PART B

Environmental assessment

BOTANY RAIL DUPLICATION

ENVIRONMENTAL IMPACT STATEMENT

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Part B – Environmental assessment

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8. TRAFFIC AND TRANSPORT

This chapter provides a summary of the traffic, transport and access impact assessment. A full copy of the assessment report is provided as *Technical Report 1 – Traffic and Transport Impact Assessment*.

8.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach, and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in *Technical Report 1 – Traffic and Transport Impact Assessment*.

8.1.1 Legislative and policy context to the assessment

Future Transport 2056 Strategy

Future Transport 2056 (TfNSW 2018a) is a customer focused 40-year strategy that outlines a vision, strategic directions and customer outcomes for the state's transport system. It is supported by a range of services and infrastructure plans, including the *Greater Sydney Services and Infrastructure Plan* (TfNSW 2018c) which established specific outcomes for the Greater Sydney area. The plan defines the Greater Sydney Strategic Freight Network which consists of the most significant road and rail corridors that support freight movement across Greater Sydney.

A key objective of the plan is to improve connections between Sydney's ports in the east and the manufacturing and distribution facilities which are primarily based in Western Sydney. The project would assist in improving freight rail capacity and efficiency to Port Botany thereby achieving this key objective.

NSW Freight and Ports Plan 2018–2023

The *NSW Freight and Ports Plan 2018–2033* (TfNSW 2018d) is a supporting plan to *Future Transport 2056* (TfNSW 2018a). The plan outlines five objectives around central elements including:

- economic growth
- efficiency, connectivity and access
- capacity
- safety
- sustainability.

The project would be consistent with the identified objectives as it would:

- provide the infrastructure to support continued economic growth within the region
- increase efficiency/capacity for freight activity by duplicating the existing section of single track
- ensure continued freight activities via rail to and from the Port Botany
- facilitate a safer environment by increasing the capacity of the rail corridor and potentially reducing the demand for the movement of freight by road.

State Infrastructure Strategy 2018–2038

The *State Infrastructure Strategy* is a long-term strategy that assesses the current state of infrastructure within NSW. *Building Momentum: State Infrastructure Strategy 2018–2038* (Infrastructure NSW, 2018b) is the most recent version of this strategy and outlines 122 recommendations for infrastructure across NSW. Of relevance to the project is recommendation 60 which recommends that, among other initiatives, that Transport for NSW finalises business cases to fund investment in the Botany Rail Duplication. The development of the project is therefore consistent with this recommendation.

2015–2024 Sydney Metropolitan Freight Strategy

This strategy (ARTC, 2015) states that the Botany freight yard has sufficient capacity until 2030. However, the yard already suffers congestion at peak times due to port activities. To overcome these constraints, the strategy recommends a range of infrastructure upgrades within the Port Botany Rail Yard itself, along with the duplication of the single-track section of the line by 2023. The development of the project is therefore consistent with this recommendation.

NSW Ports' 30-year Master Plan

Navigating the Future: NSW Ports' 30 Year Master Plan (NSW Ports, 2015) outlines NSW Ports' priorities and objectives for Port Botany over the next 30 years. It recognises that Port Botany would continue to have a vital role as Australia's premier port. The project supports many of the objectives of the masterplan seeking to improve the rail connection between Port Botany and Sydney's strategic rail freight networks.

Other guidelines

A number of other guidelines identified as part of the project SEARs were considered as part of the preparation of this EIS. The relevance of these guidelines is summarised below:

- *Guide to Traffic Management – Part 3 Studies and Analysis (Austroads 2007)* – The traffic assessment that was completed for the project was conducted with reference to this report.
- *NSW Sustainable Design Guidelines Version 3.0 (TfNSW 2013)* – While not specifically relevant to the assessment of traffic impacts associated with the project, these guidelines would be considered as part of the detailed design of project elements such as new bridge structures along the length of the project.
- *Guide to Traffic Generating Developments, Version 2.2* (RTA, 2002) – As this guide is designed to assess the impacts of a development on the road network, it was not considered to be relevant to the assessment of the project, as the guideline typically assesses impacts associated with new traffic generating developments.
- *Cycling Aspects of Austroads Guide* (Austroads, 2017) – While cycling is an important part of the transport system, the planning, design and construction of a bicycle corridor has not been included in the project. The opportunity to include an active transport corridor as part of the project was considered during the design and development phase of the project. However, the existing rail corridor was identified to have limited space to accommodate an active transport path and was not considered to be consistent with the objectives for the project (refer to section 1.2.1). These guidelines were therefore not applied to the traffic impact assessment associated with the project. However, the development of the project would not preclude the provision of an active transport path (or similar) by others in the future.

- *NSW Bicycle Guidelines* (RTA, 2003) – These guidelines were not applied to the traffic impact assessment associated with the project for the reasons noted above. Notwithstanding, the potential for impacts on existing cycling infrastructure was examined. The assessment concluded that there would be no impact on existing bicycle facilities.
- *Planning Guidelines for Walking and Cycling* (DPINR, 2004) – As the project would involve duplication of the Botany Line, these guidelines were not considered to be applicable during the assessment of the traffic impacts.

A detailed description of the legislative and policy context for the assessment is provided in section 2 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

8.1.2 Methodology

Key tasks

For the purpose of the traffic and transport assessment, the activities which may affect the road network were defined as follows:

- ***'Typical'*** construction includes day-to-day construction activities that would occur throughout the duration of the project (haulage of materials, transport of construction workforce, rail line duplication activities) and within the approved working hours. The primary activity which would impact the road network is the generation of construction related vehicles and site access arrangements.
- ***'Temporary road closure construction'*** stages refer to the occasional period when road or lane closures are required to support the construction of the Robey Street, O'Riordan Street or Southern Cross rail bridges. The primary activity which would impact the road network are road diversions.

The assessment of potential traffic, transport and access impacts associated with the project involved:

- reviewing the project design (including proposed indicative construction methodology)
- reviewing existing freight rail, road features, traffic, transport services, pedestrian and cyclist facilities, and available traffic survey data
- estimating the traffic volumes that would be generated during construction
- undertaking a qualitative assessment of the potential impacts during construction of the project ('typical' construction impacts), including impacts on the operation of the local road network, pedestrians, cyclists, and public transport network
- undertaking a quantitative assessment of key road closures at the following intersections ('temporary road or lane closure' construction activities):
  - Robey Street
  - O'Riordan Street
  - Southern Cross Drive
- assessing the potential impacts on the road network during operation
- assessing potential operational impacts on the wider transport network, including impacts on cyclists, pedestrians, and public transport
- providing mitigation measures to manage the potential impacts on traffic, transport and access.

A detailed description of the assessment methodology is provided in section 3 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

Study area

For the purpose of this traffic and transport assessment, a study area (as shown in Figure 8.1) was adopted that incorporated the project site (as identified in section 2.1 of this EIS) and a wider area surrounding the project site. The study area was established to incorporate sections of the surrounding street network that would be used or potentially impacted during the construction of the project (such as for construction haulage routes etc). The study area typically includes an area around one kilometre from the project site (with the exception of the Sydney Airport site).

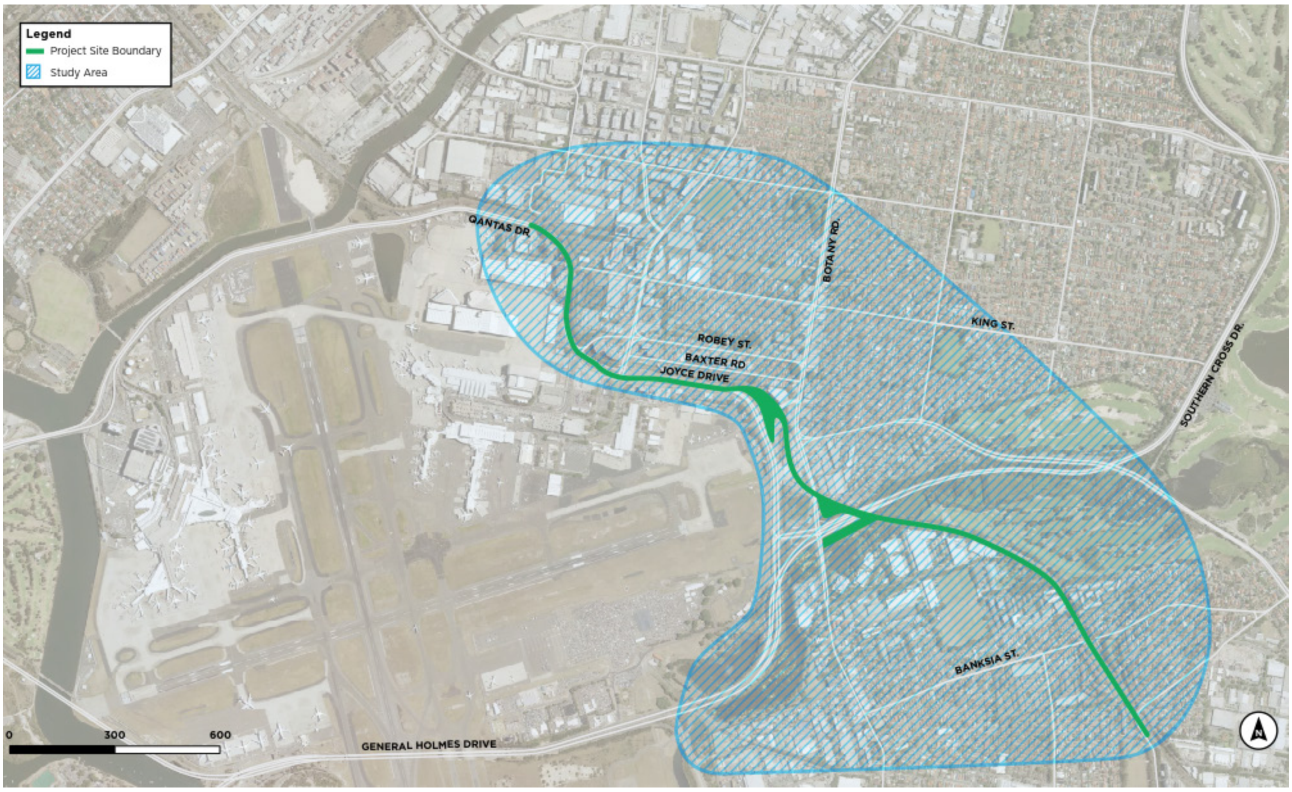


Figure 8.1 Study area – traffic and transport assessment

8.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with traffic, transport and access. Potential risks were considered according to the impacts that may be generated by the construction and operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk.

Further information on the risk assessment, including the approach, methodology, and the full results, is provided in Appendix B.

The assessed risks prior to mitigation associated with potential traffic, transport and access impacts (with a rating of medium or above) were:

- Very high risk:
  - closure of roads due to proposed bridge works including congestion impacts due to diversions
- High risk:
  - construction traffic impacts, including temporary delays to local and regional traffic
  - impacts on emergency services through delays in access due to works
- Medium risk:
  - impacts on pedestrian and cyclist movements in the vicinity of the project
  - impacts on access to private property.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and by stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 8.6.4.

8.1.4 How potential impacts have been avoided/minimised

As described in Chapters 6 and 7, design development and construction planning has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process. With respect to potential traffic, transport and access impacts, the project has sought to avoid or minimise potential impacts where possible.

In line with this approach, potential impacts have been avoided or minimised by project elements such as:

- initial assessment of the Botany Road bridge mitigated the need for demolition and replacement of the existing bridge structure at this location, removing the need for any full road closures of Botany Road to undertake works on the bridge
- where possible, the construction access points and construction traffic routes have been directed away from sensitive areas including areas of higher pedestrian movements to minimise potential impacts during construction.

8.2 Existing environment

8.2.1 Rail and road freight network

The movement of freight within the Greater Sydney region requires a focus on efficiency to ensure its important contribution to the NSW economy.

The freight network in NSW consists of ports and shipping channels, airports and prescribed airspace, roads, rail lines, pipelines, intermodal terminals and freight-related precincts. Of particular importance to the project are the existing rail freight network and the road freight network. These existing networks, within the vicinity of the project, are described below.

Rail freight network

Rail freight in Sydney is serviced by a network of dedicated corridors across the metropolitan area, shared with passenger rail. The rail network is used to transport raw construction materials, household waste, interstate and regional cargo, and import and export containers to and from Port Botany. The Botany Line forms part of the wider Sydney Metropolitan Freight Network which is maintained and operated by ARTC. The project site, which is currently configured with a single track, is located along the Botany Line. The section of single track is around three kilometres in length, extending between Mascot and Botany.

The Botany Line joins the existing Goods Line at Marrickville Junction, which in turn interfaces with the Sydney Trains Network at this location. The number of trains varies from week to week and day to day as freight operates on an as-needed basis and not on a defined schedule. A review of ARTC's *Master Train Plan* (April 2019) indicated that the Botany Line is regularly used with train arrivals ranging from 24 to 33 each day.

There is currently one at-grade road crossing of the Botany Line (also referred to as a level crossing) where it intersects with General Holmes Drive between Joyce Drive and Botany Road. The level crossing and associated infrastructure was approved for removal as part of the Airport East Precinct upgrade project (currently under construction). The Airport East project closed the level crossing by extending Wentworth Avenue to General Holmes Drive through a new rail underbridge. The underbridge was also constructed to allow for a future duplication of the track (the current project).

Table 8.1 provides an overview of the current typical maximum number of freight train movements on the Botany Line (total bidirectional train movements).

Table 8.1 Typical daily freight train movements on Botany Line

DAY OF THE WEEK	TOTAL (BOTH DIRECTIONS)
Monday	26
Tuesday	31
Wednesday	29
Thursday	33
Friday	30
Saturday	26
Sunday	24

Source: Master Train Plan – 28-04-2019 V1 (ARTC, 2019)

Road freight network

Around 80 percent of greater Sydney's freight movements is undertaken by road (*NSW Freight and Ports Plan* 2018–2023, TfNSW, 2018d). The motorways and major roads that are considered key roads in Greater Sydney's freight network, include:

- M1 Pacific Motorway
- Hume Motorway
- M4/Great Western Highway
- M5 East
- WestConnex (under construction)
- M5 West
- M7 Westlink
- Parramatta Road
- Foreshore road
- NorthConnex (under construction).

The impact of congestion is a key issue for road freight, causing increasing costs due to longer travel times and increased fuel consumption. In 2015, avoidable congestion costs were estimated at $6.1 billion (Bureau of Infrastructure, Transport and Regional Economics). This is expected to rise considerably by 2030. Key corridors within the vicinity of the project that are anticipated to be impacted further due to increasing traffic congestion include:

- the roads surrounding Port Botany and Sydney Airport including Foreshore Road
- the M5 West – a major corridor for both passenger and freight traffic
- the M4/Great Western Highway – a busy freight corridor between Sydney and the Central West.

Further details of the existing rail and road freight network is provided in section 4.2 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

8.2.2 Traffic and transport environment

This section provides a description of the land uses and transport network surrounding the project site.

Road network

All roads in the vicinity of the Botany Line are classified as local, other than Southern Cross Drive, General Holmes Drive, O'Riordan Street, Botany Road, Foreshore Road and the section of Robey Street between O'Riordan Street and Qantas Drive. The local roads are the responsibility of Bayside Council and generally are considered to only provide for local access.

There are a number of major arterial roads in the identified study area including (see Figure 1.1):

- **M1 Southern Cross Drive–General Holmes Drive** – which extends along the southern edge of the airport, connecting the M5 East Motorway and the Eastern Distributor.
- **Airport Drive and Qantas Drive** – which run along the northern edge of the airport between West Botany Street/M5 East and O'Riordan Street/Joyce Drive. These roads provide an important east–west connection between the International and Domestic airports, and for over-height or restricted freight vehicles that cannot use General Holmes Drive due to the low clearance tunnel under the runway.
- **Joyce Drive and General Holmes Drive** – a state road beginning at the intersection of Joyce Drive and O'Riordan Street, extending to meet the M1 on the eastern side of the airport.
- **Botany Road** – a state road and an important north–south connection between the Sydney CBD in the north and Botany in the south.
- **Foreshore Road** – a four-lane divided road which connects Port Botany to M1 General Holmes Drive and is an important link for road freight to and from the port.
- **O'Riordan Street and Robey Street** – which form the primary north–south corridor between the Sydney CBD and Sydney Airport. As a part of the Airport North Precinct upgrade works by Transport for NSW, Robey Street and O'Riordan Street form a one-way couplet.
- **Wentworth Avenue** – a state road that is generally four to six lanes wide and has a posted speed limit of 60 kilometres per hour between General Holmes Drive-Joyce Drive and Sutherland Street.
- **Mill Pond Drive** – a state road that is generally nine to eleven lanes wide and provides an important east–west connection between General Holmes Drive and Botany Road, while also providing access between the airport district and Southern Cross Drive eastbound.

Peak hour traffic

Weekday

The counts of intersection turning movements were collected during the weekday morning peak (6.00 am to 10.00 am) and afternoon peak (3.00 pm to 7.00 pm) periods to identify existing traffic volumes at key intersections within the study area. Surveys were conducted in June 2018 at the following intersections:

- Botany Road and Mill Pond Drive
- General Holmes Drive and Mill Pond Drive
- General Holmes Drive and Joyce Drive
- Joyce Drive and O'Riordan Street
- Qantas Drive and Robey Street
- Robey Street and O'Riordan Street.

Weekend

The weekend peak hour was determined through intersection turning count surveys during the typical weekend peak periods (from 10.00 am to 2.00 pm) in September 2018. The surveys were undertaken at the following intersections:

- Qantas Drive and Joyce Drive between Robey Street and Wentworth Avenue
- Botany Road between Wentworth Avenue and Robey Street
- Robey Street and O'Riordan Street.

The results of the survey indicated that the Sunday peak had the highest volumes of traffic and the peak hour was between 1 pm and 2 pm.

Further details of the traffic surveys undertaken are provided in section 4.3.3 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

On street parking

Existing on-street parking within the study area is characterised by the following:

- Short-term parking ranging from half-hour up to three hour periods is typically available within the proximity of commercial and retail precincts (eg Botany town centre) within the study area. These are generally applicable from 8.00 am to 6.00 pm on weekdays and from 8.00 am to midday on Saturday.
- Timed parking, with applied restrictions of three to eight hour periods is typically available in residential streets within walking distance (up to around 800 metres) of the surrounding commercial, retail and other employment areas. These are generally applicable from 8 am to 6 pm on weekdays and from 8 am to midday on Saturday; and are supported by the use of a Residential Parking Scheme.
- Unrestricted parking is provided in residential streets that are outside the typical walking distance of key commercial, retail or employment areas.
- No on-street parking is permitted on key motorways and arterial roads, including Southern Cross Drive, Airport Drive, Joyce Drive, Wentworth Avenue and O'Riordan Street.

Site visits undertaken in October 2018 as part of this assessment observed the utilisation of on-street parking within the study area as follows:

- high parking utilisation and high turnover observed within the vicinity of the Botany town centre
- high parking utilisation within the vicinity of the business park/light industrial areas north of Sir Reginald Ansett Drive, although there was a longer time restriction
- high utilisation and low-turnover in the spaces located within the business park/industrial area located between Mill Pond and Booralee Park
- high parking utilisation in areas around the medium to high density residential areas, including those located around Mascot station and near the Botany Aquatic Centre.
- low to medium utilisation in the residential areas located at further walking distance from major trip generators (ie commercial, business park, industrial areas and Airport).

Public transport

Rail services

The two closest passenger rail stations to the study area are Mascot Station and the Sydney Domestic Airport Station. Both stations are serviced by the T8 Airport and South Line. The underground portion of the line extends from Wolli Creek to Central with stations at the International Airport, Domestic Airport, Mascot and Green Square. A section of T8 line in tunnel runs directly below O'Riordan Street close to the project.

Bus services

The study area surrounding the project in Mascot and Botany is served by bus routes from the Eastern Suburbs and Inner West districts, including the following:

- **Routes 400, 400N, 420 and 420N** – connect the International and Domestic Terminals to Mascot station via Airport Drive, Qantas Drive and O'Riordan Street.
- **Route 305** – runs from Railway Square to Mascot, terminating at Stamford Plaza between Robey Street and Qantas Drive.
- **Routes M20, 307, 309, 310, L09, X09 and X10** – run in a north–south direction along Botany Road from Botany towards the city.
- **Route M20** – runs in a north–south direction from Botany Road in Botany towards the CBD and north to Gore Hill.
- **Routes 301 and 303** – runs in an east–west direction along King Street before joining Botany Road and continuing south.

Bus stops are available along these services at regular spacing (generally around every 200 metres to 400 metres). Figure 8.2 shows the bus network within Mascot and Botany.

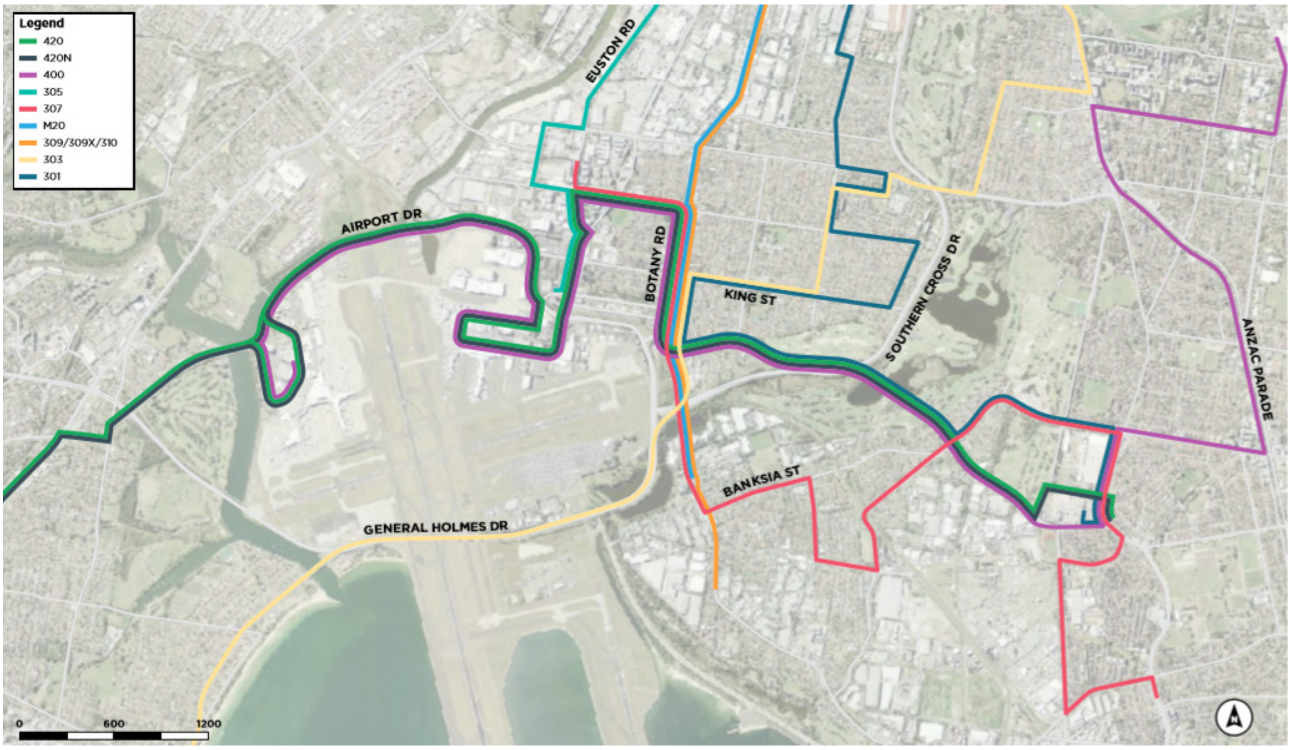


Figure 8.2 Bus routes within the project area

Point to point transport

Point-to-point transport such as taxis, hire cars, tourist services and rideshare services provide important mobility options for first and last mile trips. In the study area, designated taxi ranks are generally available within the vicinity of transport hubs (ie train stations, airport terminals).

Active transport

Cycling network

Currently there are no dedicated cycling facilities within the project site. However, there are a number of active transport corridors located in the wider study area. These are provided in a variety of forms including shared paths and dedicated cycleways. Active transport infrastructure (see Figure 8.3) in the broader vicinity of the project site includes:

- the Bourke Road Cycleway
- the Alexandra Canal cycleway
- a shared path located along Wentworth Avenue between Dranesfield Avenue and Bay Street.

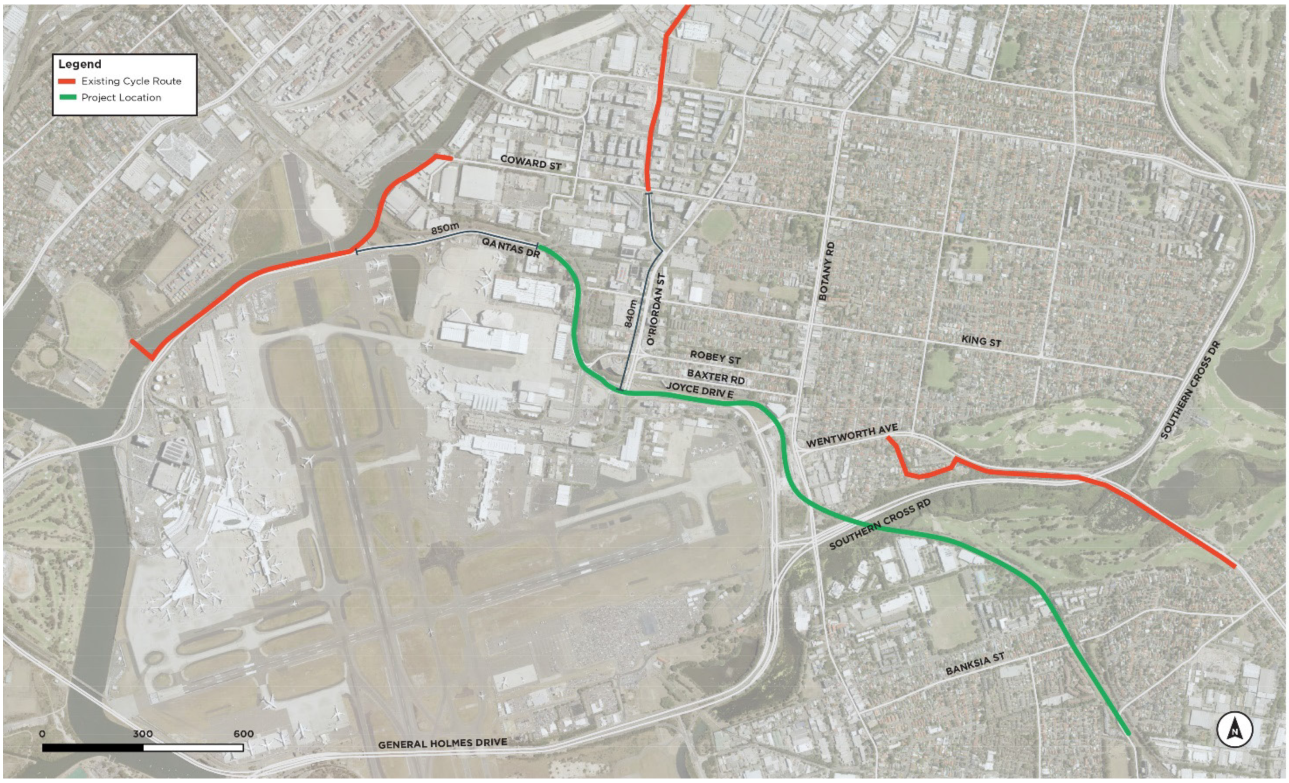


Figure 8.3 Active transport network

Pedestrian network

The pedestrian network is more developed than the bicycle network. The roads in the study area are typical of an urban environment with most streets consisting of footpaths on either side, or as a minimum, footpaths on one side of the road. Southern Cross Drive, has no footpath network. There is an existing pedestrian crossing over the Botany Line at Banksia Street. This crossing provides access for residents on either side of the rail line to schools, shopping and recreational amenities.

The Domestic Airport (Terminals 2 and 3) is linked to the Mascot Town Centre north of the study area, with pedestrian access to the terminal precinct located along at-grade roadside footpaths via Robey Street and O'Riordan Street to the north.

Further details of the existing traffic and transport network is provided in Chapter 4 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

8.3 Assessment of construction impacts

Construction impacts associated with the project have been considered based on the two main construction scenarios identified in section 8.2.1 above, being:

- *Typical* construction stage which includes typical construction activities that would occur throughout the duration of the project.
- *Temporary road closure construction* stages required to support the construction of the Robey Street, O'Riordan Street or Southern Cross rail bridges.

The assessment of each of these scenarios is provided in the following sections.

8.3.1 Typical construction stage

Road network operation

The estimated traffic volumes accessing each site gate during construction is shown in Table 5.3 of *Technical Report 1 – Traffic and Transport Impact Assessment* for both the morning (AM) and afternoon (PM) peak periods. The construction traffic includes workers travelling to and from the sites. It is divided into light vehicles and heavy vehicles (over 4.5 tonnes and 12.5 metres long). Not all sites/gates would be active throughout the full duration of the construction program as the individual construction activities would have varying durations and schedules. As such, the numbers presented in Table 5.3 of *Technical Report 1 – Traffic and Transport Impact Assessment* are cumulative and represent the typical traffic volumes that would be generated in the AM and PM peak periods for when each individual work site is in operation.

To identify the impact of the day-to-day construction traffic on the road network, the traffic numbers shown in Table 5.3 of *Technical Report 1 – Traffic and Transport Impact Assessment* were distributed across the road network within the study area (see detailed methodology outlined in section 3.3.1 of *Technical Report 1 – Traffic and Transport Impact Assessment*).

The percentage of the additional construction traffic to the road network was compared against the total traffic volumes at the key intersections during the AM and PM peak periods in year 2022 (baseline modelling forecast year). The focus of the qualitative assessment was at nearby intersections, as the impacts of increased traffic volumes would be greatest at these locations. The overall increase in peak period traffic volumes at key intersections for 2022 are shown in Table 8.2 and Table 8.3. The year 2022 was selected as the assessment year as it aligns with the base year for the proposed future Sydney Gateway project, currently being developed by Roads and Maritime.

Table 8.2 Total intersection traffic volume and construction traffic – AM peak hour

INTERSECTION NAME	2018 INTERSECTION TRAFFIC VOLUME (veh/h)*	2022 INTERSECTION TRAFFIC VOLUME (veh/h)	CONSTRUCTION TRAFFIC VOLUME (veh/h)**	TOTAL 2022 TRAFFIC VOLUME (veh/h)	CONSTRUCTION TRAFFIC AS A PERCENTAGE OF BACKGROUND TRAFFIC
Botany Road/Banksia Street	N/A	–	53	–	–
Botany Road/Bay Street	N/A	–	40	–	–
Botany Road/Mill Pond Drive	5,387	5,496	145	5,641	2.6%
General Holmes Drive/Mill Pond Drive	5,185	5,289	122	5,411	2.3%
Botany Road/Wentworth Avenue	N/A	–	68	–	–
General Holmes Drive/Joyce Drive/ Construction access	3,957	4,037	86	4,123	2.1%
Joyce Drive/O'Riordan Street	5,214	5,319	52	5,371	1.0%
Qantas Drive/Robey Street	5,554	5,666	55	5,721	1.0%
Robey Street/O'Riordan Street	4,063	4,145	60	4,205	1.4%
Botany Road/Robey Street	N/A	–	149	–	–
Botany Road/King Street	N/A	–	159	–	–

N/A – Traffic counts data not available

* 2018 Traffic counts data

** Total construction traffic (veh/h) at intersections

Table 8.3 Total intersection traffic volume and construction traffic – PM peak hour

INTERSECTION NAME	2018 INTERSECTION TRAFFIC VOLUME(veh/h)*	2022 INTERSECTION TRAFFIC VOLUME (veh/h)	CONSTRUCTION TRAFFIC (veh/h)**	TOTAL 2022 TRAFFIC VOLUME (veh/h)	CONSTRUCTION TRAFFIC AS A PERCENTAGE OF BACKGROUND TRAFFIC
Botany Road/Banksia Street	N/A	–	56	–	–
Botany Road/Bay Street	N/A	–	44	–	–
Botany Road/Mill Pond Drive	5,728	5,843	58	5,901	1.0%
General Holmes Drive/Mill Pond Drive	5,549	5,661	42	5,703	0.7%
Botany Road/Wentworth Avenue	N/A	–	27	–	–
General Holmes Drive/Joyce Drive/ Construction access	4,028	4,109	37	4,146	0.9%
Joyce Drive/O’Riordan Street	4,909	5,008	23	5,031	0.5%
Qantas Drive/Robey Street	4,613	4,706	42	4,748	0.9%
Robey Street/O’Riordan Street	4,385	4,473	21	4,494	0.5%
Botany Road/Robey Street	N/A	–	60	–	–
Botany Road/King Street	N/A	–	65	–	–

N/A – Traffic counts data not available

* 2018 Traffic counts data

** Total construction traffic (veh/h) at intersections

The results in Table 8.2 and Table 8.3 indicate that the maximum percentage increase in total traffic volume at any intersection would be up to around 2.6 percent in the AM peak at Botany Road and Mill Pond Drive. In the PM peak, the percentage increase in traffic at any intersection (where existing traffic volume data is available) is not expected to exceed around 1.0 percent. Based upon these relatively modest increases, the construction traffic generated by the project is likely to have a negligible impact on key intersections and the overall road network operation during construction. It was determined that further assessment of impact on intersection level of service was not required.

However, there may be occasional localised impacts on the efficiency of intersections and adjacent roads close to the construction site access gates as a consequence of slow moving heavy (construction) vehicles manoeuvring in and out the site.

The identified impacts on the function of intersections in proximity to the construction site gates as well as the adjacent road links are indicated in Appendix A1 of *Technical Report 1 – Traffic and Transport Impact Assessment*. In general, the assessment of these intersections indicates there is potential for short duration high impacts at the following gates:

- Botany Triangle: due to its close proximity to the Botany Road and Mill Pond Drive intersection.
- Joyce Drive – O'Riordan Street (in): due to its close proximity to the Joyce Drive and O'Riordan Street intersection.
- O'Riordan Street – Robey Street (in): due to its close proximity to the Qantas Drive and Robey Street intersection.
- O'Riordan Street – Robey Street (out): due to its close proximity to the Joyce Drive and O'Riordan Street intersection.
- Qantas Drive (out): due to its close proximity to the Qantas Drive and Robey Street intersection.
- Lancastrian Drive: due to its close proximity to the Qantas Drive and Lancastrian Drive intersection.

On-street parking

As described in section 7.6.5, where possible, parking for workers would be provided within compounds and work sites to accommodate both the projected workforce and construction vehicles at all times. It is expected that the construction contractor would manage the parking supply for both the projected workforce and construction vehicles at all times without utilising on-street parking around compounds and work sites. As the on-street parking around compounds and work sites would be restricted for the workforce to use, the impact on the demand and availability of existing on-street parking in the vicinity of the construction sites and compounds is expected to be negligible.

Local amenity

There is potential for a decrease in the local neighbourhood amenity through increased construction traffic along local streets. In particular, the slight increase in 'heavy vehicle' traffic may be noticeable to local residents due to increased noise resulting from braking or travelling over existing speed control measures (such as speed bumps). However, as the volume of construction traffic is low compared to existing traffic volumes, the effects of the temporary increase on the road network is not expected to substantially impact the local neighbourhood in the study area.

Public transport

The impacts on public transport services (buses) would be limited to the overall road network impacts described above, since the buses in the study area typically travel in general traffic lanes. No bus stops would be impacted as part of the construction works during typical construction stage works.

The project would be undertaken above the rail tunnel servicing the T8 – Airport & South Line. The works are however not expected to have any impact on the operation of the existing passenger train network.

Active transport

The construction works would mostly be undertaken within the Botany Line rail corridor. Therefore, impacts on pedestrian and cyclist infrastructure is considered minimal. The potential increase in construction traffic on the identified construction vehicle routes and at the construction access gates may lead to intermittent disruptions to pedestrian and cyclist movements along the existing adjacent footpaths and intersection crossing points. While likely to result in minimal overall travel time impacts on pedestrian and cyclists, these delays are likely to be most prevalent at gate crossing points (if stopped to give way to entering or exiting construction vehicles).

The impact on pedestrian and cyclist safety would also be at its greatest in the vicinity of the gates due to the increased vehicle activity. The gate locations where impacts on footpath users are likely to occur are:

- Banksia Street
- Morgan Street
- Botany Road (adjacent Mill Stream)
- Botany Road (Botany Triangle)
- Joyce Drive–O'Riordan Street (in and out)
- Qantas Drive (in and out).

Point-to-point transport

As noted in section 8.3.1, the overall increase in traffic volumes on the road network generated by the project is not expected to be greater than around 2.6 percent and generally in the order of around 1.0 percent. This level of additional traffic is unlikely to have any tangible effect on point-to-point transport mode travel times in the study area.

Temporary lane closures

There may be a need to implement temporary lane closures on road to support safe and efficient access to the construction gates for larger vehicles and to allow for major construction activities such as installing cranes to build and remove bridge structures. If a traffic lane is required to be closed, it may lead to a short duration reduction in mid-block capacity of the road, which may increase network congestion around the surrounding streets.

8.3.2 Road closure – Robey Street and O'Riordan Street

Overview

Closing Robey Street (between Qantas Drive and O'Riordan Street) or O'Riordan Street (between Qantas Drive and Robey Street) is required to conduct construction activities, ensure worker and general public safety, and as a result of space constraints (for activities such as moving, demolishing and erecting new bridge structures over these streets). A 54-hour weekend closure (from 11 pm Friday to 5 am Monday) would be required to avoid impacts on weekday peak period traffic. ARTC is currently in consultation with Roads and Maritime, Traffic Management Centre and the Transport for NSW Sydney Coordination Office regarding the proposed temporary closures. To facilitate the proposed scope of works, approximately 10 weekend road closures over the proposed three-year construction period would be required.

Only one of the roads is anticipated to be closed at one time, resulting in a detour around the closed portion of road. These closures are shown and discussed further in the following sections. The impact of the proposed weekend closures was assessed at the following key intersections:

- Qantas Drive/Robey Street
- Qantas Drive/O'Riordan Street
- O'Riordan Street/Robey Street

- Robey Street/Botany Road
- General Holmes Drive/Botany Road
- General Holmes Drive/Joyce Drive
- General Holmes Drive/Wentworth Avenue
- Botany Road/Wentworth Avenue.

The Level of Service (LoS) for each intersection analysed was assessed in accordance with Transport for NSW guidelines *(Guide to Traffic Generating Developments*, Roads and Traffic Authority, October 2002), which is shown in Table 8.4. Under these guidelines, the performance of a signalised intersection is measured by the average intersection delay measured in seconds per vehicle.

