicted to be most affected by tunnelling and associated works, bridge and viaduct construction, rail fitout works, and finishing works (Scenarios 2, 3, 7 and 9). Predicted noise levels are most influenced by concrete vibrators during tunnelling and associated works (Scenario 2), exceeding NMLs by up to 19 to 24 dB. These concrete vibrators are expected to be in use for a period of around eighteen months
- the worst-case exceedances of the sleep disturbance and awakening screening levels occur during tunnel segment casting as part of tunnelling and associated works (Scenario 2), and are a result of use of the concrete batch plant, exceeding by up to 7 dB.

Further details of the predicted NML exceedances within NCA10 are presented in Table 7-20.

Table 7-20 NCA10 – overview of NML exceedances at residential receivers for on-airport works – typical and worst case

Activity	Exceedances of sleep disturbance and awakening screening levels	Number of receivers exceeding NML – typical and (worst case)											
		Standard hours			Out-of-hours - day			Out-of-hours - evening			Out-of-hours - night		
		0-10	10-20	20+	0-10	10-20	20+	0-10	10-20	20+	0-10	10-20	20+
SC01 - Enabling works	N/A	7 (2)	0 (5)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC02 - Tunnelling and associated works	5	4 (0)	2 (6)	0 (0)	4 (3)	2 (3)	0 (0)	1 (0)	5 (4)	0 (2)	1 (0)	5 (4)	0 (2)
SC03 - Bridge and viaduct construction	4	3 (1)	0 (2)	0 (0)	1 (3)	2 (2)	0 (0)	3 (2)	2 (1)	0 (2)	3 (2)	2 (1)	0 (2)
SC04 - Earthworks and excavation	N/A	2 (2)	5 (4)	0 (2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC05 - Station construction	N/A	4 (1)	0 (4)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC06 - Construction of stabling and maintenance and other ancillary facilities	N/A	2 (1)	0 (2)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC07 - Rail systems fitout	4	6 (4)	0 (3)	0 (0)	4 (4)	0 (0)	0 (0)	3 (2)	1 (2)	0 (0)	3 (2)	1 (2)	0 (0)
SC08 - Station fitout, precinct and transport integration works	N/A	1 (4)	0 (0)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC09 - Finishing works	5	5 (0)	2 (7)	0 (0)	1 (7)	0 (0)	0 (0)	5 (2)	0 (5)	0 (0)	5 (2)	0 (5)	0 (0)

Note:
Where more exceedances of NMLs are predicted in an exceedance range (e.g. 0-10dB) during typical scenarios over worst-case, this is because predicted worst case impacts are higher than the typical impacts at a receiver, and therefore some number of receivers may move up into the higher exceedance ranges.

NCA11 (Badgerys Creek, south of Elizabeth Drive to generally southern boundary of Western Sydney International)

A total of 70 noise sensitive receivers, including 68 residential receivers, were assessed for NCA11 which includes the airport site and areas immediately to the east and west of the airport site. The following potential airborne noise levels were predicted for NCA11:

- during standard hours, residential receivers are predicted to be most affected along Lawson Road. Predicted noise levels are most influenced by excavators during rail embankment works along the on-airport construction corridor, and hydraulic hammers at the Airport business park, exceeding NMLs by up to 16 dB to 20 dB. These excavators may be used over a period of around 12 months, and hydraulic hammers may be used over a period of around six months
- during out-of-hours works, residential receivers are predicted to be most affected by tunnelling and associated works, bridge and viaduct construction, rail fitout works, and finishing works (Scenarios 2, 3, 7 and 9). Predicted noise levels are associated with the operation of the tunnel segment during tunnelling and associated activities and bridge and viaduct works, trackwork and overhead wiring at the Airport business park during rail systems fitout works, and testing and commissioning of the on-airport corridor
- the worst case exceedances of the sleep disturbance and awakening screening levels occur during tunnel segment casting as part of tunnelling and associated works (Scenario 2), and are a result of use of the concrete batch plant, exceeding by up to 14 dB.

Further details of the predicted NML exceedances within NCA11 are presented in Table 7-21.

Table 7-21 NCA11 – overview of NML exceedances at residential receivers – typical and worst case

Activity	Exceedances of sleep disturbance and awakening screening levels	Number of receivers exceeding NML – typical and (worst case)											
		Standard hours			Out-of-hours - day			Out-of-hours - evening			Out-of-hours - night		
		0-10	10-20	20+	0-10	10-20	20+	0-10	10-20	20+	0-10	10-20	20+
SC01 - Enabling works	N/A	27 (43)	2 (7)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC02 - Tunnelling and associated works	60	36 (27)	9 (26)	0 (0)	22 (11)	28 (40)	0 (4)	12 (12)	38 (31)	0 (13)	6 (5)	26 (11)	23 (40)
SC03 - Bridge and viaduct construction	46	38 (24)	4 (23)	0 (0)	25 (5)	22 (38)	0 (4)	13 (5)	34 (32)	0 (10)	1 (2)	25 (5)	21 (38)
SC04 - Earthworks and excavation	N/A	43 (22)	12 (35)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC05 - Station construction	N/A	15 (34)	0 (3)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC06 - Construction of stabling and maintenance and other ancillary facilities	N/A	32 (30)	0 (14)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC07 - Rail systems fitout	38	1 (28)	0 (0)	0 (0)	9 (17)	0 (0)	0 (0)	15 (24)	0 (1)	0 (0)	30 (20)	4 (15)	0 (0)
SC08 - Station fitout, precinct and transport integration works	N/A	0 (4)	0 (0)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC09 - Finishing works	3	30 (15)	17 (34)	0 (0)	2 (25)	0 (0)	0 (0)	2 (30)	0 (1)	0 (0)	0 (0)	2 (21)	0 (0)

Note:
Where more exceedances of NMLs are predicted in an exceedance range (e.g. 0-10dB) during typical scenarios over worst-case, this is because predicted worst case impacts are higher than the typical impacts at a receiver, and therefore some number of receivers may move up into the higher exceedance ranges.

NCA12 (Bringelly, generally south of the boundary of Western Sydney International to Bringelly Road)

A total of 396 noise sensitive receivers were assessed for NCA12 which is predominantly located to the south of the airport site. The following potential airborne noise levels were predicted for NCA12:

- during standard hours, residential receivers are predicted to be most affected along Derwent Road and Mersey Road, Bringelly by enabling works (Scenario 1). Predicted noise levels are most influence by the operation of dozers during site establishment, exceeding NMLs by up to 11 dB to 24 dB. These dozers may be used over a period of around 18 months
- during out-of-hours works, residential receivers are predicted to be most affected by tunnelling and associated works (Scenario 2). Predicted noise levels are most influence by the use of dozers, exceeding NMLs by up to 20 to 21 dB. These dozers may be used over a period of around 18 months
- the worst case exceedances of the sleep disturbance and awakening screening levels occur as part of tunnelling and associated works (Scenario 2), and are a result of use of dozers, exceeding by up to 3 dB.

Further details of the predicted NML exceedances within NCA12 are presented in Table 7-22.

Table 7-22 NCA12 – overview of NML exceedances at residential receivers – typical and worst case

Activity	Exceedances of sleep disturbance and awakening screening levels	Number of receivers exceeding NML – typical and (worst case)											
		Standard hours			Out-of-hours - day			Out-of-hours - evening			Out-of-hours - night		
		0-10	10-20	20+	0-10	10-20	20+	0-10	10-20	20+	0-10	10-20	20+
SC01 - Enabling works	N/A	55 (54)	7 (20)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC02 - Tunnelling and associated works	69	60 (58)	2 (8)	0 (0)	51 (40)	27 (40)	0 (0)	31 (27)	52 (59)	1 (10)	26 (26)	59 (55)	1 (7)
SC03 - Bridge and viaduct construction	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SC04 - Earthworks and excavation	N/A	34 (36)	3 (11)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC05 - Station construction	N/A	7 (14)	0 (1)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC06 - Construction of stabling and maintenance and other ancillary facilities	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC07 - Rail systems fitout	6	0 (15)	0 (0)	0 (0)	12 (52)	0 (0)	0 (0)	23 (56)	0 (10)	0 (0)	30 (58)	0 (13)	0 (0)
SC08 - Station fitout, precinct and transport integration works	N/A	0 (3)	0 (0)	0 (0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC09 - Finishing works	0	0 (13)	0 (0)	0 (0)	10(40)	0 (0)	0 (0)	22 (57)	0 (2)	0 (0)	28 (56)	0 (7)	0 (0)

Note:
Where more exceedances of NMLs are predicted in an exceedance range (e.g. 0-10dB) during typical scenarios over worst-case, this is because predicted worst case impacts are higher than the typical impacts at a receiver, and therefore some number of receivers may move up into the higher exceedance ranges.

Ground-borne noise and vibration

Assessment of ground-borne noise and vibration due to tunnelling on Western Sydney International has been undertaken for all sensitive receivers that are located within 300 metres of the tunnel alignment. The assessment has shown that ground-borne noise from tunnelling (associated with the operation of TBMs, road headers and rock breakers) can meet the most stringent ICNG residential night time targets at a separation distance of around 40 metres from the tunnel, and vibration targets can be achieved at a separation distance of around 30 metres from the tunnel.

During construction, there are two sensitive receivers within the Western Sydney International; the Airport Experience Centre and Western Sydney Airport site offices. Both of these receivers are well removed from the tunnel alignment and will not be adversely affected by ground-borne noise and vibration. The section of the metro alignment between Elizabeth Drive and the Western Sydney International tunnel portal will be at surface level and therefore construction ground-borne noise is not an issue for this part of the alignment. Vibration targets for this part of the alignment can be met within 50 metres (to avoid cosmetic damage to residential building structures) and 100 metres for human comfort targets, for the most vibration intensive plant anticipated during construction (large vibratory rollers), and therefore is also not considered to be an issue.

For construction of the Western Sydney International to Bringelly tunnel located to south east of Western Sydney International only four receivers are predicted to experience exceedances of the relevant ground-borne noise targets during the worst case night time period. Two of these receivers are located on Derwent Road over 400 metres from the airport site and the other two receivers are located immediately east of Badgerys Creek Road over 1 kilometre from the airport site. In both cases the receivers are located where the tunnel intersects those roads. The exceedances would occur for a limited duration (up to 3 to 4 days) as the TBMs progress at a rate of around 100 metres per week. These exceedances are associated with tunnelling works occurring in the immediate vicinity of these receivers and outside of the Western Sydney International site.

Therefore, no impacts on sensitive receivers are anticipated from ground-borne noise and vibration associated with tunnelling within the Western Sydney International site.

7.2.5 Potential impacts – operation

Rail noise

Noise levels at on-airport noise sensitive receivers are not predicted to exceed the Airports (Environment Protection) Regulations specified noise limits and are predicted to be less than the relevant RING noise trigger levels at all existing noise sensitive receiver locations.

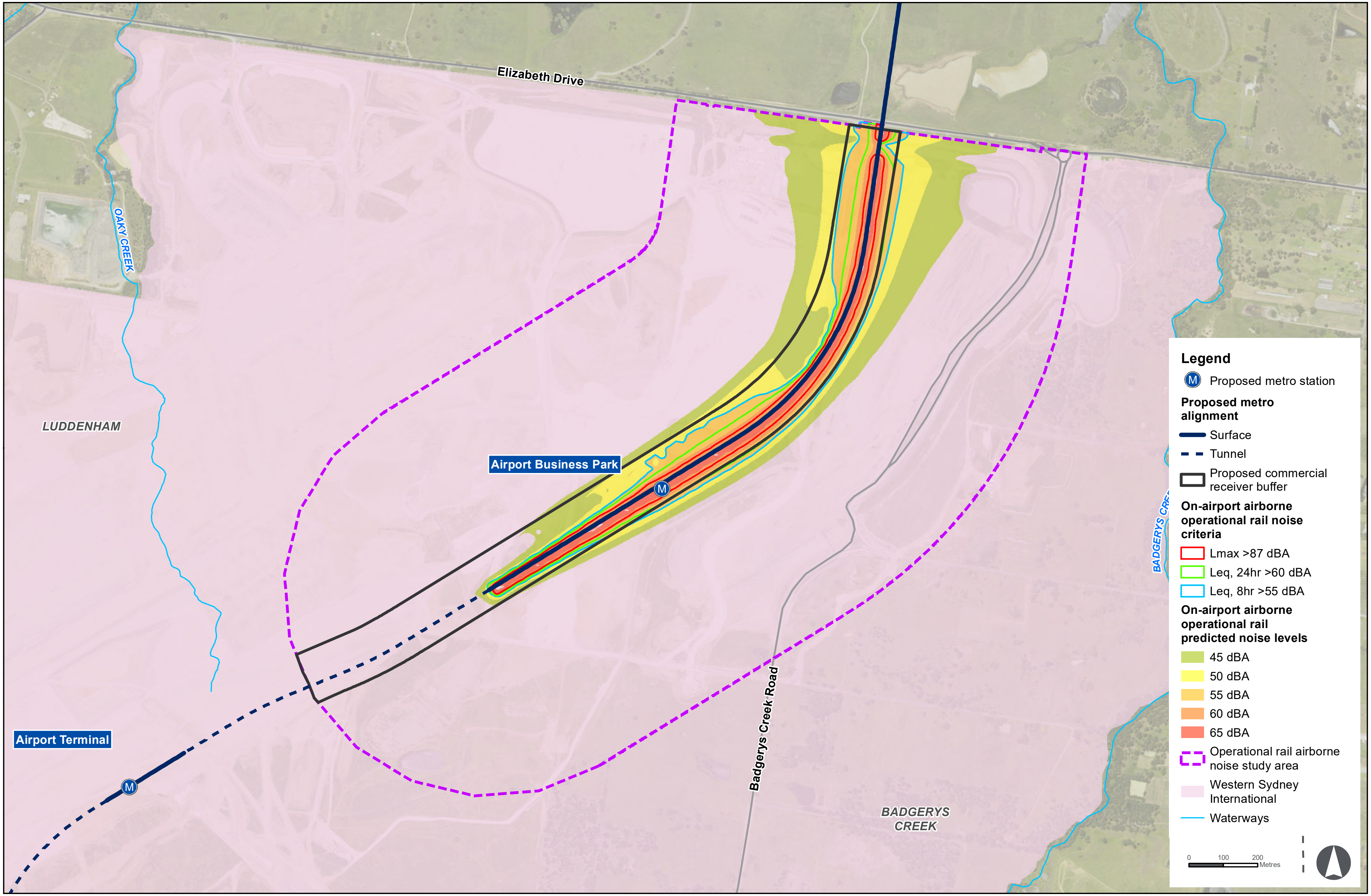
As outlined in the Western Sydney International airport site layout, commercial receivers are proposed on either side of the surface rail alignment as part of the Airport Business Park. Roads are proposed to run either side of the rail alignment, providing some setback between the commercial receivers and the rail alignment.

No exceedances of the on-airport criteria are expected at proposed commercial receivers for buildings set back at least 50 metres from the alignment for the opening year and ultimate year $L_{eq,24hr}$ and L_{max} scenarios and opening year $L_{eq,8hr}$ scenario. The ultimate year $L_{eq,8hr}$ scenario predominantly indicates that exceedances may occur up to 75 metres from the eastern side of the surface rail alignment.

As commercial receivers are not typically expected to be occupied during the night-time period (10pm to 6am), rail noise is not expected to impact occupants of buildings located between 50 and 75 metres of the eastern side of the alignment within Western Sydney International.

Further to this, commercial buildings constructed within close proximity to an airport would also likely be designed to mitigate aircraft noise, which would dominate the operational noise environment. It is expected that any buildings designed to mitigate aircraft noise would render rail noise impacts negligible when assessed at an internal location within the building.

Figure 7-4 outlines where compliance with the RING noise trigger levels occur for ultimate year (2036) operations against night time criteria that exhibits worst-case impact. As shown, no sensitive receivers are predicted to experience airborne noise levels that exceed these trigger levels.



Indicative only, subject to design development

Ultimate year (2036) – operational noise impact – night

Figure 7-4

Noise from stations and ancillary facilities

Mechanical and electrical plant

The assessment of mechanical and electrical plant has been determined at each on-airport location to comply with relevant noise criteria at the nearest sensitive receivers. The sound power levels (SPLs) represent the maximum allowable sound power levels from all site-related operation from all non-rail noise sources at the identified receivers. Results are presented in Table 7-23.

Table 7-23 Maximum allowable mechanical and electrical plant noise – stations and service facilities

Station	Element[1]	Sound Power Level, dBA
Airport Business Park Station	Station, including substation	86
Airport Terminal Station	Station, including substation	99

1. Services below ground not assumed to contribute to above ground noise levels at sensitive receivers. Public address systems and communications not assumed to contribute to noise levels at sensitive receivers.

The design of mechanical and electrical plant has not been finalised at this stage of the assessment and is subject to change.

Ground-borne noise and vibration

The airport site layout provides indicative locations of future noise sensitive buildings including the Air Traffic Control Tower, Airport Terminal building and commercial buildings which are to be located between the Airport Business Park and Airport Terminal stations.

The Air Traffic Control Tower is proposed to be located around 27 metres (slant distance) from the proposed rail alignment. The ground-borne noise is predicted to be 32 dBA LSmax with standard attenuation track, and the VDV is predicted to be 0.02 m/s1.75.

The Airport Terminal building is to be located over 100 metres from the underground rail alignment, with a plaza area located in between. Other noise sensitive commercial buildings that are to be located between the Airport Business Park and Airport Terminal stations are predicted to have ground-borne noise levels less than 40 dBA LSmax. The VDV values are predicted be in the range of 0.02 – 0.05 m/s1.75.

Given there are no objective ground-borne noise criteria provided for Air Traffic Control Tower and other commercial buildings within the RING, the assessment has been based on previous experience which suggests that ground-borne noise levels of up to 40 dBA LSmax would be acceptable for the Air Traffic Control Tower, and up to 45 dBA LSmax for the Airport Terminal building and commercial buildings. As a result the standard attenuation trackform would be appropriate to meet these noise levels.

The VDV at the Air Traffic Control Tower is below the RING target of 0.1 m/s1.75 for critical areas such as operating theatres and precision laboratories (see Section 5.2). The VDV at the Airport Terminal building and other commercial buildings is also below the RING target of 0.4 m/s1.75 (for offices) for all other sensitive receivers.

7.3 Biodiversity

This section provides an assessment of the potential impacts of the proposed action on biodiversity and is based on the Revised Biodiversity Development Assessment Report (Appendix C).

7.3.1 Overview

The project has been designed to avoid and minimise potential impacts biodiversity impacts on-airport where possible, including by designing tunnel options to avoid direct impacts on riparian vegetation, Cumberland Plain Woodland and the Badgerys Creek Environmental Conservation Zone. The siting of construction sites and use of riparian buffers would also minimise impacts to these areas. Mitigation measures have also been proposed to minimise or avoid potential biodiversity impacts which have not been avoided through design.

Potential biodiversity impacts of the proposed action (outside the Western Sydney International Stage 1 Construction Impact Zone), for Matters of National Environmental Significance (MNES) and *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) have been assessed under the NSW Biodiversity Assessment Method (BAM) (Office of Environment and Heritage, 2017a).

Delivery of the proposed action would have a residual impact on up to 42 hectares of native vegetation that is consistent with following threatened ecological communities under the *Biodiversity Conservation Act 2016* (NSW) (BC Act):

- Cumberland Plain Woodland in the Sydney Basin Bioregion – Critically Endangered
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered.

Of these, Cumberland Plain Shale Woodlands meets the criteria for listing under the EPBC Act.

A total of 12 threatened flora species and 47 threatened fauna species were considered to have a moderate or higher likelihood of occurrence within the on-airport study area.

No threatened flora species were recorded within the on-airport study area or are considered affected by the project. No threatened flora species have been assigned to species credits for offsetting purposes.

A total of two threatened fauna species (Cumberland Plain Land Snail and Southern Myotis) were recorded or assumed present within the on-airport study area and have been assigned to species credit calculations for offsetting purposes.

No threatened fish species listed under the *Fisheries Management Act* 1994 (FM Act) or EPBC Act were recorded or considered likely to occur within the study area and as such the project is unlikely to significantly impact any threatened aquatic species or their habitats.

Residual biodiversity impacts would be offset in accordance with the BAM. Up to 255 ecosystem credits and 190 species credits may be required to offset on-airport impacts to threatened fauna, flora and ecological communities.

Opportunities to minimise these impacts would be investigated further during design development.

7.3.2 Legislative and policy context

The proposed action requires an assessment of MNES in accordance with the Commonwealth Environment Minister's request for further information (Appendix B).

To address the information requirements of the variation to the Airport Plan and consider design changes subsequent to the exhibition of the Draft Environmental Impact Assessment, potential impacts of the proposed action on biodiversity outside that authorised by the Airport Plan have been assessed under the BAM within the Revised Biodiversity Development Assessment Report provided in Appendix C. Separate approvals for biodiversity impacts under the EPBC Act on-airport would not be required.

7.3.3 Assessment methodology

Study area

The study area for the biodiversity assessment is:

- the construction footprint (areas directly impacted by the proposed action).
- any areas identified for potential surface indirect impacts
- areas that may be subject to potential groundwater drawdown.

The on-airport study area for the biodiversity assessment does not include areas within the Western Sydney International Stage 1 Construction Impact Zone as the Western Sydney Airport Plan provides authorisation for the clearing of biodiversity values within the Western Sydney International Stage 1 Construction Impact Zone. The on-airport study area therefore only includes the area outside of the Western Sydney International Stage 1 Construction Impact Zone.

Desktop review

A desktop assessment was undertaken to identify threatened flora and fauna species, populations and ecological communities, migratory species or critical habitat previously recorded or predicted to occur in the locality of the project.

Background research was undertaken to identify:

- landscape-scale features of the study area in accordance with Section 4.2 of the BAM
- site context of the study area that includes assessing vegetation cover and patch size as required under Subsections 4.3.2 and 5.3.2 of the BAM
- the likely distribution of native vegetation and threatened ecological communities, based on previous mapping and aerial photograph interpretation, for targeted field verification as required under Section 5 of the BAM
- a list of predicted and candidate threatened and migratory species and populations of flora and fauna to assess the habitat suitability and threatened biodiversity data collection as required under Section 6 of the BAM, the FM Act and the EPBC Act
- evaluate baseline information to determine whether additional field surveys, mapping and reporting is required to support proposed action approval.

This allowed for known habitat characteristics of to be compared with those present within the study area to determine the likelihood of occurrence of each species or populations. These results informed the identification of appropriate field survey effort and the groups likely to occur.

Records of threatened species, populations and ecological communities known or predicted to occur in the locality of the proposed action were obtained from a range of databases as detailed in Table 7-24.

Table 7-24 Threatened and migratory species database searches

Database	Search date	Area searched	Reference
BioNet Atlas of NSW Wildlife	19 May 2020	10 kilometre search radius centred on the study area	Office of Environment and Heritage (2020)
Protected Matters Search Tool	19 May 2020	10 kilometre search radius centred on the study area	Department of Agriculture, Water and the Environment (DAWE)(2020)
PlantNet spatial search	19 May 2020	5 kilometre radius centred on the suburb of Badgerys Creek, Orchard Hills and St Marys	Royal Botanical Gardens (2020)
NSW Department of Primary Industries (Fishing and Aquaculture) spatial mapping	19 May 2020	Local waterways	Department of Primary Industries (2020a)
NSW Department of Primary Industries Critical Habitat register	19 May 2020	Search of the register	Department of Primary Industries (2020b)
NSW Environment, Energy and Science Group Areas of Outstanding Biodiversity Value register	19 May 2020	Search of the register	NSW Environment, Energy and Science Group (2020)

Spatial data

The background research included analysis of the following information sources:

- threatened species database searches outlined in Table 7-24
- aerial photographic imagery (NSW Spatial Services, 2019)
- NSW Mitchell Landscapes (NSW Office of Environment and Heritage, 2016a)
- descriptions for NSW (Mitchell) Landscapes Version 2 (2002)
- estuaries of NSW database (Environment, Energy and Science Group, 2020)
- Interim Biogeographic Regionalisation of Australia (IBRA version 7.0) (Department of Environment and Energy, 2016)
- Atlas of Groundwater Dependent Ecosystems (GDE) (Australian Bureau of Meteorology, 2020)
- Directory of Important Wetlands of Australia (DIWA – Department of Environment and Energy, 2020a)
- State Environmental Planning Policy (Coastal Management) 2018 – Coastal Wetlands (Department of Planning and Environment, 2018)
- priority weed listings for the Greater Sydney region (Department of Primary Industries, 2020c)
- Native vegetation of the Sydney Metropolitan Area (Office of Environment and Heritage, 2016b)
- Native vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands (Tozer *et al*., 2010)
- Draft Cumberland Plain Conservation Plan - a conservation plan for Western Sydney to 2056 (Department of Planning, Infrastructure and Environment, 2020a)
- Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020).

Previous surveys and assessments

The previous ecological assessments and surveys that have been undertaken within the study area and surrounds have been considered in the preparation of the Revised Biodiversity Development Assessment Report (Appendix C) and are provided in Table 7-25.

Table 7-25 Previous ecological investigations undertaken within the study area or immediate surrounds

Ecological Investigation	Reference
Environmental field survey of Commonwealth land at Creek	SMEC, 2014
Western Sydney Airport EIS – Biodiversity Assessment	Department of Infrastructure and Regional Development, 2016e
Western Sydney Airport EIS - Biodiversity Offset Package	Department of Infrastructure and Regional Development, 2016f
Western Sydney Airport – Biodiversity Assessment Report for land outside Stage 1 Development	Department of Infrastructure and Regional Development, 2018b
Western Sydney Airport – Biodiversity Offsets Delivery Plan	Commonwealth of Australia, 2018
Strategic assessment for Cumberland Plain Conservation Plan Expert report on the Cumberland Plain Land Snail, Meridolum corneovirens (Pfeiffer, 1851) in the Penrith, Western Sydney Aerotropolis, Greater Macarthur and Wilton Growth Areas	Clark, 2018

Ecological Investigation	Reference
Strategic Assessment for Cumberland Plain Conservation Plan Greater Macarthur and Wilton Growth Areas - Expert Report for Pimelea spicata Spiked Rice-flower	James, 2018
Strategic assessment for Cumberland Plain Conservation Plan *Hibbertia fumana*	Miller, 2018a
Strategic assessment for Cumberland Plain Conservation Plan *Hibbertia puberula* species group	Miller, 2018b
Strategic Assessment for the Little Eagle Hieraaetus morphnoides in the Greater Macarthur Growth Area and the Wilton Growth Area	Saunders and Debus, 2018
Strategic assessment for Cumberland Plain Conservation Plan Expert report on the Juniper-leaved Grevillea, *Grevillea juniperina* subsp. *juniperina* in the Greater Macarthur and Wilton Growth Areas	Weston, 2018a
Strategic assessment for Cumberland Plain Conservation Plan Expert report on *Pterostylis saxicola*, the Sydney Plains Greenhood, in the Greater Macarthur and Wilton Growth Areas	Weston, 2018b
Strategic assessment for Cumberland Plain Conservation Plan Expert report on the Juniper-leaved Grevillea, Grevillea juniperina subsp. juniperina in the Western Sydney Aerotropolis Growth Area, and Greater Penrith to Eastern Creek Urban Release Investigation Area	Weston, 2019a
Strategic assessment for Cumberland Plain Conservation Plan Expert report on the Sydney Plains Greenhood, Pterostylis saxicola in the Western Sydney Aerotropolis Growth Area, and Greater Penrith to Eastern Creek Urban Release Investigation Area	Weston, 2019b
Cumberland Plain Conservation Plan - Expert report for Dillwynia tenuifolia	Rymer, 2019
M12 Motorway Concept Design and EIS – Biodiversity Assessment	Transport for NSW, 2019c
Draft Cumberland Plain Conservation Plan – a conservation plan for Western Sydney to 2056	Department of Planning, Industry and Environment, 2020a
Draft Cumberland Plain Assessment Report	Open Lines and Biosis, 2020

Native vegetation

Stratification and verification of existing mapping

Preliminary mapping of vegetation community boundaries was undertaken through analysis of existing vegetation mapping and aerial photograph interpretation.

Vegetation within the study area and locality has been mapped at the regional scale in:

- Native vegetation of the Southeast NSW: Revised Classification and Map for the Coast and Eastern Tablelands (Tozer *et al*., 2010)
- The Native Vegetation of the Sydney Metropolitan Area (Office of Environment and Heritage, 2016b)
- Western Sydney Airport EIS – Biodiversity Assessment (Department of Infrastructure and Regional Development, 2016e)
- Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020).

Data on geology, dominant canopy species, native species richness, vegetation structure and condition was collected from areas able to be accessed during field surveys to validate and refine this existing vegetation mapping to determine their associated plant community type (PCT) in accordance with the BioNet Vegetation Classification System (Environment, Energy and Science Group, 2020).

Mapping of vegetation zones

The vegetation within the study area was firstly assessed to a PCT level and then aligned to a vegetation zone which is defined in the BAM as 'an area of native vegetation on the study area that is the same PCT and has a similar broad condition state' (Office of Environment and Heritage, 2017a).

A broad condition state infers that the vegetation has a similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes which determine vegetation condition.

The vegetation broad condition states which were applied to determine vegetation zones within the study area are summarised in Table 7-26. These factors were defined by using features such as levels of disturbance, weed invasion and resilience.

Justification for PCT selection within the study area was based on a quantitative analysis of vegetation integrity plot data using the Plant Community Identification tool (Environment, Energy and Science Group, 2020c) in accordance with Section 5.2.1.12 of the BAM.

Table 7-26 Vegetation broad condition states

Condition category	Description
Intact	This condition category was assigned to remnant or regrowth native vegetation with an intact overstorey, mid storey and ground strata. Vegetation in this condition is relatively undisturbed and generally displays limited exotic species diversity and abundance.
Thinned	Vegetation in this condition category included vegetation which has been disturbed i.e. under scrubbing and thinning of overstorey species. Vegetation displayed diversity of ground strata species which formed >50 per cent of the perennial understorey.
Scattered trees	Native canopy is present in this condition category and occurred as scattered individuals or as a group of remnant trees. Midstorey species were either absent or occurred as scattered individuals. Ground strata was dominated by exotic perennial species comprising >50 per cent of total plant foliage cover.
Low	This condition category was assigned to areas where ground stratum was dominated by native vegetation with exotic perennial species comprising <50 per cent of the ground strata. Native canopy was absent with midstorey was either absent or occurred as scattered individuals.

Paddock trees

Paddock trees are defined as isolated native trees that comprise a ground cover of less than 50 per cent native vegetation and are more than 50 metres from any other tree. The BAM provides a streamlined assessment module for the clearing of paddock trees which can be applied to land assessed under the *Local Land Services Act 2013* (LLS Act). As the study area falls within two local government areas (Penrith City Council & Liverpool City Council) identified as non-rural in the *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017*, the LLS Act does not apply.

As such, paddock trees have been assessed in accordance with Sections 4.6 of the BAM whereby a vegetation zone was assigned to each paddock tree. All paddock trees were assigned to "scattered tree" condition class as defined in Table 7-26.

PCTs were assigned based on landscape position, canopy species recorded and surrounding PCTs.

Vegetation integrity plots

A total of 21 vegetation integrity plots were completed for on-airport land in accordance with the BAM and as described below. A schematic diagram illustrating the layout of each vegetation integrity plot is provided in Figure 7-5.

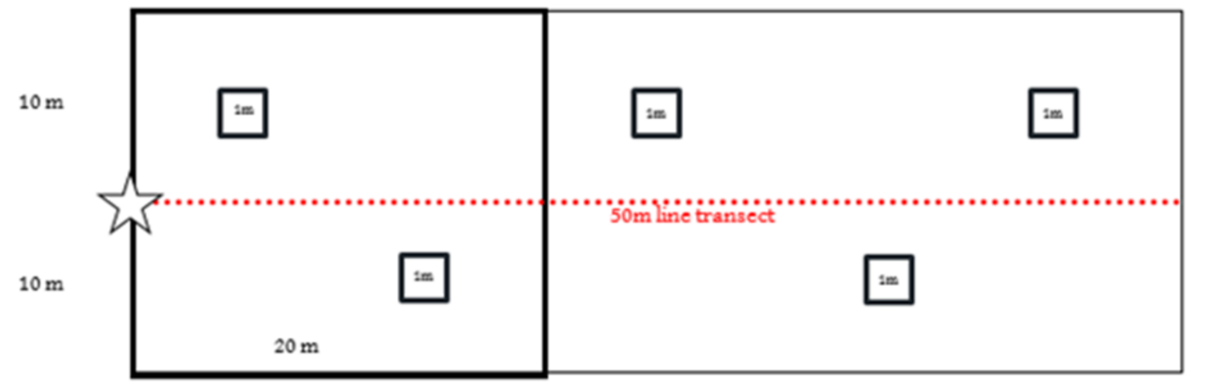


Figure 7-5 Vegetation integrity plot layout

The following site attributes were recorded at each vegetation integrity plot location:

- location (easting – northing grid type MGA 94, Zone 56)
- vegetation structure and dominant species and vegetation condition. Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer
- native and exotic species richness (within a 400-metre squared quadrat): This consisted of recording all species by systematically walking through each 20 metre x 20 metre plot. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded
- number of trees with hollows (1000 metre squared quadrat): This was the frequency of hollows within living and dead trees within each 50 metre x 20 metre plot. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least 5 centimetres across: (c) the hollow appeared to have depth: (d) the hollow was at least 1 metre above the ground and the (e) the centre of the tree was located within the sampled quadrat
- number of large trees and stem size diversity (1000 metre squared quadrat): tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 metre from the ground) of all living trees (>5 centimetre DBH) within each 50 metre x 20 metre plot. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCTs benchmarks
- total length of fallen logs (1000 metre squared quadrat): This was the cumulative total of logs within each 50 metre x 20 metre plot with a diameter of at least 10 centimetres and a length of at least 0.5 metre
- litter cover: This comprised estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter <10 centimetre which is detached from a living plant) from within five 1 metre x 1 metre sub-plots spaced evenly either side of the 50-metre central transect
- evaluation of regeneration: This was estimated as the presence/absence of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height ≤5 centimetre).

Prior to establishing plot survey locations, vegetation stratification was undertaken to provide a representative vegetation zone for sampling. Stratification involved marking waypoints and bearings randomly to provide a representative assessment of the vegetation integrity of the vegetation zone in the study area and establishing the required number of plots at some of these waypoints.

Vegetation integrity plots used for BAM calculations have been sampled within the broader study area. Given the relatively homogenous broad condition states for vegetation types, plots have been used across the study area rather than individual sampling for each on-airport section.

A comparison of the number of BAM survey plots that were completed and the required BAM plots per vegetation zones is provided in Table 7-27. Vegetation integrity plot locations and orientations are provided in Table 7-28.

Table 7-27 Comparison of number of plots required under the BAM and completed per vegetation zone for on-airport land

Vegetation type and zone	Condition	On-airport vegetation zone area (hectares)	BAM plot required	Number of plots completed
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	1.53	1	1 (Q2)
	Thinned	0.09	1	2 (Q10, Q23)
	Low	10.21	3	2 (Q8, Q9)[1]
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	4.05	1	4 (Q1, Q4, Q6, Q16)
	Scattered Trees	2.32	1	3 (Q5, Q15, Q18)
	Low	23.79	3	8 (Q11, Q12, Q13, Q14, Q17, Q28, Q31, Q32)
PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	0.01	1	1 (Q3)

1. An average of vegetation attributes collected during field survey have been used to inform the BAM Calculator

Table 7-28 Summary of vegetation integrity plots

Plot ID	Vegetation type and zone	Easting	Northing	Orientation (°)
Q1	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	288653	6246150	30
Q2	PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	288963	6246049	270
Q3	PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (Intact)	288862	6246124	320
Q4	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	288737	6246177	260
Q5	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)	288455	6246750	350
Q6	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	288653	6246150	90
Q8	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	289442	6246336	270
Q9	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	289996	6246717	235
Q10	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	290038	6246743	56
Q11	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	290606	6247771	90
Q12	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291654	6248244	280
Q13	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291677	6248341	70
Q14	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291507	6248265	270
Q15	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)	291840	6248354	160
Q16	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	290535	6247688	220
Q17	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	290705	6247716	50

Plot ID	Vegetation type and zone	Easting	Northing	Orientation (°)
Q18	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)	291423	6250270	130
Q23	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291411	625491	10
Q28	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291524	6255875	220
Q31	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291471	6255665	85
Q32	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291502	6255746	220

BAM approach

The study area has been divided into two distinct areas, off-airport and on-airport.

This approach was taken to generate individual credit calculations and offsetting requirements for each area using the BAM Calculator (version 1.2.7.2).

Vegetation Integrity Plots were undertaken following the methodology outlined in the BAM within the study area. Plots sampled across both areas were entered in the BAM Calculator in accordance with the minimum number of plots required per zone area (see Table 7-27) for each assessment. This approach was considered appropriate given the proximity between adjoining assessment areas and similar vegetation types and conditions recorded.

This approach is consistent with Section 2.2.2 of the BAM where the use of more appropriate local data which more accurately reflect local environmental conditions is used.

Terrestrial flora surveys

Threatened terrestrial flora surveys for the project were undertaken over a 18-day period between the 24-26 June 2019, 26 November 2019, 2-4 and 6 March 2020, 22-24 April 2020,10 June 2020, 15 October and 3, 9, 10, 16 and 20 November 2020. In addition, on-airport lands were also subject to targeted seasonal field surveys undertaken by Department of Infrastructure and Regional Development ((2016e) and SMEC (2014), findings from these assessments have been adopted for the assessment of on-airport lands and have been supplemented by the field surveys undertaken for the Revised Biodiversity Development Assessment Report (Appendix C).

Field surveys focused on the mapping of native and non-native vegetation types and targeting the possible presence of threatened flora species using a combination of vegetation integrity plots, random meanders and parallel field traverses generally in accordance with:

- *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft) (Department of Environment and Conservation, 2004)
- *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage, 2016c)
- *Surveying threatened plants and their habitats* (Department of Planning, Industry and Environment, 2020b) and the BAM (Office of Environment and Heritage, 2017a).

A detailed overview of terrestrial flora survey methods is presented below.

Random meander surveys

Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by Cropper (1993), whereby the recorder walks in a random meander throughout the study area recording dominant and key plant species (e.g. threatened species, priority weeds), boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Random meander surveys were undertaken in areas of highly disturbed vegetation and urban exotic vegetation as well as in areas of potential habitat for candidate threatened species. Where a threatened flora species was located, parallel field traverses were then conducted to determine the size and extent of the population.

Parallel field traverses

These involved two people walking a fixed bearing transect at 10 metre intervals over known or high likelihood potential habitat for candidate threatened flora species. These were restricted to areas of native vegetation.

Threatened flora habitat suitability assessment

The BAM Calculator was used to derive the list of candidate species, results were also supplemented with database searches, including a review of the Threatened Biodiversity Data Collection (Environment, Energy and Science Group, 2020d), to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the study area and broader locality. Additional species can be added to the BAM Calculator for further consideration if in the assessors' professional opinion, it is likely that the species would be present and/or the species has been recorded on or near the study area (Office of Environment and Heritage, 2018b).

Section 6.4 of the BAM sets out a process for determining candidate species which require further consideration (i.e. targeted seasonal surveys, expert reports).

A candidate species predicted by the BAM Calculator may be excluded from needing further assessment because of:

- ecological information about a species provided in Threatened Biodiversity Data Collection (Environment, Energy and Science Group 2020d) or published, peer reviewed literature, suggests that the species is unlikely to occur, or habitat is unlikely to be suitable (BAM Section 6.1.1.2)
- habitat constraints (defined in Threatened Biodiversity Data Collection (Environment, Energy and Science Group, 2020d)) are not present within the study area (BAM Section 6.4, step 2)
- habitat is not suitable because it is substantially degraded (BAM Section 6.4, step 3).

Each threatened flora species identified was subject to a habitat suitability assessment. These assessments considered microhabitats, soils, geologies, landscape position, vegetation types and condition within the study area and informed targeted field survey (i.e. optimal survey months). Species considered to have a low likelihood of occurrence and that did not require survey were dismissed at this habitat suitability assessment stage.

Candidate terrestrial threatened flora species and survey effort

A total of 35 threatened flora species were identified by the BAM Calculator across on-airport and off-airport land. Targeted survey effort on-airport lands were carried out by Department of Infrastructure and Regional Development (2016e and 2018a), and SMEC (2014) previously and supplemented by the field surveys undertaken in 2020 for the Revised Biodiversity Development Assessment Report (Appendix C).

A summary of survey effort for each candidate threatened flora species and section of the study area is outlined in Table 7-29.

Table 7-29 Candidate threatened flora species and survey effort

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential habitat[2]	Survey months[3]	Survey effort
Acacia bynoeana	Bynoe's Wattle	E	V	PCT 724 & 849	All year	No survey required due to low likelihood of occurrence (Department of Infrastructure and Regional Development, 2016e and 2018a).
Acacia pubescens	Downy Wattle	V	V	PCT 724 & 849	All year	4 days: 2-4, 6 March 2020 (BDAR, Appendix C) 5 days March-April 2017 (Department of Infrastructure and Regional Development, 2018a) 18 days: Feb-June 2015; April 2016 (Department of Infrastructure and Regional Development, 2016e) 3 days: September, 2014 (SMEC, 2014)
Cynanchum elegans	White-flowered Wax Plant	E	E	PCT 835 & 849	All year	4 days: 2-4, 6 March 2020 (BDAR, Appendix C) 5 days March-April 2017 (Department of Infrastructure and Regional Development, 2018a) 18 days: Feb-June 2015; April 2016 (Department of Infrastructure and Regional Development, 2016e) 3 days: September, 2014 (SMEC, 2014)
Dillwynia tenuifolia	-	V	-	PCT 724 & 849	Aug-Oct	5 days March-April 2017 (Department of Infrastructure and Regional Development, 2018a) 3 days: September, 2014 (SMEC 2014);
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V	-	PCT 724 & 849	All year	4 days: 2-4, 6 March 2020 (BDAR, Appendix C) 18 days: Feb-June 2015; April 2016 (Department of Infrastructure and Regional Development, 2016e) 3 days: September, 2014 (SMEC, 2014) Expert report relied upon for this species (Weston, 2018)
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	PCT 724	Aug-Nov	3 days: September, 2014 (SMEC, 2014)

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential habitat[2]	Survey months[3]	Survey effort
Marsdenia viridiflora subsp. viridiflora - Endangered population	Marsdenia viridiflora R. Br. subsp. viridiflora population	E	-	PCT 724, 835, 849 & 1800	Nov-Feb	5 days March-April 2017 (Department of Infrastructure and Regional Development, 2018a) 18 days: Feb-June 2015; April 2016 (Department of Infrastructure and Regional Development, 2016e) 3 days: September, 2014 (SMEC, 2014)
Micromyrtus minutiflora	-	E	V	PCT 724	All year	Potential habitat not recorded.
Persoonia nutans	Nodding Geebung	E	E	PCT 724	All year	No survey required due to low likelihood of occurrence (Department of Infrastructure and Regional Development, 2016e).
Pimelea curviflora var. curviflora	-	V	V	PCT 849	Oct-Mar	No survey required due to low likelihood of occurrence (Department of Infrastructure and Regional Development, 2016e).
Pimelea spicata	Spiked Rice-flower	E	E	PCT 849	All year	4 days: 2-4, 6 March 2020 (BDAR, Appendix C) 5 days March-April 2017 (Department of Infrastructure and Regional Development, 2018a) 18 days: Feb-June 2015; April 2016 (Department of Infrastructure and Regional Development, 2016e) 3 days: September, 2014 (SMEC, 2014)
Pomaderris brunnea	Brown Pomaderris	E	V	PCT 835 & 1800	Aug-Oct	18 days: Feb-June 2015; April 2016 (Department of Infrastructure and Regional Development, 2016e) 3 days: September, 2014 (SMEC, 2014)
Pterostylis saxicola	Sydney Plains Greenhood	E	E	PCT 849	Oct	Field surveys not conducted within optimal survey months. Expert report relied upon for this species (Weston, 2018)
Thesium australe	Austral Toadflax	V		PCT 849	Nov-Feb	18 days: Feb-June 2015; April 2016 (Department of Infrastructure and Regional Development, 2016e) 3 days: September, 2014 (SMEC, 2014)

1. V = Vulnerable, E = Endangered, CE = Critically Endangered under the NSW BC Act or Commonwealth EPBC Act
2. Associated vegetation types were obtained from the Threatened Biodiversity Data Collection (EES, 2020d)
3. Optimal survey months were obtained from the BAM-C and cross-referenced with the Threatened Biodiversity Data Collection (EES, 2020d)

Terrestrial fauna surveys

Targeted survey effort within on-airport lands were carried out by GHD (2016) and SMEC (2014).

Fauna surveys undertaken through the study area were carried out with reference to various survey guidelines including:

- *'Species Credit' threatened bats and their habitats* (Office of Environment and Heritage, 2018b)
- *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft) (Department of Environment and Conservation, 2004)
- *Survey Guidelines for Australia's Threatened Birds* (Department of Environment Water Heritage and the Arts, 2010a)
- *Threatened Species survey and assessment guidelines: field survey and methods for fauna-Amphibians* (Department of Environment and Climate Change, 2009b)
- *Survey guidelines for Australia's threatened frogs* (Department of the Environment Water Heritage and the Arts, 2010b).

A summary of methods and survey effort is provided below.

Habitat assessment

Fauna habitat assessments were undertaken throughout the study area, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, nest trees, vegetation patch size, connectivity, density of understorey vegetation, level of disturbance, the composition of ground cover, the soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted.

Habitat assessments included searches for resources of potential value to threatened fauna, including:

- wetlands, ponds, drains, dams that could provide habitat for frogs and threatened migratory birds
- trees with bird nests or other potential fauna roosts (with a focus on searching for raptor nests)
- hollow-bearing trees (with a focus on searching hollows great than 20 centimetre diameter suitable for owls and large cockatoos)
- specific food trees (e.g. Winter flowering trees that may be important for the Grey-headed Flying-fox and Swift Parrot)
- rocky outcrops and ground debris
- evidence of fauna species included searches for:
  - distinctive scats or latrine sites, owl white wash and regurgitated pellets under roost sites
  - tracks or animal remains
  - evidence of activity such as feeding scars, scratches and diggings
  - evidence of foraging.

Evaluation criteria used to assess fauna habitat value is provided in Table 7-30.

Table 7-30 Fauna habitat assessment evaluation criteria

Habitat value	Evaluation criteria
Good	A full range of fauna habitat components are usually present (for example, old growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
Moderate	Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
Poor	Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

Herpetofauna searches

Herpetofauna active searches during the day and at night, involved looking for active specimens and eye shine, turning over suitable ground shelter, such as fallen timber, sheets of iron and rubbish, raking debris, and peeling decorticating bark. Specimens were either identified visually, by aural recognition of call (frogs only) or were collected and identified using nomenclature outlined in *A Field Guide to Reptiles of New South Wales* (Swan et al., 2004).

Herpetofauna surveys were completed by one or two persons over a 30-minute period with all ground shelter returned to their original position. Herpetofauna active searches were completed in conjunction with diurnal and nocturnal field surveys. Frogs and reptiles were also surveyed opportunistically during all other field surveys in the study area.

Active invertebrate searches

Active invertebrate searches involve diurnal hand searches (i.e. disturbance of habitat) and visual searches targeting specific habitat. In relation to threatened invertebrate species (Cumberland Plain Land Snail) specific habitat preferences include under logs and other debris, amongst leaf litter and bark accumulations around bases of trees and sometimes in clumps of grass. Invertebrates are also known to shelter under rubbish, disposed building materials and abandoned car parts (National Parks and Wildlife Service, 2000).

Microchiropteran bat surveys (Ultrasonic Anabat bat detection)

Microbat ultrasonic echolocation call recordings were undertaken to identify the species of microbats foraging across several native vegetation communities in the study area. Passive monitoring of these survey sites was achieved by setting an Anabat Swift bat detector (Titley Scientific) to record continuously throughout the evening within the study area. Active surveys for the Southern Myotis were undertaken at farm dams on the study area with a handheld Echometer Touch (Wildlife Acoustics, USA) and headtorch.

Diurnal bird surveys

Formal 20-minute diurnal bird searches were completed within the study area. Bird surveys were completed by actively walking through the study area over a period of 20 minutes. All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed during different times of the day, but generally occurred during morning hours or evening. Birds were also recorded opportunistically during all other field surveys.

Call playback

Call playback was used to survey for frogs (i.e. Green and Golden Bell Frog), nocturnal birds (i.e. Powerful Owl) and nocturnal mammals, using standard methods. Call playback was completed after dusk within several sites in the off-airport non-restricted areas around key fauna habitat such as ephemeral creeks, farm dams or remnant vegetation.

For frog surveys, an initial listening period of 5 minutes was undertaken. The call of the Green and Golden Bell Frog was then played for 1 minute, followed by a 5-minute listening period. Nocturnal call playback surveys were followed by a spotlight search for 10 minutes to detect any frogs present but not calling. Calls from the Australian Museum FrogID App were broadcast using a portable media player and bluetooth speaker.

For threatened owl surveys, an initial listening period of 10 minutes was undertaken. The calls of the target species were then played for three 2 minute intervals followed by three listening periods. A spotlight search was undertaken for 10 minutes after call playback to identify any owls that may have responded by flying quietly to the playback site. Calls were broadcast using a portable media player and bluetooth speaker.

Threatened fauna habitat suitability assessment

The BAM Calculator was used to derive the list of candidate species, results were also supplemented with database searches, including a review of the Threatened Biodiversity Data Collection (EES, 2020d), to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the study area and broader locality. Additional species can be added to the BAM Calculator for further consideration if in the assessor's professional opinion, it is likely that the species would be present and/or the species has been recorded on or near the study area (Office of Environment and Heritage, 2018b).

These searches returned a list of threatened fauna species identified as Candidate species and/or Predicted species. Each species was subject to a habitat suitability assessment for on-airport and off-airport land areas of the study area.

The BAM does not require further assessment of NSW-listed Predicted species, as these species are associated with specific PCTs and their presence in these PCTs is assumed for the purposes of the BAM.

Section 6.4 of the BAM sets out a process for determining candidate species which require further consideration (i.e. targeted seasonal surveys, expert reports).

A candidate species predicted by the BAM Calculator may be excluded from needing further assessment because of:

- ecological information about a species provided in Threatened Biodiversity Data Collection (Environment, Energy and Science Group, 2020d) or published, peer reviewed literature, suggests that the species is unlikely to occur, or habitat is unlikely to be suitable (BAM Section 6.1.1.2)
- habitat constraints (defined in Threatened Biodiversity Data Collection (Environment, Energy and Science Group, 2020d)) are not present within the study area (BAM Section 6.4, step 2)
- habitat is not suitable because it is substantially degraded (BAM Section 6.4, step 3).

These assessments considered microhabitats, soils, geologies, landscape position, vegetation types and condition within the study area and informed targeted field survey (i.e. optimal survey months).

Candidate terrestrial threatened fauna species and survey effort

A total of 47 threatened fauna species were identified by the BAM Calculator and Candidate species across off-airport and on-airport land. Of these, 12 were considered likely to occur based on geographic limitations, habitat constraints and professional opinion. These species were the focus of detailed targeted surveys.

Targeted surveys within on-airport lands were carried out by Department of Infrastructure and Regional Development (2016e; 2018a) and SMEC (2014). Candidate species which did not require survey were dismissed during habitat suitability assessments or are predicted species and can be reliably predicted through habitat surrogates.

A summary of survey effort for each candidate threatened fauna species and section of the study area is outlined in Table 7-31.