Table 8.4 Level of Service criteria for intersections

LEVEL OF SERVICE	AVERAGE DELAY (seconds per vehicle)	TRAFFIC SIGNALS
A	Less than 14	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity
E	57 to 70	At capacity; at signals, incidents would cause excessive delays; roundabouts require other control mode
F	Greater than 71	Unsatisfactory with excessive queuing

Robey Street closure

Proposed detour route

In consultation with Transport for NSW, three existing approach routes to the Robey Street underpass were identified and an alternative detour route developed. The existing and proposed detour routes are described in the following and depicted in Figure 8.4 and Figure 8.5.

- Route 1A:
  - **Existing route**: Left turn from Qantas Drive into Robey Street, then left from Robey Street to O’Riordan Street.
  - **Detour Route**: Travel along Joyce Drive and General Holmes Drive, left turn to Wentworth Avenue, travel along Botany Road, left turn to Robey Street, right turn to O’Riordan Street.
- Route 1B:
  - **Existing route**: Northbound through movement from Seventh Street onto Robey Street, left from Robey Street to O’Riordan Street.
  - **Detour Route**: Right turn to Joyce Drive and General Holmes Drive, left turn to Wentworth Avenue, travel along Botany Road, left turn to Robey Street, right turn to O’Riordan Street.
- Route 1C:
  - **Existing route**: Right turn from Joyce Drive to Robey Street, left from Robey Street to O’Riordan Street
  - **Detour Route**: Turn right onto Wentworth Avenue (rather than travel along Joyce Drive), travel along Botany Road, left turn to Robey Street, right turn to O’Riordan Street.

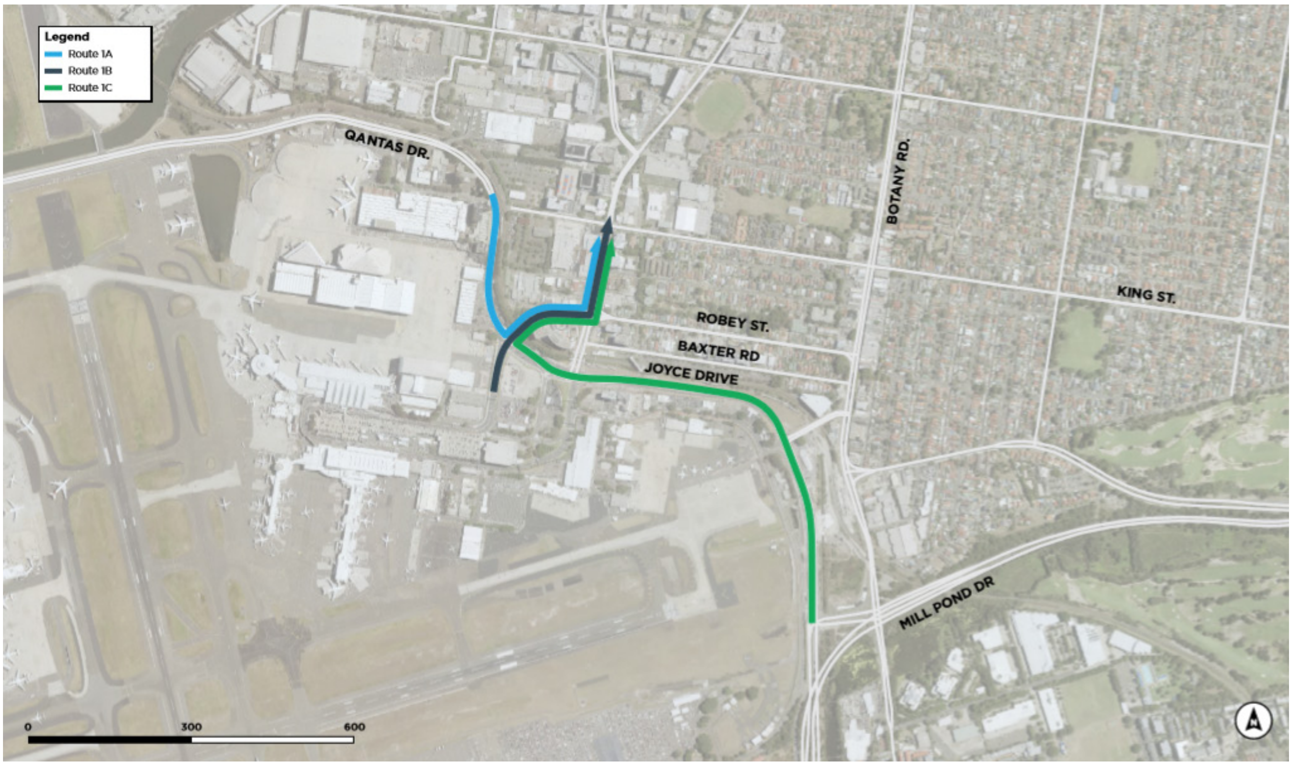


Figure 8.4 Key existing routes for Robey Street

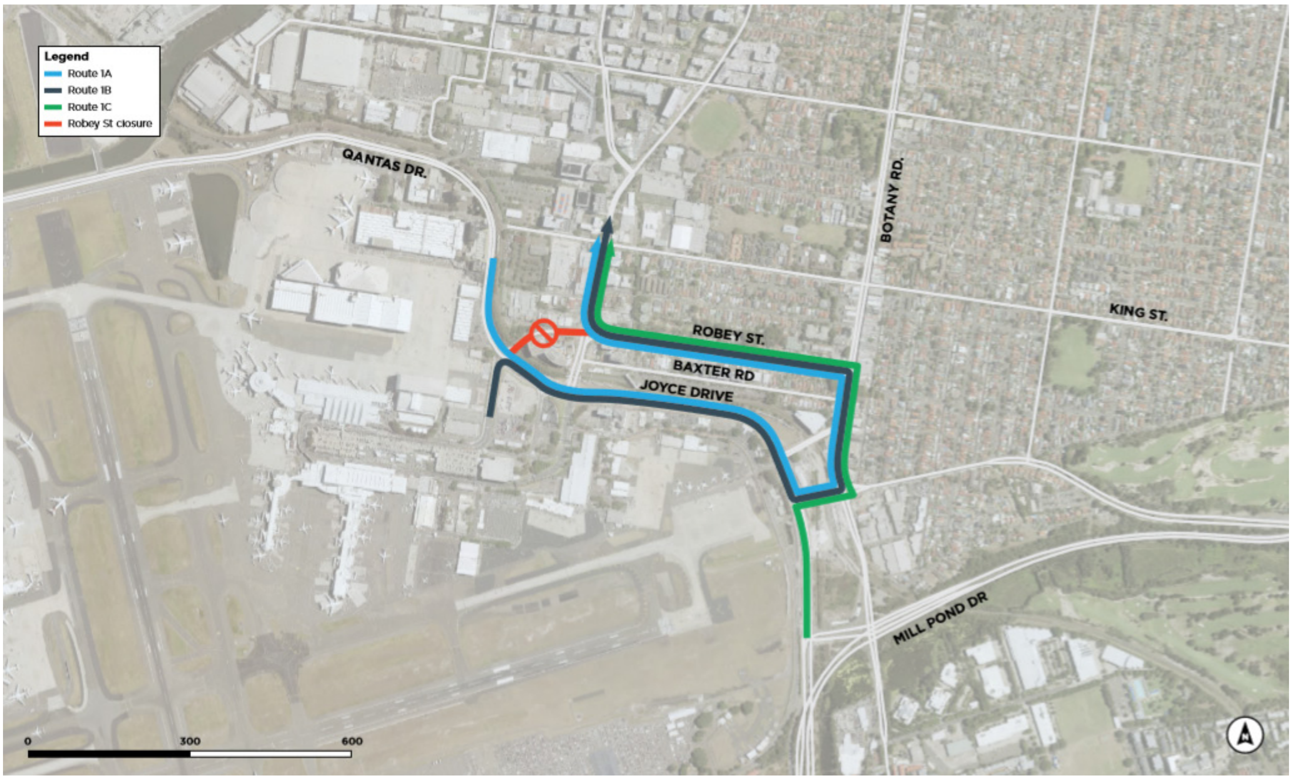


Figure 8.5 Key detour routes for Robey Street (during proposed closure)

The detailed forecast 2022 Base and 2022 Robey Street closure traffic volumes at key intersections, along with the intersection SIDRA performance results are shown in Table 5.7 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

The diversion of traffic due to the proposed detours would result in adverse impacts on the following intersections, with increased delays and intersection capacity exceeded:

- Qantas Drive/Robey Street (degree of saturation > 1.0, LoS F, average delay 193 seconds), compared to a degree of saturation < 1.0, LoS D and average delay of 52 seconds in base year (2022).
- O'Riordan Street/Robey Street (degree of saturation > 1.0, LoS F, average delay 84 seconds), compared to a degree of saturation < 1.0, LoS C and average delay of 32 seconds in base year (2022).
- General Holmes Drive/Wentworth Avenue (degree of saturation > 1.0, LoS F, average delay 82 seconds), compared to a degree of saturation < 1.0, LoS B and average delay of 23 seconds in base year (2022).
- Botany Road/Wentworth Avenue (degree of saturation > 1.0, LoS F, average delay 186 seconds), compared to a degree of saturation < 1.0, LoS C and average delay of 40 seconds in base year (2022).

For vehicles travelling along each of the key impacted routes (1A, 1B and 1C, as shown in Figure 8.5), the detours would result in the following increase in average travel times during the identified Sunday 1 pm-2 pm peak period:

- Detour route 1A: increase of 11.9 minutes
- Detour route 1B: increase of 19.5 minutes
- Detour route 1C: increase of 8.1 minutes.

As such, the anticipated maximum delay for vehicles using the road network during the proposed weekend closure of Robey Street is anticipated to be about 10 to 20 minutes during the Robey Street closure.

Public transport

As bus services travelling via and through the identified detour routes operate with general traffic and without priority, they are expected to experience similar delays to other road users (as described above). Bus route 400 and 420, which travels along Robey Street, between O'Riordan Street and Qantas Drive, during its outbound (eastbound) route would be directly impacted by the Robey Street weekend closures, requiring a detour to be implemented. Inbound (westbound) bus routes would not be detoured. An extract of the route diagram for bus route 400 is shown in Figure 8.6.

Alternatives for bus route 400 have been identified to identify potential impacts and delays as a result of each option. Alternative bus routes during the Robey Street closure would include:

- Option A – servicing all bus stops. This option has been designed to ensure all existing bus stops will be serviced during the closure. Outbound bus services to follow a proposed detour route in an eastbound direction, via Joyce Drive, General Holmes Drive, Wentworth Avenue, Botany Road, and Robey Street to O'Riordan Street.

- Option B – priority for on-time running. This option has been designed to provide a route which is would be more reliable for buses on-time running, and remove the 2-kilometre detour considered in Option A.

- Option C – balancing on-time running and accessibility. This option has been developed to ensure services to the Mascot town centre on Botany Road is maintained, while selecting a route that is less impacted by the closure of Robey Street. The eastbound detour route will travel via Joyce Drive, General Holmes Drive, Botany Road, Coward Street, Sutherland Street before continuing its journey eastbound at Wentworth Avenue.

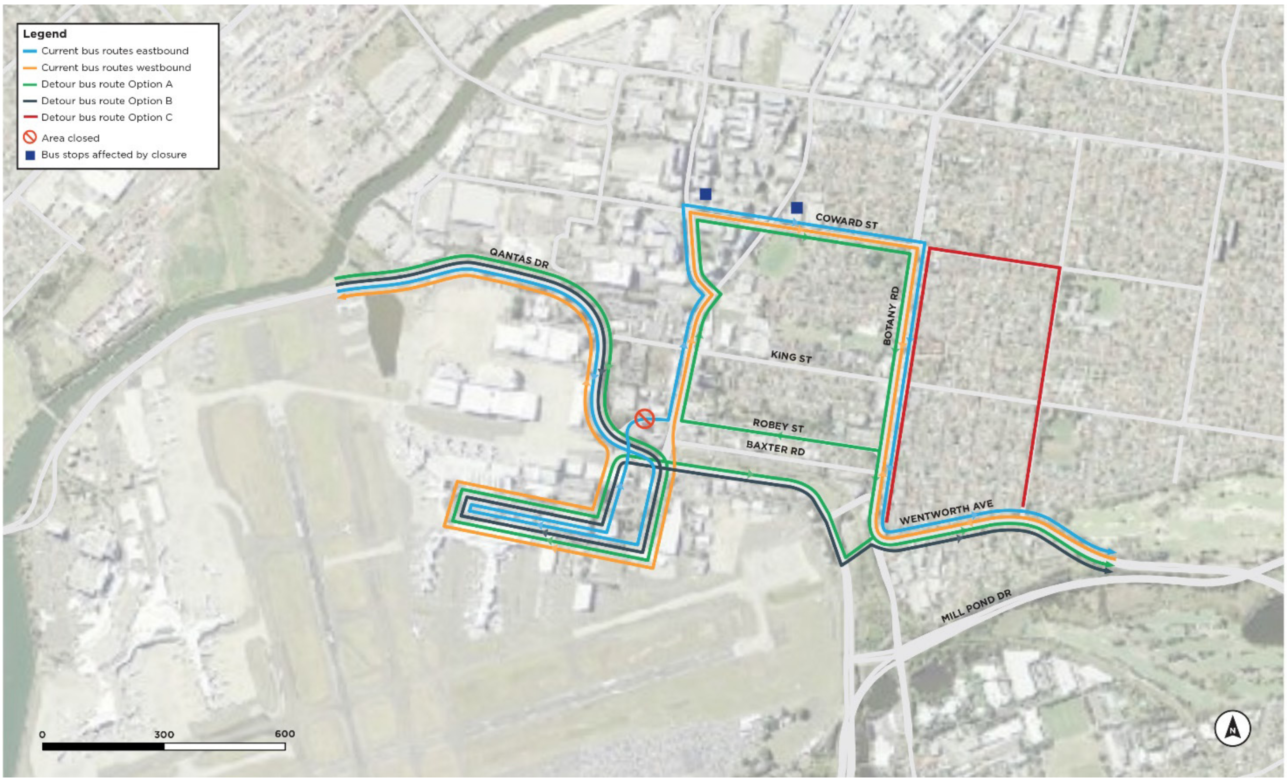


Figure 8.6 Robey Street closure – bus detour routes – 400 and 420

Considering the available options above, it is considered that Option C is ideal for Route 400 and 420 during the day, where a balance of accessibility and on-time running are important. However, Option A would be more ideal for Route 420N, as it prioritises accessibility for all stops and is less likely to be affected by potential traffic congestion issues, due to the low background traffic at night time.

In addition, routes M20, 303, 301, 307, 309, 310, L09, XO9, X10 all run along roads that are proposed as part of the Robey Street detour route. Therefore, these bus services would be affected to some degree by the delays as a result of congestion generated by the diversion away from Robey Street.

ARTC would continue to consult with Transport for NSW regarding the final decision for the preferred detour route.

Active transport

There are no dedicated on-road cycle facilities on Robey Street, however a pedestrian footpath is provided on both sides of the road which would also be closed as a result of the road closure. Pedestrians and cyclists would be diverted to Qantas Drive and O'Riordan Street as an alternate route to bypass the Robey Street closure. While this would increase trip distance (by approximately 100 metres), the overall impact is likely to be minimal. Appropriate signage would also be provided to ensure that pedestrians are appropriately directed to alternative pedestrian routes.

Point-to-point transport

Point-to-point transport modes would be subject to the same road network delays and detours as general traffic, as described earlier in this section. In particular, those trips to/from the Airport terminals would be subject to additional travel time, and therefore potential additional passenger costs.

Parking

There is no on-street parking on this section of Robey Street, therefore there would be no parking impact resulting from the temporary road closure.

O'Riordan Street closure

Proposed detour route

In consultation with Transport for NSW, three existing approach routes to the O'Riordan Street underpass were identified and an alternative detour route developed. The existing and proposed detour routes are described below and depicted in Figure 8.7 and Figure 8.8.

- Route 2A:
  - **Existing route**: Southbound from O'Riordan Street, turning right into Qantas Drive.
  - **Detour Route**: Left turn onto Robey Street, right turn onto Botany Road, right turn into Wentworth Avenue, travel along General Holmes Drive or Joyce Drive.
- Route 2B:
  - **Existing route**: Southbound through movement from O'Riordan Street to Sir Reginald Ansett Drive.
  - **Detour Route**: Left turn onto Robey Street, right turn onto Botany Road, right turn into Wentworth Avenue, travel along General Holmes Drive/Joyce Drive, left turn into Sir Reginald Ansett Drive.
- Route 2C:
  - **Existing route**: Southbound from O'Riordan Street into Joyce Drive.
  - **Detour Route**: Left turn onto Robey Street, right turn onto Botany Road, right turn into Wentworth Avenue, left turn into General Holmes Drive for travel south.

The forecast 2022 Base and 2022 O'Riordan Street closure traffic volumes at key intersections, along with the intersection SIDRA performance results are shown in Table 5.8 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

This shift in traffic volumes due to the proposed detours would result in adverse impacts on the following intersections, with increased vehicle delays and intersection capacity being exceeded:

- Robey Street/Botany Road (degree of saturation > 1.0, LoS F, average delay 74 seconds), compared with degree of saturation <1.0, LoS B and average delay of 19 seconds (in base year)
- Botany Road/Wentworth Avenue (degree of saturation > 1.0, LoS F, average delay 177 seconds), compared with degree of saturation <1.0, LoS C and average delay of 40 seconds (in base year)

For vehicles travelling along each of the key impacted routes (2A, 2B and 2C, as shown in Figure 8.8), the detours would result in the following changes in average travel times:

- Detour route 2A and 2B: increase of 9.9 minutes
- Detour route 2C: increase of 7.9 minutes.

The average delay for vehicles using the road network is anticipated to be about 10 minutes during the O'Riordan Street closure.

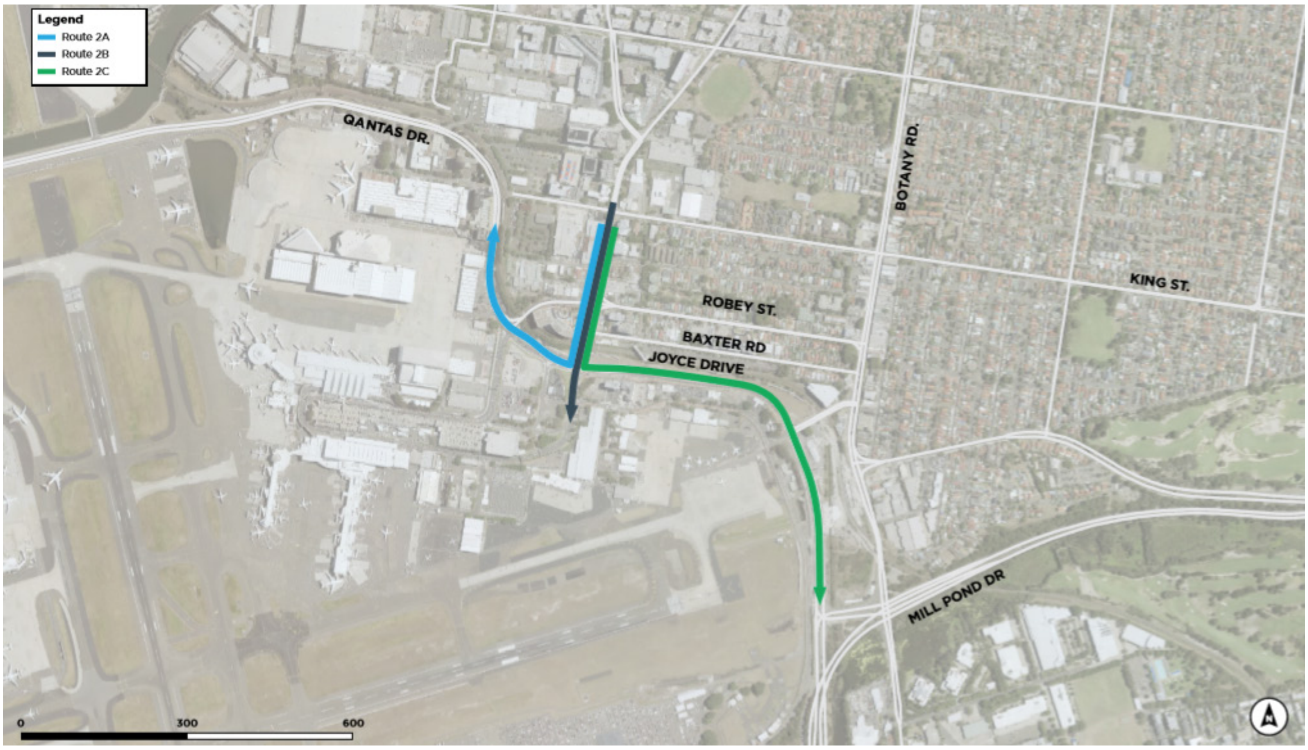


Figure 8.7 Impacted key routes for O'Riordan Street

Figure 8.8 Key detour routes for O'Riordan Street (during proposed closure)

Public transport

As bus services travelling via and through the identified detour routes operate with general traffic and without priority they are expected to experience similar delays to other road users. Bus route 400, which travels along O'Riordan Street during its trip towards the airport, would be directly impacted by the O'Riordan Street weekend closures. Bus route 420 would also be directly impacted by the O'Riordan Street weekend closures.

Alternatives for bus route 400 and 420 have been examined to identify potential impacts and delays as a result of each option. Alternative bus routes during the O'Riordan Street closure would include (see Figure 8.9):

- Option A – servicing all bus stops. This option has been designed to ensure all existing bus stops will be serviced during the closure. Inbound bus services would follow the proposed detour route 2B in the westbound direction, via Robey Street, Botany Road, Wentworth Avenue, General Holmes Drive and Joyce Drive, to the intersection of Joyce Drive–Qantas Drive–Sir Reginald Ansett Drive.
- Option B – priority for on-time running. This option has been designed to provide a route that would be more reliable for buses on-time running and remove the 2-kilometre detour considered in Option A.
- Option C – balancing on-time running and accessibility. This option has been developed to ensure services to the Mascot town centre on Botany Road is maintained, while selecting a route that is less impacted by the closure of O'Riordan Street. The westbound detour route would travel via Sutherland Street, Coward Street, Botany Road, General Holmes Drive and Joyce Drive, before continuing its journey westbound at Joyce Drive–Qantas Drive–Sir Reginald Ansett Drive intersection.

Considering the available options above, it is considered that Option C is ideal for Route 400 and 420 during the day, where a balance of accessibility and on-time running are important. However, Option A would be more suitable for Route 420N, as it prioritises accessibility for all stops and is less likely to be affected by potential traffic congestion issues, due to the low background traffic at night time.

As per the Robey Street closure, routes M20, 303, 301, 307, 309, 310, L09, XO9 and X10 all run along roads that are to be used as part of the O'Riordan Street detour route. Therefore, these bus services would be affected by the delays as a result of congestion generated by the diversion away from O'Riordan Street.

As with the Robey Street closure, ARTC would continue to consult with Transport for NSW regarding the final decision for the preferred detour route.

Active transport

There are no dedicated on-road cycle facilities on O'Riordan Street, however a pedestrian footpath is provided on both sides of the road and this would also be closed as a result of the road closure. Pedestrians and cyclists would be diverted to Qantas Drive and Robey Street as an alternate route to bypass the O'Riordan Street closure. While this would increase trip distance (by approximately 260 metres), the overall impact is considered to be manageable.

Point-to-point transport

Point-to-point transport modes would be subject to the same road network delays and detours as general traffic, described earlier in this section. In particular, those trips to and from the Airport terminals would be subject to additional travel time, and therefore result in additional passenger costs.

Parking

There is no on-street parking on this section of O'Riordan Street, so there would be no parking impact resulting from the temporary road closure.

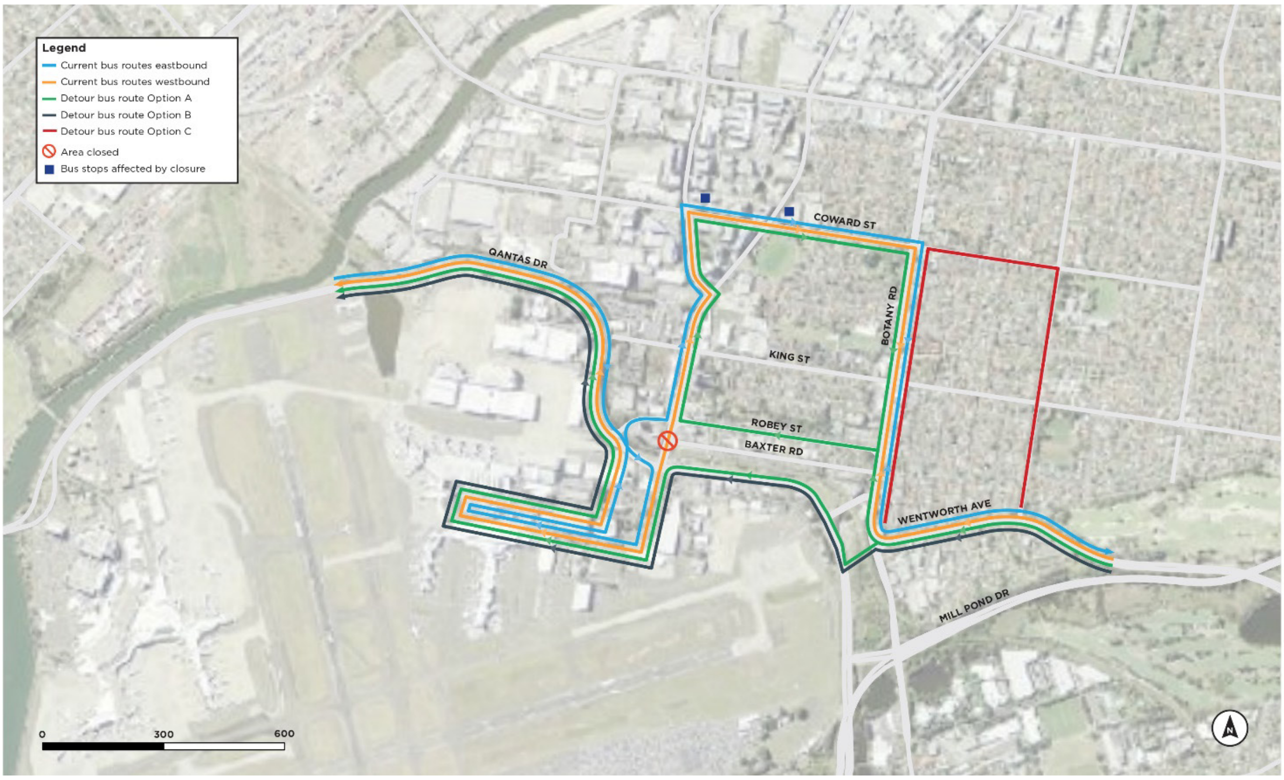


Figure 8.9 O'Riordan Street closure – bus detour routes for 400 and 420

8.3.3 Road closure – Southern Cross Drive

Proposed road closure arrangement

There are three potential road closure arrangements for Southern Cross Drive to correspond with the types of works required at the rail overpass on Southern Cross Drive. Works are proposed generally with closure of the carriageway in one direction with an additional lane closure in the opposing direction. Full closure is not currently anticipated, however given that work in this area is subject to multiple constraints including approval for access within the OLS, it has been considered as a worst-case scenario. In all cases, the road closure period will be between 11 pm to 5 am to align with the airport curfew. Around six closures are anticipated across the three-year construction period.

It is anticipated that any required road closures would typically occur between Monday and Thursday, however there may be some periods where weekend closures are required (such as to align with a scheduled track possession period). As such, potential assessment of both weekday and weekend period impacts has been undertaken.

The types of road closures proposed are:

- **Full road closure** – This represents the worst-case scenario and would have the most impact on the road network. Both directions on the Southern Cross Drive would be impacted and traffic would be detoured via Wentworth Avenue and General Holmes Drive or Joyce Drive to travel southwest bound or northwest bound respectively.
- **Eastbound carriageway road closure** – The road closure proposes to occupy the entire eastbound carriageway and one westbound lane. Eastbound traffic on the Southern Cross Drive would be detoured via Wentworth Avenue. The westbound carriageway would operate at a reduced capacity.

- **Westbound carriageway road closure –** The road closure proposes to occupy the entire westbound carriageway and one eastbound lane. Westbound traffic on the Southern Cross Drive would be detoured via Wentworth Avenue. The eastbound carriageway would operate at a reduced capacity.

The detailed staging of the bridge works and the proposed staging would be developed by the construction contractor and would subject to approval by the relevant roads authority. At this stage, six major closures are anticipated during the project's construction period.

Proposed detour routes

The identified detour routes during the proposed closure of Southern Cross Drive in either direction are shown in Figure 8.10.

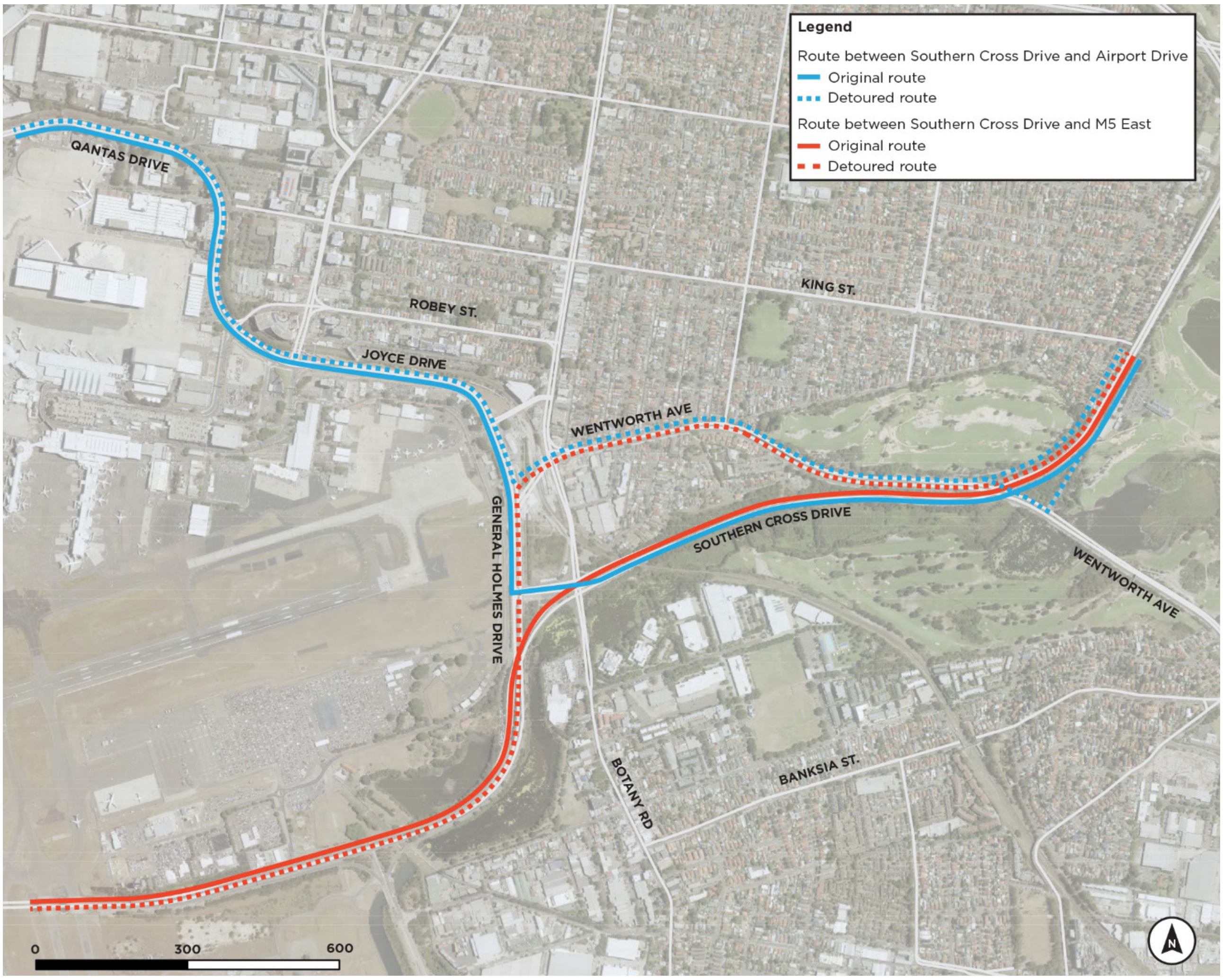


Figure 8.10 Proposed detour routes during Southern Cross Drive closure

The detour routes as shown in Figure 8.10 include:

- Route between Southern Cross Drive and Sydney CBD as well as Qantas Drive/Airport Drive in the northwest direction will be detoured via Wentworth Avenue–General Holmes Drive–Joyce Drive–Qantas Drive.
- Route between Southern Cross Drive and Sydney CBD as well as the M5 East in the southwest direction will be detoured via Wentworth Avenue–General Holmes Drive/M5 East.

Assessment of potential weekday closure

The highest night time one-hour traffic volume on Southern Cross Drive during the midweek period was recorded on Thursday between 11 pm and midnight, where flows on Southern Cross Drive reached 900 vehicles/hour and 400 vehicles/hour in the westbound and eastbound directions respectively. Although a higher bidirectional volume was observed on Wednesday between 4 am and 5 am, modelling indicated that the westbound closure would have a far more significant impact on network performance. Therefore, the one-hour volume for Thursday 11 pm to mid-night was identified as the critical weekday period as the westbound flow was higher during this time period.

Overall, the assessment of the proposed detour routes identified that:

- Modelling results of the 2022 traffic condition the during critical weekday evening peak period 11 pm to midnight are summarised Table 8.5 with key findings as follows:
  - the six key intersections affected by the proposed closure currently operate satisfactorily, with the worst performing intersections (Mill Pond Drive / Botany Road) operating at a level of service B, not surpassing maximum desirable level of service D typically applied in NSW
  - a full-closure during this period would result in slight deterioration of road network performance, with level of service C forecasted at Mill Pond-Botany Road. However, the six key intersections affected by proposed closure would operate satisfactorily, achieving a level of service C or better
  - road closure impacting the eastbound carriageway and one westbound lane would result in slight deterioration of the road network performance. The existing level of service at the assessed intersections are generally able to be maintained.
- The most adverse travel time increase observed during full road closure is observed in the route travelling eastbound from M5 to Southern Cross Drive in the weekday period 11 pm to midnight. The current travel time of approximately 6.7 minutes would be increased to approximately 9.5 minutes, representing an increase of 42 percent (or around 2.8 minutes). Similar delay is also experienced in the closure of the westbound carriageway. The modelling results for the critical peak hour (11 pm to midnight) during the weekday night time period is tabulated in Table 8.6.

Table 8.5 Intersection performance comparison across all road closure scenario (weekday 11 pm-midnight)

ID	INTERSECTION	NO CLOSURE		FULL CLOSURE			EASTBOUND CARRIAGEWAY CLOSURE			WESTBOUND CARRIAGEWAY CLOSURE		
		DELAY (S)	LOS	DELAY (S)	LOS [1]	INCREASED DELAY FROM 'NO CLOSURE' (S)	DELAY (S)	LOS	INCREASED DELAY FROM 'NO CLOSURE' (S)	DELAY (S)	LOS	INCREASED DELAY FROM 'NO CLOSURE' (S)
1	General Holmes Drive–Wentworth Avenue	15	B	24	B	9	27	B	12	17	B	2
2	General Holmes Drive–Mill Pond Drive	16	B	18	B	2	19	B	3	17	B	1
3	Mill Pond Drive–Botany Road	28	B	42	C	14	31	C	3	35	C	7
4	Wentworth Avenue–Botany Road	20	B	22	B	2	23	B	3	22	B	2
5	Wentworth Avenue–Southern Cross Drive on-ramp	9	A	8	A	-1	9	A	0	9	A	0
6	Wentworth Avenue–Southern Cross Drive off-ramp	2	A	21	B	19	2	A	0	21	B	19

(1) Level of service (LoS)

Table 8.6 Key route performance across all road closure scenario (11pm-midnight on weekday)

TRAVEL TIME ROUTE	NO CLOSURE TRAVEL TIME	FULL CLOSURE		EASTBOUND CARRIAGEWAY CLOSURE		WESTBOUND CARRIAGEWAY CLOSURE	
	TRAVEL TIME (MINUTES: SECONDS)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM 'NO CLOSURE' (%)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM 'NO CLOSURE' (%)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM 'NO CLOSURE' (%)
Airport Drive to Southern Cross Drive (citybound)	6:43	8:04	20%	7:49	16%	6:50	2%
Southern Cross Drive to Airport Drive (north-west bound)	7:03	7:51	11%	7:24	5%	7:49	11%
M5 West to Southern Cross Drive (citybound)	6:46	9:35	42%	9:33	41%	6:46	0%
Southern Cross Drive to M5 East (south-west bound)	7:20	9:24	28%	7:20	0%	9:19	27%

Assessment of potential weekend closure

Weekend night traffic volumes were higher than on any weekday evening. During the peak/critical hour (11 pm to midnight), the traffic volume on the Southern Cross Drive was in the order of 2,400 vehicles/hour and 900 vehicles/hour in the westbound and eastbound direction respectively. Friday was found to be the peak week-day period and during the critical hour it carries approximately 1,300 vehicles/hour and 780 vehicles/hour in the respective westbound and eastbound direction, indicating a lower traffic volume than the weekend periods.

Overall, the assessment of the proposed detour routes identified that:

- Modelling results of the 2022 traffic conditions during the peak traffic hour period (Saturday 11.00 pm to midnight) are summarised in Table 8.7 with key findings as follows:
    - The six key intersections affected by the proposed closure currently operate satisfactorily, with the worst performing intersections (Mill Pond Drive–Botany Road and Wentworth Avenue–Botany Road) operating at a level of service C, better than the worst acceptable level of service D typically applied in NSW.
    - A full-closure during this period would adversely impact the performance of the network with level of service F observed at General Holmes Drive–Mill Pond Drive and Wentworth Avenue–Southern Cross Drive off-ramp; level of service E is found at General Holmes Drive–Wentworth Avenue.
    - Road closure impacting the eastbound carriageway and one westbound lane would result in slight deterioration of the road network performance, however still within the threshold of level of service D, which will be experienced at the worst-performing intersection (Wentworth Avenue–Botany Road). Other intersections would operate with acceptable level of service.
    - Road closure impacting the westbound carriageway and one eastbound lane would generally have a higher impact on the road network. Wentworth Avenue–Southern Cross Drive off-ramp would operate at level of service F and Wentworth Avenue–Botany Road will operate at level of service E. A substantial intersection delay of 354 seconds (approximately six minutes) on average would be experienced at the intersection of Wentworth Avenue–Southern Cross Drive off-ramp. This intersection currently operates at level of service A with an average delay of five seconds.
- Modelling results of the 2022 traffic conditions during the second highest peak hour (Saturday midnight to 1.00 am) are summarised in Table 8.8 with key findings as follows:
    - The six key intersections affected by the proposed closure currently operate satisfactorily, with the worst performing intersection (Mill Pond Drive–Botany Road and Wentworth Avenue–Botany Road) operating at a Level of Service C, not surpassing maximum desirable level of service D.
    - A full-closure during this period would result in deterioration of the road network performance, with level of service F forecast at Wentworth Avenue–Southern Cross Drive off-ramp. level of service D is forecast at the intersection of General Holmes Drive–Wentworth Avenue and Wentworth Avenue–Botany Road.
    - Road closure impacting the eastbound carriageway and one westbound lane would result in slight deterioration of the road network performance. The existing levels of service at the assessed intersections are generally able to be maintained.
    - Road closure impacting the westbound carriageway and one eastbound lane would have a higher impact on the road network compared with the eastbound carriageway closure.

- A level of service D is forecasted at the intersection of Wentworth Avenue–Botany Road with an average delay of 42 seconds. This is an increase of one second from the baseline (no closure) operation.

  The worst performing intersection, Wentworth Avenue–Southern Cross Drive off-ramp, is forecast to operate at a level of service F with the average delay at the intersection estimated at 173 seconds (approximately three minutes), which is half the delay of those assessed in the period 11:00 pm to midnight. This level of service is not desirable and the average delay of 173 seconds would be a substantial increase on the four seconds assessed without any road closure.
- Impacts on travel time for the key routes affected by the detour correspond with the findings of intersection performance above. The modelling results for the critical peak hour (11.00 pm to midnight) and the second highest peak hour (midnight to 1.00 am) during the weekend night time period are shown in Table 8.9 and Table 8.10 respectively. The key findings of the analysis are as follows:
  - All routes are expected to be subjected to increased travel time.
  - The most adverse travel time increase observed during full road closure is observed in the route travelling westbound from Southern Cross Drive to M5 in the weekend period 11:00 pm to midnight. The current travel time of approximately 7.5 minutes would be increased to approximately 19 minutes, representing an increase of 148 percent. Similar delay is also experienced in the closure of the westbound carriageway. Due to the higher traffic volume affected in the westbound direction, the closure of the westbound carriageway is considered to be the key driver of substantial delay experienced in the road network.

    During this period, closure of the eastbound carriageway would result in a slight increase in travel time. The worst increase is observed for the citybound route from M5 to Southern Cross Drive. This route would experience an increase from under 7 minutes to approximately 11 minutes.
  - In the second weekend peak hour period (midnight to 1 am), greatest travel time increase observed during full road closure is observed in the route travelling westbound from Southern Cross Drive to M5. The current travel time of approximately 7.5 minutes would be increased to approximately 13.5 minutes, representing an increase of 86 percent. Similar delay is also experienced in the closure of the westbound carriageway. Due to the higher traffic volume affected in the westbound direction, the closure of the westbound carriageway is considered to be the key driver of substantial delays experienced in the road network.

    During this period, closure of the eastbound carriageway would result in a slight increase in travel time. The worst increase is observed for the citybound route from M5 to Southern Cross Drive. This route would experience an increase from under 7 minutes to approximately 11 minutes.

Table 8.7 Intersection performance comparison across all road closure scenarios (11 pm–midnight on weekend)

ID	INTERSECTION	NO CLOSURE		FULL CLOSURE			EASTBOUND CARRIAGEWAY CLOSURE			WESTBOUND CARRIAGEWAY CLOSURE		
		DELAY (S)	LOS	DELAY (S)	LOS	INCREASED DELAY FROM 'NO CLOSURE' (S)	DELAY (S)	LOS	INCREASED DELAY FROM 'NO CLOSURE' (S)	DELAY (S)	LOS	INCREASED DELAY FROM 'NO CLOSURE' (S)
1	General Holmes Drive–Wentworth Avenue	25	B	67	E	42	38	C	13	25	B	0
2	General Holmes Drive–Mill Pond Drive	24	B	75	F	51	28	B	4	16	B	-8
3	Mill Pond Drive–Botany Road	29	C	42	C	31	31	C	2	35	C	6
4	Wentworth Avenue–Botany Road	39	C	54	D	15	44	D	5	63	E	24
5	Wentworth Avenue–Southern Cross Drive on-ramp	11	A	12	A	1	11	A	0	10	A	-1
6	Wentworth Avenue–Southern Cross Drive off-ramp	5	A	359	F	354	16	B	11	354	F	349

Table 8.8 Intersection performance comparison across all road closure scenario (midnight–1 am on weekend)

ID	INTERSECTION	NO CLOSURE		FULL CLOSURE			EASTBOUND CARRIAGEWAY CLOSURE			WESTBOUND CARRIAGEWAY CLOSURE		
		DELAY (S)	LOS	DELAY (S)	LOS	INCREASED DELAY FROM 'NO CLOSURE' (S)	DELAY (S)	LOS	INCREASED DELAY FROM 'NO CLOSURE' (S)	DELAY (S)	LOS	INCREASED DELAY FROM 'NO CLOSURE' (S)
1	General Holmes Drive–Wentworth Avenue	24	B	48	D	24	41	C	17	26	B	2
2	General Holmes Drive–Mill Pond Drive	23	B	24	B	1	26	B	3	14	B	-9
3	Mill Pond Drive–Botany Road	28	C	41	C	13	32	C	4	35	C	7
4	Wentworth Avenue–Botany Road	41	C	52	D	11	38	C	-3	42	D	1
5	Wentworth Avenue–Southern Cross Drive on-ramp	11	A	11	A	0	11	A	0	11	A	0
6	Wentworth Avenue–Southern Cross Drive off-ramp	4	A	141	F	137	15	B	11	173	F	169

Table 8.9 Key route performance across all road closure scenario (11 pm–midnight on weekend)

TRAVEL TIME ROUTE	NO CLOSURE TRAVEL TIME	FULL CLOSURE		EASTBOUND CARRIAGEWAY CLOSURE		WESTBOUND CARRIAGEWAY CLOSURE	
	TRAVEL TIME (MINUTES: SECONDS)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM ‘NO CLOSURE’ (%)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM ‘NO CLOSURE’ (%)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM ‘NO CLOSURE’ (%)
Airport Drive to Southern Cross Drive (citybound)	6:32	8:47	34%	8:46	34%	8:54	36%
Southern Cross Drive to Airport Drive (northwest bound)	7:41	17:15	124%	9:41	26%	17:39	130%
M5 West to Southern Cross Drive (citybound)	6:48	15:30	128%	10:58	61%	9:16	36%
Southern Cross Drive to M5 East (southwest bound)	7:32	18:42	148%	10:14	36%	19:18	156%

Table 8.10 Key route performance across all road closure scenario (midnight–1 am on weekend)

TRAVEL TIME ROUTE	NO CLOSURE TRAVEL TIME	FULL CLOSURE		EASTBOUND CARRIAGEWAY CLOSURE		WESTBOUND CARRIAGEWAY CLOSURE	
	TRAVEL TIME (MINUTES: SECONDS)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM 'NO CLOSURE' (%)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM 'NO CLOSURE' (%)	TRAVEL TIME (MINUTES: SECONDS)	INCREASE FROM 'NO CLOSURE' (%)
Airport Drive to Southern Cross Drive (citybound)	6:35	8:57	36%	8:43	32%	9:11	40%
Southern Cross Drive to Airport Drive (northwest bound)	7:39	11:40	52%	9:39	26%	12:18	61%
M5 West to Southern Cross Drive (citybound)	6:44	11:16	68%	10:49	61%	9:09	36%
Southern Cross Drive to M5 East (southwest bound)	7:20	13:41	86%	9:58	36%	14:10	93%

Public transport

Rail services

The road closure location on Southern Cross Drive is not within the vicinity of passenger rail lines. As such, there would be no expected impacts on the passenger rail network.

Bus services

There are currently no public transport bus services on Southern Cross Drive, as such the road closure would not directly impact them. However, bus services are currently available on Wentworth Avenue, which is the detour routes for the proposed road closure.

Regular bus service 400 and 420 conclude their service approximately around midnight and 1.00am respectively (Transport for NSW information website). Route 420N (night service), however continues to service the route, arriving hourly between 1.00 am and 5.00 am.

Buses may therefore experience slight delays through the proposed detour route, during the implementation of the road closure.

Active transport

There are no dedicated pedestrian or bicycle facilities on Southern Cross Drive. Active transport use however is typically done during daylight, outside of the proposed road closure period. However, this does not preclude any on-road bicycle access. As such, cyclists would be detoured in the same manner as motorised vehicles. It is considered that the proposed impact to the active transport mode in general would be minimal.

Taxi transport

Point-to-point transport modes would be subject to the same road network delays and detours as general traffic, described earlier in this section. However, as the major attractor/generator for point-to-point transport mode (Kingsford Smith Airport) would not be operating during the proposed road closure period, the impact to this mode is considered to be minimal.

Parking

All parking would be contained within the work site, presenting no impact on the surrounding roads.

8.4 Assessment of operational impacts

As described previously, the primary driver of the project is to support improved rail efficiency to and from Port Botany and enable more freight to be moved by rail to meet expected increases in freight demands over the long term.

Following completion of construction, the project is not expected to result in any permanent changes to the existing road network, pedestrian footpaths or bus networks. There would be no impacts during operational period given the project lies within the existing rail corridor which was allocated with the intent of duplication in the future. In addition, the project would not preclude the establishment of any new active transport corridors outside or adjacent to the current rail corridor.

The duplication of the Botany Line would unlock additional rail network capacity (with improved travel times through the Botany Line), resulting in a potential increase in the number of freight rail services supporting the movement of goods. By 2030, the Botany Duplication Project is expected to allow for increased freight movement on the Botany Line from the current average of about 20 trains per day (per direction) up to around 45 trains per day (per direction) by 2030, based on current and predicted operational requirements identified by ARTC.

The project also presents an opportunity to encourage a shift of freight transport from road towards rail. The increased rail capacity also has the potential to reduce the number of number of trucks in the region This would also support a potential reduction in the rate of growth in truck movements and associated traffic congestion around Sydney Airport and Port Botany. The reduction of heavy vehicle traffic on the road network would not only free up capacity for general traffic, it also has the potential to provide road safety advantages. Based on the data available in the NSW Freight and Ports Plan 2018–2023, the provision of a single 600-metre long freight train is roughly equivalent to the haulage capacity of around 54 trucks.

While overall there may not be any noticeable decrease in congestion levels on the road network, the cost of freight movement may decrease as freight is shifted from a mode which can be severely impacted by road network congestion to another which has no interaction with other modes. The increased efficiency of the existing rail line as a result of the project would be a vital part of the solution to encourage freight to be transported by rail, reducing the need to transport freight by road and therefore overall congestion on the roads around Port Botany and Sydney Airport.

8.5 Cumulative impacts

8.5.1 Cumulative construction impacts

Cumulative construction traffic, transport and access impacts may occur if construction on the project occurs at the same time as construction on other nearby projects. Table 8.11 summarises the potential cumulative construction traffic, transport and access impacts identified.

Table 8.11 Summary of cumulative construction traffic, transport and access impacts

PROJECT	POTENTIAL CUMULATIVE CONSTRUCTION TRAFFIC, TRANSPORT AND ACCESS IMPACTS
Sydney Gateway road project	Construction of the proposed Sydney Gateway project is expected to commence during the construction of the project, resulting in simultaneous construction. Construction of the two projects is likely to increase the overall level of traffic using the existing road network, increasing the potential impact and duration of the traffic delays and other impacts experienced by drivers and pedestrians/cyclists.
WestConnex Stage 3a (the M4–M5 Link)	The proposed opening of WestConnex Stage 3a (the M4–M5 Link) would have notable network impacts with the construction of the T2/T3 viaduct, which is proposed to begin in late 2022, and which coincides with the project's bridge construction works at Robey Street, O'Riordan Street and Southern Cross Drive. Construction (and subsequent operation) of the two projects would have the potential to result in increases to general traffic in the local area. Additionally, should the two projects not overlap directly, increased construction traffic fatigue may still be experienced by drivers, pedestrians and cyclists.
Qantas Flight Training Centre	Should construction of this facility overlap with construction of the project, the increased amount of traffic between the two projects is not expected to result in significant impacts on the existing traffic network.

PROJECT	POTENTIAL CUMULATIVE CONSTRUCTION TRAFFIC, TRANSPORT AND ACCESS IMPACTS
Airport North and Airport East upgrades	It is anticipated that both the Airport North and Airport East upgrade projects would be completed when the construction of the project begins. However, while not directly overlapping, construction fatigue from ongoing increases in traffic levels (as a result of ongoing construction works) may be experienced by drivers, pedestrians and cyclists.
F6 Extension – Stage 1	Should construction of this facility overlap with construction of the project, the increased amount of traffic between the two projects may result in increases to the overall level of traffic within the vicinity of the project (in particular at the western end of the project site).

Overall, it is likely that there would be some cumulative construction traffic impacts where construction of two (or more) of the identified projects are undertaken at the same time. The main cumulative impact would be associated with an overall potential increase in the amount of overall traffic using the local road network, rather than a specific increase in traffic at any one location.

Where more than one project occurs in the same area consecutively, there may also be a combined effect from the increased duration of impacts on nearby receivers. This effect is termed ‘construction fatigue’. There is the potential for construction traffic fatigue for drivers, pedestrians and cyclists who currently utilise the local road network. This is due to several consecutive and ongoing projects in the area including Airport East, Airport North, Sydney Gateway road project, Qantas Flight Training centre and the currently proposed project.

Further discussion regarding potential cumulative impacts is provided in section 5.4 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

8.5.2 Cumulative operational impacts

As discussed in section 8.5, it is not expected that the project would result in any ongoing impacts on the existing road network, pedestrian footpaths or bus networks during operation of the project. As such, it is not anticipated that there would be any ongoing cumulative impacts between the Botany Rail Duplication project and other known proposed projects.

8.6 Management of impacts

8.6.1 Approach

The identified traffic, transport and access impacts identified would be reduced through a number of mitigation measures. These measures would be detailed as part of a Construction Transport, Traffic and Access Management Plan (CTTAMP) as part of the project CEMP. The CTTAMP would include the guidelines, general requirements and principles of traffic management to be implemented during construction. It would be prepared in accordance with Austroads Guide to Road Design (Austroads 2019), the Roads and Maritime Services *Traffic Control at Work Sites* manual (RMS 2018b) and AS1742.3 (2009): *Manual of uniform traffic control devices – Part 3: Traffic control for works on roads*, and other relevant standards and guidelines. It would seek to minimise delays and disruptions as well as identify and respond to changes in road safety as a result of project construction works.

The CTTAMP would outline a process to develop site-specific Traffic Management Plans in consultation with Transport for NSW. Part of this process would be to facilitate relevant licenses and permits for road occupation.

Further details on the approach to management of environmental impacts is provided in Chapter 24.

8.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential traffic, transport and access impacts are listed in Table 8.12. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works. Further details regarding each of the identified mitigation measures are provided in section 6.2 to section 6.7 of *Technical Report 1 – Traffic and Transport Impact Assessment*.

Table 8.12 Traffic, transport and access mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Construction	General management of traffic during the project	Implementation of a CTTAMP for main construction works. As a minimum, the plan will include: • identification of haulage routes • notification and consultation strategy with public and relevant authorities/stakeholders • special event and emergency services management • parking restrictions • protocol for monitoring cumulative traffic impact. The CTTAMP will also consider cumulative construction impacts and define a suitable management approach. The CTTAMP will not be created for enabling works, however the relevant mitigation measures will form part of the site EMPs. *Note: relevant mitigation measures will form part of the site EMP(s) for enabling works.*	✓	✓
	Localised vehicular, pedestrian, cyclists and public transport management around site accesses	Provide suitably designed construction site access which will consider: • road design guidelines • visible temporary regulatory, warning and guide signs • use of accredited traffic controllers where appropriate • provision of deceleration lanes at access points for busy roads.	✓	✓
	Increased heavy vehicles in the road network	• Administrative controls to limit truck activities during peak periods. • Implement radio communication and designated truck idling areas to minimise impact of truck queuing on public roads. • Temporary traffic controls.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	On-street parking management	• Maximise parking at each site and compound. • Encourage carpooling/cycling/public transport. • Providing shuttle buses between off-site parking locations. • Providing shuttle buses between the two main on-site compounds and smaller construction compounds.	✓	✓
	Public transport services travel time	• Consultation with service providers to develop alternative service arrangements. • Notification to the general public prior to implementation of service changes. • Changes to services during possessions.		✓
	Active transport facility closures and diversions	• Ensure appropriate detours such as maintaining access on at-least one side of the road. • Provide safe access across site gates.		✓
	Reduced accessibility on the road network. Detour can result in increased travel time.	• Manage closures during off-peak periods. • Select a bus detour route that would minimise impacts on punctuality of bus services and public transport accessibility to the community. • Implement suitable traffic management during closures to manage and guide motorists at the approaches and through or around the work sites. • Public information campaigns. • Truck travel time management.		✓

8.6.3 Consideration of the interaction between measures

In addition to the measures for traffic, transport and access described above, there would be interactions between the mitigation measures for noise and vibration (Chapter 9) and socio-economic (Chapter 19).

All mitigation measures for the project will be consolidated and described in the relevant management plan. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures will be consolidated to ensure consistency and implementation.

8.6.4 Managing residual impacts

A residual risk analysis was undertaken considering the impact assessment summarised in this chapter and implementation of the mitigation measures as recommended in section 8.6.2.

Despite the measures identified, there would likely be some residual impacts associated with the construction of the project. This would include delays along the key routes within the study area as well as at key intersections during road closure periods. Some delays may also result from general construction traffic and haulage accessing the main construction compounds and satellite work sites.

The residual risk levels for potential traffic, transport and access issues are detailed in Appendix B.

9. NOISE AND VIBRATION

This chapter provides a summary of the noise and vibration assessment undertaken by SLR Consulting. A full copy of the assessment report is provided as *Technical Report 2 – Noise and Vibration Impact Assessment*.

9.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in *Technical Report 2 – Noise and Vibration Impact Assessment*.

9.1.1 Legislative and policy context to the assessment

Guidelines and policies for construction noise and vibration assessment

Interim Construction Noise Guideline (ICNG) (DECC, 2009)

The ICNG is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW. It contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The NMLs are not mandatory limits, however where construction noise levels are predicted to be or measured above the NMLs, feasible and reasonable work practices to minimise noise emissions should be investigated. The NMLs adopted for this noise assessment are outlined in section 9.2.3. 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 project (see section 9.3).

Other guidelines and policies

Other guidelines and policies relevant to the construction noise and vibration assessment for the project include:

- *Noise Policy for Industry* (NPfI) (EPA, 2017), which provides a method for assessing sleep disturbance and maximum noise level assessment, which was used in the selection of noise management levels and criteria (see section 9.2.3).
- *Road Noise Policy* (RNP) (DECCW, 2011), which provides a method for assessing construction traffic impacts on public roads, which was used in the construction traffic noise assessment (see section 9.3.2).
- *Assessing Vibration: a technical guideline* (DEC, 2006a), which is used to assess human comfort vibration impacts on sensitive receivers and was used in the construction vibration assessment (see section 9.3.3).
- *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors,* which provides recommended design sound levels for internal areas of occupied spaces (see Table 9.5).
- *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2* (BSI, 1993), which is used to assess vibration impacts (structural damage) on non-heritage sensitive structures (see section 9.3.3).
- *DIN 4150:Part 3 – 2016 Structural vibration – Effects of vibration on structures* (Deutsches Institute fur Normung, 1999), which is used to assess vibration impacts (structural damage) on heritage sensitive structures or where the structure is found to be unsound (see section 9.3.3).

Guidelines and policies for operational noise and vibration assessment

Rail Infrastructure Noise Guideline (RING) (EPA, 2013)

The RING is used to assess and manage potential airborne noise impact from the operation of new and redeveloped railway projects. The guideline provides non-mandatory 'trigger levels' for residential and other sensitive land uses. These trigger levels have been used to determine the criteria for the operational rail noise impact assessment (see section 9.4.1).

However, the RING does not provide specific criteria for hotels. Certain hotels may have people who reside permanently on site. Therefore, the RING residential criteria has been conservatively applied to hotels, noting that this assessment would only apply to areas of permanent residence within specific hotels. Other areas of hotels are considered commercial land uses, which do not have operational noise criteria as per the RING. The RING also provides ground-borne noise criteria for the operation of rail infrastructure projects. Ground-borne noise criteria only applies where internal ground-borne noise levels are higher than noise transmitted through the air. As discussed in section 9.4.1, the airborne noise impact is expected to be higher than the ground-borne noise impact for this project.

Other guidelines and policies

Other guidelines and policies relevant to the operational noise and vibration assessment for the project include:

- *Noise Prediction and Mitigation Guideline* (ARTC, 2018), which is an internal ARTC document that forms part of ARTC's Environmental Management System and provides guidance on the assessment and design of mitigation measures for ARTC projects (see section 9.6).
- *Assessing Vibration: a technical guideline* (DEC, 2006a), which is used to assess vibration impacts on sensitive receivers (see section 9.4.2).
- *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors,* which provides recommended design sound levels for internal areas of occupied spaces (see Table 9.5).

9.1.2 Methodology

Key tasks

The noise and vibration assessment involved:

- identifying noise and vibration sensitive receivers
- identifying existing noise and vibration levels in the study area by measuring the noise levels through:
  - unattended noise monitoring in June, September and October 2018 (the noise monitoring locations are shown in Figure 9.1)
  - short-term attended noise monitoring at each noise monitoring location
  - train pass-by noise measurements in June and July 2018 at seven locations (see Table 4 in *Technical Report 2 – Noise and Vibration Impact Assessment*) to determine existing operational rail noise
- establishing noise and vibration criteria and management levels to provide a basis for assessing the potential for impacts during construction and operation of the project
- identifying the main potential noise and vibration sources during construction and operation
- developing a noise and vibration model based on 13 representative construction scenarios (see section 9.3.1) to predict airborne noise generated during construction
- developing and validating a noise and vibration model to predict noise levels from operation of the project (see section 4.2 in *Technical Report 2 – Noise and Vibration Impact Assessment*)

- assessing the potential for noise and vibration to exceed the applicable criteria and impact on the amenity of sensitive receivers
- identifying noise and vibration mitigation measures.

A detailed description of the assessment methodology is provided in sections 2 and 4 of *Technical Report 2 – Noise and Vibration Impact Assessment*.

Study area

For the purpose of the noise assessment, the study area (the area surrounding the project site) was divided into eight noise catchment areas (NCAs) (see section 9.2.2).

9.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with noise and vibration. Potential risks were considered according to the impacts that may be generated by the construction or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology and full results, is provided in Appendix B.

The assessed risk level for potential noise and vibration risks (without mitigation) ranged from low to very high. Prior to assessment and identification of mitigation measures, risks with an assessed level of medium or above included:

- Very high:
  - noise impacts on local residents and sensitive receivers from out-of-hours construction activities
  - noise impacts on local residents and sensitive receivers from the operation of trains.
- High:
  - noise impacts on local residents and sensitive receivers from construction activities within standard work hours
  - noise impacts on local residents and sensitive receivers from out-of-hours construction traffic.
- Medium:
  - noise impacts on local residents and sensitive receivers from construction traffic during the day
  - damage to structures including heritage structures from vibration caused by construction activities.

These potential risks and impacts were considered as part of the assessment. This also considered matters identified by the SEARs and stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 9.6.4.

9.1.4 How potential impacts have been avoided or minimised

As described in sections 6.1.2 and 7.1.1, design development and construction planning have included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process.

The potential for construction noise and vibration impacts has been minimised by:

- locating the construction access points and construction traffic routes away from sensitive areas
- considering the surrounding land uses when defining the use and operation of specific site compounds
- locating construction compounds and other construction areas within the existing rail corridor wherever possible.

Potential noise and vibration impacts during operation have been minimised by proposing a lubrication procedure to reduce high frequency wheel squeal from operational trains. The procedure would involve the application of a friction modifying agent (lubricant) to the top running surface of the rail, where it would be picked up by the wheels of passing trains.

9.2 Existing environment

9.2.1 Overview

Existing noise levels at the project site are generally dominated by transportation noise, with road, rail and aircraft noise affecting most locations during the day. This is because the project site is located close to:

- Sydney Kingsford Smith Airport
- Major roads including Joyce Drive, Qantas Drive and O'Riordan Street in the northwest and Southern Cross Drive and Botany Road in the southeast
- The Botany Line (runs through the project site), which is an existing freight rail line.

During the evening and night-time, ambient noise levels typically decrease due to a reduction in road traffic volumes on the surrounding road network and flight curfew at Sydney Airport from 11:00 pm to 6:00 am.

The project site is also surrounded by areas of residential receivers in Mascot and Botany and commercial areas near Sydney Airport and Botany Road, where noise from light industrial activities is present as times.

9.2.2 Noise catchment areas

The study area for the noise assessment is made up of eight NCAs, which are described in Table 9.1 and shown on Figure 9.1. Receivers that are potentially sensitive to noise and vibration have been categorised on the basis of their use, which includes residential dwellings, commercial/industrial buildings or 'other sensitive' land uses, such as educational institutions, childcare centres, medical facilities, places of worship, outdoor recreation areas, etc. The locations of receivers and the receiver types are shown in Figure 9.1. Table 2 of *Technical Report 2 – Noise and Vibration Impact Assessment* provides further details on the other (non-residential) sensitive receivers within the study area.

Table 9.1 Noise catchment areas and surrounding land uses

NCA	DESCRIPTION OF NCA	OTHER SENSITIVE RECEIVERS WITHIN NCA
NCA01	Located to the north of the Botany Line and Sydney Airport. This catchment is mainly commercial with some distant residential receivers in the north, near Coward Street. A number of hotels are in this catchment, including the Stamford Plaza Hotel which is immediately north of the rail corridor. Robey Street Bridge and O'Riordan Street Bridge are in this catchment.	• Child care: Aero Kids Early Learning Centre, Toybox Early Learning • Place of worship: Citygate Fellowship Church • Hotel: Holiday Inn, Ibis Sydney Airport, Stamford Plaza Sydney Airport, Adina Apartments, Travelodge, Pullman Hostel • Outdoor passive: Coleman Reserve
NCA02	This catchment is south of the rail corridor and covers Sydney Airport. The catchment is mainly commercial with the Qantas Flight Training Centre to the west, and the Ibis Budget and Mantra Hotel near the Joyce Drive and O'Riordan Street intersection.	• Educational: Qantas Flight Training Centre • Hotel: Ibis Budget Sydney Airport, Mantra Hotel
NCA03	This catchment is located north of the rail corridor in Mascot and is mainly residential, with the nearest receivers opposite the rail corridor on Baxter Road. Two hotels, Quest Mascot and Felix Hotel, are located near O'Riordan Street.	• Educational: Mascot Public School • Library: Mascot Library • Hotel: The Branksome Hotel, Quest Mascot, Felix Hotel • Medical: Mascot Medical & Dental Centre • Outdoor passive: Robey Street Reserve, John Curtin Reserve
NCA04	Located east of the rail corridor in Mascot, north of Southern Cross Drive. The catchment is mainly residential with the nearest receivers being on Botany Road and McBurney Avenue. A commercial area is located near Wentworth Avenue and Botany Road. Southern Cross Drive Bridge is in the south extent of this NCA. Airport East construction works are currently being completed.	• None
NCA05	This catchment is north of the rail corridor and is the Eastlake Golf Course.	• Outdoor active: Eastlake Golf Course
NCA06	Located south of the rail corridor and to the south of Southern Cross Drive. The catchment is primarily commercial use. Mill Stream Bridge is located in the north of the catchment.	• Outdoor active: Botany Aquatic Centre, Booralee Park
NCA07	Located to the east of the rail corridor in Pagewood. This catchment is generally residential with the nearest receivers being adjacent to the project on Myrtle Street, Banksia Street and Ocean Street.	• Child care: Pagewood Kindergarten • Outdoor passive: Gaiarine Gardens
NCA08	Located to the west of the rail corridor in Botany. This catchment is mainly residential with the nearest receivers being adjacent to the project on Ellis Street, Morgan Street and Victoria Street.	• Outdoor active: Garnet Jackson Reserve

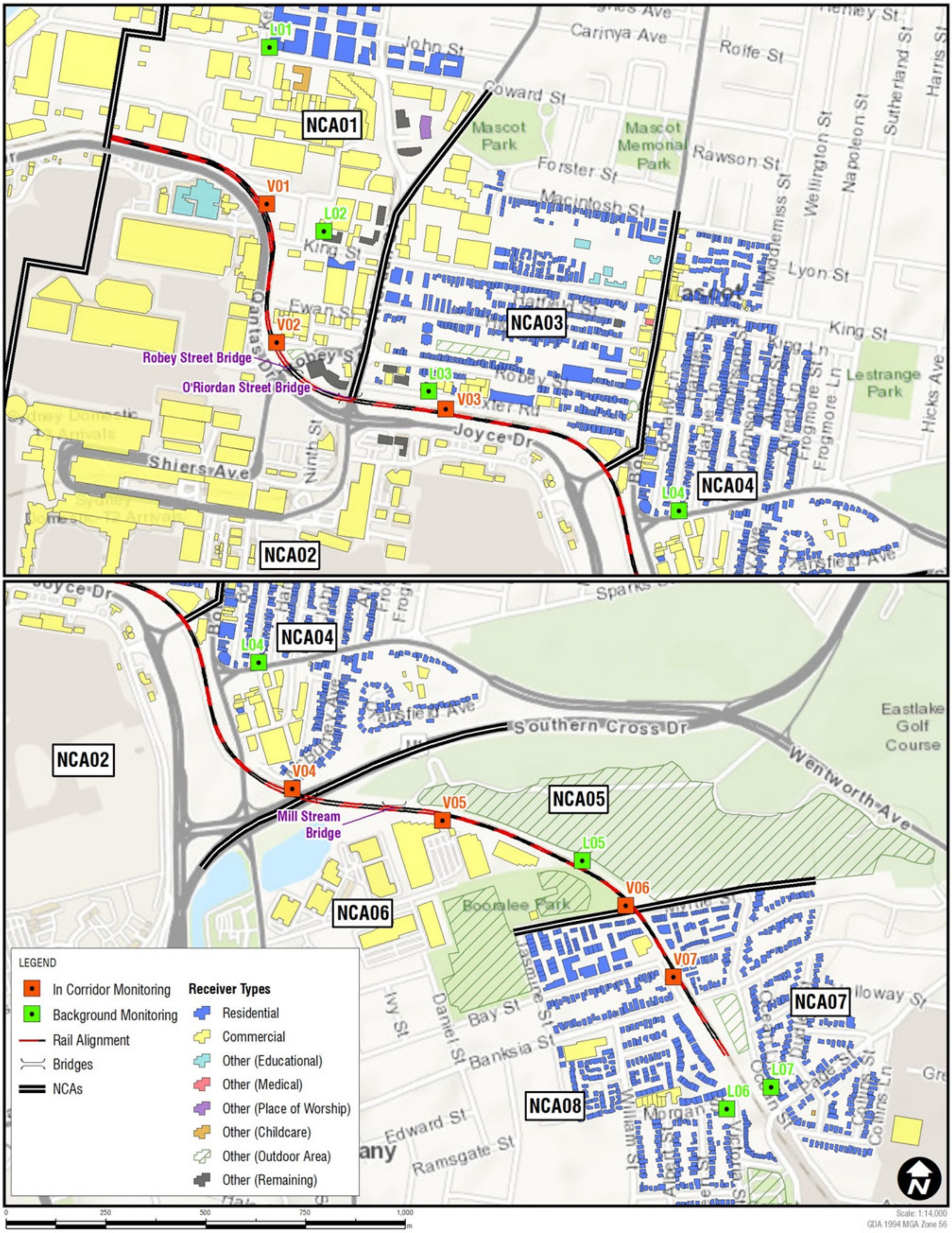


Figure 9.1 NCAs, receivers and noise monitoring locations within the noise assessment study area

9.2.3 Existing noise levels and noise management levels

Table 9.2 provides the noise levels that were measured during the unattended noise monitoring (see section 2.3 in *Technical Report 2 – Noise and Vibration Impact Assessment*). The noise monitoring locations (shown on Figure 9.1) were selected to measure background noise levels at front row receivers in each NCA. These locations would likely be most affected during construction of the project and represent the 'worst-case noise impacts' for the NCA.

The attended measurements (see section 2.4 in *Technical Report 2 – Noise and Vibration Impact Assessment*) were generally consistent with the results of the unattended noise monitoring and show that the existing noise levels are typically dominated by transportation sources including road, rail and aircraft noise, depending on location.

In addition, train pass-by levels were measured to determine the noise from existing rail operations on the Botany Line and validate the rail noise assessment model. Table 5 in *Technical Report 2 – Noise and Vibration Impact Assessment* presents the results of the train pass-by measurements.

The existing noise levels were used to develop project specific NMLs for residential receivers (see Table 9.3). NMLs for other receiver types are provided in Table 9.4 and Table 9.5.

Table 9.2 Summary of unattended noise logging results

ID	ADDRESS	MEASURED NOISE LEVEL (dBA)[1]					
		Background noise (RBL)			Average noise level (L_{Aeq})		
		Day	Evening	Night	Day	Evening	Night
L01	39 Kent Road, Botany	60	56	50	71	69	67
L02[2]	289 King Street, Mascot	60	58	53	68	66	64
L03	105 Baxter Road, Mascot	54	51	45	67	65	62
L04	87 Hardie Street, Mascot	57	54	48	69	66	64
L05	Eastlake Golf Club Pagewood	47	47 (49 actual)[3]	45	61	68	57
L06	13 Morgan Street, Botany	39	39 (41 actual)[3]	37	56	53	51
L07	38 Ocean Street, Pagewood	46	46	43	58	54	54

(1) Daytime is 7.00 am to 6.00 pm, evening is 6.00 pm to 10.00 pm and night-time is 10.00 pm to 7.00 am.
(2) This location was influenced by noise from nearby construction works.
(3) The monitored evening level was found to be higher than the daytime, therefore the NPfI requires that the evening level be reduced to match the daytime level.

Table 9.3 Residential receiver construction NMLs

NCA	REPRESENTATIVE BACKGROUND MONITORING LOCATION	NML ($L_{Aeq(15minute)}$ – dBA)				SLEEP DISTURBANCE SCREENING CRITERIA (RBL +15 dB)
		Standard construction (RBL +10 dB)	Out of hours (RBL +5 dB)			
		Daytime	Daytime[1]	Evening	Night-time	
NCA01	L01[2]	70	65	61	55	65
NCA02[3]	–	–	–	–	–	–
NCA03	L03	64	59	56	50	60
NCA04	L04	67	62	59	53	63
NCA05[3]	–	–	–	–	–	–
NCA06[3]	–	–	–	–	–	–
NCA07	L07	56	51	51	48	58
NCA08	L06	49	44	44	42	52

(1) Daytime out of hours includes 7.00 am to 8.00 am on Saturday, 1.00 pm to 6.00 pm on Saturday, and 8.00 am to 6.00 pm on Sunday and public holidays.

(2) NCA01 has two noise monitoring locations – L01 and L02. L01 has been used to set the NMLs for the catchment as it has lower background levels and results in more stringent criteria.

(3) NCA has no residential receivers.

Table 9.4 ICNG NMLs for other sensitive receivers

LAND USE	NML $L_{Aeq(15minute)}$ (APPLIED WHEN THE PROPERTY IS IN USE)
Classrooms at schools and other education institutions	Internal noise level 45 dBA[1]
Hospital wards and operating theatres	Internal noise level 45 dBA[1]
Places of Worship	Internal noise level 45 dBA[1]
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion)	External noise level 60 dBA
Community centres	Refer to the recommended 'maximum' internal levels in AS 2107 for specific uses
Commercial	External noise level 70 dBA

(1) The criterion is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows, and external noise levels are 10 dB higher than the corresponding internal level. This is representative of windows being partially open to provide ventilation. Hospital wards are assumed to have fixed windows with 20 dB higher external levels.

Table 9.5 AS2107 NMLs for other sensitive receivers

USE	PERIOD	AS2107 CLASSIFICATION	NML $L_{Aeq(15minute)}$
Hotel	Daytime and evening	Bars and lounges	Internal noise level 50 dBA[1]
	Night-time	Sleeping Areas: Hotels near major road	Internal noise level 40 dBA[1]
Library	When in use	Reading areas	Internal noise level 45 dBA[1]

(1) These receivers are assumed to have fixed windows with a conservative 20 dB reduction assumed for external to internal noise levels.

9.3 Assessment of construction impacts

9.3.1 Construction scenarios and equipment assessed

Table 9.6 describes the representative scenarios that have been developed to assess the likely noise impacts from the various construction phases of the project. These scenarios represent the 'worst-case', as it is assumed that several items of construction equipment would be in use at the same time at the closest point to each receiver. In reality, it is anticipated that the worst-case noise levels would only last for short periods of time during the construction duration, and there would be periods when no (or limited) noisy construction activities occur.

Table 9.6 Summary of construction scenarios modelled

ID	SCENARIO	TYPE OF WORK	DESCRIPTION
1a	Enabling Works – Billboard Demolition	Fixed	Enabling works would be required early on in the project to allow the main construction activities to occur. These works are expected to include: • billboard removal – several existing billboards on Qantas Drive and Joyce Drive would likely be impacted by the project and would require removal • utility relocation/protection – ground works to adjust, relocate or protect existing services • vegetation clearing and property adjustment – works required to remove existing vegetation and adjust property boundaries before starting the main works. Works using noise intensive equipment would be required at certain times and would include the use of concrete saws during billboard removal and utility works, and chain saws and chippers during vegetation removal.
1b	Enabling Works – Utilities	Progressive	
1c	Enabling Works – Vegetation Clearing & Property Adjustments	Progressive	
2a	Compounds – Establishment	Fixed	The main compounds would be near the level crossing off General Holmes Drive, which is an existing compound off Banksia Street within the existing rail corridor. The main compounds would include site offices, worker amenities and workforce parking. Smaller satellite compounds would be located along the alignment and have limited worker amenities. Groundworks would be required to establish the compounds. Operation of the compounds would last throughout construction and would include deliveries, storage of equipment and materials, and typical worker activities. Compound operation generally has no requirement for noise intensive equipment.
2b	Compounds – Operations	Fixed	

ID	SCENARIO	TYPE OF WORK	DESCRIPTION
3a	Bridge Works – Demolition (including rockbreakers)	Fixed	There are four bridge locations in the project site – Mill Stream bridge, Southern Cross bridge, O'Riordan Street bridge and Robey Street bridge. New bridge structures would be required at each location and demolition and replacement of the existing bridge would be required at O'Riordan Street and Robey Street. Works using noise intensive equipment would be required at certain times during bridge demolition and would include the use of concrete saws or rockbreakers.
3b	Bridge Works – Construction	Fixed	
4a	Retaining Walls – Construction	Progressive	Retaining wall works would be required where the alignment is on embankment. Retaining wall works would include: • excavation and preparation of foundations • piling works, including construction of piling platforms • installation of panels and reinforcement.
5a	Track Works – Peak	Progressive	The track works would involve the construction of new track, the upgrading of existing track and installation of new crossovers, turnouts and catchpoints. The works would vary but could include: • ground works to excavate, backfill and compact formation layer • installing concrete sleepers, rail and fastenings • ballast placing and tamping track to final height • cutting and welding rails. The works have been categorised into 'Peak' and 'Typical' works. An example of 'Peak' work includes the use of noise intensive equipment for shorter durations along the project site. These could be concrete saws or track machines including a ballast tamper or ballast regulator. 'Typical' works are representative of noise levels outside the worst-case when noise intensive equipment isn't being used.
5b	Track Works – Typical	Progressive	
6a	Signalling (including the CSR)	Progressive	The existing CSR would require adjustment and relocation due to the new track alignment. New signalling equipment would also be required in certain locations. Signalling and CSR works would include: • ground excavation • installation of conduit and cable pulling • excavation and installation of pits • installation of equipment. Signalling works generally have no requirement for noise intensive equipment.
6b	Testing, Commissioning & Finishing	Progressive	Testing and commissioning works are required for the new track and signalling equipment prior to operation. Finishing works would include: • removal of temporary fencing • landscape activities • removal of ancillary compounds. Testing, commissioning and finishing works generally have no requirement for noise intensive equipment.