Table 7-31 Candidate threatened fauna species and survey effort

Scientific name	Common name	BC Act[1]	EPBC Act[1]	Potential breeding habitat[2]	Survey months[3]	Survey effort (on-airport)
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Eucalypt tree species with hollows greater than 9 centimetres diameter.	Oct-Jan (Breeding)	Diurnal bird surveys: 17 days; May-June, 2015 (Department of Infrastructure and Regional Development, 2016e) Opportunistic surveys: 18 days; Feb-June 2015 (Department of Infrastructure and Regional Development, 2016e)
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Living or dead tree with hollows greater than 15 centimetres diameter and greater than 5 metres above ground.	Mar-Aug (Breeding)	Diurnal bird surveys: 10 days; May-June, 2015 (GHD, 2016) Opportunistic surveys: 18 days; Feb-June 2015 (Department of Infrastructure and Regional Development, 2016e)
Hieraaetus morphnoides	Little Eagle	V	-	Nest trees - live (occasionally dead) large old trees within vegetation.	Aug-Oct (Breeding)	Diurnal bird surveys: 10 days; May-June, 2015 (GHD, 2016) Opportunistic surveys: 18 days; Feb-June 2015 (Department of Infrastructure and Regional Development, 2016e)
Lathamus discolor	Swift Parrot	E	CE	The species is only present during March to September - winter migrant to NSW. Breeding constraint: As per mapped areas in the National Recovery Plan	No survey required	Diurnal bird surveys: 17 days; May-June, 2015 (Department of Infrastructure and Regional Development, 2016e)
Litoria aurea	Green and Golden Bell Frog	E	V	Wet areas, swamps, waterbodies or within 1 kilometre of these areas	Nov-Mar	Four nights of targeted surveys in March, 2015 at the airport site and three nights surveying a reference site (Homebush population) (Department of Infrastructure and Regional Development, 2016e)

Scientific name	Common name	BC Act[1]	EPBC Act[1]	Potential breeding habitat[2]	Survey months[3]	Survey effort (on-airport)
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	-	All year	Invertebrate active searches: 11 days: Mar-May, 2015 (Department of Infrastructure and Regional Development, 2016e)
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	Dec-Feb (Breeding)	Anabats: two units for 9 nights in March and April, 2015, 3 nights in May (Department of Infrastructure and Regional Development, 2016e)
Myotis macropus	Southern Myotis	V	-	Breeding requirements (HBTs within 200 metres of riparian zone and waterbodies within 200 metres of the study area) not recorded within the study area	Nov-Mar	Anabats: two units for 9 nights in March and April, 2015, 3 nights in May (Department of Infrastructure and Regional Development, 2016e)
Ninox connivens	Barking Owl	V	-	Living or dead trees with hollows greater than 20 centimetres diameter and greater than 4 metres above the ground	May-Dec (Breeding)	Call-playback: 9 nights: Mar - May 2015 (Department of Infrastructure and Regional Development, 2016e) Habitat assessments: 18 days Feb – June 2015 (Department of Infrastructure and Regional Development, 2016e)
Ninox strenua	Powerful Owl	V	-	Living or dead trees with hollows greater than 20 centimetres diameter and greater than 4 metres above the ground	May-Aug (Breeding)	Call-playback: 9 nights: Mar - May 2015 (Department of Infrastructure and Regional Development, 2016e) Habitat assessments: 18 days Feb – June 2015 (Department of Infrastructure and Regional Development, 2016e)

Scientific name	Common name	BC Act[1]	EPBC Act[1]	Potential breeding habitat[2]	Survey months[3]	Survey effort (on-airport)
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Breeding camps	All year	Bird surveys (nocturnal): 12 nights Mar-May, 2015 (Department of Infrastructure and Regional Development, 2016e) Habitat assessment: Feb-June 2015 (Department of Infrastructure and Regional Development, 2016e)
Tyto novaehollandiae	Masked Owl	V	-	Living or dead trees with hollows greater than 20 centimetres diameter and greater than 4 metres above the ground	May-Aug (Breeding)	Call-playback: 9 nights: Mar - May 2015 (Department of Infrastructure and Regional Development, 2016e) Habitat assessments: 18 days Feb – June 2015 (Department of Infrastructure and Regional Development, 2016e)

1. V = Vulnerable, E = Endangered under the NSW BC Act or Commonwealth EPBC Act
2. Breeding habitat constraints were obtained from the Threatened Biodiversity Data Collection (EES, 2020d)
3. Optimal survey months were obtained from the BAM-C and cross-referenced with the Threatened Biodiversity Data Collection (EES, 2020d)

Determining the site context

To determine site context as required under Section 4.3 of the BAM, an assessment of native vegetation cover and patch size in accordance with subsections 4.3.2 and 5.3.2 of the BAM have been undertaken.

Groundwater dependent ecosystems

Groundwater dependent ecosystems within the on-airport study area were identified using the *Atlas of Groundwater Dependent Ecosystems* (Australian Bureau of Meteorology 2020).

Geospatial data showing the groundwater drawdown results for the proposed action was then overlaid with the mapping of groundwater dependent ecosystems to identify potential impacts.

Aquatic ecology

Aquatic habitats within the study area were assessed against the policy and guidelines for fish habitat conservation and management – Update 2013 (NSW Department of Primary Industries, 2013) and Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003). The Aquatic Ecology in Environmental Impact Assessment – EIA Guideline (Lincoln Smith, 2003) was used to guide the level of aquatic assessment required. There is sufficient existing information from previous studies to describe the existing aquatic environment and to assess the quality and importance of the aquatic environments potentially impacted.

Searches of databases, existing mapping and other literature were used to identify aquatic biodiversity values. The sources reviewed included:

- Fisheries Spatial Data Portal (freshwater threatened species maps)
- Protected Matters Search Tool
- Key Fish Habitat mapping.

The aquatic ecology assessment for the proposed action incorporates a desktop assessment and field verified aquatic habitat assessments (where access was available). The desktop assessment for the proposed action incorporates results from detailed existing aquatic assessments undertaken for on-airport (Department of Infrastructure and Regional Development, 2016e).

The aquatic ecology assessment undertaken for the *Western Sydney Airport – Environmental Impact Statement* (Department of Infrastructure and Regional Development 2016b) provides sufficient information for assessment of the on-airport lands. It should be noted that Badgerys Creek forms the boundary of Western Sydney International and does not fall directly within the study area. Badgerys Creek is considered further within the on-airport assessment as it is within 200 metres of the proposed action study area and could be subject to potential indirect impacts.

The aquatic ecology assessment undertaken for the Western Sydney Airport – Environmental Impact Statement identifies the habitat quality and in-stream physical habitat of the waterways on and adjacent to the airport land including Badgerys Creek, Oaky Creek, Cosgroves Creek, South Creek and Thompsons Creek.

The habitat assessment of in-stream physical habitat was conducted at survey sites upstream and downstream of the airport land and involved detailed assessments of the substrata and water channel and an on-site assessment of hydraulic habitat features and suitability for threatened aquatic species (Department of Infrastructure and Regional Development, 2016e). Water quality sampling was also conducted using a water quality meter to record in-situ parameters and alkalinity was tasted via the use of in field titration kits (Department of Infrastructure and Regional Development, 2016e).

Water quality grab samples were also collected to test for conductivity and to test for the presence of metals, nutrients, BTEX (benzene, toluene, ethylbenzene and xylenes), hydrocarbons and other constituents (Department of Infrastructure and Regional Development, 2016e). Macroinvertebrates were sampled in accordance with AUSRIVAS sampling protocols (Department of Infrastructure and Regional Development, 2016e). Fish surveys were undertaken using fyke netting and bait trapping (Department of Infrastructure and Regional Development, 2016e).

Prescribed impacts

Prescribed impacts include impacts on biodiversity values other than clearing of native vegetation or loss of habitat. For example, the removal of non-native vegetation and human-made structures, or impacts on the movement of threatened species that maintains their life cycle.

Relevant prescribed impacts have been assessed for the construction and operation of the proposed action in accordance with Section 9.1.1.2 and 9.2 of the BAM.

7.3.4 Potential impacts – construction

The main impacts on biodiversity during the construction phase would be:

- clearing of native vegetation
- clearing of TECs
- removal of threatened species and/or their habitat.

No threatened fish species listed under the FM Act or EPBC Act were recorded or considered likely to occur within the study area (both off-airport and on-airport) and as such the proposed action is unlikely to significantly impact any threatened aquatic species or their habitats.

Direct impacts

Native vegetation

Direct clearing impacts on native vegetation for on-airport works (outside of the Western Sydney International Stage 1 Construction Impact Zone) are presented in Table 7-32.

Table 7-32 Direct impact to native vegetation (on-airport)

Plant community type	Condition	Area (Ha)
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	1.53
	Thinned	0.09
	Low	10.21
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	4.05
	Scattered Trees	2.32
	Low	23.79
PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	0.01
Total		**42**

Threatened ecological communities

Direct impacts on threatened ecological communities listed under the BC Act and EPBC Act for on-airport works are presented in Table 7-33.

The potential impacts of the proposed action on the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest TEC is based on a worst-case scenario. Opportunities throughout design development and construction management would aim to further minimise these impacts. The proposed action would not create new areas of fragmentation to the TEC. The proposed action is considered unlikely to cause a substantial change in the species composition of the TEC or exacerbate invasive species such that it would substantially reduce the quality or integrity of the TEC occurrence.

Table 7-33 Direct impact to TECs listed under the BC Act and EPBC Act (on-airport)

Threatened Ecological Community	Conservation status[1]	Area (Ha)
BC Act		
Cumberland Plain Woodland in the Sydney Basin Bioregion	CE	30.16
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	11.83
Total		**41.99**
EPBC Act[2]		
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	3.94
Total		**3.94**

1. E = Endangered, CE = Critically Endangered under the BC Act and EPBC Act
2. EPBC Act vegetation also forms part of the BC listed vegetation

Threatened species

Direct impacts on threatened species and/or their habitats listed under the BC Act and EPBC Act for on-airport works are presented in Table 7-34.

Table 7-34 Direct impact to threatened species habitat (on-airport)

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	PCT	Zone	Impact
Threatened fauna						
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	835, 849	Intact and scattered trees	5.57 ha
Myotis macropus	Southern Myotis	V	-	835	Intact	0.05 ha

1. E = Endangered, V = Vulnerable under the BC Act
2. EPBC Act vegetation also forms part of the BC listed vegetation

Indirect impacts

Potential indirect biodiversity impacts for on-airport works (outside of the Western Sydney International Stage 1 Construction Impact Zone and within the construction footprint) are presented in Table 7-35.

Table 7-35 Indirect impacts (on-airport)

Indirect impact	Description
Inadvertent impacts on adjacent habitat or vegetation	Sediment-laden runoff and spills could adversely affect water quality and aquatic life, particularly during construction near creek lines and Key Fish Habitats. These impacts have the potential to reduce the viability of habitat for aquatic and semi aquatic species temporarily. The proposed action has been designed to minimise impacts on these sensitive environmental receivers through the tunnel beneath the Environmental Conservation Zone associated with Badgerys Creek riparian area. The mobilisation of sediments would be contained within the construction footprint as sediment containment measures would be implemented to minimise impacts.

Indirect impact	Description
Reduced viability of adjacent habitat due to edge effects	Potential edge effects during construction include increased noise, dust and light, erosion and sedimentation, introduction of weeds, and the associated degradation of vegetation at the interface of intact vegetation and cleared areas as part of the study area. Edge effects have the potential to impact on a range of flora and fauna species identified as occurring or having the potential to occur within the study area. Most of the study area within the on-airport section of the project contain patches of native vegetation that are highly degraded and fragmented, with limited or no habitat connectivity. Edge effects are considered unlikely to extend beyond the proposed action's construction footprint and/or would be avoided through mitigation and management measures.
Reduced viability of adjacent habitat due to noise, dust or light spill	Noise and vibration from activities associated with the proposed action would potentially disturb fauna and may disrupt foraging, reproductive, or movement behaviours. Elevated levels of dust may be deposited onto the foliage of vegetation adjacent to construction activities impacting on the overall health of the vegetation. However, deposition of dust on foliage is likely to be highly localised, intermittent and temporary and is therefore not considered likely to be a major impact of the project. Ecological light pollution includes light pollution such as direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting that can have potentially adverse effects on wildlife. Ecological light pollution may potentially impact nocturnal fauna by interrupting their lifecycle. Some species (i.e. light tolerant microchiropteran bats) may benefit from the lighting due to increased food availability (insects attracted to lights).
Transport of weeds and pathogens from the site to adjacent vegetation	Construction activities, in general, have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into native vegetation and habitats. The clearing of native vegetation would increase the potential for weed invasion into native vegetation adjacent to the construction footprint. The potential impact of pathogens and/or weeds are unlikely to extend beyond the construction footprint and/or would be avoided through mitigation measures.
Increased risk of starvation, exposure and loss of shade or shelter	An increase in the risk of starvation, exposure and loss of shade or shelter for flora and fauna species is considered unlikely to extend beyond the proposed action's construction footprint and would be avoided through mitigation and management measures.
Loss of breeding habitats	The loss of breeding habitat such as hollow-bearing trees has the potential to affect native animals such as hollow-dependent bats, hollow-nesting and canopy-nesting birds, arboreal mammals and reptiles. The loss of breeding habitats is unlikely to extend beyond the proposed action's construction footprint. Impacts beyond this area would be avoided through mitigation measures.
Impacts on groundwater dependent ecosystems	Potential impacts on groundwater dependent ecosystems include changes to groundwater level and flow resulting from groundwater drawdown during excavation works. Based on the *Sydney Metro – Western Sydney Airport, Groundwater assessment* (Sydney Metro, 2020d), there are no significant groundwater drawdown impacts expected to native vegetation within Western Sydney International. This is consistent with findings of previous ecological assessment (Department of Infrastructure and Regional Development, 2016e).

Prescribed impacts

As outlined in Section 7.3.3 relevant prescribed impacts have been assessed for construction of the project in accordance with the BAM. These potential prescribed impacts during construction are all located off-airport.

Key Threatening Processes

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or an ecological community. KTPs are listed under the BC Act, FM Act and EPBC Act.

The proposed action would have a moderate-high likelihood of directly or indirectly contributing to KTPs listed under the BC Act, FM Act and EPBC Act that are identified in Table 7-36. Standard mitigation measures would be implemented to further reduce the chances of those KTPs occurring.

Table 7-36 Relevant Key Threatening Processes

Relevant Key Threatening Process	BC Act, EPBC Act, FM Act	Likelihood of the project directly or indirectly contributing to the KTP
Clearing of native vegetation	BC Act	High - clearing of native vegetation would occur.

7.3.5 Potential impacts – operation

This section presents the potential impacts of the proposed action on biodiversity during operation which have not been avoided through the design and construction planning for the project.

The main impacts on biodiversity during operation are:

- indirect impacts on adjacent vegetation and habitat during operation
- impacts on adjacent vegetation and habitat arising from a change in land-use patterns
- prescribed biodiversity impacts during operation.

Operational impacts are considered likely to extend beyond the construction footprint. On-airport biodiversity impacts during operation are summarised in Table 7-37.

Table 7-37 Biodiversity operational impacts (on-airport)

Operational biodiversity impact	Nature	Extent
Reduced viability of adjacent habitat due to light pollution	Ecological light pollution is the descriptive term for light pollution that includes direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting (including lights from a passing vehicles), that can have potentially adverse effects on wildlife. The immediate area surrounding the proposed action would have areas lit during operation and subject to artificial lighting, essentially creating permanent 'daylight' conditions. Light pollution may potentially affect nocturnal fauna by interrupting their life cycle. Some species (i.e. light tolerant microchiropteran bats) may benefit from the lighting due to increased food availability (insects attracted to lights) around these areas. Due to the frequency and sustained nature of the lighting, it is likely that animals would alter their behaviour in response to the light disturbance and a long-term impact around lighting is likely	Western Sydney International is proposed to be operational 24 hours a day, 7 days a week and would result in more significant light spill impacts compared to the proposed action. The potential for light spill impacts on fauna as a result of the proposed action is therefore considered to be minor
Aquatic ecology - changes to duration of flood inundation	The flooding assessment for the proposed action (refer to Section 7.6) assumes the Stage 1 development of Western Sydney International is complete and operational. Changes to duration of inundation within Western Sydney International as a result of the proposed action are predicted to be minimal. There are localised areas along Badgerys Creek where durations have increased, but these are small areas that correlate with the newly inundated areas and are not considered to be a significant impact. The detailed assessment of this modelling is provided in *Sydney Metro – Western Sydney Airport, Flooding, Hydrology and Water Quality Assessment* (Sydney Metro, 2020e).	Areas associated with waterways and water bodies, specifically Badgerys Creek
Aquatic ecology – change in flood level and extent (afflux)	The changes in flood level and extent (afflux) on-airport from the proposed action are not substantial and are isolated to one location within Western Sydney International. The potential permanent spoil placement area to the west is located across a main overland flow path that discharges to Badgerys Creek, causing changes to flood behaviour through redistribution of floodwaters. The potential permanent spoil placement area to the east is located across two minor overland flow paths that combine beyond this spoil placement area and discharge into Badgerys Creek. These overland flow paths are currently influenced by the adjacent land uses and while the spoil placement areas will impact these overland flow paths, flood compatible design will minimise the impacts.	Areas associated with waterways and water bodies, specifically Badgerys Creek
Aquatic ecology - water quality	The most likely source of pollutants from the proposed action would be the transformation of pervious areas to impervious surfaces. This would potentially cause impacts on the water quality of the receiving waterways through increased runoff volumes and increased pollutant loads, sedimentation or erosion. Station areas would feature areas of increased pedestrian and vehicle traffic which would potentially generate pollutants.	Areas associated with waterways and water bodies in association with on-airport lands, specifically Badgerys Creek

7.3.6 Conservation advices

The relevant conservation advices for MNES species and communities to be impacted by the proposed action were referenced and considered throughout the preparation of the Revised Biodiversity Development Assessment Report (Appendix C).

In particular, for on-airport impacts to MNES and relevant conservation advices and recovery plans, there is one TEC listed under the EPBC Act that occurs within the on-airport land to be impacted by the proposed action, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

The following conservation advices were reviewed and referenced in the assessment of the project impacts to this TEC:

- Department of Environment and Conservation (2005). Recovering bushland on the Cumberland Plain - Best practice guidelines for the management and restoration of bushland. Hurstville, Department of Environment and Conservation
- Department of Environment and Water Resources (2007). Cumberland Plain Woodlands. Advice to the Minister for the Environment and Water Resources from the Endangered Species Scientific Subcommittee (ESSS) on a project to add an ecological community to Schedule 2 of the *Endangered Species Protection Act 1992* (ESP Act). Department of Environment and Water Resources
- Department of Environment Climate Change and Water (2010a). Cumberland Plain Recovery Plan. C. C. a. W. Department of Environment. Sydney, Department of Environment, Climate Change and Water
- NSW Scientific Committee (1997). Final determination to list Cumberland Plain Woodland as an endangered ecological community. Hurstville, NSW National Parks and Wildlife Service
- NSW Scientific Committee (2008). "Preliminary determination to list Cumberland Plain Woodland in the Sydney Basin Bioregion as a Critically Endangered Ecological Community." from **http://www.environment.nsw.gov.au/determinations/cumberlandplainpd.htm**
- SW Scientific Committee (2011). "Final determination to list Cumberland Plain Woodland in the Sydney Basin Bioregion as a Critically Endangered Ecological Community." from **http://www.environment.nsw.gov.au/determinations/cumberlandwoodlandsFD.htm**
- Office of Environment and Heritage (2017b). "Cumberland Plain Woodland in the Sydney Basin Bioregion - Profile.".

There is one fauna species, Grey-headed Flying-fox, listed under the EPBC Act that has potential foraging habitat within the on-airport land to be impacted by the proposed action.

The following conservation advices were reviewed and referenced in the assessment of the potential impacts to this species:

- Department of Environment, Climate Change and Water NSW (2009). *Draft National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus*. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.

There are no flora species listed under the EPBC Act that occurs within the on-airport land to be impacted by the proposed action.

There are no aquatic species listed under the EPBC Act that occurs within the on-airport land to be impacted by the proposed action.

7.3.7 Recovery and threat abatement plans

The relevant recovery and threat abatement plans considered throughout the preparation of this assessment are outlined below.

Grey-headed Flying-fox

The NSW Draft Recovery Plan (DECCW 2009) for the Grey-headed Flying-fox outlines criteria for foraging habitat that can be considered critical to survival of the Grey-headed Flying-fox, being:

- productive during winter and spring
- known to support populations of > 30,000 individuals within an area of 50 kilometre radius.

With reference to DAWE's National Flying-fox monitoring viewer, there are no recorded Flying-fox camps within the study area (DAWE, 2020d). The closest existing camp to the study area is located at Ropes Creek, approximately five kilometres to the northeast of the study area, with anywhere from 500 to 10,000 individuals counted during surveys between 2013 and 2019. Based on a review of the National Flying-fox monitoring viewer, there are therefore likely to be >30,000 individuals of the species within a 50 kilometres radius of the study area.

Occurrences of this species within the study area are not at the limits of the species' distribution, nor are any maternity camps present. As such, the study area can only be considered to represent a part of the foraging range of widely occurring individuals. An abundance of similar or high quality foraging habitat occurs in the wider locality (>1700 hectares of mapped native vegetation (Tozer, Turner et al. 2010)). Approximately 1700 hectares of potential foraging habitat in the form of native vegetation has been mapped within 10 kilometres of the study area which is accessible to this species. The proposed action would result in the potential removal of up to eight hectares or some 0.5 percent of available foraging habitat for this species within 10 kilometres. Cumulative impacts on Grey-headed Flying-fox foraging habitat as a result of the project are discussed in the Revised Biodiversity Development Assessment Report (Appendix C).

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

The Cumberland Plain Recovery Plan (Department of Environment Climate Change and Water, 2010) lists the activities to assist the community's recovery. The proposed action is likely to interfere with one activity listed being, *protect habitat by minimising further clearing*.

7.4 Non-Aboriginal heritage

This section provides a summary of the assessment of impacts to non-Aboriginal heritage during construction and operation of the proposed action. Further detail is provided in *Sydney Metro – Western Sydney Airport, Non-Aboriginal Heritage Assessment* (Sydney Metro, 2020f).

7.4.1 Overview

Potential non-Aboriginal heritage impacts have been avoided and minimised where possible. There are several listed and potential non-Aboriginal heritage items within the on-airport environment. The proposed action is not expected to impact these items. Design development for the proposed action would continue to identify opportunities to minimise adverse impacts on heritage buildings, elements, fabric, spaces and vistas that contribute to the overall heritage significance of heritage items.

7.4.2 Legislative and policy context

The relevant legislative and policy context relating to the non-Aboriginal heritage assessment within the airport site include:

- Airports Act
- Airports (Environment Protection) Regulations
- EPBC Act
- Airport Plan

- *Western Sydney Airport European and Other Heritage Construction Environmental Management Plan* (Western Sydney Airport, 2019e).

7.4.3 Assessment methodology

Study area

The study area for the non-Aboriginal heritage assessment was defined as the construction footprint, comprising all the areas of surface level ground disturbance and an additional 100 metre buffer, as well as the surface area above tunnelled sections.

Historic review

Previous heritage studies undertaken for other projects were reviewed to understand their impacts to non-Aboriginal heritage items within the study area including the non-Aboriginal heritage assessment prepared for the *Western Sydney Airport Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b). Listed and potential heritage items within Western Sydney International have been or will be removed and managed in accordance with the *Western Sydney Airport European and Other Heritage Construction Environmental Management Plan* and the Airport Plan for Western Sydney International. As such, no further consideration of these impacts is required for the proposed action.

7.4.4 Potential impacts

There are several listed and potential non-Aboriginal heritage items within the on-airport environment. The *Western Sydney Airport European and Other Heritage Construction Environmental Management Plan* for Western Sydney International contains protocols for the management of these items. The proposed action is not expected to impact these items.

7.5 Aboriginal heritage

This section provides a summary of the assessment of impacts to Aboriginal heritage during construction and operation of the proposed action.

7.5.1 Overview

Development of the proposed action has largely avoided direct impacts to known Aboriginal sites and minimised the potential interface with areas with high Aboriginal archaeological potential. Searches of the Aboriginal Heritage Information Management System (AHIMS) database found ten sites registered within the construction footprint on the airport site. Three of these sites are located outside of the Western Sydney International Stage 1 construction footprint.

For sites that are not removed as part of the Western Sydney International development, Sydney Metro would prepare an Aboriginal Cultural Heritage Construction Environmental Management Plan for the on-airport rail works which would include the related methodologies for collection and salvage of sites that remain within the construction footprint where required, unexpected finds, and outlining nominated sites for protection.

7.5.2 Legislative and policy context

The relevant legislative and policy context relating to the Aboriginal heritage assessment within the airport site include:

- Airports Act
- Airports (Environment Protection) Regulations
- EPBC Act
- Airport Plan
- *Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan* (Western Sydney Airport, 2019e).

In addition, this assessment has been undertaken in accordance with the following guidance documents:

- Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (Office of Environment and Heritage, 2011)
- Aboriginal Cultural Heritage Consultation Requirements for Proponents (Department of Environment, Climate Change and Water (DECCW), 2010b)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010c)
- Australia ICOMOS Charter for Places of Cultural Significance, 1999 (Burra Charter)
- EPBC Act consultation guidelines *Ask First* (Australian Heritage Commission, 2002) and *Engage Early* (Department of the Environment, 2016)
- Designing with Country (Government Architect NSW, 2020).

7.5.3 Assessment methodology

Study area

The study area forms the boundary for the AHIMS searches undertaken for this assessment comprising an area centred on the proposed action alignment. While the primary impacts of the proposed action would be direct impacts to known sites and areas of archaeological sensitivity within the construction footprint, the larger study area provides context for those sites and allows for considerations of the proposed action within a broader landscape.

The risk for accidental and indirect impacts to sites outside the bounds of, but in close proximity to, the construction footprint have been considered as part of this assessment for sites with a 200 metre buffer area around the construction footprint.

Methodology

The Aboriginal heritage assessment comprised:

- a search of the Aboriginal Heritage Information Management System (AHIMS) database for listed Aboriginal sites was undertaken in May 2020 for the study area
- review of the landscape context of the proposed action, with specific consideration to its implications for past Aboriginal land use (archaeological potential)
- review of relevant archaeological and ethnohistoric information for the study area and its surrounding environment, including review of the *Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan* (Western Sydney Airport, 2019b)
- preparation of a predictive model to determine the archaeological potential in the study area
- archaeological field investigations within accessible areas
- consultation with Registered Aboriginal Parties, including to understand the cultural values significant to Aboriginal people resulting from traditions, observances, lore, customs, beliefs and history
- assessment of the significance of the archaeological potential
- assessment of the potential direct and indirect impacts of the proposed action
- identification of mitigation measures to minimise the risk of impacting Aboriginal items or areas of Aboriginal cultural sensitivity.

Direct impacts are those with the potential to have a physical effect on a site, resulting in damage, partial destruction or full destruction. Potential direct impacts as a result of the proposed action have been considered for known and potential Aboriginal archaeological sites and features within the construction footprint.

Indirect impacts are those that do not directly impact on the physical site itself but do have an impact on its cultural heritage significance. These include visual impacts and settlement and vibration and are likely to occur as a result of tunnelling. Potential indirect impacts have been considered for sites within a 200 metre buffer area outside the construction footprint.

Significance assessment

In Australia, the primary guide to the assessment of cultural significance is the Burra Charter for which significance assessments are required to consider the social value, historic value, aesthetic value and scientific value of an item or place. Definitions of these terms are outlined in Table 7-38.

Social and cultural values are not limited to specific sites or objects or physical expressions of place and are considered either present or not and Registered Aboriginal Parties will not draw a hierarchical distinction between sites and features.

Table 7-38 Values relevant to determining cultural significance, as defined by The Burra Charter (1999)

Value	Definition
Aesthetic	"Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use" (ICOMOS, 1999: 12).
Historic	"Historic value encompasses the history of aesthetics, science and society...[a] place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may have historic value as the site of an important event" (ICOMOS, 1999: 12).
Scientific	"The scientific or research value of a place will depend on the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information" (ICOMOS, 1999:12).
Social and cultural	"Social value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group" (ICOMOS, 1999: 12).

Consultation

Aboriginal community consultation was undertaken in accordance with the requirements of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010b). Following newspaper advertisements and letters requesting registration, a total of 68 Registered Aboriginal Parties registered for consultation regarding the wider project. The draft methodology for survey and test excavation was provided to the Registered Aboriginal Parties for comment by email and letter with responses received predominantly agreeing with the proposed methodology without changes. Consultation provided an opportunity for information to be shared on the cultural heritage values of the study area.

Inspections of accessible areas were undertaken with a representative from the relevant Local Aboriginal Land Councils (LALC); Gandangara LALC and Deerubbin LALC. Feedback from the LALC representatives during the inspections indicated that the waterways within and in proximity to the construction footprint have cultural significance as pathways and focal resource areas for Aboriginal people in the past. Consultation with Registered Aboriginal Parties helped to determine areas of archaeological potential which were largely focussed on areas of low disturbance near waterways.

The Aboriginal cultural heritage assessment report that formed part of the Project Environmental Impact Statement was provided to the Registered Aboriginal Parties for review and comment during July and August 2020. The feedback received from the Aboriginal community regarding Aboriginal cultural heritage values associated with the study area is detailed in Section 3.4.2.

Ongoing consultation with Aboriginal knowledge holders and other Aboriginal stakeholders would be undertaken to ensure cultural design principles and interpretation aspects are considered as part of the design development process for the proposed action.

7.5.4 Potential impacts

There are known Aboriginal sites, areas of cultural value and areas of archaeological potential within the on-airport environment. The *Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan* contains protocols for the removal and protection of all known sites within Western Sydney International.

For sites that are not removed as part of the Western Sydney International development, Sydney Metro would prepare an Aboriginal Cultural Heritage Construction Environmental Management Plan for the on-airport rail works which would include the related methodologies for collection and salvage of sites that remain within the construction footprint where required, unexpected finds, and outlining nominated sites for protection. The Aboriginal Cultural Heritage Construction Environmental Management Plan would align with the Western Sydney International Survey and Salvage Plan.

7.6 Flooding, hydrology and water quality

This section provides a summary of the assessment of potential flooding, hydrology and water quality impacts during construction and operation of the proposed action. Further detail is provided in *Sydney Metro – Western Sydney Airport, Flooding, Hydrology and Water Quality Assessment* (Sydney Metro, 2020e).

7.6.1 Overview

The project would be designed to avoid potential flooding impacts and achieve the recommended performance outcomes. The proposed action would be in tunnel under Badgerys Creek but this creek would receive overland flows from its associated works. The existing water quality for this creek is considered poor and generally does not meet Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines due to high nutrient and low dissolved oxygen concentrations. Potential impacts on water quality would be managed through mitigation measures and erosion and sediment controls consistent with the construction environmental management requirements of the Western Sydney International Stage 1 project.

The proposed action has the potential to increase peak flood levels in isolated locations during construction, such as around the tunnel and viaduct segment production and storage facility and potential permanent spoil placement areas (refer to Figure 4-14). Temporary changes to the local flooding regime may also occur during construction due to the temporary blockage of flow paths, and increased flow rates due to vegetation clearing.

Further investigation and modelling would be carried out during design development and appropriate arrangements would be in place to manage any flood events should they occur during either construction or operation.

7.6.2 Legislative and policy context

The flooding, hydrology and water quality assessment has been prepared in accordance with the following legislation and guidelines:

- Airports Act
- Airport Plan – provides specific conditions on elements such as soil and water management, including water quality management strategies
- Airports (Environment Protection) Regulations:
  - Clause 4.01 provides that the operator of an undertaking at an airport must take all reasonable and practicable measures to prevent or, where prevention is not possible, to mitigate impacts generation of pollution.
  - Schedule 2 lists accepted limits for water pollution which apply to on-airport lands to the exclusion of State (NSW) legislation. These limits constitute one method of complying with the duty of clause 4.01. It is noted that these limits are more stringent than ANZECC guidelines. The Airports (Environment Protection) Regulations water quality pollutant limits are shown in Table 4-6 of *Sydney Metro – Western Sydney Airport, Flooding, Hydrology and Water Quality Assessment* (Sydney Metro, 2020e).

The following legislation and guidelines are relevant to the assessment of flooding impacts for the proposed action unless overridden by the Airports (Environment Protection) Regulations as discussed above:

- Water Management Act 2000 (NSW) (WM Act)
- Protection of the Environment Operations Act 1997 (NSW) (POEO Act)

- *National Water Quality Management Strategy* (NWQMS) (Australia and New Zealand Environment and Conservation Council/Agriculture and Resource Management Council, 2000)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)
- New South Wales Floodplain Development Manual: the management of flood liable land (DIPNR, 2005)
- Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (Australian Institute for Disaster Resilience, 2017).

Relevant community emergency management arrangements for flooding are provided in:

- *City of Penrith Local Flood Plan* (State Emergency Service, 2012)
- *Liverpool City Local Flood Plan* (Liverpool City Council, 2015)
- *Hawkesbury-Nepean Flood Plan* (NSW State Emergency Service, 2015).

The M4 Western Motorway is a defined flood evacuation route in the emergency planning documents listed above.

The Penrith City Council *Development Control Plan 2014* was also used to inform project specific flood impact criteria.

7.6.3 Assessment methodology

Study area

The study area is shown in Figure 6-7 and has been developed to capture potential impacts within the South Creek and Duncans Creek catchments from the proposed action.

General methodology

For this assessment, potential on-airport water quality impacts are considered against the Airports (Environment Protection) Regulations limits where appropriate.

The assessment (including the flood modelling) assumes the following for the condition of on-airport land:

- for the construction of the proposed action, it is assumed that construction works for Western Sydney International Stage 1 are being carried out concurrently, while site preparation activities including vegetation clearing and earthworks have been completed or almost completed (refer to 6.1.2)
- for the operation of the proposed action, it is assumed that Western Sydney International Stage 1 is operational (as per the Airport Plan). The assessment is based on an assumed landform proposed for Western Sydney International informed by the Airport Plan site layout (refer to Figure 1-2).

During initial design development for the project, details of the future M12 Motorway were not available to be included in the flood modelling; however, the *M12 Motorway Environmental Impact Statement* (Transport for NSW, 2019b) released in October 2019 has been reviewed to consider potential cumulative flood impacts with the project.

Flooding

The flooding assessment involved:

- review of historic flooding information and flood assessments
- identification of project-specific criteria for operational impacts
- flood modelling of existing and proposed flooding conditions
- qualitative assessment of potential construction flooding impacts based on flood modelling
- quantitative assessment of potential operation flooding impacts based on flood modelling
- development of performance outcomes to be achieved by the project in relation to flood impacts

- identification of mitigation measures to minimise potential impacts during construction and operation.

The most recent flood study for the study area is the *Updated South Creek Flood Study* (Worley Parsons, 2015) developed for Penrith City Council. This study developed a hydrological and hydraulic flood model of South Creek and its main tributaries. Its findings have been used to ensure flood modelling completed for the project is compatible with previous flooding investigations.

The operational model prepared for the project has assessed the full range of flood events, including the:

- 0.5 exceedances per year (EY) event (an event that has a chance of occurring on average once every two years)
- 0.2 EY event (an event that has a chance of occurring on average once every five years)
- five per cent Annual Exceedance Probability (AEP) event (indicating there is a five per cent chance that this flood event could be exceeded in any one year)
- one per cent AEP event (indicating there is a one per cent chance that this event could be exceeded in any one year)
- one per cent AEP including climate change event (indicating there is a one per cent chance that this event could be exceeded in any one year including allowing for changes associated with climate change). This was based on the CSIRO and BoM high emissions scenario for 2090, as recommended in the *Australia Runoff and Rainfall Guidelines* (Commonwealth of Australia (Geoscience Australia), 2019))
- probable maximum flood (PMF) event – the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions.

These cover the full range of probable flood events. Given the timeframe for the construction period, potential temporary flooding impacts during construction are considered for the five per cent AEP event only (typical of a more frequent flood event).

For operational impacts, this section generally summarises the potential impact of the one per cent AEP event. The one per cent AEP including climate change event is discussed in Section 7.9.4.

Project-specific criteria for operational flooding impacts were established through a review of other linear infrastructure projects across greenfield sites and the *Penrith City Council Development Control Plan 2014* (Penrith City Council, 2014). The criteria guided the design of the location and extent of permanent infrastructure to minimise disruption to local flood flows.

The criteria are broken into the following key flood parameters:

- afflux – with reference to flooding, afflux refers to the predicted change, usually in flood levels, between the existing scenario and project scenario
- velocity – relates to how fast flood waters are moving. Areas subject to high velocities are more prone to scour and erosion
- hazard – flood hazard is defined as the potential loss of life, injury and economic loss caused by future flood events
- duration – refers to the time from start to finish that floodwaters are present on the surface.

The operational flood impact criteria for the project and the hazard vulnerability classification are provided in *Sydney Metro – Western Sydney Airport, Flooding, Hydrology and Water Quality Assessment* (Sydney Metro, 2020e).

Hydrology

Hydrology was considered by assessing potential changes to catchment and watercourse health and geomorphology.

Catchment and watercourse health relates to how surface water flows are generated and move through a catchment, and how these flows contribute to environmental and human processes. The catchment and watercourse health assessment involved:

- review of available rainfall and flow gauge data
- review of existing geomorphic conditions
- identification of surface water connection to groundwater sources
- identification of existing surface water storages
- assessment of potential impacts in the context of flood modelling for the project
- development of performance outcomes to be achieved by the project in relation to hydrology impacts
- identification of mitigation measures to minimise potential impacts.

Geomorphology relates to the form, shape, size and structure (slopes, presence of rocks, locations of ponds, soil types) of watercourses. The geomorphic condition of a watercourse is dependent on factors such as flows, vegetation, soil types and aquatic biodiversity, and these can be affected by human induced changes to catchments and watercourses. Watercourses in good geomorphic condition are important for overall catchment health.

The geomorphology assessment involved:

- review of geotechnical information, topographic data and aerial photographs to inform the understanding of geomorphic conditions for waterways intersected by the project
- review of flood modelling to understand potential changes to the flows that influence geomorphic condition
- development of performance outcomes to be achieved by the project in relation to geomorphic impacts
- identification of mitigation measures to minimise potential impacts.

Water quality

The water quality assessment involved:

- review of previous water quality studies and assessments to understand the existing environment and water quality conditions within the study area
- identification of project-specific environmental values and assessment criteria (including Airports Regulations limits)
- qualitative assessment of potential water quality impacts during construction and operation against the assessment criteria
- development of performance outcomes to be achieved by the project in relation to water quality impacts
- identification of mitigation measures to minimise potential impacts.

7.6.4 Potential impacts – construction

Flooding

Construction of the proposed action has the potential to temporarily impact the local flooding regime and to be temporarily impacted by flooding events.

Potential impacts on the local flooding regime include:

- temporary blockage of flow paths causing changes to flood levels beyond the construction footprint due to stockpiling, location of construction works or equipment and fencing
- temporary increased flow rates in receiving drainage lines downstream of the construction footprint due to vegetation clearing and increased hardstand areas

- temporary changes to flow paths downstream of the construction footprint due to construction of culverts, construction of civil works, permanent and temporary roads.

The likelihood and magnitude of potential risks would vary depending on the stage of construction and timing of high rainfall events. Flood events during construction have the potential to temporarily impact construction sites for the proposed action and construction activities.

The construction flooding assessment considers the flooding extent for a five per cent AEP flood event as shown in Figure 7-6.

The proposed action is in tunnel through Western Sydney International from around 400 metres southwest of Airport Business Park Station and is generally located away from flood prone land. Areas with the greatest potential for on-airport flood impacts during construction would be focused around the tunnel and viaduct segment production and storage facility and the potential permanent spoil placement areas (see Hydrology section below). The tunnel and viaduct segment production and storage facility would be located just outside the five per cent AEP flood extent.

Some areas near the potential permanent fill placement area to the west are identified as being newly inundated due to the redistribution of overland flows away from the existing flow path with introduction of the permanent fill. However, flood depths in a one per cent AEP event including climate change remain below 200 mm in the newly inundated areas and therefore within the project flood impact criteria. These areas are within land that forms part of the Environmental Conservation Zone for Western Sydney International, bordering the existing Badgerys Creek flood extent, and as such flood impacts are considered to be minor.

The potential permanent spoil placement area to the west is located across a main overland flow path through Western Sydney International to Badgerys Creek, causing changes to flood behaviour in Badgerys Creek through redistribution of floodwaters. The potential permanent spoil placement area to the east is located across two minor overland flow paths that combine beyond this spoil placement area and discharge into Badgerys Creek. These overland flow paths are currently influenced by the adjacent land uses and while the spoil placement areas will impact these overland flow paths, there is unlikely to be any change in flow distribution into Badgerys Creek. Flood compatible design would need to demonstrate adequate conveyance of diverted flows to minimise impacts and ensure compliance with applicable land use criteria.

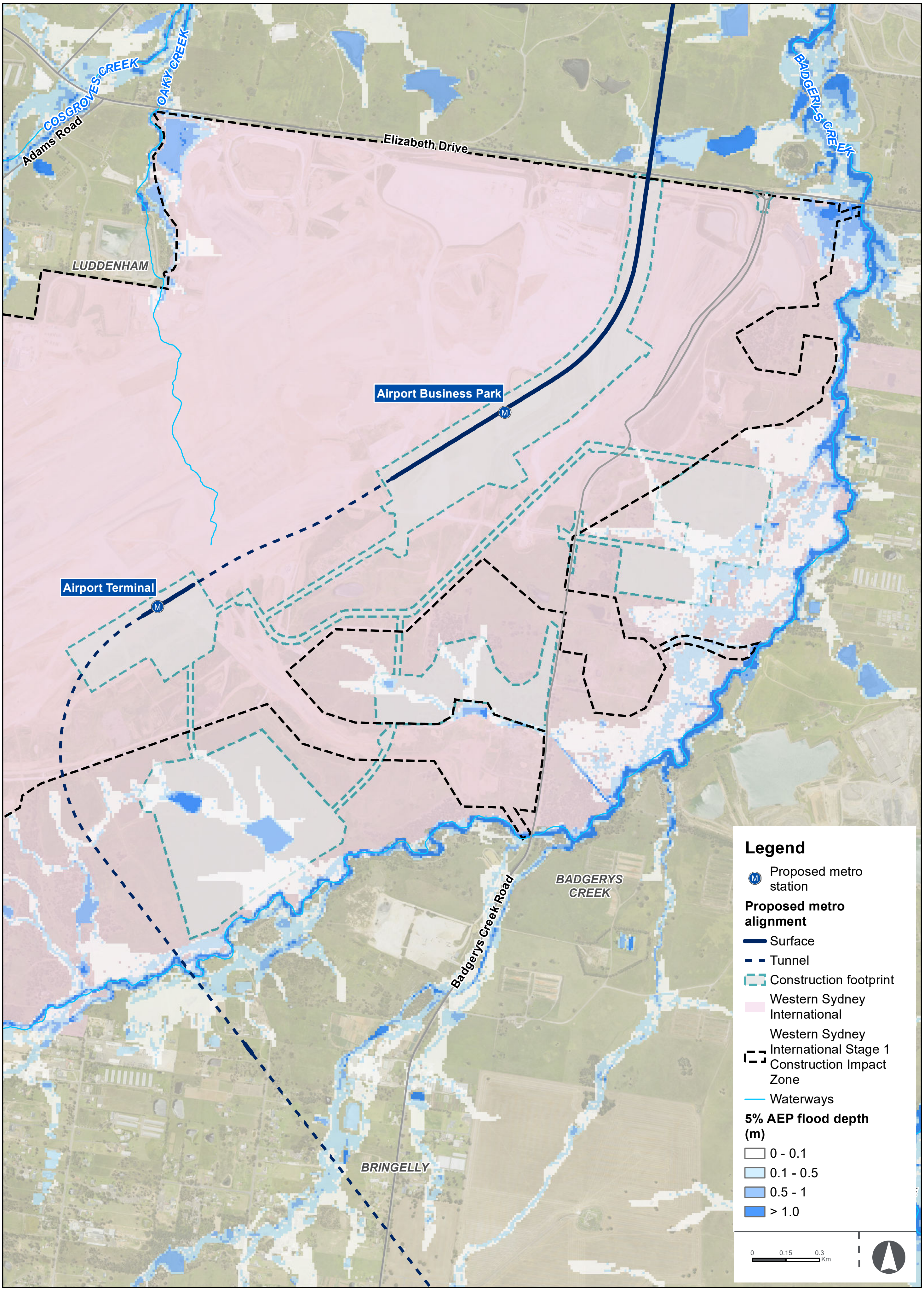
The stations and associated construction sites are located outside flood prone land and therefore there would be no flooding impacts at the stations.

Hydrology

Construction activities in and around waterways may have a potential short-term impact on the hydrology of Badgerys Creek and overland flow paths within the on-airport environment. Potential impacts could include:

- changes in low flow channel shape due to temporary works changing local runoff behaviour
- increased sedimentation due to clearing the site for construction
- loss of riparian vegetation and aquatic vegetation during construction which may increase the vulnerability of the channel to erosion
- removal of local levee banks or existing flood control works or farm dams which would change flood behaviour and therefore change flows in the channel.

Construction of a temporary and permanent power supply route would require crossing of Badgerys Creek. It is proposed that horizontal directional drilling would be carried out to install the cables underground. This would avoid potential impacts to riparian vegetation associated with the Environmental Conservation Zone, water quality and geomorphology.



Five per cent AEP flood extent across construction footprint

Figure 7-6

Indicative only, subject to design development

The introduction of the potential permanent spoil placement area to the west would involve the diversion of overland flow paths and removal of farm dams. It may also result in a change to the location at which overland flows currently discharge into Badgerys Creek, which has the potential for scour. The potential permanent spoil placement area to the east would involve diversion of the overflow from the farm dam into the creek on the southern border of this spoil placement area. Appropriate management of the diversions, and potential used of on-site detention to compensate for the loss of farm dam storage, would minimise these potential impacts. Once the proposed action is completed, the operation and management of the potential permanent spoil placement areas would be the responsibility of Western Sydney Airport.

With the application of appropriate management measures, potential impacts are considered to be minor.

Water quality

The construction of the proposed action has the potential to temporarily impact on and further degrade the water quality of the waterways within the study area and areas downstream if not properly managed.

Potential water quality impacts are presented in Table 7-39.

Table 7-39 Potential surface water quality impacts for key construction activities

Construction activity	Assessment
Earthworks	Earthworks would be required as part of the construction of the proposed action and would include excavation for station sites and tunnelling activities. Earthworks would increase the amount of disturbed and exposed soil present in the environment, which may potentially temporarily impact the surface water quality of the environment through: • changes to surface water runoff or evaporation due to clearing vegetation coverage. This may increase runoff volumes in the short or long term, or both • increased surface water runoff due to soil stabilisation earthworks. Soil stabilisation may result in a change to the permeability of the natural soils • increased turbidity, lowered dissolved oxygen levels and increased nutrients in waterways • reduction in channel habitat as a result of sediment transport and deposition.
Stockpiling and spoil handling	Stockpiling of earthwork materials poses a potential temporary risk to water quality in receiving environments through the increased likelihood of movement of sediment. Stockpiling of mulched vegetation from clearing of trees and shrubs poses a risk of tannins leaching into watercourses (which can impact a range of water quality parameters), and increased loads of organics in watercourses.
Operation of construction equipment and vehicles	The operation of construction equipment may result in the temporary release of contaminants into nearby waterways as a result of: • refuelling, maintenance and washdown • spills and failure of machinery.

Key construction activities with the potential for water quality impacts would include:

- temporary spoil stockpiling materials handling
- spoil placement within the potential permanent spoil placement areas
- earthworks at the potential permanent spoil placement areas, station construction sites, the Western Sydney International tunnel portal and the on-airport construction corridor
- operation of construction equipment and vehicles

- potential discharge from construction water treatment plants
- activities at the tunnel and viaduct segment production and storage facility including concrete batching.

As detailed in Section 6.8.3, previous water quality monitoring data shows that both Western Sydney International and downstream catchments are degraded, particularly in terms of nutrients, and the existing water quality is not compliant with the Airports (Environment Protection) Regulations limits or the relevant ANZECC guideline values.

On-airport construction water discharge points would be required for both the Airport Terminal and Western Sydney International tunnel portal construction sites and would likely be directly into a major drainage swale being delivered as part of the Western Sydney International project. Specific discharge locations would be confirmed during design development and construction planning in consultation with Western Sydney Airport. Indicative treated groundwater discharge volumes for each of the two sites has been estimated to be up to around 10 litres per second.

The potential permanent spoil placement areas form part of the airport construction support site. The exact location for placement of the spoil would be confirmed during design development in consultation with Western Sydney Airport. The areas would be located outside the Environmental Conservation Zone located along Badgerys Creek. The implementation of soil and water mitigation and management measures at potential permanent spoil placement areas would mitigate and manage potential impacts to the water quality of receiving environments, and would ensure the risk of runoff of pollutants and sediments into Badgerys Creek would be minor.

Potential impacts would be managed through the implementation of mitigation measures which have been developed to be consistent with the construction environmental management requirements of the Western Sydney International Stage 1 project (refer to Chapter 8 (Environmental management and mitigation) for further detail). With the application of these mitigation measures, the risk of water quality impacts from the construction of the proposed action is anticipated to be low.

7.6.5 Potential impacts – operation

Flooding

Operational flooding design criteria were established for the proposed action as described in *Sydney Metro – Western Sydney Airport, Flooding, Hydrology and Water Quality Assessment* (Sydney Metro, 2020e). Potential on-airport operational flood impacts are within the operational flooding design criteria, and are described in Table 7-40.

Table 7-40 Operational flooding impacts

Flood aspect	Flood impact criteria	Impact
Peak flood levels	**<u>Maximum allowable peak flood levels for:</u>** **Residential houses, commercial buildings and critical infrastructure:** No change (maximum 10 millimetres (mm) increase) to buildings that are flood prone in existing conditions No new above floor flooding 50 mm at properties where flooding is below floor level **Roads:** 50 mm **Crown land open space, farming, grazing and cropping land:** 200mm	Along the western floodplain of Badgerys Creek, the proposed action results in no substantial change in peak flood levels, and afflux is not predicted to increase above the project flood impact criteria. For all flood events up to and including the one per cent AEP event, the proposed action meets the flood impact criteria.

Flood aspect	Flood impact criteria	Impact
Peak flood velocity	**Criteria:** **All areas:** Velocities are to remain below 1 metre per second (m/s) where they are currently below this figure and that an increase of no more than 20 per cent should result from the Project where existing velocities are above 1 m/s.	The predicted changes in peak velocities comply with the design criteria for all storm events up to and including the one per cent AEP event.
Flood duration	**Criteria:** **Residential and commercial buildings:** No increase to duration of above floor flooding **Roads:** No more than 10 per cent increase in flood duration **Farm cropping:** Dependent on the crop	The predicted changes in duration of inundation are minimal and comply with the design criteria for storm events up to and including the one per cent AEP event. There are localised areas along Badgerys Creek where durations have increased, but these are small areas that correlate with the newly inundated areas and would not constitute a significant impact.
Flood hazard	**Criteria:** **Residential and commercial buildings** No change in flood hazard vulnerability classification limits **Roads** No change in flood hazard vulnerability classification limits.	There are no material differences in flood hazard regime for storm events up to and including the one per cent AEP event.
Flood behaviour	No specific criteria applicable	Potential impacts to overland flow paths or watercourses within Western Sydney International have been minimised and avoided as it would be located predominantly in-tunnel (from around 400 metres southwest of Airport Business Park Station until it exits the site underneath Badgerys Creek).

Potential Impacts to overland flow paths or watercourses within Western Sydney International have been minimised and avoided as it would be located predominantly in-tunnel (from around 400 metres southwest of Airport Business Park Station until it exits the site underneath Badgerys Creek).

Water quality

The operation of the proposed action has the potential to impact on and potentially degrade the water quality of the waterways within the study area and areas downstream if not properly managed.