The locations of the construction activities modelled in the scenarios are shown in Figure 9.2.

Construction of a majority of the project would be carried out during standard construction hours. Standard construction hours as defined in the ICNG are:

- Monday to Friday: 7.00 am to 6.00 pm
- Saturday: 8.00 am to 1.00 pm
- Sundays and public holidays: no work.

However, evening and night-time work would be required at certain times (or for certain activities) for the full duration of construction to minimise impacts on road, rail and air traffic, and for safety reasons. For example, the construction works for the Robey, O'Riordan and Mill Stream bridges are highly constrained by the operational Botany Line and major roads, and therefore would require evening and night-time work for safety and access. Therefore, out-of-hours work (OOHW, see section 4.1.1.1 in *Technical Report 2 – Noise and Vibration Impact Assessment*) has been included in the construction noise assessment, as all scenarios would likely require construction activities to occur outside of standard construction hours at some point.

Some of the construction scenarios are progressive (would move along the alignment and would not impact the same receivers for the duration of the scenario) and some are fixed works (works that would remain in one place and may impact the same receivers for duration of the scenario).

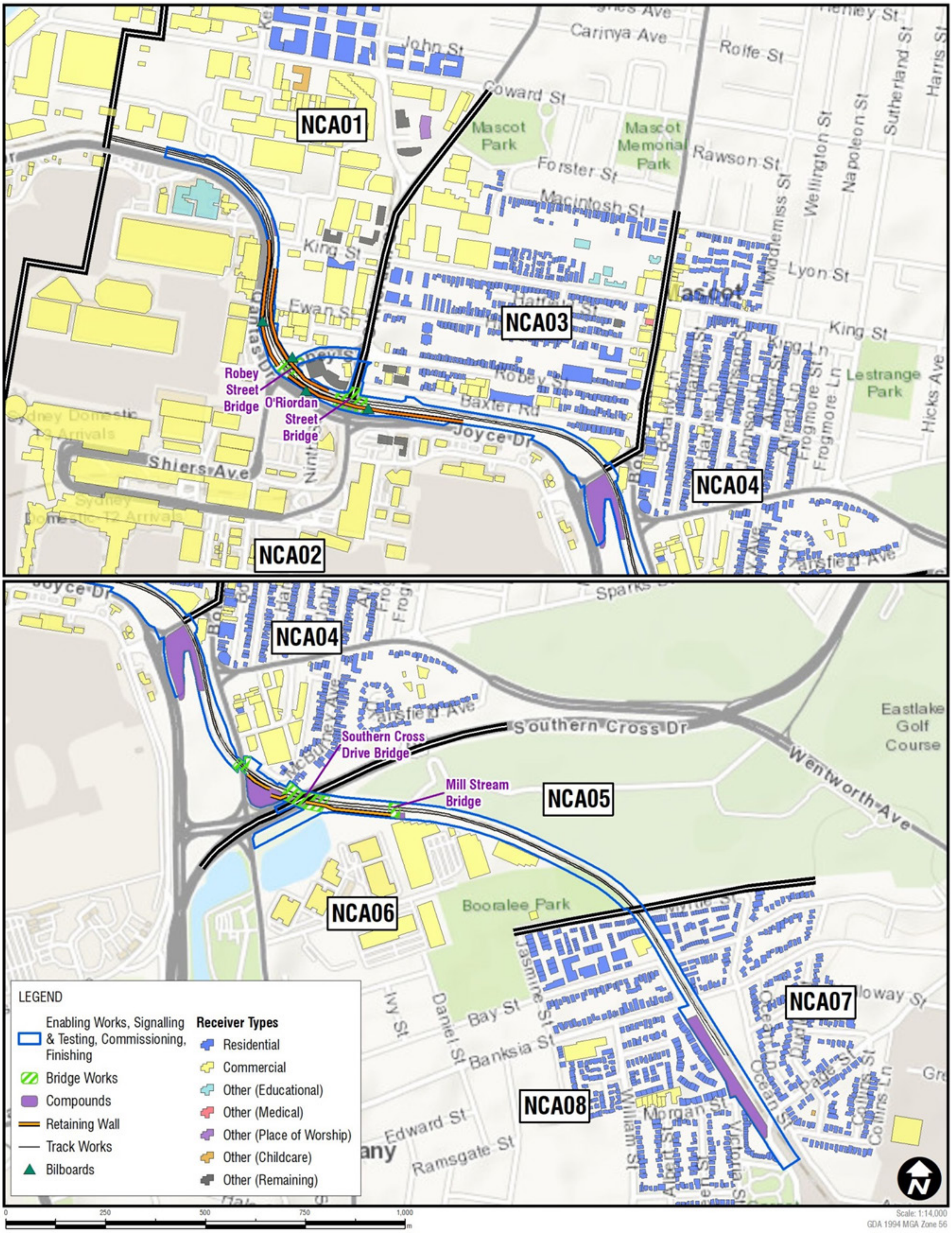


Figure 9.2 Location of construction works relative to NCAs and sensitive receivers

9.3.2 Construction noise assessment results

Predicted construction noise impacts on residential receivers

Table 9.7 presents the predicted exceedances of the adopted NMLs (see section 9.2.3) for residential receivers in each NCA during the construction scenarios outlined in section 9.3.1. The predicted construction noise level exceedances are presented for the most affected receiver within each NCA. This is conservative as receivers which are further away from the works and/or shielded from view would experience lower noise impacts.

Table 9.7 Predicted construction noise exceedances - residential receivers

PERIOD	ID	SCENARIO	CONSTRUCTION ACTIVITY	NCA01	NCA03	NCA04	NCA07	NCA08
Daytime	1a	Enabling Works	Billboard Demolition	·	●	·	·	·
	1b		Utilities	·	◆	◆	■	■
	1c		Veg. Clearing & Property Adjustment	·	◆	◆	■	■
	2a	Compounds	Establishment	·	·	·	●	■
	2b		Operations	·	·	·	·	◆
	3a	Bridge Works	Demolition (incl. rockbreaker)	·	●	◆	·	●
	3b		Construction	·	·	●	·	·
	4a	Retaining Walls	Construction	·	·	●	·	·
	5a	Track Works	Peak	·	◆	◆	■	■
	5b		Typical	·	·	·	●	◆
	6a	Signalling (incl. combined services route)		·	●	●	◆	■
	6b	Testing, Commissioning & Finishing		·	●	●	◆	■
Evening	1a	Enabling Works	Billboard Demolition	·	●	·	·	·
	1b		Utilities	●	■	◆	■	■
	1c		Veg. Clearing & Property Adjustment	●	■	■	■	■
	2a	Compounds	Establishment	·	·	·	●	■
	2b		Operations	·	·	·	·	◆
	3a	Bridge Works	Demolition (incl. rockbreaker)	·	◆	■	·	●
	3b		Construction	·	●	◆	·	·
	4a	Retaining Walls	Construction	·	●	◆	·	·
	5a	Track Works	Peak	●	■	■	■	■
	5b		Typical	·	●	●	◆	◆
	6a	Signalling (incl. combined services route)		·	◆	●	■	■
	6b	Testing, Commissioning & Finishing		·	◆	◆	■	■

PERIOD	ID	SCENARIO	CONSTRUCTION ACTIVITY	NCA01	NCA03	NCA04	NCA07	NCA08
Night-time	1a	Enabling Works	Billboard Demolition	·	◆	·	·	·
	1b		Utilities	●	■	■	■	■
	1c		Veg. Clearing & Property Adjustment	◆	■	■	■	■
	2a	Compounds	Establishment	·	●	●	◆	■
	2b		Operations	·	·	·	●	■
	3a	Bridge Works	Demolition (incl. rockbreaker)	●	◆	■	●	●
	3b		Construction	·	◆	■	·	●
	4a	Retaining Walls	Construction	●	◆	◆	·	●
	5a	Track Works	Peak	●	■	■	■	■
	5b		Typical	·	●	●	◆	■
	6a	Signalling (incl. combined services route)		·	◆	◆	■	■
	6b	Testing, Commissioning & Finishing		·	◆	◆	■	■

● Marginal to minor exceedance (1-10 dB) ◆ Moderate exceedance (11-20 dB) ■ High exceedance (>20 dB)
Cells with no coloured shape represent no exceedances of the NMLs
No results for NCA02, NCA05 or NCA06 are presented as there are no residential receivers within these NCAs

Scenarios resulting in the highest noise impacts

The results in Table 9.7 show that the highest noise impacts are predicted for scenarios that include use of noise intensive equipment such as rockbreakers, concrete saws or ballast tampers. This includes:

- Scenario 1b, Enabling Works – Utilities
- Scenario 1c, Enabling Works – Vegetation Clearing and Property Adjustment
- Scenario 2a, Compounds – Establishment
- Scenario 5a, Track Works – Peak
- Scenario 6a, Signalling including the combined services route
- Scenario 6b, Testing, Commissioning and Finishing.

Scenarios that do not require noise intensive equipment, such as Scenario 5b – Track Works – Typical, would generally result in considerably lower noise impacts than the worst-case scenarios predicted.

Figure 9.3 shows the locations of the predicted exceedances for the worst-case scenario, Scenario 1c – Enabling Works – Vegetation Clearing and Property Adjustment, which was identified to have the highest predicted noise levels, including the highest impacts for night-time work. During this scenario, high noise impacts are predicted to be experienced by the nearest receivers to the project site in most NCAs. However, the worst-case impacts would only occur for a relatively short period of time when noise intensive equipment is in use.

Several scenarios would require consecutive days of OOHW to minimise impacts on road, rail and air traffic and for safety reasons, which could result in sleep disturbance impacts at nearby receivers. These scenarios include (see section 5.6 in *Technical Report 2 – Noise and Vibration Impact Assessment*):

- Scenario 3b – Bridge Works – Construction, which would require major out-of-hours road closures for bridge construction at Southern Cross Drive.
- Scenario 3a – Bridge Works – Demolition, which would require major out-of-hours road closures for works near traffic lanes at Robey and O'Riordan Streets.
- Scenarios where works are required immediately adjacent to the active rail line. This would need to be carried out during morning rail possessions, such as Scenario 4a – Retaining Walls – Construction, Scenario 5a/b – Track Works, Scenario 6a – Signalling (including the CSR).

Scenario resulting in the longest duration noise impacts

The construction scenarios would occur for varying durations.

Scenario 2b – Compounds – Operation would occur for the longest period of time during the construction period compared to the other construction scenarios. This means that the noise impacts from Scenario 2b would be experienced for the longest period of time at surrounding sensitive receivers compared to the other scenarios. Scenario 2b is predicted to result in moderate to high noise level exceedances for the nearest row of residential receivers to the compound in NCA08, depending on the time of day.

Most affected residential receivers

NCA07 and NCA08 (located to the south of Eastlake Golf Course in Botany and Pagewood) would experience the highest noise impacts during construction of the project due to the close proximity of residential receivers in this area to the project site. These high noise impacts would be experienced at NCA07 and NCA08 during daytime, evening and night-time work for several construction scenarios.

NCA03 and NCA04 (located in Mascot near Joyce Drive and Botany Road) are also predicted to experience high noise impacts, however only during periods where evening or night-time work is required at these locations. During the daytime, the noise level exceedances at NCA03 and NCA04 are expected to be moderate to minor.

NCA01 is expected to experience some minor noise impacts during evening or night-time work.

The receivers which would potentially be affected by sleep disturbance impacts would generally be the same receivers where 'high' night-time impacts have been predicted.

Highly noise affected residential receivers

Residential receivers that are subject to noise levels of 75 dBA or greater are considered Highly Noise Affected by the ICNG. Highly noise affected residential receivers are predicted during:

- Scenario 1b – Enabling Works – Utilities within NCA08 (39 receivers), NCA07 (13 receivers), NCA04 (three receivers), NCA03 (three receivers)
- Scenario 1c – Enabling Works – Vegetation Clearing and Property Adjustment within NCA08 (72 receivers), NCA07 (32 receivers), NCA04 (8 receivers), NCA03 (11 receivers)
- Scenario 3a – Bridge Works – Demolition including rockbreaker within NCA04 (2 receivers)
- Scenario 3b – Bridge Works – Construction within NCA04 (one receiver)
- Scenario 5a – Track Works – Peak within NCA08 (40 receivers), NCA07 (21 receivers), NCA03 (seven receivers), NCA04 (four receivers)
- Scenario 6b – Testing, Commissioning and Finishing within NCA07 (one receiver).

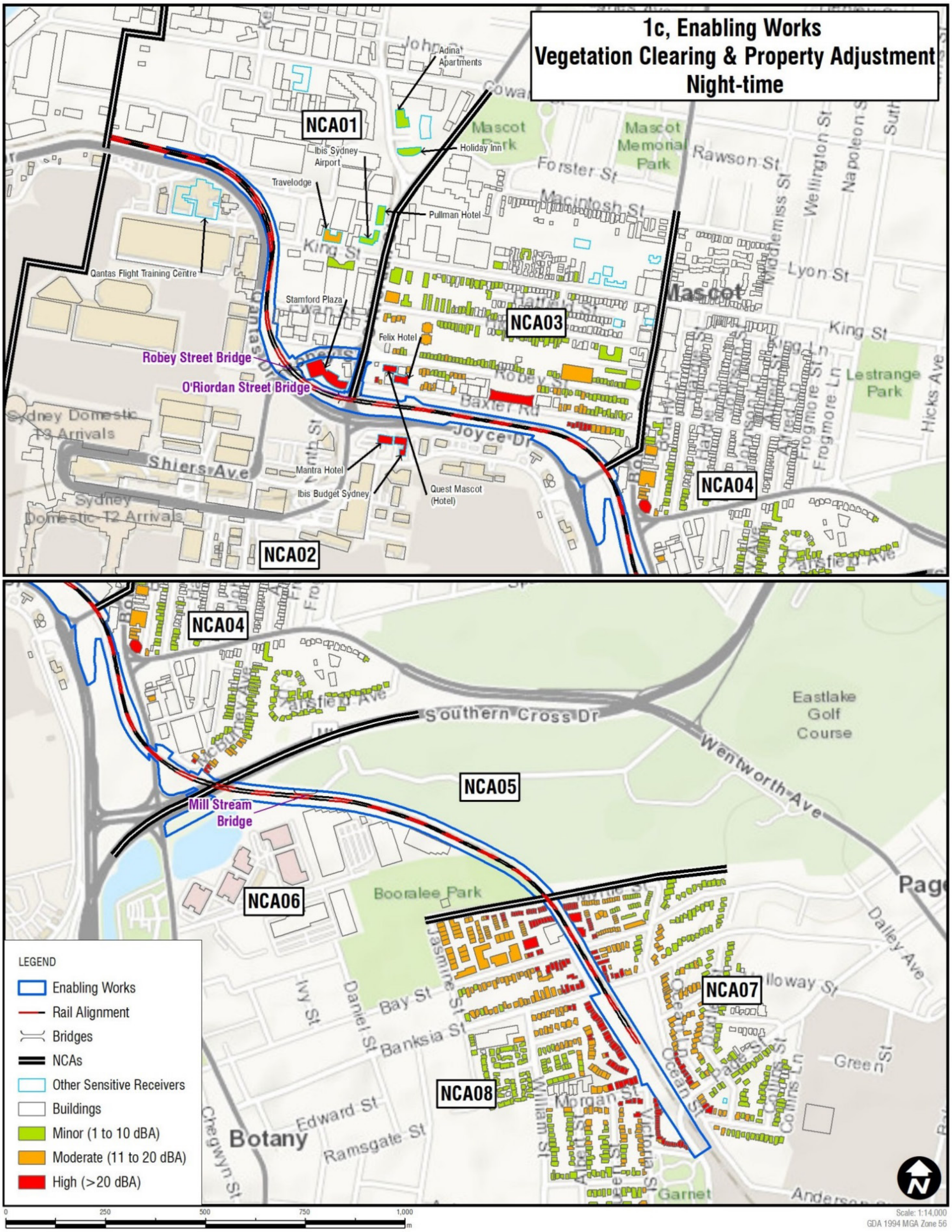


Figure 9.3 Predicted noise level exceedances for Scenario 1c during night-time work

Predicted construction noise impacts on other sensitive receivers

Table 9.8 presents the predicted exceedances of the adopted NMLs (see section 9.2.3) for the other sensitive receivers in each NCA during the construction scenarios outlined in section 9.3.1.

Figure 9.4 shows the locations of predicted noise level exceedances at other sensitive receivers during the worst-case scenarios. Similar to the assessment of residential impacts (see section 9.3.2), the worst-case scenarios include use of noise intensive equipment, which would only be typically used for short periods of time. The predicted noise levels without use of noise intensive equipment would be significantly lower.

During the worst-case scenarios, the following other sensitive receivers are predicted to experience high noise impacts from construction of the project:

- Stamford Plaza Hotel and Travelodge in NCA01
- Mantra Hotel and Ibis Budget Sydney Airport Hotel in NCA02
- Quest Hotel and Felix Hotel in NCA03
- The Qantas Flight Training Centre.

It is noted that a new hotel is proposed on Qantas Drive as part of the Sydney Airport T2/T3 Ground Access Solutions and Hotel project. This new hotel would be located around 60 metres south of the project site, which is a similar distance to the Mantra Hotel and Ibis Budget Hotel in NCA02. Should this hotel open during the construction of the project, the potential noise impacts would be comparable to the impacts predicted for the Mantra Hotel and Ibis Budget Hotel.

Another new hotel (the Holiday Inn) is also currently being constructed on Sarah Street in Mascot. If this hotel becomes operational during construction of the project, the potential construction noise impacts would be comparable to the impacts predicted for the Quest Hotel.

However, it is expected that the facade of the new hotels would be high performing, due to proximity to the airport, which would likely reduce the potential airborne construction noise impacts. The existing hotels listed above are also likely to have high performance facades and glazing due to high existing noise levels, which could potentially reduce construction noise to acceptable internal levels.

The Qantas Flight Training Centre provides flight training for pilots and cabin crew and operates continuously. It has several specialist flight simulators that are highly sensitive to noise impacts as they simulate aircraft warning sounds and events, which need to be easily discernible by pilots during training. However, it is noted that Qantas are proposing to relocate the centre to King Street in Mascot around 40 metres from the project site. If operational, the new centre could potentially be subject to high noise impacts during construction of this project. However, it is anticipated that the new centre would be constructed with appropriate facades to manage the high existing noise levels from the Botany Line and Sydney Airport, which would also likely mitigate the potential construction noise impacts from this project.

During the worst-case scenarios, the following other sensitive receivers are predicted to experience moderate or minor noise impacts from construction of the project:

- Aero Kids Early Learning Centre in NCA01
- Eastlake Golf Course in NCA05
- Booralee Park in NCA06
- Pagewood Kindergarten and Gaiarine Gardens in NCA07
- Other hotels within the study area.

The remaining ‘other sensitive’ receivers identified are not expected to experience noise impacts from construction of the project.

Table 9.8 Predicted construction noise exceedances – other sensitive receivers

ID	SCENARIO	ACTIVITY	NUMBER OF RECEIVERS Educational			Medical			Place of Worship			Child Care			Library			Outdoor Active			Outdoor Passive			Hotels – Daytime			Hotels – Night-time		
			1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Enabling Works	Billboard Demolition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	1	-	3	3	1
1b		Utilities	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	1	1	-	1	4	1	4	1	5
1c		Clearing and Property Adjustment	1	-	1	-	-	-	-	-	-	1	1	-	-	-	-	2	-	-	-	1	1	2	5	1	2	2	6
2a	Compounds	Establishment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-
2b		Operations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
3a	Bridge Works	Demolition (incl. rockbreaker)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	3	-	4	2	3
3b		Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	4	-	-	1	4	-
4a	Retaining Walls	Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	4	1	-	3	4	1
5a	Track Works	Peak	-	-	1	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	2	-	1	4	1	4	1	5
5b		Typical	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	4	1	-
6a	Signalling (incl. combined services route)		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	4	-	-	2	4	-
6b	Testing, Commissioning & Finishing		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	4	1	-	1	4	1

Cells with no number represent no exceedances of the NMLs

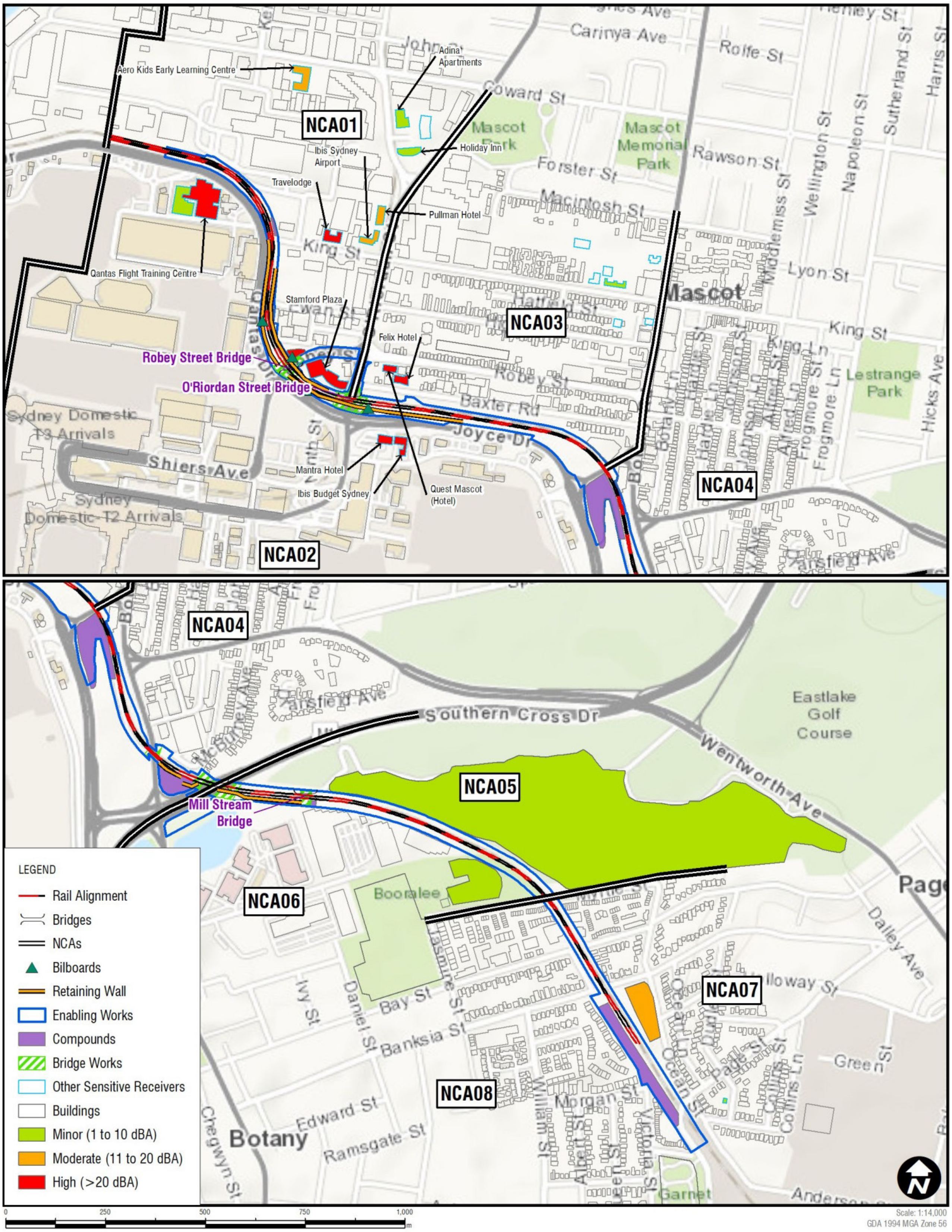


Figure 9.4 Predicted noise exceedances at other sensitive receivers during the worst-case scenario

Predicted construction noise impacts on commercial receivers

The assessment predicted that no commercial receivers within the study area would experience high noise impacts during construction of the project. However, several commercial receivers would experience moderate noise impacts including during:

- Scenario 1b, Enabling Works – Utilities for commercial receivers in NCA03, NCA04 and NCA08
- Scenario 1c, Enabling Works – Vegetation Clearing and Property Adjustment for commercial receivers in NCA01, NCA02, NCA03, NCA04, NCA06 and NCA08
- Scenario 3a, Bridge Works – Demolition (incl. rockbreaker) for commercial receivers in NCA06
- Scenario 5a, Track Works – Peak for commercial receivers in NCA01, NCA02, NCA03, NCA04, NCA06 and NCA08.

Figure 9.5 shows the locations of predicted worst-case construction noise impacts on commercial receivers.

Construction traffic noise assessment

The construction of the project would result in a temporary increase in the number of vehicles on roads surrounding the project site due to construction worker vehicles and material pick-up and deliveries. This has the potential to temporarily increase the existing road traffic noise levels on roads used by construction related traffic.

As shown on Figure 9.6, it is expected that the existing road traffic noise levels on major roads surrounding the project would only increase by up to 1 dBA due to construction related traffic. Therefore, construction traffic is unlikely to result in a noticeable increase in traffic noise levels. This is due to the high existing volumes of traffic that currently use the assessed routes.

However, if construction vehicles use smaller local roads to access the project site (which were not assessed as potential haulage routes in this assessment), there may be a noticeable increase in road traffic noise as the existing traffic volumes and corresponding traffic noise levels are likely to be relatively low on these roads. This potential impact is unlikely, as local road usage would be avoided where possible during construction of the project.

There would potentially be a requirement to close certain roads and traffic lanes during construction to allow works to be completed in a safe manner and to ease space constraints (refer to section 8.3). The potential impacts to receivers from detour traffic has been evaluated qualitatively and are summarised in Table 9.9.

Table 9.9 Qualitative noise impacts from detours

CLOSURE	ROADS USED FOR DETOUR	POTENTIAL IMPACTS
Robey Street or O'Riordan Street	Joyce Drive, General Holmes Drive, Wentworth Avenue, Botany Road, Robey Street	The majority of the proposed detour routes are busy arterial roads with high existing traffic volumes and few adjacent sensitive receivers, meaning the potential noise impacts are likely to be relatively minor. An exception to this is Robey Street, which has a much lower volume of existing traffic and residential receivers in close proximity. Road traffic noise levels on Robey Street would potentially be increased by >2.0 dB during detour periods.
Southern Cross Drive	Wentworth Avenue, General Holmes Drive, Joyce Drive, Qantas Drive	The majority of the proposed detour routes are busy arterial roads with high existing traffic volumes and few adjacent sensitive receivers. Wentworth Avenue does have adjacent residential receivers, however, existing volumes on this road are generally high. The potential noise impacts during detours of Southern Cross Drive are likely to be relatively minor.

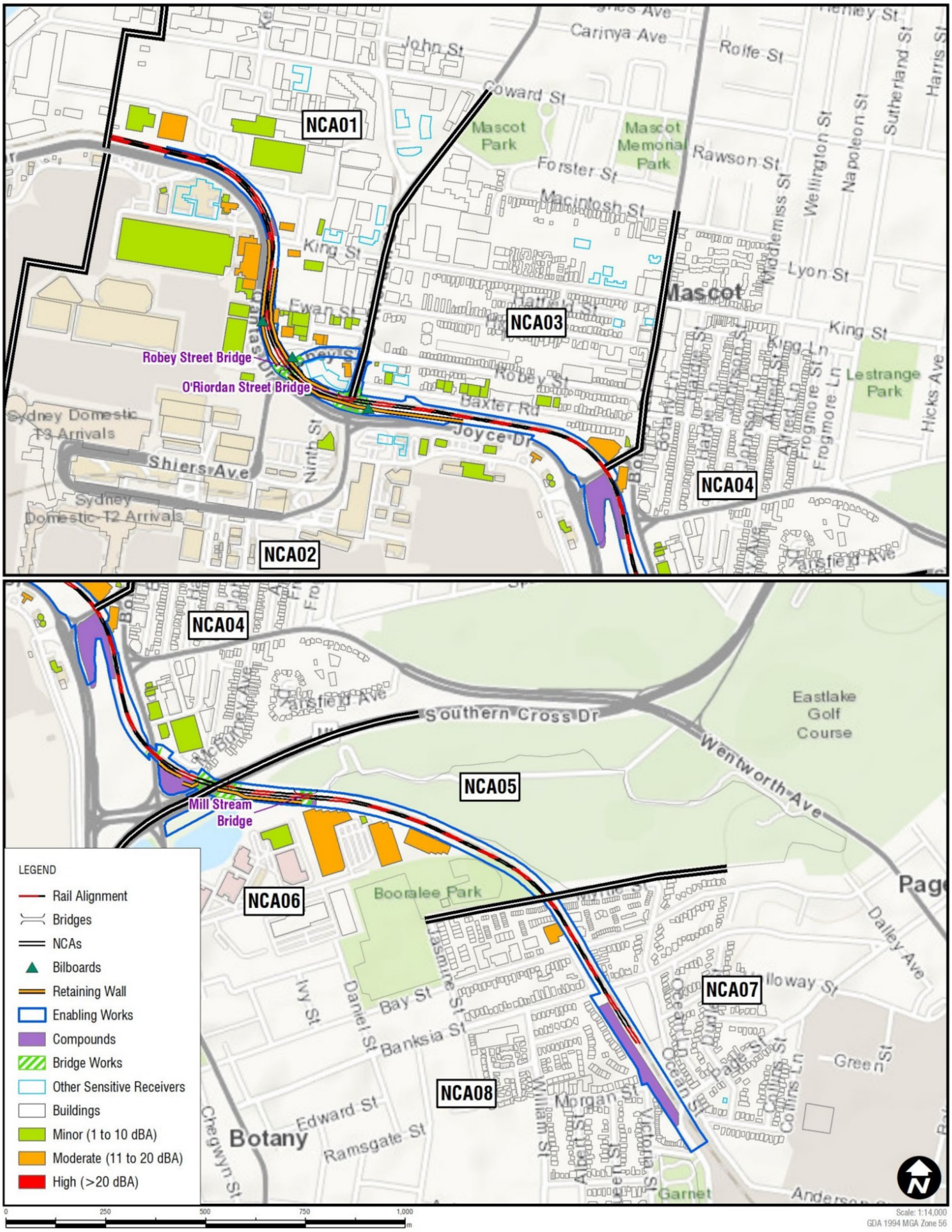


Figure 9.5 Predicted noise exceedances at commercial receivers during the worst-case scenario

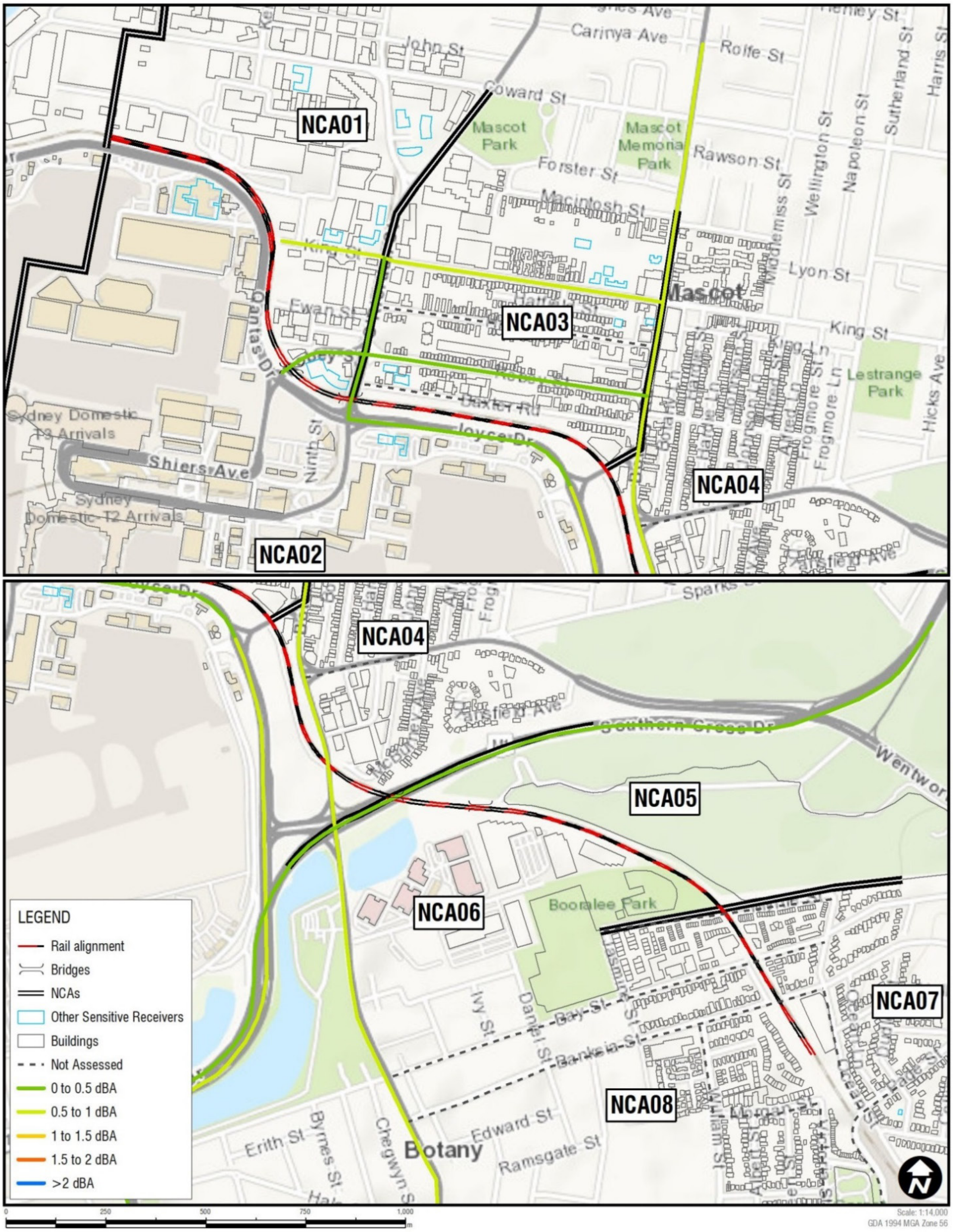


Figure 9.6 Predicted road traffic noise impacts from construction traffic

The locations of the construction activities modelled in the scenarios are shown in Figure 9.2.

Construction of a majority of the project would be carried out during standard construction hours. Standard construction hours as defined in the ICNG are:

- Monday to Friday: 7.00 am to 6.00 pm
- Saturday: 8.00 am to 1.00 pm
- Sundays and public holidays: no work.

However, evening and night-time work would be required at certain times (or for certain activities) for the full duration of construction to minimise impacts on road, rail and air traffic, and for safety reasons. For example, the construction works for the Robey, O'Riordan and Mill Stream bridges are highly constrained by the operational Botany Line and major roads, and therefore would require evening and night-time work for safety and access. Therefore, out-of-hours work (OOHW, see section 4.1.1.1 in *Technical Report 2 – Noise and Vibration Impact Assessment*) has been included in the construction noise assessment, as all scenarios would likely require construction activities to occur outside of standard construction hours at some point.

Some of the construction scenarios are progressive (would move along the alignment and would not impact the same receivers for the duration of the scenario) and some are fixed works (works that would remain in one place and may impact the same receivers for duration of the scenario).

9.3.3 Construction vibration assessment results

The main potential sources of vibration from the construction works would include vibratory rollers and rockbreakers. To assess the potential for construction vibration impacts, vibration offset distances have been estimated from the recommended minimum working distances for cosmetic damage (from BS7385 (BSI 1993) and DIN4150-3 (DIN 1993) and human comfort (from *Assessing Vibration: a technical guideline* (DEC, 2006a) (see section 3.1.1.6 in *Technical Report 2 – Noise and Vibration Impact Assessment*).

Figure 9.7 shows the locations surrounding the project site that may experience cosmetic damage or human comfort vibration related impacts from construction of the project.

Potential cosmetic damage vibration impacts

In general, the distance between the project site and nearest sensitive receivers is considered to be large enough to prevent cosmetic damage impacts. However, as shown on Figure 9.7, some buildings are located within the minimum recommended working distance for cosmetic damage. These buildings include:

- residential buildings near Myrtle Street, Ellis Street and Banksia Street in Botany
- six heritage items including:
  - Mascot (Robey Street) Underbridge in NCA01
  - Mascot (O'Riordan Street) Underbridge in NCA01
  - Sydney (Kingsford Smith) Airport Group in NCA02
  - Commonwealth Water Pumping and Sewerage Pumping Station in NCA02
  - Railway Bridge over Botany Road in NCA04
  - Botany Water Reserves in NCA05/NCA06.

The buildings listed above may experience cosmetic damage vibration related impacts, however the potential for this to occur would be minimised through implementation of management and mitigation measures (see section 9.6).

Additionally, three of the heritage items are rail bridges and therefore are not expected to be overly sensitive to potential vibration impacts from nearby construction works. BS 7385 states that 'a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive', which indicates that structures should not be assumed to be sensitive to vibration on the basis of being a heritage item alone.