Potential operational water quality impacts would be generally consistent with the impacts and mitigation in the design of operational infrastructure presented in Table 7-41.

The most likely source of pollutants from operation of the proposed action would be as a result of the transformation of pervious areas to impervious surfaces. An increase in impervious surfaces such as roofs, footpaths and paved areas would potentially cause impacts to the water quality of the receiving waterways through increased runoff volumes and increased pollutant loads, sedimentation or erosion. Additionally, station areas would feature areas of increased pedestrian and vehicle traffic which would generate pollutants.

Table 7-41 Potential surface water quality impacts from operational infrastructure

Infrastructure	Potential pollutant sources	Mitigation in design	Ongoing design considerations
Track and tunnel infrastructure	• dust from train brakes • fuels used during the operation of the proposed action	• surface sections (including in-cutting) of the track would be drained and water quality treatment would be provided through surface water quality basins. • for tunnel sections, stormwater would be captured, pumped and treated in quality basins and the operational water quality treatment plants. Operational water treatment plants are proposed at Bringelly services facility.	• water quality monitoring would occur at all discharge points. During operation, surface water and ground water discharged from the proposed action would be treated to meet the relevant ANZECC water quality guidelines • Water Sensitive Urban Design (WSUD) principles would be incorporated as part of further design development
Station and ancillary facilities	• increased runoff from an increase in impervious surfaces • increased vehicle and pedestrian traffic • litter, oils, sediments and chemicals from station cleaning activities, train wash down and maintenance	• water quality treatment for stormwater runoff from the station sites would be provided through bioretention treatment within proposed detention basins and treatment at the proposed water treatment plant at Bringelly services facility • water captured within the Western Sydney International to Bringelly tunnel would be pumped to a water treatment plant at Bringelly services facility • wash down and maintenance activities would be carried out in covered buildings and wash down water would be collected in a separate system for treatment and reuse.	• WSUD features at stations would treat stormwater runoff to required levels prior to discharge into the environment.

7.7 Groundwater and geology

This section provides a summary of the assessment of the impact of potential changes to the groundwater and geological environment (i.e. groundwater inflows, groundwater quality and ground movement) during construction and operation of the proposed action. The full groundwater assessment is provided in *Sydney Metro – Western Sydney Airport, Groundwater Assessment* (Sydney Metro, 2020d).

7.7.1 Overview

To limit potential groundwater inflows and groundwater drawdown, the metro tunnels would be tanked (designed to prevent the inflow of groundwater, typically using concrete lining and waterproofing membranes). Similarly, the cross passages and the station caverns would be tanked. As a result, limited change is expected to groundwater levels.

During construction, groundwater drawdown may occur at locations with drained excavations, such as Western Sydney International tunnel portal and Airport Terminal Station. These excavations would allow groundwater ingress to occur which would result in a lowering of the groundwater levels in the adjacent soils and bedrock. Water levels at those locations which were drained during construction would recover during the operational phase.

Long term changes in water levels are anticipated to be relatively small and within the range of seasonal and long-term groundwater fluctuation, and localised around the structures. Detailed hydrogeological and geotechnical models would be developed and progressively updated during design development and groundwater monitoring would be carried out to confirm the predictions.

The airport site is under construction and has been cleared of all buildings or structures. There are no existing roads or utility assets within the airport site that would be potentially be impacted by ground movement impacts associated with the proposed action.

Consultation with Western Sydney Airport will be on-going in respect to the construction programs for both projects to understand the potential for ground movement impacts to proposed buildings and structures.

7.7.2 Legislative and policy context

The relevant legislation, policies and assessment guidelines considered in the preparation of the groundwater and geology impact assessment are listed below:

- Airports Act
- Airports (Environment Protection) Regulations
- EPBC Act
- National Water Quality Management Strategy 2018
- Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC)
- *Water Management Act 2000* (NSW)
- *Aquifer Interference Policy* (AIP) (Department of Primary Industries, 2012a)
- State Groundwater Policy Framework Document 1997 (including the Groundwater Quantity Management Policy, the Groundwater Quality Protection Policy and the Groundwater Dependent Ecosystems Policy)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (Department of Primary Industries, 2012b).

7.7.3 Assessment methodology

Due to the nature of potential groundwater and geology impacts, the assessment approach was considered at both a regional level and, with respect to specific on-airport impacts, at a more localised level. Assessment of potential groundwater impacts was undertaken through a process of qualitative and quantitative assessment. This assessment approach is summarised below.

Groundwater

Study area

For the purposes of the groundwater assessment, the study area consisted of the on-airport proposed alignment plus a two-kilometre radius around the on-airport proposed alignment. A two-kilometre radius study area was chosen as a conservative distance and covers a much broader area than the likely zone of impact.

The assessment considered key groundwater attributes and features of the environment within the study area in order to develop conceptual models of the baseline groundwater environment. The regional geological and hydrological setting was used to inform the impact assessment for the on-airport environment.

Geotechnical investigations

A preliminary phase of geotechnical investigation was undertaken at key locations as part of the design development process. This included hydrogeological testing and monitoring undertaken as part of the project. In addition to the geotechnical investigations, groundwater monitoring data from within the study area was obtained from other historic geotechnical investigations, including investigations at Western Sydney International.

Further phases of geotechnical investigations are ongoing. The scope includes drilling geotechnical boreholes across the alignment with hydrogeological monitoring and testing at a number of locations.

Aquifer Interference Policy 2012 requirements

The AIP requires that potential impacts on groundwater sources, including their users and groundwater dependent ecosystems, be assessed against the minimal impact considerations. If the predicted impacts are less than the Level 1 minimal considerations, then the impacts of the proposed action are acceptable. The key criteria/requirements of the AIP relate to elements such as; impacts to the existing water table, changes to water pressure, and changes to water quality.

The criteria outlined in the AIP provide an appropriate reference to assess the impact of the project on groundwater. The impact of the proposed action in relation to these criteria is addressed in Section 7.7.5.

Conceptual model

A conceptual model was established to further investigate potential impacts on groundwater from the proposed action in the airport environment. The assessment focused on the potential impacts associated with the Airport Terminal Station and the proposed tunnel portal and cutting between Airport Business Park Station and Airport Terminal Station.

An Environmental Impact Statement was prepared for the Western Sydney International in 2016 (DIRD, 2016b) which included a detailed groundwater assessment. This information was reviewed for this assessment. As a result, there is baseline groundwater information for the on-airport environment, allowing detailed cross-sectional groundwater modelling to be undertaken to assess the potential impacts associated with the proposed action.

Using a simplified 2D numerical modelling approach, cross-sectional modelling was undertaken at two locations perpendicular to the rail alignment:

- at Western International tunnel portal
- at Airport Terminal Station.

A series of conceptual groundwater models was used to estimate groundwater inflows and changes to groundwater levels associated with the proposed action to understand the potential impacts on groundwater dependent ecosystems, groundwater users and the proposed action (groundwater ingress) during construction and operation. Further detail regarding the hydraulic modelling is provided in section 3.6 of *Sydney Metro – Western Sydney Airport, Groundwater assessment* (Sydney Metro, 2020d).

Further geotechnical investigations have commenced, and groundwater monitoring data would be available to support further design development. Additional groundwater assessment would be undertaken during further design development to supplement the current investigations.

Ground movement

Ground movement refers to a localised lowering of the ground level typically associated with either the release or redistribution of stress in rock formations during tunnelling and excavation, or from ground consolidation following the drawdown of groundwater (during construction and/or operation). Movement caused by stress redistribution in rock generally occurs shortly after excavation, while consolidation settlement from groundwater drawdown can occur over a longer period of time.

Assessment has been carried out as part of the design process to identify buildings and structures, road and rail infrastructure and utility assets at risk of potential ground movement associated with the project. This included assessment of movement associated with groundwater drawdown as well as excavation for tunnelling and cut and cover stations associated with the project.

Groundwater drawdown is likely to be an issue for structures such as the tunnels and cut and cover station boxes which are drained (un-tanked) during the construction phase. Groundwater drawdown during operation is not likely to be a substantial issue and would be limited to drained structures and would occur over a longer period of time.

The ground movement assessment identified properties/buildings, road and rail infrastructure and utility assets within areas considered to be potentially subject to ground movement as a result of the project. The ground movement assessment is undertaken in a phased manner to minimise the number of structures or assets requiring a detailed assessment. At this stage of the project, a preliminary assessment has been undertaken for assets deemed to be critical along the alignment and within a pre-defined zone of influence of the ground movement.

The specific risk to buildings and structures due to ground movement during construction depends on geotechnical conditions, relevant elements of the project design (such as depth of tunnelling, size and depth of station boxes and indicative construction methodology), distance from construction activities and building characteristics including condition and type of masonry and noting that all buildings located on the airport site either have been, or are in the process of being, removed.

7.7.4 Potential impacts – construction

This section presents the potential impacts of the proposed action on the groundwater and geological environment that may occur during construction. The impact of groundwater drawdown on the potential migration of contamination is considered in Section 7.8.4.

Potential impacts on the groundwater environment during the construction phase include:

- impacts on groundwater dependent ecosystems, water supply wells, creeks or other environmental receptors resulting from changes to groundwater level or flow. Further discussion on GDEs, including mapped GDEs, is provided in Section 7.3
- impacts on groundwater quality due to contamination from release of chemicals used during construction activity and potential impacts on other connected environmental receptors
- impacts on groundwater quality due to exposure, storage and leaching of saline soils along the alignment
- impacts on buildings and infrastructure from surface settlement related to groundwater drawdown or ground settlement from excavation during construction.

Hydrogeological conditions at elements of the proposed action which are likely to interact with the groundwater environment are presented in Table 7-42.

Table 7-42 Hydrogeological conditions at proposed action elements

Location /structure	Hydrogeological units	Anticipated groundwater level (metres below existing ground level)[1]	Approximate depth below groundwater level (m)
Western Sydney International tunnel portal	Residual soil Bringelly Shale	0.5 to 3	0 to 20
Airport Terminal Station	Residual soil Bringelly Shale	0.5 to 3.5	15 to 19
Western Sydney International to Bringelly tunnel	Bringelly Shale	1 to 9	Up to 28

Note: Groundwater depths based on existing ground levels.

Changes to groundwater level

Rail tunnels

Changes in groundwater level as a result of tunnel and cross passage excavation during construction are likely to be of short duration and unlikely to lead to a material change in groundwater levels.

Groundwater inflow may occur during construction in the short period between excavation at the tunnel face and installation of the tunnel lining. Once the lining is in place, the tunnel would be effectively waterproofed and groundwater inflow would cease.

Groundwater inflow to cross passage excavations could occur since they are constructed using traditional mining excavation methods. However, efforts to minimise groundwater inflow such as ground improvement are usually undertaken prior to excavation, to minimise the volume of groundwater entering the tunnel cross-passages.

The magnitude of groundwater level change during excavation is expected to be small given that inflows would be localised and of short duration, and excavation would be within the Bringelly Shale, which has a low hydraulic conductivity.

Western Sydney International tunnel portal

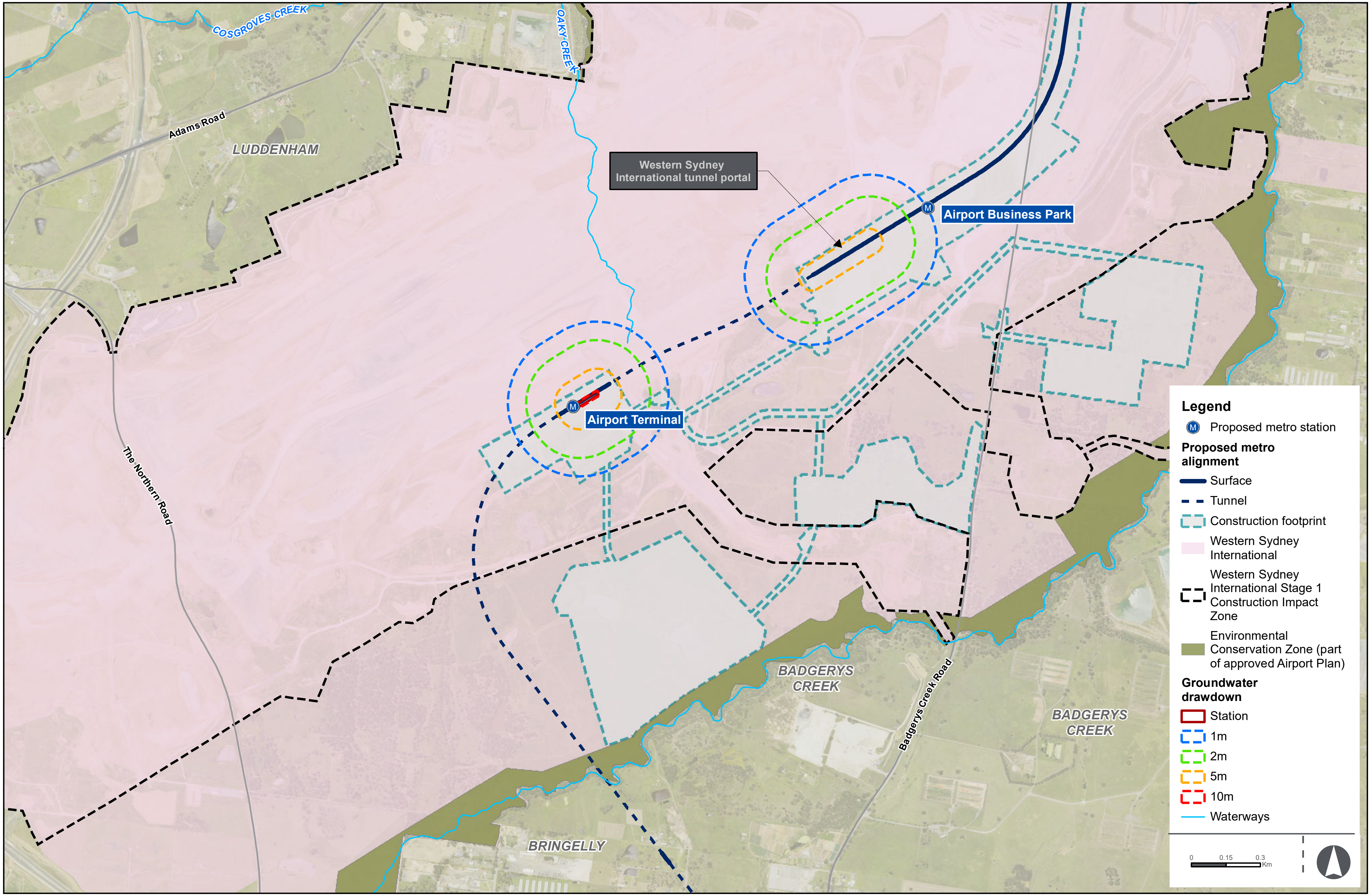
Groundwater inflows at the Western Sydney International tunnel portal would occur during construction as the excavation would take place within a drained (untanked) retaining wall. This would lead to potential changes to groundwater levels in the surrounding shale and residual soil. The temporary changes to groundwater level would occur over the course of construction until the permanent watertight portal structure is in place. The groundwater impacts from this permanent infrastructure is discussed in Section 7.7.5

The predicted changes to groundwater level during the construction phase is presented in Figure 7-7. Drawdown at the excavation is expected to be close to the base of the excavation. However, since the excavation is deeper to the west, greater drawdown and inflow would be expected in that area. The assessment indicates that the one metre drawdown contour would to about 285 metres from the excavation. This extent is unlikely to occur across the entire length of the tunnel portal since there would be less drawdown in shallower areas. However, for the purposes of reporting, it is assumed that this drawdown occurs uniformly across the length of the structure.

Airport Terminal Station

Groundwater inflows at Airport Terminal Station would occur during construction as the excavation would take place within a drained (untanked) retaining wall. This would lead to potential changes to groundwater levels in the surrounding shale and residual soil. The temporary changes to groundwater level would occur over the course of construction until the permanent watertight station structure is in place.

At the Airport Terminal Station, modelling results indicate that that the one metre drawdown contour would extend to around 270 metres from the excavation face (refer to Figure 7-7).



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Predicted changes in groundwater level on-airport during construction

Figure 7-7

Changes to groundwater recharge

Groundwater recharge is the proportion of rainfall that makes its way into an aquifer system, as a result of infiltration through unsaturated soils. The principal mode of recharge to groundwater systems is through rainfall. Changes to recharge from the surface can cause changes in groundwater level in the underlying system.

Changes to recharge during construction are likely to occur principally because of:

- introduction and construction of engineered fill, paved surfaces and site facilities preventing rainfall from infiltrating the ground, leading to a reduction in groundwater recharge
- surface runoff on construction areas being captured by drainage systems, as opposed to infiltrating the ground, leading to a reduction in recharge
- sedimentation basins used during construction acting as local points of increased recharge.

The effect of the reduction in direct recharge to groundwater levels across the construction footprint is anticipated to be minor due to the limited scale of the proposed action and its footprint (compared to the size of the catchment) and the existing low recharge within the study area due to the low hydraulic conductivity of the residual clay soils and Bringelly Shale bedrock. In addition, large potential permanent spoil placement areas for excavated spoil material would be stored within Western Sydney International (refer to Figure 4-14) which could reduce groundwater recharge into the underlying ground. Further details on the potential permanent spoil placement areas are provided in Section 4.2.

As the spoil placement areas would be permanent, its effect on groundwater recharge would continue into the operational phases of the proposed action. However, given the existing low permeability residual soils and low recharge rates present across the majority of Western Sydney International, it is unlikely that this would have a significant impact on recharge rates and underlying groundwater levels.

Potential impact on groundwater dependent ecosystems

The Western Sydney International Stage 1 Construction Impact Zone would be cleared before or during construction of the proposed action, removing the potential for occurrence of GDEs. Groundwater drawdown outside the Western Sydney International Stage 1 Construction Impact Zone is considered unlikely due to the undrained tunnel design and construction method and given that proposed excavation areas (Western Sydney International tunnel portal and Airport Terminal Station) are over 400 metres away from any potential GDEs.

Condition 8.4 of the Airport Plan states that groundwater monitoring would be undertaken for the *Soil and Water Construction Environmental Management Plan* (Western Sydney Airport, 2019g) which must include monitoring points adjacent to woodlands in areas outside of the Western Sydney International Stage 1 Construction Impact Zone (but within the airport). This measure is intended to monitor changes at groundwater dependent vegetation as a result of construction of the airport site.

Potential impact on groundwater users

No groundwater supply wells have been identified within Western Sydney International and therefore existing groundwater users would therefore not be affected by the proposed action. No impacts to existing groundwater supply wells are predicted as a result of changes to groundwater level or flows at the airport site.

Potential impacts from ground movement

A preliminary assessment of potential ground movement impacts due to construction of Western Sydney International to Bringelly tunnel within the airport site has been carried out. This assessment considered ground movements resulting from tunnelling works, excavation for cut and cover stations including retention systems and temporary groundwater drawdown. The surface environment within the airport site is assumed to have been cleared and not contain any remaining buildings or structures.

The preliminary assessment assumes that ground movements arising from the proposed action would occur prior to construction of the Airport Terminal building and associated civil works at the airport.

Tunnel construction movement

For the Western Sydney International to Bringelly tunnel, the maximum predicted ground movement associated with construction of the twin tunnels within the airport site is expected to be in the range of 5 and 10. Where the tunnels interface with the Western Sydney International tunnel portal and the Airport Terminal Station ground movement at the surface is expected to be higher and approaching the ranges detailed in Table 7-43 below.

The maximum predicted ground surface movements from the excavation of mined tunnels (cross passages) within the airport site is less than five millimetres.

Combined ground movements

Table 7-43 summarises the predicted combined ground movements from tunnel excavation and excavation of cut and cover stations, inclusive of groundwater drawdown. It should be noted that the combined ground movements would not be uniform across the excavation.

Table 7-43 Summary of predicted combined ground movement

Location	Indicative maximum excavation depth (m)	Indicative range of predicted ground movement (mm)	Indicative range of predicted ground surface slope (V:H)
Western Sydney International tunnel portal	About 5 to 20	5 to 30	1:500 to 1:2,000
Airport Terminal Station	About 25	25 to 60	1:200 to 1:2,000

Note: Predicted ground movement does not include any ground movements from Western Sydney International construction works.

Building, road infrastructure and utility impacts

The airport site is under construction and has been cleared of all buildings or structures. There are no existing roads or utility assets within the airport site that would be potentially be impacted by ground movement impacts associated with the proposed action.

Consultation with Western Sydney Airport will be on-going in respect to the construction programs for both projects to understand the potential for ground movement impacts to proposed buildings and structures.

Potential impacts on groundwater quality

The potential risks to groundwater quality during construction would include:

- hydrocarbon (or other chemical) contamination from potential fuel and chemical spills during construction, leading to contamination of groundwater
- infiltration of contaminated surface water runoff at discharge basins
- release of saline groundwater seepage from excavations during construction into the environment (including impacting on shallow, better quality soil groundwater)
- mobilisation of existing groundwater contamination due to dewatering, groundwater ingress to excavations or because of altered groundwater flow directions due to construction activity
- leaching of saline, acidic or contaminated water from soil stockpiles into the groundwater environment.

Groundwater ingress into excavations for stations or other cuttings would be captured, treated and then reused for construction activity where possible. Where reuse of the groundwater is not possible, the water would be discharged from the sites via construction water quality treatment plants. Water captured during tunnelling would be treated and recirculated to the cutting face or used for dust suppression purposes. Further information is provided in Section 7.5.4

The potential permanent spoil placement areas at Western Sydney International may potentially lead to an increased risk of generating saline runoff and leachate with resultant impacts on groundwater.

The overall potential risk of impacts on groundwater quality remain low due to:

- the low permeability soil cover, limiting the risk of infiltration of water into the ground
- the limited environmental value of the groundwater at the site
- the low likelihood of existing chemical contamination at Western Sydney International (refer to Section 7.8.4).

The proposed action would also include the provision of water treatment plants to treat any contaminated groundwater intercepted during construction before discharge to ensure that works meet the requirements under Schedule 2 of the Airports (Environment Protection) Regulations 1997.

Potential impacts to creeks and wetlands

Groundwater drawdown at creek lines is not expected to occur during the construction phase of the proposed action. Due to the significant earthworks being undertaken at the Western Sydney International site, there are not anticipated to be any impacts on artificial wetlands, since the Stage 1 site would be fully redeveloped.

Estimated construction groundwater take

Predicted groundwater inflows for the on-airport environment are provided in Table 7-44. The total estimated construction inflow rate is likely to be a conservative estimate and may be substantially lower in practice.

Table 7-44 Estimated maximum construction groundwater inflows

Project element	Predicted average groundwater inflow (kL/d)	Predicted maximum groundwater inflow (kL/d)
Western Sydney International tunnel portal	30	53
Airport Terminal Station	44	88
Western Sydney International to Bringelly tunnel (within Western Sydney International)	4	62
Total	**78**	**203**

Notes:
1. The combined predicted inflow may not occur due to staged construction.
2. The maximum inflow is likely to be of short duration and unlikely to occur concurrently across the project

Total project groundwater take – construction

The total estimated water take for the project (combining on-airport and off-airport components) during construction is about 240 mega litres per year compared to the long-term average annual extraction limit of 45,915 mega litres per year in the water sharing plan for the Sydney Basin Metropolitan Region Groundwater Sources (NSW, 2015).

The results indicate that there is sufficient groundwater available from a licensing perspective for the maximum estimated construction inflow. This water take represents less than one per cent of the extraction limit for the Sydney Basin.

The Sustainability Plan for the project includes the objective of maximising opportunities for the re-use of non-potable water sources during construction including water from groundwater inflows during tunnelling and excavations. Further information on the potential re-use of non-potable water sources during construction is provided in Section 7.10.

7.7.5 Potential impacts – operation

Changes to groundwater level and flow

All tunnels, structures and stations at Western Sydney International are designed as undrained. Groundwater inflow to these structures would be prevented due to waterproofing and groundwater levels that were lowered during construction would recover slowly. In the longer term, these undrained structures would present a barrier to the natural groundwater flow.

Over the longer term, minor increases in groundwater level upgradient and minor decreases downgradient of these structures can be expected. However, changes in groundwater level are anticipated to be relatively small and within the range of seasonal and long-term groundwater fluctuation. The extent of changes to groundwater level are expected to be localised around the structures.

Changes to recharge may also lead to a change in groundwater level at Western Sydney International. This may occur:

- below detention and treatment basins where there is increased infiltration to the ground
- below the potential permanent spoil placement areas where decreased groundwater recharge may occur.

Given the existing low permeability at the site, changes to infiltration are expected to be small with only minor changes in groundwater level occurring as a result.

There is not anticipated to be any additional impacts on GDEs, supply works and other receptors during operation than discussed previously.

Salinity impacts

Potential salinity risks from the proposed action component of the project may occur due to increases in groundwater levels, which could lead to an increase in salt loading of shallow soils. This is most likely to occur at locations where design elements impede water movement (i.e. undrained structures) causing groundwater to rise. The risk of potential salinity impacts occurring is considered to be relatively low as:

- changes to groundwater level are expected to be relatively small as a result of impedance to groundwater flow
- groundwater levels are generally anticipated to be well below the surface suggesting that any increased water level would be unlikely to impact on shallow soils
- in locations where shallow groundwater is currently near the surface such as the Western Sydney International tunnel portal, substantial reprofiling of the surface is being undertaken so that in the long term, groundwater levels are likely to be well below the final ground surface.

Potential impacts on groundwater quality

During operation, any minor groundwater ingress which may be collected within rail tunnels on Western Sydney International would be directed to Bringelly services facility where it would be treated at the water quality treatment plant. Ongoing seepage is likely to be of relatively small quantity and would be treated in accordance with criteria established in consultation with the Environment Protection Authority and DPIE (Water).

Impacts on groundwater quality during the operation phase of the project are not expected on the airport site. It is unlikely that groundwater would be impacted from contamination from unintended release of chemicals or fuels used by the project. As all stations, tunnel portals and rail tunnels at the airport site are undrained during the operational phase, the risk of capturing groundwater contaminated by the airport site is considered negligible.

The proposed water treatment plant would treat wastewater and groundwater ingress pumped from the stations, tunnels and other below ground facilities. The water treatment plant building would include chemical treatment tanks, water storage tanks, and filters which would collect treated collected water to a standard in line with the performance outcomes prior to discharge from the site (refer to the performance outcomes in Chapter 8 (Environmental management and mitigation)).

The interaction between the Western Sydney International and the proposed action would continue to be considered in the operational phase of the project. Stormwater treatment systems and the use of other chemicals at Western Sydney International could infiltrate into the groundwater environment and eventually be captured by the rail cutting. The proposed management and mitigation measures implemented by Western Sydney International would mean that the risk of this occurring is likely to be low. The Airport Plan includes specific conditions on elements such as groundwater monitoring (conditions 8(4) to 8(6) of the Airport Plan construction conditions).

Estimated operational groundwater take

The estimated operational groundwater inflows for the proposed action are presented in Table 7-45.

Table 7-45 Estimated maximum operational groundwater inflows

Project element	Estimated inflow drained structures (kL/d)	Estimated inflow undrained structures [1] (kL/d)
Western Sydney International tunnel portal	-	0.8
Airport Terminal Station	-	0.9
Western Sydney International to Bringelly tunnel	-	10.1
Total	**0 kL/d**	**11.7 kL/d**

Note: Based on waterproofing criteria of 2.0 ml per hour per m^2 of concrete lining surfaces

Total project groundwater take – operation

The total estimated water take for the project (including on-airport and off-airport) during operation is about nine mega litres per year compared to the long-term average annual extraction limit of 45,915 in the water sharing plan for the Sydney Basin Metropolitan Region Groundwater Sources (NSW Government Office of Water, 2015).

The results indicate that there is sufficient groundwater available from a licensing perspective for the estimated long-term steady state operational inflow.

The Sustainability Plan for the project includes the objective of maximising opportunities for the re-use of non-potable water sources during operation including the harvest and reuse of groundwater at permanent water treatment facilities where feasible (refer to Section 7.10).

Aquifer Interference Policy 2012

The AIP provides a useful basis for determining whether a groundwater source should be considered productive or less productive. The definition for a less productive source is:

- a groundwater source having total dissolved solids greater than 1,500 mg/l
- a groundwater source that does not contain water supply works that can yield water at a rate greater than five litres per second.

On this basis, the Bringelly Shale is a less productive source since the groundwater contains total dissolved solids generally in excess of 1,500 mg/l and low permeability such that yields are likely to be well below five litres per second.

The AIP requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against the minimal impact considerations. If the predicted impacts are less than the Level 1 minimal considerations, then the impacts of the project are acceptable. As noted above, the AIP provides appropriate criteria against which the impacts of the project on groundwater can be assessed.

Consideration of the potential impacts on the hydrogeological environment are compared to the criteria/requirements of the AIP in Section 6.6 of *Sydney Metro – Western Sydney Airport, Groundwater assessment* (Sydney Metro, 2020d). This assessment is summarised below:

- water table – no water supply work is expected to be affected by a decline in water table and therefore the project meets the requirements of Level 1. No high priority terrestrial GDEs are likely to be within the zone of influence of predicted groundwater change within the airport site
- water pressure - no water supply work is anticipated to be affected by a decline in pressure head of more than two metres and therefore the project meets the requirements of Level 1
- water quality - groundwater in the study area has limited beneficial use owing to its high background salinity. Groundwater quality is unlikely to be impacted because of the project and there would be no change to the beneficial use category. The impacts associated with the project are therefore expected to meet the requirements of Level 1.

The groundwater monitoring network for the project is being expanded and additional monitoring is being undertaken. This additional monitoring data will be used to inform the development of the hydrogeological and geotechnical model for the project (mitigation measure GW5) and preparation of the Groundwater Management Plan (mitigation measure GW6) during the design development phase.

7.8 Soils and contamination

This section provides an assessment of the potential impact on soils and contamination as a result of the proposed action. In relation to contamination, this section draws upon information provided in *Sydney Metro – Western Sydney Airport, Contamination Assessment* (Sydney Metro, 2020g).

7.8.1 Overview

Soil erosion, soil salinity and potential acid sulfate soils would be adequately managed in accordance with proven standard mitigation measures. The potential risks of encountering contamination would also be appropriately managed to avoid impacts on human health and ecological receivers. Areas of medium risk of contamination were identified within the construction footprint.

Any contamination encountered on the airport site would be managed in accordance with a project specific Remediation Action Plan that would be consistent with the *Western Sydney Airport Remediation Action Plan* (Department of Infrastructure and Regional Development, 2019). Other mitigation measures would include an unexpected finds protocol and measures for the prevention of contamination, including spill prevention and spoil and stockpile management.

7.8.2 Legislation and policy context

A list of the relevant legislation, assessment guidelines, standards and policies considered in the preparation of the soils and contamination impact assessment include:

- Airports Act
- Airport Plan
- Airports (Environment Protection) Regulations
- National Environment Protection (Assessment of Contamination) Measure 1999 as amended in 2013 (ASC NEPM) (National Environment Protection Council, 1999)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (under the National Water Quality Management Strategy)
- PFAS National Environmental Management Plan 2.0 (HEPA, 2020)
- relevant Commonwealth environmental management guidance on perfluorooctanoic acid and perfluorooctane sulfonic acid (HEPA, 2020).

7.8.3 Assessment methodology

Study area

The study area for the soils and contamination assessment comprises the on-airport proposed action alignment plus a one kilometre buffer either side of the alignment. The assessment of existing potential contamination relating to surface construction has been described by construction sites that make up the construction footprint.

General methodology

The methodology involved the review of the following plans and reports prepared for Western Sydney International Stage 1:

- Western Sydney Airport Soil and Water Construction Environmental Management Plan (Western Sydney Airport, 2019g)
- *Western Sydney Airport Environmental Impact Statement* (Commonwealth Department of Infrastructure and Regional Development (DIRD), 2016b)
- Western Sydney Airport Remediation Action Plan, June 2019 (Department of Infrastructure and Regional Development, 2019).

The *Western Sydney Airport Environmental Impact Statement* and Western Sydney Airport Remediation Action Plan were informed by, and included a summary of information from the following reports:

- Preliminary (Phase 1) Contaminated Assessment Report, Proposed Western Sydney Airport, February 2016 (Department of Infrastructure and Regional Development, 2016c - prepared by GHD)
- Detailed Site Contaminated Investigation, Proposed Western Sydney Airport, February 2016 (Department of Infrastructure and Regional Development, 2016d - prepared by GHD).

The proposed action construction footprint and tunnel alignment is located both within and outside the Western Sydney International Stage 1 Construction Impact Zone. Additional contamination, geotechnical and hydrogeological investigations undertaken for the proposed action were also reviewed.

Areas of potential contamination risk identified in the review of previous reports were assessed for potential human or ecological health risks in the context of the proposed action. A conceptual site model was then developed for the study area.

Conceptual site model

The conceptual site model considers the different exposure pathways between a contamination source and receptor in the present and/or future. This approach provides a conservative assessment of exposures and enables a consistent approach on appropriate mitigation measures to be adopted.

The conceptual site model utilises a risk ranking matrix, which considers the likelihood and potential consequence of contamination (i.e. the potential for human health and/or ecological exposure based on the type of potential contamination source and the extent and type of construction works). The risk ranking matrix is detailed in Section 3.3 of *Sydney Metro – Western Sydney Airport, Contamination Assessment* (Sydney Metro, 2020g). The risk rankings provided in Section 7.8.4 were used to inform the type of mitigation measure to manage potential contamination risk.

Section 7.10 provides information on the approach for the management of spoil (including contaminated spoil) during construction of the project. Sydney Metro would continue to consult with Western Sydney Airport regarding specific requirements for the transport and placement of spoil at the airport site.

7.8.4 Potential impacts – construction

The potential impacts from contamination, acid sulfate soils and salinity on sensitive receivers during construction are described in the following sections.

Contamination

Potentially contaminating construction activities

Construction works could result in potential soil, surface water or groundwater contamination from the following activities if unmitigated:

- spills of oils, fuels or chemicals from plant and equipment within the construction footprint
- accumulation of potentially contaminated sediments in sedimentation and water quality basins

- importing or backfilling of excavations with spoil which could result in exposure of project workers and surrounding human and ecological receptors to contamination if the spoil happened to be contaminated (i.e. not or incorrectly classified as virgin excavated natural material, excavated natural material or other applicable exemptions)
- stockpiling of potentially contaminated spoil.

Impacts associated with disturbance of existing contamination sources

Preliminary site investigations (Department of Infrastructure and Regional Development, 2016c) identified extensive waste dumping and stockpiling as the main source of potential contamination. Potential sources of contaminants mainly relate to past use of fuels, oils, hazardous building materials, pesticides and waste burial and dumping. The main contaminants of concern related to these activities are heavy metals, TRH, BTEX, PAHs, PCBs, OCPs and asbestos.

Asbestos has been previously been detected in areas of Western Sydney International (Department of Infrastructure and Regional Development, 2016c and 2019). The asbestos was mainly identified in shallow soils and stockpiles sourced from the demolition of buildings containing asbestos and waste dumping.

Remediation of soils impacted by asbestos and other contaminants within the Western Sydney International Stage 1 Construction Impact Zone, as described in the Western Sydney Airport Remediation Action Plan (Department of Infrastructure and Regional Development, 2019), is anticipated to be completed prior to the proposed action commencing.

However, given that the project would involve construction activities and construction depths that may vary from those associated with Western Sydney International, Sydney Metro would develop a project-specific Remediation Action Plan (Sydney Metro Remediation Action Plan). The Sydney Metro Remediation Action Plan would be prepared in a manner consistent with the Western Sydney Airport Remediation Action Plan (Department of Infrastructure and Regional Development, 2019), and would be applied to any contamination encountered by Sydney Metro that has not been remediated by Western Sydney Airport.

In non-remediated areas, such as areas outside the Western Sydney International Stage 1 Construction Impact Zone, areas not yet remediated or areas where asbestos has been capped and contained, there is a risk of construction workers being potentially exposed to asbestos fibres via disturbance of asbestos in soils and transport via wind, erosion and spoil transport.

In previous investigations undertaken within the airport site (Department of Infrastructure and Regional Development, 2016c), there were two high-risk areas for potential chemical contamination (i.e. non-asbestos contamination) identified. These locations are within the construction footprint of the proposed action, specifically the tunnel and viaduct segment production and storage facility. Based on the previous investigations, the likelihood of chemical contamination presenting an unacceptable risk to ecological and human receivers was considered low. Potential chemical contamination, if encountered, is expected to be in isolated areas.

A preliminary conceptual site model and risk ranking was completed in the context of the construction footprint associated with the proposed action and is presented in Appendix D of *Sydney Metro – Western Sydney Airport, Contamination Assessment* (Sydney Metro, 2020g). The updated risk ranking relating to the construction footprint is summarised in Table 7-46.

Table 7-46 On-airport potential contamination impacts and risk ranking

<table>
<tr><th>Construction site</th><th>Potential contamination</th><th>Overall risk ranking</th></tr>
<tr><td>On-airport construction corridor</td><td rowspan="4">Primarily asbestos contamination in soil with potential isolated areas of chemical contamination from past agricultural and light industrial land uses.

The proposed action construction footprint would likely be remediated during Western Sydney International Stage 1 works prior to proposed action construction. Some areas may contain capped contamination or subject to management plans where there is still a potential for contamination to remain in-situ and might be disturbed during construction.</td><td>Medium</td></tr>
<tr><td>Airport Business Park Station</td><td>Medium</td></tr>
<tr><td>Airport Terminal Station</td><td>Medium</td></tr>
<tr><td>Western Sydney International tunnel portal</td><td>Medium</td></tr>
<tr><td>Airport construction support site (outside the Western Sydney International Stage 1 Construction Impact Zone)</td><td>Primarily asbestos contamination in soil with potential isolated areas of chemical contamination from past agricultural and light industrial land uses.</td><td>Medium</td></tr>
</table>

Management of contaminated soils could result in other potential environmental impacts if transported off-site to be disposed at an appropriately licensed facility. These potential impacts may be reduced by containment or beneficial reuse under a resource recovery exemption. See Section 7.10 for further discussion of waste management.

Salinity

Excavation of soils within an area of known high salinity in the Airport Terminal construction site would be required. If excavated, the runoff or reuse of high salinity soils could potentially cause localised impacts on soil and require mitigation measures.

There would also be widespread excavation and disturbance of soils, including those with high likelihood of soil salinity across the airport. Areas of saline soils, if encountered, could potentially contribute to local degradation of soil and water quality. Saline groundwater extracted from areas of the construction footprint could potentially adversely impact water quality in Badgerys Creek and Oakey Creek if not treated prior to discharge. The areas of known or high potential salinity are outside of the Western Sydney International Stage 1 Construction Impact Zone and would therefore remain a potential risk during construction of the proposed action.

Acid sulfate soils

Excavation of ASS could potentially occur around the Badgerys Creek and Oakey Creek riparian zones associated with parts of the Airport construction support site, on-airport construction corridor, Airport Terminal and Airport Business Park construction sites. If ASS are present, they are not expected to occur in large quantities and potential impacts would be expected to be localised if encountered.

If ASS are disturbed, runoff from excavated soils can potentially be acidic and leach iron, aluminium and other heavy metals. These heavy metals and acids can leach into soil and groundwater, and impacted runoff can enter waterways and have negative impacts on water quality and aquatic ecosystems.

Prior to ground disturbance in areas of potential ASS, testing would be carried out to determine the actual presence of ASS. If ASS are encountered, they would be managed in accordance with the *Acid Sulfate Soil Manual* (Acid Sulfate Soil Management Advisory Committee, 1998).

Soil erosion

Construction of the proposed action would temporarily expose the natural ground surface and sub-surface through the removal of vegetation, and excavation for stations, structures and foundations. The temporary exposure of soil to water runoff and wind could increase soil erosion potential. There is the potential that exposed soils – and other unconsolidated materials, such as spoil, sand and other aggregates – could be transported from the construction sites into surrounding waterways via stormwater runoff.

Erosion controls would be implemented and managed in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004).

7.8.5 Potential impacts – operation

The potential impacts of contamination, ASS and salinity on sensitive receivers during operation are described in the following sections.

Contamination

The potential contamination impacts on soil, surface water and groundwater from the operation of the proposed action consist of:

- potentially contaminated stormwater and groundwater ingress into the tunnel portal that may contain slightly elevated concentrations of chemical contaminants
- stormwater runoff from tracks which may contain slightly elevated concentrations of heavy metals and oils from train operations.

The potential contamination impacts on soils, surface water and groundwater are expected to be negligible as the proposed action is operating within the context of an operational airport.

Acid sulfate soils

Potential inland ASS are not expected to be disturbed during operation of the proposed action.

Groundwater and salinity

Groundwater modelling undertaken for *Sydney Metro – Western Sydney Airport, Groundwater assessment* (Sydney Metro, 2020d) indicated that the undrained tunnels and associated structures would cause relatively minor increases in groundwater levels over the long term. The greatest increase was predicted to occur closest to the tunnels, where the natural groundwater level is deep. It is unlikely to cause any impact in the shallow soils. Although there may be a broader increase in water levels upgradient, this change was generally considered to be within the range of natural groundwater level variation.

The sedimentation ponds for the proposed action could potentially result in accumulation of saline sediments. These sedimentation ponds would be planted with salt tolerant species and therefore the potential impacts on soils and surface water are expected to be negligible. Minor changes to groundwater infiltration caused by the permanent soil and detention basins are expected to be small with only minor changes in groundwater level occurring as a result.

7.9 Sustainability, climate change and greenhouse gas

This section assesses the proposed action in terms of sustainability, and how it meets, and would continue to meet, relevant sustainability requirements. This section also summarises the initial climate change risk, greenhouse gas and resource use assessments undertaken for the project.

The resource use assessment in this section considers resources that would be consumed by the project. Section 7.10 provides an overview of the waste and resources generated by the project, including the spoil management approach for the project.

7.9.1 Overview

Sydney Metro is preparing a Sustainability Plan that will apply to both the on and off-airport components of the project which will set out the sustainability policy and objectives and identify key activities so that sustainability considerations are embedded across the project life cycle. The

Sustainability Plan would also be consistent with the *Western Sydney Airport Sustainability Plan* (Western Sydney Airport, 2020) in relation to the construction of the on-airport works.

Six principles have been developed to govern environmental and socio-economic outcomes and performance for the project based around demonstrating leadership, tackling climate change, managing resources efficiently, driving supply chain best practice, valuing community and customers and respecting the environment. Targets and initiatives would be developed to support these sustainability principles.

7.9.2 Legislative and policy context

Sustainability overview

Sustainability governance and policy context

Ecologically Sustainable Development is defined in Australia's *National Strategy for Ecologically Sustainable Development* (Ecologically Sustainable Development Steering Committee,1992) as: 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.'

The four principles that underpin this definition include the precautionary principle, inter-generational equity, conservation of biological diversity and ecological integrity, and improved valuation, pricing and incentive mechanisms for environmental resources.

One of the objects under Part 3 of the EPBC Act is to 'facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment'.

Chapter 11 (Conclusion) outlines how the proposed action addresses these ESD principles in accordance with Part 3A of the EPBC Act and the Commonwealth assessment requirements (Appendix B).

Sydney Metro sustainability approach

Sydney Metro addresses sustainability by developing effective and appropriate responses to the key challenges of today and tomorrow such as climate resilience, energy security, water security, resource scarcity, land use, liveability, employment, diversity and inclusion.

Transport for NSW's Environment and Sustainability Policy (Appendix I) (the Policy) applies to the transport cluster including Sydney Metro. The Policy includes the following commitments:

- leadership – contributing to and influencing the strategic environment and sustainability agenda of the NSW Government
- environmental protection – being accountable for addressing and minimising the environmental impacts of our activities to satisfy the expectations and legislative requirements of the NSW Government and community
- energy and carbon – improving energy efficiency and working towards net zero carbon emissions
- resilience – embedding climate risk and resilience considerations in our activities
- sustainable procurement – procuring and delivering sustainable, efficient and cost effective transport options, including responsible supply chains
- whole of life – considering whole of life benefits and impacts from our activities across all life cycle stages - demand/need, plan, acquire, operate/maintain and disposal
- social – recognising the social impacts and benefits of our activities, and working for healthy liveable communities
- awareness – raising the awareness and capacity of our workforce to be accountable for implementing the Policy through their activities to achieve enhanced environmental outcomes and a culture of environmental responsibility
- communication – communicating openly, responsively and empathetically with our customers, partners and stakeholders on environmental matters and report on our performance.

The Sustainability Plan for the project is currently being developed and will include the sustainability objectives, initiatives and targets that have been informed by the above policies and legislation. These initiatives and targets would be benchmarked against past Sydney Metro projects, and international best practice on similar infrastructure projects to ensure continual sustainability improvements are made across Sydney Metro projects. They would be integrated during further design development, construction and operation of the project.

Key focus areas of the Sustainability Plan and the sustainability assessment for the project are resource use and efficiency, and reducing potential energy use and associated emissions (see Section 7.10 for an assessment of resources generated by the project and Section 7.9.5 for the greenhouse gas assessment for the project).

Sustainability was a key consideration in the design development and consideration of project alternatives. A ‘sustainable and deliverable solution’ is one of the project objectives against which options for station locations were assessed. Sustainability was also considered in the development of the construction approach for the project. Further details on the design refinements to enhance sustainability and minimise environmental impacts are provided in Chapter 5 (Avoidance of impacts during development of the proposed action).

Sustainability assessment approach

The legislation and policies summarised in the following sections will be used to inform the Sustainability Plan and the objectives, initiatives and targets that are embedded in that Plan. The Plan would apply project-wide (on-airport and off-airport).

The sustainability assessment in this section considers the application of the sustainability principles for the project, and the opportunities to achieve sustainability targets and outcomes aligned with best practice infrastructure projects.

Cumulative sustainability issues between the project and other projects, including Western Sydney International, would be managed through their respective sustainability plans which are tailored to the nature of each asset. Consultation would continue to be undertaken with Western Sydney Airport in regard to cumulative impacts.

Commonwealth legislation and policies

The Commonwealth legislation and policies relevant to the sustainability, climate change risk and greenhouse gas assessment for the project include:

- National Greenhouse and Energy Reporting Act 2007 (Cth) (NGER Act)
- *Trajectory for Low Energy Buildings* (Council of Australian Government’s (COAG) Energy Council, 2019)
- National Greenhouse Gas Accounts Factors (DoEE, 2018)
- United Nations Framework Convention on Climate Change – Paris Agreement 2016.

Western Sydney Airport Sustainability Plan

Western Sydney Airport has also prepared the *Western Sydney Airport Sustainability Plan* (Western Sydney Airport, 2020) for Western Sydney International Stage 1.

The sustainability, climate change risk and greenhouse gas initiatives to be identified in the project’s Sustainability Plan would be consistent with, and not hinder the achievement of, the initiatives identified in the Western Sydney Airport Sustainability Plan.

NSW legislation and policies

NSW legislation and policies relevant to the sustainability and climate change risk assessment for the project include:

- Future Transport 2056 Strategy (NSW Government, 2018)
- *NSW Net Zero Plan 2020 – 2030* (NSW Department of Planning, Industry and Environment (DPIE), 2020)

- Transport for NSW Climate Risk Assessment Guidelines (Transport for NSW, 2019a)
- Transport for NSW Carbon Estimate and Reporting Tool (Transport for NSW, 2017)
- Sydney Metro Corporate Plan 2019 – 21

The regional policies relevant to the climate risk assessment for the project include:

- Western City District Plan (Greater Sydney Commission, 2018b)
- Western Sydney Regional Organisation of Councils (WSROC) Turn Down the Heat Strategy and Action Plan (2018)
- Western Sydney Aerotropolis Plan (NSW Government, 2020) (WSAP).

Other policies and guidelines

The Transport Authorities Greenhouse Gas Group (TAGG) consists of state road authorities within Australia and the New Zealand Transport Agency. The *Greenhouse Gas Assessment Workbook for Road projects* (TAGG, 2013) outlines a process for estimating greenhouse gas emissions for all major activities that were found to contribute significantly to the overall emissions arising from a road project including emissions associated with land clearing.

7.9.3 Sustainability objectives and initiatives

The project-wide initiatives and targets that would be integrated into the design, construction and operation of the proposed action, following confirmation during further design development, are summarised in Table 7-47. These initiatives and targets would be included in the Sustainability Plan for the project. To the extent these initiatives and targets relate to the proposed action, they would be finalised in consultation with Western Sydney Airport and would not hinder the achievement of the targets outlined in the Western Sydney Airport Sustainability Plan.

Table 7-47 Project sustainability objectives and potential initiatives

Sustainability objective	Potential sustainability initiatives and targets
Demonstrate leadership	
Embedding sustainability objectives into decision making	• ensure environmental and social principles are integrated into the project decision making framework • establish collaborative working relationships with stakeholders to drive innovation and efficiencies in approach to environmental and social sustainability.
Transparency and assurance	• develop performance targets across all sustainability focus areas, based on best practice benchmarking and responding to policy and regulatory context • achieve a best practice level of performance using market leading sustainability rating tools (for example ISCA, Green Star, or equivalent) • develop an assurance framework and reporting system to assist Sydney Metro and contractors in reliably reporting against sustainability targets • monitor sustainability performance and provide public sustainability plans and reports.
Capture sustainability benefits	• documentation and ongoing evaluation of environmental and social costs and benefits • adopt a whole-of-life costing model to maximise benefits • optimise station precincts and other residual land developments to deliver better sustainability outcomes where practicable.

Sustainability objective	Potential sustainability initiatives and targets
Tackle climate change	
Infrastructure and operations to be resilient to the impacts of climate change	• identify and implement mitigation measures to reduce all very high and high risks (to at least a medium) and address all medium and low climate risks for the project (see Section 7.9) • continued engagement with key stakeholders to develop and implement appropriate responses to dependent and interdependent climate change risks.
Reduce energy use and carbon emissions	• identify and prioritise areas where the greatest reductions in carbon and energy can be achieved • use energy efficient equipment, methods and practices • local sourcing of materials where feasible • offset 100 per cent of the greenhouse gas emissions associated with consumption of electricity during operation
Establish energy efficiency and renewable energy targets	• offset 25 per cent of the greenhouse gas emissions associated with consumption of construction electricity • target to source at least 10 per cent of the low voltage electricity required at above ground stations from onsite renewable energy sources.
Efficient use of resources	
Minimise the use of potable water	• set targets and monitor potable water use • integrate current best-practice water-efficient features, equipment and appliances at stations and construction sites • avoid use of potable water for non-potable purposes if non-potable water is available.
Maximise opportunities for reuse of non-potable water sources	• identify and implement opportunities for treatment of water for reuse on the proposed action, including water from tunnelling works, concrete batching and casting facilities • set targets and monitor non-potable water use • connect to district recycled water networks during construction and operation where feasible • harvest and reuse rainwater and groundwater at permanent and temporary facilities where feasible.
Minimise waste through the project lifecycle	• target 95 per cent construction and demolition waste recycling • optimise operational efforts for waste collection through design • implement a variety of waste collection streams including organics, comingled recycling and general waste.
Reduce the embodied carbon of construction materials	• minimise the embodied impacts of concrete through the adoption of low carbon alternatives • minimise the embodied impacts of steel through maximising the use of recycled steel and steel produced using energy-reducing processes • identify and implement best practice low-impact alternative materials in the construction supply chain including recycled materials and engineered timber • undertake lifecycle assessments and minimise the embodied impacts of materials, through the selection of low carbon alternatives and considering durability and local sourcing • prioritise products made from recycled content.
Spoil management	• 100 per cent beneficial reuse of usable spoil generated by the project, in accordance with the project spoil management hierarchy.

Sustainability objective	Potential sustainability initiatives and targets
Environmentally responsible sourcing	• source timber products from either re-used timber, post-consumer recycled timber, Forest Stewardship Council or Programme for the Endorsement of Forest Certification certified timber suppliers where feasible. • prioritise local sourcing of materials, where feasible.
Drive supply chain best practice	
Influence contractors, subcontractors and materials suppliers	• ensure procurement strategies are consistent with ISO:20400 Sustainable Procurement Guidelines • ensure supply chain sustainability objectives are adopted downstream including sustainability training to high impact suppliers.
Increase supply chain transparency and responsibility	• adopt environmental product declarations and eco-labelling • conduct due diligence to ensure supply of materials and equipment aligns with human rights legislation and environmental standards.
Workforce development and industry participation	• industry and jobs participation – increase opportunities for employment of local people, participation of small and medium enterprises, including recognised Aboriginal businesses, and support industry to compete in home and global markets through active participation in client-led programs • workforce skills development – enable targeted and transferable skills development in areas with local and national skills shortages, support changing job roles and increased skill requirements, and embed transferable skills in the workforce • diversity and inclusion – establish initiatives to increase diversity within the workforce and supply chain through collaborative partnerships • inspiring future talent and developing capacity – engage young people via education and work experience, and through higher and vocational education and institutions to encourage interest in STEM and infrastructure related careers • collaboration – Sydney Metro will continue to collaborate with organisations that have a shared interest in driving skills, diversity, jobs and industry capacity through infrastructure projects.
Value customers and community	
Protect and promote Aboriginal and non-Aboriginal heritage and culture	• ensure key Aboriginal stakeholders are meaningfully engaged • develop and integrate Aboriginal cultural design principles into project design, delivery and operations • avoid or minimise impacts to Aboriginal and non-Aboriginal heritage and culture • identify and implement opportunities to enhance heritage and cultural values via design and interpretation • develop partnerships with relevant stakeholders to identify heritage and cultural places to promote social values • create opportunities for archaeological research and interpretation.
Enable and promote active transport access and public transport usage	• integrate with surrounding active transport network such as footpaths, public and green spaces, and bicycle corridors • design to enhance connectivity to green and blue corridors for active transport corridors.
Community and customer wellbeing	• design in accordance with best practice urban design principles (Appendix G) (Design Guidelines) • design to minimise urban heat island and associated health risks • ensure efficiency and durability of built infrastructure that requires minimum expenditure in maintenance and upkeep.
Deliver community benefits	• deliver projects that benefit local communities and provide social outcomes during construction and operation.

Sustainability objective	Potential sustainability initiatives and targets
Respect the environment	
Provide and promote green infrastructure	• use native climate resilient species in landscaping and prioritise use of indigenous knowledge (six seasons) • integrate water sensitive urban design solutions.
Promote ecological functions	• avoid or minimise impacts on biodiversity, particularly with regard to endangered, vulnerable and threatened species, habitats and communities • contribute to the restoration and conservation of local ecological communities.
Minimise environmental impact	• target zero major pollution incidents • reduce sources of pollution through the development and implementation of a Construction Environmental Management Framework (Appendix H).

7.9.4 Climate change adaptation

The peak body for climate change research, the Intergovernmental Panel on Climate Change (IPCC), has confirmed that increasing global greenhouse gas concentrations are influencing earth's climate (IPCC, 2014). Climate change has the potential to alter the frequency, intensity, and distribution of extreme weather-related natural hazards, including more intense and extreme heat, droughts, flood and storm surges. The risk of climate change impacts on the project needs to be considered as part of the design process, as it needs to be resilient to these potential impacts.

Infrastructure assets, including rail networks, are vulnerable to climate change because of their long design lives, during which the potential impacts of climate change would become more significant. Therefore, infrastructure design and planning needs to incorporate mitigation measures, based on the identified climate change risk to an asset.

Climate change risk assessment methodology

A climate change risk assessment has been undertaken for the project which considered risks and mitigation measures that apply to on and off-airport.

The climate change risk assessment has used the methodology outlined in the Transport for NSW Climate Risk Assessment Guidelines (2019a). These guidelines are based on the Australian Standard *AS 5334-2013 Climate change adaptation for settlements and infrastructure* and follow the principles of risk management outlined in the International Standard ISO31000:2018 *Risk management – Principles and Guidelines.*

The climate risk assessment involved:

- determining the climate change context using current climate change science and projections
- identifying potential climate risks to the project and developing risk statements
- assessing each climate change risk by:
  - determining the consequence of each risk occurring
  - determining the likelihood of each risk occurring
  - considering the existing controls expected to be applied through design and construction
  - determining the risk rating
  - identifying appropriate mitigation measures to treat potential climate risks and assessing the residual risk to the project.

The initial climate change risk assessment was informed by two multi-disciplinary workshops held during the project's design phase. The climate change risks and adaptation options that are discussed in this section are based on the current design and construction information for the project, and the mitigation options suggested in the multi-disciplinary workshops.

Climate change risks and mitigation will continue to be reassessed and addressed throughout the project lifecycle.

Climate change projections

Climate projections for the project are available at regional scales, and therefore the study area for the climate change risk assessment is the Western Sydney region. Climate change projections for the study area have been sourced from the Climate Futures Tool underpinned by the climate model evaluation by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM) (2015). These projections are based on the IPCC Fifth Assessment Report (AR5) and use the latest emissions scenarios (referred to as 'representative concentration pathways' (RCPs)). The high emissions scenario (called RCP8.5) has been selected to inform the project's climate change risk assessment.

Climate data and climate change projections were investigated for the following time periods to assess impacts over the design life of the project:

- 1995 (Baseline climate), representing the 40-year average for the period 1976–2015
- 2030 (Near future), representing the 40-year average for the period 2010–2049
- 2070 (Far future), representing the 40-year average for the period 2050–2089
- 2090 (Late century), representing the 40-year average for the period 2070–2109.

The baseline reference period used by CSIRO and BoM (1986–2005) has been extended for this assessment (to 1976–2015) to account for the increases in average temperatures experienced in recent years.

Future climate

Changes in the climate for Western Sydney are expected to include increasing average and extreme temperatures, shifting rainfall patterns, more intense storms and extreme rainfall events, and increasing bushfire risk (NSW Office of Environment and Heritage (OEH), 2014). Detailed climate change projections are presented in Table 7-51.

Table 7-48 Climate change projections for the study area for a high emissions scenario (RCP8.5)

Climate variable	**Baseline climate (centred on 1995)[1]**	**Future climate[2,3]**		
		2030 (Near future)	**2070 (Far future)**	**2090 (Late century)**
Temperature (°C)[3]				
Average annual temperature	17.8	18.8	20.6 – 21.3	21.4 – 22.6
Average maximum temperature	23.4	24.3	26.0 – 26.9	27.2 – 28.2
Highest recorded temperature	45.1	45.7	47.8 – 49.6	48.8 – 49.6
Average minimum temperature	12.2	13.3	15.1 – 15.7	15.7 – 17.0
Lowest recorded temperature	-0.8	0.4	1.9 – 3.0	2.7 – 3.9
Extreme heat days (number of days per year)[3]				
Average daily maximum temperature ≥35°C	11.8	15.9	25.5 – 33.3	33.0 – 44.1
Average daily maximum temperature ≥40°C	1.4	2.4	4.7 – 7.3	6.8 – 10.4
Average daily maximum temperature ≥45°C	0.0	0.1	0.3 – 0.7	0.7 – 1.1
Average daily maximum temperature ≥50°C	0.0	0.0	0.0	0.0
Cold days (number of days per year)				
Average days per year ≤0°C	0.2	0.0	0.0	0.0

Climate variable	Baseline climate (centred on 1995)[1]	Future climate[2,3]		
		2030 (Near future)	2070 (Far future)	2090 (Late century)
Rainfall (mm)[2,3,7]				
Mean annual rainfall	881	934	804 –- 789	604 –- 628
2.5% AEP daily rainfall event	321	339	372 –- 384	389 –- 404
Change in extreme rainfall events (%)[4,7]	-	+5.6%	+15.8%	+21.3%
Potential evapotranspiration (percentage change)[2,7]				
Change in annual average potential evapotranspiration (%)	-	4.2%	n/a	14.3%
Humidity (percentage change)[2,7]				
Average relative humidity	-	-0.6%	n/a	-1.5%
Wind speed (percentage change)[2,7]				
Average wind speed	-	-0.5%	n/a	-1.1%
Atmospheric concentration of CO_2 (parts per million (ppm))[5]				
Atmospheric concentration of CO_2	369 (in 2000)	449	541	935
Sea level rise (metres)[2,6,7]				
Mean sea level rise	-	+0.14 (0.10-0.19)	n/a	+0.66 (0.45-0.88)

Notes:
1. The historical baseline climate uses a 40 year reference period centred on the year 1995. Baseline data were extracted from the BoM Climate Data Online portal for the Prospect Reservoir site (no.67016) (the nearest site to the study area with continuous historical records of temperature and rainfall data).
2. Projections for future climate are presented as absolute values for the study area unless otherwise stated.
3. Projections for 2070 and 2090 are presented for models that represent the median (50th percentile) (left) and the 90th percentile (right) of model results for temperature to demonstrate the uncertainty in the magnitude of change between climate models for the far future and late century time periods. Note that the selection of models on the basis of projected changes in temperature may not necessarily align to the 50th and 90th percentiles for rainfall.
4. Data for change in extreme rainfall events sourced from ARR 2019 which uses projections from CSIRO and BoM (2015) to estimate change in design rainfall intensity frequency duration and design flood events under climate change.
5. Based on IPCC data (2013) for RCP8.5.
6. Change in mean sea level, showing the median (50th percentile) of model results, with the range of model results shown in brackets (5th and 95th percentiles).
7. “n/a” and “-“ denotes climate projection data and baseline historical data not available.

The flood modelling undertaken for the project, summarised in Section 7.6 considers the potential impact of climate change on rainfall using the approach recommended in *Australian Rainfall and Runoff (ARR): A guide to flood estimation 2019* (Ball J, et al, 2019).

Drainage infrastructure has been designed to incorporate considerations of climate change for the late century (2090). The project railway track levels have been designed to achieve flood immunity during a one per cent AEP event inclusive of climate change.

The project also generally meets the flood impact criteria for the project which has also been developed for the one per cent AEP event inclusive of climate change.

Climate change risk assessment results

The climate change risk assessment process identified:

- nil very high (‘unacceptable’) or high (‘undesirable’) risks
- 30 medium (‘tolerable’) risks in 2070; and 31 medium (‘tolerable’) risks in 2090
- 28 low (‘acceptable’) risks in 2070; and 27 low (‘acceptable’) risks in 2090.

Climate change risk will be assessed throughout the design development and risk treatments will be progressively incorporated as appropriate.

Of the medium risks identified, the potential risks described in Table 7-52 were considered to present the most material risks to the operational performance of the project in terms of service disruption, passenger and income reduction, increased maintenance costs and concerns for passenger and staff safety.

The material risks reflect the susceptibility of the Western Sydney region to extreme heat and extreme rainfall and flooding events, which aligns with the priorities identified by regional climate planning documents including the Western City District Plan (Greater Sydney Commission 2018).

While the increase in severe fire weather days was not identified as a medium or high risk, potential bushfire risks and relevant mitigation measures are discussed in Section 7.15.

Table 7-49 Summary of potential climate change risks identified as 'Medium' and proposed risk treatments

Risk statement	Pre-mitigation risk rating		Risk treatment
	2070	2090	
An increase in rainfall intensity leading to flooding (surface and subsurface) and damage to track, landscaping and supporting infrastructure	Medium, tolerable	Medium, tolerable	Drainage infrastructure would be designed to achieve the operational flooding performance outcomes for the project (see Section 7.6), which includes limits for changes to peak flood levels and duration for the one precent AEP event. The rail alignment has been designed to achieve one percent AEP flood immunity inclusive of climate change.
An increase in extreme weather events (lightning, high winds and intense rainfall) damaging infrastructure which causes an unsafe environment for customers and staff	Medium, tolerable	Medium, tolerable	Adequate shelter would be included in station, and service facilities. In addition, drainage infrastructure would be designed to achieve the operational flooding performance outcomes for the project (refer to Section 7.6), which includes limits for changes to peak flood levels and duration for the one percent AEP event.

Risk statement	Pre-mitigation risk rating		Risk treatment
	2070	2090	
An increase in average temperatures and extreme heat days resulting in a reduction in passenger comfort and service reliability	Medium, tolerable	Medium, tolerable	The following risk treatments would be applied: • adequate shelter would be included in station, and service facilities • urban design to consider extreme heat and thermal load in and around stations and service facilities • building configurations to maximise air circulation where possible and consider potential for misting and evaporative cooling technologies • ensure selection of materials considers reflectance and transmissivity values to reduce contribution to extreme heat and thermal load • landscaping and green cover to produce cooler microclimates in and around stations, and to include drought and heat tolerant species • testing the sensitivity of air-conditioning and ventilation systems to increased temperatures for passenger comfort and service reliability impacts.
An increase in average temperatures and the number of extreme heat days impacting the integrity, life and operation of critical infrastructure and assets, especially those served by air conditioning and ventilation systems	Medium, tolerable	Medium, tolerable	Testing would be completed for the sensitivity of air-conditioning and ventilation systems to increased temperatures to maintain passenger comfort and service reliability

Risk statement	Pre-mitigation risk rating		Risk treatment
	2070	2090	
An increase in temperatures due to urban development and increased hard surfaces onsite and in neighbouring communities leading to urban heat island effects, increasing heat stress on the project and the broader community	Medium, tolerable	Medium, tolerable	The following risk treatments would be applied: • adequate shelter would be included in station, service facilities, and stabling and maintenance facility design • urban design to consider extreme heat and thermal load in and around stations, service facilities, and stabling and maintenance facility • building configurations to maximise air circulation where possible and consider potential for misting and evaporative cooling technologies • ensure selection of materials considers reflectance and transmissivity values to reduce contribution to extreme heat and thermal load • landscaping and green cover to produce cooler microclimates in and around stations, and to include drought and heat tolerant species
Decreased winter and spring rainfall combined with increased temperatures affecting the health, condition and coverage of vegetation and landscaping used to control other climate risks such as extreme heat days and increased fire risk	Medium, tolerable	Medium, tolerable	Landscaping and green cover would be incorporated within the project where possible (subject to compliance with airspace safety requirements as discussed in Section 7.15) to produce cooler microclimates in and around stations. Species selection of landscaping and green cover to include drought and heat tolerant species.
An increase in rainfall variability, leading to subsurface geotechnical and groundwater fluctuations, impacting the structural integrity of subsurface infrastructure or the foundations of surface infrastructure	Medium, tolerable	Medium, tolerable	Further design development would include geotechnical assessment to determine soil properties and potential impacts of rainfall variability on structural elements (see Section 7.7 for details on geotechnical conditions and refer to Section 8.4 for mitigation measures to manage groundwater and geology impacts such as settlement).

7.9.5 Greenhouse gas and energy

Greenhouse gas assessment methodology

The greenhouse gas assessment and reporting area is based on the ability to control emissions and the generation of emissions by the project, in accordance with the *National Greenhouse and Energy Reporting Act 2007* (NGER Act).

While the effects of climate change vary based on local context, the cause of anthropogenic climate change, being the increased generation and concentration of greenhouse gas emissions in the atmosphere, occurs on a global scale. As a result, the estimate of greenhouse gas emissions generated by the project is considered as a contribution to global climate change.

The Climate Change 2014 Synthesis Report produced by the Intergovernmental Panel on Climate Change (IPCC) confirms that human activity is influencing earth's climate resulting in flow-on impacts that have been observed across all continents and oceans. Continued increases in global greenhouse gas emissions contribute to a warming climate which is projected to cause more extreme weather events. Longer term climatic changes include higher average temperatures, changes to rainfall patterns and sea level rise.

The Paris Agreement was agreed under the United Nations Framework Convention on Climate Change (UNFCCC) at the 21st Conference of the Parties in Paris in December 2015. Australia ratified its commitment to the Paris Agreement in November 2016 with targets of reducing greenhouse gas emissions to 26-28 per cent below 2005 levels by 2030, with a goal to contributing to limiting the global average temperate increase to below 2 degrees Celsius.

The greenhouse gas assessment was prepared following the principles and guidance outlined in *AS ISO 14064-1:2018 Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removal* (ISO, 2018).

In addition, the following guidelines and tools were used for the assessment:

- National Greenhouse Gas Accounts Factors (DEE, 2018a)
- Transport for NSW Carbon Estimate and Reporting Tool (Transport for NSW, 2017)
- Greenhouse Gas Assessment Workbook for Road projects (TAGG, 2013).

Project-wide greenhouse gas emissions have been categorised into direct and indirect emission sources as defined by the *Greenhouse Gas Protocol* (WRI and WBCSD, 2012). The *Greenhouse Gas Protocol* classify direct emissions into Scope 1 and indirect emissions into Scopes 2 and 3 as follows:

- **Scope 1** – direct greenhouse gas emissions released into the atmosphere as a result of the project. These emissions consider construction and operational activities such as emissions from burning diesel fuel within trucks or equipment to build or maintain the project
- **Scope 2** – indirect greenhouse gas emissions are released into the atmosphere from indirect consumption of energy. An example of these would be purchased grid electricity for the project activities such as construction activities or operational phase lighting, where actual emissions are generated elsewhere
- **Scope 3** – other indirect greenhouse gas emissions that are indirectly influenced by the project but are generated within the wider economy. While these emissions are a consequence of the project they are not controlled by the project operators. Scope 3 emissions would include greenhouse gas emissions associated with the extraction, production and transport of purchased materials, waste and fuels used during construction and operation.

This greenhouse gas assessment is based on current indicative design and construction information and should be considered as preliminary estimates. Greenhouse gas emissions calculations can be validated and/or updated during further design development following approval of the project.

The key inputs for the assessment were resource use estimates, for example, electricity consumption and construction materials. Default emissions factors, based on guidance documents and policies outlined in Section 7.9.2, were used to estimate greenhouse gas emissions.

Resource use estimates

Estimates for fuel and electricity consumption and materials use (such as concrete and steel) during the construction and operation of the project were estimated based on the current design as detailed in Section 4.1 and proposed construction methodology as provided in Section 4.2.

The methodology outlined in the *Greenhouse Gas Assessment Workbook for Road projects* (TAGG, 2013) was used to calculate the carbon within the vegetation that would be cleared for the project and the loss of future carbon sequestration potential.

To estimate construction and demolition waste, it was assumed that five per cent of material delivered to site (excluding fill and aggregates) would become offcuts. It was also assumed that 100 per cent of this waste would be transported to landfill for disposal. These are conservative estimates in the absence of more detailed waste estimates, and some of this material is likely to be reused or recycled based on the sustainability initiatives in the Sustainability Plan for the project.

Transport of materials to and from site can contribute significantly to a project's greenhouse gas emissions. Default transport distances and modes of transport from the *Carbon Estimate and Reporting Tool* (Transport for NSW, 2017) were used for the haulage of material to site as well as the transport of waste to landfill. The estimates used are considered a worst-case, and in practice are likely to be less than has been assumed, based on the sustainability initiatives in the Sustainability Plan for the project.

Water usage was estimated during construction based on standard requirements for construction activities including earthworks, concreting, tunnelling, site facilities and dust suppression.

Estimated greenhouse gas emissions during construction

Resource use

The construction of the project would require a significant amount of resources including fuel, electricity and construction materials including concrete and steel. Table 7-50 provides a summary of the estimated quantities of resources that would be required for construction of the project.

Construction resource quantities would be refined during further design development for the project.

Table 7-50 Indicative quantities of resources required to construct the project

Resource	Estimated quantity
Diesel	63,000 kilolitres
Concrete	520,000 cubic metres
Precast concrete (including segments)	75,000 tonnes
Cement grout	70,000 tonnes
Epoxy (waterproof) grout	10 kilolitres
Rail steel	6,700 tonnes
Reinforcing steel and other steel products	133,000 tonnes
Structural steel	12,000 tonnes
Aluminium	650 tonnes
Asphalt	65,000 tonnes
Sand and aggregates	250,000 tonnes
Ballast	71,000 tonnes
Electrical cables	1,400 tonnes
Structural fill	875,000 tonnes
Electricity consumption	513,000 mega-watt hour
Water	524,651 kilolitres

The consumption of these resources is unavoidable when delivering infrastructure projects. The long design life of the project means the upfront consumption of these resources would enable the construction of an asset that would support communities and the economic growth of Sydney in the long-term.

Water required for the construction of the project would be associated with activities such as dust suppression, and would be sourced from water treatment plants, sedimentation basins and rainwater tanks where feasible. The project would maximise the use of non-potable water for non-potable uses and prioritise opportunities to use recycled water on-site. The project would also consider current water use restrictions at the time of construction of the project.

Sydney Metro is committed to the implementation of initiatives through construction to enhance sustainability outcomes, such as effective water management and resource efficiency. Section 7.9.3 provides specific initiatives for resource efficiency and reuse, including for water usage that would be incorporated during further design development and construction of the project.

Estimated greenhouse gas emissions

Potential Scope 1, 2 and 3 greenhouse gas sources for construction of the project, as well as estimated emissions by scope, are provided in Table 7-51.

Table 7-51 Greenhouse gas emission sources broken down by scope for construction

Scope	Construction	Greenhouse gas emissions (tCO2-e)
Scope 1	Diesel fuel combusted onsite from mobile construction plant and equipment including on-site generators	170,460
	Removal of vegetation (including the release of carbon existing within this vegetation when it is cleared and the loss of its potential to act as a carbon sink in the future), in accordance with the methodology outlined in the *Greenhouse Gas Assessment Workbook for Road projects* (TAGG, 2013).	22,091
	Subtotal	**192,551**
Scope 2	Electricity generated offsite to power construction plant, equipment (including tunnel boring machine (TBM) operation) and site offices	420,490
	Subtotal	**420,490**
Scope 3	Emissions associated with the extraction and production of materials used during the construction of the project	670,800
	Transport emissions associated with the delivery of plant, equipment and construction materials	29,510
	Transport emissions associated with the removal of construction and demolition waste from site	35,800
	Decomposition of construction and demolition waste taken to landfill	19,250
	Emissions associated with fuel extraction, transmission and distribution associated with electricity which is used for the project	8,740
	Emissions associated with fuel extraction and processing for fuel supplied to construction plant and equipment	51,280
	Subtotal	**815,380**
Total		**1,428,421**

The greenhouse gas emissions from Scope 1, 2 and 3 emissions for construction activities of the proposed project are estimated to be a total of around 1,428,400 tonnes of carbon dioxide equivalent (tCO_2-e). The estimated Scope 1, 2 and 3 emissions are shown by percentage in Figure 7-8.

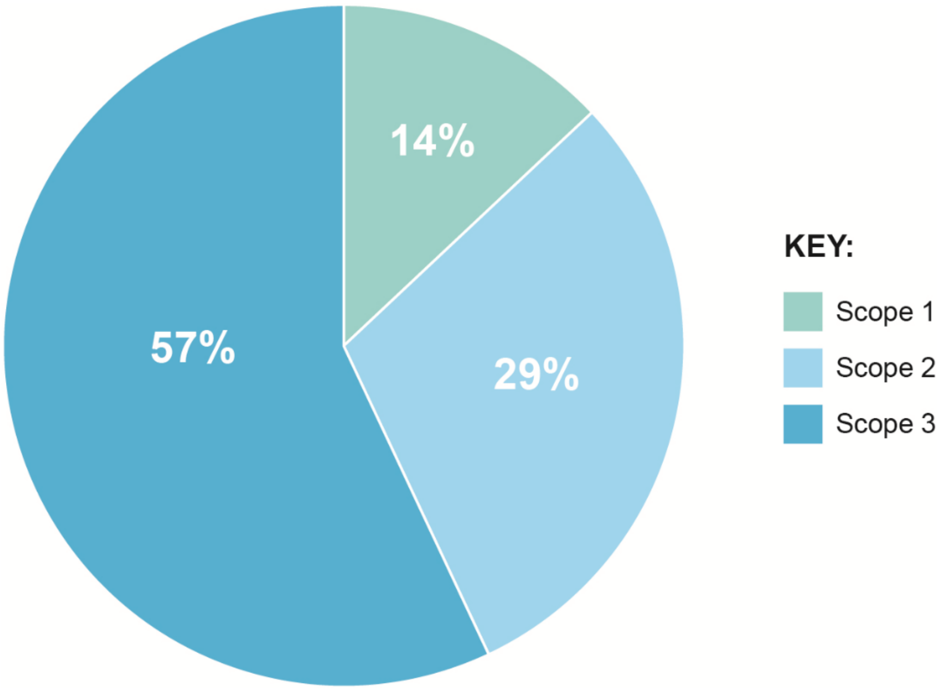


Figure 7-8 Estimated construction greenhouse gas emissions by scope

Table 7-52 provides a breakdown of the greenhouse gas emissions associated with material required for the construction of the project (included in Scope 3 emissions). As shown in Table 7-15, concrete and steel have the highest material impact accounting for around 34 per cent and 63 per cent of total embodied carbon emissions respectively.

Table 7-52 Estimated embodied carbon emissions within construction materials

Material	Greenhouse gas emissions (tCO_2-e)	Per cent (%)
Reinforcing steel and other steel products	370,660	55%
Ready mix concrete	215,940	32%
Precast concrete	12,510	1.9%
Structural steel	34,640	5.2%
Steel rail	19,470	2.9%
Other	17,590	2.6%
Total	**670,810**	**100%**

The *National Greenhouse Gas Inventory* estimates that approximately 128.9 million tonnes of greenhouse gas emissions were produced in NSW in 2017 (DEE, 2017) with approximately four per cent of these emissions resulting from manufacturing and construction practices. The project would likely be constructed over a five-year period, therefore, the construction emissions are estimated to be approximately 285,684 tCO_2-e per annum. This would be equivalent to approximately 0.2 per cent of NSW total emissions and five per cent of the manufacturing and construction sector emissions.

The introduction of initiatives to improve the efficient use of materials on the project and reduce the embodied emissions within these construction products, particularly concrete and steel, would have the most significant impact on reducing the project's construction carbon footprint. Section 7.9.3 outlines initiatives and targets for reducing the embodied carbon of construction materials, increasing resource efficiency and diverting resources from landfill during construction of the project.

The use of energy efficient plant and equipment and the use of alternative fuel/electricity supply during construction would also contribute to the reduction of the project's carbon footprint. The project is committed to the implementation of initiatives through design, construction and operation to enhance sustainability outcomes. These outcomes would be captured in the Sustainability Plan for the project.

Estimated greenhouse gas emissions during operation

Estimated greenhouse gas emissions has been determined based on the operation of the project, both on and off-airport.

Resource use

Resource use (and associated greenhouse gas emissions) during operation would be predominantly associated with electricity consumption to power the trains, stations, stabling and maintenance and service facilities. Other resource use during operation would also be associated with maintenance activities and the replacement of materials over the life of the project. These resource use estimates are based on information available at the preliminary planning stage and will be reviewed during further design development.

The annual operational energy demand has been estimated for the following operational scenarios:

- initial condition – with peak service of up to 12 trains per hour and off-peak service of up to six trains per hour with up to three train car sets
- ultimate condition – with peak service of up to 20 trains per hour and off-peak service of up to 10 trains per hour with up to four train car sets.

See Table 7-53 for a summary of estimated annual energy demand for the two operational scenarios.

Table 7-53 Estimated annual energy demand for the two operational scenarios

Load Type	Annual Energy Consumption – Initial condition (MWh)	Annual Energy Consumption – Ultimate condition (MWh)
Train operations	14,800	30,300
Stations and service facilities	19,100	19,100
Total	**33,900**	**49,400**

Approximately 44 per cent of the initial operating demand is expected to be for the operation of trains and the remaining energy demand would be associated with the operations of the stations, service facilities and stabling and maintenance facility. This would increase to approximately 61 per cent of the operating demand under the ultimate operating condition.

Sydney Metro is committed to the implementation of initiatives through design and operation to enhance sustainability outcomes, such as energy efficiency. These outcomes would be captured in the Sustainability Plan for the project, which Sydney Metro is currently developing.

Water use during operation would be associated with station operation and maintenance activities such as wash down and general maintenance of trains at ancillary facilities. Section 7.9.3 provides resource efficiency measures that would be adopted during operation. These measures include avoiding the use of potable water for non-potable purposes if non-potable water is available.

Estimated greenhouse gas emissions

Potential Scope 1, 2 and 3 greenhouse gas emission sources for operation of the project, under both initial and ultimate operation scenarios, are provided in Table 7-54. These greenhouse gas emissions estimates are preliminary and based on the current design and therefore may be subject to change as the design progresses.

Table 7-54 Greenhouse gas emission sources broken down by scope for operation

Scope	Operation	Initial operation annual greenhouse gas emissions (tCO_2-e)	Ultimate operation annual greenhouse gas emissions (tCO_2-e)
Scope 1	N/A	N/A	N/A
Scope 2	Electricity generated offsite to power the operation of metro trains, stations, service facilities, stabling and maintenance facility, signalling and communication systems, tunnel ventilation and waste treatment plants.	27,800	40,510
Scope 3	Emissions associated with fuel extraction, transmission and distribution associated with the generation of electricity that is used for the project.	3,390	4,940
Total		**31,190**	**45,450**

In line with the ISO14064-1 exclusion requirements, the following operational related GHG emission sources have been excluded from this assessment since detailed information was not available at this stage of the project to enable calculation:

- emissions associated with mobile equipment used for maintenance activities
- emissions associated with the extraction and production of materials used for maintenance activities and replacement of materials over the life of the asset
- decomposition of operational waste.

The operational greenhouse gas emissions over the life of the project are likely to be significantly more than the emissions associated with the construction of the project due to the long operational life of the asset. Operational greenhouse emissions would predominately be associated with electricity consumption to power the trains, stations, stabling and maintenance and service facilities.

The emissions associated with the operation of the project would be equivalent to approximately 0.035 per cent of NSW total annual greenhouse gas emissions. Although the project would increase greenhouse gas emissions through the consumption of electricity, the project would contribute to the *Future Transport 2056* aim to increase access to, and the level of service of, public transport as an alternative means of transport to vehicles on the road network.

Similar to the existing Sydney Metro network, 100 per cent of the project's greenhouse gas emissions associated with the consumption of electricity during operation would be offset. This means the 0.035 per cent emissions increase is neutralised, and will also contribute to the NSW Premier's aspirational target of net-zero emissions by 2050, as well as DPIE's Net Zero Plan 2020 – 2030, which is forecast to deliver a 35 per cent emissions reduction in NSW by 2030 compared to 2005.

Sydney Metro is committed to improving energy efficiency and reducing greenhouse gas emissions, in line with the COAG Energy Council's *Trajectory for Low Energy Buildings* document which aims to optimise demand side energy efficiency and transition towards net zero carbon.

7.10 Resource management

This section assesses the predicted waste and resource generation during construction and operation of the proposed action and provides a description of how waste, including spoil, would be managed for the project (with a focus on its beneficial reuse as a resource). Further detail about spoil management is provided in *Sydney Metro – Western Sydney Airport, Contamination Assessment* (Sydney Metro, 2020g).

Resource consumption (i.e. materials and other resources consumed in the construction and operation of the proposed action) is identified in Section 7.9.

7.10.1 Overview

A Waste Management Plan would be prepared for the construction and operational phases of the project addressing waste generation, including measures to accurately calculate materials procured to limit packaging, segregation of waste streams, materials tracking, waste storage, waste disposal and opportunities for reuse. A Spoil Management Plan would also be prepared based on the waste hierarchy. Sydney Metro is currently preparing a project-specific Sustainability Plan. The Sustainability Plan would also be consistent with the Western Sydney Airport Sustainability Plan (Western Sydney Airport, 2020) in relation to the construction of the on-airport works.

During construction, spoil and other waste would be temporarily generated from earthworks associated with tunnelling, station excavations and cuttings and tunnel and station fit-out. Most spoil would be temporarily generated during excavation required to achieve required ground surface levels for surface sections of the track, the excavation of station boxes as well as the construction of bored tunnels.

It is estimated that the project would potentially generate a surplus of 1,055,000 cubic metres on-airport. Strategies to address spoil management would include opportunities for reuse beyond the project. Subject to meeting specified criteria, spoil generated on-airport may be beneficially reused for the construction of Western Sydney International, including at potential permanent spoil placement areas located within the proposed action construction footprint, but outside of the Western Sydney International Stage 1 Construction Impact Zone. Future use of the permanent spoil placed in these locations would be determined by Western Sydney Airport.

Where spoil is reused on-airport, the Spoil Management Plan would be consistent with the strategies identified in the *Western Sydney Airport Remediation Action Plan* (Department of Infrastructure and Regional Development, 2019) and spoil management strategies in the Western Sydney International Stage 1 development CEMPs.

7.10.2 Legislative and policy context

Spoil generated by the project may be subject to the provisions of the following legislative instruments:

- Approvals for Western Sydney Airport development (inclusive of any variations to those approvals) under the Airports Act and the Airports (Environment Protection) Regulations
- POEO Act and Protection of the Environment (Waste) Regulation 2014 (NSW).

Excess spoil from the project (off-airport or on-airport) that is transported to the Western Sydney International to support the Western Sydney International Stage 1 Construction Impact Zone or transported to the potential permanent spoil placement areas outside of the Western Sydney International Stage 1 Construction Impact Zone would be required to undergo a contamination assessment to ensure that it does not cause pollution as defined by the Airports (Environment Protection) Regulations.

7.10.3 Assessment methodology

A desktop assessment was carried out and involved:

- reviewing the regulatory framework for waste management (including spoil reuse, recycling and disposal options)
- identifying potential waste generating activities during construction and operation
- reviewing the likely waste streams and volumes, including wastewater and demolition materials
- identifying the likely classification of waste streams in accordance with relevant legislation and guidelines
- estimating the quantities of bulk earthworks and spoil balance (cut and fill) to be generated through the construction of the proposed action

- identifying the environmental impacts associated with the generation (and subsequent disposal) of waste materials including spoil (where not suitable for beneficial reuse or recycling)
- developing targets for the beneficial reuse of spoil, wastewater and other construction wastes in accordance with the project's Sustainability Plan
- developing management strategies to adequately address waste during construction and operation.

7.10.4 Waste generation – construction

The main construction activities anticipated to temporarily generate waste during construction are outlined in Table 7-55 along with the likely materials produced.

Table 7-55 Indicative types of waste generated during construction of the proposed action

Activity	Materials produced
Tunnelling, station excavations, cuttings and general earthworks	Spoil comprising virgin excavated natural material, excavated natural material, general solid waste, special waste, restricted solid waste, hazardous waste, tunnel boring machine cutter heads and associated equipment replacement (such as conveyer belts), tunnel boring machine lubricants (bentonite slurry or similar), wastewater including groundwater inflows to tunnels, in-cutting sections and station excavations.
Dust suppression, wash down of plant and equipment, and staff amenities at construction sites	Sediment-laden and/or potentially contaminated wastewater, sewage and grey water.
Tunnel and station fitout and general construction activities and resource use	Concrete waste, timber formwork, scrap metal, steel, plasterboard, cable and packaging material.
Maintenance of construction plant, vehicles and equipment	Adhesives, lubricants, waste fuels and oils, engine coolant, batteries, hoses and tyres.
Activities at construction site offices	Putrescibles, paper, cardboard, plastics, glass and printer cartridges.
Clearing and grubbing of vegetation, landscaped and/or turfed areas	Green waste.

The types and quantities of construction waste generated by the proposed action would be site specific and would vary throughout the stages of construction.

The volumes of other construction wastes (i.e. apart from spoil) are expected to be comparable to other similar (type and scale) infrastructure projects and have not been estimated as part of this Final Environmental Impact Assessment. These construction waste volumes are expected to be manageable through the application of standard waste management strategies (addressing waste generation, storage, disposal and reuse) and the project-specific sustainability initiatives documented in Section 7.9.3.

Spoil volumes

Indicative cut and fill volumes along the on-airport alignment are provided in Table 7-56.

Table 7-56 Indicative cut and fill volumes for proposed action

Location	Approx. cut volume (m^3)	Approx. fill volume (m^3)
Western Sydney International - Elizabeth Drive to Airport Business Park	130,000	75,000
Airport Business Park	25,000	15,000

Location	Approx. cut volume (m^3)	Approx. fill volume (m^3)
Airport **construction** support site	65,000	65,000
Airport Business Park to Aerotropolis Core (including Airport Terminal and Western Sydney International to Bringelly tunnel)	1,065,000	75,000
Total	**1,285,000**	**230,000**
Balance	**1,055,000 surplus**	

The estimates are based on the assumption that cut material can be used as fill for the project, which may not be the case if unsuitable material is encountered during earthworks. Fill volumes do not include reuse opportunities beyond the project which would reduce surplus volumes. Spoil volumes and the earthworks balance would be confirmed during further design development.

7.10.5 Waste generation – operation

The main types of activities anticipated to potentially generate waste during operation of the proposed action are outlined in Table 7-57.

Table 7-57 Indicative types of waste potentially generated during operation of the proposed action

Waste-generating activity	Waste materials produced
Disposal of general litter in station bins and cleaning activities associated with trains, stations and other infrastructure	General non-recyclable and putrescible waste (such as food waste from station rubbish bins).
Management of recyclable materials associated with passengers (materials placed in recycling bins at stations) and activities associated with trains, station and other infrastructure	Recyclable wastes such as plastics and aluminium cans, office waste including paper and plastics.
Infrastructure maintenance	Cable and conduit offcuts from maintenance of electrical infrastructure, solvents, paints, adhesives, cleaning fluids, greases, acids and alkali materials, and spent spill kit absorbent materials used to clean up accidental spills during maintenance.
Capture and treatment of groundwater and stormwater ingress into tunnels and stations	Sediment-laden and/or potentially contaminated wastewater, solids, filter cake (consisting of oxides and iron and manganese) and water treatment chemicals from the on-site detention basins.
Use of station customer facilities	Sewage and grey water.

The capture and treatment of groundwater and stormwater ingress into the tunnels, in-cutting sections and stations would require the operation of a water treatment plant including at Bringelly (off-airport). The final location and design of the water treatment system for the proposed action would be confirmed during further design development.

The other wastes potentially generated during the operation of the proposed action (as listed in Table 7-57) would be considerably lower than those generated during construction and would be typical of similar infrastructure projects. Confirmation of the volumes of these wastes are subject to further design development.

7.10.6 Potential impacts – construction

Potential temporary waste management impacts during construction of the proposed action would include:

- waste being directed to landfill due to its inadequate collection, handling, classification and disposal, which would deplete available landfill capacity within the Sydney region
- contamination of soil, surface and/or groundwater from the inappropriate storage, transport and disposal of liquid and solid wastes
- an increase in vermin from the incorrect storage, handling and disposal of putrescible waste from construction sites
- incorrect classification and/or disposal of waste, including the incorrect storage, handling and disposal of contaminated spoil and other hazardous materials (for example, asbestos)
- excessive amounts of materials being ordered, resulting in a large amount of leftover, unused resources
- lack of identification of feasible options for recycling or reuse of resources.

The above issues are considered to be manageable through standard mitigation measures. These measures would be developed in accordance with the project's Sustainability Plan (refer to Section 7.9.3).

Due to the staging of Western Sydney International construction works, it is likely that parts of the proposed action construction footprint would be remediated prior to construction. Where remediation hasn't been completed, the remediation would be undertaken in accordance with the remediation strategy in the *Western Sydney Airport Remediation Action Plan* where applicable.

Spoil management

A Spoil Management Plan would be prepared for the project in consultation with Western Sydney Airport (for the on-airport works).

The high-level approach and hierarchy for spoil management includes:

- Priority 1: Reuse of spoil in construction of the project off-airport or on-airport, where spoil is suitable (or can be made suitable through remedial actions) for the placement location under the applicable regulatory regime
- Priority 2: Reuse of spoil for other development projects (e.g. Western Sydney International or for other projects off-site) where spoil meets the requirements of the regulatory regime and approvals for the receiving site
- Priority 3: Recycling of materials at off-site facilities in accordance with the licenses and approvals of the recycling facility
- Priority 4: Off-site disposal to landfill in accordance with the licenses and approvals of the facility.

The quantities and locations of on-site reuse opportunities would be further investigated and determined during further design development. Where spoil cannot be reused for the project, opportunities to reuse this material on other projects (preferably within the Sydney region to reduce transport distances) would be identified. Temporary stockpiling sites would be established as required throughout the proposed action construction footprint to facilitate reuse opportunities.

The geology of the spoil material as well as its consistency and quality would determine the reuse options. The majority of excavated spoil would be Bringelly shale which is likely to require blending with suitable materials sourced from off-site (e.g. sandstone) and stabilising.

Spoil generated by the proposed action may be reused for the construction of Western Sydney International, including in the potential permanent spoil placement areas located within the proposed action construction footprint, but outside of the Western Sydney International Stage 1 Construction Impact Zone (refer to Figure 4-14). Reuse of spoil within Western Sydney International would be undertaken in accordance with the Airport Plan, Construction Plan and any relevant CEMPs, including any subsequent variations to those plans. Future use of the permanent spoil placed in these locations would be determined by Western Sydney Airport.

Management of other construction wastes

Construction water, including groundwater intercepted during tunnelling, would be captured, treated and discharged. Treated water would be recirculated to the tunnel cutting face and used for surface dust suppression. Treated water that could not be recirculated would be discharged from the sites via a construction water treatment plan off-airport. The reuse of treated water would be maximised during the construction works. Further information on construction water management is provided in Section 4.2.9.

Impacts associated with the disturbance of ASS and other hazardous wastes is considered in Section 7.8.4. Disturbance, movement and disposal of asbestos containing materials would be carried out in accordance with the *Work Health and Safety Regulation 2011* (NSW) and applicable guidelines. The proposed action would not require the management of demolition waste.

7.10.7 Potential impacts – operation

Potential waste management issues that could occur during operation of the proposed action include:

- waste from stations and maintenance activities being directed to landfill due to the inadequate collection, classification and disposal of waste, which would increase the demand for landfill capacity within the Sydney region
- waste (such as litter) from station buildings being blown into the surrounding environment if adequate bins are not provided or emptied regularly
- wastewater from stations (toilets and station cleaning activities)
- disposal of wastewater from tunnels and stations
- an increase in vermin from the incorrect storage, handling and disposal of putrescible waste at stations
- excessive amounts of maintenance materials being ordered, resulting in a large amount of left-over, unused resources.

The above issues are manageable through the mitigation measures outlined in Chapter 8 (Environmental management and mitigation). Additional measures would be developed in accordance with the project's Sustainability Plan (see Section 7.9).

7.11 Land use and property

This section considers the potential land use implications of constructing and operating the proposed action. It also describes the framework for integrated land use and transport planning as a result of the proposed action.

7.11.1 Overview

The project supports the implementation of State and Commonwealth strategic land use policies for the development of Greater Sydney particularly the Western Parkland City, the Western Sydney Aerotropolis and the Western Sydney International.

Commonwealth land on-airport consists of Western Sydney International Stage 1 and associated land uses. Much of the land to the north and south of the airport is located within the future Western Sydney Aerotropolis, for which the *Western Sydney Aerotropolis Plan* (NSW Government, 2020) provides a strategic plan for future urban growth as part of the development of the Western Parkland City.

Given construction planning of the project would align with construction planning of Western Sydney International, an Airport and Rail Integration Deed would be established between Sydney Metro, Transport for NSW, Western Sydney Airport and the Commonwealth to address integration issues.

Once operational, the project would support planned urban growth and be a key element of the future Western Sydney Aerotropolis by improving access to public transport infrastructure.

7.11.2 Legislative and policy context

The key legislation and policies guiding land use are:

- Airports Act and Airport Plan

  The Airport Plan has been approved under the Airports Act to guide development on the site until an airport master plan is developed and approved. The proposed action will comply with the Airport Plan as varied (refer to Section 2.2)

- strategic land use planning policies:
  - *Western City District Plan* (Greater Sydney Commission, 2018b)
  - Western Sydney Aerotropolis Plan (WSAP) (NSW Government, 2020)
  - State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 (WSA SEPP).

7.11.3 Assessment methodology

The assessment of potential on-airport land use impacts associated with the construction and operation of the proposed action involved:

- describing the existing environment with reference to the Western Sydney International Stage 1 development
- assessing the potential interaction of construction and operation of the project on proposed planned land use associated with the Western Sydney International Stage 1 development
- identifying mitigation measures to avoid or manage the impacts identified and to maximise benefits of the project on property and land use.

The study area for the purposes of the land use assessment includes the construction and operational footprint of the proposed action as well as the properties adjacent to the construction and operational footprint.

7.11.4 Potential impacts – construction

Construction of the project is being planned to occur at the same time as construction of Western Sydney International and it is expected that the project would be operational in time for the commencement of airport operations. Given construction planning of the project would align with construction planning of Western Sydney International, potential impacts on land use or property associated with the Western Sydney International during construction would be managed in coordination with Western Sydney Airport.

An Airport and Rail Integration Deed would be established between Sydney Metro, Transport for NSW, Western Sydney Airport and the Commonwealth, which would address integration issues including providing for a temporary licence regime to enable Sydney Metro to undertake construction of the project within the Western Sydney International site.

The construction interface, final alignment and land requirements for the project are currently being refined by Sydney Metro in consultation with Western Sydney Airport and the Commonwealth.

7.11.5 Potential impacts – operation

Western Sydney Airport has developed an airport site layout as shown in Figure 1-2 which has preserved a rail corridor.

Operation of the proposed action is not expected to impact on the operational activities associated with Western Sydney International. The design development of Western Sydney International and the proposed action would be coordinated.

The majority of the proposed action alignment has been designed as in-tunnel to minimise surface disturbance within the airport site and allow for the full realisation of the long-term Airport Plan (refer to Figure 6-14). The tunnelled section will continue under the Western Sydney International and associated infrastructure and Badgerys Creek to minimise impact on the environmental values of the Environmental Conservation Zone identified by the Airport Plan.

The Airport and Rail Integration Deed established between Sydney Metro, Transport for NSW, Western Sydney Airport and the Commonwealth and related agreements would address responsibility for the ongoing operation of the proposed action (as part of the broader project), with a view to establishing a single compliance and governance regime for the project as a whole.

7.12 Landscape and visual

This section provides a summary of the assessment of potential landscape character and visual amenity impacts during construction and operation of the proposed action. The full landscape and visual assessment is provided in *Sydney Metro – Western Sydney Airport, Landscape and Visual Impact Assessment* (Sydney Metro, 2020h).

7.12.1 Overview

Stage 1 of Western Sydney International is currently under construction, which is changing the landscape character and the potential visual catchment of the proposed action. More broadly, the proposed action is located within the Western Parkland City where transformational changes to the landscape and visual character of the area are expected during construction and operation.

During construction, there would be a negligible landscape impact on the airport site, as works would be absorbed into this changing landscape. Existing views across the airport site would not be affected due to the visual absorption capacity of this setting.

During operation, the landscape and visual impacts of the proposed action would be minor beneficial given a large section would be in tunnel and that stations will be designed to be compatible with their future land use context. In the longer term the proposed action would be visually absorbed into Western Sydney International and the surrounding landscape which is intended to transition to become the Western Parkland City and Western Sydney Aerotropolis.

Construction and operation mitigation measures to manage potential landscape and visual impacts of the proposed action include addressing matters such as appearance of acoustic sheds during construction, opportunities for vegetation screening, and integration of water management measures with the existing landforms and natural features.

7.12.2 Assessment methodology

The future layout for the Stage 1 area is defined by the Western Sydney International Stage 1 airport layout (refer to Figure 1-2). As such it is possible to understand the likely impact of the proposed action on this area.

The landscape and visual amenity assessment approach assumed construction of the proposed action concurrently with the Western Sydney International Stage 1 construction to assess potential construction impacts. The future character of the completed Western Sydney International Stage 1 is assumed as a baseline for operational impacts.

This approach identifies the different types of construction activities and proposed built elements and assesses these types against the predicted character of the Western Sydney International Stage 1 construction and future character of the Western Sydney International Stage 1 airport operations respectively. For the areas of Western Sydney International outside the Western Sydney International Stage 1 Construction Impact Zone, a greenfield landscape has been assumed, followed in the longer term by potential construction and then operation of future stages of the development of the airport to accommodate anticipated long term demand, including a second runway. The impact of the proposed action in relation to these anticipated future landscape conditions has been considered generally.

Due to the ongoing construction of Western Sydney International Stage 1, there are limited publicly accessible views to the proposed action to determine the impacts of the proposed action during construction. The context of any views to the proposed action would be greatly altered during construction of the airport. The existing views (refer to Section 6.12) have been considered in this assessment.

The assessment methodology included:

- daytime landscape impact assessment
- daytime visual impact assessment
- night-time visual impact assessment.

These assessments considered the sensitivity of either the landscape character area or airport receivers to the magnitude of change from the proposed action to assign a level of impact.

7.12.3 Study area and landscape character area

The study area for this landscape character and visual impact assessment extends to include the potential visual catchment of the proposed action; that is, the area from which the proposed action would be visible. The study area for the on-airport assessment is defined as Western Sydney International character area – Elizabeth Drive to Badgerys Creek as shown in Figure 7-9.

Landscape character

The landscape character of Western Sydney International is described in Section 6.12.

Once operational, Western Sydney International will be used by a large volume of airport travellers and workers and would be of local landscape sensitivity for the purposes of assessing the operational impacts of the proposed action.

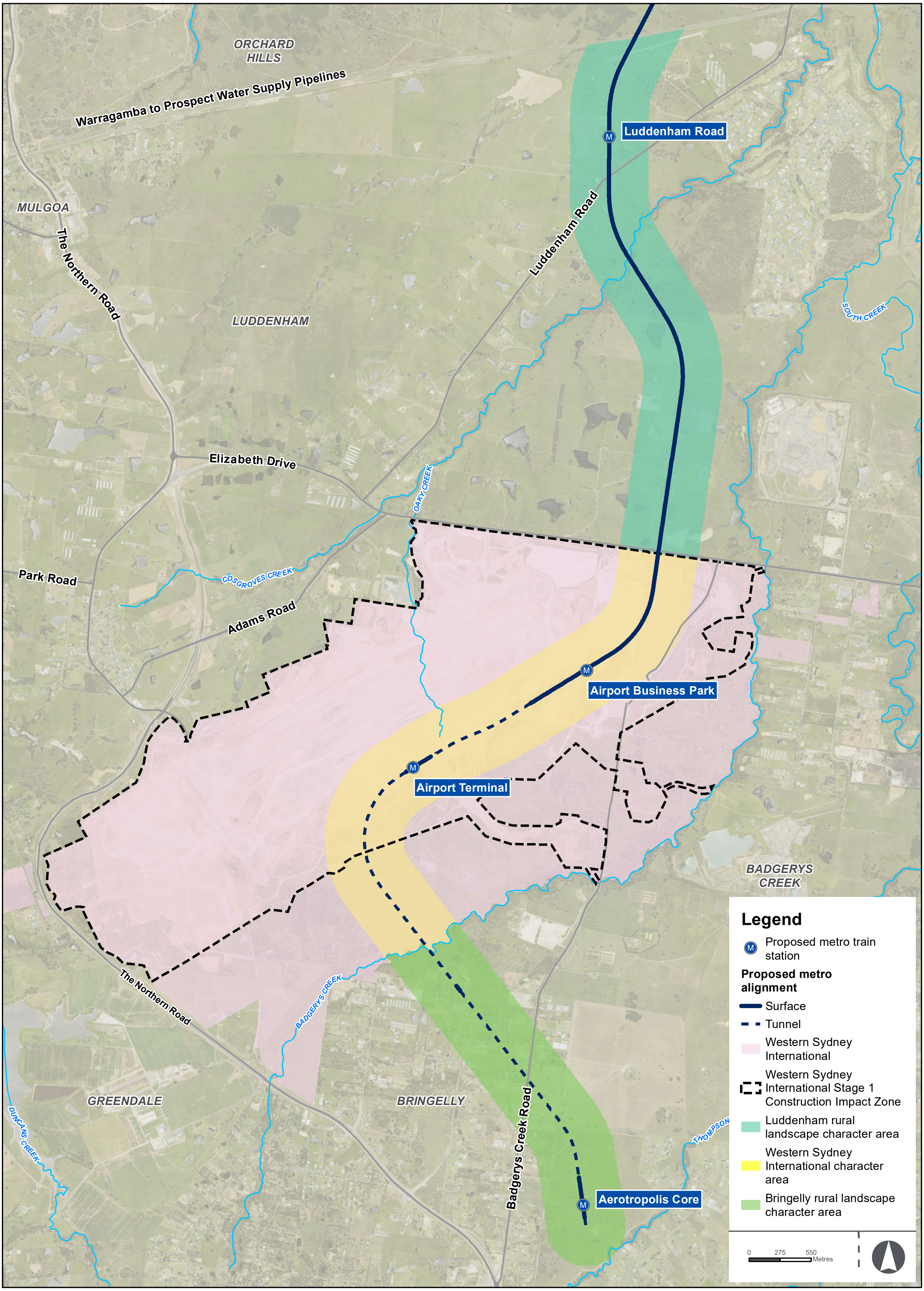
The construction phase night-time sensitivity of the landscape was rated as moderate as a result of the rural uses and relatively dark urban locations with light from traffic movements along Elizabeth Drive, Badgerys Creek Road and The Northern Road. The future operational Western Sydney International landscape character area would become an area of negligible sensitivity as a result of 24/7 airport activities and other proposed developments surrounding the airport site.