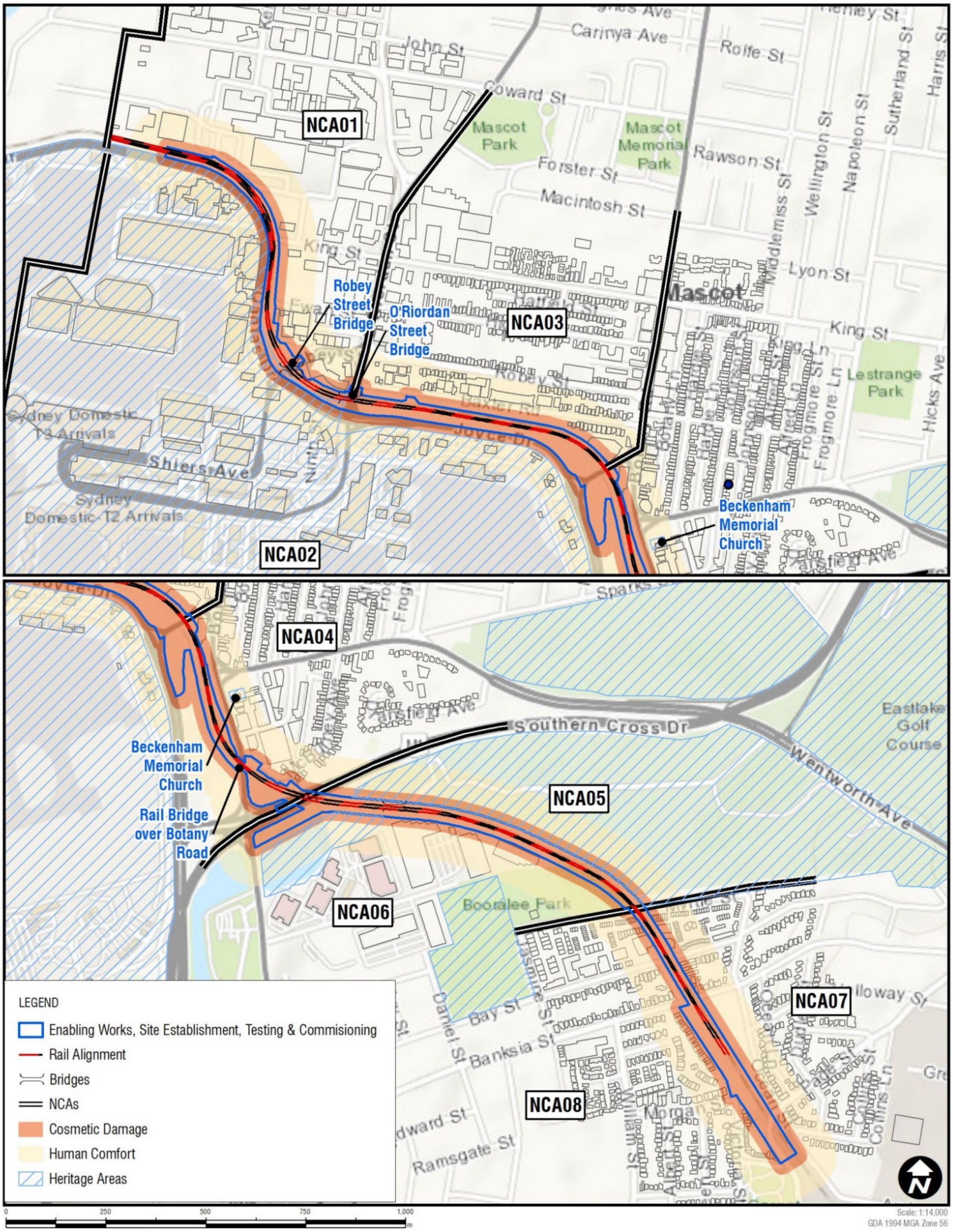


Figure 9.7 Potential construction vibration impacts during construction of the project

Potential human comfort vibration impacts

As shown on Figure 9.7, several sensitive receivers near the project site are within the human comfort minimum working distance. Occupants of these affected buildings may be able to perceive vibration impacts at times, when vibration generating equipment is in use. However, these impacts are likely to occur for relatively short durations when equipment such as rockbreakers or vibratory rollers are in use nearby.

9.4 Assessment of operational impacts

9.4.1 Overview of rail noise impacts during operation

Operational rail noise impacts have been predicted for all identified sensitive receivers in the study area. Figure 9.8 shows the location of residential and non-residential receivers that are predicted to experience noise levels above the adopted RING trigger levels. Operational rail noise contours are provided in Appendix D of *Technical Report 2 – Noise and Vibration Impact Assessment*.

In general, the operation of the project would result in increased rail noise levels due to:

- increased train speeds through the project site, which increases rail noise levels adjacent to the project and also increases the occurrence and noise level of trains going around curves
- a higher volume of trains predicted to use the project site
- the new track being closer to certain receivers. This is generally limited to receivers to the south of the alignment in NCA08, near Myrtle Street in Botany.

Further discussion on the predicted noise levels and the impacts on sensitive receivers is provided in the sections below.

The potential rail noise impacts from operation of the project would be higher in the 2034 future design scenario compared to in the 2024 project opening scenario, due to the assumption that more trains would use the Botany Line in the future. Therefore, the 2034 future design scenario has been assessed to consider the worst-case impacts from operation of the project.

Predicted rail noise impacts on residential receivers

Table 9.10 summarises the predicted rail noise levels and noise level increases, respectively, at residential receivers for the 2024 at-opening and 2034 design year scenarios. The tables show the highest noise levels in each NCA, which is typically at receivers nearest to the project site. There are no results for NCA02, NCA05 and NCA06 as these NCAs do not contain residential receivers. The locations of the exceedances are shown on Figure 9.8.

The results show the following:

- The existing rail noise levels in the study area are already high in most NCAs, where receivers are close to the rail tracks.
- The project is predicted to increase rail noise levels by up to 8 dB for maximum noise levels and up to 3 dB for daytime and night-time L_{Aeq} noise levels.
- The residential noise trigger levels are predicted to be exceeded in all NCAs, particularly due to exceedances of the maximum noise level criteria.
- In total, 182 exceedances of the noise trigger levels are predicted to occur in both the 2024 ‘at opening’ and 2034 ‘design year’ scenarios based on the current design of the project.
- Most noise level exceedances are predicted to occur in NCA03 (43 exceedances), NCA04 (52 exceedances), NCA07 (39 exceedances) and NCA08 (47 exceedances), because the residential receivers are closely grouped and located adjacent to curved track.
- The L_{Aeq} daytime and night-time noise levels increase by a greater degree for the 2034 scenario, compared to the at opening scenario, due to more train services being predicted by 2034.

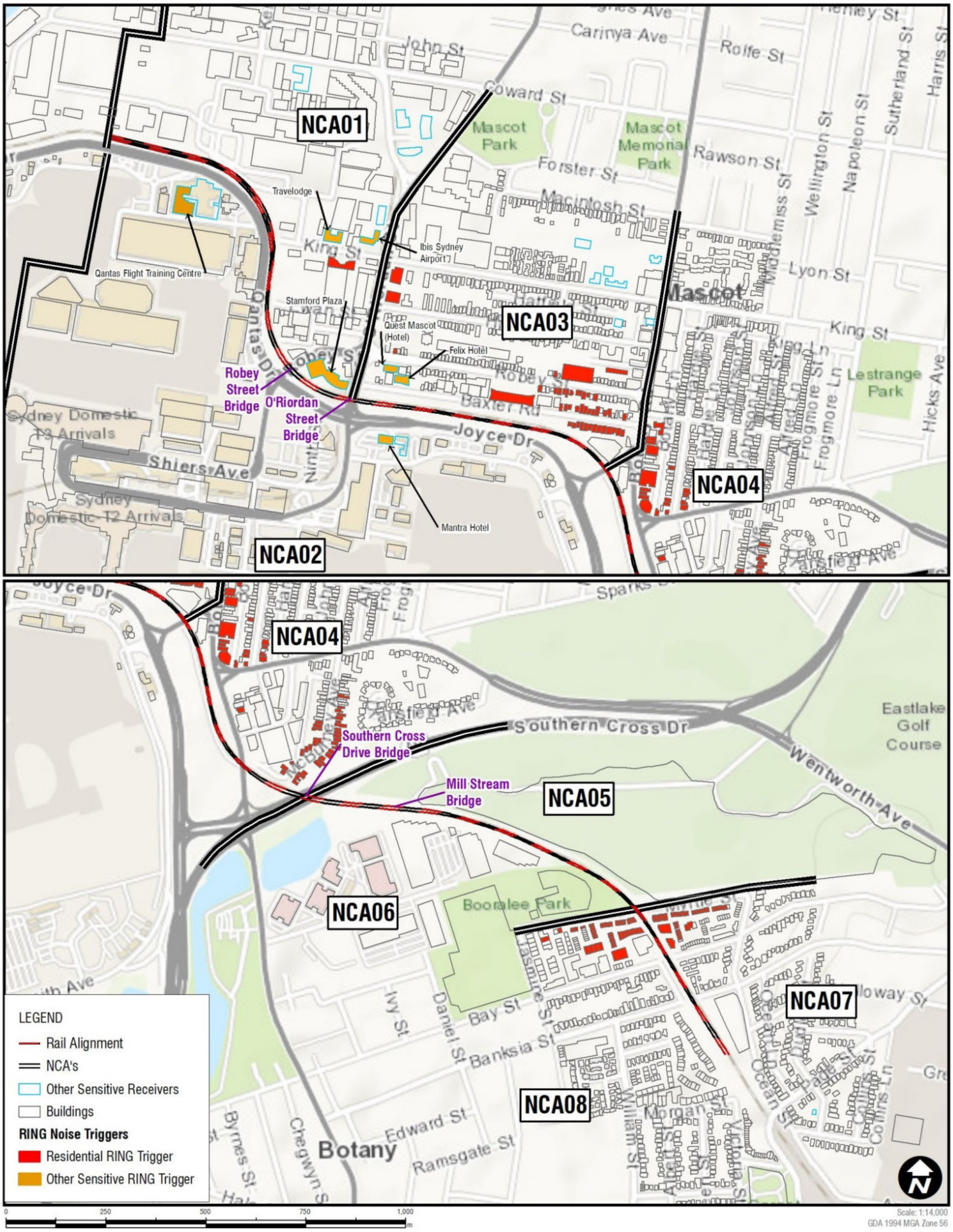


Figure 9.8 Locations of predicted RING noise trigger level exceedances during operation

Table 9.10 Summary of the predicted Operational Rail Noise Levels at Residential Receivers in each NCA

NCA	PREDICTED NOISE LEVEL (dBA)[1]												NUMBER OF RECEIVERS (2034)						
	Daytime LAeq(15hour)				Night-time LAeq(9hour)				Maximum LAmax[2]										
	At opening (2024)		Design year (2034)		At opening (2024)		Design year (2034)		At opening (2024)		Design year (2034)		Number of receivers with predicted exceedances of noise level criteria[3]			Number of receivers with noise level increases over the trigger level[4]			Receivers above both trigger levels
	Without project	With project	Without project	With project	Without project	With project	Without project	With project	Without project	With project	Without project	With project	Day	Night	Max	Day	Night	Max	-
Criteria[3]	**65**	**65**	**65**	**65**	**60**	**60**	**60**	**60**	**85**	**85**	**85**	**85**	**65**	**60**	**85**	**-**	**-**	**-**	-
NCA01	62	64	62	65	61	64	62	66	90	95	90	95	-	1	1	22	22	22	**1**
NCA03	70	72	71	73	70	72	71	73	99	104	99	104	19	37	57	268	276	274	**43**
NCA04	67	68	67	70	68	69	69	71	100	106	100	106	11	29	52	420	433	457	**52**
NCA07	65	66	65	67	69	70	70	72	101	106	101	106	30	98	107	16	39	105	**39**
NCA08	71	73	72	74	71	73	72	75	99	105	99	105	49	106	127	30	38	134	**47**
TOTAL NUMBER OF RECEIVERS FOR FURTHER CONSIDERATION OF MITIGATION[5]																			182

(1) The results are for the receiver with the highest predicted noise level in the controlling 2034 'with project' scenario in each NCA for the daytime, night-time and maximum noise levels. As such the daytime, night-time and maximum results may be for a different receiver in the same NCA. The receiver with the highest predicted 2034 'with project' noise level may not be subject to the largest increase in noise from the project in that NCA.

(2) Maximum refers to the LAmax noise level and applies to both the daytime and night-time

(3) RING residential absolute noise trigger level criteria for redeveloped rail projects

(4) Predicted noise level increases of the existing daytime or night-time rail noise levels by 2 dB or more, or the existing LAmax rail noise levels by 3 dB or more

(5) Mitigation measures should be investigated for receivers that are predicted to experience noise levels above both the RING residential absolute noise trigger level criteria and RING noise level increase trigger level.

In addition, 45 residential receivers in the study area are predicted to exceed the night-time ground-borne noise trigger level of 35 dBA by up to 5 dB (refer to section 6.5 in *Technical Report 2 – Noise and Vibration Impact Assessment*). The triggered receivers are generally within 10 to 20 metres of the rail track or near where the new rail crossovers are proposed to be installed. However, for these receivers, the external airborne noise impacts (as summarised in Table 9.10) are expected to dominate over the ground-borne noise impacts.

Predicted rail noise impacts on other sensitive receivers

Table 9.11 summarises the predicted rail noise levels and noise level increases at 'other sensitive' receivers for the 2034 design year scenario. As discussed in section 9.1.1, hotels have been conservatively assessed under the residential criteria provided in the RING, as they may have areas of permanent residence. However, for other areas of hotels, or hotels without any areas of permanent residence, the RING does not apply.

The locations of the exceedances are shown on Figure 9.8.

The results show the following:

- The noise levels are predicted to exceed the maximum noise trigger levels at all six hotels assessed in the study area, including three hotels in NCA01, one hotel in NCA02 and two hotels in NCA03. However, only areas of permanent residence in hotels require consideration of mitigation (refer to section 3.1.2 in *Technical Report 2 – Noise and Vibration Impact Assessment*).
- The absolute daytime and night-time L_{Aeq} noise levels are predicted to exceed the noise criteria for a number of the hotels (including the future new airport hotel, refer to section 9.3.2).
- Noise levels at the existing Qantas Flight Training Centre in NCA02, which has been assessed as an educational receiver, are predicted to be above the noise trigger levels.

Table 9.11 Predicted noise levels and increases for other sensitive receivers

NCA	RECEIVER	DESIGN YEAR (2034)					
		Predicted noise level[1] (dBA)			Increase in noise level compared to existing noise level (dB)		
		Day	Night	Max	Day	Night	Max
Hotels							
	Criteria[2]	***65***	***60***	***85***	***2.0***	***2.0***	***3.0***
NCA01	Ibis Sydney Airport	57	57	**87**	**2.9**	**3.0**	**6.4**
	Travelodge Sydney Airport	**66**	**63**	**93**	**3.2**	**3.7**	**6.8**
	Stamford Plaza Hotel	**71**	**71**	**107**	**3.0**	**3.1**	**5.1**
NCA02	Mantra Hotel	65	**63**	**87**	1.6	**2.5**	**5.6**
NCA03	Quest Mascot	64	**63**	**86**	1.3	**2.2**	**6.4**
	Felix Hotel	**66**	**66**	**86**	0.9	1.0	**5.4**
Educational							
	Criteria[2]	***55***	***55***	n/a	***2.0***	***2.0***	n/a
NCA02	Qantas Flight Training Centre	**67**	**67**	n/a	**2.1**	1.9	n/a

(1) The results represent the façade of the receiver with the highest noise level increase.
(2) Criteria is the corresponding external level for redeveloped rail projects.
(3) Red text indicates exceedances of the adopted noise level criteria.

Predicted rail noise impacts on future developments

As discussed in section 9.3.2, Qantas is proposing to relocate its existing Qantas Flight Training Centre to King Street in Mascot around 40 metres from the project site. During operation, the new centre could be impacted by wheel squeal and other noise from trains operating on the curves between Lancastrian Road and O'Riordan Street. This could result in daytime and night-time LAeq noise levels of up to around 75 dBA and maximum noise levels of over 100 dBA at the future centre. However, it is expected that the façades of the Qantas Flight Training Centre would be high performing, due to high existing noise levels in the area, which would likely reduce the potential airborne construction noise impacts.

A new hotel on Qantas Drive between Seventh and Ninth Street is proposed around 60 metres to the south of the project site. Operational rail noise impacts on the future hotel would be similar in nature to the nearby Stamford Hotel. Daytime and night-time LAeq noise levels of around 70 dBA, and maximum noise levels of above 100 dBA are predicted at the future building.

A new hotel is also currently being constructed on Sarah Street in Mascot. The potential operational rail noise impacts at this new hotel would be comparable to the impacts predicted for the Quest Mascot, meaning areas of permanent residence in the hotel would likely require consideration of noise mitigation.

Noise from idling locomotives

Freight trains typically leave their engines idling while waiting to be passed, resulting in the generation of noise from the stationary locomotive. The project involves the duplication of an existing rail line, which minimises the need for trains to stop and idle while other trains use the existing single-track section of the Botany Line within the project site.

9.4.2 Operational vibration assessment

Figure 9.9 presents a summary of the predicted vibration dose values for residential receivers within the study area in the 2034 scenario. The results show that the vibration levels predicted from the project are not expected to exceed the adopted daytime or night-time criteria for cosmetic damage. As a result, no cosmetic damage or human comfort vibration related impacts are expected and consideration of specific vibration mitigation measures for the project is not required.

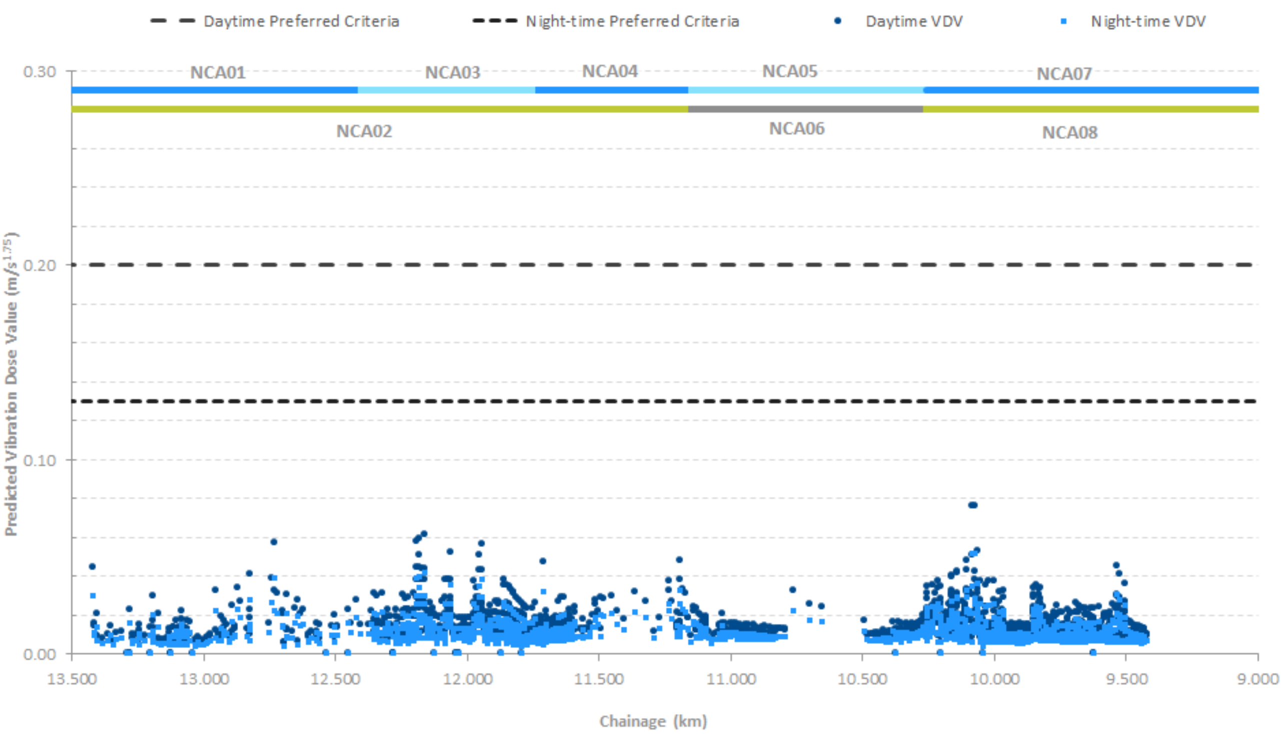


Figure 9.9 Predicted vibration dose values for residential receivers

9.5 Cumulative impacts

9.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to noise and vibration are described below.

9.5.2 Cumulative construction impacts

Cumulative construction noise impacts may occur if construction on the project occurs at the same time as construction on other nearby projects. Figure 9.10 shows the location of nearby projects which may result in cumulative noise impacts. Table 9.12 summarises the potential cumulative construction noise impacts identified for major projects close to the project site. These projects are described in Chapter 24.

Table 9.12 Summary of cumulative construction impacts

PROJECT	POTENTIAL CUMULATIVE CONSTRUCTION NOISE IMPACTS
Sydney Gateway road project	The study area for the Sydney Gateway road project overlaps with the western section of the Botany Rail Duplication study area. If the Sydney Gateway road project is constructed at the same time as this project, receivers in NCA01, NCA02 and NCA03 may experience an additional increase in noise levels of up to 3 dB. In addition, construction of the two projects is likely to increase the duration of the noise impacts experienced by receivers in NCA01, NCA02 and NCA03.
WestConnex – New M5	Residential apartments are located between both projects in the area of Kent Road in NCA01. However, as these receivers are over 400 metres from the project and 600 metres from the new M4, and the existing noise levels are high in this area, the potential for cumulative noise impacts from concurrent construction of the two projects is low.

PROJECT	POTENTIAL CUMULATIVE CONSTRUCTION NOISE IMPACTS
Qantas Flight Training Centre Relocation	The sensitive receivers near the new Qantas Flight Training Centre are generally commercial, however Travelodge Hotel and King Apartments (an approved residential development but not built yet) are nearby. The new Qantas Flight Training Centre would be much closer to these receivers than the project, meaning that if concurrent construction were to occur on both projects, the noise levels from construction of the new Qantas Flight Training Centre would likely be dominant over the noise levels from the Botany Rail Duplication. Therefore, the cumulative impact is expected to be managed by the mitigation measures used to control the impacts from the Qantas Flight Training Centre Project.
Airport North	The Airport North study area overlaps the western section of the project in NCA01, NCA02 and NCA03, near the Sydney Airport Terminal 2/3 entrance. While NCA01 is generally commercial, the Airport North works would likely affect residential receivers and hotels near O'Riordan Street, Baxter Road and Joyce Drive. However, the Airport North works are likely to be completed prior to Botany Rail Duplication works starting and therefore no cumulative impacts are expected.
Airport East	The Airport East study area overlaps the central section of the project in NCA02, NCA03 and NCA04, along General Holmes Drive. However, the Airport East works are likely to be completed prior to project works starting and therefore no cumulative impacts are expected.
F6 Extension – Stage 1	No cumulative impacts are expected if the F6 Extension is built concurrently with the project given the large distance between the two projects.

Overall, the cumulative construction noise impacts are expected to be relatively minor, with a low likelihood of worst-case noise levels being generated by two different projects at the same time.

The main cumulative impact would likely be associated with a potential increase in the duration of the noise impacts, rather than a cumulative increase in the noise levels themselves. If more than one project occurs in the same area consecutively, there may be a combined effect from the increased duration of impacts on nearby receivers and the associated reduced respite period between consecutive construction works. This effect is termed 'construction fatigue'. There is potential for construction fatigue for receivers near the Joyce Drive and O'Riordan Street intersection, including several hotels in NCA01 and NCA02, residential receivers on Baxter Road in NCA03 and residential receivers on Botany Road and McBurney Avenue in NCA04. This is due to several consecutive projects in the area including Airport East, Airport North, Sydney Gateway road project, Qantas Flight Training Centre and this project.

9.5.3 Cumulative operational impacts

During operation, receivers near the Joyce Drive and O'Riordan Street intersection would potentially be affected by operational noise from both the Botany Rail Duplication and Sydney Gateway road project, associated with a greater number of trains and cars using the area. However, operational noise from different types of transportation (ie road and rail) have different characteristics and result in different annoyance responses from affected communities. Therefore, a quantitative cumulative assessment of the combined operational noise impacts from the two projects is not possible, as the criteria for road and rail noise impacts are different.

Where elements of both projects occur in the same location, there is potential for operational mitigation measures to be required for both projects at the same receivers. The final operational mitigation strategy for each project would consider the impacts from both the Botany Rail Duplication and Sydney Gateway road project with the aim of maximising the benefit provided to receivers by the mitigation in a practical way.

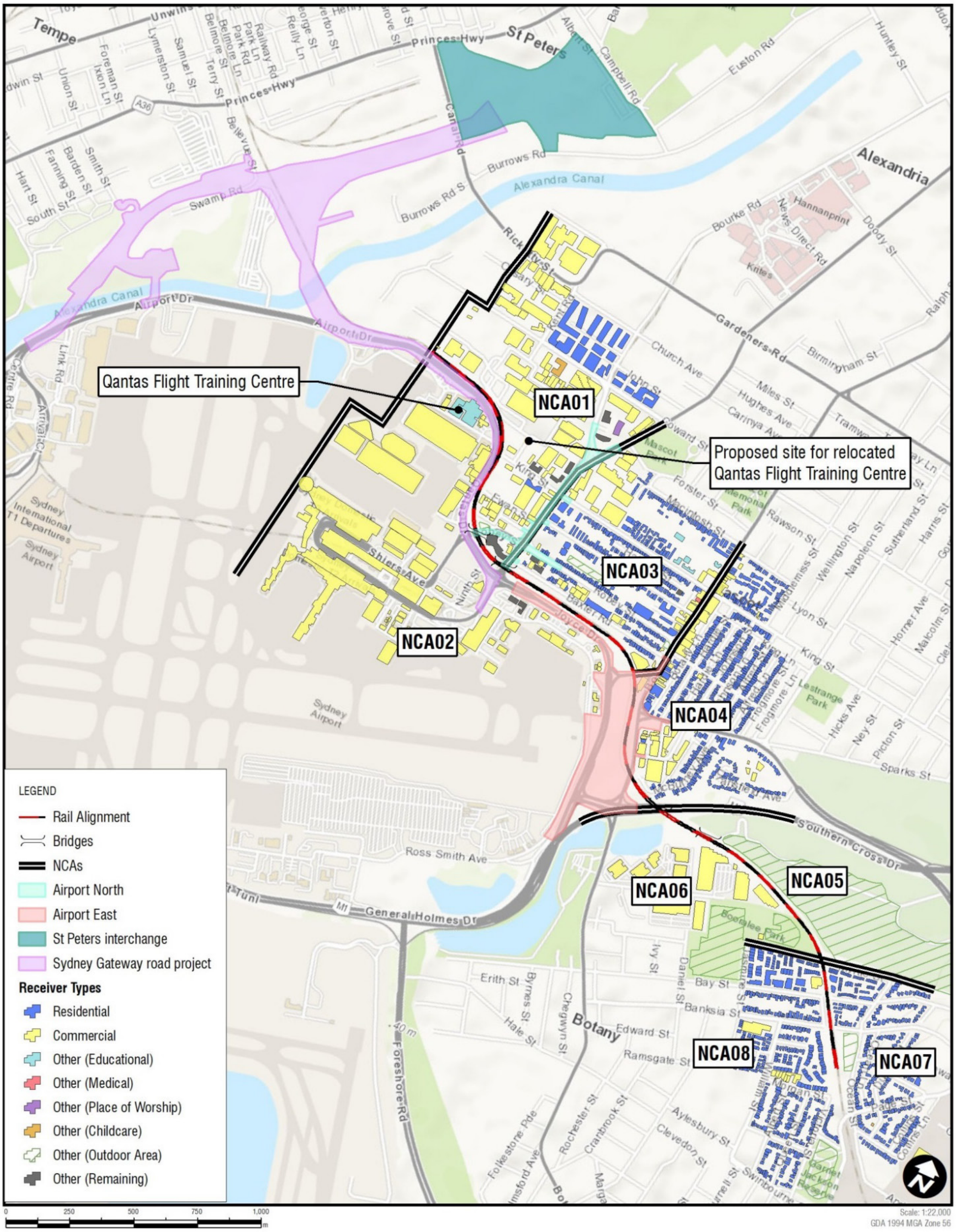


Figure 9.10 Location of nearby projects considered in cumulative construction noise assessment

9.6 Management of impacts

9.6.1 Approach

ARTC is committed to minimising the environmental impact of the project and is investigating opportunities to reduce actual impact areas where practicable. As discussed in section 9.1.4, ARTC has, where possible, altered the project to avoid and minimise noise and vibration impacts in the project planning stage (see section 9.1.4). This includes construction planning and proposing a lubrication procedure to reduce high frequency wheel squeal from operational trains. Further refinement will be made during detailed design, where possible, to minimise noise and vibration impacts.

The ICNG acknowledges that construction noise impacts cannot always be avoided where construction activities are required near sensitive receivers. However, the construction strategy for the project would need to take into account the communities' willingness to tolerate the level of construction noise predicted. Potential noise and vibration related issues raised during stakeholder and community consultation activities have been considered as a part of this noise and vibration assessment, to help identify appropriate mitigation strategies to minimise potential impacts such as respite periods. The approach to construction management would be managed through development of relevant environmental management plans, including site environmental management plans (site EMPs) during enabling works and a construction noise and vibration management plan (CNVMP) during main construction works. Monitoring will be carried out at the start of noise and vibration intensive activities near receivers, to confirm the effectiveness of the noise and vibration mitigation measures implemented.

Operational noise impacts can be controlled in a variety of ways. The RING requires that preference is given to source control measures, as they offer the greatest benefit to the largest number of receivers when compared to more localised mitigation options. Path control measures are considered next, with receiver controls being the final approach. Where exceedances of the RING trigger levels are predicted for hotels, at-property treatment would only need to be considered for areas of permanent residence within the hotels (if any). An Operational Noise and Vibration Review (ONVR) would be prepared to confirm the noise and vibration impacts from the project (based on the final detailed design) and define the operational mitigation measures that would be implemented. This would ensure that the operational mitigation measures would be suitable to effectively control operational noise and vibration impacts.

ARTC have experience in managing potential noise and vibration impacts as a result of developments of similar scale and scope to this project. As such, based on prior experience, the measures proposed to avoid noise and vibration impacts during construction and operation are expected to be effective in managing potential impacts from noise and vibration.

Further details on the approach to management is provided in Chapter 24.

9.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential noise and vibration impacts are listed in Table 9.13. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 9.13 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Design	Sleep disturbance from consecutive night-time works	The need for consecutive night-time works and likelihood for sleep disturbance impacts will be reviewed during detailed design. Where impacts are considered likely, appropriate noise mitigation will be developed which takes into consideration factors such as the existing facade performance of affected residential receivers. Appropriate respite will be provided to affected receivers to limit impacts from night-time works in the same location, as required by the conditions of approval.	N/A – Design phase	N/A – Design phase
	Potential noise impacts on hotels	Further investigation will be completed during detailed design to determine appropriate criteria which takes into account the existing facade performance of the affected hotels, noting that most of the hotels are of recent construction and are likely to have high performance facades. Prior to construction, all hotels within 50 metres of the project site will be consulted and assessed to determine their sensitivity to airborne and ground-borne noise impacts, existing facade performance, areas of permanent residence (if any) and to allow appropriate criteria and mitigation to be determined.	N/A – Design phase	N/A – Design phase
	Potential vibration impacts on pipeline assets	The project has the potential to impact a number of pipeline assets during construction. An assessment will be completed in detailed design which will: • calculate the actual distance of the works from the structure • assess ground conditions and the effect this would have on vibration. Where impacts are considered likely, the susceptibility of the various assets to vibration levels and appropriate monitoring and management protocols will be developed in consultation with the relevant owners. Condition surveys will be completed before and after the works where appropriate.	N/A – Design phase	N/A – Design phase

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Noise impacts on the community	In locations where 'moderate' or 'high' noise impacts are predicted, engagement with the affected communities will be outlined in the community and stakeholder engagement plan and undertaken during detailed design to determine their preference for mitigation and management measures.	N/A – Design phase	N/A – Design phase
	Operational noise impacts	Investigate operational noise and vibration mitigation options during detailed design, including source control measures, path control measures and receiver controls as per the RING. This will include a review of the: • use of track lubrication as the primary source of noise control for operation noise impacts • feasibility and reasonableness of using noise barriers to provide path control mitigation to nearby receivers, noting the specific constraints that are applicable to this project • need for at-property treatment to be used to mitigate residual impacts at receivers which require consideration of mitigation after the use of source of path control measures. The potential operational noise and vibration mitigation options to be investigated are discussed further in section 8.3 in *Technical Report 2 – Noise and Vibration Impact Assessment*.	N/A – Design phase	N/A – Design phase
	Operational ground-borne noise impacts	Potential ground-borne noise impacts will be investigated further during detailed design when the extent of airborne rail noise mitigation, train speeds, and the position of track turnouts are confirmed.	N/A – Design phase	N/A – Design phase

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Construction	Noise generated from enabling activities including billboard removal, utilities relocation and vegetation clearing and property adjustments	Site EMPs will be prepared before any enabling works begin. Specific to the activities proposed, these plans will include: • identification of nearby sensitive receivers • description of works, construction equipment and hours of work • mitigation measures that apply to the works proposed • criteria for the project and relevant licence and approval conditions • requirements for noise and vibration monitoring • details of how community consultation would be completed in accordance with the Community and Stakeholder Engagement Plan • details of how respite would be applied where ongoing high impacts are seen at certain receivers. The requirement for enabling works out of hours will be described in the site EMPs to be approved by the independent Environmental Representative (ER). The Site EMPs will detail: • the proposed activities and predict the potential noise impact against the relevant noise and vibration criteria • the relevant mitigation measures including consideration of sleep disturbance and respite periods • the required community notification specific to the activities proposed.	✓	

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Noise generated from main construction activities	A CNVMP will be prepared as a sub plan to the CEMP before any main construction works begin. This will include: • identification of nearby sensitive receivers • description of works, construction equipment and hours of work • criteria for the project and relevant licence and approval conditions • requirements for noise and vibration monitoring • details of how community consultation and notification would be completed • procedures for handling complaints • details on how respite would be applied where ongoing high impacts are seen at certain receivers. The CNVMP will also consider cumulative construction impacts and the likelihood for ‘construction fatigue’ from consecutive projects in the area and define a suitable management approach. Quantitative road traffic noise impacts from temporary detours during construction would also be evaluated, especially for local roads with low existing volumes.		✓
		Community consultation measures will be included in the CNVMP and community and stakeholder engagement plan, including periodic notification (monthly letterbox drop or equivalent) detailing all upcoming construction activities delivered to impacted sensitive receivers at least 14 days prior to commencement of relevant works.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Noise generated from out-of-hours work	Unless subject to an Environment Protection License, an Out-of-Hours Work Protocol will be prepared and included as part of the CNVMP for main construction works. It would identify a process for the consideration, management and approval of works which are outside standard hours. The protocol will be prepared in consultation with the EPA and approved by the independent ER before the commencement of main construction works. The Protocol will include processes for: • the consideration of out of hours work against the relevant noise and vibration criteria • the identification of mitigation measures for residual impacts, including respite periods in consultation with the community at affected locations • consideration of the risk of activities, proposed mitigation, management and coordination for works outside of standard hours to be approved by the independent ER.		✓
		Where feasible and reasonable, construction will be carried out during Standard Construction Hours. If it is not possible to restrict the works to daytime, then they would be scheduled so noise intensive equipment is not used after 11:00 pm, where possible, noting that there is a requirement for many of the works to be completed during possessions, and restrictions on working hours during these periods are generally not feasible.	✓	✓
	Noise generated from use of noise intensive equipment	Where noise intensive equipment is to be used near sensitive receivers, the works will be scheduled for Standard Construction Hours, where possible. If it is not possible to restrict the works to daytime then they would be scheduled so noise intensive equipment is not used after 11:00 pm, where feasible.	✓	✓
		Monitoring will be carried out at the start of noise and vibration intensive activities which are near to receivers to confirm that actual levels are consistent with the predictions. Where mitigation measures have been specified, the monitoring results will confirm their effectiveness.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Use of construction compounds	Hoardings, or other shielding structures, will be used where receivers are near compounds or worksites with long-term works. To provide effective noise mitigation, the hoarding would break the line-of-sight from the nearest receivers to the works, where possible, and be of solid construction with minimal gaps. Hoarding for construction sites is typically around three metres in height.		✓
		Noise generating activities in compounds will be positioned away from receivers where possible. Items such as sheds can also be used to shield receivers from noise generated in other parts of the compound.		✓
		Noise impacts are predicted for the compound between Banksia Street and Stephen Road due to the proximity of the nearest receivers. The use of this compound site during out of hours works associated with the road closures at Robey Street and O'Riordan Street will be avoided as far as practicable.	✓	✓
	Vibration impacts from use of vibration intensive equipment	Where works are required within the minimum working distances and considered likely to exceed the cosmetic damage criteria: • different construction methods with lower source vibration levels will be investigated and implemented, where feasible • attended vibration measurements will be undertaken at the start of the works to determine actual vibration levels at the item. Works will be ceased if the monitoring indicates vibration levels are likely to, or do, exceed the relevant criteria.	✓	✓
		Building condition surveys will be completed before and after the works where buildings or structures, including heritage items, are within the minimum working distances and considered likely to exceed the cosmetic damage criteria during the use of vibration intensive equipment. Appropriate criteria will be confirmed for each item before the works begin, based on the surveys.	✓	✓
		The potential human comfort impacts and requirement for vibration intensive works would be reviewed as the project progresses. Where receivers are within the human comfort minimum working distances, the impacts will be managed with the procedures defined in the CNVMP.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
		The requirement for vibration intensive works near heritage items will be reviewed during detailed construction planning. Where heritage items are considered potentially sensitive to vibration impacts, the more stringent DIN 4150 Group 3 guideline values will be applied and monitoring will be completed when vibration intensive works are in close proximity. Condition surveys will be completed before and after the works where heritage items are within the minimum working distances and considered likely to exceed the cosmetic damage criteria.	✓	✓
	Cumulative construction noise impacts	The likelihood of cumulative or consecutive construction noise impacts will be reviewed during detailed design when detailed construction schedules are available. Coordination will occur between the various projects to minimise concurrent works (particularly concurrent OOHW) in the same areas, where possible. Specific additional management and mitigation measures designed to address potential consecutive impacts will be developed and used to minimise the impacts as far as practicable, in consultation with the affected community.	✓	✓
	Noise generated from construction workers	All employees, contractors and subcontractors would receive an environmental induction. The induction will at least include: • all relevant project specific and standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on noise generating activities with special audible characteristics • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures.	✓	✓
		No swearing or unnecessary shouting or loud stereos/radios/phone calls on speaker on site. No dropping of materials from height, throwing of metal items and slamming of doors. No unnecessary idling of vehicles near to receivers.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	General construction noise generation	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored pile rather than impact-driven piles will minimise noise and vibration impacts.	✓	✓
		Simultaneous operation of noisy plant within discernible range of a sensitive receiver will be avoided. The offset distance between noisy plant and adjacent sensitive receivers will be maximised. Plant used intermittently will be throttled down or shut down. Noise-emitting plant will be directed away from sensitive receivers, where possible.	✓	✓
		Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.	✓	✓
		Non-tonal reversing beepers (or an equivalent mechanism) will be fitted and used on all construction vehicles and mobile plant regularly used on site as well as any out of hours work.	✓	✓
		Loading and unloading of materials/deliveries would occur as far as possible from sensitive receivers. Site access points and roads will be selected as far as possible away from sensitive receivers. Dedicated loading/unloading areas will be shielded if close to sensitive receivers.	✓	✓
		Where possible, noise from mobile plant will be reduced through additional: • residential grade mufflers • damped hammers such as ‘City’ Model Rammer Hammers • Air Parking brake engagement is silenced.	✓	✓
		Stationary noise sources will be enclosed or shielded while ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436: 1981 lists materials suitable for shielding.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
		A CTTAMP will be prepared for the project to manage the haul routes and vehicle movements. Where construction routes are along local roads there is potential for impacts at the adjacent residential receivers, depending on the volume of construction traffic. The potential impacts will be managed using the following approaches: • vehicle movements will be away from sensitive receivers and during less sensitive times, where possible • the speed of vehicles will be limited and avoid the use of engine compression brakes • on-site storage capacity will be maximised to reduce the need for truck movements during sensitive times • heavy vehicles would be restricted from idling near residential receivers.		✓
		Structures, such as site sheds, will be used to shield residential receivers from noise (where practicable), noting that upper floors of multi-storey buildings would be unlikely to benefit.	✓	✓
	Detours during construction	The assessment indicates there is potential for noticeable increases in road traffic noise for some receivers along the detours routes, such as Robey Street. Detours using this road are planned for up to 10 weekends (for closures to either Robey Street or O’Riordan Street) during construction of the project. The potential impacts would be reviewed as the project progresses using detailed traffic volume data Where residential receivers are expected to be subject to a >2.0 dB night-time increase during detours, the project would: • consider the use of different detour routes that do not put traffic during the night-time on roads with low existing volumes. Where this is not possible, the project would: • apply appropriate mitigation measures to the affected residential receivers, as agreed with the independent Environmental Representative (ER), based on the expected magnitude of the exceedance and the total duration of night-time impacts from all detours during construction of the project.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Operation	Operational noise impacts	An Operational Noise and Vibration Review (ONVR) will be prepared to confirm the noise and vibration impacts from the project and define the mitigation measures used to control the impacts. The ONVR will be prepared in consultation with affected stakeholders and the community. It will: • be based on the operational noise and vibration objectives identified in *Technical Report 2 – Noise and Vibration Impact Assessment* • confirm the predicted operational noise and vibration impacts at the surrounding receivers based on the final design • review the suitability of the operational noise mitigation measures identified below and any other measures which may be considered appropriate to manage additional impacts identified as a result of design changes and include the timing of implementation • include a consultation strategy to seek feedback from directly affected landowners on the noise and vibration mitigation measures outline how complaints will be managed in accordance with ARTC's existing complaints handling service (Enviroline).The ONVR will be prepared with reference to the *ARTC Noise Prediction and Mitigation Guideline* (ARTC, 2018) and will be made publicly available once complete.	N/A – Operation	N/A – Operation
		Implement noise and mitigation source controls, path controls and receiver controls where feasible and reasonable as determined during detailed design. These mitigation measures will be included in the ONVR, with the identified measures being managed through ARTC's environmental management system for operation of the project.	N/A – Operation	N/A – Operation

9.6.3 Consideration of the interaction between measures

In addition to the measures for noise and vibration described above, there are interactions between the mitigation measures for traffic and transport (Chapter 8) and the community and stakeholder consultation approach, which would help manage and mitigate potential noise and vibration impacts. All mitigation measures for the project are consolidated in Chapter 24 to ensure consistency in implementation.

9.6.4 Managing residual impacts

A residual risk analysis was undertaken taking into account the impact assessment summarised in this chapter and implementation of the mitigation measures as recommended in section 9.6.2. Residual risks with an assessed level of medium or above are summarised below:

- High:
  - noise impacts on local residents and sensitive receivers from out-of-hours construction activities.
- Medium:
  - noise impacts on local residents and sensitive receivers from construction activities within standard work hours
  - noise impacts on local residents and sensitive receivers from out-of-hours construction traffic
  - noise impacts on local residents and sensitive receivers from construction traffic during the day
  - noise impacts on local residents and sensitive receivers from the operation of trains.

The reduction in risk levels assumes effective implementation of several mitigation and management measures (as recommended in section 9.6.2) including implementation of noise and vibration management plans and appropriate construction scheduling and planning, vibration monitoring and inclusion of source, path and/or receiver controls in the design to minimise operational noise.

10. AIR QUALITY

This chapter provides a summary of the air quality impact assessment. A full copy of the assessment is provided as *Technical Report 3 – Air Quality Impact Assessment*.

10.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment.

10.1.1 Legislative and policy context to the assessment

The assessment was undertaken with reference to the requirements summarised below.

Protection of the Environment Operations Act 1997

The POEO Act provides the statutory framework for managing pollution in NSW, including the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. Companies and property owners are legally bound to control emissions from construction sites under the POEO Act. Activities undertaken on site must not contribute to environmental degradation, and pollution and air emissions must not exceed the standards.

The criteria outlined in this Act and considered in this assessment are specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

Protection of the Environment Operations (Clean Air) Regulation 2010

The *Protection of the Environment Operations (Clean Air) Regulation 2010* (the Clean Air Regulation) provides regulatory measures to control emissions from motor vehicles, fuels and industry. The project would be operated to ensure it complies with the Clean Air Regulation.

The criteria outlined in this Regulation and considered in this assessment are specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (EPA, 2016)

The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (EPA, 2016) lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in NSW. It considers the above-mentioned legislation and constructs pollutant assessment criteria.

The Approved Methods (EPA, 2016) is the main guidance document that has been followed for this assessment.

National Environment Protection (Ambient Air Quality) Measure (2015)

The National Environment Protection Council (NEPC) *National Environment Protection (Ambient Air Quality) Measure* (Air NEPM) (NEPC 2015) sets national standards for the six key air pollutants to which most Australians are exposed: Carbon monoxide (CO), Ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), lead and particulate matter with diameter less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$). Under the Air NEPM, all Australians have the same level of air quality protection.

The criteria and pollutants specified in this NEPM have been considered in this assessment.

Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC, 2007)

The Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC, 2007) provides the approved methodology for sampling and analysing air pollutants.

This guidance was reviewed but as sampling was not undertaken as part of this air quality assessment this guidance has not been considered further.

Technical Framework – Assessment and Management of Odour from Stationary Sources in NSW (DEC, 2006b)

The Technical Framework – Assessment and Management of Odour from Stationary Sources in NSW (Technical Framework) (DEC, 2006b) provides a framework to assess and manage odour from stationary sources. The Approved Methods (EPA 2016) incorporates guidance supplied in the Technical Framework. An air quality assessment conducted in accordance with the Approved Methods (EPA 2016).

As odour was not found to be significant based on the train emissions reported in *Diesel Locomotive Fuel Efficiency and Emissions Testing*: Prepared for NSW EPA (ABMARC, 2016) and the findings of the contamination assessment for this project (*Technical Report 5 – Contamination Assessment*), detailed odour management has not been incorporated into this assessment.

Protocol for Environmental Management, State Environment Protection Policy (Air Quality Management) (Victorian EPA, 2007)

The Protocol for Environmental Management (PEM) (Victorian EPA, 2007) provides the requirements for assessment and management of emissions to the air environment from the mining and extractive industries. It provides an alternate method to assess air quality impacts by using the 70th percentile of background concentrations. This method is considered more appropriate for the construction phase of this project based on the intermittent and changing location of air quality emissions.

This policy was followed to develop the background concentrations used in this construction assessment based upon the 70th percentile particulate concentrations.

Western Regional Air Partnership Fugitive Dust Handbook (Countess Environmental, 2006)

Dust emissions from construction activities have been calculated using recommended particulate emission factors for general construction operations. The derived emission rates were characterised using recommended emission factors for average conditions and worst-case conditions published in the *Western Regional Air Partnership Fugitive Dust Handbook* (WRAP) (Countess Environmental, 2006).

10.1.2 Methodology

Key tasks

The air quality assessment involved the following tasks:

- a desktop review of site plans, aerial photographs and topographic maps undertaken to gain an understanding of the existing environment in terms of local terrain, existing/proposed operations and sensitive receptors within the study area
- the applicable air quality impact assessment criteria is defined by the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (EPA, 2016) and the *National Environment Protection (Ambient Air Quality) Measure* (‘the Air NEPM’)

- a review of available background air quality in the local area using DPIE (formerly Office of Environment and Heritage (OEH)) air quality monitoring data (Randwick and Earlwood monitoring stations)
- meteorological modelling to gain an understanding of the local wind climate for use as model input for conducting atmospheric dispersion modelling
- creation of a construction emissions inventory including emissions to air from the construction of the project (primarily particulates)
- review of *Technical Report 5 – Contamination Assessment* was undertaken to verify management plans have been recommended during construction
- creation of an operational emissions inventory to include locomotives on the project using the report *Diesel Locomotive Fuel Efficiency and Emissions Testing*: Prepared for NSW EPA (ABMARC, 2016) and National Pollutant Inventory (NPI) emission factors
- dispersion modelling to predict construction and operational impacts at nearby receptors in the study area using regulatory approved models was undertaken as follows:
  - using AUSPLUME 6.0 for construction impacts
  - using CALPUFF version 6 for operation impacts
- a cumulative impact assessment to consider potential regional air quality impacts combined with other projects
- development of general mitigation measures for construction and operation of the project to mitigate potential impacts which could arise as a result of the project.

Study area

The study area was selected to be large enough to capture all air quality impacts from the project. The model domain was selected to be 22 kilometres by 22 kilometres in size centred on the project site. The study area is considered the same size as the modelling domain. A cumulative impact assessment considered the local and regional impact of the project combined with other proposals.

Technical Report 13 – Health Impact Assessment provides further assessment of potential local and regional air quality impacts on receivers.

10.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with air quality. Potential risks were considered according to the impacts that may be generated by the construction or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology, and the full results, is provided in Appendix B.

Prior to assessment and identification of mitigation measures, risks with an assessed level of medium or above include:

- generation of dust during construction (from exposed soil/stockpiles, excavations and vehicle movements)
- emissions from vehicles or plant during construction
- mobilisation of asbestos fibres from disturbance of contaminated soils
- impacts on local air quality during operation from maintenance vehicles and emissions from an increase in trains.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 10.6.4.

10.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning for the project has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process. Measures taken to avoid or minimise impacts which relate to air quality include directing construction access points and construction traffic routes away from sensitive areas and consideration of sensitive land uses when defining the use and operation of specific compounds.

10.2 Existing environment

10.2.1 Background air quality

Pollutant average and maximum background concentrations from Randwick and Earlwood monitoring stations, for 2014, were considered as a representative year for input to the modelling undertaken for impact assessment. These stations were the closest stations providing this data. Records and the averaging period are shown in Table 10.1. Meteorological data was taken from the nearest Bureau of Meteorology monitoring station (Sydney Airport Aeronautical Meteorological Office).

Data was not available from Randwick and Earlwood monitoring stations for Carbon Monoxide (CO), therefore CO data was taken from the nearest representative station providing this data. CO data taken for 2018–2019 from the Chullora DPIE monitoring station was 4,140 µg/m^3.

Table 10.1 Background air quality daily concentrations (2014)

POLLUTANT	AVERAGING PERIOD	DPIE MONITORING SITE RECORDS (MAXIMUM MICRO GRAMS PER METRE CUBED (µg/m^3)	
		Randwick	Earlwood
NO_2	1 hour	88.4	75.2
	Annual	11.0	15.8
SO_2	1 hour	68.1	–
	24 hours	10.5	–
	Annual	2.4	–
O_3	1 hour	37.9 (average µg/m^3)	30.2 (average µg/m^3)
	1 hour	129.4	135.2
PM_{10}	24 hours	46.1	45.2
	Annual	18.2	18.4
	24 hours	20.5 (70th percentile µg/m^3)	20.7 (70th percentile µg/m^3)
$PM_{2.5}$	24 hours	–	22.7
	Annual	–	7.8
	24 hours	–	9.2 (70th percentile µg/m^3)

Note: '–' denotes data not sampled at the site

10.2.2 Local emission sources

The main local sources of air pollution in the study area which contributes to the existing background concentrations include:

- vehicle emissions especially from roads with high traffic volumes such as Qantas Drive, Joyce Drive, General Holmes Drive and Southern Cross Drive. Emissions can include NOx, volatile organic compounds (VOC), CO, PM_{10} and $PM_{2.5}$
- suspended dust along roadways, from pulverised pavement materials, particles from brake linings and tyres. Dust emissions from existing rail movements along the Botany Line. Dust can include Total Suspended Particles (TSP) PM_{10} and $PM_{2.5}$
- residential emissions such as domestic products as well as fuel combustion from domestic machinery like lawn mowers, etc. Diesel emissions from existing rail movements along the Botany Line. Emissions can include NOx, VOC, CO, TSP PM_{10} and $PM_{2.5}$
- secondary particulate emissions from freight movement (i.e. wheel and brake action, wagon turbulence in the rail corridor and windblown particulates). Secondary particulate matter pollution consists of NOx, VOC, sulfur dioxide (SO_2) and ammonia which react in the atmosphere to form secondary organic aerosols, nitrate, sulfate compounds and ozone (O_3).

10.2.3 Sensitive receptors

The Approved Methods (EPA 2016) defines sensitive receptors as locations where people are likely to work or reside and may include a dwelling, school, hospital, office and recreation areas.

The nearest sensitive receptors are anticipated to experience the worst case air quality impact and therefore have been selected to represent worst case scenario pollutant concentrations. If potential air quality impacts from the project comply with the impact assessment criteria at the nearest receptors, then those situated at a greater distance will also likely comply.

The location of the representative sensitive receptors to the site are presented in Table 10.2. The location of representative sensitive receptors in the study area are shown in Figure 10.1.

Table 10.2 Representative sensitive receptors locations

ID	DESCRIPTION	ID	DESCRIPTION
R01	Qantas Joy building	R11	Rovacraft
R02	Qantas Flight Training Centre	R12	Residential (on McBurney Avenue)
R03	Qudos Bank	R13	Sims Metal Management
R04	Redspot car rentals headquarters	R14	Eastlake Golf Club Halfway House
R05	Stamford Plaza Sydney Airport	R15	Big Picture Australia Pty Ltd
R06	Krispy Kreme Mascot	R16	Residential (between Myrtle Street and Bay Street)
R07	Regional Express (Rex)	R17	Residential (on Bay Street)
R08	IMO Carwash Mascot	R18	Residential (between Bay Street and Morgan Street)
R09	Residential (on Baxter Road)	R19	Gaiarine Gardens
R10	AEA Sydney airport serviced apartments	R20	Residential (on Ocean Street)

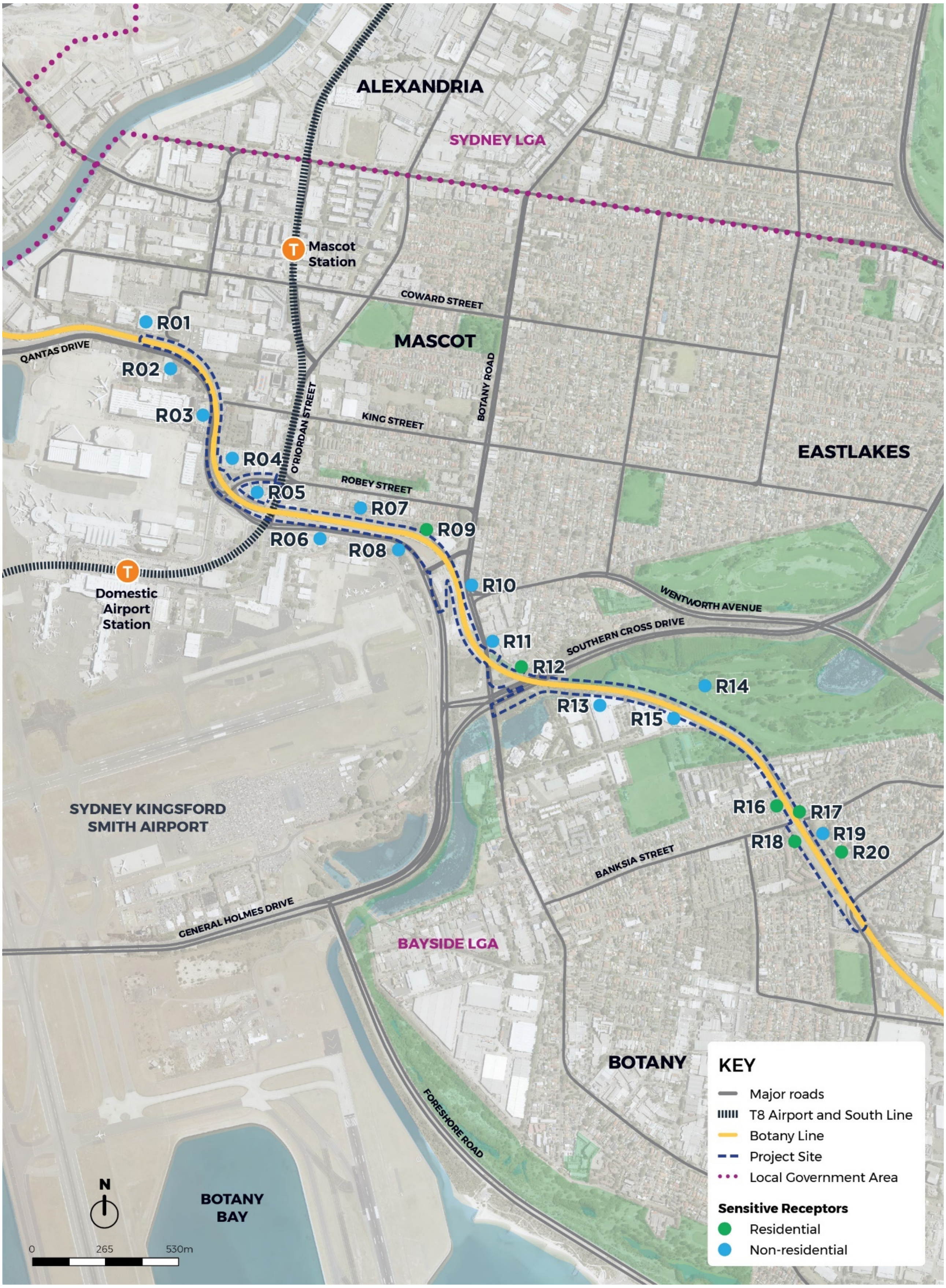


Figure 10.1 **Sensitive receptors location**

10.3 Assessment of construction impacts

10.3.1 Construction overview

Construction of the project would broadly involve the following key steps:

- early and enabling works including compound establishment, utility works, vegetation clearance, billboard removal and track slewing
- main construction works including track and bridge works
- finishing and rehabilitation works.

It is noted that the construction methodology including the plant and equipment usage presented in this section are indicative and would continue to be modified and refined as the design process continues. A final construction methodology and program would be developed by the construction contractor when appointed.

A high level conservative worst case construction assessment has been undertaken.

There is potential for air quality emissions to occur during the construction of the project. The principle activities which may result in emissions include:

- combustion and pollutant emissions from construction vehicles and plant exhaust
- odour and pollutant emissions from disturbance of contaminated land
- dust and particulate matter emissions from earth working activities.

10.3.2 Construction vehicles and exhaust emissions

Construction vehicles are expected to travel along the alignment and resulting emissions will be discontinuous, transient and mobile. Particulate emissions from the exhaust of mobile plant and stationary engines are accounted for in the emission factors for earthmoving and handling (emissions factors further discussed in section 10.3.4) used in the air quality assessment. Therefore, combustion vehicle exhaust emissions have not been considered further in this assessment.

10.3.3 Odour and pollutant emissions

There is potential for odorous and pollutant (including PFAS and asbestos) emissions to occur during the construction of the project from the disturbance of contaminated land. Previously contained contamination (covered by topsoil) may be agitated resulting in the release of contamination into the air.

A contamination assessment has been undertaken. The assessment identified the risk of airborne asbestos fibres being generated during construction activities associated with the excavation, movement and stockpiling of ACM.

PFOS and PFAS concentrations have been recorded in surface water and ground water samples located near the rail corridor. There is higher risk of these contaminants becoming airborne during constructions works in these areas. Management measures have been included in 10.6.2

Further details and a complete contamination assessment including measures to manage contamination is provided in the contamination land specialist report (*Technical Report 5 – Contamination Assessment*).

10.3.4 Dust

Source of dust emissions

Dust and particulate matter was identified as the primary emission to air during the construction of the project. Other air emissions such as combustion products (eg vehicle exhaust) will also be present during construction and maintenance activities. The combustion exhaust emissions from vehicles, plant and equipment are expected to be insignificant compared to existing combustion engine emissions from road and rail traffic.

Construction activities that generate dust include earthworks and the handling and transfer of earth and other material. The key construction activities that could generate dust include:

- vegetation clearing and grubbing
- installation of a new track and embankment widening
- track upgrading and minor adjustments
- bridge works and demolition
- retaining wall works
- drainage system construction and relocation of underground services and pipelines
- service routes and signalling works
- finishing and rehabilitation works.

Plant, equipment and activities likely to generate dust include:

- use of earth working plant including excavators, bull dozers and front-end loaders
- trucks dumping soil and aggregate
- drilling
- scraper/graders
- wheel generated dust from vehicle movements on unsealed surfaces.

Predicted impact from dust emissions

For this project, air quality impacts were assessed in terms of distances at which the relevant criteria are achieved at any time. The pollutant assessment criteria accord with the levels set in the Approved Methods (EPA, 2016). By complying with these assessment criteria, the construction phase of the project should meet air quality obligations under the POEO Act 1997 and the Clean Air Regulation 2010. Dust emissions from construction activities were characterised using recommended emission factors for average conditions and worst-case conditions published in the *Western Regional Air Partnership Fugitive Dust Handbook* (WRAP) (Countess Environmental, 2006). The WRAP scenarios are:

- average construction conditions were used to model general construction areas and include track upgrading and minor adjustments, retaining wall works, drainage system construction and relocation of underground services and pipelines, service routes and signalling works, and finishing and rehabilitation works
- worst case conditions were used to model heavy construction areas include vegetation clearing and grubbing, installation of a new track and embankment widening, bridge works and demolition.

The standard construction methodology for managing soils would be outlined in the relevant management plan and would include dust suppression watering. Two levels of watering are considered in this assessment:

- Level 1 watering (2 litres per metre squared per hour (L/m^2/h)) achieving a 50 percent reduction in dust generation was assumed to occur at all general construction areas.
- Level 2 watering (greater than 2 L/m^2/h) achieving a 75 percent reduction in dust generation was assumed to occur at all construction areas that would occur in the same location for a year or more in duration.

Detailed approach, assumptions for emissions rate calculations and modelling are provided in *Technical Report 3 – Air Quality Impact Assessment*.

The next sections present the predicted daily and annual construction dust impacts compared with the existing background levels and the assessment criteria as defined in the Approved Methods (EPA, 2016):

- The Daily impacts are expressed as the worst case impacts averaged over a 24 hour period. The worst case daily impacts are predicted to occur once (for one 24 hour period) in the modelled year. Lower dust impacts are predicted for all other days (remaining 364 days of the modelled year).
- The Annual impacts are expressed as the impacts averaged over the entire modelled year.

The modelling scenarios discussed below are used for assessment purposes only and do not suggest that these impacts would occur daily or annually.

Daily construction impacts

The results of the daily assessment show that impacts decrease the further the distance away from the site. Dust emissions from the project are relatively low compared with the assessment criteria and background concentrations. There are significant existing background particulate concentrations:

- the background PM_{10} accounts for 41 percent of the assessment criteria
- the background $PM_{2.5}$ accounts for 37 percent of the assessment criteria.

The results of the modelling of the worst case construction conditions with level 2 watering found that:

- the daily PM_{10} assessment criteria is met at six metres from the site boundary of the construction works
- the daily $PM_{2.5}$ assessment criteria is met at the site boundary of the construction works (no off site impacts are predicted).

The results of the modelling of the average construction conditions with level 1 watering:

- the daily PM_{10} criteria is met at the site boundary of the construction works (no off site impacts are predicted)
- the daily $PM_{2.5}$ criteria is met at the site boundary of the construction works (no off site impacts are predicted).

The majority of impacts are predicted to be contained within the project site. The only off site impacts are predicted for daily total impact (project emissions combined with background emissions) PM_{10} for worst case construction conditions with level 2 watering. The two areas of potential impact identified in Figure 10.2 are:

- Area A – the 6 metre impact zone extends on to residential properties located at 142 Banksia Street and 235 Bay Street to the east of the construction works and commercial premises located at 96A Bay Street and residential properties located at 23 Myrtle Street to the west of the construction works.
- Area B – the 6 metre impact zone extends on to commercial premises at 1010–1016 Botany Road, 1008 Botany Road to the northeast of the construction works.

Figure 10.2 Predicted daily PM10 impacts for worst case construction conditions with level 2 watering

Annual construction impacts

The majority of earthworks and dust generating activities would move throughout the project site as each segment of the project is completed. Therefore, it is unlikely that dust generating construction works will be active in the same location for the entire duration of the construction program.

To provide a conservative assessment however, annual project generated emissions and total impact (project emissions combined with background emissions) for TSP, PM_{10} and $PM_{2.5}$ impacts for general construction conditions with level 2 watering have been assessed. This comprehensively assesses potential worst-case air quality impacts for all long-term construction activities (construction activities that occur for over a year in the same location).

The results indicate that there are significant annual background particulate concentrations from existing sources of particulates in the area. The background PM_{10} accounts for 73 percent of the assessment criteria and the background $PM_{2.5}$ accounts for 98 percent of the assessment criteria.

The results of the assessment of general construction conditions with level 2 watering found that:

- the annual TSP assessment criteria is met at the site boundary of the construction works (no off-site impacts are predicted)
- the annual PM_{10} assessment criteria is me at the site boundary of the construction works (no off-site impacts are predicted)
- the annual $PM_{2.5}$ assessment criteria is met at 7 metres from the site boundary of the construction works.

The assessment identified the potential for elevated annually-averaged $PM_{2.5}$ concentrations to occur within seven metres of dust generating construction works if the works occur in the same location for an entire year. The $PM_{2.5}$ exceedance is attributed to high background $PM_{2.5}$ concentrations (98 percent of assessment criteria) despite relatively low project generated emissions.

Annual $PM_{2.5}$ impacts are not anticipated at any location as long-term dust generating construction activities (such as bridge demolition and construction) are not expected to result in continual dust generation for an entire year. It is also unlikely that significant dust generating activities within compound sites would continue for a year as the majority of dust generating activities would be associated with compound site establishment.

10.4 Assessment of operational impacts

10.4.1 Operation overview

The primary source of air quality emissions from the operation of the project are produced from combustion related particle emissions from locomotives. Combustion engines produce emissions that predominantly comprise the following pollutants:

- nitrogen dioxide (NO_2)
- carbon monoxide (CO)
- hydrocarbons (HC)
- sulfur dioxide (SO_2)
- dust in the form of PM_{10} and $PM_{2.5}$.

The quantity of the above pollutants emitted by locomotive operation depends on the following locomotive operational parameters:

- locomotive type
- locomotive speed and notch (throttle position) settings
- locomotive movement (pass bys) frequency.

Locomotive emissions were calculated assuming worst case notch and speed that resulted in the highest emissions. Locomotives were assumed to travel at that worst-case speed/notch for the entire length of track. Worst case emissions occurred when locomotives travel at their slowest speed. The assessment has modelled one operational locomotive per train.

Train movements to and from Port Botany for daytime and night-time periods are presented in Table 10.3. It is acknowledged that the actual train movements would be heavily dependent on demand so peak (maximum expected) movements have been provided and used to predict worst case impacts.

To account for all present and future operational possibilities, Table 10.3 presents the operational scenarios that been considered for peak and daily average train movements per hour. A detailed description of the scenarios is provided in section 6.2 of *Technical Report 3 – Air Quality Impact Assessment*.

Table 10.3 Detailed train movements

SCENARIO	TRAIN MOVEMENTS			
	Daytime (7 am–10 pm)		Night-time (10 pm–7 am)	
	To Port Botany	From Port Botany	To Port Botany	From Port Botany
2019 Existing (to and from Port Botany - daily total)	40			
2024 At opening – no build (without the project)	24	24	14	14
2024 At opening – build (with the project)	24	24	14	14
2034 10 year future – no build (without the project)	28	28	17	17
2034 10 year future – build (with the project)	35	35	21	21

Other sources of emissions are considered insignificant and are not assessed further. This includes:

- wheel and brake actions on rail tracks
- entrainment of surface particles in the rail corridor
- dust emissions during maintenance activities including minor earthworks, plant movements and vegetation trimming
- odour and pollutant emissions from the disturbance of contaminated land during maintenance activities including minor earthworks (further details are provided in sections 12.3 and 1.4).

10.4.2 Operational air quality impacts

Predicted concentrations for each pollutant emitted from operation of locomotives has been compared to the assessment criteria to identify potential exceedances. The results of the operational impact assessment for project generated (incremental) or total impact (project generated plus existing background air quality) emissions predict that:

- NO_2 concentrations – no project generated or total impact exceedances of the criteria are predicted.
- CO concentration – no project generated or total impact exceedances of the criteria are predicted.
- HC concentration (as benzene) – no project generated exceedances of the criteria are predicted. No background concentration data is available to predict total impact concentrations.
- SO_2 concentrations – no project generated or total impact exceedances of the criteria are predicted.
- PM_{10} concentrations – no project generated or total impact criteria exceedances are predicted for both daily and annual averaging periods.
- $PM_{2.5}$ concentrations – no project generated or total impact criteria exceedances are predicted for both daily and annual averaging periods.

Key findings of the operational impact assessment are:

- the air quality criteria are designed to reduce the risks to human health and the environment. The assessment predicts no exceedances of the assessment criteria for any of the assessed pollutants and therefore is not predicted to have adverse air quality impacts in the surrounding areas
- particulate (PM_{10} and $PM_{2.5}$) background concentrations are below the criteria. Background 24 hour concentrations account for 92 percent of the PM_{10} criteria and background annual concentrations account for 73 percent of the PM_{10} criteria. Background 24 hour concentrations account for 91 percent of the $PM_{2.5}$ criteria and background annual concentrations account for 98 percent of the $PM_{2.5}$ criteria
- all other pollutants are below assessment criteria.

General mitigation measures for operation of the project to help reduce any additional impacts are discussed in section 10.6 of this report.

10.5 Cumulative impacts

10.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to air quality are described below.

10.5.2 Cumulative construction impacts

A number of other projects are anticipated to be constructed at the same time and similar location as the project such as the Sydney Gateway road project.

Potential cumulative impacts may include an exacerbation of dust impacts (PM_{10} and $PM_{2.5}$). As the impacts from the construction of the project are predicted to be transitory and confined to an area of seven metres from the boundary of the project site, the cumulative impacts would be minimal unless an additional source of dust (to this project) was generated close to receptors.

10.5.3 Cumulative operational impacts

Background air pollutant concentrations recorded at the Randwick and Earlwood DPIE stations include emissions from all regional sources. Cumulative assessment of all existing regional sources of air pollution are accounted for by including the ambient air quality concentrations measured at the DPIE stations and adding them to the predicted project generated (incremental) emission.

Future sources of air quality emissions include a number of large proposals local to the project site, such as:

- Sydney Gateway road project
- WestConnex New M5
- WestConnex M4-M5
- F6 Extension stage 1
- Banksmeadow Waste Transfer Terminal
- Airport East and Airport North road projects.

It is acknowledged that the operation of the above mentioned projects have the potential to increase air quality pollutant emissions. It is deemed unlikely that future cumulative air quality criteria exceedances would occur as a result of the project due to the following reasons:

- Project generated (incremental) impacts due to the operation of the project account for a relatively small portion of the assessment criteria and localised around the location of the rail duplication.
- The above mentioned projects would complete their own air quality impact assessments that would also identify mitigation measures to reduce the likelihood of any future air quality criteria exceedances. The combination of management measures from all projects would minimise cumulative impacts across the study area.

10.6 Management of impacts

10.6.1 Approach

Overall, the majority of potential construction related air quality impacts would be short term and temporary in nature. The potential for these impacts would be significantly reduced by:

- effective construction design and planning
- implementation of the mitigation measures provided in Table 10.4.

Monitoring requirements are discussed in section 10.6.2. This includes ongoing visual monitoring for construction dust and complaint based particulate sampling. During operation, air quality would be managed in accordance with ARTC's environmental management system. Based on the findings of this assessment, no additional air quality monitoring is proposed during operation of the project. While it is noted that ARTC do not operate the locomotives, it is assumed these locomotives would be operated in accordance with relevant regulatory requirements to minimise air emissions.

A full description of the approach to environmental management and mitigation is provided in Chapter 25.

10.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential air quality impacts are listed in Table 10.4. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 10.4 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Construction	Minor and temporary elevated particulate matter (PM_{10}) at receptors within six metres of the construction boundary	Dust suppression will be undertaken as required using water sprays, water carts or other media on: • unpaved work areas subject to traffic or wind • sand, spoil and aggregate stockpiles • during the loading and unloading of dust generating materials. As a minimum, level 1 watering should be undertaken on general construction areas and level 2 watering should be undertaken on heavy construction areas. Further discussion including a description of construction work classification is provided in section 5.2 of *Technical Report 3 – Air Quality Impact Assessment*.	✓	✓
		Visual dust monitoring will be performed on a routine basis, and all staff will be trained to look out for visible dust leaving the worksite in the direction of sensitive receptors. If the works are creating visible dust plumes, the works will be modified or stopped until the dust hazard is reduced to an acceptable level. If complaints are received relating to dust from construction works, works will be reviewed to identify opportunities to reduce potential impacts from dust. In the instance of ongoing dust issues, or complaints, a short term dust monitoring device will be installed in the relevant area which may be adjacent to a sensitive receptor near any longer term construction area.	✓	✓
	Dust from construction vehicles	Construction vehicles with potential for loss of loads (such as dust or litter) will be covered when using public roads.	✓	✓
	Emissions from construction equipment and plant	Plant and equipment will be maintained in good condition to minimise spills and air emissions that may cause air quality impacts.	✓	✓
	Dust from stockpiles	The size of stockpiles will be minimised where possible and located as far as practicable from sensitive receptors.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Contaminated dust with PFAS may become airborne and disperse to receptors	Identified areas which may have elevated PFAS/PFOS concentrations are limited to small areas shown in the *Technical Report 5 – Contamination Assessment* (WSP 2019)). This report includes specific management measures. Dust management measures are considered sufficient to manage dust from areas potentially containing PFAS however high risk areas will be identified in the site induction so all personnel are aware of the importance of dust management in these areas. Dust management measures will prevent visible dust from potentially contaminated areas from leaving the construction site boundary.	✓	✓
	Release of odour and pollutants from disturbance of contaminated land	An unexpected finds protocol will be prepared and implemented as part of the relevant management plan. It would identify the process to follow in the event that indicators of contamination are encountered during construction (such as odours, ACM or visually contaminated materials).	✓	✓
Operation	Emissions	Plant and equipment used for maintenance works will be operated in accordance with manufacturer specifications and ARTC's Safety Management System and Environment Management System.	N/A – Operation	N/A – Operation
	Release of odour and pollutants from contaminated land	Ongoing management measures will be implemented for areas where contamination remains following construction. These management measures will be documented in an environmental management plan that is specific to contamination. In particular, the plan will clearly identify areas of remaining ACM impacts and detail the controls to be implemented during maintenance works likely to disturb soils. The plan will also detail the requirements for periodic inspections of ACM capping layer to ensure its integrity.	N/A – Operation	N/A – Operation

10.6.3 Consideration of the interaction between measures

The management of construction dust and pollutants such as asbestos or odorous contaminants, is described across a number of chapters. In Chapter 12 (Contamination) and Chapter 14 (Soils and water quality), soil and erosion control measures will be managed through a Soil and Water Management Plan during construction in accordance with *Soils and Construction – Managing Urban Stormwater Volume 1* (Landcom, 2004) and *Volume 2A* (DECC, 2008). Implementation of these measures will be guided by the relevant management plan.

Chapter 23 (Climate Change) provides measures to be implemented to manage emissions of greenhouse gases during construction and operation.

10.6.4 Managing residual impacts

A residual risk analysis was undertaken following the impact assessment summarised in this chapter. The results of the residual risk analysis are provided in Appendix B. Residual risks with an assessed level of medium or above are summarised below:

- generation of dust during construction (from exposed soil/stockpiles, excavation and vehicle movements)
- mobilisation of asbestos fibres from disturbance of contaminated soils.

Despite measures taken to avoid and mitigate impacts, the project would result in some unavoidable residual adverse impacts. The mitigation and management measures proposed are expected to manage the potential for impacts on air quality.

11. BIODIVERSITY

This chapter provides a summary of the biodiversity assessment. A full copy of the assessment is provided as *Technical Report 4 – Biodiversity Development Assessment Report*.

11.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in *Technical Report 4 – Biodiversity Development Assessment Report*.

11.1.1 Legislative and policy context to the assessment

Biodiversity Conservation Act 2016 and *Biodiversity Conservation Regulation 2017*

The BC Act, together with the *Biodiversity Conservation Regulations 2017,* provides a mechanism to address impacts on biodiversity from land clearing associated with development. Under this legislation, there are provisions for a Biodiversity Offsets Scheme (BOS), which includes a framework to avoid, minimise and offset impacts of development on biodiversity. The Biodiversity Assessment Method (BAM) was established as a standard method to implement the aims of the BOS and to address the loss of biodiversity and threatened species.

The BOS and BAM have been addressed in accordance with the project SEARs through the preparation of *Technical Report 4 – Biodiversity Development Assessment Report*.

Fisheries Management Act 1994

The objectives of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. The FM Act provides for the listing of threatened species, populations and ecological communities, listing of ‘Key Threatening Processes’, and the requirements or otherwise for the preparation of a Species Impact Statement (SIS). One of the objectives of the FM Act is to 'conserve key fish habitats' which includes aquatic habitats that are important to the maintenance of fish populations. The NSW DPI has a ‘no net loss’ habitat policy which may require proponents to conduct habitat rehabilitation and/or provide environmental compensation.

This assessment considers the potential effects on key fish habitat associated with Mill Stream, Alexandra Canal and potential effects on threatened species.

The project is being assessed as SSI under Division 5.2 of the EP&A Act. Under section 5.23 of the EP&A Act, a permit under section 201, 205 or 219 of the FM Act is13.1 not required.

Biosecurity Act 2015

The *Biosecurity Act 2015* provides for risk-based management of biosecurity in NSW. It provides a statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds. The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

Priority weeds recorded in the study area have been identified and control measures detailed where appropriate.

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES).