Viewpoint locations

The viewpoints identified in Western Sydney International to assess potential construction impacts rating are presented in Figure 7-10. In addition to these views, views to the temporary construction power supply route that would extend between the Airport Business Park construction site and the Kemps Creek Zone substation (the Kemps Creek construction power corridor) have been considered generally.

During operation, views to the key elements of the proposed action would be mainly available to pedestrians and cyclists at short range, approaching and transiting between the stations and the airport terminal, car parking and commercial areas. This would include a large volume of commuters using the airport for regional, national and international travel, and associated workers at the airport and airport-related business park. The proposed design elements likely to give rise to visual impacts are:

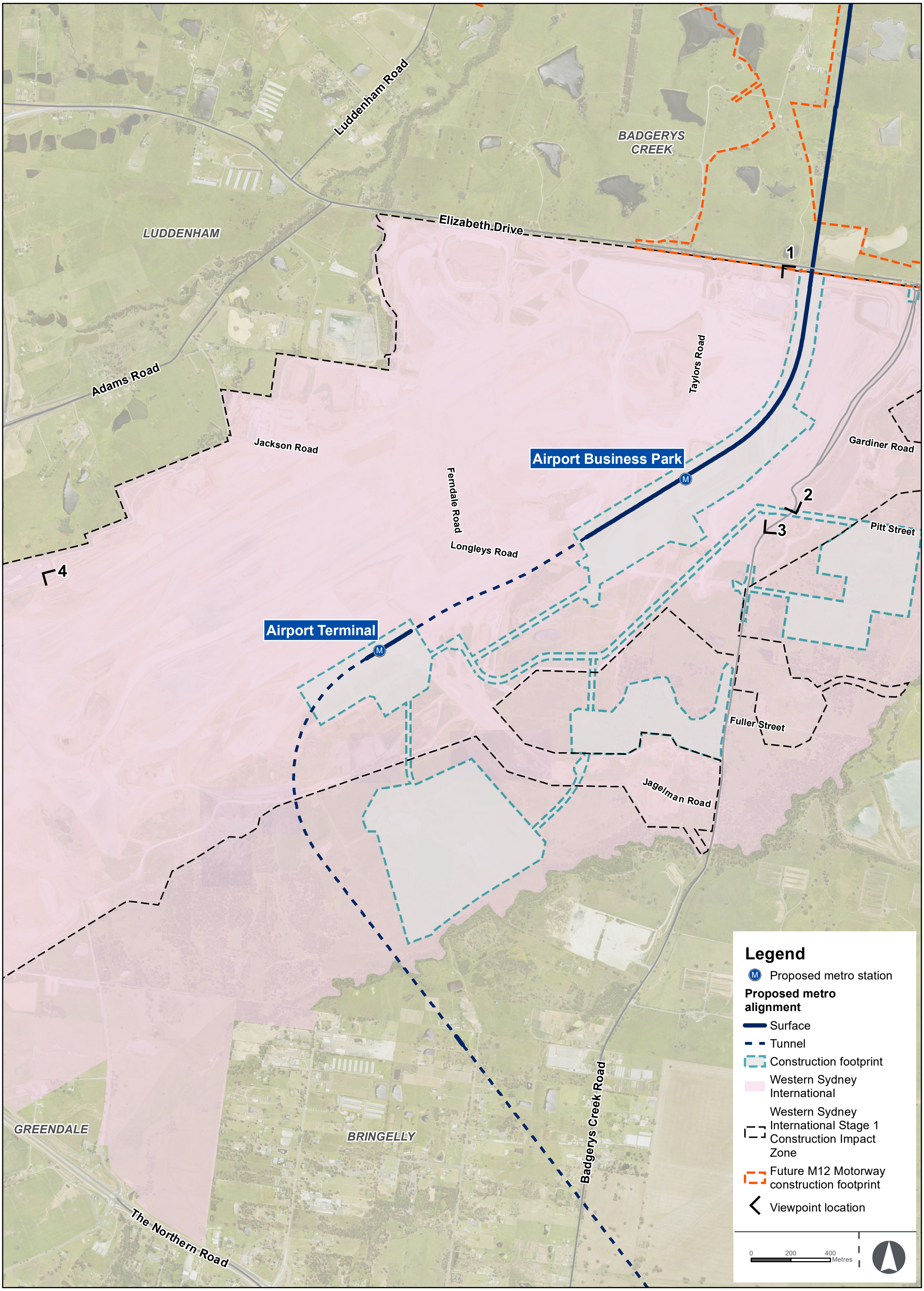
- at-grade corridor
- at-grade (shallow cutting) station – Airport Business Park Station
- cut-and-cover station – Airport Terminal Station
- tunnel portal
- tunnel ventilation facility.



Indicative only, subject to design development

Existing landscape character areas

Figure 7-9



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Construction viewpoint locations

Figure 7-10

7.12.4 Potential impacts – construction

Landscape character impacts

During construction, there would be a negligible landscape impact on the airport site, as Western Sydney International is currently under construction and the works would be absorbed into this changing landscape.

Visual amenity impacts

During daytime construction, the proposed action would be visible from parts of Elizabeth Drive and the rural areas to the north of the airport site. Public access within the airport site is restricted; however, there would be views to the on-airport corridor construction site, tunnel and viaduct segment production and storage, potential permanent spoil placement areas and haulage routes from Badgerys Creek Road, which has recently been realigned to the east between Elizabeth Drive and Longleys Road. There are broad, panoramic views across the airport site from the Western Sydney International Airport Experience Centre and views to Badgerys Creek from rural areas to the south in Bringelly.

The scale of the proposed action during construction would be largely consistent with, albeit of a lesser scale than, the Western Sydney International Stage 1 construction works. There would be a negligible visual impact on views from the Western Sydney International Airport Experience Centre, Elizabeth Drive and Badgerys Creek Road due to the visual absorption capacity of this setting. There would also be a negligible visual impact on views of the Kemps Creek construction power corridor due to the minor scale of the works, which would be constructed to avoid vegetation impacts along the South Creek and Badgerys Creek corridors.

During night-time construction, there would be a negligible visual impact on the Western Sydney International landscape character area due to the minor nature of the lighting required for the proposed action during construction.

7.12.5 Potential impacts – operation

Landscape character impacts

During operation, the majority of the proposed action would be in tunnel. The surface elements of the proposed action would be compatible with the character of the future landscape and offer improvements to the accessibility and permeability of the Western Sydney International precinct. The stations would have a high-quality architectural treatment and be set within landscaped plazas and streetscapes so that they are integrated with the surrounding urban setting. In particular, Airport Terminal Station would complement the Airport Terminal precinct and terminal buildings, providing direct and legible access to the heart of this precinct. This would result in a minor beneficial landscape impact.

In the longer term, following full development of the airport site, the proposed action would be a key component of the surrounding landscape of Western Sydney International. This would result in an urban built form that would substantially reduce the potential visibility of the proposed action. Overall, the landscape impacts of the proposed action would reduce as this transformation occurs.

Visual amenity impacts

During daytime operation, there would be a minor adverse visual impact on views to the at-grade sections of the on-airport alignment, due to the compatibility of the proposed action with the character of views expected within the future Western Sydney International. There would be a minor adverse impact on views from Badgerys Creek Road to the potential permanent spoil placement areas as these areas would be absorbed into views of the airport and construction of future development over time.

There would be negligible visual impacts on views to the on-airport alignment, as the alignment would have limited visibility from surrounding areas. There would be a negligible visual impact on views to Airport Business Park Station and Airport Terminal Station as the built form of these stations would be modest in relation to the scale of the surrounding built form and infrastructure. The stations would have a high-quality architectural treatment, would integrate with the surrounding urban setting and be compatible with the expected character of future land uses within Western Sydney International.

During operation at night, there would be a negligible visual impact as lighting at the stations and along the alignment in the Western Sydney International would be consistent in character with the setting of the future airport.

Figure 4-7 and Figure 4-11 show artist's impressions of Airport Business Park Station and Airport Terminal Station respectively.

7.13 Social and economic

This section provides an assessment of the potential social and economic impacts of the proposed action, including impacts on social infrastructure, communities, the broader economy and local businesses during construction and operation.

7.13.1 Overview

The project would have positive local and regional economic and employment impacts, including supporting jobs during construction.

The main potential temporary social and economic impacts associated with the on-airport proposed action would be beyond the airport site, and would generally be managed through appropriate mitigation of other aspects, such as noise, traffic, visual and air quality impacts. The Overarching Community Communication Strategy (Appendix D) contains the strategy for stakeholder and community involvement that has been developed for the proposed action. The strategy outlines the approach for proactive consultation with affected businesses and the community.

There would be temporary changes to community character, such as changes to access and increased numbers of workers and visitors in the area due to construction activity. The wider area surrounding the on-airport proposed action would also be subject to urban growth and development as part of strategic planning for the Western Parkland City, including for the Western Sydney Aerotropolis and Greater Penrith to Eastern Creek Growth Investigation Area.

The proposed action would have positive regional economic and employment impacts through facilitating increased trade catchments, efficient freight movements and providing connection to employment opportunities. It would also directly employ people to operate and maintain the trains and stations.

7.13.2 Legislative and policy context

The social and economic impact assessment has been carried out in accordance with and guidance from:

- Airport Plan
- Requirements of section 96A of the Airports Act
- Significant impact guidelines 1.2 - Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies (Commonwealth of Australia, 2013).
- Social Impact Assessment Guideline for State Significant Mining, Petroleum Production and Extractive Industry Development (Department of Planning and Environment, 2017) (DPE guidelines)
- Environmental Impact Assessment Practice Note (EIA-N05) – Socio-economic assessment (Transport for NSW, 2020b)
- Australian Transport Council's Australian Transport Assessment and Planning Guidelines (2018) (ATAP Guidelines)
- key NSW strategic planning policies and guidelines, including the *Greater Sydney Region Plan* (Greater Sydney Commission, 2018a) and *Western Sydney Aerotropolis Plan – Draft for Public Comment* (NSW Government, 2019)
- Penrith City Council and Liverpool City Council's strategies and community plans, including Local Environmental Plans (LEPs) and Local Strategic Planning Statements (LSPS).

7.13.3 Assessment approach

Study area

The study area for the social and economic impact assessment encompasses the suburbs and communities (including landowners, businesses and sensitive land uses) that have the potential to experience changes to social conditions or local movement patterns due to construction and/or operation of the proposed action. These suburbs and communities are identified and described in Section 6.13.

Social impact assessment approach

The approach for the social and economic assessment included:

- development of a social baseline for the study area, based on analysis of Australian Bureau of Statistics (ABS) Census data (2016), and identification of community stakeholders and community assets
- identification of community values and concerns through a review of outcomes from consultation undertaken to date for the North-South Rail Line corridor and the project, and in LSPSs for Penrith and Liverpool LGAs
- impact identification and assessment for construction and operation phases of the project (including direct, indirect, negative and positive/beneficial impacts). The categories and matters considered in the impact assessment are consistent with DPE guidelines and described in Table 7-58.

Impacts have been evaluated based on the likelihood of occurrence and the consequence of the potential social and economic impact. A risk rating was then determined by combining the likelihood and consequence. Risk ratings range from low, medium, high to extreme and can be positive or negative. Once an initial risk rating was identified, a residual risk rating was identified based on the implementation of the performance outcomes and mitigation measures identified for the proposed action.

Table 7-58 Categorisation of social and economic impacts

Impact category	Description
Way of life	Including: • how people live, e.g. how they get around, access to adequate housing • how people work, e.g. access to adequate employment, working conditions and/or practices • how people play, e.g. access to recreation activities • how people interact with one another on a daily basis.
Community	Including its composition, cohesion and character, how it functions, and sense of place.
Access to and use of infrastructure, services and facilities	Whether provided by local, State or Federal governments, or by for-profit or not-for-profit organisations or volunteer groups.
Culture	Including shared beliefs, customs, values and stories, connections to land, places and buildings, and including Aboriginal culture and connection to country.
Health and wellbeing	Including physical and mental health.
Surroundings	Including access to and use of ecosystem services, public safety and security, access to and use of the natural and built environment and their aesthetic value and/or amenity.
Personal and property rights	Including whether their economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected.
Decision-making systems	Particularly the extent to which they can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms.

Impact category	Description
Fears and aspirations	Related to one or a combination of the above, or about the future of their community.
Economy	Including local and regional impacts to the economy through changes in the investment environment and productivity.

Source: Adapted from the DPE Social Impact Assessment Scooping Tool – Impact Rating Guide

Local business impact assessment approach

Potential impacts of the proposed action on businesses were assessed qualitatively. The assessment approach included:

- identifying local businesses within the study area which are most likely to be directly impacted by the proposed action during construction and operation
- carrying out a desktop review for each local business study area during April and May 2020 and conducting a site visit to verify the desktop review to understand what businesses are present
- identification of types of changes and/or impacts (both positive and negative) that could occur to businesses within each local business study area.
- a qualitative assessment using both the ATAP and DPE Guidelines to allow for both impacts and benefits to be considered, along with their likelihood of occurring
- identification of measures to manage and mitigate adverse impacts and enhance positive impacts on local businesses as a result of the project.

Regional economic impacts

The project has the potential to result in regional economic impacts and benefits which extend beyond the study area used for the assessment of more localised social and economic impacts. These potential regional impacts, such as the provision of jobs, altered trade catchments and employment connectivity, have been considered and assessed qualitatively and apply to the project as a whole (i.e. for the off-airport and on-airport).

Other considerations

The assessment has also considered the following:

- construction of the Western Sydney International Stage 1 development would be concurrent with the construction of the proposed action
- the potential for impacts associated with on-airport construction to extend beyond the physical boundary of Western Sydney International i.e. the economic and social impacts (including amenity impacts such as traffic impacts and noise) of the proposed action have an influence beyond the airport boundary
- the Western Sydney International Stage 1 development will be operational from 2026.

7.13.4 Potential impacts – construction

The main social and economic impacts associated with construction on-airport are impacts to communities beyond the airport site on way of life and health and wellbeing relating to traffic, noise and air quality. Substantial earthworks and construction activities would be carried out within Western Sydney International. These would be associated with the manufacture of pre-cast tunnel and viaduct segments, construction of the Western Sydney International tunnel portal, Airport Business Park Station and Airport Terminal Station and excavation of large volumes of spoil. Stockpiling activities would be carried out at the potential permanent spoil placement areas. The potential for dust emissions from earthworks, construction and track-out is considered to be high.

There are no sensitive receptors within Western Sydney International and limited sensitive receptors within the study area outside Western Sydney International that would be potentially affected by on-airport construction activities. The sensitivity of Western Sydney International to traffic, noise, visual and air quality impacts is considered to have a low risk rating.

Potential impacts on receivers outside Western Sydney International would be mitigated through transport, visual, air quality and noise mitigation measures and result in a low risk rating. Chapter 8 (Environmental management and mitigation) provides the full list of proposed mitigation measures for the proposed action, including some social and economic specific proposed mitigation measures.

As minimal businesses were identified within the on-airport local business study area, the proposed action is not expected to impact business during construction. However, the proposed action may result in a benefit to nearby business clusters on regional roads leading to the area, particularly those along The Northern Road and Elizabeth Drive, resulting from increased passing trade of construction workers.

Cumulative construction impacts of the project and Western Sydney International are assessed in Section 7.16.

Ongoing consultation with Western Sydney Airport has ensured the construction strategy for the proposed action also considers construction of the Western Sydney International Stage 1 project.

There would be continued consultation between Sydney Metro and Western Sydney Airport as part of the ongoing development of the construction approach for the two projects. Opportunities for the construction of the proposed action to integrate with construction activities for Western Sydney International would be developed as the proposed action design and construction planning is refined.

Regional economic impacts

The project would have construction impacts that are not specific to within the study area or certain construction sites. These regional impacts would likely affect a broader area and represent wider positive effects of the project.

The main broader economic impact during construction is the provision of temporary construction jobs. The project would have positive local and regional economic and employment impacts, supporting around 14,000 jobs during construction which would contribute to economic recovery. This includes over 150 apprenticeships, as well as tradespeople, tunnellers, and truck drivers. This would also result in local businesses (such as retail and convenience services) experiencing an increase in passing trade during the construction period.

Sydney Metro has developed a Workforce Development and Industry Participation Strategy and an Aboriginal Participation Plan which includes objectives to support jobs and skills for a more diverse and inclusive workforce and supply chain.

7.13.5 Potential impacts – operation

Potential positive on-airport socio-economic impacts include:

- the addition of the metro would create better access for workers, commuters and travellers to Western Sydney International
- the proposed stations and supporting infrastructure would form an essential part of the community fabric of the future precincts within the airport
- the proposed action would reduce pressure of on-airport road networks, improving access for travellers and workers to Western Sydney International
- the proposed action would have significant widespread impacts on the local, regional and national economies and would catalyse early jobs growth associated with the Airport Business Park and Airport Terminal
- the proposed action would add value to the Australian Government's investment in Western Sydney International Airport and would enable future stages of an integrated metro network necessary to achieve planned growth for Greater Sydney. It would support the attraction of investment in a new and emerging economic centre for multinational businesses. These investments would, in time, be important to the long-term economic growth of NSW.

The design would also continue to consider the integration of the proposed action with Western Sydney International. The key characteristics of the Sydney Metro network of being a fast and reliable service would ensure sufficient frequency that passengers can turn up and go to Western Sydney International with sufficient time to connect to flights.

Regional economic impacts

The project and proposed action would contribute to broader productivity benefits for the region that are not specific to within the study area or certain station catchments. These regional impacts would likely affect a broader area and represent wider effects of the project including altered trade catchments, freight efficiency and employment connectivity, for example:

- altered trade catchments:
  - the project is anticipated to broaden the trade catchments of businesses along the wider Greater Sydney rail network. Businesses that are reliant on in-person trade would have access to new customers along the project corridor, including those from the development of future transport, education, health and social infrastructure in the region around the station precincts
  - the project would provide a sustainable, low carbon travel mode that would reduce private vehicle use and road congestion in the study area
- freight efficiency:
  - at a regional level, it is anticipated that potential reduced road traffic volumes associated with private vehicle users choosing rail would benefit businesses that are reliant on road freight for supply or dispatch of goods
  - reduced and more predictable travel times would potentially reduce costs associated with freight or allow for additional freight movements
- employment connectivity:
  - the project is anticipated to increase connectivity between businesses and the broader labour market, improved knowledge sharing opportunities between businesses, increased access to suitable workers due to increased direct connections via public transport, potential reductions to private vehicle travel times, and access to future development of transport, education, health and social infrastructure in the region around the station precincts
  - the project would improve access to employment to be generated along the alignment throughout Western Parkland City, including at Western Sydney International, the Northern Gateway and Aerotropolis Core precincts and St Marys Town Centre. Business travellers from Western Sydney International would also have access to destinations within and beyond Western Parkland City
  - by supporting local job access and creation, this reduces the need for people to travel into Parramatta and the Sydney CBD to access jobs. This is anticipated to improve travel times for road users as well as provide amenity and health benefits associated with increased public transport use.

7.14 Air quality

This section provides an assessment of potential air quality impacts during construction and operation of the proposed action.

7.14.1 Overview

Air quality during construction of the proposed action would be adequately managed in accordance with proven standard mitigation measures. Temporary dust generating activities would include earthworks and construction activities and stockpiling activities carried out at the potential permanent spoil placement areas. Temporary emissions from combustion of diesel fuel by heavy vehicles, mobile construction equipment and stationary equipment such as diesel generators are not expected to result in adverse impacts on the surrounding environment.

During operation, the project is anticipated to benefit regional air quality by delivering an attractive alternative mode of transport, which could result in a mode shift from road to rail. This has the potential to reduce air pollution emissions associated with road transport and associated congestion, when compared to the emissions that would otherwise occur if the project was not delivered.

7.14.2 Legislative and policy context

The air quality assessment has been prepared in accordance with the following legislation and guidelines:

- Airports Act
- Airport Plan
- Airports (Environment Protection) Regulations
- POEO Act
- Protection of the Environment Operations (Clean Air) Regulation 2010 (NSW)
- *Guidance on the assessment of dust from demolition and construction* (UK Institute of Air Quality Management (IAQM) 2014)
- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016)
- *National Environment Protection (Ambient Air Quality) Measure* (National Environment Protection Council (NEPM), 1998).

7.14.3 Assessment methodology

Construction

The construction air quality assessment involved the application of a semi-quantitative risk-based approach to the assessment of potential temporary construction impacts related to dust generation following the guidance developed by the UK Institute of Air Quality Management (IAQM, 2014). This methodology has been commonly used to assess air quality impacts for the construction of infrastructure projects in NSW.

The assessment also includes a qualitative discussion on the potential temporary construction air quality impacts from vehicle emissions.

The assessment methodology considers three separate potential air quality impacts:

- annoyance due to dust soiling e.g. dust covering items or objects such as cars and houses
- the risk of health effects due to an increase in exposure to particulate emissions (PM_{10})
- harm to ecological receptors.

The assessment identified any receptors close enough to warrant further assessment. An assessment is required where there is a human receptor within:

- 350 metres of the construction footprint; or
- 50 metres of the route used by construction vehicles on public roads and up to 500 metres of a construction vehicle access point to a highway.

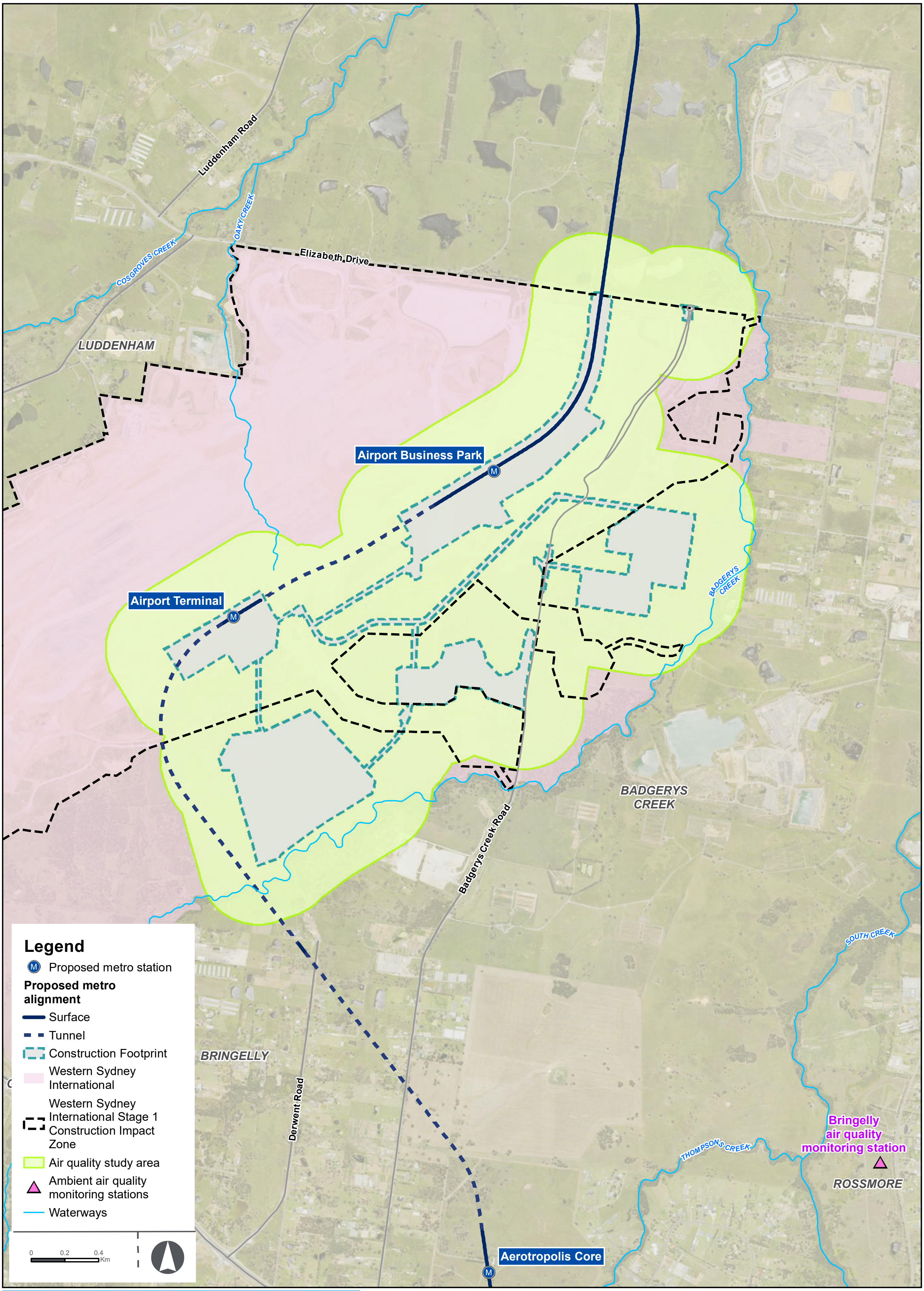
This determined the study area for the construction air quality assessment.

The risk of air quality impacts associated with different construction activities including earthworks and construction is assessed. The risk of dust impacts is assessed without mitigation. Based on a revised assessment with standard mitigation measures the residual risks of air quality impacts are identified. The category of risk is shaded in accordance with the relevant risk table in the IAQM (IAQM, 2014).

The Airports (Environment Protection) Regulations provide accepted limits of air quality emissions at Commonwealth Airports. The limits relate primarily to air quality emissions associated with operational activities rather than dust generated during construction.

Study area

The study area for the airport land and the closest ambient air quality monitoring station is shown in Figure 7-11.



Indicative only, subject to design development

Air quality study area and monitoring station

Figure 7-11

A temporary power supply route for the construction of the proposed action is located between the existing Kemps Creek substation and Western Sydney International (refer to Section 4.2.9).

Given the short-term transient nature of construction works for these power supplies, a study area of 50 metres from the indicative alignment of this power supply route has been considered for this assessment. The assessment is based on a worst-case scenario of the construction works being carried out in a medium density urban residential area.

Operation

Operational impacts have been assessed qualitatively as emissions during operation are likely to be minor given the metro trains are powered by electricity (see Section 7.14.5).

The qualitative assessment involves a discussion of the potential sources of air pollution during operation of the proposed action, the potential proximity of sensitive receivers and the potential impacts the emissions may have on the environment.

7.14.4 Potential impacts – construction

There would be substantial earthworks and construction activities carried out for the proposed action associated with the tunnel and viaduct segment production and storage and the construction of the Western Sydney International tunnel portal, Airport Business Park Station and Airport Terminal Station. Stockpiling activities would also be carried out at the potential permanent spoil placement areas.

The potential for temporary dust emissions from earthworks, construction and track-out is therefore considered to be high. Track-out refers to the transportation of dust and dirt from heavy vehicle movements from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

Demolition activities have been carried out as part of the Western Sydney International Stage 1 project and no further demolition is required as part of the proposed action.

There are no sensitive receivers within the on-airport environment and limited sensitive receivers within the study area outside of the on-airport environment that would be potentially affected by the proposed action. The sensitivity of the affected environment to potential dust soiling and human health effects (as a result of the on-airport works) is therefore considered to be low.

The results of the assessment are summarised in Table 7-59. There is generally a negligible to low risk of unmitigated dust impacts for the on-airport environment. The risk would be temporary during the construction period and would be reduced given the application of the mitigation measures outlined in Chapter 8 (Environmental management and mitigation).

Table 7-59 Summary of dust risk assessment

Activity	Dust emission magnitude	Sensitivity of area			Risk of unmitigated dust impacts		Risk of mitigated dust impacts	
		Dust soiling	Human health	Eco-logical	Dust soiling	Human health	Dust soiling	Human health
Demolition	Small[1]	Low[1]	Low[1]	Low	Negligible	Negligible	Negligible	Negligible
Earthworks	Large	Low	Low	Low	Low	Low	Negligible	Negligible
Construction	Large	Low	Low	Low	Low	Low	Negligible	Negligible
Track-out	Large	Low	Low	Low	Low	Low	Negligible	Negligible

[1]**:** Although no demolition is occurring and there are no receptors within Western Sydney International, “Small” and “Low” are the lowest categories available for demolition and dust sensitivity using the IAQM assessment methodologies.

The assessment of potential air quality impacts to ecological receptors is considered as part of the biodiversity assessment in Section 7.3.

Vehicle and plant emissions

Potential emissions other than dust that would be generated during construction include emissions from the combustion of diesel fuel by heavy vehicles, mobile construction equipment and stationary equipment such as diesel generators. Potential emissions are expected to depend on the nature of the emissions source (that is, the size of the equipment, usage rates, duration of operation). Pollutants emitted by construction vehicles include carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), nitrous oxides (NO_2), sulphur dioxide (SO_2), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs).

Given anticipated construction plant and vehicle numbers and the commonly applied mitigation measures expected to be used (such as minimising equipment idling), potentially temporary adverse air quality impacts from the operation of construction equipment are not anticipated.

Power supply routes

Construction activities for the Kemps Creek construction power route into Western Sydney International would include earthworks for trenching, and underboring. Construction activities would be limited to cable installation and demolition would be limited to the relocation or protection of existing utilities if required. Track-out would be associated with earthworks and the delivery of materials. Each activity is considered to have a small potential for dust generation and is assessed in Table 7-60.

There is a low risk of dust soiling and human health impacts associated with unmitigated dust impacts for the power supply route. These potential impacts would be temporary and are expected to occur for only a limited period during the construction period. The risk would be temporary during the construction period and would be reduced given the application of standard mitigation measures identified in Chapter 8 (Environmental management and mitigation).

Table 7-60 Summary of dust risk assessment for power supply route

Activity	Dust emission magnitude	Sensitivity of area		Risk of unmitigated dust impacts		Risk of mitigated dust impacts	
		Dust soiling	Human health	Dust soiling	Human health	Dust soiling	Human health
Demolition	Small	Medium	Medium	Low	Low	Negligible	Negligible
Earthworks	Small	Medium	Medium	Low	Low	Negligible	Negligible
Construction	Small	Medium	Medium	Low	Low	Negligible	Negligible
Track-out	Small	Medium	Medium	Negligible	Low	Negligible	Negligible

7.14.5 Potential impacts – operation

The proposed action would be powered by electricity and therefore local emissions generated during operation are expected to be minimal. It is proposed emissions would be 100 percent offset under the Sustainability Plan for the project (refer to Section 8.2.4).

The operation of metro trains would generate minor quantities of particulate matter (PM_{10}), carbon monoxide, volatile organic compounds and oxides of nitrogen mainly due to the wear of the train brake pads, vaporisation of metals due to sparking, and wear of steel due to friction between wheels and rail. These emissions would represent very low concentrations, and potential impacts at nearby sensitive receivers during operation would be negligible.

The tunnel ventilation system is described in Section 4.1.4. In addition to mechanical ventilation, air would be pushed through the tunnels via the piston effect of the trains moving through the tunnels. Pollutant concentrations would be negligible, and emissions are anticipated to quickly disperse into the ambient environment from tunnel and station ventilation points.

Potential impacts at nearby sensitive receivers during operation would be negligible and within the limits identified in the Airports (Environment Protection) Regulations.

Overall, the project is anticipated to benefit regional air quality by delivering an attractive alternative mode of transport, which could result in a mode shift from road to rail. This has the potential to reduce potential air pollution emissions associated with road transport and associated congestion, when compared to the emissions that would otherwise occur if the project was not delivered.

7.15 Hazard and risk

This section provides an assessment of environmental hazards and risks that could arise during construction and operation of the proposed action.

7.15.1 Overview

Potential temporary environmental hazards and risks associated with the on-site storage, use and transport of chemicals, fuels and materials would be managed through standard mitigation measures which would include the storage and management of all hazardous substances in accordance with the Airports (Environment Protection) Regulations, the *National Airports Safeguarding Framework* (NASF), the *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover NSW, 2005) and *Applying SEPP 33* (Department of Planning, 2011).

Regular track inspections and maintenance would be carried out. Sydney Metro would continue to develop construction planning and the design of the project to minimise risks in consultation with Western Sydney Airport.

The project is located in tunnel between Western Sydney International and Bringelly, which mitigates potential bushfire risks in these areas. A bushfire management plan would be prepared for both construction and operational phases to manage bushfire risk and response actions.

A key metro characteristic is to provide a system that is inherently safe for customers on trains, at stations, and at the interface with the public domain. The safety of passengers and the general public has been, and would continue to be, a key consideration during the design process.

7.15.2 Legislative and policy context

The assessment considered of the following relevant guidelines and legislation:

- Airports Act
- Airports (Environment Protection) Regulations
- *Australian Code for the Transport of Dangerous Goods by Road and Rail* (Edition 7.6) (National Transport Commission, 2018) – sets out the requirements for transporting dangerous goods by road or rail
- *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (Department of Planning 2011) (Applying SEPP 33) – presents a systematic approach to planning and assessing proposals for potentially hazardous and offensive development for the purpose of industry or storage
- *Dangerous Goods (Road and Rail Transport) Act 2008* (NSW) – to regulate the transport of dangerous goods by road and rail in order to promote public safety and protect property and the environment
- *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover, 2005) – provides practical guidance and advice on how to comply with regulations
- NASF
- Recommended Practices No. 1 – Standards for Aerodrome Bird/Wildlife Control (International Birdstrike Committee, 2006)
- *International Standard (ISO 31000:2018) Risk Management Guidelines* – provides a common approach to manage risk that is not industry or sector specific
- bushfire prone land mapping developed and published by NSW Rural Fire Service (RFS).

7.15.3 Assessment methodology

A desktop assessment was carried out to identify environmental hazards and risks that could arise during construction and operation of the project's on-airport components, as well as the management measures to address potential issues. The assessment focused on hazards and risks with the potential to adversely affect the quality of the surrounding environment, land uses and communities.

A key input to the desktop assessment was a review of the hazards and risks identified in the *Western Sydney Airport – Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b) and the *Western Sydney Airport Stage 1 Construction Plan* (Western Sydney Airport, 2019) and consideration of how the proposed action would change or contribute to the on-airport hazards and risks.

A qualitative assessment was also undertaken to identify construction and operational activities with the potential to cause risks to public health and safety.

7.15.4 Potential impacts – construction

Potential on-airport hazards and risks identified for the proposed action during construction would be associated with:

- on-site storage, use and transport of dangerous goods and hazardous substances
- rupture of, or interference with, underground utilities
- bushfire risks
- exposure to hazardous materials and any contaminated soils during construction works
- health impacts from noise and air pollution during construction
- other construction health and safety risks including movement of construction vehicles and construction equipment, and construction failures or incidents.

Construction of the proposed action is expected to be completed prior to the opening of Western Sydney International, and therefore airspace obstructions are not expected to be a potential risk on-airport.

Flooding risks, including inundation of construction sites and excavation have been addressed in Section 7.6. Climate change risks, including changes in the frequency of air temperature extremes, changes in mean and extreme rainfall, and changes in the frequency and intensity of storm events, are assessed Section 7.9.

On-site storage and transport of dangerous goods and hazardous substances

It is proposed that the NSW and National Transport Commission guidelines would be adopted (including Apply SEPP 33).

Potential risks

Potentially dangerous goods and hazardous substances are anticipated to be temporarily used, stored and transported during construction of the project. The potentially hazardous materials include petrol, diesel, lubricating and hydraulic oils and greases, industrial grade oxygen, acetylene, cement, premix concrete, concrete curing compounds, concrete retardant, shotcrete accelerator, epoxy glue, coagulants, acids, bases, disinfectant, antiscalant, membrane preservative, de-bonding agents, contaminated waste and paints.

The method of storage would vary depending on the materials but would include drums of various sizes, small and intermediate bulk containers, cylinders in racks, bags/pallets and bunded areas where appropriate. Typically, low volumes of potentially hazardous materials, such as diesel, petrol, lubricants and paints, would be stored on-site, with the exception of the Western Sydney International tunnel portal site where larger volumes of materials would be required to support tunnel construction. The volume required to be stored on-site would largely depend on the anticipated rates of consumption, with deliveries of dangerous goods coordinated to match consumptions rates.

How potential risks and impacts would be managed

Construction site planning would ensure hazardous materials are stored appropriately and at an appropriate distance from sensitive receivers, in accordance with the thresholds established under Applying SEPP 33. Should the minimum buffers be unable to be maintained a risk management strategy would be developed on a case-by-case basis.

Environmental hazards and risks associated with the on-site storage, use and transport of chemicals, fuels and materials would be managed through standard mitigation measures to be developed as part of the construction environmental management documentation – refer to Chapter 8 (Environmental management and mitigation). These measures would include the storage and management of all hazardous substances in accordance with the guidelines referenced in mitigation measure HR1 (refer to Section 8.4.3), so that they do not cause a significant off-site risk.

Rupture of, or interference with, underground utilities

Potential risks

Power, communications and stormwater infrastructure is located within the proposed action's construction footprint. Construction of the proposed action would also involve provision of temporary power supply to the Western Sydney International tunnel portal construction site to support the tunnel boring machines.

Damage, rupture and/or failure to shut down or isolate underground utilities during construction of the project has the potential to result in the following environmental hazards and risks:

- release of untreated sewage and/or gas from a sewer main, and potential impacts on water mains and drains
- release of large electrical currents through the ground surface from an underground electricity cable (known as earth potential rise).

How potential risks and impacts would be managed

Potential risks associated with utilities on-airport would be minimised by carrying out utility checks (such as Dial Before You Dig searches and non-destructive digging) and if required, relocating and/or protecting utilities in and around the proposed action prior to construction. Sydney Metro would continue to consult with Western Sydney Airport to identify the management approach for utilities on-airport.

Bushfire risk

Potential risks

Construction would occur within and adjacent to the Western Sydney International Stage 1 Construction Impact Zone. Bushfire prone land is mapped within the airport site, as shown in Figure 6-16.

Much of the existing vegetation is likely to be cleared at the time of construction of the proposed action as a result of bulk earthworks associated with Stage 1 construction of the airport. Areas within the airport site that would not be cleared of vegetation as part of the Stage 1 construction would include the Environmental Conservation Zone and other areas outside the Stage 1 Construction Impact Zone. Construction of the proposed action has the potential to provide sources of ignition including sparks from the use of construction equipment, or hot or halogen lighting. Under adverse winds, these sources of ignition could allow a fire to escape off-site.

How potential risks would be managed

A bushfire management plan would be prepared and implemented to manage current bushfire risk and identify response actions during construction of the proposed action. The plan would be prepared in consultation with the NSW Rural Fire Service and Western Sydney Airport and would have regard to the existing *Western Sydney Airport Site at Badgerys Creek Bushfire Risk Management Plan* (Western Sydney Airport, 2019k).

Contamination risks

Potential risks

Potential contaminants associated with prior rural, commercial and light industrial land uses have been identified at Western Sydney International (refer to Section 6.9.4). The main contaminant of potential concern that could be exposed during excavation works for the proposed action is asbestos in soil. Localised areas of petroleum hydrocarbon and heavy metal contamination in soil have also been identified.

Exposure to these contaminants could potentially cause health and safety impacts on the community in the event of mobile contaminants impacting off-airport sensitive receivers, or impacts on the environment due to contamination of land.

How potential risks would be managed

Environmental and human health risks associated with potential exposure to contaminated and hazardous materials on-airport would be minimised through implementation of a project-specific Remediation Action Plan (Sydney Metro Remediation Action Plan) as well as the implementation of an unexpected finds protocol and waste management plan. The Sydney Metro Remediation Action Plan would be prepared in a manner consistent with the *Western Sydney Airport Remediation Action Plan* (Department of Infrastructure and Regional Development, 2019), and would be applied to any contamination encountered by Sydney Metro that has not been remediated by Western Sydney Airport.

Contaminated waste (such as waste containing asbestos) would be removed and disposed of in accordance with the relevant legislation, codes of practice and guidelines. Further information on contamination and waste is provided in Section 7.8.

Other construction health and safety risks

Potential risks

Other construction activities could result in impacts on the health and safety of users, visitors, and the local community if improperly managed. These include:

- the operation of vehicles and construction equipment on-site
- the transportation of equipment, excavated spoil, and material to and from the site
- health impacts from noise and air pollution during construction
- reduced safety for road users and pedestrians during construction
- construction failures or incidents resulting in flooding, inundation, or excavation collapse
- cumulative construction impacts or increased construction-related risks resulting from concurrent construction of other projects, including Stage 1 of Western Sydney International.

In addition to the above, there is the potential for risks to pedestrians/public safety resulting from unauthorised access to construction work areas.

How potential risks and impacts would be managed

On-airport works would be within the existing airport site which is currently inaccessible to the public and is subject to controlled access by Western Sydney Airport for approved personnel. This would help minimise safety risks during construction as the site is isolated from the general public, and would not pose a risk to road users and pedestrians.

The construction contractor would ensure that construction sites are secure at all times, and take all possible actions to prevent entry by unauthorised persons.

Health and safety risks during construction would be managed by the implementation of standard workplace health and safety requirements. A work health and safety management plan and safe work method statements would be developed in accordance with regulatory requirements.

There are interactions between the mitigation and management measures for public hazards, risks and safety, and traffic and transport, noise and vibration, flooding, hydrology and water quality, air quality, soils and contamination and waste impacts. Chapter 8 (Environmental management and mitigation) provides a consolidated list of mitigation measures for the proposed action. Together, these measures would serve to minimise the potential hazard and risk impacts on the community and environment.

Cumulative construction impacts or increased construction-related risks resulting from the concurrent construction of other projects (such as Western Sydney International) are discussed in Section 7.16. This includes mitigation measures proposed to manage potential cumulative impacts. Construction planning for the proposed action has involved consultation with the respective proponents of other infrastructure projects to avoid construction conflicts where possible and minimise cumulative construction impacts. This consultation would be ongoing through to the design development and construction phases of the proposed action.

7.15.5 Potential impacts – operation

Potential hazards and risks identified during operation of the proposed action would be associated with:

- on-site storage, use and transport of dangerous goods and hazardous substances
- airspace obstructions and safety
- bushfire risks
- train or station fire
- potential for train strike for pedestrians in the event of trespass in the rail corridor.

These hazards and risks are described further in the following sections.

Flooding risks, including inundation of station sites are assessed in Section 7.6. Climate change risks, including changes in the frequency of air temperature extremes, changes in mean and extreme rainfall, and changes in the frequency and intensity of storm events, are assessed in Section 7.9.

The ongoing development of the Western Parkland City and Western Sydney International may introduce other hazards and risks which have the potential to impact on the operation of the proposed action, or the proposed action may impact on those developments. These potential risks, such as the introduction of pipes for the conveyance of aviation fuel or development above stations, would be assessed in the relevant planning approvals for those developments.

On-site storage, use and transport of dangerous goods and hazardous substances

Potential risks

The main risks likely to be encountered during the operation of the proposed action would be the storage, use and transport of chemicals, fuels and materials, including sodium hydroxide, poly-aluminium chloride and polymer.

How potential risks and impacts would be managed

It is proposed that the NSW and Australian guidelines identified in Section 7.15.2 would be adopted for the proposed action (including Apply SEPP 33). Transport and storage methods would be confirmed during design development but would be designed in accordance with relevant guidelines outlined in HR6 (refer to Section 8.4.3), in order to ensure the hazardous materials would not pose a significant off-site risk.

Airspace obstructions and safety

The Airports Act and the Airspace Regulations enable the protection of airspace at and around regulated airports in Australia, which includes Western Sydney International. The Airspace Regulations define the 'prescribed airspace' for airports as the airspace above any part of either an obstacle limitation surface (OLS), or procedures for air navigation systems operations surface (PANS-OPS), or any other airspace declared to be prescribed for the airport under the Airspace Regulations.

Approvals under Part 12 of the Airports Act relate to intrusion into prescribed airspace by physical structures or other impacts including from lightning, smoke and emissions. The proposed action would not obstruct protected airspace and would therefore not require separate approvals. The design development of the project would comply with OLS requirements. The OLS area for Western Sydney International is shown in Figure 7-12.

Public Safety Areas (PSA) defined under the NASF Guideline I, are designated areas of land at the end of an airport runway within which development may be restricted to control the number of people in the area. The size and shape of a PSA typically depends on the likelihood of an aircraft accident occurring (for example, a plane overshooting the runway). Generally, this likelihood decreases with increasing distance from the runway.

The *Western Sydney Aerotropolis Plan* (NSW Government, 2020) has adopted a PSA based on the UK Public Safety Area model. The PSA extends from the runway ends, beyond the boundary of the airport site (see Figure 7-13). The proposed action crosses through the PSA for Runway 1 for around 400 metres.

Potential risks and options for the realignment of the proposed action (both horizontal and vertical) have been considered in determining the alignment presented in this Final Environmental Impact Assessment, while noting station locations are fixed at the Airport Business Park and Airport Terminal. The development of the project alignment has considered the crossing of the future M12 Motorway to the north, the crossing of Elizabeth Drive to the south and the vertical alignment of the rail corridor within Western Sydney International (i.e. in-tunnel south of Airport Business Park Station, including under Badgerys Creek). No physical risk mitigation (such as barriers) is considered necessary as part of the design.

The landscape design for the proposed action would include consideration of appropriate species lists to minimise opportunities to attract wildlife at levels likely to present a hazard to aviation operations. The landscape design will have regard to relevant requirements and species lists under Western Sydney Airport's Wildlife Management Plan and other relevant guidelines, including the NASF Guideline C and *Recommended Practices No. 1 – Standards for Aerodrome Bird/Wildlife Control* (International Birdstrike Committee, 2006).

The proposed action would be designed to avoid pilot distraction and minimise the risk of headlight glare from metro trains where on surface rail alignment. This would include providing glare screens in those locations where the proposed action creates an unacceptable risk of pilot distraction.

Further design development for the project would continue to consider and respond to other requirements relating to airport operations outlined in the NASF, including issues such as plume rise from the proposed action's tunnel and portal ventilation systems as well as windblown dust.

Bushfire risks

Potential risks

Operation of the proposed action has the potential to provide sources of ignition, including electrical cabling. Under adverse winds, these sources of ignition could allow a fire to escape off-site. The proposed action is located in tunnel between around 400 metres southwest of Airport Business Park Station and the southeast boundary of Western Sydney International, which mitigates bushfire risks in these areas.

How potential risks and impacts would be managed

As for construction, a bushfire management plan would be prepared and implemented to manage current bushfire risk and identify response actions during operation of the proposed action. Overall, bushfire risks during operation are considered to be low provided a bushfire management plan is successfully implemented.