The EPBC Act has been considered in this assessment through:

- a desktop review to determine the listed biodiversity matters that are predicted to occur within the locality of the project, subject to the habitats present
- targeted field surveys for listed threatened biota and migratory species
- assessment of potential effects on MNES and plants and animals, as a component of the environment of Commonwealth land, including assessments of significance in accordance with the EPBC Act Significant Impact Guidelines (Department of the Environment, 2013), where relevant
- identification of suitable impact mitigation and environmental management measures for threatened and migratory biota, where relevant
- identification of the need or otherwise for biodiversity offsets for effects on listed biodiversity matters.

Provisions for the protection of Ramsar sites of international importance are outlined in this Act.

Under the EPBC Act, proposed actions (ie activities or projects) with the potential to significantly impact matters protected by the EPBC Act must be referred to the Australian Minister for the Environment to determine whether they are controlled actions. The Commonwealth Department of Environment and Energy confirmed that the project is not a controlled action and does not require approval from the Australian Minister for the Environment and Energy. A detailed description of the legislative and policy context for the assessment is provided in section 2 of *Technical Report 4 – Biodiversity Development Assessment Report*.

NSW Sustainable design guidelines

NSW Sustainable design guidelines v3.0 (TfNSW 2013) are part of TfNSW process of achieving sustainable best practice. These guidelines identify initiatives and how they can be implemented through monitoring changes in technology and innovation. The initiatives in this guideline have not been included as the project specific mitigation measures provide greater detail on management of impacts.

Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources

Water sharing plans are being progressively developed for rivers and groundwater systems across NSW following the introduction of the *Water Management Act 2000* (WMA 2000). These plans protect the health of our rivers and groundwater. The relevant plan for the study area is for the greater metropolitan region. Communities of potential groundwater dependent ecosystems (GDEs) relating to the study area were identified from the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* (NSW Government 2011b).

11.1.2 Methodology

Key tasks

Key tasks undertaken for this BDAR have included:

- desktop assessment, including a protected matters database search, to identify landscape-scale features, site context, distribution of native vegetation and threatened ecological communities, and a list of threatened species and populations of flora and fauna
- terrestrial flora surveys including vegetation mapping, identification of plant community types and vegetation zones in accordance with the BAM and targeted threatened flora surveys
- terrestrial fauna surveys including habitat assessments and targeted threatened fauna surveys

- aquatic habitat surveys
- assessment of potential impacts of the project, including identification of measures to avoid and minimise impacts on biodiversity
- identification of offset requirements, including calculation of credit requirements in accordance with the BAM and discussion of offset requirements under the EPBC Act and FM Act.

The assessment also includes:

- key threatening processes listed under the BC Act, FM Act and EPBC Act relevant to this project
- Serious and Irreversible Impact (SAII) entities under the BC Act
- prescribed biodiversity impacts.

The results of these are outlined in *Technical Report 4 – Biodiversity Development Assessment Report*.

Field survey

Threatened flora surveys were undertaken over a three-day period on the 26 June, 19 and 26 September 2018. 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 the NSW *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004b).

Fauna surveys were undertaken on the 26 and 27 June, 26 September, 3, 10, 11 and 18 October 2018 in accordance with the BAM and with reference to the NSW *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004b) and other species specific survey guidelines. Surveys included habitat surveys, general fauna surveys, bird survey and nocturnal fauna including bats. Targeted Green and Golden Bell Frog surveys at Botany Wetland in and adjacent to the project site, and at Tempe Wetland were carried out on 10, 11, 18 and 30 October 2018.

Study area

The study area includes the project site and some additional areas outside of the rail corridor that would be used as compound sites. It extends to around 10 square kilometres centred on the project site for desk studies.

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. This comprised an area of around 500 metres from the project site. Flora and fauna field surveys were carried out in this area.

A detailed description of the assessment methodology is provided in section 3 of *Technical Report 4 – Biodiversity Development Assessment Report*.

11.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with biodiversity. Potential risks were considered according to the impacts that may be generated by the construction or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology and the full results, is provided in Appendix B.

Prior to assessment and identification of mitigation measures, risks with an assessed level of medium or above include:

- clearing of native vegetation resulting in loss of fauna habitat
- direct impacts on threatened species and endangered populations and communities (terrestrial) from clearing
- indirect impacts due to increased dust, sedimentation and erosion, noise, light
- disturbance to aquatic habitats and reduced water quality as a result of sedimentation and altered hydrology
- native fauna mortality from vehicle strikes due to construction vehicles.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 11.7.5.

11.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process.

The project has adopted the following 'avoid, minimise and offset' approach to mitigate impacts on biodiversity values in accordance with the BAM, the BC Act and associated policy. In line with this approach, potential biodiversity impacts have been avoided or minimised where possible by:

- avoiding impacts on habitat, through the project planning and design process
- minimising impacts on habitat, through the use of a range of environmental management and impact mitigation measures
- identifying offset requirements for any residual impact that could not be avoided or mitigated.

There are small patches of vegetation consistent with the EECs Swamp Oak Floodplain Forest and Sydney Coastal Freshwater Wetlands adjacent to the rail corridor. The project site has been purposefully designed to avoid vegetation removal in these areas as far as is practicable.

Construction compounds and other construction areas have been selected to avoid impacts on areas of significant ecological communities and species. Where possible, these areas have been positioned within previously disturbed areas. This may include the use of the current (Roads and Maritime Services) Airport East project site located adjacent to General Holmes Drive.

11.2 Existing environment

11.2.1 Terrestrial flora

Plant Community Type (PCT)

Two native vegetation PCTs were recorded in the project site. These are:

- PCT 1071 *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands of the Sydney Basin Bioregion (PCT 1071 Coastal Freshwater Wetlands)
- PCT 1234 Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234 Swamp Oak Forest).

An overview of the type and zone is provided in Table 11.1.

Table 11.1 Overview of native vegetation types and zones identified within the project site

VEGETATION TYPE	VEGETATION ZONE (VZ)	BC ACT THREATENED ECOLOGICAL COMMUNITY	EPBC ACT STATUS	VEGETATION FORMATION	VEGETATION CLASS	PCT % CLEARED	PATCH SIZE (ha)	VEGETATION INTEGRITY SCORE	EXTENT IN PROJECT SITE (ha)
PCT 1071	VZ1 – Moderate	Freshwater wetland on coastal floodplains – Endangered BC Act	Not listed	KF_CH8 Freshwater Wetlands	Coastal Freshwater Lagoons	75	<5	65.2	0.10
PCT 1234	VZ2 – Poor	Swamp Oak Floodplain Forest – Endangered BC Act	Does not meet key characteristics or condition thresholds for EPBC Act listing.	KF_CH9 Forested Wetlands	Coastal Floodplain Wetlands	90	5-24	25.7	0.46
	VZ3 – Low						<5	22.7	0.16
								Total native vegetation	0.72

In addition, three non-native vegetation types were assigned to a miscellaneous ecosystem class. Non-native vegetation types do not meet floristic or structural characteristics of any recognised native PCT. The miscellaneous ecosystem types identified are:

- highly disturbed areas with no or limited native vegetation
- urban exotic/native landscape plantings
- water bodies.

An overview of the ecosystem types and extent in the project site is provided in Table 11.2. The highly disturbed vegetation type occurs over the majority of the project site (about 5.53 hectares) and is the result of previous clearing and ongoing maintenance of rail infrastructure.

Table 11.2 Overview of non-native vegetation types and zones identified within the project site

VEGETATION TYPE	VEGETATION ZONE (VZ)	EXTENT IN PROJECT SITE (ha)
Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation	VZ4	5.53
Miscellaneous ecosystem – urban exotic/native landscape plantings	VZ5	1.92
Miscellaneous ecosystem – water bodies	VZ6	0.10
	Total non-native vegetation	7.55

These two native and three non-native vegetation types (listed above) were assigned to six discrete vegetation zones based on broad vegetation condition class criteria. The total area of vegetation recorded is 8.27 hectares.

The project site is located predominantly within the existing rail corridor. The rail corridor is periodically cleared to allow for ongoing operations and maintenance of the existing line and management of weeds.

The location of vegetation types within the study area is illustrated in Figure 11.1.

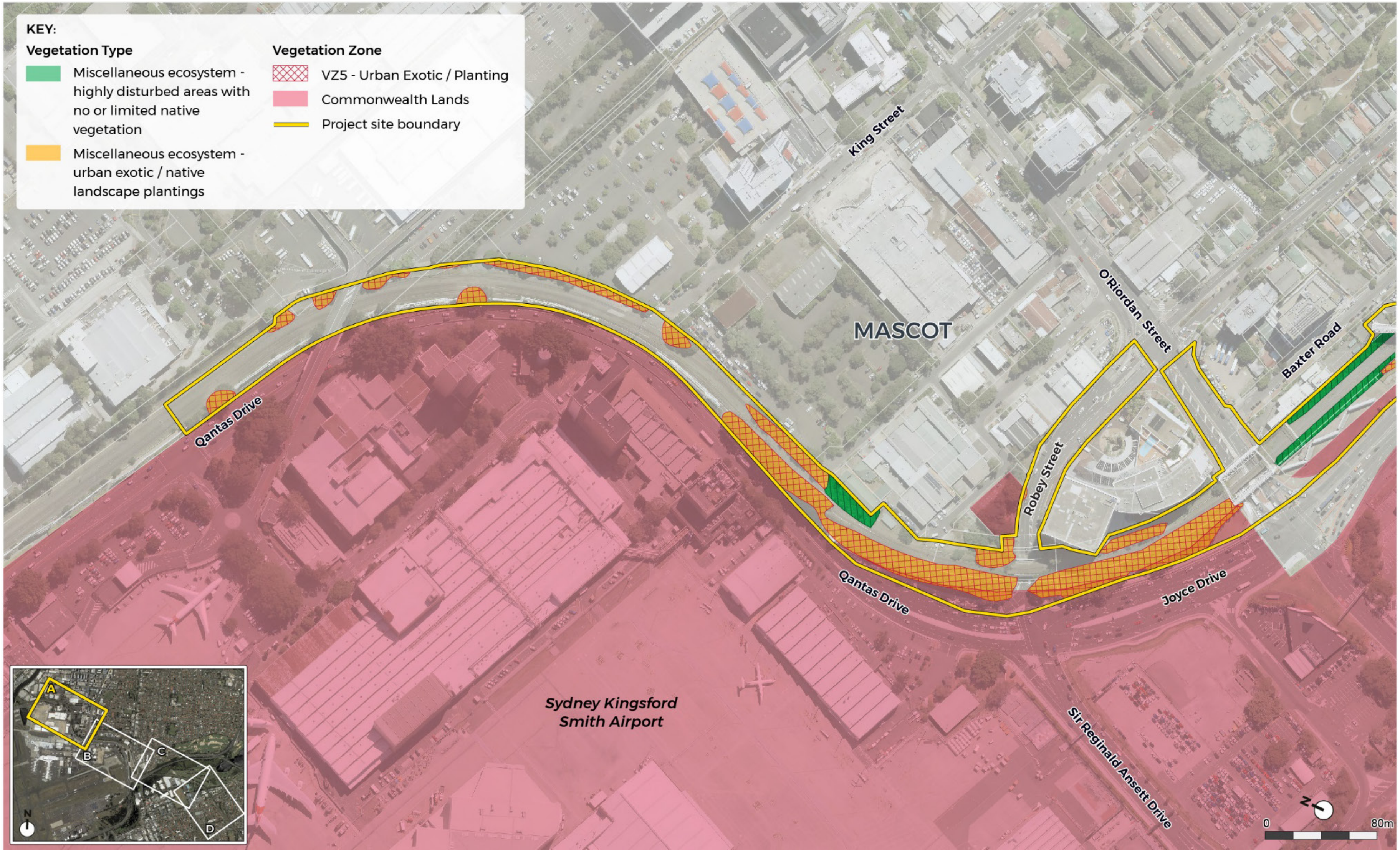


Figure 11.1a Vegetation types and threatened biodiversity with the study area

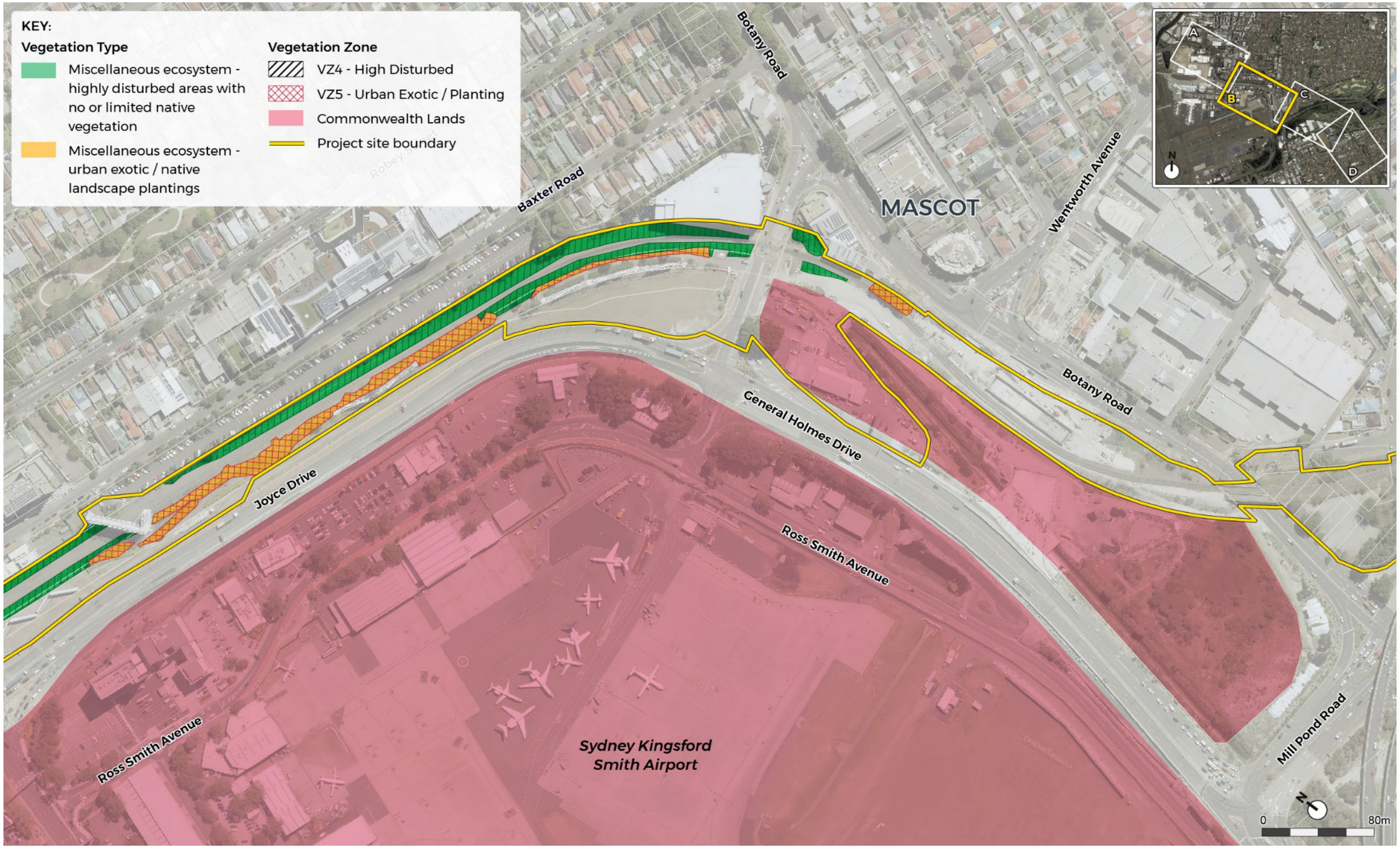


Figure 11.1b Vegetation types and threatened biodiversity with the study area

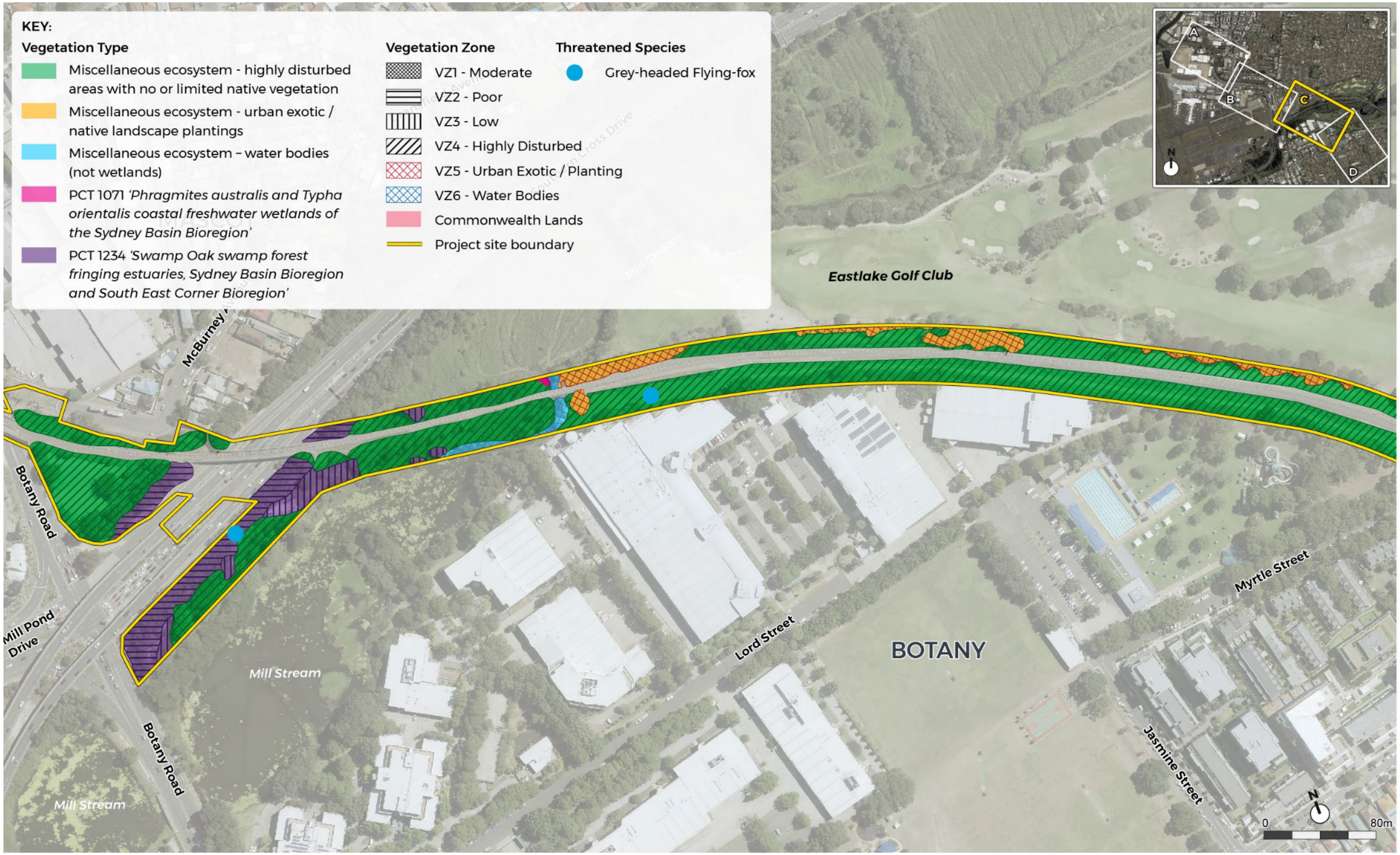


Figure 11.1c Vegetation types and threatened biodiversity with the study area

Figure 11.1d Vegetation types and threatened biodiversity with the study area

Priority weeds

Thirteen species identified during field survey were listed under the NSW *Biosecurity Act 2015* as priority weeds for the Greater Sydney region (DPI, 2018) while nine are also Commonwealth listed Weeds of National Significance (AWC, 2015) as weeds comprising the highest threat nationally. All priority weeds and Weeds of National Significance identified are outlined in Table 11.3. Landowners and land managers are responsible for managing these weeds and preventing their spread. Specific duties for land managers under the *Biosecurity Act 2015* are listed in Table 11.3.

Table 11.3 Priority weeds and weeds of national significance

SCIENTIFIC NAME	COMMON NAME	DUTY UNDER THE *BIOSECURITY ACT 2015*	WEED OF NATIONAL SIGNIFICANCE?
Alternanthera philoxeroides	Alligator Weed	Prohibition on dealings: Must not be imported into the State or sold. Land managers prevent spread from their land where feasible. Exclusion zone: The plant is eradicated from the land and the land kept free of the plant. Core infestation area: Land managers mitigate the risk of new weeds being introduced to their land. Land managers reduce the impact on priority assets.	Yes
Anredera cordifolia	Madeira Vine	Prohibition on dealings: Must not be imported into the State or sold.	Yes
Arundo donax	Giant Reed	Regional Recommended Measure: Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.	No
Asparagus aethiopicus	Ground asparagus	Prohibition on dealings: Must not be imported into the State or sold.	Yes
Asparagus plumosus	Climbing Asparagus Fern	Prohibition on dealings: Must not be imported into the State or sold.	Yes
Cestrum parqui	Green Cestrum	Regional Recommended Measure: Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.	No
Chrysanthemoides monilifera subsp. *rotundata*	Bitou Bush	Prohibition on dealings: Must not be imported into the State or sold. Biosecurity Zone: The Bitou Bush Biosecurity Zone is established for all land within the State except land within 10 kilometres of the mean high water mark of the Pacific Ocean between Cape Byron in the north and Point Perpendicular in the south (includes the study area).	Yes

SCIENTIFIC NAME	COMMON NAME	DUTY UNDER THE *BIOSECURITY ACT 2015*	WEED OF NATIONAL SIGNIFICANCE?
Cortaderia selloana	Pampas Grass	Regional Recommended Measure: Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment. This Regional Recommended Measure applies to *Cortaderia jubata* (pink pampas grass).	No
Lantana camara	Lantana	Prohibition on dealings: Must not be imported into the State or sold.	Yes
Olea europaea subsp. *cuspidata*	African Olive	Regional Recommended Measure: The Greater Sydney region is classified as the core infestation area. Whole region: The plant or parts of the plant are not traded, carried, grown or released into the environment. Core infestation area: Land managers prevent spread from their land where feasible. Land managers reduce impacts from the plant on priority assets.	No
Opuntia sp.	Prickly Pear	Prohibition on dealings: Must not be imported into the State or sold.	Yes
Rubus fruticosus agg.	Blackberry	Prohibition on dealings: Must not be imported into the State or sold.	Yes
Senecio madagascariensis	Fireweed	Prohibition on dealings: Must not be imported into the State or sold.	Yes

Threatened ecological communities

One threatened ecological community listed under the EPBC Act, being the ‘Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community’, was considered as a candidate to occur within the study area. However, the patches of this habitat present within the study area do not meet the patch size or understory cover thresholds to meet the listing under the EPBC Act.

Two threatened ecological communities listed under the BC Act were recorded within the study area. These are:

- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

The conservation status of each recorded threatened ecological community, associated PCT, vegetation zone and extent within the project site is provided in Table 11.4. Vegetation zones indicate the condition of an area related to levels of disturbance, weed invasion and resilience for example.

Table 11.4 A summary of threatened ecological communities listed under the BC Act recorded within the project site

THREATENED ECOLOGICAL COMMUNITY	STATUS[1]	PLANT COMMUNITY TYPE	VEGETATION ZONE	EXTENT IN PROJECT SITE
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 1071 *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands of the Sydney Basin Bioregion	VZ1 Moderate condition	0.1 ha
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 1234 Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin Bioregion and South East Corner Bioregion	VZ2 Poor condition	0.46 ha
			VZ3 Low condition	0.16 ha
			Total	0.72 ha

(1) E= listed as an endangered species under the BC Act

Groundwater dependent ecosystems

Communities of potential groundwater dependent ecosystems (GDEs) relating to the study area were identified from the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* (NSW Government 2011b) and the Bureau of Meteorology (BOM) *Groundwater Dependent Ecosystems Atlas* (BOM 2018).

Parts of the Botany Wetlands northeast of Wentworth Avenue (over one kilometre upstream of the project site) are mapped as an aquatic GDE, while small patches of native vegetation associated with the Botany Wetlands, including some near the project site, are mapped as terrestrial GDEs (BOM 2018). Aquatic ecosystems rely on the surface expression of groundwater such as rivers and wetlands. Terrestrial ecosystems rely on the subsurface presence of groundwater.

The Botany Sand Beds Aquifer is a large subterranean GDE that extends from Botany Bay northwards to Surry Hills and Centennial Park (BOM 2018). It is relatively shallow (1–2 metres below the surface), and has been an important groundwater source for the area for many decades. Due to the permeability of the sands, shallowness of the aquifer and a long history of industry in many parts of the aquifer's catchment, the Botany Sand Beds Aquifer has been and continues to be, highly vulnerable to contamination (Bayside Council 2019).

It is likely that patches of PCT 1234 Swamp Oak Forest in the project site are dependent on groundwater to some degree, given the BOM (2018) mapping of other patches of PCT 1234 Swamp Oak Forest in the Botany Wetlands as being groundwater dependent. Surface water studies undertaken as part of this EIS suggest that Mill Stream and its associated riparian vegetation is contaminated from the Botany Sand Beds Aquifer (see section 14.2).

Threatened flora species and habitats

Limited potential habitat for threatened flora species has been identified in the study area. The overall likelihood of occurrence for the 27 threatened flora species that are known or predicted to occur within the locality have been assessed as low. Given remnant native vegetation patches of PCT 1071 and PCT 1234 are mostly disturbed and provide limited habitat for threatened flora species, the likelihood of future threatened flora occurrence is also considered low.

Four threatened flora species were considered as candidate species. These species were identified based on the BAM candidate species report for the project provided in *Technical Report 4 – Biodiversity Development Assessment Report*. A brief overview of survey and likelihood assessment results for each threatened flora candidate species and how this relates to the project is presented in Table 11.5.

Table 11.5 Threatened flora candidate species assessment results

SCIENTIFIC NAME COMMON NAME (if available)	BC ACT STATUS[1]	EPBC ACT STATUS[1]	DESCRIPTION AND SURVEY RESULTS
Ancistrachne maidenii	V	–	There are no known records of this species in the locality. The study area does not contain specific geological habitat and no individuals were observed within native vegetation patches (PCT 1234) during targeted surveys. Based on the lack of recent records and absence of suitable habitat, the potential occurrence of this species within the study area is considered low. Given this, *Ancistrachne maidenii* is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.
Cryptostylis hunteriana Leafless Tongue Orchid	V	V	This species has not been recorded within the project locality. Within the study area, documented potential habitat identified by the BAM calculator occurs in the form of PCT 1234. This vegetation type has been recorded in poor and low condition with both classes exhibiting an understorey that has been highly disturbed, has low native species richness/cover and is mostly dominated by transformer exotic weed cover. While flora surveys were conducted outside the known flowering period for this species, the lack of any records in the locality and the generally unfavourable understorey habitat conditions lead to a low likely occurrence of this species within the study area is considered. Given this, *Cryptostylis hunteriana* is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.
Wilsonia backhousei Narrow-leafed Wilsonia	–	–	This species has not been recorded within the project locality. The occurrence of this species within the broader Sydney region is mostly restricted to discrete populations in the localities of the Parramatta River at Ermington, Clovelly, Voyager Point and the Royal National Park (OEH 2018a). Habitat associated with this species is generally restricted to the margins of salt marshes and lakes with potential habitat listed to include PCT 1234. Within the study area, the vegetation type PCT 1234 has been recorded in poor and low condition with both classes exhibiting an understorey that has been highly disturbed, have low native species richness/cover and are mostly dominated by transformer exotic weed cover.

SCIENTIFIC NAME COMMON NAME (if available)	BC ACT STATUS[1]	EPBC ACT STATUS[1]	DESCRIPTION AND SURVEY RESULTS
			There are no seasonality issues associated with surveying for *Wilsonia backhousei* as the species is readily identifiable all year (OEH 2018b). Targeted surveys failed to identify any individuals of this species and given the lack of any records in the locality and the generally unfavourable understorey habitat conditions, the likely occurrence of this species within the study area is considered low. Given this, *Wilsonia backhousei* is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.
Zannichellia palustris	E	–	*Zannichellia palustris* is a submerged aquatic plant that is only known from the lower Hunter and Sydney Olympic Park in NSW. The plant grows in fresh or slightly saline stationary or slowly flowing water. *Zannichellia palustris* flowers during the warmer months and completely dies back every summer. This species has not been recorded within the locality. Targeted surveys were conducted in PCT 1071 and standing water associated with the Mill Stream. No individuals of this species were observed despite surveys being conducted during favourable seasonal conditions. Given this, *Zannichellia palustris* is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.

(1) E: endangered species; V: vulnerable species

No threatened flora were identified during surveys, and no threatened flora are likely to occur given the absence of suitable habitat in the project site. The project is therefore considered unlikely to impact on threatened flora species or their habitats and as such no species are considered affected in terms of project impacts and therefore no offset has been identified adopting relevant BAM calculations.

11.2.2 Terrestrial fauna

Fauna survey results

A moderate diversity of species was recorded during field surveys, with better quality habitats at Botany Wetlands contributing to the range of species present. Most species are those typical of urban environments and wetlands in urban areas.

A total of 67 species were recorded in the study area. This comprised 46 bird species, nine mammal species, five reptile species, four frog species, three fish species and ten introduced species.

Two threatened species listed as vulnerable under the BC Act, were recorded during surveys. These were the Grey-headed Flying-fox (*Pteropus poliocephalus*) and the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*). The Grey-headed Flying-fox is also listed as vulnerable under the EPBC Act.

Migratory species

Botany Bay and surrounds, and in particular Towra Point Nature Reserve around 6.5 kilometres from the site, are known to provide habitat for a range of migratory species listed under the EPBC Act. Further discussion of these habitats is provided in section 11.2.3. No habitat suitable for migratory species has been identified within the project site.

Terrestrial fauna habitats

Much of the land within the study area has been previously cleared of native vegetation for the existing rail corridor, roads, residential, industrial and recreation areas. The majority of the rail corridor is cleared and planted with introduced grasses and herbs interspersed with bare ground, ballast and other artificial substrates. Planted trees also occur in some areas, as do thickets of weeds such as Lantana. Much of the study area therefore provides low habitat value for terrestrial fauna.

Fauna habitats with higher biodiversity value are located in areas adjacent to the rail corridor and include the Botany Wetlands associated with Mill Stream, which is crossed by the rail corridor. This area contains freshwater wetlands and PCT 1234 Swamp Oak Forest. Proposed compound sites also contain a combination of native vegetation, planted introduced trees and weed infestations.

Habitats identified comprise:

- highly disturbed areas (exotic grassland)
- urban exotic and planted native species
- PCT 1234 Swamp Oak Forest
- PCT 1071 Coastal Freshwater Wetlands.

These habitats and potential associated species are discussed further below.

Highly disturbed areas (exotic grassland)

Exotic grassland is present within areas of the rail corridor where areas are used for access, operations or other maintenance of the rail network. These areas are narrow and some areas are isolated from other habitat. Exotic grassland is interspersed with ballast, bare ground and other artificial substrate. Some planted trees and shrubs are present. These areas would have historically supported native woodland vegetation but have been extensively modified by previous clearing.

Exotic grassland contains few habitat resources of relevance to most native species due to its low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species.

Figure 11.2 Exotic grassland adjacent to Banksia Street

Figure 11.2 shows a typical example of this habitat type located adjacent to Banksia Street. Table 11.6 identifies the potential species which may be recorded in this habitat type and species identified during the field surveys.

Table 11.6 Fauna habitats – Highly disturbed areas (exotic grassland)

	POTENTIAL SPECIES
Typical fauna species recorded or likely to occur	Bird species commonly recorded in this habitat type included the Crested Pigeon (*Ocyphaps lophotes*), Welcome Swallow (*Hirundo neoxena*), Magpie-lark (*Grallina cyanoleuca*), Superb Fairy-wren (*Malurus cyaneus*), Willie Wagtail (*Rhipidura leucophrys*) and Grey Fantail (*Rhipidura albiscapa*). These species are insectivorous and were observed foraging within mown portions of the grassland. Small, common lizards such as the Dark-flecked Garden Sunskink *(Lampropholis delicata*) are likely to occur in this habitat type, particularly in areas where shelter such as ballast or woody debris is present. The Common Eastern Froglet (*Crinia signifera*) was heard calling from a table drain in grassland areas. Other common native frog species, including the brown Striped Frog (*Limnodynastes peronii*) would also likely occur in drains in these areas.
Threatened fauna species	Microchiropteran bats such as the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) may forage over this habitat type on occasion.
Migratory species	No migratory species were observed and none are likely to occur in this habitat type.
Introduced species	During field survey the following were identified: Rock Dove (*Columba livia*) and feral/domestic cat (*Felis catus*).

Urban exotic and planted native species

Exotic forest and scrub and planted native species are present on the fringes of the rail corridor. Exotic forest and scrub is dominated by dense midstorey vegetation of variable structural complexity and includes Camphor Laurel (*Cinnamomum camphora*) and Lantana. These areas appear to have been once cleared, but have since overgrown.

Patches of weeds and planted native or exotic trees and shrubs within the rail corridor provide potential foraging habitat for a range of common bird species and mammal species typical of urban parks and gardens.

Figure 11.3 Urban exotic forest and scrub adjacent to Botany Road

Figure 11.3 shows a typical example of this habitat type located adjacent to Botany Road. Table 11.7 identifies the potential species which may be recorded in this habitat type and species identified during the field surveys.

Table 11.7 Fauna habitats – Urban exotic and planted native species

	POTENTIAL SPECIES
Typical fauna species recorded or likely to occur	Large flocks of honeyeaters, including the Yellow-faced Honeyeater (*Caligavis chrysops*) and New Holland Honeyeater (*Phylidonyris novaehollandiae*) were observed foraging within this habitat type. Red-whiskered Bulbuls (*Pycnonotus jocosus*) were recorded in exotic forest and scrub adjacent to wetland areas. Smaller flocks of Silvereyes (*Zosterops lateralis*) were recorded foraging on the edge of the rail corridor and in Eastlake Golf Club. Native mammals, including the Common Ring-tailed Possum (*Pseudocheirus peregrinus*) and small introduced mammals, such as Black Rats (*Rattus rattus*) may den and forage in the dense midstorey of exotic scrub, although none were recorded.
Threatened fauna species	The Grey-headed Flying-fox was recorded flying over the site, and may forage in planted eucalypts and figs when specimens are flowering or fruiting. No breeding camps are present. Microchiropteran bats such as the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and Eastern Freetail Bat (*Mormopterus norfolkensis*) may forage in these habitats on occasion. No hollow-bearing trees were observed that would be suitable for bats to roost in.
Migratory species	No migratory fauna species were recorded during surveys. Migratory terrestrial woodland species such as the Rufous Fantail (*Rhipidura rufifrons*) could occur on occasion, but would unlikely depend on the habitats present.
Introduced species	During field survey the following were identified: Common Myna (*Sturnus tristis*), Eurasian Blackbird (*Turdus merula*), Red-whiskered Bulbul (*Pycnonotus jocosus*), feral cat (*Felis catus*) and Black Rat (Rattus rattus).

PCT 1234 Swamp Oak Forest

Riparian forest occurs in a small patch adjacent to Mill Stream within the rail corridor. This forest was dominated by Swamp Oak, with various introduced canopy species also present, including Coral trees and Mulberry trees. This vegetation contains a moderate to severe weed infestation with evidence of erosion where the batter slopes are steep.

Understorey vegetation closer to the Mill Stream waterline contains moisture loving species such as rushes and sedges.

No hollow-bearing trees were identified at the time of surveys in this habitat type.

Canopy species provide foraging and shelter resources for a range of bird species. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias would help provide year-round foraging resources for a range of nectarivorous native birds, bats and possums.

High quantities of woody debris and leaf litter are present, where exotic canopy species such as Camphor Laurel are present. Fallen timber and leaf litter provides shelter and foraging habitat for small reptiles and snakes. Dense weed infestations are present along the creek banks which may also reduce habitat quality for some species.

Figure 11.4 PCT 1234 Swamp Oak Forest alongside Botany Wetland

Figure 11.4 shows a typical example of this habitat type located alongside Botany Wetland. Table 11.8 identifies the potential species which may be recorded in this habitat type and species identified during the field surveys.

Table 11.8 Fauna habitats – PCT 1234 Swamp Oak Forest

	POTENTIAL SPECIES
Typical fauna species recorded	A moderate number of nectarivorous bird species were observed foraging within the dense midstorey of riparian forest, including the Scarlet Honeyeater (*Myzomela sanguinolenta*), Silvereye (*Zosterops lateralis*), Lewin's Honeyeater (*Meliphaga lewinii*) and Yellow-faced Honeyeater (*Caligavis chrysops*). Seed eaters, including Red-browed Finches (*Neochmia temporalis*) were also observed. Other bird species recorded included the Rufous Whistler (*Pachycephala rufiventris*), Spotted Pardalote (*Pardalotus punctatus*) and Grey Fantail (*Rhipidura albiscapa*). Some of these species also occur in forest patches away from riparian corridors. A number of snake eggs were recorded within mounds of sand in this habitat type, likely from the Eastern Brown Snake (*Pseudonaja textilis*).
Threatened fauna species	The Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded flying over the study area and foraging within fruiting Mulberry trees. Limited foraging habitat is present within the study area for this species. There is no roosting habitat or camp sites.
Migratory species	No migratory fauna species were recorded during surveys. Migratory woodland species such as the Rufous Fantail (*Rhipidura rufifrons*) could occur on occasion, but would not depend on the habitats present.
Introduced species	During field survey, the following were identified: Red-whiskered Bulbul (*Pycnonotus jocosus*), Common Starling (*Sturnus vulgaris*) and Black Rat (*Rattus rattus*).

PCT 1071 Coastal Freshwater Wetlands

The study area crosses Botany Wetland, which contains a number of ponds associated with Mill Stream. Large expanses of open water were observed in wetlands south of Southern Cross Drive. Smaller waterbodies with extensive reed beds also occur in the study area, particularly adjacent to East Lakes Golf Club. Wetlands in the study are connected with wetlands to the north in The Lakes Golf Club and also Eastlake Golf Club.

These areas range in habitat value for native fauna depending on their size and presence of emergent or aquatic vegetation. Wetlands contained a low diversity of aquatic vegetation including *Typha orientalis*. Open water in some areas was heavily choked with aquatic weed.

Figure 11.5 Wetland south of Southern Cross Drive bordered by reed habitat

Figure 11.5 shows a typical example of this habitat type in the study area. Table 11.9 identifies the potential species which may be recorded in this habitat type and species identified during the field surveys.