NSW GOVERNMENT | Planning, Industry & Environment

Source: State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 Obstacle Limitation Surface Map

Sheet OLS_001

Obstacle Limitation Surface

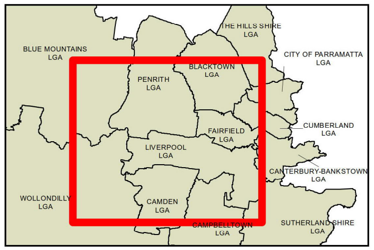
Land Application

Runway Boundary

Cadastre

Cadastre 01/09/2020 © Spatial Services

Figure 7-12 Obstacle Limitation Surface Map - Western Sydney International



N

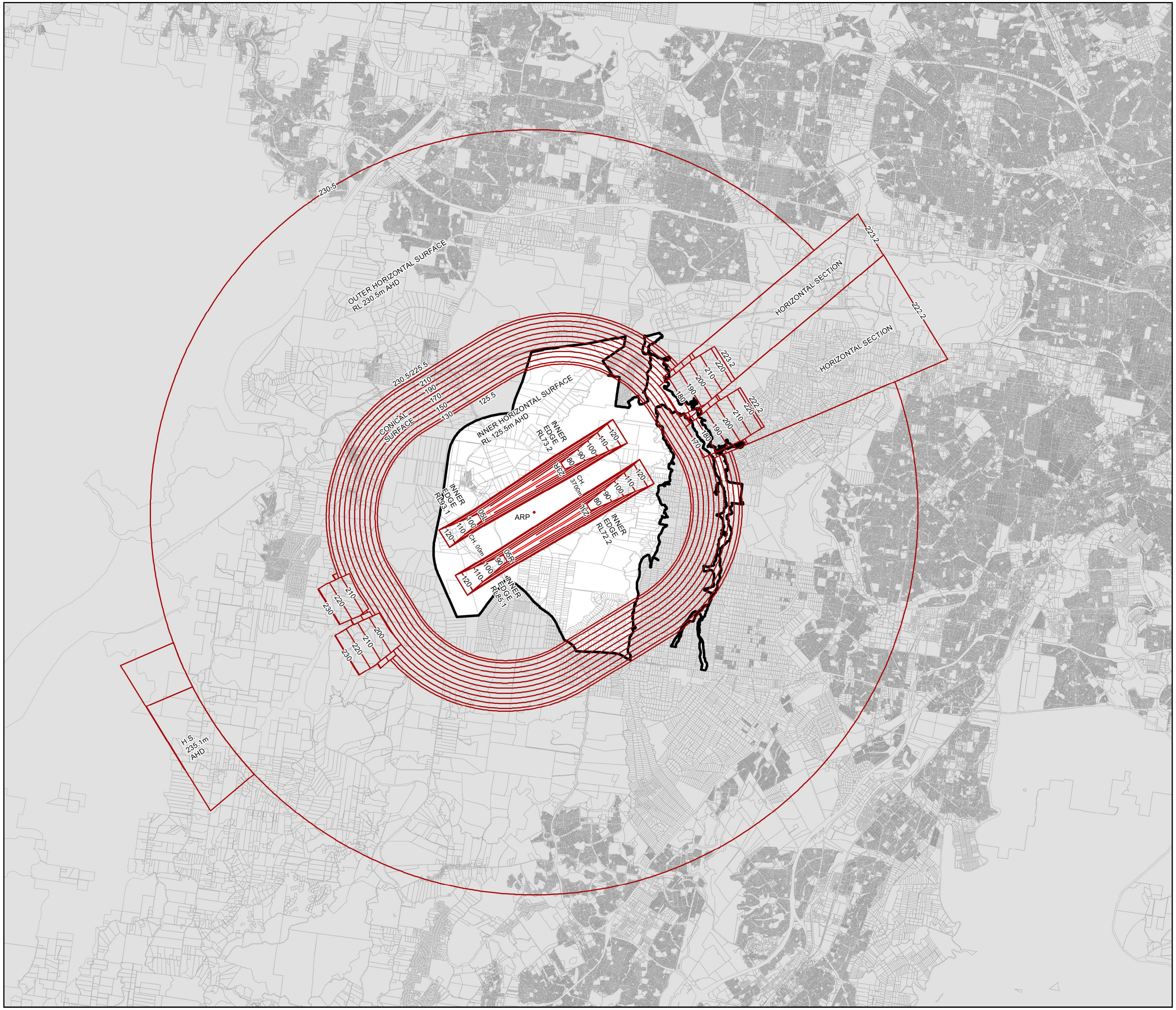
0 1 2 3 4

Kilometres

Projection: GDA94 MGA Zone 56

Scale: 1:140,000 @ A3

Map Identification Number: SEPP_WSA_OLS_001_140_20200901



Planning, Industry & Environment

Source: State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 Public Safety Area Map

Sheet PSA_001

Land Application

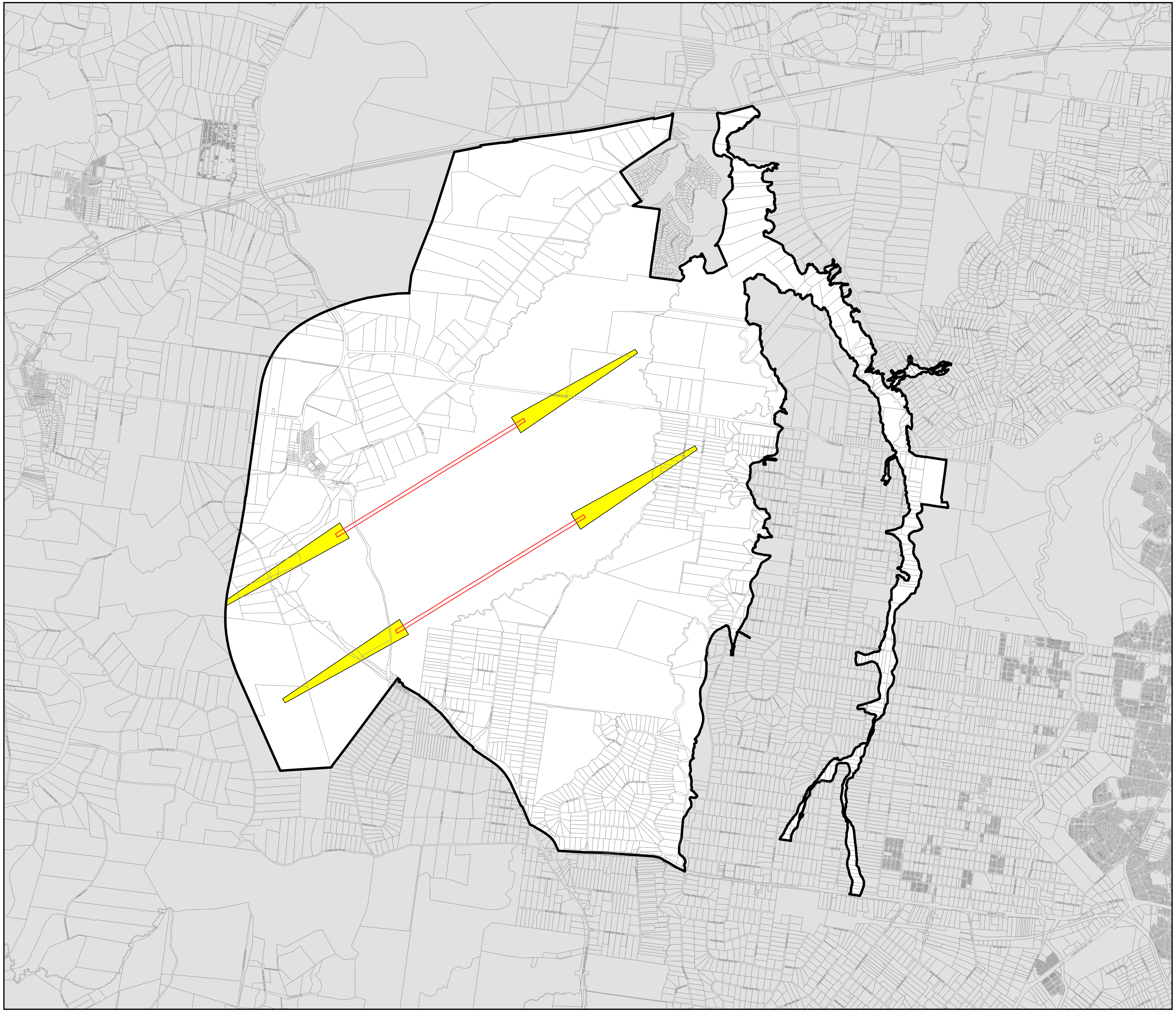
Public Safety Areas

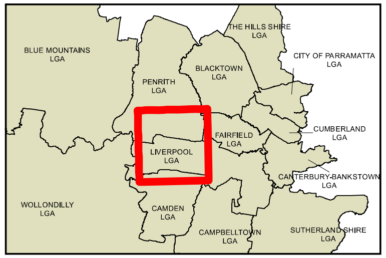
Runway Boundary

Cadastre

Cadastre 01/09/2020 © Spatial Services

Figure 7-13 Public Safety Area Map - Western Sydney International





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Kilometres

Projection: GDA94 MGA Zone 56

Scale: 1:60,000 @ A3

Map Identification Number: SEPP_WSA_PSA_001_060_20200901

Train or station fire

Potential risks

During operation, a fire within metro train carriages or stations may result from flammables catching fire, incidents of arson or terrorism. This may result in injury and/or smoke inhalation for customers, and would result in emergency evacuation and/or a halt in services.

How potential risks and impacts would be managed

Trains, tunnel and station design would be compliant with National Fire Protection Association (NFPA) guidelines and other relevant Australian fire codes and standards. Station sites would include fire stairs to allow for customer evacuation and emergency services access. Tunnels would provide space for fire and life safety systems.

A tunnel ventilation system would be provided for underground stations and tunnelled sections of the alignment to allow for a range of ventilation requirements including station ventilation and ventilation for fire and life safety and operational scenarios (such as heat build-up). Tunnel ventilation facilities are proposed at the Western Sydney International tunnel portal.

The ventilation systems for the proposed action would also provide ventilation in the unlikely event of fire to ensure suitable conditions in the tunnel for safe egress of customers and safe access for emergency services personnel. In the event of fire, smoke-laden air would be discharged to the atmosphere via ventilation outlets at the stations and the tunnel ventilation facilities at the tunnel portal.

Other public safety risks

Potential risks

During operation of the proposed action, there would be other potential public safety risks, including train strike due to trespass, and safety or crime incidents at stations. Unauthorised access to the rail corridor has the potential to result in serious injury or fatality.

How potential risks and impacts would be avoided

In general, potential public safety impacts would be avoided by:

- managing operations in accordance with relevant legislative and policy requirements
- measures to prevent public access to the rail corridor including trackside intruder detection system, consisting of non-mechanical protection measures to supplement fencing, (including closed circuit television)
- more generally, designing and operating the project to minimise risks to health and safety
- implementing the management and mitigation measures described in Chapter 8 (Environmental management and mitigation).

A key metro characteristic is to provide a system that is inherently safe for customers on trains, at stations, and at the interface with the public domain. The safety of passengers and the general public has been, and would continue to be, a key consideration during the design process. The following metro features would contribute to the safety and security of customers:

- customer service assistants at every station and moving through the network during the day and night
- station and train design that allow for good line of sight to enable passive and active surveillance
- stations and surrounding areas that are designed to be highly visible, active spaces with good lighting and amenity
- ensuring customers can see all the way along the train and move easily between carriages, including wide, open walkways between carriages
- level access between the platform and train and reduced gaps between the platform and the train

- providing platform screen doors at stations, creating a physical barrier which keeps people and objects separated from the edge of the platform and operating tracks, improving customer safety and allowing trains to get in and out of stations faster.

Other station safety features include CCTV cameras linked to the operations control centre, emergency help points and passenger information signage.

7.16 Cumulative impacts

7.16.1 Overview

Potential cumulative impacts have been identified from the construction and operation from Stage 1 of the Western Sydney Airport and the proposed action, and of the proposed action and surrounding developments, including:

- future M12 Motorway
- Elizabeth Drive upgrade
- Western Sydney International
- The Northern Road.

Measures to address these cumulative impacts are provided in Chapter 8 (Environmental management and mitigation).

Cumulative impacts defined

Cumulative benefits or impacts are impacts that, when considered together, have different and/or greater impacts than a single impact on its own. Cumulative impacts can result from the successive, incremental and/or combined effects of a project when added to another project. Once Sydney Metro – Western Sydney Airport is operational, other projects which interrelate may enhance the proposed action and create positive cumulative benefits.

The extent to which another development or activity could interact with the construction and/or operation of the proposed action would depend on its scale, location and/or timing of construction and/or operation. Generally, cumulative impacts would be expected to occur in situations where multiple long-duration construction activities are undertaken close to, and over a similar timescale to, construction activities for the proposed action. Cumulative impacts would also be expected to occur in situations where projects are operating at a similar scale to the proposed action.

The population of Western Sydney will continue to grow, requiring services and infrastructure to support the Western Parkland City. Major transport infrastructure planned for Western Sydney includes road, rail and airport developments. While new or upgraded infrastructure is essential to support planned growth in Western Sydney, multiple developments being undertaken at the same time and in the same geographic area have the potential for cumulative impacts.

Construction fatigue can occur when the same sensitive receivers experience construction impacts from multiple, sequential projects over a prolonged period with few or no breaks between construction activities. Construction fatigue could be experienced if the project and another project occur consecutively or concurrently.

7.16.2 Assessment methodology

The steps followed in undertaking the cumulative impact assessment are illustrated in Figure 7-14 and described in more detail in the following sections.

Figure 7-14 Overview of cumulative impact assessment methodology

Identification of potential projects

Projects identified for consideration as part of the cumulative impact assessment were those that were:

- located in the same local government areas as the proposed action
- listed on the NSW Government Major projects website as State significant development or State significant infrastructure.

The following criteria were used to screen the projects initially identified:

- spatial relevance: a project was considered to be spatially relevant if it overlapped with or was adjacent or proximal to the proposed action
- timing: a project was considered to be relevant if the expected timing of its construction would overlap or occur consecutively to the proposed action with the timing of the construction or operation of the proposed action
- scale: large-scale major development or infrastructure projects that could cause cumulative impacts with the proposed action were considered, as listed on the NSW Government Major projects website
- publicly available information: projects under consideration must have publicly available information (at the time of preparing the Project Environmental Impact Statement), with a sufficient level of detail to allow for analysis of potential cumulative impact issues.

All the above criteria need to be met for a project to be included in the cumulative impact assessment.

A number of strategic planning projects identified in NSW transport and land use planning or policy documents may interact with the proposed action in the future, including the East West Rail Link, South West Rail Link extension, Outer Sydney Orbital, the Aerotropolis precincts and potential future metro extensions north to Schofields/Tallawong Station in Rouse Hill and south to Macarthur. These projects generally underpin the development of the Western Parkland City. However, as these projects do not meet the criteria described above, and particularly given that their impacts are not known with sufficient precision, they were not considered for inclusion in the cumulative impact assessment for the proposed action.

Projects included in the cumulative impact assessment

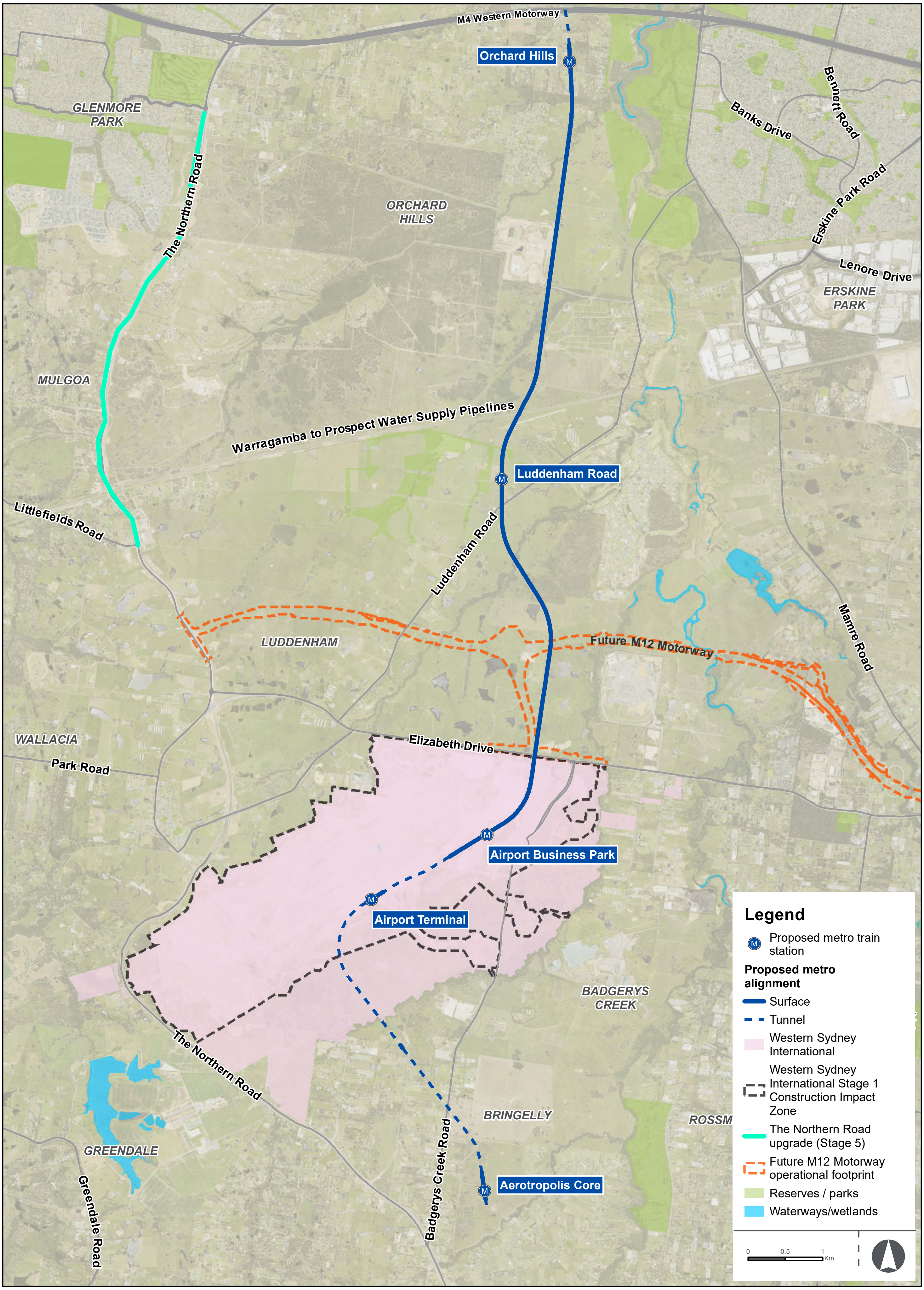
Analysis of whether identified projects meet the cumulative impact assessment criteria is provided in Table 7-61. The projects that were identified for inclusion in the cumulative impact assessment are shown on Figure 7-15.

Table 7-61 Projects considered for the cumulative impact assessment

Project name	Brief project description	Status	Spatially relevant?	Temporally relevant?	Scale	Publicly available information	Included in assessment?
Western Sydney International	Stage 1 of Western Sydney International will include a 3,700 metre runway, integrated international and domestic passenger terminal, air cargo precinct with landside and airside access and other relevant facilities for an operational capacity of approximately 10 million passengers annually. There will also be an on-airport business park providing opportunities for a range of businesses to locate on the doorstep of the terminal.	Approved. Under construction	Yes. A part of the project, including two metro stations, would be constructed and operate within Western Sydney International.	Yes. Construction has commenced and will continue to 2026.	Major infrastructure	Yes. (Environmental Impact Statement, Airport Plan, Construction Plan and environmental management plans).	Yes
Future M12 Motorway	A new east–west motorway between the M7 Motorway near Cecil Hills and The Northern Road at Luddenham. The future M12 Motorway will serve as the major access route to Western Sydney International and connect to Sydney's motorway network.	Under assessment	Yes. The project intersects and is located adjacent to the future M12 Motorway in the area between Luddenham Road and Elizabeth Drive.	Yes. Concurrent construction and operation. Construction period is expected between 2022 and end 2025. Operation is expected to commence in 2026.	Critical State Significant Infrastructure	Yes. Scoping Report, Environmental Impact Statement, Amendment Report, Submissions Report and Amendment Report - Submissions Report.	Yes

Project name	Brief project description	Status	Spatially relevant?	Temporally relevant?	Scale	Publicly available information	Included in assessment?
The Northern Road	The upgrade of 35 km of The Northern Road, a key north–south arterial link, as part of the *Western Sydney Infrastructure Plan* road investment program. The upgrade is being delivered in six stages. All stages are expected to be operational by 2021 except Stage 5: Littlefields Road, Luddenham to Glenmore Parkway, Glenmore Park, which is expected to be operational in 2022. Stage 1 has been completed.	Approved. Under construction	Yes. The Northern Road project, once completed, will run in a north–south direction to the west of the project including immediately adjacent to Western Sydney International. Stage 5 construction works are generally located between the M4 Western Motorway and Elizabeth Drive.	Yes. Concurrent construction with Stage 5 is possible. Other stages will be operational when project construction commences.	Critical State Significant Infrastructure	Yes. Environmental Impact Statement, Submissions and Preferred Infrastructure Report.	Yes

Project name	Brief project description	Status	Spatially relevant?	Temporally relevant?	Scale	Publicly available information	Included in assessment?
Elizabeth Drive upgrade	Options to improve Elizabeth Drive between Cecil Hills and Luddenham to support Western Sydney International and the Western Parkland City are currently being investigated. The next stage of the project is to prepare the concept road design and environmental assessment.	Proposed	Yes. The project intersects Elizabeth Drive, which forms the northern boundary of Western Sydney International.	Unknown	Unknown	Limited	No
Upper South Creek Advanced Water Recycling Centre	Construction and operation of the Upper South Creek Advanced Water Recycling Centre to collect and treat wastewater from the South West and Western Sydney Aerotropolis Growth Areas, provide recycled water and maintain the potential for any further re-use opportunities in the future.	Proposed	Yes. The Centre would be located north-east of Elizabeth Drive in Kemps Creek, with associated pipelines proposed to run along Elizabeth Drive which forms the northern boundary of Western Sydney International.	Unknown	State Significant Infrastructure	Limited. Scoping Report	No



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Projects included in the cumulative impact assessment

Figure 7-15

Type of assessment

Table 7-62 identifies relevant proposed action issues that may result in potential cumulative impacts during construction and operation. A description of these potential impacts is provided in Section 7.16.3 and Section 7.16.4.

Table 7-62 Nature of potential cumulative impacts

Project name	Key construction issues	Key operational issues
Western Sydney International	• Transport • Noise and vibration • Biodiversity • Non-Aboriginal heritage • Aboriginal heritage • Flooding, hydrology and water quality • Soils and contamination • Air quality (dust) • Landscape and visual • Social and economic	• Transport • Noise and vibration • Flooding, hydrology and water quality • Landscape and visual • Land use and property • Social and economic
Future M12 Motorway	• Transport • Noise and vibration • Biodiversity • Non-Aboriginal heritage • Aboriginal heritage • Flooding, hydrology and water quality • Soils and contamination • Air quality (dust) • Landscape and visual • Social and economic	• Transport • Noise and vibration • Flooding, hydrology and water quality • Landscape and visual • Land use and property • Social and economic
The Northern Road	• Transport • Aboriginal heritage • Social and economic	• Transport • Social and economic

Depending on the environmental issue, the type of cumulative impact assessment may be quantitative (such as predictive through modelling), qualitative, or a combination of both. In most cases, a high level qualitative assessment has been undertaken for potential cumulative construction impacts across key issue technical disciplines.

Figure 7-16 shows the main construction works and operational timeframes for each project considered in the cumulative impact assessment and how these overlap with the project.

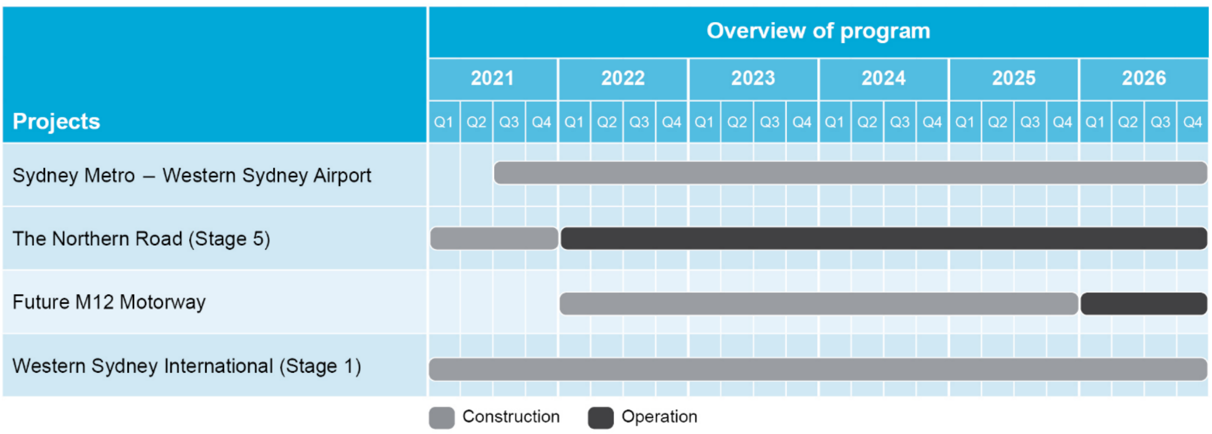


Figure 7-16 Main construction works and operational stages of relevant projects

7.16.3 Potential cumulative impacts – construction

Potential cumulative impacts during construction are related to:

- transport
- noise and vibration
- biodiversity
- non-Aboriginal heritage
- Aboriginal heritage
- flooding, hydrology and water quality
- air quality
- soils and contamination
- landscape and visual
- social and economic.

Transport

Limited overlap is anticipated with The Northern Road as construction of these projects is expected to be completed in 2021 before the peak construction year for the project.

Based on the construction program for the proposed action, construction of the proposed action would overlap with the construction activities associated primarily with Western Sydney International and the future M12 Motorway which are due to be completed in 2025 and 2026 respectively.

As part of the *M12 Motorway Amendment Report* (Transport for NSW, 2020c), further WestConnex Road Traffic Model updates have been undertaken using more recent traffic data and updated land use and demographics data (based on 2016 land use forecasts by the Department of Planning, Industry and Environment and adjusted to include Western Sydney International forecast data). The model for the M12 Motorway Amendment Report indicates that there is an overall reduction in forecast future trips to the South West Growth Area in Western Sydney in 2036 compared to the forecast future trips reported in the M12 Environmental Impact Statement, which were based on 2014 land use forecasts by the Department of Planning, Industry and Environment. This would indicate that traffic forecasts are likely to be lower by comparison to those reported in this Final Environmental Impact Assessment. As such, the traffic assessment prepared for the on-airport proposed action is considered likely to be conservative.

For the purposes of this cumulative impact assessment, peak construction activities for all projects are conservatively assumed to occur concurrently in 2023/2024. Cumulative impacts could occur as a result of a temporary increase in construction vehicles on the road network resulting in potential impacts to both mid-block and intersection performance, as well as potential safety impacts arising from increased numbers of heavy vehicles using the road network during construction.

Aside from the cumulative impacts associated with the projects identified in this assessment, the road network impacted by construction of the proposed action is likely to experience growth in background traffic and this is anticipated to result in reduced performance of the road network. The transport assessment indicates that some of the intersections and mid-block sections impacted by the project are forecast to operate at or above capacity due to this forecast growth in background traffic within the study area. This is likely to result in significant delays and queuing at these intersections that would be expected to increase with the addition of traffic forecast to be generated by the proposed action.

Mid-block performance

The weekday AM peak and PM peak traffic volumes were assessed to determine the general performance of the road network configuration in the peak year of construction (2023/2024) for the project only (project construction scenario) as well as with construction activity occurring simultaneously for all three projects (cumulative construction scenario). This assessment is provided in Table 7-63. The analysis indicates that all mid-block sections are forecast to operate with a similar LoS in the peak year project construction scenario and cumulative construction scenario, except at:

- Elizabeth Drive (west of Badgerys Creek) which is expected to change from LoS D to LoS E during the AM peak and from LoS E to LoS F during the PM peak
- Elizabeth Drive (east of Badgerys Creek) which is expected to change from LoS E to LoS F during the PM peak.

These exceedances are shown in bold and shaded grey in Table 7-63 and are predicted to be at or above capacity during the future year 2026 without the project due to the forecast growth in background traffic within the study area.

Intersection performance

A summary of the forecast performance of intersections around the project during the peak year of construction (2023/2024) for the project construction scenario compared to the cumulative construction scenario is summarised in Table 7-64. This analysis indicates that a deterioration in intersection performance at several intersections shaded grey in Table 7-64. During the cumulative construction scenario, all intersections operate at LoS D or better, except the intersection of Badgerys Creek Road/Badgerys Creek Road site access, which operates at LoS E during the AM peak (as shown in bold and shaded grey in Table 7-64). The Badgerys Creek Road/Badgerys Creek Road site access is proposed to be shared with the Western Sydney International construction access. However, this intersection is forecast to operate at LoS D during the AM peak with only project construction traffic included.

Mitigation measures to manage this potential impact are outlined in Chapter 8 (Environmental management and mitigation).

Table 7-63 Peak year cumulative construction scenario (2023/2024) mid-block performance

Location	Direction[1]	TC[2] (pcu[3]/h)	Future year without construction scenario (2023/2024) AM Peak Volume (pcu/h)	AM Peak LoS	PM Peak Volume (pcu/h)	PM Peak LoS	Future year with project construction scenario (2023/2024) AM Peak Volume (pcu/h)	AM Peak LoS	PM Peak Volume (pcu/h)	PM Peak LoS	Future year with cumulative construction scenario[4] (2023/2024) AM Peak Volume (pcu/h)	AM Peak LoS	PM Peak Volume (pcu/h)	PM Peak LoS
Luddenham Road (north of Elizabeth Drive)	NB	900	1080	F	590	C	1280	F	660	C	1280	F	660	C
	SB	900	300	A	860	E	370	B	1070	F	370	B	1070	F
Elizabeth Drive (west of Badgerys Creek Road)	EB	900	560	C	580	C	720	D	680	D	740	D	740	D
	WB	900	690	D	730	D	790	D	880	E	840	**E**	910	**F**
Elizabeth Drive (east of Badgerys Creek Road)	EB	900	770	D	620	C	840	E	850	E	880	E	920	**F**
	WB	900	930	F	1000	F	1160	F	1070	F	1220	F	1100	F
Badgerys Creek Road (south of Elizabeth Drive)	NB	900	420	B	380	B	510	C	690	D	530	C	710	D
	SB	900	440	B	610	C	750	D	710	D	780	D	730	D
Badgerys Creek Road (north of The Northern Road)	NB	900	500	C	340	B	1320	F	440	B	1360	F	450	B
	SB	900	280	A	550	C	400	B	1370	F	410	B	1420	F
The Northern Road (west of Badgerys Creek Road)	NB	1900	880	B	770	B	960	C	840	B	960	C	880	B
	SB	1900	1100	C	1100	C	1170	C	1180	C	1190	C	1180	C

Location	Direction[1]	TC[2] (pcu[3]/h)	Future year without construction scenario (2023/2024)				Future year with project construction scenario (2023/2024)				Future year with cumulative construction scenario[4] (2023/2024)			
			AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
			Volume (pcu/h)	LoS	Volume (pcu/h)	LoS	Volume (pcu/h)	LoS	Volume (pcu/h)	LoS	Volume (pcu/h)	LoS	Volume (pcu/h)	LoS
The Northern Road (east of Badgerys Creek Road)	NB	1900	1550	D	1380	C	2330	F	1440	D	2390	F	1450	D
	SB	1900	1110	C	1260	C	1180	C	2040	F	1190	C	2130	F

Notes:

1. NB – northbound, SB – southbound
2. TC – theoretical capacity
3. PCU – passenger car unit

- Traffic volumes have been rounded to the nearest 10
- Cumulative construction impacts presented above only considers the project in combination with the future M12 Motorway and Western Sydney International.

Table 7-64 Peak construction year cumulative intersection performance

Intersection[1]	Future year without construction scenario (2023/2024)				Future year with project construction scenario (2023/2024)				Future year with cumulative construction scenario[2] (2023/2024)			
	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
	Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS
Luddenham Road/Elizabeth Drive (P)	10	A	12	A	15	B	16	B	16	B	21	B
Elizabeth Drive/Adams Road (P)	9	A	16	B	13	A	32	C	18	B	53	D
Elizabeth Drive/Badgerys Creek Road (R)	13	A	14	A	17	B	28	B	25	B	48	D
Badgerys Creek Road/Badgerys Creek Site Access (P)	-	-	-	-	33	C	36	C	60	**E**	50	D
Badgerys Creek Road/Aerotropolis Site Access (P)	-	-	-	-	43	D	42	C	46	D	50	D
Badgerys Creek Road/The Northern Road (S)	34	C	28	B	53	D	32	C	56	D	33	C
The Northern Road/Derwent Road (S)	6	A	6	A	7	A	6	A	7	A	6	A

Notes:

1. Intersection control type as indicated against each (P - priority-controlled, R - roundabout, S - signalised)

- Cumulative construction impacts presented above only considers the project in combination with the M12 Motorway and Western Sydney International.
- For traffic signals, the average movement delay and level of service over all movements is used. For roundabouts and priority control intersections (with stop and give way signs), the critical movement for level of service assessment with the worst movement delay is used.
- Dashes indicate new construction site accesses that would only be constructed and used by construction vehicles and hence would not exist during the base year scenario.

Noise and vibration

No potential cumulative construction noise and vibration impacts are anticipated for The Northern Road as this project is anticipated to have completed construction in the vicinity of the airport before commencement of main construction for the project and the project would not affect the same noise and vibration sensitive receivers.

An overview of the noise sensitive receivers most likely to be adversely impacted by cumulative construction noise from the project and concurrent projects are shown in Figure 7-17. It has not been possible to assess cumulative construction noise impacts in a quantitative manner due to the different stages of these projects.

The figure presents the locations where the cumulative construction noise levels during standard hours exceed 50 dBA $L_{eq,15min}$ for more than one project (i.e. this is not the cumulative sum of construction noise, rather an indication of where the project and concurrent projects are predicted to exceed 50 dBA $L_{eq,15min}$ during standard hours). Potential cumulative noise and vibration impacts outside standard hours would be considered at a later stage when further details are known about the future M12 Motorway.

The assessment is based on the worst case (highest) predicted noise level over the duration of construction of the project. The noise level of 50 dBA $L_{eq,15min}$ was selected as it represents the project's typical standard hours construction noise target for most NCAs (where the typical range is around 45-55 dBA across the project) and for consistency with the approach adopted for the future M12 Motorway cumulative impact assessment.

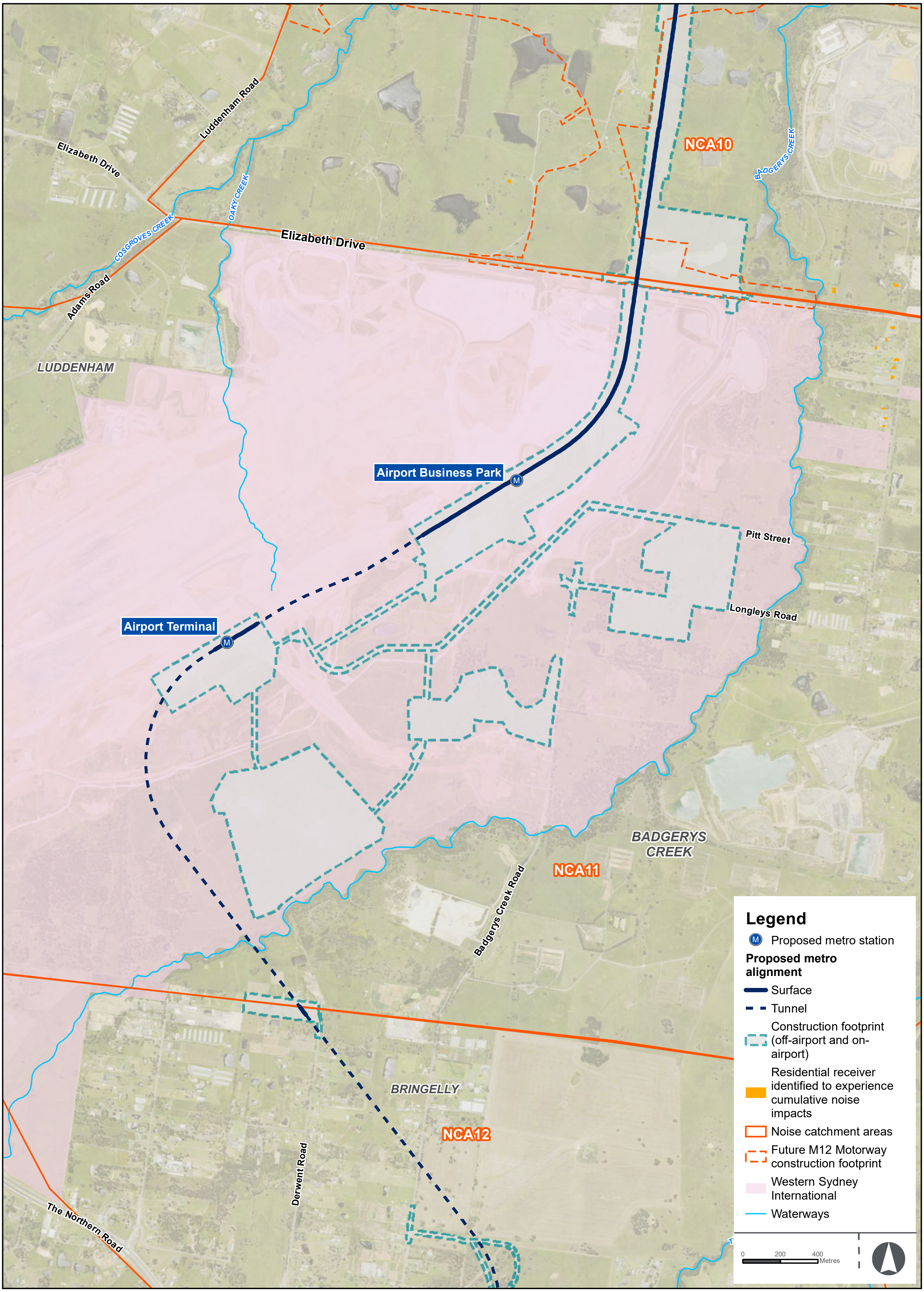
Noise sensitive receivers at Badgerys Creek may be affected by cumulative construction noise from the project and the future M12 Motorway. The future M12 Motorway would be constructed in an east-west direction across the southern portion of NCA10 outlined for the purpose of the project (see Figure 7-17). The nearest noise sensitive receivers would be located within NCA10 and NCA11 of the project.

Exceedances of the standard hours Interim Construction Noise Guideline (ICNG) noise targets by more than 20 dB for construction of the future M12 Motorway are predicted to occur in NCA10 and NCA11 of the project (M12 Motorway Environmental Impact Statement (Transport for NSW, 2019b)). Based on the assessment of areas where the construction noise levels would exceed 50 dBA $L_{eq,15min}$ for the project and future M12 Motorway, the most sensitive receivers are shown on Figure 7-17 and would include:

- low density single storey residential dwellings on the eastern and western sides of Luddenham Road, and Farmingdale Court, Luddenham around 1.5 to 2 kilometres north of Elizabeth Drive
- low density single storey residential dwellings immediately to the north and south of Elizabeth Drive near Lawson Road, Badgerys Creek.

Sydney Metro would work closely with Transport for NSW as the proponent for the future M12 Motorway to manage potential construction noise impacts on sensitive receivers.

Due to the large size of the Western Sydney International site, there are no areas beyond its site boundary that are predicted to have construction noise levels in excess of 50 dBA $L_{eq,15min}$ (Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development, 2016b)). As a result, construction of the project and Western Sydney International is not anticipated to result in cumulative noise impacts at any sensitive receiver locations.



Indicative only, subject to design development

Cumulative construction noise impacts

Figure 7-17

Biodiversity

Potential cumulative impacts as a result of the proposed action combined with Western Sydney International, the future M12 Motorway and The Northern Road are summarised in Table 7-65 and include:

- increased removal of native vegetation and fauna habitat resources
- increase in displacement of native fauna and flora species
- increase in edge effects and habitat fragmentation
- increase in noise, light, vibration and other disturbance for fauna that may inhabit or use resources near the proposed action
- increase in the impact of Key Threatening Processes.

The project is located within Greater Western Sydney, an area already subject to historic environmental pressures which encompasses a highly fragmented landscape with areas of agricultural, residential and commercial land use. Together these projects may result in the further loss of habitat from an already modified environment with fragmented natural biodiversity values.

The implementation of standard mitigation measures consistently across projects would mean that cumulative impacts on biodiversity from this proposed action are not considered to be substantial.

For the land north of the Western Sydney International, strategic conservation planning is currently being undertaken in the form of the *Cumberland Plain Conservation Plan 2020–56* (CPCP) (Department of Planning, Industry and Environment, 2020) to manage cumulative biodiversity impacts for the Western Parkland City. While the CPCP has not been used for the assessment of project impacts specifically, it will provide the appropriate mechanism for the long-term management of cumulative biodiversity impacts for land north of the Western Sydney International.

For land south of Western Sydney International, cumulative biodiversity impacts are substantially addressed through the strategic assessment completed as part of the *Sydney Growth Centres Strategic Assessment* (DECCW and DoP, 2010c). The cumulative impact assessment in the Project Environmental Impact Statement therefore only considers potential cumulative biodiversity impacts to the north of the airport. Potential cumulative impacts south of Western Sydney International are unlikely as there are no other projects identified occurring in this area that could interact with the proposed action. In addition, the proposed action will not remove non-certified vegetation so no impacts are anticipated beyond those already assessed in the *Sydney Growth Centres Strategic Assessment.*

Table 7-65 does not include cumulative biodiversity impacts associated with the St Marys Intermodal project given that this project is located a significant distance (over 12 kilometres) to the north of the on-airport proposed action.

Table 7-65 Summary of cumulative biodiversity impacts

Vegetation type	Western Sydney International[1]	Future M12 Motorway	The Northern Road	Sydney Metro – Western Sydney Airport (and hectares specific to proposed action)	Total
	Area (hectares)[2]				
Cumberland Plain Woodland (CEEC)*	272.80	66.86	30.87	39.8 (30.16)	**410.33**
River-flat Eucalypt Forest (EEC)*	47.6	3.18	3.86	18.06 (11.83)	**72.70**
Shale-Gravel Transition Forest (EEC)	5.9	6.91	0	10.42 (0)	**23.23**
Swamp oak floodplain forest (EEC)	0	2.82	0	5.38 (0)	**8.20**
Moist Shale Woodland (EEC)	0	0.44	0	0 (0)	**0.44**
Other non-threatened vegetation	37.20	0.57	6.06	0.01 (0)	**43.84**
Total	**363.50**	**80.78**	**40.79**	**73.67 (41.99)**	**558.74**

Notes:

1. Impacts are derived from the Western Sydney International Biodiversity Offsets Delivery Plan (Commonwealth of Australia, 2018)
2. Areas subject to change

* CEEC – Critically endangered ecological community

* EEC – Endangered ecological community

Non-Aboriginal heritage

Potential cumulative impacts on non-Aboriginal heritage values have been considered for the proposed action in combination with the future M12 Motorway and Western Sydney International.

No potential cumulative impacts are anticipated for The Northern Road given the approximate two kilometre separation distance from the proposed action.

Luddenham Road

The future M12 Motorway would involve a new motorway crossing over Luddenham Road around five kilometres south of the proposed action works near Luddenham Road.

This would not involve altering the heritage significant alignment of Luddenham Road, although it may further impede on the rural landscape setting within which the Luddenham Road heritage item is located.

There may be minor cumulative impacts from the alteration of the setting of Luddenham Road in conjunction with similar landscape changes from the introduction of the metro viaduct in the northern portion of the item.

McMaster Farm

Neither the future M12 Motorway nor the proposed action would impact any of the moderately significant structures present on the McMaster Farm, an item identified as having potential heritage significance. The future M12 Motorway would traverse the central portion of the property but would be located on the western side of the group of significant structures to be retained, while the proposed action would traverse predominantly along its eastern boundary.

While all significant structures would be conserved, the development of new infrastructure on either side of the buildings would remove the heritage significant setting of the item, as well as removing remaining agricultural infrastructure elements (dams, out-sheds, former feeding troughs). This would result in moderate cumulative impacts to the McMaster Farm.

McGarvie-Smith Farm

Heritage item McGarvie-Smith Farm may be affected by the cumulative impacts from construction of the proposed action and the future M12 Motorway. McGarvie-Smith Farm is a local heritage item listed on the Penrith LEP 2010.

The future M12 Motorway would involve the removal of six heritage significant structures on the property. The proposed action would involve the removal of a further three structures as well as the majority of dams and canals on the same property.

Two of the original buildings would remain, which are considered of high heritage value to the site.

The majority of the curtilage of this item (around 80 per cent) would be removed by both projects. Remnant fabric at the McGarvie-Smith Farm is in poor condition, and with the loss of all other structures and farm infrastructure, as well as the complete renovation of the rural topography into modern rail and roadways, the cumulative impact on this heritage item would be major.

Kelvin/Kelvin Park Group

Heritage item Kelvin would be indirectly affected by the cumulative impacts from construction of the proposed action and Western Sydney International. Kelvin is a homestead listed on the State Heritage Register as having State significance and Kelvin Park Group is listed on the Liverpool LEP 2008 as having local significance.

Western Sydney International would introduce a large new airport complex around three kilometres northwest of the Kelvin item resulting in an indirect impact due to the reduction in the extent of the surrounding rural setting for the item.

The introduction of Aerotropolis Core Station would alter the rural setting of Kelvin to the west of the heritage item; however, heritage significant rural landscapes to the north and north-east would be preserved.

Given the significant separation distance between Western Sydney International and the proposed development of Aerotropolis Core Station, indirect impacts from the construction of the airport would not exacerbate the change in setting to Kelvin. The cumulative impact to Kelvin is considered negligible and would not exacerbate indirect impacts resulting from the proposed action alone.

Aboriginal heritage

Potential cumulative construction impacts on Aboriginal heritage values have been considered for the proposed action in combination with the Western Sydney International, future M12 Motorway and The Northern Road.

The proposed action would impact one known artefact scatter site located within the Aerotropolis Core construction site in the off-airport environment. This scatter site is one of many similar sites represented across the wider region (i.e. no rarity value by site type).

All other sites in proximity to but outside the construction footprint are proposed to be avoided and protected.

In addition to this one known site impact, the proposed action could potentially impact a number of unidentified surface and subsurface archaeological sites and identified cultural values which could result in potential cumulative impacts on identified cultural and archaeological values (such as values of significance to Aboriginal people resulting from traditions, customs, beliefs and history, and those associated with waterways surrounding the proposed action). Further consultation with Registered Aboriginal Parties as well as archaeological fieldwork during design development would determine potential cumulative impacts on places of cultural significance such as creeks and waterways.

The future M12 Motorway would impact known Aboriginal sites. While the section of the proposed action that intersects with the future M12 Motorway immediately north of Western Sydney International does not have any previously identified AHIMS sites within its bounds or landform elements with potential associated cultural value (such as waterways), areas of archaeological potential have been identified within this area and further investigation has been proposed.

There are known Aboriginal sites, areas of cultural value and areas of archaeological potential within the on-airport environment. The *Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan* (Western Sydney Airport, 2019b) contains protocols for the removal and protection of all known sites within Western Sydney International.

For sites that are not removed as part of the Western Sydney International development, Sydney Metro would prepare an Aboriginal Cultural Heritage CEMP for the on-airport rail works which would include the related methodologies for collection and salvage of sites that remain within the construction footprint where required, unexpected finds, and outlining nominated sites for protection. The CEMP would align with the Western Sydney International Survey and Salvage Plan.

Flooding, hydrology and water quality

Potential cumulative construction impacts on flooding, hydrology and water quality have been considered for the project in combination with the Western Sydney International, future M12 Motorway and The Northern Road.

All of these projects are located within the South Creek catchment and therefore there is the potential for cumulative construction impacts on local water quality from concurrent construction activities including vegetation clearing, earthworks, materials handling and from exposed surfaces and stockpiles.

During design development and construction planning for the project, opportunities to combine construction water quality mitigation and/or treatment measures to ensure a consistent approach to minimising water quality impacts in the downstream catchment would be considered.

Soils and contamination

No potential cumulative construction soil and contamination impacts are anticipated for The Northern Road given its distance from the proposed action.

Potential cumulative construction impacts on soils and contamination have been considered for the proposed action in combination with the future M12 Motorway and Western Sydney International. These include increased volumes of spoil going to landfill, cross contamination of soils between the projects or disturbance of already remediated areas within the Western Sydney International site.

Consultation would occur with stakeholders for the future M12 Motorway and Western Sydney International during design development and construction planning to ensure a coordinated approach to the management of soil and contamination for the projects.

Air quality

The highest potential for cumulative air quality impacts is where construction of other projects would occur concurrently with the proposed action, including where the proposed action intersects the future M12 Motorway to the north of Elizabeth Drive and Western Sydney International. Bulk earthworks would be the highest dust generating activity associated with Western Sydney International, however this activity is expected to be completed in 2022 and therefore cumulative dust impacts in this area are expected to be minor following completion of bulk earthworks at Western Sydney International.

Landscape and visual

Potential cumulative construction impacts on landscape and visual values have been considered for the proposed action in combination with the Western Sydney International and the future M12 Motorway. No potential cumulative construction impacts are anticipated for The Northern Road due to the separation distance from the proposed action and that the projects would be experienced and viewed separately.

Potential impacts for the area of Badgerys Creek where cumulative construction landscape and visual impacts could occur from the proposed action, the future M12 Motorway and Western Sydney International include:

- a moderate adverse landscape impact as a result of removed vegetation as well as road, rail and airport infrastructure which may divide this landscape
- a minor adverse visual impact in views from Elizabeth Drive as a result of extensive large-scale concurrent construction activity associated with these projects.

There would be negligible landscape and visual impacts at Western Sydney International as this site is currently under construction and the proposed action would be absorbed into this changing landscape and the scale of the proposed action during construction would be largely consistent or of a lesser scale than the airport construction works. Further details are provided in Section 7.12.

Social and economic

The cumulative social and economic benefits of the identified projects during construction may include increased opportunities for economic development and employment opportunities, contributing to increased household incomes across the Western Sydney region.

The potential cumulative social and economic impacts during construction may include:

- concurrent construction activities may cause a temporary increase in construction traffic with the potential to produce a potential cumulative traffic noise impact along common haulage routes
- increased traffic on local roads, as well as construction activities may cause temporary changes in the rural character and lifestyle impacting the amenity of nearby properties and communities due to construction noise, vibration and dust
- concurrent construction may produce a temporary spike in temporary workers in an area which may create a temporary shortage of accommodation
- extended construction periods and potential associated impacts on traffic, noise, air quality and amenity may result in construction fatigue in surrounding communities
- positive regional economic benefits including increased passing trade from the construction workforce, and employment opportunities for construction of the proposed action.

7.16.4 Potential cumulative impacts – operation

Potential cumulative impacts during operation are related to:

- transport
- noise and vibration
- flooding, hydrology and water quality
- landscape and visual
- land use and property
- social and economic.

Transport

The cumulative operational assessment considers two future operational year scenarios; 2026 (opening) and 2036 (10 years after opening). The project, the future M12 Motorway and Western Sydney International would all be operational by 2026.

Potential cumulative transport operational impacts were determined from the WestConnex Road Toll Model (WRTM) outputs developed for the Environmental Impact Statement for the future M12 Motorway to ensure cumulative impacts from the operation of the project along with the future M12 Motorway and Western Sydney International. This assessment considers the traffic model used in the M12 Motorway Environmental Impact Statement as this was the most current data available at the time of the assessment.

Projected future traffic growth in the study area is forecast to be mainly from Western Sydney International, the future M12 Motorway and surrounding urban development, rather than the project. The additional road-based traffic, including park and ride, kiss and ride, point to point and bus movements forecast to be generated by the proposed action is minimal. It is also expected that the proposed action would facilitate a transport mode shift from private vehicle travel towards public transport, a more sustainable and low carbon travel mode for drivers and passengers accessing the Western Parkland City (including Western Sydney International).

The cumulative operational scenarios are forecast to perform satisfactorily along the main transport corridors in the areas surrounding the airport site, including Luddenham Road, Elizabeth Drive and The Northern Road.

Potential cumulative operational transport impacts are considered in detail in *Sydney Metro – Western Sydney Airport, Transport Assessment* (Sydney Metro, 2020b).

Noise and vibration

The future noise environment during operation of the proposed action is expected to be largely different to that currently experienced. This is due to the future urban development occurring in the area including the operation of infrastructure such as the future M12 Motorway and Western Sydney International. The cumulative impact of these projects would increase the level of background noise in the environment surrounding the airport site.

Due to the varying nature of noise assessment metrics used in the assessment of impacts from aircraft, road and rail noise, it is not possible to quantitatively assess cumulative operational noise impacts from these projects.

Flooding, hydrology and water quality

The future M12 Motorway is predicted to have local flooding impacts at Cosgrove Creek and Badgerys Creeks, however the cumulative impact on flooding with the proposed action is considered insignificant for peak flood levels. The duration of inundation and the peak velocities at these creek crossings may temporarily change during operation.

The key changes to flood behaviour resulting from operation of the proposed action and Western Sydney International site would include changes to runoff volumes and direction of runoff across the Western Sydney International site. Potential cumulative impacts would be mitigated through the joint management of velocity and duration across a range of flood events to minimise geomorphic changes to Badgerys Creek and Cosgroves Creek.

Cumulative water quality impacts may also occur in the vicinity of Badgerys Creek where the proposed action, future M12 Motorway and Western Sydney International are located as a result of changed catchment conditions as a result of the introduction of impervious surfaces. Road drainage of the future M12 Motorway would typically include gross pollutant and sediment traps to remove the majority of sediment particles, as well as design measures and scour protection to prevent erosion and sedimentation within receiving waterways. As such the risk of cumulative water quality impact to the receiving waterways during operation is considered low.

Opportunities to combine operational water quality mitigation and/or treatment measures to ensure a consistent approach to minimising water quality impacts in the downstream catchment would be considered. This would include consideration of opportunities to use the existing Western Sydney International stormwater management measures comprising bioretention basins and drainage swales to provide water quality treatment for stormwater runoff prior to discharge to Badgerys Creek, Oaky Creek, Cosgroves Creek and Duncans Creek.

Landscape and visual

No potential cumulative operational impacts are anticipated for The Northern Road as this project is visually separated from the proposed action.

Potential impacts for the area of Badgerys Creek where cumulative operational landscape and visual impacts could occur from the proposed action in combination with the future M12 Motorway and Western Sydney International include:

- a minor adverse landscape impact due to the introduction of built elements associated with road, rail and airport infrastructure
- a minor adverse visual impact in views from Elizabeth Drive as the project alignment would be a small change to a view in the context of the visual transformation that would be associated with operation of the future M12 Motorway and Western Sydney International
- a moderate adverse visual impact during night-time, due to the introduction of lighting associated with the projects.

There is significant development planned to occur in the area surrounding the proposed action as part of the Western Parkland City and Western Sydney Aerotropolis. In the longer term the project would be visually absorbed into this surrounding urban landscape.

During operation, the Western Sydney International site will have undergone a substantial landscape and visual change and include a single runway, airport terminal, airport access roads and other support facilities. Cumulative impacts from the proposed action in combination with the operational Western Sydney International would not be significant as the proposed action would be seen within the context of the airport site.

Potential cumulative operational landscape and visual impacts are considered in detail in *Sydney Metro – Western Sydney Airport, Landscape and Visual Impact Assessment* (Sydney Metro, 2020h).

Land use and property

Cumulative land use impacts may occur during operation as the project is located within an area subject to extensive land use change arising from other infrastructure projects (such as the future M12 Motorway and Western Sydney International) and broader strategic planning processes. The implementation of mitigation measures are expected to adequately manage potential land use and property impacts of the project.

While the future strategic planning projects identified in the *Greater Sydney Region Plan 2056* and *Western City District Plan* for the Western Parkland City do not meet the criteria to be included in this cumulative impact assessment, they would result in significant future land use changes in the area surrounding the project. These planned land use changes are described in Section 7.9 (Land use and property).

During operation, potential cumulative impacts on land use and property may include:

- changes to the traditional rural residential land use to include road, rail and airport transport infrastructure
- possible property severance and/or fragmentation where the project is located at surface level or on viaduct, particularly in the area to the north of Elizabeth Drive where the project alignment is located in proximity to the future M12 Motorway
- property acquisition (some partial and some full) and property adjustments (access, fences and farm infrastructure) in areas surrounding the airport site.

Social and economic

During operation, the cumulative social and economic benefits may include:

- the availability of jobs and increased economic activity may drive economic and employment growth in Western Sydney
- greater transport efficiencies by relieving pressure on existing roads, and reducing traffic volumes and congestion along some of western Sydney's main arterial roads
- improved access to the future Western Sydney Aerotropolis and the South West Growth Area including direct access to Western Sydney International
- increased road capacity for future growth and development as well as increased opportunities for pedestrian and cyclist infrastructure and associated reduced congestion impact on the community and businesses

- generation of diverse employment opportunities to support the airport operations, as well as the commercial activities at the Western Sydney Aerotropolis.

Potential cumulative social and economic impacts may include changes in local character and potential impacts on social amenity. Any potential residual cumulative adverse impacts would be offset by the benefits of the project.

Potential cumulative construction social and economic impacts are considered in detail in *Sydney Metro – Western Sydney Airport, Socio-Economic Impact Assessment* (Sydney Metro, 2020i).

8 Environmental management and mitigation

This chapter describes the environmental management approach and framework for the proposed action during construction and operation. The environmental management approach and framework has been developed to be consistent with the regulatory requirements for the on-airport and off-airport environment, including the existing environmental management framework established under the Airport Plan.

The chapter also identifies the process for inspections, monitoring, auditing and reporting of environmental compliance.

8.1 Overview

The key legislation that will govern environmental management for the proposed action is as follows:

- *Airports Act 1996* (Cth) (Airports Act)
- Airports (Environment Protection) Regulations 1997 (Cth) (Airports (Environmental Protection) Regulations)
- Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act).

A range of other legislation and regulations are also applicable as identified in Section 2 of the Construction Environmental Management Framework (CEMF) (Appendix H).

The proposed action would need to be delivered in accordance with any conditions of approval issued under the Airports Act, as well as any other permits or licences required.

Environmental management associated with construction of Western Sydney International has been established through the following documents:

- *Western Sydney Airport – Airport Plan* (Airport Plan) (Department of Infrastructure and Regional Development, 2016a)
- *Western Sydney Airport - Environmental Impact Statement* (Department of Infrastructure and Regional Development, 2016b)
- *Western Sydney Airport Stage 1 Construction Plan* (Construction Plan) (Western Sydney Airport, 2019)
- Western Sydney Airport - Community and Stakeholder Engagement Plan (Western Sydney Airport, 2019a)
- Western Sydney Airport construction environmental management plans (Western Sydney Airport, 2019b-k)
- Western Sydney Airport Sustainability Plan (Western Sydney Airport, 2020).

Consistency with the environmental management provisions of these documents, including any variation to the Airport Plan, will be an essential aspect of the project's environmental management strategy for the on-airport works. As part of the proposed variation to the Airport Plan, it is anticipated that there would be a condition requiring the preparation of a construction plan to outline the construction program, methodology and staging of the on-airport works, referred to as a Construction (Rail) Plan.

The proposed approach to environmental management is to prepare an overarching, integrated environmental management strategy for the whole of the project that addresses both the on-airport and off-airport environmental management regimes. The management strategy would be consistent with the Western Sydney International regime detailed in the above documents but would be a standalone environmental management regime. This approach is required given construction contractors may carry out work in both the on-airport and off-airport environment, including construction packages that cross the airport boundary.

The primary document that will achieve this approach during construction is the CEMF. The CEMF provides a whole-of-project approach to construction environmental management and includes a range of requirements including the preparation of specific environmental management plans to implement the framework. The CEMF has been prepared to be consistent with the Sydney Metro project framework and the environmental management framework at Western Sydney International (see Section 8.2 for further information).

For the construction and operation of the proposed action, an Airport and Rail Integration Deed would be established between Sydney Metro, Transport for NSW, Western Sydney Airport and the Commonwealth.

The deed would represent an agreement between the parties that would establish a regime where Sydney Metro, in cooperation with Western Sydney Airport for the implementation of mitigation measures for provisions of the Airport and Rail Integration Deed, would be responsible for the ongoing construction and operational environmental management of the proposed action, constructing the proposed action under licence and operating it under an easement.

An operational environmental management plan (OEMP) or system would be developed for the whole project and for the proposed action. The OEMP would be consistent with the Airport and Rail Integration Deed, the airport's OEMPs and the airport masterplan and environment strategy (see Section 8.3 for further information).

8.2 Proposed construction environmental management approach

Sydney Metro carries out the construction of its projects in accordance with a range of management frameworks and strategies. The approach to environmental management during construction of the project is illustrated on Figure 8-1.

The overarching approach to construction environmental management is guided by the following:

- Planning approval documentation (see Section 8.2.1) including:
    - Construction Environmental Management Framework (CEMF) (Appendix H)
    - Construction Traffic Management Framework (CTMF) (Appendix E)
    - Construction Noise and Vibration Standard (CNVS) (Appendix F)
    - Overarching Community Communications Strategy (OCCS) (Appendix D)
    - performance outcomes
    - mitigation measures
- Construction (Rail) Plan/Staging Report (see Section 8.2.2)
- Construction Environmental Management Plans (CEMPs) and CEMP sub-plans, including CEMPs for on-airport rail works consistent with the existing Western Sydney Airport CEMPs (see Section 8.2.3)
- Sustainability Management Plans (SMPs) (see Section 8.2.4)
- performance and compliance reporting (see Section 8.2.5).

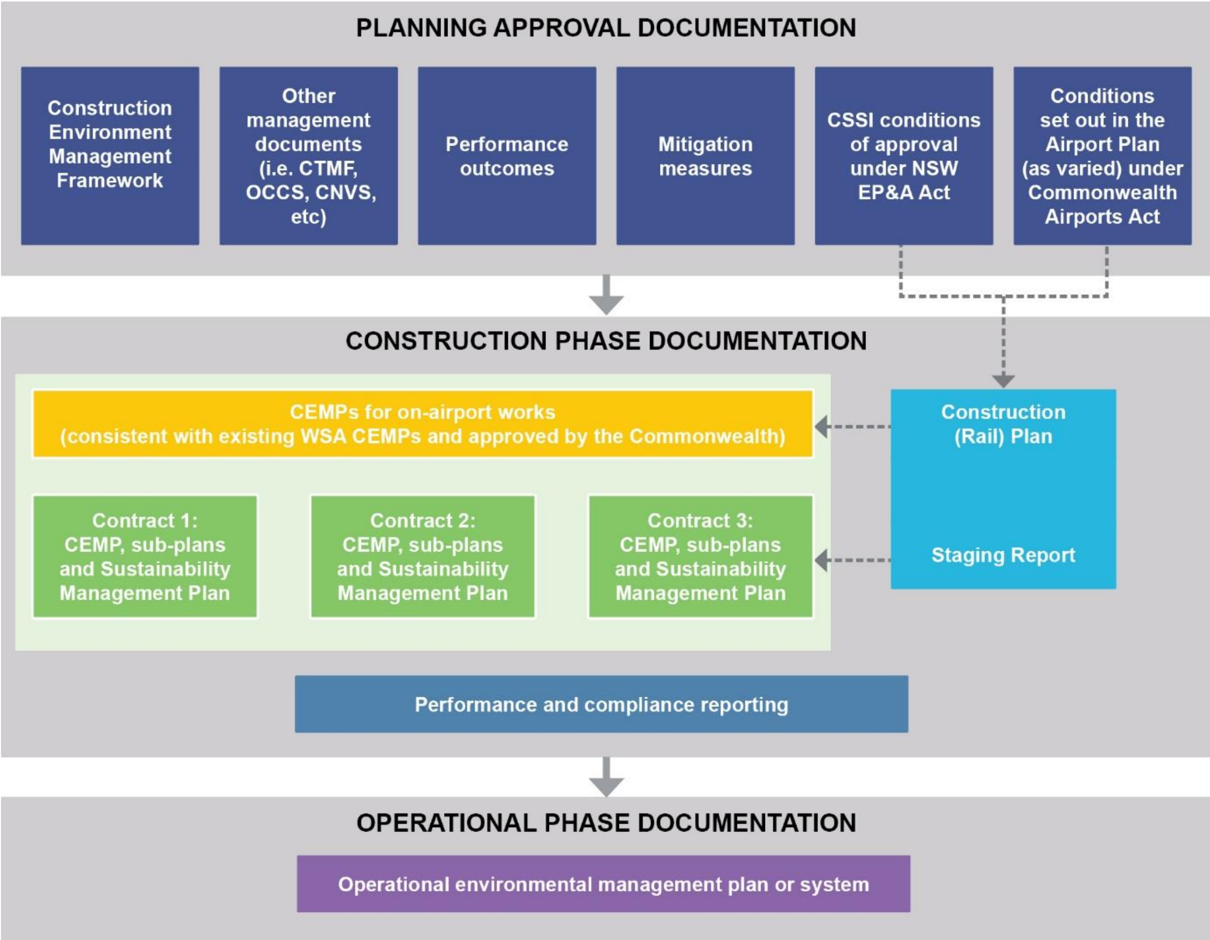


Figure 8-1 Construction environmental management approach

8.2.1 Planning approval documentation

The frameworks and strategies described below have been prepared for the project as a whole and would also apply to the proposed action to outline how environmental impacts would be managed during construction. The key documents include:

- OCCS
- CEMF
- CTMF
- CNVS.

In addition, this Final Environmental Impact Assessment has identified a series of performance outcomes and mitigation measures to minimise and manage the environmental impacts of the proposed action (see Section 8.4 for a compilation of these outcomes and measures).

Construction Environmental Management Framework

The CEMF describes the approach to environmental management during construction. The framework provides the basis for environmental management and informs the development of CEMPs by Sydney Metro for on-airport works which would be developed prior to construction.

The framework identifies the environmental, stakeholder, and community management systems and processes that would be applied during construction. Specifically, it lists the requirements to be addressed by construction contractors and Sydney Metro in developing the CEMPs, sub-plans, and other supporting documentation for each specific environmental aspect. The CEMF also identifies protocols for environmental monitoring, inspections, auditing and reporting.

The CEMF comprises a consolidated document to be implemented for the construction of on-airport and off-airport works.

Overarching Community Communications Strategy

The OCCS will guide the approach to stakeholder and community consultation to be adopted during construction. The OCCS:

- identifies relevant communities, individuals or organisations to be consulted during construction
- identifies procedures for the regular distribution of information
- identifies procedures for the community to provide feedback and to resolve issues.

The OCCS comprises a consolidated document to be implemented for the construction of on-airport and off-airport works. For the works associated with the proposed action, the OCCS would be implemented in coordination with Western Sydney Airport.

Construction Noise and Vibration Standard

The CNVS defines how construction noise and vibration impacts will be managed for Sydney Metro projects, in accordance with the *Interim Construction Noise Guideline* (Department of Environment & Climate Change NSW, 2009) and the Airports (Environment Protection) Regulations for on-airport works associated with the proposed action.

The standard identifies the requirements and methodology to develop Construction Noise and Vibration Impact Statements. These would be prepared prior to specific construction activities, based on a more detailed understanding of construction methods, including the size and type of construction equipment.

The standard is based on the following strategic objectives:

- a risk-based approach to implementing a hierarchy of controls at each stage of the project lifecycle to minimise potential impacts
- active collaboration with internal and external stakeholders in building the approach to reducing potential noise and vibration impacts at each stage of the project lifecycle
- development of a clear understanding of potential noise and vibration impacts and the application of best-practice management techniques
- community engagement that is sensitive to the needs and expectations of local communities and businesses
- commitment to the continual improvement of noise and vibration management.

The CNVS would be implemented for the construction of on-airport and off-airport works.

Construction Traffic Management Framework

The CTMF would provide the overall strategy and approach for construction traffic management for Sydney Metro projects.

The CTMF outlines construction contractor requirements and establishes traffic management processes and acceptable criteria to be considered and followed in managing roads and footpaths adjacent to construction worksites. The CTMF would apply to the management of traffic generated by construction of the proposed action on the broader road network outside the Western Sydney International site.

Site-specific Construction Traffic Management Plans (CTMPs) and Traffic Control Plans (TCPs) would be prepared by construction contractors, in consultation with Western Sydney Airport, based on the CTMF as well as relevant mitigation measures and requirements of the Airport Plan (as varied).

The CTMF would apply to the construction of on-airport and off-airport works.

8.2.2 Construction (Rail) Plan/Staging Report

It is anticipated that a combined Construction (Rail) Plan/Staging Report would be prepared for on-airport and off-airport construction activities respectively, to demonstrate the consistency of the construction of the project with the regulatory requirements outlined in Section 8.1.

Although a combined document, the Construction (Rail) Plan would form a standalone section of the document such that measures applicable to works on-airport are clearly identifiable.

The Construction (Rail) Plan/Staging Report would not identify new measures to be applied to the construction of the project, rather it would clearly document how regulatory requirements would be satisfied by Sydney Metro and its construction contractors through the application of the CEMF and other relevant plans and strategies during the proposed construction stages.

The content of the document would generally include:

- an overview of how the project would be constructed including the construction staging, program, details of the areas where the construction activities will occur, and methodology and the delivery strategy
- applicability of the Airport Plan conditions (as varied) to each construction stage and contract package
- applicability of the CSSI conditions of approval (for off-airport works) to each construction stage and contract package
- applicability of the requirements in the CEMF to each construction stage and contract package
- applicability of performance outcomes and mitigation measures to each construction stage and contract package.

Within that broader document, the Construction (Rail) Plan would be consistent with the provisions of the Construction Plan and would describe:

- the program and timetable for construction
- details of the construction methodology
- the construction footprint
- measures to avoid or minimise impacts to biodiversity values outside of the construction footprint.

8.2.3 Construction Environmental Management Plans

Sydney Metro would prepare CEMPs for the on-airport rail works, consistent with the existing CEMPs for Western Sydney International, for approval by the Commonwealth. The CEMPs for the on-airport works prepared by Sydney Metro would apply to the on-airport environment and would address the relevant requirements of the Airport Plan.

CEMPs would then be prepared by the construction contractors for the project as they relate to their scope of work. The CEMPs would apply to the on-airport and off-airport environment depending on the scope of works to be completed by the contractors. Where on-airport works are involved, the contractor's CEMPs would reference the approved CEMPs for on-airport works. CEMPs would address the relevant requirements of the planning approval document (including the CEMF, performance outcomes, mitigation measures and any conditions of approval) and the Construction (Rail) Plan/Staging Report.

8.2.4 Sustainability Management Plans

Sydney Metro would develop and implement SMPs for each construction work package. The SMPs would be informed by the project-specific Sustainability Plan which would be consistent with the Western Sydney Airport Sustainability Plan (Western Sydney Airport, 2020) for on-airport works, and address the relevant requirements of the Transport for NSW Environment and Sustainability Policy (Appendix I). Further requirements for the SMPs are outlined in the CEMF.

8.2.5 Construction performance and compliance reporting

Section 3 of the CEMF includes a range of requirements for the recording and reporting of environmental non-compliances for construction contractors. In accordance with the CEMF, Sydney Metro would include in its CEMPs a range of specific construction performance and compliance reporting requirements to ensure the CSSI conditions of approval relevant to the off-airport works (including that the project shall be constructed in accordance with the Project Environmental Impact Statement), the conditions of approval in the Airport Plan (as varied) and the performance outcomes are met, and that the mitigation measures and the CEMPs and sub-plans are being implemented.

8.3 Operational environmental management approach

The approach to environmental management during operation involves:

- project design – measures which are inherent in the design of the project to avoid and minimise impacts. Further detail on these aspects of the project are provided in Chapter 7 (Project description – operation) of the Project Environmental Impact Statement.
- performance outcomes and mitigation measures for the project (refer to Section 8.4)
- operational environmental management – the approach to environmental management during operation would be defined in a project operational environmental management plan or system.

8.3.1 Operational environmental management plan or system

Environmental performance during operation of the project would be managed by the implementation of an operational environmental management plan or system. As described in Section 8.1, the plan or system would be prepared to be consistent with the Airport and Rail Integration Deed for the project, the Airport Plan (as varied) and the CSSI conditions of approval (relevant to the off-airport works) and would apply consistently to the on-airport and off-airport components of the project.

The plan would identify how the performance outcomes and mitigation measures would be implemented and achieved during operation, and would specify the environmental management practices and procedures to be followed. The plan would include the following:

- a description of activities to be undertaken during operation
- statutory and other obligations, including approvals, consultations and agreements required from authorities and other stakeholders
- overall environmental policies, guidelines and principles to be applied to operation
- a description of the roles and responsibilities, including relevant training and induction to ensure that employees are aware of their environmental and compliance obligations
- an environmental risk analysis to identify the key environmental performance issues associated with the operation phase
- details of how environmental performance would be managed and monitored.

8.4 Environmental management requirements, performance outcomes and mitigation measures

8.4.1 Relevant requirements for on-airport works

The relevant requirements of the proposed construction and operational environmental management approach, as they relate to the on-airport works, are summarised in Table 8-1.

These requirements would be implemented through their inclusion in the relevant CEMPs and operational environmental management plans for the on-airport works and are in addition to the project-specific performance outcomes and mitigation measures provided in Sections 8.4.2 and 8.4.3.

Table 8-1 On-airport environmental management framework requirements

Framework document and ID	Requirement
Construction environmental management framework	
CEMF1	Sydney Metro would prepare Construction Environmental Management Plans (CEMPs) for the on-airport rail works. The on-airport CEMPs would be developed in consultation with Western Sydney Airport and be consistent with existing Western Sydney Airport CEMPs. The on-airport CEMPs would be submitted to the Commonwealth for approval. The approved on-airport CEMPs would be implemented for all on-airport rail construction works.
CEMF2	The on-airport Traffic and Access CEMP would detail the Sydney Metro – Western Sydney Airport management objectives and be consistent with the Western Sydney Airport Traffic and Access CEMP, including all appendices (and sub plans) to the CEMP.
CEMF3	The on-airport Soil and Water CEMP would detail the Sydney Metro – Western Sydney Airport groundwater management objectives, including: • reduce the potential for drawdown of surrounding groundwater resources • prevent the pollution of groundwater through appropriate controls and • reduce the potential impacts of groundwater dependent ecosystems. The on-airport Soil and Water CEMP would be consistent with the Western Sydney Airport Soil and Water CEMP, including all appendices (and sub plans) to the CEMP. Groundwater management of on-airport works would be implemented through the groundwater management plan approved as part of the on-airport Soil and Water CEMP. The groundwater quality criteria would be in accordance with Appendix G of the Western Sydney Airport Soil and Water CEMP. The on-airport Soil and Water CEMP (with the groundwater management plan) would include the following groundwater mitigation measures: • implement all feasible and reasonable measures to limit groundwater inflows to stations and crossovers • undertake groundwater monitoring (in terms of levels and quality) during construction in areas identified as 'likely' and 'potential' groundwater dependent ecosystems.
CEMF4	The on-airport Noise and Vibration CEMP would detail the Sydney Metro – Western Sydney Airport noise and vibration management objectives, including: • minimise unreasonable noise and vibration impacts on residents and businesses • avoid structural damage to buildings or heritage items as a result of construction vibration; • undertake active community consultation and • maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners. The on-airport Noise and Vibration CEMP would be consistent with the Western Sydney Airport Noise and Vibration CEMP, including all appendices (and sub plans) to the CEMP. The plan would include as a minimum: • identification of work areas, site compounds and access points • identification of sensitive receivers and relevant construction noise and vibration goals • details of construction activities and an indicative schedule for construction works, including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios) that have the potential to generate noise or vibration impacts on surrounding off-airport sensitive receiver.

Framework document and ID	Requirement
	• identification of feasible and reasonable mitigation measures to manage potential impacts • additional requirements in relation to activities undertaken 24 hours of the day, 7 days per week • compliance record generation and management, including: - Records of noise and vibration monitoring results against appropriate NMLs and vibration criteria and - Records of community enquiries and complaints, and the Contractor's response • identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibrations and blasting criteria are achieved, including a suitable blast program • noise monitoring requirements. Detailed Construction Noise and Vibration Impact Statements will be prepared for noise-intensive construction sites and/or activities to ensure the adequacy of the noise and vibration mitigation measures. Specifically, Construction Noise and Vibration Impact Statements will be prepared for works proposed to be undertaken outside of standard construction hours and to support applications to undertake out of hours works (this includes variations of EPLs and applications to relevant agencies). The on-airport Noise and Vibration CEMP would include the following noise and vibration mitigation measures: • hoarding and enclosures would be implemented where required to minimise airborne noise impacts • layout of construction sites would aim to minimise airborne noise impacts to surrounding receivers • provision of respite periods • equipment would be selected with consideration of their maximum noise levels. Where required, works would be undertaken in accordance with the Western Sydney Airport Out of Hours Works procedure.
CEMF5	The on-airport Aboriginal Cultural Heritage CEMP and the European and Other Heritage CEMP would detail the Sydney Metro – Western Sydney Airport heritage management objectives, including: • embed significant heritage values through any architectural design, education or physical interpretation • minimise impacts on items or places of heritage value • avoid accidental impacts on heritage items and • maximise worker's awareness of indigenous and non-indigenous heritage. The on-airport Aboriginal Cultural Heritage CEMP and the European and Other Heritage CEMP would be consistent with the WSA Aboriginal Cultural Heritage CEMP and European and Other Heritage CEMP, including all appendices (and sub plans) to these CEMPs. The plans would include as a minimum: • evidence of consultation with Registered Aboriginal Parties and the NSW Heritage Council where relevant • procedures for interpretation of heritage values uncovered through salvage or excavation during detailed design • procedures for undertaking salvage or clearance works • details for the short and/or long term management of artefacts

Framework document and ID	Requirement
	• details of management measures to be implemented to prevent and minimise impacts on heritage items (including further heritage investigations, archival recordings and/or measures to protect unaffected sites during construction works in the vicinity) • procedures for unexpected heritage finds, including procedures for dealing with human remains • heritage monitoring requirements • compliance record generation and management, including: - Inspections undertaken in relation to heritage management measures - archival recordings undertaken of any heritage item; - unexpected finds and stop work orders; and - records of any impacts avoided or minimised through design or construction methods. The on-airport Aboriginal Cultural Heritage and European and Other Heritage CEMPs would include the following mitigation measures: • induction courses for site workers will include training in the identification of Aboriginal artefacts and management of Aboriginal heritage values • any heritage item not affected by the works will be retained and protected throughout construction • implement unexpected heritage find procedures for Indigenous and non-Indigenous heritage items.
CEMF6	The on-airport Biodiversity CEMP would detail Sydney Metro – Western Sydney Airport fauna and flora management objectives, including: • minimise impacts on flora and fauna; • design waterway modifications and crossings to incorporate best practice principles; • retain and enhance existing flora and fauna habitat wherever possible; and • appropriately manage the spread of weeds and plant pathogens. The on-airport Biodiversity CEMP would be consistent with the Western Sydney Airport Biodiversity CEMP, including all appendices (sub plans) to the Biodiversity CEMP. The plan would include as a minimum: • procedures for the clearing of vegetation and the relocation of flora and fauna • details on the locations, monitoring program and use of nest boxes by fauna • procedures for the demarcation and protection of retained vegetation, including all vegetation outside and adjacent to the construction footprint, and the protection of retained vegetation within the environmental conservation zone on the airport site • plans for impacted and adjoining areas showing vegetation communities; important flora and fauna habitat areas; locations where threatened species, populations or ecological communities have been recorded • vegetation management plan(s) for sites where native vegetation is proposed to be retained • identification of measures to reduce disturbance to sensitive fauna • rehabilitation details, including identification of flora species and sources, and measures for the management and maintenance of rehabilitated areas (including duration of the implementation of such measures) • weed and disease management measures focusing on early identification of invasive weeds and diseases and protocols to address the effective management of these risks • a procedure for dealing with unexpected threatened species identified during construction. The procedure shall define how appropriate mitigation measures

Framework document and ID	Requirement
	(including relevant relocation measures) and updating of ecological monitoring or offset requirements • ecological monitoring requirements • compliance record generation and, including: - records of pre-clearing inspections undertaken; - records of the release of the pre-clearing hold point; and - records of ecological inspections undertaken. • the following ecological monitoring will be undertaken as a minimum: - a pre-clearing inspection will be undertaken prior to any native vegetation clearing by a suitable qualified ecologist and the Contractor's Environmental Manager (or delegate). The pre-clearing inspection will include, as a minimum: ▪ identification of hollow bearing trees or other habitat features; ▪ identification of any threatened flora and fauna; ▪ a check on the physical demarcation of the limit of clearing; ▪ an approved erosion and sediment control plan for the worksite; and ▪ the completion of any other pre-clearing requirements required by any project approvals, permits or licences. - the completion of the pre-clearing inspection will form a HOLD POINT requiring sign-off from the Contractor's Environmental Manager (or delegate) and a qualified ecologist; and - a post clearance report, including any relevant Geographical Information System files, will be produced that validates the type and area of vegetation cleared including confirmation of the number of hollows impacted and the corresponding nest box requirements to offset these impacts. The on-airport Biodiversity CEMP would include the following flora and fauna mitigation measures: • areas to be retained and adjacent habitat areas will be fenced off prior to works to prevent damage or accidental over clearing • weed management is to be undertaken in areas affected by construction prior to any clearing works. On-airport weed management will also be undertaken in accordance with the *NSW Noxious Weeds Act 1993* and the *NSW Biosecurity Act 2015*, which is consistent with the approach adopted in the We Weed and Disease Management Plan (Appendix C of the Western Sydney Airport Biodiversity CEMP).
CEMF7	The on-airport Visual and Landscape CEMP would detail the Sydney Metro – Western Sydney Airport visual amenity and landscaping management objectives, including: • minimise impacts on existing landscape features as far as feasible and reasonable • ensure the successful implementation of the Landscape Design and • reduce visual impact of construction to surrounding community. The on-airport Visual and Landscape CEMP would be consistent with the Western Sydney Airport Visual and Landscape CEMP, including all the appendices (and sub plans) to the CEMP. The plan would include as a minimum: • visual mitigation measures • maintenance of outward facing elements of site hoarding or noise barriers, including the removal of graffiti and weeds • apply the principles of Australian Standard 4282-1997 Control of the obtrusive effects of outdoor lighting and relevant safety design requirements and detail

Framework document and ID	Requirement
	mitigation measures to minimise lighting impacts on sensitive receivers for all permanent, temporary and mobile light sources • identify the processes and procedures that will be used for the incorporation of the principles of Crime Prevention Through Environmental Design (CPTED) in the design and construction of any temporary site facilities. The on-airport Visual and Landscape CEMP would include the following visual amenity and landscaping management objectives mitigation measures: • wherever feasible and reasonable, vegetation around the perimeter of the construction sites will be maintained • existing vegetation not affected by the construction works will be retained • temporary site lighting, for security purposes or night works will be installed and operated in accordance with AS4282:1997 Control of the obtrusive effects of outdoor lighting.
CEMF8	The on-airport Soil and Water CEMP would detail all the Sydney Metro – Western Sydney Airport soil and water management objectives, including: • minimise pollution of surface water through appropriate erosion and sediment control; • minimise leaks and spills from construction activities • maintain existing water quality of surrounding surface watercourses and • source construction water from non-potable sources, where feasible and reasonable. The on-airport Soil and Water CEMP would be consistent with the Western Sydney Airport Soil and Water CEMP, including all appendices (and sub plans) to the CEMP. The plan would include as a minimum: • soil and water mitigation measures • details of construction activities and their locations, which have the potential to impact on water courses, storage facilities, stormwater flows, and groundwater • surface water and ground water impact assessment criteria consistent with the Airports (Environment Protection) Regulations 1997 (with due consideration of the ANZECC guidelines) • management measures to be used to minimise surface and groundwater impacts, including identification of water treatment measures and discharge points, details of how spoil and fill material required by the project will be sourced, handled, stockpiled, reused and managed; erosion and sediment control measures; salinity control measures and the consideration of flood events • a contingency plan, consistent with the NSW Acid Sulphate Soils Manual (EPA 1998), to deal with the unexpected discovery of actual or potential acid sulphate soils and procedures for the investigation, handling, treatment and management of such soils and water seepage • management measures for contaminated material (soils, water and building materials) and a contingency plan to be implemented in the case of unanticipated discovery of contaminated material, including asbestos, during construction • a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be undertaken, the locations where monitoring would take place, how the results of the monitoring would be recorded and reported, and, if any exceedance of the criteria is detected how any non-compliance can be rectified

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procedures for the development and implementation of progressive Erosion and Sediment Control Plans (ESCPs) in accordance with Managing Urban Stormwater: Soils & Construction Volume 1 (Landcom, 2004) (known as the “Blue Book”). ESCPs will detail all required erosion and sediment control measures for the particular site at the particular point in time and be progressively updated to reflect the current site conditions. Any amendments to the ESCP will be approved by the Contractor’s Environmental Manager (or delegate)
identification of locations where site specific Stormwater and Flooding Management Plans are required. Stormwater and Flooding Management Plans will be developed and implemented for the relevant construction sites These plans will identify the appropriate design standard for flood mitigation based on the duration of construction, proposed activities and flood risks. The plan will develop procedures to ensure that threats to human safety and damage to infrastructure are not exacerbated during the construction period.
compliance record generation and management, including:

weekly inspections of the erosion and sediment control measures. Issues identified would be rectified as soon as practicable
additional inspections will be undertaken following significant rainfall events (greater than 20 mm in 24 hours) and
all water will be tested (and treated if required) prior to discharge from the site in order to determine compliance with the appropriate approvals and licencing. No water will be discharged from the site without written approval of the Contractor’s Environmental Manager (or delegate). This is to form a HOLD POINT.

The on-airport Soil and Water CEMP would include the following soil and water quality mitigation measures:

clean water will be diverted around disturbed site areas, stockpiles and contaminated areas
control measures will be installed downstream of works, stockpiles and other disturbed areas
exposed surfaces will be minimised, and stabilised/revegetated as soon feasible and reasonable upon completion of construction
dangerous good and hazardous materials storage will be within bunded areas with a capacity of 110 per cent of the maximum single stored volume
chemicals will be stored and handled in accordance with relevant Australian standards such as:

AS 1940-2004 The storage and handling of flammable and combustible liquids
AS/NZS 4452:1997 The storage and handling of toxic substances
AS/NZS 5026:2012 The storage and handling of Class 4 dangerous goods
AS/NZS 1547:2012 On-site domestic wastewater management

spill kits will be provided at the batch plants, storage areas and main work sites
a protocol will be developed and implemented to respond to and remedy leaks or spills
a remedial action plan and unexpected finds protocol would be established to facilitate the quarantining, isolation and remediation of contamination identified throughout the construction programme. Any asbestos identified on site would be managed in accordance with applicable regulatory requirements.

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Framework document and ID	Requirement
CEMF9	The Waste and Resources CEMP would detail the Sydney Metro – Western Sydney Airport spoil management objectives, including: • minimise spoil generation where possible • the project will mandate 100% reuse or recycling (on or off-site) of usable spoil • spoil will be managed with consideration to minimising adverse traffic and transport related issues • spoil will be managed to avoid contamination of land or water • spoil will be managed with consideration of the impacts on residents and other sensitive receivers, and • site contamination will be effectively managed to limit the potential risk to human health and the environment. The on-airport Waste and Resources CEMP would be consistent with the Western Sydney Airport Waste and Resources CEMP including all appendices (and sub plans) to the CEMP. Contractors would develop and implement a Spoil Management Plan for their scope of works. The Spoil Management Plan would include as a minimum: • the spoil mitigation measures as detailed in the planning approval documentation • the responsibilities of key project personnel with respect to the implementation of the plan • procedures and methodologies for the haulage and disposal locations, storage and stockpiling arrangements, including those for virgin excavated natural material, contaminated and unsuitable material • procedures for the testing, excavation, classification, handling and reuse of spoil • measures that will be implemented to both reduce spoil quantities and maximise the beneficial reuse of spoil which will be generated during the performance of the Contractor's Activities, including how spoil generation is minimised through the design development process • details, links or references to where traffic movements in relation to spoil are described, and measures that will be implemented to minimise traffic and noise impacts associated with haulage and disposal of spoil • quantities for reuse of spoil within the construction site or Western Sydney International, for beneficial reuse of spoil off site and for spoil disposal • processes and procedures for the management of the environmental and social impacts of spoil transfer and reuse • a register of spoil receipt sites that includes the site or project name, location, capacity, site owner and which tier the site is classified as under the spoil reuse hierarchy • spoil management monitoring requirements, and • compliance record generation and management. Spoil management measures would be included in regular inspections undertaken by the Contractor, and compliance records will be retained. These would include: • records detailing the beneficial re-use of spoil either within the project or at off-site locations, and • waste dockets for any spoil disposed of to landfill sites. The Spoil Management Plan would include the following examples of spoil mitigation measures: • implementing the spoil re-use hierarchy

Framework document and ID	Requirement
	• handling spoil to minimise potential for air or water pollution, and • minimising traffic impacts associated with spoil removal.
CEMF10	The on-airport Air Quality CEMP would detail the Sydney Metro – Western Sydney Airport air quality management objectives, including: • minimise gaseous and particulate pollutant emissions from construction activities as far as feasible and reasonable and • identify and control potential dust and air pollutant sources. The on-airport Air Quality CEMP would be consistent with the Western Sydney Airport Air Quality CEMP including all appendices (and sub plans) to the CEMP. The plan would include as a minimum: • air quality mitigation measures • site plans or maps indicating locations of sensitive receivers and key air quality/dust controls • air quality and dust monitoring requirements • compliance record generation and management, including: - records of any meteorological condition monitoring - records of any management measures implemented as a result of adverse, windy weather conditions and - records of air quality and dust inspections undertaken. The on-airport Air Quality CEMP would include the following air quality mitigation measures: • plant and equipment will be serviced and maintained in good working order to reduce unnecessary emissions from exhaust fumes • plant and equipment to be switched off engines when not in use • avoidance of the use of diesel or petrol powered generators and instead using mains electricity or battery powered equipment, where practicable • appropriate vehicle speeds on sealed and unsealed roads • development and implementation of a construction logistics plan to manage the sustainable delivery of goods and materials • implementing measures to support and encourage sustainable travel for construction workers to and from the construction sites • water suppression will be used for active earthwork areas, stockpiles, unsurfaced haul roads and loads of soil being transported to reduce wind-blown dust emissions • wheel-wash facilities or rumble grids will be provided and used near the site exit points, as appropriate • dust extraction and filtration systems will be installed for tunnel excavation works and deep excavation with limited surface exposure.
CEMF11	The on-airport Waste and Resources CEMP would detail the Sydney Metro – Western Sydney Airport waste management objectives and be consistent with the Western Sydney Airport Waste and Resources CEMP including all appendices (and sub plans) to the CEMP. The following waste objectives would apply: • minimise waste throughout the project life-cycle • waste management strategies will be implemented in accordance with the waste management hierarchy as follows: - avoidance of unnecessary resource consumption - resource recovery (including reuse, reprocessing, recycling and energy recovery) - disposal. The plan would include as a minimum:

Framework document and ID	Requirement

	• waste management mitigation measures
	• waste management monitoring requirements
	• a procedure for the assessment, classification, management and disposal of waste
	• compliance record generation and management by including:
	  - weekly inspections will include checking on the waste storage facilities on site and
	  - all waste removed from the site will be appropriately tracked from 'cradle to grave' using waste tracking dockets.
	
	The on-airport Waste and Resources CEMP would include the following waste management mitigation measures:
	
	• a central waste area (or areas) would be established, at which waste (including recyclables) would be stored or stockpiled. Stockpiles and bins would be appropriately labelled, managed and monitored till being removed from site
	• all waste materials removed from the sites will be directed to an appropriately licensed waste management facility
	• use of raw materials (such as noise hoarding and site fencing) will be reused or shared, between sites and between construction contractors where feasible and reasonable
	• recyclable wastes, including paper at site offices, will be stored separately from other wastes.

CEMF12	The Workforce Development and Industry Participation Plan would address and detail:
	
	• the proposed response to State and Commonwealth requirements including but not limited to:
	  - NSW Aboriginal Participation in Construction Policy
	  - NSW Infrastructure Skills Legacy Program
	  - Australian Jobs Act – Australian Industry Participation Plan
	  - Western Sydney City Deal
	  - Indigenous Participation Plan – National Partnerships Agreement
	• proposed appropriately skilled key personnel to support delivery of the workforce development and industry participation requirements
	• implementation approach, processes and systems to ensure delivery and reporting of workforce development and industry participation priority areas:
	  - jobs and Industry Participation
	  - skills Development
	  - diversity and Inclusion including Aboriginal Participation
	  - inspiring Future Talent.

Construction noise and vibration standard	
CNVS1	Quantitative noise and vibration impact assessments will be carried out prior to construction. Where a potential exceedance of the construction noise and vibration management levels is identified, additional mitigation measures (such as individual briefings, letter box drops, phone calls, emails and specific notifications to affected sensitive receivers) would be considered.
CNVS2	Noise monitoring would be carried out where a potential exceedance of the construction noise management levels has been identified.
CNVS3	Vibration monitoring would be carried out at the nearest affected receiver where it is anticipated that an item of plant would exceed the cosmetic damage or human response/ground-borne noise criteria.

Framework document and ID	Requirement
CNVS4	Where feasible and reasonable, construction would be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels would be scheduled during less sensitive time periods.
CNVS5	All complaints handling would be in accordance with the Overarching Community Communications Strategy and Construction Complaints Management System and in consultation with Western Sydney Airport.
Operational environmental management plan	
OEMP1	The on-airport OEMP(s) would be consistent with the relevant Western Sydney Airport OEMPs.

8.4.2 Performance outcomes

The performance outcomes for the project are summarised in Table 8-2 and identify measurable, performance-based standards for environmental management. The performance outcomes identified in Table 8-2 would be developed to ensure that they meet the standards of the Western Sydney Airport CEMPs for on-airport matters.

The performance outcomes applicable to the proposed action have been revised in response to submissions received during public exhibition of the Project Environmental Impact Statement and/or any minor changes made following exhibition. The revised list of performance outcomes is provided in Table 8-2.

In addition, there are several performance outcomes that are only partially applicable to the on-airport assessment. In this case the entire wording of the performance outcome has been retained, but the elements which are not applicable to the on-airport proposed action are displayed as strikethrough text.

Mitigation measures, including measures necessary to achieve the performance outcomes, are identified in Section 8.4.3.

Table 8-2 Consolidated list of performance outcomes

Project performance outcome	Phase
Design, place and movement	
The Sydney Metro – Western Sydney Airport Design Guidelines and Design Quality Framework are implemented to deliver a rail corridor, stations and ancillary facilities that achieve the project vision and design objectives	Operation
Within Western Sydney International, the project is integrated with and supports the outcomes and design objectives set out in the Airport Plan, future master plans for Western Sydney International and design guidelines for Western Sydney International	Operation
Transport	
The local community and relevant authorities are informed of transport, access and parking changes/impacts to minimise inconvenience to the public	Construction
Each station and station plaza is provided with sufficient customer capacity to achieve a minimum Fruin’s Level of Service C (for 2056 demand)	Operation
Stations and interchanges are fully accessible and compliant with the *Disability Discrimination Act 1992* (Cth) and the *Disability Standards for Accessible Public Transport* (Australian Government, 2002)	Operation

Project performance outcome	**Phase**
Noise and vibration	
Construction noise and vibration impacts on local communities (including airborne noise and ground-borne noise and vibration) are managed in accordance with the Construction Noise and Vibration Standard, the Interim Construction Noise Guideline, and the Airports (Environment Protection) Regulations 1997	Construction
Operational noise and vibration levels from rail operations are managed in accordance with the Rail Infrastructure Noise Guidelines and Airports (Environment Protection) Regulations 1997 Operational noise levels for the ~~stabling and maintenance facility,~~ stations and other fixed infrastructure are managed in accordance with the *Noise Policy for Industry 2017*	Operation
Biodiversity	
Minimise or where possible avoid impacts on threatened flora and fauna species, and ecological communities listed under the *Biodiversity Conservation Act 2016* (NSW) and *Environment Protection and Biodiversity Conservation Act 1999* (Cth)	Construction
Impacts on threatened ecological communities and threatened species are offset in accordance with the requirements of the *NSW Biodiversity Assessment Method* (OEH, 2017)	Construction
Aboriginal heritage	
The heritage significance of Aboriginal objects and places are protected, conserved and/or managed in order to ensure the project does not diminish the story and cultural understanding associated with the objects and places of Aboriginal people in New South Wales	Construction
The design of the project incorporates Aboriginal heritage interpretation and Aboriginal cultural design principles in consultation with Aboriginal knowledge holders	Operation
Flooding, hydrology and water quality	
Land and property beyond the construction footprint would not be impacted by construction for the 0.5 Exceedances per Year (EY) storm event	Construction
No aspect of construction to materially adversely affect existing water quality in receiving waters to a minimum 0.5 EY storm event, or in line with the 'Blue Book' (*Managing Urban Stormwater: Soils & Construction Volume 1* (Landcom, 2004))	Construction
No material change to channel shape within the construction footprint for the 0.5 EY storm event for streams classified first order and higher	Construction
Water discharged from the project, including runoff from hardstand areas, surface and ground water storages would: • contribute towards achieving ANZECC guideline water quality trigger values for physical and chemical stressors for slightly disturbed ecosystems in lowland rivers in southeast NSW, or • meet any water quality criteria determined in consultation with the NSW Environment Protection Authority (off-airport) where an EPL is required or in consultation with Western Sydney Airport in accordance with the Airports (Environmental Protection) Regulations 1997 (on-airport)	Construction and operation
No change to flood hazard vulnerability classification limits for residential and commercial buildings or roads	Operation

Project performance outcome	**Phase**
No change to flood hazard vulnerability classification limits for all land types as a result of the location of the permanent spoil placement areas at Western Sydney International	Operation
No change to the one per cent annual exceedance probability duration of inundation up to the following limits: • residential, commercial, critical infrastructure – no increase for above floor flooding • roads – maximum change of 10 per cent increase in duration • agricultural land for cropping – dependant on cropping type	Operation
Critical infrastructure (including stations entries and tunnel portals) to have immunity against the probable maximum flood event	Operation
Groundwater and geology	
Groundwater availability and quality for water supply and environmental benefit (e.g. groundwater dependent ecosystems) is not affected beyond the requirements outlined in the NSW Aquifer Interference Policy	Construction and operation
Soils and contamination	
Contamination risks to human health and ecological receivers are minimised through effective management of existing contaminated land	Construction
Contaminated land and soil within the footprint of the project is remediated where required, to ensure the land is suitable for the intended future land use	Operation
Sustainability, climate change and greenhouse gas	
The project achieves a minimum 'Design' and 'As built' rating score of Leading +75, using the Infrastructure Sustainability Council of Australia Infrastructure Sustainability Rating Scheme Version 1.2 or equivalent	Operation
Sustainability initiatives are incorporated into the planning, design and construction of the project	Construction and operation
100 per cent of the greenhouse gas emissions associated with consumption of electricity during operation are offset	Operation
25 per cent of the greenhouse gas emissions associated with consumption of electricity during construction are offset	Construction
The project is designed to withstand known impacts associated with climate change to year 2100	Construction and operation
Resource management	
100 per cent of useable spoil is reused in accordance with the spoil reuse hierarchy	Construction
A minimum 95 per cent recycling target is achieved for construction and demolition waste	Construction
Products made from recycled content are prioritised	Construction
The use of potable water for non-potable purposes is avoided if non-potable water is available	Construction and operation
The reuse of water is maximised, either on-site or off-site	Construction and operation
Cumulative impacts	
Cumulative impacts are managed through coordination of construction activities and communication processes with nearby projects (Western Sydney International, M12 Motorway and The Northern Road~~, St Marys Intermodal and St Marys Commuter Carpark Expansion~~)	Construction

8.4.3 Mitigation measures

Mitigation measures have been developed to mitigate and manage the potential impacts of the project and achieve the performance outcomes outlined in Table 8-2.

A range of measures for the management of potential impacts from construction are included in the CEMF, OCCS, CNVS and CTMF (refer to Section 8.2). Additional mitigation measures have been identified throughout the Project Environmental Impact Statement and State Submissions Report to manage project-specific impacts and the measures that apply to the proposed action are compiled in Table 8-3.

The measures have been identified to manage both construction and operational impacts and some measures have been identified to manage impacts in a site-specific location. The location(s) applicable to each mitigation measure are identified in the table. The measures have been developed in consultation and coordination with Western Sydney Airport to take into consideration the environmental management and mitigation requirements under the Airports Act.

The mitigation measures applicable to the proposed action have been revised in response to submissions received during public exhibition of the Project Environmental Impact Statement and/or any minor changes made following exhibition. The revised list of mitigation measures is provided in Table 8-3.

The mitigation measures for the proposed action, outlined in Table 8-3, correspond to the mitigation measures applicable to the broader Sydney Metro – Western Sydney Airport project, as documented in the Project Environmental Impact Statement and State Submissions Report. To maintain consistency (including numbering of individual mitigation measures) between the Project and the proposed action, the mitigation measures from the Project Environmental Impact Statement that are not applicable to the proposed action have been included but with the following text: "*Not required/applicable*".

In addition, there are several mitigation measures that are only partially applicable to the on-airport assessment. In this case the entire wording of the mitigation measure has been retained, but the elements which are not applicable to the on-airport proposed action are displayed as strikethrough text.

Table 8-3 Consolidated list of on-airport mitigation measures

Ref	Mitigation measures	Applicable location(s)
Transport – construction		
T1	Construction Traffic Management Plans would be prepared in accordance with the Construction Traffic Management Framework	All
T2	Not required/applicable	
T3	Coordination with Western Sydney Airport and Transport for NSW would be undertaken through the Traffic and Transport Liaison Group to manage potential cumulative construction traffic impacts with future M12 Motorway and Elizabeth Drive	All
T4	Road Safety Audits would be carried out to address vehicular access and egress, and pedestrian, cyclist and public transport safety. Road Safety Audits would be carried out as per the guidelines outlined in Section 10 of the Construction Traffic Management Framework	All
T5	Not required/applicable	
T6	Access for construction vehicles to be planned as per the guidelines outlined in the Construction Traffic Management Framework. Construction site traffic would be managed to minimise movements during peak periods. Vehicle access to and from construction sites would be managed to maintain pedestrian, cyclist and motorist safety	All
T7	Not required/applicable	

Ref	Mitigation measures	Applicable location(s)
T8	Not required/applicable	
T9	Not required/applicable	
Transport – operation		
OT1	Not required/applicable	
OT2	Not required/applicable	
OT3	Not required/applicable	
OT4	Not required/applicable	
Noise and vibration – construction		
NV1	Where acoustic sheds are installed, the internal lining and type of material used in the construction of the sheds would be considered during design development and construction planning to ensure appropriate attenuation is provided	Western Sydney International tunnel portal construction site Airport Terminal construction site
NV2	Not required/applicable	
Noise and vibration – operation		
ONV1	Not required/applicable	
Biodiversity – construction		
FF1	The Biodiversity Construction Environmental Management Plan (on-airport) ~~/ and Flora and Fauna Management Plan (off-airport)~~ would be prepared by a suitably qualified and experienced person to minimise and manage the clearing of native vegetation and habitat by: • seeking to locate site offices, site compounds and ancillary facilities in areas where there are limited biodiversity values (e.g. cleared land) • delaying the removal of vegetation until absolutely necessary • avoiding the removal of hollow-bearing trees, where possible • using a qualified surveyor and suitably qualified ecologist to mark out exclusion zones and clearing/project boundaries prior to construction • providing contractors with regularly updated sensitive area maps (showing clearing boundaries and exclusion zones) • investigating opportunities for salvage and storage of felled native trees for potential use in landscape design The Biodiversity Construction Environmental Management Plan (on-airport) ~~and Flora and Fauna Management Plan (off-airport)~~ would be implemented throughout construction	Airport construction support site
FF2	Not required/applicable	
FF3	Works on-airport would be undertaken in consultation with Western Sydney Airport subject to the wildlife hazard management requirements	On-airport
FF4	Not required/applicable	

Ref	Mitigation measures	Applicable location(s)
FF5	Works on-airport would be managed in accordance with the *Western Sydney Airport Microbat Management Plan* and in consultation with Western Sydney Airport	On-airport
FF6	During construction, shading and artificial light impacts would be minimised in areas adjoining remnant bushland that is in intact condition	On-airport construction support site
FF7	Not required/applicable	
FF8	Not required/applicable	
FF9	A Dewatering Plan would be prepared and implemented for the dewatering of rural dams which are impacted as a result of the construction of the project. This would include measures to manage the transfer of native aquatic fauna, if required, prior to dewatering and removing of dams. The plan would be consistent with the *Western Sydney Airport Biodiversity Construction Environmental Management Plan* (on-airport).	On-airport
FF10	The impact of Key Threatening Processes as a result of the project would be managed and minimised where possible through: • implementation of weed management measures to prevent the introduction and spread of weeds including exotic vines and scramblers, *Olea europaea* (African Olive), *Chrysanthemoides monilifera*, *Lantana camara*, and exotic perennial grasses • implementation of pathogen management measures to prevent the introduction and spread of pathogens including amphibian chytrid, *Phytophthora implementa*, and Exotic Rust Fungi of the order Pucciniales • implementation of management measures to protect the riparian zone to ensure fish passage and protect fish habitat in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI (Fisheries NSW), 2013), and minimisation of vegetation removal within the riparian zone where possible	All
FF11	A native vegetation seed collection and salvage program would be developed prior to the commencement of construction and implemented during construction. The seed collection and salvage program would target native species prioritising the Cumberland Plain Woodland species to be utilised in landscaping for the project where possible. Opportunities for use of collected and salvaged seed outside of the project would also be investigated	All
Biodiversity - operation		
OFF1	Not required/applicable	
OFF2	Not required/applicable	
Non-Aboriginal heritage - construction		
NAH1	Not required/applicable	
NAH2	Not required/applicable	
NAH3	Not required/applicable	
NAH4	Not used	
NAH5	Not required/applicable	
NAH6	Not required/applicable	
NAH7	Not required/applicable	

Ref	Mitigation measures	Applicable location(s)
NAH8	Not required/applicable	
NAH9	If suspected human remains or unexpected items of potential heritage significance are discovered within the on-airport area, all activity would cease and the unexpected/chance finds requirements specified in the *Western Sydney Airport European and Other Heritage Construction Environmental Management Plan* would be followed	On-airport
Non-Aboriginal heritage - operation		
ONAH1	Not required/applicable	
ONAH2	Not required/applicable	
ONAH3	Not required/applicable	
ONAH4	Not required/applicable	
ONAH5	Not required/applicable	
ONAH6	Not required/applicable	
ONAH7	Not required/applicable	
Aboriginal heritage - construction		
AH1	Not required/applicable	
AH2	Not required/applicable	
AH3	Not used	
AH4	Not used	
AH5	Not required/applicable	
AH6	Not required/applicable	
AH7	Not required/applicable	
AH8	If any suspected human remains or unexpected Aboriginal cultural heritage objects are discovered within the on-airport area, all activity would cease and the unexpected finds protocol and discovery of human remains protocol specified in the *Western Sydney Airport Aboriginal Cultural Heritage Construction Environmental Management Plan* would be followed	On-airport
AH9	Not required/applicable	
AH10	Not required/applicable	
AH11	Not required/applicable	
AH12	Not required/applicable	
AH13	Not required/applicable	
Aboriginal heritage - operation		
OAH1	A heritage interpretation strategy would be prepared for the project in consultation with Aboriginal knowledge holders. Aboriginal heritage interpretation would be developed with reference to the findings of the Aboriginal Cultural Heritage Assessment Report and Aboriginal Archaeological Report, to promote understanding and awareness of cultural heritage values	All

Ref	Mitigation measures	Applicable location(s)
Flooding, hydrology and water quality - construction		
HYD1	Construction planning would consider flood related mitigation, including: • staging construction works to reduce the duration of works within the floodplain • daily and continuous monitoring of weather forecasts and storm events, rainfall levels and water levels in key watercourses to identify potential flooding events and related flood emergency response • ~~consultation with NSW State Emergency Services and relevant local councils to ensure consistent approaches to the management of flood events (off-airport only)~~ • provide flood-proofing to excavations at risk of flooding during construction, where reasonable and feasible, such as raised entry into shafts and/or pump-out facilities to minimise ingress of floodwaters into shafts and the dive structure • review of site layout and staging of construction works to avoid or minimise obstruction of overland flow paths and limit the extent of flow diversion required	On-airport construction corridor Airport construction support site
HYD2	Not required/applicable	
HYD3	Not required/applicable	
WQ1	A surface water quality monitoring program would be implemented to monitor water quality during construction. The program would be developed in consultation with (as relevant) Western Sydney Airport, NSW Environment Protection Authority, relevant sections of Department of Planning, Industry and Environment and relevant local councils. The program would consider monitoring being undertaken as part of other infrastructure projects such as the M12 Motorway and Western Sydney International. On-airport, the water quality monitoring program would ensure that works meet the requirements under Schedule 2 of the Airports (Environment Protection) Regulations 1997 The program would monitor all construction discharge locations	All
WQ2	Water treatment plants would be designed to ensure that wastewater is treated to a level that is compliant with the ANZECC/ARMCANZ (2000), ANZG (2018) and draft ANZG (2020) default guidelines for 95 per cent species protection and 99 per cent species protection level for toxicants that bioaccumulate unless other discharge criteria are agreed with relevant authorities	All
WQ3	Not required/applicable	

Ref	Mitigation measures	Applicable location(s)
Flooding, hydrology and water quality - operation		
OHYD1	The flood model for the project would be updated with regard to flood modelling undertaken for the South Creek Sector Review (anticipated to be released in 2021) and would include updated calibration and validation. The updated flood modelling would be used to inform design development ~~including but not limited to, addressing potential residual flood impacts identified at the following locations:~~ ~~• the viaduct and earthworks in the vicinity of Blaxland Creek so as to minimise the extent of the project within the floodplain~~ ~~• the earthworks arrangement at the stabling and maintenance facility in the area affected by the Probable Maximum Flood~~ The flood model for the project would be updated in consultation with relevant stakeholders	All
OHYD2	Not required/applicable	
OHYD3	Flood compatible design would need to be demonstrated for the permanent spoil placement areas to ensure compliance with applicable land use criteria	On-airport
OHYD4	Not required/applicable	
OWQ1	Design batter slope gradients and surface treatments to minimise erosion risk	All
OWQ2	Drainage and water treatment design to be undertaken in accordance with Water Sensitive Urban Design requirements specified in local council, Transport for NSW and on-airport standards	All
OWQ3	Suitably designed scour and erosion controls should be included at drainage and sedimentation basin outlet discharge points	All
OWQ4	Not required/applicable	
OWQ5	Where feasible, on-site detention of stormwater would be introduced where stormwater runoff rates are increased. Where there is insufficient space for the provision of on-site detention, the upgrade of downstream infrastructure would be implemented where feasible and reasonable	All
OWQ6	At all locations where stormwater is discharged, water quality measures such as gross pollutant traps, bio-retention swales and Water Sensitive Urban Design features would be investigated and implemented where feasible and reasonable	All
OWQ7	Not required/applicable	
Groundwater and geology - construction		
GW1	Not required/applicable	
GW2	Not required/applicable	
GW3	Not required/applicable	
GW4	Consultation with Western Sydney Airport will be on-going in respect to the construction programs for both projects to understand the potential for ground movement impacts to proposed buildings and structures	On-airport

Ref	Mitigation measures	Applicable location(s)
GW5	Detailed hydrogeological and geotechnical models for the project would be developed and progressively updated during design and construction These models would: • be informed by the results of groundwater monitoring undertaken before and during construction • identify predicted changes to groundwater levels, including at nearby water supply works and at groundwater dependent ecosystems or other sensitive groundwater receptors Where changes to groundwater levels are predicted at nearby water supply works, groundwater dependent ecosystems or other sensitive groundwater receivers, an appropriate groundwater monitoring program would be developed and implemented Where changes to groundwater level are close to the ground surface, dryland salinity monitoring would be implemented to allow for management of any identified impacts The groundwater monitoring program would aim to confirm no adverse impacts on the receiver during construction or to effectively manage any impacts with the implementation of appropriate mitigation measures. Monitoring at any specific location would be subject to the status of the water supply work and agreement with the landowner	All
GW6	A Groundwater Management Plan would be prepared and implemented. The plan must include the following trigger-action-response measures in relation to groundwater levels in areas identified as subject to potential drawdown (at groundwater dependent ecosystems or other sensitive receivers) but outside the construction footprint and Western Sydney International Stage 1 Construction Impact Zone: a. target criteria, set with reference to relevant standards and site specific parameters b. trigger values and corresponding corrective actions to prevent recurring or long-term exceedance of the target criteria described in (a) c. corrective actions to compensate for any recurring or long-term exceedance of the target criteria described in (a) Response measures may include: • targeted ground improvement and grouting to limit groundwater inflows into station excavations, tunnels and cross-passage to reduce groundwater drawdown • design of undrained temporary retention systems to minimise groundwater inflow into station excavations and reduce groundwater drawdown • supplementing groundwater supply at affected groundwater dependent ecosystems or watercourses • make good provisions for groundwater supply wells impacted by changes in groundwater level or quality	All
Groundwater and geology - operation		
OGW1	Not required/applicable	

Ref	Mitigation measures	Applicable location(s)
Soils and contamination - construction		
SC1	The Soil and Water Management Plan would incorporate the following measures: • for low risk areas of environmental concern, worker health and safety measures, waste management and tracking for contamination would be outlined • for medium and high risk areas of environmental concern, detailed site investigations and review of further available information would be undertaken prior to the start of construction	All
SC2	Not required/applicable	
SC3	Not required/applicable	
SC4	Not required/applicable	
SC5	An unexpected finds procedure would be developed and implemented as part of the project Soil and Water Management Plan, outlining a set of potential contamination issues which could be encountered, and detailing the management actions to be implemented. The unexpected finds procedure would include a process for chemical and asbestos contamination and would generally include: • cessation of works within the affected area until inspection of the suspected contamination by a qualified contaminated lands consultant • collection of soil samples for chemical or asbestos analysis, where required, based on observations • assessment of results against applicable land use or waste classification criteria in accordance with statutory guidelines made or endorsed by the NSW Environment Protection Authority • management of the contamination in accordance with statutory guidelines made or endorsed by the NSW Environment Protection Authority The unexpected finds procedure for on-airport construction would be consistent with the Western Sydney Airport unexpected finds procedure detailed in the *Western Sydney Airport Soil and Water Construction Environmental Management Plan*	All
SC6	Post construction, an inspection of construction, stockpiling and laydown sites and soil validation of redundant sedimentation/water quality basins would be undertaken to assess if further investigation and remediation is required. Investigation and remediation (if required) would be undertaken in accordance with ~~the Soil and Water Management Plan (off-airport) and~~ a project specific Remediation Action Plan that would be consistent with the *Western Sydney Airport Remediation Action Plan* (on-airport). All inspections, investigations and remediation would be undertaken by a qualified contaminated lands consultant with reports prepared or reviewed by a Certified Contaminated Land Consultant	All
SC7	Prior to ground disturbance in areas of potential acid sulfate soil occurrence, testing would be carried out to determine the actual presence of acid sulfate soils. If acid sulfate soils are encountered, they would be managed in accordance with the *Acid Sulfate Soil Manual* (Acid Sulfate Soil Management Advisory Committee, 1998)	All

Ref	Mitigation measures	Applicable location(s)
SC8	Prior to ground disturbance in high probability salinity areas testing would be carried out to determine the presence of saline soils. If salinity is encountered, excavated soils would not be reused or would be managed in accordance with *Book 4 Dryland Salinity: Productive Use of Saline Land and Water* (NSW DECC 2008). Erosion controls would be implemented in accordance with the *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004)	All
SC9	Targeted groundwater investigations would be undertaken prior to construction to identify high salinity areas at risk from rising groundwater. Where high saline areas (>1000 µS/cm) are identified, measures such as planting, regenerating and maintaining native vegetation and good ground cover in recharge, transmission and discharge zones would be implemented where possible	All
SC10	Not required/applicable	
SC11	For works within Western Sydney International: • a review of further available information from Western Sydney Airport would be undertaken prior to the commencement of construction, which may include review of investigations, the *Western Sydney Airport Remediation Action Plan* and validation reports • any remediation works (for contamination encountered by Sydney Metro that has not been remediated by Western Sydney Airport) would be undertaken in accordance with the Sydney Metro Remediation Action Plan, developed in a manner consistent with the *Western Sydney Airport Remediation Action Plan*	On-airport
Sustainability, climate change and greenhouse gas - construction		
SUS1	A Sustainability Plan would be developed and implemented during construction of the project. The Sustainability Plan would identify the sustainability, climate change and greenhouse gas objectives, initiatives and targets which would be implemented during further design development and construction of the project. The Sustainability Plan would be developed to be consistent with the *Western Sydney Airport Sustainability Plan* for on-airport works ~~The Sustainability Plan would also inform the preparation of Sustainability Management Plans for each off-airport construction work package~~	All
SUS2	Protect sensitive construction equipment from the effects of extreme weather, such as direct exposure to the sun on extreme heat days and flooding	All
SUS3	Address climate change impacts in emergency management procedures for the construction of the project, such as consideration of impacts of flash flooding on evacuation procedures	All
GHG1	Carry out an iterative process of greenhouse gas assessments and design refinement prior to construction to identify opportunities to minimise greenhouse gas emissions Performance would be measured in terms of a percentage reduction in greenhouse gas emissions, and assessed against a business as usual project benchmark verified by Infrastructure Sustainability Council of Australia or equivalent independent industry body	All

Ref	Mitigation measures	Applicable location(s)
Sustainability, climate change and greenhouse gas - operation		
OSUS1	A Sustainability Plan would be developed and implemented during operation of the project. The Sustainability Plan would identify the sustainability, climate change and greenhouse gas objectives, initiatives and targets which would be implemented during further design development and operation of the project. The Sustainability Plan would be developed to be consistent with the *Western Sydney Airport Sustainability Plan* for on-airport works	All
OSUS2	Climate change risk treatments would be confirmed and incorporated during further design development	All
OGHG1	Carry out an iterative process of greenhouse gas assessments and design refinement during detailed design to identify opportunities to minimise greenhouse gas emissions Performance would be measured in terms of a percentage reduction in greenhouse gas emissions, and assessed against a business as usual project benchmark verified by Infrastructure Sustainability Council of Australia or equivalent independent industry body	All
Resource management - construction		
WR1	Construction waste would be minimised by accurately calculating materials brought to the site and limiting materials packaging	All
WR2	Waste streams would be segregated to avoid cross-contamination of materials and maximise reuse and recycling opportunities	All
WR3	A materials tracking system would be implemented for material transferred between construction sites	All
Resource management – operation		
OWR1	Generation of waste would be minimised and reused where possible in line with the waste hierarchy and the sustainability objectives outlined in a Sustainability Plan. In addition: • bins would be provided for general waste and recyclables and collection would be undertaken by an authorised contractor for off-site recycling or disposal at a licenced waste facility • waste from maintenance activities, including containers holding grease and lubricants, would be stored in designated areas for collection by an authorised contractor for off-site disposal • waste oil and oil filters would be stored in recycling bins and collected by an authorised contractor, and recycled off-site, where feasible • wastewater, sewage and grey water would be disposed to stormwater, sewer, recycled wastewater system or transported to an appropriately licenced liquid waste treatment facility (if water quality does not meet requirements for discharge to the stormwater/sewer system)	All
Land use and property – construction		
LU1	Not required/applicable	
LU2	Not required/applicable	
LU3	Not required/applicable	
Land use and property – operation		
OLU1	Not required/applicable	

Ref	Mitigation measures	Applicable location(s)
OLU2	Not required/applicable	
Landscape and visual - construction		
LV1	Not required/applicable	
LV2	Existing trees to be retained would be protected prior to the commencement of construction in the vicinity of these trees in accordance with AS4970-2009 Protection of Trees on Development Sites	All
LV3	All structures (including potential acoustic sheds, site offices, workshop sheds and site hoarding) would be finished in a colour which aims to minimise their visual impact where appropriate. This finish is to be applied to all visible fixtures and fittings (such as exposed downpipes)	All
Landscape and visual - operation		
OLV1	The landscape design for the project would include consideration of appropriate species lists to minimise opportunities to attract wildlife at levels likely to present a hazard to aviation operations. The landscape design would have regard to relevant requirements and species lists under the *Western Sydney Airport Wildlife Management Plan* and other relevant guidelines, including the *National Airports Safeguarding Framework Guideline C*: *Managing the Risk of Wildlife Strikes in the Vicinity of Airports* (Australian Government, 2014) and *Recommended Practices No. 1 – Standards for Aerodrome Bird/Wildlife Control* (International Birdstrike Committee, 2006)	All
OLV2	Lighting at stations would be designed and operated in accordance with AS4282- 2019 Control of the obtrusive effects of outdoor lighting and the *National Airports Safeguarding Framework (Guideline E): Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports* (Australian Government, 2014) (where relevant)	All
OLV3	Not required/applicable	
OLV4	Landscape screening would be provided along the corridor including restoring vegetation along the creeks to contain local views, in accordance with the Sydney Metro – Western Sydney Airport Design Guidelines, to minimise adverse visual impacts where feasible	All
OLV5	Corridor services, including the combined services route would be designed to reduce visual clutter and minimise visual impact ensuring these structures have a low profile and do not obstruct views across the corridor	All
OLV6	Proposed engineering batters and water management measures would be designed to integrate with the existing landforms and natural features	All
OLV7	The landscape design for the project would • incorporate salvaged native trees (including tree hollows and root balls), to enhance fauna habitat in suitable locations, including riparian corridors, where practicable • use native species from the relevant native vegetation communities within the local area for tree planting programs	All
Social and economic – construction		
SE1	Not required/applicable	
SE2	Not used	
SE3	Not required/applicable	

Ref	Mitigation measures	Applicable location(s)
Air quality – construction		
AQ1	The Air Quality Management Plan for the project would incorporate the following best-practice odour management measures which would be implemented as appropriate during relevant construction works: • the extent of opened and disturbed contaminated soil at any given time would be minimised • temporary coverings or odour supressing agents would be applied to excavated areas where appropriate • regular odour monitoring would be conducted during excavation to verify that no offensive odours are being generated	All
AQ2	Where acoustic sheds are proposed these would be designed and managed to prevent/minimise the escape of dust emissions	All
AQ3	Air quality monitoring, consistent with the *Western Sydney Airport Air Quality Construction Environmental Management Plan* would be carried out during construction to ensure that works meet the requirements under Schedule 1 of the Airports (Environment Protection) Regulations 1997	On-airport
Hazard and risk - construction		
HR1	All hazardous substances that may be required for construction would be stored and managed in accordance with the *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover NSW, 2005), the *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (Department of Planning, Industry and Environment, 2011) the *Work Health and Safety Act 2011* (Commonwealth and NSW) and the requirements of the *Environmentally Hazardous Chemicals Act 1985* (NSW)	All
HR2	A Bushfire Management Plan would be prepared and implemented to manage current bushfire risk and identify response actions during construction of the project. The Plan would be prepared in consultation with the NSW Rural Fire Service and Western Sydney Airport. For project areas within Western Sydney International the Plan would be prepared having regard to the existing *Western Sydney Airport Site at Badgerys Creek Bushfire Risk Management Plan*	All
HR3	A hazardous materials analysis would be carried out prior to stripping and demolition of structures and buildings which are suspected of containing hazardous materials (particularly asbestos) Hazardous materials and special waste (such as asbestos) would be removed and disposed of in accordance with the relevant legislation, codes of practice and Australian Standards (including the Work Health and Safety and Regulation 2011 (NSW))	All
HR4	Not required/applicable	
Hazard and risk - operation		
OHR1	All hazardous substances that may be required for operation would be stored and managed in accordance with the *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover NSW, 2005), the *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (Department of Planning, Industry and Environment, 2011), the *Work Health and Safety Act 2011* (Commonwealth and NSW) and the requirements of the *Environmentally Hazardous Chemicals Act 1985* (NSW)	All

Ref	Mitigation measures	Applicable location(s)
OHR2	A Bushfire Management Plan would be prepared and implemented to manage current bushfire risk and identify response actions during operation of the project. The Plan would be prepared in consultation with the NSW Rural Fire Service and Western Sydney Airport. For project areas within Western Sydney International the Plan would be prepared having regard to the existing *Western Sydney Airport Site at Badgerys Creek Bushfire Risk Management Plan*	All
OHR3	Not required/applicable	
OHR4	The project would be designed to avoid pilot distraction and minimise the risk of headlight glare from metro trains where on surface rail alignment. This would include providing glare screens in those locations where the project creates an unacceptable risk of pilot distraction	All
Cumulative impacts - construction		
CL1	A Cumulative Construction Impacts Management Plan would be developed and would detail co-ordination and consultation requirements with the following stakeholders (as relevant) to manage the interface of projects under construction at the same time: • Western Sydney Airport • Transport for NSW • Western Parkland City Authority • Sydney Water • Emergency service providers • Utility providers Co-ordination and consultation requirements with these stakeholders would be detailed in the plan to include: • provision of regular updates to the detailed construction program, construction sites and haul routes • identification of key interfaces with other construction projects • development of mitigation strategies to manage cumulative impacts associated with these interfaces	All

8.5 Expected or predicted effectiveness of mitigation measures

The construction methodology for the project has been developed to a level where potential environmental impacts of the proposed action can be appropriately identified. The application of comprehensive mitigation measures that have been shown to be proven and effective on previous construction projects would be implemented (see Section 8.4).

The effectiveness of the proposed mitigation measures will be ensured through:

- clear statements of the intended performance outcomes for the construction and operation of the proposed action
- the requirement for approval of construction environmental management plans by the Commonwealth
- inclusion of best practice measures, including the adoption of continuous improvement mechanisms during the detailed design, construction and operation of the proposed action
- ongoing monitoring of, and compliance with, the proposed environmental management plans through a review, reporting and auditing framework approved by the Commonwealth Infrastructure Minister

- environmental management requirements of the Airports Act, including the regulation of land use through ongoing master planning and environmental strategy requirements, as well as a system to regulate, and assign accountability for, activities associated with the proposed action
- the SMP which will establish a benchmark for the sustainable performance of the proposed action
- ongoing stakeholder consultation and oversight through the OCCS.

Taken together, these mechanisms will ensure that the mitigation measures proposed in the environmental management strategy for the on-airport works associated with the proposed action are effective and achieve the intended outcomes.

The effectiveness of mitigation measures during construction would be continually monitored through the range of specific construction performance and compliance reporting requirements for construction contractors (see Section 8.2.5).

8.6 Statutory or policy basis for measures

The measures proposed in Section 8.4 have been derived based on:

- legislative context for each individual environmental component as described in Chapter 7 (Impact assessment)
- key Commonwealth legislation and supporting documents that govern environmental management associated with construction of Western Sydney International, for example, the Airports Act (see Section 8.1)
- construction environmental management documentation associated with the project (see Section 8.2).

8.7 Description of contingency or adaptive management measures

The CEMF for the project sets out minimum requirements to be addressed in each CEMP that will be prepared for the proposed action. The CEMF is provided at Appendix H.

Requirements include strategies for compliance with environmental management measures and continuous improvement through review of the performance of environmental controls. Augmented with a requirement for environmental inspections and monitoring, auditing and review, and reporting on environmental performance and compliance tracking, these procedures provide a robust, proven mechanism for dealing with contingencies.

9 Offsets

The Biodiversity Assessment Method (BAM) is an endorsed offset framework under the EPBC Act and has been used to calculate the offset obligation from the biodiversity impacts of the proposed action.

This chapter addresses Section 10 of the BAM and provides information on:

- impacts on a potential entity that are serious and irreversible impacts
- impacts for which the assessor is required to determine an offset requirement
- impacts for which the assessor is not required to determine an offset requirement
- impacts that do not require further assessment by the assessor.

This chapter also addresses Section 11 of the BAM and provides information on the application of the no net loss standard and the biodiversity offset obligations for the proposed action. Credit calculations were quantified using the BAM Calculator (BAM-C) version 1.2.7.2. Further information on the calculations for the proposed action offset obligation is provided in the Revised Biodiversity Development Assessment Report (Appendix C).

9.1 Thresholds for the assessment and offsetting of impacts of development

9.1.1 Serious and irreversible impacts

This section addresses Section 10.2 of the BAM and following the *Guidance to assist a decision-maker to determine a serious and irreversible impact* (Department of Planning, Industry and Environment, 2019).

All threatened entities impacted by the proposed action have been considered if they form or have potential to be Serious and Irreversible Impact (SAII) entities. Criteria for listing as an SAII entity are those species which:

- are in a rapid rate of decline
- have a very small population size
- are severely degraded or disrupted
- have a very limited geographic distribution
- are unlikely to respond to measures to improve habitat.

Entities currently listed as SAIIs are provided in the Threatened Biodiversity Data Collection (EES, 2020d) and have been outlined below in Table 9-1.

Table 9-1 SAII entities affected by the proposed action

SAII entity	Threshold	Proposed action impact
Cumberland Plain Woodland in the Sydney Basin Bioregion	Not listed	30.16 hectares
Allocasuarina glareicola	Not listed	0.00 hectares

Additional impact assessment provisions for ecological communities

Threatened ecological communities have been assessed in accordance with Section 10.2.2 of the BAM in Table 9-2.

Table 9-2 Additional impact assessment provisions for SAII TECs

Impact assessment provisions	Cumberland Plain Woodland in the Sydney Basin Bioregion
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	Efforts to avoid and minimise impacts on native vegetation are outlined in Chapter 5 (Avoidance of design through development of the proposed action). Avoidance was primarily designed to minimise impacts of higher quality patches of Cumberland Plain Woodland including intact and thinned condition classes. An example of avoidance through design is the tunnel alignment from Western Sydney International to the airport site boundary (and beyond off-airport to Aerotropolis Core) to avoid impacts on Cumberland Plain Woodland.
(b) the area (hectares) and condition of the Threatened Ecological Community (TEC) to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone	**Direct impacts are:** Plant Community Type (PCT) 849 (intact) 4.05 hectares – vegetation integrity (VI) 67.8 PCT 849 (scattered trees) 2.32 hectares – VI 20.3 PCT 849 (low) 23.79 hectares – VI 7.8. **Indirect impacts are:** No indirect impacts have been calculated for on airport land as adjacent areas would be subject to assessment and offsets under separate Western Sydney International approval.
(c) a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	To date no thresholds have been issued for this SAII entity.
(d) the extent and overall condition of the potential TEC within an area of 1000 ha, and then 10,000 ha, surrounding the proposed development footprint	The study area (refer to Section 7.3) occurs within a mix of land uses from residential and commercial development to rural residential that was historically cleared for rural agricultural. The extent of Cumberland Plain Woodland has been greatly reduced in the locality. The current known extent within 100 metres of the study area is 97.6 hectares and 1000 metres is 590.1 hectares.
(e) an estimate of the extant area and overall condition of the potential TEC remaining in the Interim Biogeographic Regionalisation for Australia (IBRA) subregion before and after the impact of the proposed development has been taken into consideration	Estimated total extent of Cumberland Plain Woodland (PCT 849 & PCT 850) within the Sydney Basin Bioregion has been identified to be 11,200 hectares (Office of Environment and Heritage, 2020a). Within the Cumberland subregion the current extent of Cumberland Plain Woodland is <11,200. Given the exiting small patch sizes within the project and highly urbanised surrounding environment, the project is unlikely to result in a substantial reduction in extent and overall condition of Cumberland Plain Woodland at the subregion level.

Impact assessment provisions	Cumberland Plain Woodland in the Sydney Basin Bioregion
(f) an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion	It is estimated that within the Cumberland subregion about 1,289 hectares of Cumberland Plain Woodland is protected within land reserved under the *National Parks and Wildlife Act* 1974 (NPW Act) (Open Lines and Biosis, 2020). Under the Draft Cumberland Plain Conservation Plan 2020 – 2056 an additional commitment of 3,568 hectares of Cumberland Plain Woodland would be added to the reserve system within the Cumberland subregion (Open Lines and Biosis, 2020).
(g) the development, clearing or biodiversity certification proposal's impact on: (i) abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact would lead to a reduction of groundwater levels or the substantial alteration of surface water patterns (ii) characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants (iii) the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the potential TEC	Potential impact resulting from the project on Cumberland Plain Woodland within on-airport land has been mostly limited to low condition patches that are unlikely to led to a reduction in abiotic factor critical to the long-term survival of the threatened ecological community (TEC) in the Cumberland subregion. Mitigation measures outlined in Chapter 8 (Environmental management and mitigation measures) would ensure invasive flora and fauna species are not further increased because of the project. Further, appropriate management of fertilisers, herbicides or other chemicals or pollutants would be controlled minimising any potential harm to this TEC. Given this, indirect impacts are considered unlikely to extend beyond the construction footprint for this TEC.
(h) direct or indirect fragmentation and isolation of an important area of the potential TEC	Within on-airport lands impacts include 6.37 ha of intact and Scattered Trees with the remaining areas mostly restricted to low condition patches of Cumberland Plain Woodland and would unlikely result in direct or indirect fragmentation and isolation of an important area of the potential TEC. The project would tie into the Western Sydney International and is unlikely to lead to additional fragmentation of Cumberland Plain Woodland within this area.

Impact assessment provisions	Cumberland Plain Woodland in the Sydney Basin Bioregion
i. the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.	The project is committed to providing biodiversity offsets required for impacts to Cumberland Plain Woodland as calculated using the BAM-C. In addition to this, commitment 7.2 of the Draft Cumberland Plain Conservation Plan 2020 – 2056 would ensure a further 3,568 hectares of Cumberland Plain Woodland would be protected and managed within the Cumberland subregion to contribute to the recovery of this TEC (DPIE, 2020a).

Additional impact assessment provisions for threatened species

Threatened species have been assessed in accordance with Section 10.2.3 of the BAM. Additional impact assessment provisions for SAII threatened species are not required for the proposed action. The local population of *Allocasuarina glareicola* is located east of St Marys to the north of the airport site, and would not be directly or indirectly affected by the on-airport works.

9.1.2 Offsetting requirements

Section 10.3 of the BAM outlines that an offset is not required for impacts on native vegetation where the vegetation integrity:

- is a vegetation zone that has a vegetation integrity score ≤15 where the PCT is representative of an endangered or critically endangered ecological community, or
- is a vegetation zone that has a vegetation integrity score of ≤17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or
- is a vegetation zone that has a vegetation integrity score ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

All vegetation integrity scores above those specified above for each group require biodiversity offsets in the form of ecosystem credits. Table 9-3 outlines each vegetation type and condition and determines if offsets are required

9.1.3 Impacts that do not require further assessment

Section 10.4 of the BAM outlines that an assessor is not required to assess areas of land impacted by the project for ecosystem credits without native vegetation. Within the study area, this applied to vegetation not assigned to recognised NSW PCTs and are outlined in Table 9-4.

Table 9-3 Offsetting requirement for ecosystem credits

Vegetation type	Condition	Threatened ecological community (BC Act)	Threatened ecological community (EPBC Act)	Vegetation integrity score	Extent on-airport land (hectares)	Offsets required?
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	River-Flat Eucalypt Forest (Endangered)	Not listed	65.9	1.53	Yes
	Thinned			71.2	0.09	Yes
	Low			2.4	10.21	No
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	Cumberland Plain Woodland (Critically Endangered)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically endangered)	67.8	4.05	Yes
	Scattered Trees		Not commensurate	20.3	2.32	Yes
	Low		Not commensurate	7.8	23.79	No
PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	Not listed	Not listed	57.4	0.01	Yes

Notes [1] Offsets are not required for the direct impacts to PCT 835 in 'low' condition as their vegetation integrity falls below the specific thresholds within Section 10.3 of the BAM.

Table 9-4 Summary of non-native vegetation types

Non-native vegetation types	Area within study area (Ha)
Miscellaneous ecosystem - non-native	45.14
Miscellaneous ecosystem - urban exotic/native landscape plantings	0.00
Miscellaneous ecosystem - water bodies rivers, lakes, streams (not wetlands)	3.48

9.2 Biodiversity credit report

This section specifically addresses Section 11 of the BAM and provides information on the application of the no net loss standard and the biodiversity offset obligations for the proposed action. Credit calculations were quantified using the BAM-C Version 1.2.7.2.

9.2.1 Ecosystem credit offset

Ecosystem credits required by the proposed action impacts are outlined in Table 9-5.

9.2.2 Species credit offset

Species credits required by the proposed action impacts are outlined in Table 9-6.

9.2.3 Summary of ecosystem credits

A summary of ecosystem credits required by the proposed action is outlined in Table 9-7.

Table 9-5 Ecosystem credit offset obligation

Vegetation type	Condition	Threatened ecological community (BC Act)	Threatened ecological community (EPBC Act)	Vegetation integrity Loss	Biodiversity Risk Weighting	Extent on-airport land (hectares)	Ecosystem credits required
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	River-Flat Eucalypt Forest (Endangered)	Not listed	-65.9	2	1.53	50
	Thinned			-71.2	2	0.09	3
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	Cumberland Plain Woodland (Critically Endangered)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically Endangered)	-67.8	2	4.05	172
	Scattered Trees		Not commensurate	-20.3	2.5	2.32	29
PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	Not listed	Not listed	-57.4	2	0.01	1
Total						**8.0**	**255**

Table 9-6 Species credit offset obligation

Vegetation zone	Habitat condition loss	Area/ count	SAII	Species credits
***Meridolum corneovirens* (Cumberland Plain Land Snail) - Fauna**				
PCT 849_intact	-67.8	4.00 hectares	No	137
PCT 835_intact	-65.9	1.5 hectares	No	50
PCT 849_scattered trees	-20.3	0.07		1
Total				**188**
***Myotis macropus* (Southern Myotis) - Fauna**				
PCT 835_intact	-65.9	0.05 hectares	No	2
Total				2
Total combined species credit offset				**190**

Table 9-7 Summary of ecosystem credits required

Credit obligations	On-airport
Ecosystem credits	
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	53
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	201
PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	1
Total number of ecosystem credits	**255**
Species credits	
Meridolum corneovirens (Cumberland Plain Land Snail) - Fauna	188
Myotis macropus (Southern Myotis) - Fauna	2
Total number of species credits	**190**

9.2.4 Offsetting strategy

Residual impacts that are not able to be avoided or managed through mitigation measures would be offset in accordance with BAM based on BAM-C calculations for both TECs (ecosystem credits) and threatened species (species credits).

The proposed action offset obligation has been calculated to require the following biodiversity credits:

- up to 255 ecosystem credits
- up to 190 species credits.

During design development and construction planning for the project the biodiversity impacts, offset obligations and credit calculations associated with the proposed action will be reviewed, and if necessary updated. If any changes are proposed, these would be reported in the Construction (Rail) Plan for the on-airport proposed action.

Implementation

The biodiversity offset strategy for the project that would enable the credit obligations to be met does not include the establishment of biodiversity stewardship sites.

The two options identified to meet the biodiversity offsets for the proposed action are:

- the purchase and retirement of existing biodiversity credits currently available on the biodiversity credit register
- through making a payment into the Biodiversity Conservation Fund.

Existing biodiversity credits

The purchase and retirement of existing biodiversity credits is required to be undertaken based on like for like trading rules as outlined under the Biodiversity Conservation Regulation 2017 and as identified by the BAM calculator output for the proposed action. The like for like ecosystem credit class options for each biodiversity offset credit obligation is summarised in Table 9-8.

Table 9-8 Like for like trading ecosystem credit classes

Any PCT within the below TEC	HBT[1]	In the below IBRA subregion
Credit classes for PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion		
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCTs: 686, 828, 835, 839, 941, 971, 1064, 1108, 1109, 1212, 1228, 1232, 1293, 1318, 1326, 1386, 1522, 1556, 1594, 1618, 1646, 1648, 1720, 1794	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.
Credit classes for PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion		
Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCTs: 849, 850	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.

Any PCT within the below TEC	HBT[1]	In the below IBRA subregion
Credit classes for PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion		
Coastal Freshwater Lagoons This includes PCTs: 781, 783, 1071, 1735, 1736, 1737, 1740, 1741, 1742 Coastal Freshwater Lagoons - ≥ 70per cent - <90 per cent cleared group (including Tier 4 or higher)	No	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.

Notes:

1. Hollow-bearing tree (HBT)

In relation to like for like species credit trading options, the offset for species credits can be sourced from anywhere in NSW.

The BAM provides a prescribed method to robustly quantify and deliver offsets that provide appropriate environment gains targeted at the biodiversity values to be impacted. SM is committed to delivering an offset strategy that meets the quantum of the offsets requirement in accordance with BAM.

Status

Credits are currently being sourced and it is anticipated that any NSW approval conditions for the project will specify a timeframe for the securing and retirement of those credits in relation to the commencement of construction activities.

The purchase and retirement of existing biodiversity credits is required to be undertaken based on like for like trading rules as outlined under the NSW Biodiversity Conservation Regulation 2017 and as identified by the BAMC output. The like for like ecosystem credit class options for each biodiversity offset credit obligation are summarised in Table 12.12 of the Revised Biodiversity Development Assessment Report (Appendix C).

Sydney Metro would make a payment into the Biodiversity Conservation Fund prior to the commencement of construction of the main works should credits be unable to be sourced.

10 Environmental history of person proposing to take the action

This chapter provides a statement in relation to the environmental history of Sydney Metro.

There are no proceedings under a Commonwealth, state or territory law for the protection of the environment, or the conservation and sustainable use of natural resources, against Sydney Metro.

The proposed action would be undertaken in accordance with the Transport for NSW Environment and Sustainability Policy 2020a (included as Appendix I) (and the Sydney Metro Environment and Sustainability Statement of Commitment (included as Appendix J).

11 Conclusion

This chapter provides a conclusion to the Final Environmental Impact Assessment. It summarises the potential residual impacts of the proposed action and how these would be addressed. Compliance with the principles of Ecological Sustainable Development and the objects of the EPBC Act is discussed.

11.1 Summary of potential impacts

Many potential impacts have been avoided through the project development process which included input from key stakeholders and the community. In particular, locating the majority of the proposed action almost completely underground would substantially reduce most major environmental impacts, including:

- noise
- Aboriginal heritage
- biodiversity.

Potential impacts have also been minimised through the specific design and the construction methods chosen, such as the use of TBMs for tunnelling and a spoil management strategy to minimise haulage and movement of a large amount of surplus material. Design development and refinements would continue to further minimise any potential impacts.

Despite this, the proposed action would still have potential impacts that require mitigation.

11.1.1 Potential impacts requiring mitigation

Chapter 7 (Impact assessment) provides an assessment of the potential impacts of the proposed action. The key potential impacts requiring mitigation and management are summarised in Table 11-1.

These potential impacts would be mitigated by implementing the environmental management approach, including the project-specific performance outcomes and mitigation measures described in Chapter 8 (Environmental management and mitigation).

Table 11-1 Summary of potential impacts requiring mitigation

Issue	Potential impact
Transport	• temporary increase in construction traffic on the local and regional road network, resulting in potentially temporary increased congestion and delays.
Noise and vibration	• potential temporary airborne noise impacts at some sensitive receivers during worst-case construction activities such as the use of hydraulic hammers and concrete saws. It is predicted that some receivers at NCA12 (south of Western Sydney International) may be highly noise affected for a short duration throughout the construction period. • potential temporary ground-borne noise impacts at some sensitive receivers during worst-case tunnel construction works along the tunnel alignment. It is predicted that up to four receivers along the Western Sydney International to Bringelly tunnel may experience noise levels that exceed the residential night management level.

Issue	Potential impact
Biodiversity	• clearing of around 42 hectares of native vegetation outside the Western Sydney Airport Stage 1 Construction Impact Zone • clearing of Threatened Ecological Communities (TECs), including around 30 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion outside the Western Sydney Airport Stage 1 Construction Impact Zone • potential removal of threatened species and/or their habitat • potential indirect impacts to threatened species and/or their habitat such as reduced viability of adjacent habitat due to edge effects, noise, dust or light spill • potentially reduced viability of adjacent habitat due to noise and light impacts • potential impacts on aquatic ecology arising from changes in hydrology and water quality.
Flooding, hydrology and water quality	• potential temporary changes to the local flooding regime during construction due to temporary blockage of flow paths, increased flow rates due to vegetation clearing and hardstand area and modification of downstream flow paths due to construction activities. • potential temporary flooding at construction sites by flood events. • potential temporary increases of pollutants in waterways which would further degrade water quality due to the release of nutrients from previous agricultural activities, increased sediment from clearing activities, release of construction related contaminants including from water treatment plants.
Groundwater and geology	• potential minor impacts associated with localised ground movement and/or settlement due to excavation or groundwater drawdown causing damage to infrastructure • potential migration of groundwater towards, and into, station excavations. • potential increase in groundwater levels upgradient of any structure and a lowering downgradient due to the undrained structures which would present a barrier to the natural groundwater flow.
Soils and contamination	• potential contamination of soils or water from spills of oils, fuels or chemicals from plant and equipment within the construction footprint • accumulation of potentially contaminated sediments in sedimentation and water quality basins • potential impact on areas of existing chemical contamination within the construction footprint of the tunnel and viaduct segment production and storage • widespread excavation and disturbance of soils with medium-high likelihood of soil salinity across the airport. Areas of saline soils, if encountered, could contribute to local degradation of soil and water quality. • excavation of acid sulfate soils could potentially occur around the Badgerys Creek and Oakey Creek riparian zones associated with parts of the Airport construction support site, construction corridor, Airport Terminal and Airport Business Park construction sites.
Sustainability, climate change and greenhouse gas	• potential climate change risks associated with extreme heat and extreme rainfall and flooding events. • increase in greenhouse gas emissions through the consumption of electricity.
Resource management	• potential generation of unusable spoil during tunnelling due to contamination or acid sulfate soils.
Air quality	• potential temporary nuisance impacts during construction from dust and emissions from vehicles and construction plant.

Issue	Potential impact
Hazard and risk	• potential temporary impacts associated with the storage, use and transport of dangerous goods and hazardous substances. • potential exposure to hazardous materials (particularly asbestos) and contaminated soils (containing hydrocarbons, heavy metals) during demolition and construction works. • the project would continue to consider and respond to other requirements relating to airport operations outlined in the Airports Act, Airport Regulations and *National Airports Safeguarding Framework.*

11.1.2 Cumulative impacts

Potential temporary cumulative impacts during construction have been an important consideration given the potential concurrent construction with a number of large infrastructure projects. Potential temporary cumulative impacts have been identified in relation to the future M12 Motorway, Western Sydney International and The Northern Road projects.

Key potential construction cumulative impacts could include:

- potential temporary local traffic and access impacts
- potential temporary noise and vibration impacts
- potential temporary visual and amenity impacts of construction compounds and associated sites and activities
- construction fatigue as a result of concurrent or consecutive construction projects
- potential temporary localised flooding, hydrology and water quality impacts
- direct and indirect biodiversity impacts
- direct and indirect impacts on non-Aboriginal heritage
- direct and indirect impacts on Aboriginal heritage.

These impacts would be managed in accordance with the environmental management framework, performance outcomes and mitigation measures as outlined in Chapter 8 (Environmental management and mitigation). Coordination and engagement with other projects has been undertaken and would continue throughout construction to further manage construction fatigue and cumulative impacts where possible.

Any potential cumulative adverse impacts would be offset by the benefits of the project.

11.2 Summary of avoidance, mitigation measures and offsets

The proposed avoidance, mitigation measures and offsets for the proposed action are summarised in Section 8.4.

11.3 A statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible

Potential environmental impacts of the proposed action can be appropriately identified at this stage of the design development. Impacts relating to the majority of issues are well understood and any uncertainties are documented where relevant in individual impact assessments of Chapter 7 (Impact assessment), Revised Biodiversity Development Assessment Report (Appendix C) and technical reports (Sydney Metro, 2020b-i). The application of comprehensive mitigation and management measures and continuous improvement through review of the performance of environmental controls would be implemented (see Chapter 8 (Environmental management and mitigation).

Cumulative impacts associated with the project, Western Sydney International and the future M12 project are likely to be partially unpredictable due to the complexity and uncertainty of the exact timing associated with these developments. However, measures in Section 8.4.3have been developed to manage the cumulative impacts of project interfaces and mitigate uncertainty over these impacts.

11.4 How the proposed variation to the Airport Plan will manage the impacts of the proposed action

The environmental management and framework approach for the proposed action has been developed to be consistent with the regulatory requirements for the on-airport environment, including the existing environmental management framework established under the Airport Plan, but would be a stand-along regime. The specific environmental management framework requirements for the on-airport works in addition to the project-specific performance outcomes and mitigation measures is provided in Section 8.4. Table 8-1 clarifies what on-airport CEMPs would be prepared, how the existing WSA plans, procedures and protocols will relate and any additional mitigation and management measures required to address impacts from the proposed action. The on-airport CEMPs will be prepared to be consistent with the existing WSA plans.

The draft variation to the Airport Plan does not form part of this Final Environmental Impact Assessment. A copy of the proposed Airport Plan variation would be provided to the Commonwealth Environment Minister along with this finalised environmental impact assessment.

11.5 Ecologically Sustainable Development principles

The promotion of Ecological Sustainable Development (ESD) through the conservation and ecologically sustainable use of natural resources is an object under section 3 of the EPBC Act. Section 3A of the EPBC Act defines the principles of ecologically sustainable development which are described in more detail in Section 7.9.2. The project is assessed against section 3A in Table 11-2.

Table 11-2 Evaluation of the project against ESD principles

Principles	Evaluation
Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	Decision-making processes for the project have consistently integrated long-term and short-term biophysical, economic, social and equitable considerations. Social and economic: The project would be a key component in delivering an integrated transport system for the Western Parkland City that can support its growth in a sustainable manner to enhance the liveability and productivity of the area. Alternative horizontal and vertical alignments for the proposed action have been considered however would not allow for the avoidance and minimisation of impacts on ecological values including the Environmental Conservation Zone. They would also necessitate the construction of a viaduct over Badgerys's Creek. The construction footprints for the stations, rail corridor, services facilities and the stabling and maintenance facility have been developed taking into account expected future requirements for the stations, as well as considering the key construction requirements. Environment: The construction methodology for the project has been developed to a level where environmental impacts can be appropriately identified. Optimisation of the vertical alignment has resulted in on-airport tunnel alignments which avoid or minimise impacts to areas of high ecological value, (including the Environmental Conservation Zone), and reduce the extent of potential visual and landscape sensitivity, flood, and Aboriginal archaeological impacts.

Principles	Evaluation
If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	The detailed impact assessment carried out in preparing this Final Environmental Impact Assessment (refer to Chapter 7 (Impact assessment) and Section 11.3) indicates that there would be no threat of serious or irreversible damage to the environment. In addition, the lack of full scientific certainty has not been used as a reason for postponing measures to prevent environmental degradation. As detailed in Chapter 8 (Environmental management and mitigation), mitigation measures have been proposed to manage identified risks/threats of environmental damage. The assessments carried out are consistent with accepted scientific and assessment methodologies and have considered relevant statutory and agency requirements. The assessments have applied a conservative approach with regard to proposed construction and operational arrangements, and the modelling used has been carried out in collaboration with key stakeholders and relevant statutory and agency requirements.
The principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The objectives of the project are essentially around connecting the Western Parkland City and ensuring an efficient and reliable public transport network to connect to Western Sydney International. This would benefit current and future generations. Once operational, the project would leave a positive legacy for future generations. It would provide long term benefits by providing a new transport linkage to the Western Parkland City and connection to Western Sydney International. In addition to the broader Sydney transport operational benefits, the ‘door-to-door’ experience provided by the project could also result in long-term health benefits with the creation of safer and more appealing conditions for pedestrians, cyclists and other transit users. These benefits would also flow through to future generations. The project would result in a greater demand on electricity however operational electricity use would be fully offset. Significant changes to carbon and energy policy (and legislation) are currently occurring in Australia which aim to shift electricity generation from coal fired to renewable sources. As more electricity is generated from renewable sources, the climate change benefits of using electric rail would be improved. A range of measures to mitigate greenhouse gas emissions have been developed and would be implemented.
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.	Conservation of biological diversity and ecological integrity has been considered throughout the project development and design stages. The on-airport construction footprint has been developed to avoid or minimise impact to areas of high ecological value. Detailed assessments have been carried out to identify flora and fauna impacts and a range of mitigation measures identified for implementation. Impacts on biological diversity and ecological integrity have been assessed as moderate and are to be offset (refer to Chapter 9(Offsets)).
Improved valuation, pricing and incentive mechanisms should be promoted.	Economic appraisal of the project draws on a number of established methodologies which provide for the valuation of externalities, including environmental externalities, and their inclusion in the appraisal process. Environmental parameters which can be valued include air pollution, greenhouse gas emissions, noise pollution, water run-off, nature and landscape and urban separation. Valuations typically adopt broad average values.

Principles	Evaluation
	The value placed on the environment was inherent in the development of the design. In addition, the costs associated with the planning and design of measures to avoid/minimise adverse environmental impacts and the costs to implement them have been considered as part of the overall project costs. Ongoing design development together with specific issue-based management plans would represent further commitment to the recognition of the value of protecting environmental resources.

11.6 Objects of the EPBC Act

The objects of the EPBC Act provide a policy framework within which the proposed action can be considered. Table 11-3 evaluates the compliance of the proposed action against each of these objects.

Table 11-3 Compliance of the proposed action against objects of EPBC Act

Objects	Evaluation
To provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance	The proposed action is largely contained within the Western Sydney International Stage 1 Construction Impact Zone (which would be pre-cleared) or located underground. This minimises direct impacts to surrounding natural and built environments, including aspects that are matters of national environmental significance relating to threatened species and ecological communities and the environment of Commonwealth land. The potential impacts of the proposed action on the environment including matters of national environmental significance are assessed in detail in Chapter 7 (Impact assessment) and protection measures to avoid, mitigate and offset (where necessary) potential impacts have been developed (see Chapter 8 (Environmental management and mitigation) and Chapter 9 (Offsets)).
To promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources	Sustainability has been a key driver for Sydney Metro – Western Sydney Airport. The proposed action will be guided by a project specific Sustainability Plan (refer to Section 7.9). The construction of the proposed action within the Western Sydney International would be consistent with the Western Sydney Airport Sustainability Plan. Sydney Metro would develop and implement Sustainability Management Plans for construction works consistent with this plan. During construction and operation of the proposed action, opportunities would be taken to reduce material use and maximise the use of materials with low embodied environmental impact, where practical. Further details on how the proposed action addresses the principles of ESD are provided in Table 11-2.

Objects	Evaluation
To promote the conservation of biodiversity	Conservation of biological diversity and ecological integrity has been considered throughout the proposed action development and design stages. Where the proposed action is outside the Western Sydney International Stage 1 Construction Impact Zone, on-airport tunnel alignments avoid or minimise impacts to areas of high ecological value (including Cumberland Plains Woodland and the Environmental Conservation Zone). The potential impacts of the proposed action on terrestrial and aquatic ecology is assessed in detail in Section 7.3 and protection measures to avoid, mitigate and offset potential impacts on biodiversity have been developed (see Chapter 8 (Environmental management and mitigation)).
To promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples	A co-operative approach has been adopted in the design development of the proposed action. Extensive consultation with the Commonwealth and NSW governments, the community, other key stakeholders including Western Sydney Airport, and Indigenous peoples has occurred in relation to the protection and management of the environment (refer Chapter 3(Consultation)).
To assist in the co-operative implementation of Australia's international environmental responsibilities	The biodiversity assessment for the proposed action has been based on the BAM methodology which addresses the ESD hierarchy of avoid, minimise and offset. This led to the project being designed for avoidance of impacts on biodiversity and where residual impacts are unavoidable, these have been offset and minimised against Commonwealth requirements. The proposed actions assessment under the BAM is also generally consistent with the Australia's international obligations, specifically the Biodiversity Convention, the Apia Convention and CITES (refer Section 7.3)
To recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity	Extensive consultation with Indigenous peoples has occurred in relation to the protection and management of the environment (refer Chapter 3 (Consultation)).
To promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge	Extensive consultation with Indigenous peoples has occurred in relation to the protection and management of the environment (refer Chapter 3 (Consultation)).

11.7 Concluding statement

The on-airport component of Sydney Metro – Western Sydney Airport (proposed action) has been assessed in accordance with Part 1 of the Commonwealth environmental assessment requirements for preliminary documentation under section 95A of the EPBC Act set out by the Commonwealth Environment Minister. It also includes consideration of the issues raised by the community and stakeholders during the development of the project.

Key environmental issues have been examined throughout the design development process. Consultation has been carried out with affected stakeholders during the assessment process so that key potential impacts of the proposed action have been identified at an early stage, and where possible, avoided or appropriate mitigation measures developed. This has resulted in a number of changes to the earlier designs that have mitigated many of the potential significant impacts as discussed in Table 5-1.

Notwithstanding, it is inevitable that a proposed action of this scale would have some residual impacts, particularly during construction.

Key potential residual impacts associated with the proposed action are identified in Chapter 7 (Impact assessment) and would largely include:

- temporary construction traffic impacts associated with traffic generated by the proposed action
- potential construction noise and vibration impacts to sensitive receivers located outside but adjacent to the airport site
- clearing of threatened ecological communities and other vegetation within the construction footprint, and other potential biodiversity impacts outside Western Sydney International Stage 1 Construction Impact Zone
- potential impacts to the flooding regime during construction and operation
- potential temporary local community amenity impacts associated with an increase in noise levels, traffic movements and congestion, dust, and changes in visual outlook
- cumulative impacts from the construction of multiple projects (including the construction of Western Sydney International and future M12 Motorway), including construction fatigue.

The potential residual impacts identified would not result in any unacceptable impacts once further mitigation is considered during design development and construction planning. This would include the decision on appropriate construction methodologies and the implementation of the environmental management practices. Proposed mitigations outside of those in the existing Airport Plan have been recommended.

Identified potential residual impacts of the proposed action need to be considered within the context of the overall objectives of the project and the significant transportation and other benefits that Sydney Metro – Western Sydney Airport would provide over the medium to longer term and particularly for future generations. The consequences of not proceeding (i.e. do nothing) would compromise the sustainable and successful growth of the Western Parkland City for future generations to come. In addition, the lack of high quality public transport connection to Western Sydney International would compromise the success of Sydney's newest airport.

The proposed action has been evaluated as consistent with the principles of ecological sustainable development defined under the EPBC Act and the objects of the EPBC Act. Sydney Metro is committed to managing the potential impacts to the environment including matters of national environmental significance through significant commitments to mitigation measures, a detailed, comprehensive offset package and recommended variations to the Airport Plan. This demonstrates that the proposed offset package and recommended variations to the Airport Plan can more than compensate for the residual impacts of the proposed action.

Sydney Metro holds the position that this assessment (along with Part 2 of the Commonwealth environmental assessment requirements being submitted separately but concurrently to this document) is sufficient to allow the Commonwealth Environment Minister to provide informed advice to the Commonwealth Infrastructure Minister on the proposed action.

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