Table 11.9 Fauna habitats – PCT 1071 Coastal Freshwater Wetlands

	POTENTIAL SPECIES
Typical fauna species recorded	A moderate diversity and abundance of native waterfowl, waders and other wetland birds were observed in these water bodies. An unidentified falcon species (*Falco* spp.) was observed flying over the study area. A range of ducks and grebes was observed, including various common species. Many Eurasian Coot (*Fulica atra*) and some Australasian Grebe (*Tachybaptus novaehollandiae*) were recorded foraging in open water. The Purple Swamphen (*Porphyrio porphyrio*), Royal Spoonbill (*Platalea regia*), eastern Great Egret (*Ardea modesta*) and Dusky Moorhen (*Gallinula tenebrosa*) were observed foraging in the shallows of wetlands. Little Pied Cormorants (*Microcarbo melanoleucos*) and Little Egrets (*Egretta garzetta*) were recorded perching on submerged woody debris and on the edges of riparian vegetation overlooking the wetland in the study area. Eastern Snake-necked Turtles (*Chelodina longicollis*) were recorded basking at the old jetty, and Eastern Water Skinks (*Eulamptus quoyi*) were observed basking on the footpath at Botany Road. Eastern Water Dragons (*Intellagama lesueurii*) were observed near the rail bridge. The wetlands provide potential habitat for the Green and Golden Bell Frog (*Litoria aurea*) however none were recorded during targeted surveys (see *Technical Report 4 – Biodiversity Development Assessment Report* for detailed survey methodology). This species was last recorded in 1993 at this location and is considered to be no longer present at Botany Wetland (White and Pyke 2008a). Common frog species recorded included the Dwarf Eastern Tree Frog (*Litoria fallax*), Peron's Tree Frog (*Litoria peroni*) and Common Eastern Froglet (*Crinia signifera*). The Dwarf Eastern Tree Frog and Common Eastern Froglet were recorded at one backwater in Pond 1a about 200 metres upstream of the rail bridge. The Dwarf Eastern Tree Frog was also heard calling at various locations around Mill Pond downstream of the rail bridge. Peron's Tree Frog was heard calling near Botany Road. No frogs were heard or observed in the large *Typha orientalis* patch immediately upstream of the rail bridge. The location of water bodies are shown in Figure 11.6. Long-finned Eels (*Anguilla rhinehardtii*), Common Carp (*Cyprinus carpio*) and Mosquitofish (*Gambusia holbrooki*) were also observed in a number of wetlands.
Threatened fauna species	The Eastern Bentwing Bat was possibly recorded at the rail bridge based on Anabat analysis. No calls of the Southern Myotis (*Myotis macropus*) (or any similar calls of *Nyctophilus* species) were recorded. No bats were observed at the rail bridge at dusk, or foraging above the Botany Wetlands during frog surveys.
Migratory species	No migratory species were recorded during surveys. DPIE (OEH 2018a) records show that a number of species have been observed in the Botany Wetlands on rare occasions, including the Sharp-tailed Sandpiper (*Calidris acuminata*), Wood Sandpiper (*Tringa glariola*) and Latham's Snipe (*Gallinago hardwickii*).
Introduced species	During field survey the following were identified: Common Carp (*Cyprinus carpio*) and Mosquitofish (*Gambusia holbrooki*).

Threatened fauna species and populations

One threatened fauna species listed as vulnerable under the EPBC Act and the BC Act, the Grey-headed Flying-fox, was recorded in the project site. Occasional fig trees, eucalypts and mulberry trees occur along the edges of the rail corridor and in planted vegetation in the project site. Grey-headed Flying-foxes would forage in these trees on occasion when fruiting or flowering. There is no breeding camp in the project site. Nearby breeding camps include those at Wolli Creek (three kilometres to the west) and Centennial Park (5.5 kilometres to the northeast). Foraging habitat in the project site would be a negligible proportion of available foraging habitat used by individuals from these camps and thus would not be habitat critical to the survival of the species.

The location of threatened species identified within the study area is illustrated in Figure 11.1.

This assessment has considered the predicted threatened species and candidate species (credit species) as required by the BAM. The findings are summarised below.

Threatened species

Following the desktop assessment and habitat assessments conducted in the field, two threatened fauna species were considered to be species for which offsetting credits may need to be calculated: The Green and Golden Bell Frog and the Southern Myotis. A discussion of the presence of these species is summarised in Table 11.10.

Table 11.10 Threatened species (candidates for offsetting credits)

SCIENTIFIC NAME COMMON NAME	BC ACT STATUS[1]	EPBC ACT STATUS[1]	DISCUSSION
Litoria aurea Green and Golden Bell Frog	E	V	Detailed surveys for the Green and Golden Bell Frog were conducted in suitable weather conditions over a number of months. Most surveys were conducted in months identified as suitable in the survey guidelines for the species (DEWHA 2010a). Green and Golden Bell Frogs were active at other reference sites during the survey period indicating that the survey was conducted in the appropriate season. No evidence of the species has been recorded at Botany Wetlands since 1993, and it is accepted by DOEE in the Green and Golden Bell Frog species profile (DOEE 2018c) to no longer be present in this area. Given this, the Green and Golden Bell Frog is not considered likely to be affected by the project and as such no further consideration or assessment of this species is considered necessary.
Myotis macropus Southern Myotis	V	–	No evidence of roosting bats was observed at the bridge over Mill Stream at the Botany Wetlands. No hollow-bearing trees were observed in the vicinity of the wetland that could be used for roosting by this species. No calls attributable to this species were recorded on anabats at Botany Wetland, within the rail corridor, at the Alexandra Canal or Tempe Wetland. There are no records of the species in the last 30 years associated with Botany Wetlands (OEH 2018a). The Southern Myotis is therefore not considered likely to be affected by the project and as such no further consideration or assessment of this species is considered necessary.

(1) E: endangered species; V: vulnerable species

11.2.3 Aquatic ecology

Aquatic habitats

The project is located within the catchments of Alexandra Canal (which is a sub-catchment of the Cooks River catchment) and the Mill Stream catchment (which is a sub-catchment of the Georges River catchment). Mill Stream is part of the Botany Wetlands, which are the largest freshwater wetlands in the Sydney Metropolitan Region.

Figure 11.6 shows the location of the Botany Wetlands and Sydney Airport Wetlands which are local to the project site.

The project crosses the Botany Wetlands at Mill Stream adjacent to Mill Pond. Upstream of the existing rail bridge Mill Stream is a small water channel adjacent to a raised sediment island dominated by *Typha orientalis*. Some deeper pools occur further upstream. Large beds of Myriophyllum (*Myriophyllum aquaticum*) and Ribbon Weed (*Valiseria americana*) are present in the channel and larger polls. A large gross pollutant trap upstream of sediment island (between New Pond and Pond 1a) was observed during surveys to have trapped large amounts of rubbish and is also likely to be a barrier to fish movement along Mill Stream.

Mill Pond downstream of the existing rail bridge (and adjacent to Botany Road) is a large open pond area dominated by Myriophyllum. Lilies are present in the downstream end of the pond along with a high concentration of surface scum and algae. Some *Typha orientalis* stands are present in the upstream end of the pond.

Another gross pollutant trap is present near the Botany Road bridge, and similarly contained large amounts of rubbish at the time of survey. This would also likely be a barrier to fish passage. Mill Stream passes through four large culverts at Foreshore Drive.

The main areas of natural biodiversity value remaining at Sydney Airport are the Sydney Airport Wetlands (Engine Pond East and West). The project crosses the Botany Wetlands upstream of Mill Pond, and thus does not directly affect the Sydney Airport Wetlands.

The mouth of Mill Stream at Botany Bay has been substantially modified by the construction of Sydney Airport's third runway and Foreshore Drive. Further downstream the recent construction of the expanded Sydney Ports container terminal has further modified the natural environment of Botany Bay. A small section of Foreshore Beach remains alongside Mill Stream. Seagrasses are present off shore.

Key fish habitat

Mill Stream is mapped as key fish habitat (DPI 2007) and considered moderate key fish habitat according to DPI (2013) given the presence of clearly defined bed and banks with permanent waters in pools or in connected wetland areas, the presence of freshwater aquatic vegetation and native fish (eels).

Threatened aquatic species identified in the study area

Botany Wetlands and Mill Stream are not habitat for any threatened fish species. Freshwater habitats crossed by the project are outside the natural range of the Australian Grayling (*Prototroctes maraena*). The Black Rock Cod (*Epinephelus daemelii*) occurs around rocky shores and reefs, and no habitat is present in the study area.

Coastal Management SEPP 2018 – Coastal Wetland

The small wetland located north of Mill Pond Drive and west of Botany Road is mapped as a Coastal Wetland according to the Coastal Management SEPP 2018. This wetland is located immediately adjacent to the project boundary and the project crosses its proximity area northwest of Southern Cross Drive.

Parts of the Botany Wetlands are also mapped as Coastal Wetlands. These comprise small areas upstream of the bridge over Mill Stream located adjacent to Eastlake Golf Club and larger areas located in Bonnie Doon Golf Club further upstream. No areas of Coastal Wetlands or their proximity areas along Mill Stream are within the project site.

Figure 11.6 shows the location of the main wetland areas which are local to the project site and their proximity areas (areas where development is restricted) as defined by Coastal Management SEPP 2018.

Wetlands of international importance (Ramsar wetlands)

Towra Point Nature Reserve Ramsar Site is located on the southern side of Botany Bay, about 6.5 kilometres from the project site. The reserve contains a gradation of environments from subtidal areas to extensive intertidal mudflats and mangrove forest to occasionally tidal-flooded saltmarsh to freshwater wetlands to shallow and deep sand dunes supporting littoral forest.

This Ramsar Site provides important habitat for a number of migratory waders. It also hosts one of the most important nesting sites in NSW for the Little Tern (*Sterna albifrons*) and a significant proportion of the state-wide nesting population of the Pied Oystercatcher (*Haematopus longirostris*) which are listed as endangered under the NSW BC Act (OEH 2013a).

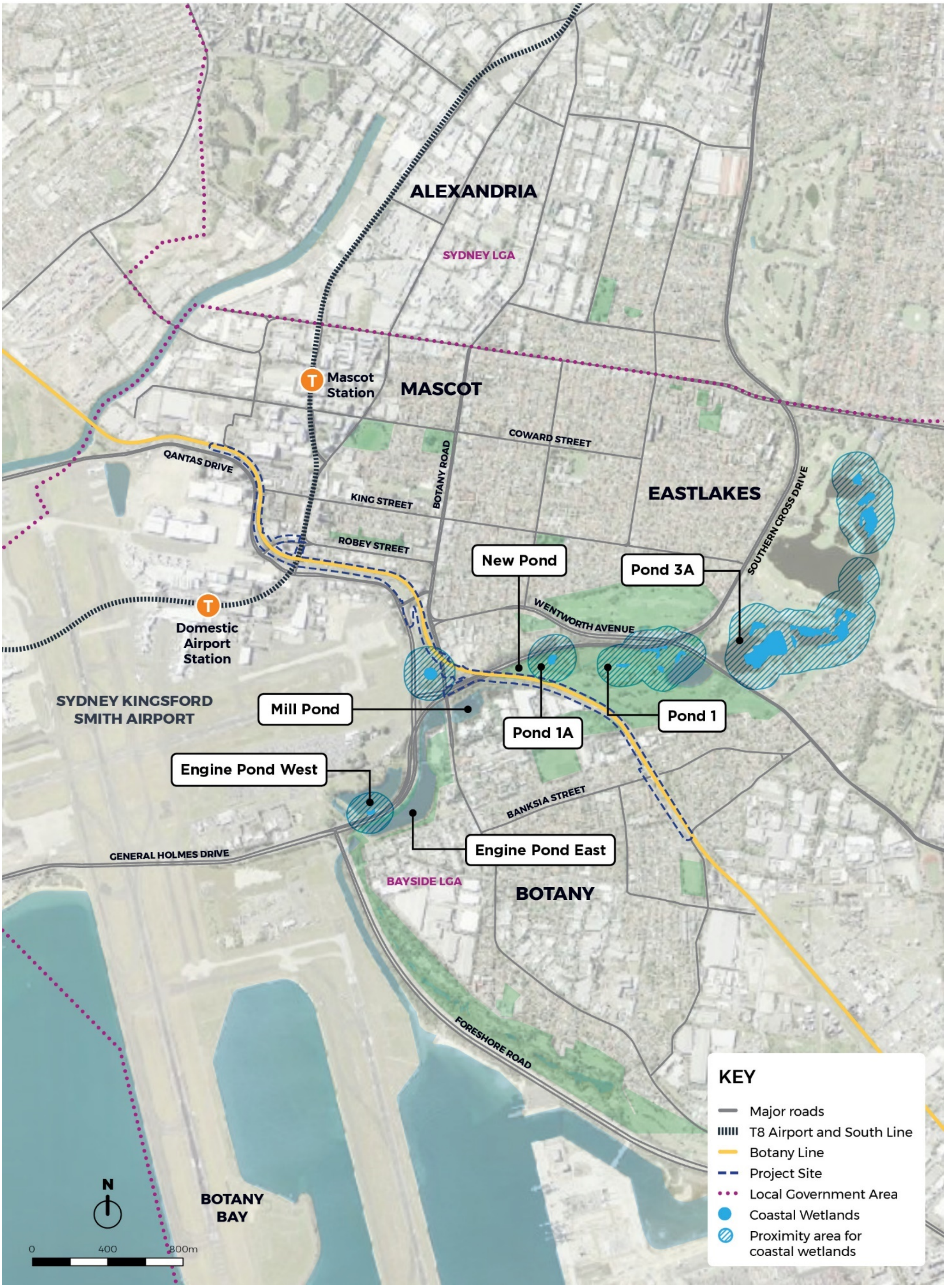


Figure 11.6 Aquatic habitat

11.3 Assessment of construction impacts

11.3.1 Direct impacts on vegetation and habitat

The project site is characterised in general by cleared land in a rail corridor with minimal value for native biodiversity. The project site is located predominantly within the existing rail corridor. The rail corridor is periodically cleared to allow for ongoing operations and maintenance of the existing line and management of weeds. The majority of the project would occur within the existing rail corridor, however in some areas, land outside the corridor is required to access the site or to facilitate construction works for key features such as bridges and retaining walls or embankments. Vegetation removal would be required predominantly in these areas outside the corridor.

The majority of the vegetation to be removed for the project is not native vegetation and comprises exotic plants or planted, often non-indigenous (native but not naturally occurring in this area) native species on fill material. Construction within these areas would remove a small number of individuals of non-threatened native plants, including planted trees and weeds.

Table 11.11 lists the areas of vegetation which would be potentially removed for the project. In total, the project would remove about 0.72 hectares of native vegetation from a total impact area of 8.12 hectares.

Table 11.11 Vegetation removal

<table>
<tr><th>VEG ZONE</th><th>PLANT COMMUNITY TYPE (PCT)</th><th>THREATENED ECOLOGICAL COMMUNITY</th><th>AREA IMPACTED (ha)</th></tr>
<tr><td>VZ1</td><td>PCT 1071 Phragmites australis and Typha orientalis Coastal Freshwater Wetlands of the Sydney Basin Bioregion (moderate condition)</td><td>Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions</td><td>0.10</td></tr>
<tr><td>VZ2</td><td>PCT 1234 Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin Bioregion and South East Corner Bioregion (poor condition)</td><td rowspan="2">Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions</td><td>0.46</td></tr>
<tr><td>VZ3</td><td>PCT 1234 Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin Bioregion and South East Corner Bioregion (low condition)</td><td>0.16</td></tr>
<tr><td>VZ4</td><td>Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation</td><td>Not native</td><td>5.53</td></tr>
<tr><td>VZ5</td><td>Miscellaneous ecosystem – urban exotic/ native landscape plantings</td><td>Not native</td><td>1.89</td></tr>
<tr><td>VZ6</td><td>Miscellaneous ecosystem – water bodies (not wetlands)</td><td>Not native</td><td>0.05</td></tr>
<tr><td></td><td colspan="2" align="right">Total native vegetation</td><td>0.72</td></tr>
<tr><td></td><td colspan="2" align="right">Total area</td><td>8.12</td></tr>
</table>

11.3.2 Direct impacts on fauna and fauna habitat

The project may result in direct impacts on fauna and fauna habitats. The potential impact are described in Table 11.12.

Table 11.12 Direct impacts on fauna and fauna habitat resources

IMPACT	DESCRIPTION
Removal of habitat resources	Construction of the project would remove a very small area of fauna habitat, as most of the project site is already cleared land. The vegetation that would be removed or modified provides limited habitat resources for native fauna species due to its existing highly modified nature and the surrounding urban environment. Fauna habitat resources that would be removed include foraging and shelter resources for mainly common native fauna typical of urban environments. The project would remove a small number of trees which may be used for foraging by the Grey-headed Flying-fox and habitat used for foraging by microbats.
Impact on wetland habitat	There would be limited direct impacts on wetland habitat at the Botany Wetlands. Clearing would be limited in area, and would comprise mainly the removal of weed-infested planted vegetation. Impacts on native vegetation would be restricted to the removal of 0.62 ha of PCT 1234 Swamp Oak Forest and 0.1 ha of PCT 1071 Coastal Freshwater Wetlands from immediately adjacent to the rail bridge at Mill Stream. Some minor material within Mill Stream would be excavated and scour protection would also be constructed along the eastern and western banks of Mill Stream, where required. Impacts on the waterbody would be minor.
Removal of hollow-bearing trees	No hollow-bearing trees were recorded in the project site.
Injury and mortality	Construction is likely to result in the injury or mortality of some individuals of less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the project site during clearing activities. This could include nestlings, small lizards and frogs. More mobile native fauna such as native birds, bats, terrestrial and arboreal mammals that may be sheltering in vegetation in the project site are likely to evade injury during construction activities.
Fragmentation and isolation of habitat.	The project would require the removal of vegetation and habitat and would create or increase small gaps in habitat. The vegetation within the study area is currently fragmented by the existing rail corridor, roads and urban development. It is unlikely that the project would create an additional barrier to the movement of pollinator and seed dispersal vectors, such as insects and birds.
Impacts on key fish habitat	There would be no loss of key fish habitat. There would be no impacts on aquatic connectivity or fish passage along Mill Stream. The gap in riparian vegetation at this location would be increased, but would be unlikely to prevent the movement of any fauna along this corridor. Impacts on aquatic habitats are discussed further in section 11.3.6.

11.3.3 Indirect impacts on flora and fauna

The project may result in indirect impacts on flora and fauna. The potential impacts that may result from construction of the project are detailed in Table 11.13.

Table 11.13 Indirect impacts on biodiversity values

IMPACT	DESCRIPTION
Weed invasion and edge effects	'Edge effects' refer to increased noise and light or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats or change the behaviour of resident animals. Edge effects would result from construction activities and then continue to affect vegetation and habitats adjoining the project site. The project site and adjoining land has been extensively cleared for the existing rail corridor and surrounding urban development. Small, linear patches of vegetation occur at scattered locations. Due to the small size and linear arrangement of native vegetation patches in the study area, they are already severely affected by edge effects and associated negative impacts such as weed infestation. The project would create few new edge effects and is unlikely to result in a significant increase in the impact of existing edge effects.
Pests and pathogens	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. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys, however Chytrid fungus is likely to have contributed to the loss of the Green and Golden Bell Frog from the area (DECC 2008b). The potential for impacts associated with these pathogens is low, given the existing disturbed nature and high visitation rates to the study area, and lack of intact native vegetation in the vicinity of the project site.
Noise, light and vibration	Construction of the project would require the use of additional vehicles and plant in the site. Fauna that occupy habitats within the project site and adjacent areas are likely to be accustomed to existing high noise and vibration levels originating from trains, road traffic and the urban environment. Similarly, fauna and fauna habitats are already exposed to existing light from trains, cars, street lights and residential and industrial areas. Noise and vibration disturbance at the bridge at Mill Stream could disturb temporary roost habitat for threatened microchiropteran bats. While there would be localised increases in noise, vibration and light that would temporarily create substantial disturbance, increases above existing background levels during construction are unlikely to result in a significant impact on fauna that occur in the study area.
Sedimentation and erosion	Construction of the project has the potential to result in sedimentation and erosion within the construction corridor and adjoining native vegetation and aquatic habitats, through soil disturbance and construction activities. This is of particular risk during construction of the second bridge at Mill Stream. Sediment laden runoff to waterways can alter water quality and adversely affect aquatic life.
Aquatic disturbance and pollution	Impacts on aquatic habitats are discussed in section 11.3.6.

11.3.4 Threatened flora species

No threatened flora species or their habitat, listed under BC Act, have been determined to be affected by the project.

11.3.5 Threatened fauna species

The project could have minor impacts on threatened fauna species listed under the BC Act as a result of impact to potential foraging habitat. Only two species, the Grey-headed Flying-fox and the Eastern Bentwing Bat, were recorded during surveys. Some other highly mobile species may occur on occasion within the project site.

One threatened fauna species listed under the EPBC Act, the Grey-headed Flying-fox, was recorded in the project site.

Impacts on threatened fauna would comprise:

- the removal of up to 2.51 hectares of canopied foraging habitat for the threatened Eastern Bentwing Bat, Grey-headed Flying-fox and other threatened fauna species with potential habitat in the study area (consisting of 1.89 hectares of planted native species and 0.62 hectares of native vegetation)
- the removal of 0.10 hectares of Freshwater Wetland habitat, which is marginal potential foraging habitat for a variety of migratory waders
- noise and vibration disturbance at the bridge over Mill Stream, which could provide temporary roost habitat for threatened microchiropteran bats, although no roosting bats or evidence of roosting bats was observed during surveys.

There would be no impacts on habitat for species which would require offset. Targeted surveys did not find any evidence of the Green and Golden Bell Frog or Southern Myotis. No suitable habitat for any other candidate species credit species is present in the project site. It is highly unlikely that any threatened species or any fauna populations would rely on the habitat resources within the project site for their survival.

11.3.6 Aquatic fauna and habitats

The project includes a new bridge across Mill Stream, which is mapped as key fish habitat. Construction at this location would include piling for the bridge, some minor works along the banks and potentially instream to stabilise the abutments in this area. The aquatic habitats within and downstream of the project site have the potential to be impacted during construction if not mitigated. Potential aquatic issues during construction include:

- potential sedimentation of Mill Stream, as a result of soil disturbance, erosion and sediment-laden runoff
- exposure of actual or potential acid sulfate soils, which may generate acidic runoff and affect water quality
- potential effects on surface and groundwater quality as a result of disturbance of contaminated soils
- potential spills or leaks of fuels or oils from construction equipment or vehicle/truck incidents.

Construction involving excavation would interact with contaminated soils and groundwater during piling for the new bridge over Mill Stream. Works would intercept the Botany Sand Beds Aquifer, which is known to be shallow and contaminated. Construction water runoff and sedimentation in Mill Stream could affect habitat for fish, wading birds and other species that utilise this waterway. This waterway is already subject to substantial disturbance and pollution. Design of construction and mitigation measures would be in place to minimise these impacts where possible. No extraction or dewatering is anticipated for the project.

The project would not directly impact any habitat for threatened biota listed under the FM Act. Potential habitat for the Black Rock Cod is located over five kilometres downstream of the project (rock headlands of Botany Bay), and indirect effects on habitat are highly unlikely. Impacts on the geomorphology of the waterways are minor and short term and considered manageable with appropriate mitigation measures. There would be no blockage of fish passage and no removal of snags as a result of the project.

For the purposes of this assessment, it has been assumed that all native vegetation within the project site would be removed. The majority of this native vegetation removal (0.72 hectares) would occur in the vicinity of Mill Stream and the Botany Wetlands. This riparian vegetation would be impacted during construction of the bridge over Mill Stream and use of the associated compound site adjacent to Mill Pond. Following construction, disturbed areas alongside Mill Stream, Mill Pond and New Pond would be stabilised and revegetated with locally endemic species (see section 11.7.3).

11.3.7 Groundwater dependent ecosystems

The project would remove 0.62 hectares of PCT 1234 Swamp Oak Forest, which is likely to be somewhat dependent on groundwater. This vegetation is in a highly modified state. Construction of the bridge over Mill Stream has the potential to further mobilise contaminated groundwater at Mill Stream. There is a potential for a minimal increase in groundwater recharge during construction due to re-profiling works exposing more permeable materials. No groundwater extraction or dewatering is anticipated for the project. Given the existing contamination of the Botany Wetlands, limited clearing of native vegetation, and negligible drawdown of groundwater, impacts on GDEs outside the project site is likely to be minimal.

11.4 Assessment of operational impacts

Effects on biodiversity would be largely restricted to the construction phase of the project. Effects on biodiversity that may result from operation of the project are detailed in Table 11.14.

The project site is located within or immediately adjoining existing urban infrastructure and highly modified environments, in particular an existing operational freight rail corridor. Each of the potential operational impacts identified below would already be occurring in the project site and affecting the surrounding study area and the existing environment discussed above. Fauna that occupy habitats within the project site and adjacent areas are likely to be accustomed to existing noise originating from road traffic, trains, planes and the urban environment. The project when operational is unlikely to significantly increase the risk of fauna collisions above current levels, given the highly modified habitats present. In this context, the project is likely to comprise only a minor increase in any of these potential negative effects. The project is unlikely to increase the extent, duration or magnitude of any of these impacts to the extent that would result in a significant negative effect on biodiversity values.

Table 11.14 Potential operational effects on biodiversity values

IMPACT	DESCRIPTION
Noise, light and vibration	Operation of the project would introduce some additional noise, light and vibration from the movement of trains and maintenance vehicles. The project is located in a highly industrial urban environment already subject to substantial noise, light and vibration levels and with limited habitat value for biodiversity. Fauna species present would be accustomed to existing noise, light and vibration. The project is likely to involve only a minor increase in noise, light and vibration given the levels of existing disturbance and is not likely to result in a significant impact on fauna and flora that occur adjacent to the project site.
Vehicle strike	Few terrestrial fauna species occur in the project site that are at high risk of vehicle strike (trains and maintenance vehicles), and those that occur are already subject to the risk of vehicle strike given the location of the project. The project is unlikely to significantly increase the risk of vehicle collisions with fauna above current levels.
Erosion and sedimentation	Operation of the project has the potential to introduce pollutants to the environment as a result of incidental spills from trains or maintenance vehicles and result in erosion and sedimentation from runoff from impermeable surfaces. The project is located in a highly industrial area subject to substantial existing contamination and risk of chemical spills, and operation of the project would not substantially increase this risk.

11.5 Cumulative impacts

11.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to biodiversity are described below.

11.5.2 Cumulative construction impacts

The study area is located within central Sydney, with an extensive and complex road and rail network. Residential and industrial/commercial areas dominate the area.

The project would involve the removal of small patches of already highly fragmented, predominantly planted, vegetation. Other local rail projects such as the Chatswood to Sydenham metro project and Sydenham to Bankstown metro project would similarly affect small patches of fragmented habitat in highly modified urban areas (GHD 2017, Arcadis 2016), however these developments are not in close proximity to the project.

Road projects such as the proposed Sydney Gateway road project, as well as the WestConnex New M5 and future M4–M5 Link would also result in the removal of mainly planted vegetation and associated fauna habitats.

Losses in biodiversity from these projects and developments are also likely to be restricted in area, given their location in a highly modified environment. Together these projects and other developments would result in the further loss of habitat from an already modified environment with only limited natural biodiversity values.

11.5.3 Cumulative operational impacts

Operational impacts of the project would comprise a minor addition to the existing activities in the rail corridor and extent of development in the locality. The project is unlikely to increase the extent, duration or magnitude of any of the cumulative impacts on biodiversity values occurring in the study area and region to the extent that would result in a significant negative effect on biodiversity values.

11.6 Matters of national environmental significance

There is a general lack of habitat present and only small areas of vegetation to be removed within the project site. The project therefore, is unlikely to result in a significant impact on any MNES.

A summary of impacts on MNES is provided in Table 11.15.

Table 11.15 Impacts on MNES

MNES	IMPACT
Threatened ecological communities	No threatened ecological communities listed under the EPBC Act have been determined to be affected by the project.
Threatened flora species	No threatened flora species listed under the EPBC Act have been determined to be affected by the project.
Threatened fauna species	The project would result in the loss of 2.38 hectares of foraging habitat for the Grey-headed Flying-fox. The project is unlikely to impact any habitat of the Green and Golden Bell Frog. An assessment of significance has been prepared for the Green and Golden Bell Frog given the historic records of the species in the area and is provided in *Technical Report 4 – Biodiversity Development Assessment Report*. No other threatened fauna species listed under the EPBC Act are likely to rely on habitats present in the project site.
Migratory fauna species	The project would remove 0.1 ha of PCT 1071 Coastal Freshwater Wetlands habitat that is marginal potential habitat for migratory waders and 0.62 ha of forested vegetation that may provide habitat for migratory woodland bird species. This habitat is not considered important habitat for any species. An ecologically significant proportion of a migratory species would not occur at the site. The project is highly unlikely to impact Towra Point Nature Reserve, which provides important habitat for migratory waders, given its location over 6.5 kilometres from the project site.
Wetlands of National Significance	The project is highly unlikely to impact the Towra Point Ramsar site, given its location over 6.5 kilometres from the project site.
Commonwealth land	Limited areas of Commonwealth Land intersect with the project site. These are predominantly cleared hardstand, although occasional planted shrubs or trees and weeds are present (totalling 0.1 hectares). The majority of the vegetation to be removed in Commonwealth land for the project is not native vegetation. The removal of a small area of planted and exotic vegetation would remove limited habitat for some common flora and fauna species typical of urban and industrial areas. There would be no direct impacts on the Sydney Airport Wetlands. Construction at Mill Stream has the potential to result in downstream impacts on Mill Pond and other downstream areas. An assessment of the likely significance of effects on flora and fauna (as a component of the environment of Commonwealth land) pursuant to the *Significant Impact Guidelines 1.2* (DSEWPC 2013) for actions on Commonwealth land (provided in *Technical Report 4 – Biodiversity Development Assessment Report*). The conclusion of this assessment is that the project would not have a significant impact on plants and animals within Commonwealth land given the highly modified nature of the existing environment and the small magnitude and extent of effects on plants and animals.

11.7 Management of impacts

11.7.1 Approach

ARTC is committed to minimising the environmental impact of the project and is investigating opportunities to reduce actual impact areas where practicable. The area that would be directly impacted by construction activities would depend on factors such as presence of significant vegetation, constructability, construction management and safety considerations, land form, slopes and anticipated sub-soil structures. Direct impacts would be reduced as far as practicable. The exact amount of clearance (within the project site) would be refined during detailed design.

ARTC has, where possible, altered the project to avoid and minimise ecological impacts in the project planning stage. The project has adopted the following 'avoid, minimise and offset' approach to mitigate impacts on biodiversity values in accordance with the BAM, the BC Act and associated policy (see section 11.1.4 for further discussion). A range of impact mitigation strategies have been included in the project to mitigate the impact on ecological values. Further refinement will be made during detailed design, where possible, to minimise ecological impacts.

Further details on the approach to management is provided in Chapter 24.

11.7.2 Biodiversity offsets

Biodiversity offsetting for residual impacts on BC Act biodiversity values is mandatory for SSI developments being assessed under Part 7 of the BC Act and subject to a BDAR. Biodiversity offset obligations have been determined using the BAM calculator. The required ecosystem and species credit obligations are outlined below.

Ecosystem credits

The required ecosystem credits, as determined using the BAM calculator, for the project are provided in Table 11.16.

Table 11.16 Ecosystem credits required to offset project impacts

PLANT COMMUNITY TYPE (PCT)	THREATENED ECOLOGICAL COMMUNITY	AREA IMPACTED (ha)	ECOSYSTEM CREDIT OBLIGATION
PCT 1071 *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands of the Sydney Basin Bioregion	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.10	3
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.62	8
	Total	0.72	11

Species credits

No species credit obligations were deemed warranted for this project.

Offsetting approach

The approach to biodiversity offsets for this project, that will enable the credit obligations to be met, comprises two options. These are, the purchase and retirement of existing biodiversity credits currently available on the biodiversity credit register or through making a payment into the Biodiversity Conservation Fund. The fund is managed by NSW Biodiversity Conservation Trust (BCT) which was established by the *Biodiversity Conservation Act 2016*.

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 project. The like for like ecosystem credit class options for each ecosystem credit obligation is summarised Table 11.17.

Table 11.17 Like for like trading credit classes

CREDIT CLASS PCT	ANY PCT WITH THE BELOW TEC	CONTAINING HBT[1]	IN THE BELOW AUSTRALIAN SUBREGIONS
PCT 1071 *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands of the Sydney Basin Bioregion	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (including PCTs 780, 781, 782, 828, 1071, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1911).	No	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any sub region that is within 100 kilometres of the outer edge of the impacted site.
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (including PCTs 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808).	No	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any sub region that is within 100 kilometres of the outer edge of the impacted site.

(1) HBT: hollow bearing tree

Payment into the Biodiversity Conservation Fund

Payments for the project offset obligations could be paid into the Biodiversity Conservation Fund as outlined in Table 11.18.

It should be noted that payment for offsets are subject to change and that credit payment prices are reviewed quarterly. The payment amounts presented within this report were calculated and valid as of 31 May 2019.

Table 11.18 Estimated biodiversity offset credit payment price

CREDIT CLASS	PRICE PER CREDIT	NUMBER OF CREDITS REQUIRED	FINAL CREDIT PRICE
PCT 1071 *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands of the Sydney Basin Bioregion	$2,499.32	3	$7,497.95
PCT 1234 Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin Bioregion and South East Corner Bioregion	$1,494.19	8	$11,953.55
		Subtotal (excl. GST)	$19,451.50
		GST	$1,945.15
		Total	$21,396.65

EPBC Act – Offset for affected threatened biota

Under the EPBC Act *Environmental Offsets Policy* (DSEWPaC, 2012) biodiversity offsets are required to compensate for significant residual effects on MNES. This BDAR includes the identification and assessment of potentially affected MNES, including an assessment of the likely significance of effects on the Grey-headed Flying-fox pursuant to the EPBC Act *Significant Impact Guidelines* 1.1 (DotE, 2013). The outcome of these assessments of significance is that the project would not be likely to result in a significant impact on the Grey-headed Flying-fox or on any other MNES.

The project is unlikely to impact Towra Point Ramsar site as it is located about 6.5 kilometres away on the southern side of Botany Bay.

No biodiversity offsets for effects on MNES are therefore required in accordance with the EPBC Act *Environmental Offsets Policy*.

11.7.3 List of mitigation measures

The mitigation measures that would be implemented to address potential biodiversity impacts are listed in Table 11.19 and will be included within the relevant management plan. This table also outlines which of the construction phase mitigation measures would be implemented during the enabling works and main construction works.

Table 11.19 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Construction	Additional clearing	If additional vegetation is identified to be impacted, an ecologist will undertake further assessment for impact and the need for offsetting in accordance with the legislation prior to clearing.	✓	✓
	Spread of chytrid fungus	Protocols to prevent introduction or spread of chytrid fungus will be detailed in the relevant management plan and implemented following the DPIE Hygiene protocol for the control of disease in frogs (DECC, 2008c).	✓	✓
	General	The project environmental induction will include information on the ecological values of the study area, protection measures to be implemented to protect biodiversity and penalties for breaches.	✓	✓
	Vegetation clearing	Disturbance of vegetation will be limited to the minimum necessary to construct works. The contractor will design the layout of the work areas to locate infrastructure, where practicable, to previously cleared areas or areas of exotic vegetation to minimise or avoid impacts on native vegetation (and particularly EECs). Equipment storage and stockpiling of resources will be restricted to designated areas in cleared land.	✓	✓
	Impact to flora and fauna during vegetation clearance or works to bridges	A trained ecologist will undertake pre-clearing surveys and be present during the clearing of native vegetation or removal of potential fauna habitat during construction where necessary to avoid impacts on resident fauna as far as is practicable. Pre-clearing surveys will include: • inspections of native vegetation for resident fauna and nests or other signs of fauna occupancy • inspections of bridges for roosting bats • pre-clearing surveys for the Green and Golden Bell Frog at Mill Stream as a precaution • capture and relocation or captive rearing of less mobile fauna (such as nestling birds) by a trained fauna handler and with assistance from Wildlife Information Rescue and Education Service (WIRES) as required.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Impact on vegetation to be retained	Where the project site adjoins native vegetation, the limits of clearing will be marked and temporary fencing installed and maintained around the vegetated areas prior to the commencement of construction activities to avoid unnecessary vegetation and habitat removal.	✓	
	Increase in weeds	Management and disposal of the weeds, including the priority weeds, will be conducted in accordance with the *Biosecurity Act 2015* and the *NSW Weed Control Handbook* (DPI 2018c). Vehicles and other equipment to be used within the rail corridor will be cleaned to minimise seeds and plant material entering the study area to prevent the introduction of further exotic plant species or disease.	✓	✓
	Reinstatement of vegetation	Revegetation of riparian areas along Mill Stream, Mill Pond and New Pond following construction will be undertaken by a bush regeneration contractor. Disturbed areas will be stabilised as soon as possible following construction and locally endemic species typical of Swamp Oak swamp forest and Coastal freshwater wetlands would be used to revegetate these disturbed riparian areas.		✓
Operation	Increase in weeds	ARTC's Assessment Management System (under the Safety Management System) includes provision for regular weed management and ARTC's Environmental Management System provides procedures for weed management and pesticide use. Ongoing weed management throughout the rail corridor will be undertaken in accordance with ARTC's procedures, as well as relevant legislation such as the *Biosecurity Act 2015*.	N/A – Operation	N/A – Operation

11.7.4 Consideration of the interaction between measures

In addition to the measures for biodiversity described above, there are interactions between the mitigation measures for noise and vibration (Chapter 9), contamination (Chapter 12), and soils and water quality (Chapter 14).

All mitigation measures for the project will be consolidated and described in the relevant management plan. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures will be consolidated to ensure consistency and implementation.

11.7.5 Managing residual impacts

A residual risk analysis was undertaken following the impact assessment summarised in this chapter. The results of the residual risk analysis are provided in Appendix B. Residual risks with an assessed level of medium or above are summarised below.

- clearing of native vegetation resulting in loss of fauna habitat
- direct impacts on threatened species and endangered populations and communities (terrestrial) from clearing

Despite measures taken to avoid and mitigate impacts, the project would result in some unavoidable residual adverse impacts imposed upon some elements of the natural environment. In total, the project would remove about 0.72 hectares of native vegetation, comprising 0.62 hectares of PCT 1234 Swamp Oak Forest and 0.10 hectares of PCT 1071 Coastal Freshwater Wetlands.

The project would remove a very small proportion of available habitat resources for local populations of native fauna. Impacts would include the removal of up to 5.34 hectares of patchily distributed potential foraging habitat for mobile threatened fauna species, including the Grey-headed Flying-fox and microbats. The site is unlikely to contain any important breeding, roosting or nesting habitat for native fauna.

Biodiversity offsetting for residual effects on BC Act biodiversity values is mandatory for SSI developments being assessed under Part 7 of the BC Act and subject to a BDAR. Biodiversity offset obligations have been determined using the BAM calculator.

12. CONTAMINATION

This chapter provides a summary of the contamination assessment. A full copy of the assessment report is provided as *Technical Report 5 – Contamination Assessment*.

12.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in *Technical Report 5 – Contamination Assessment*.

12.1.1 Legislative and policy context to the assessment

Contaminated Land Management Act 1997

The CLM Act enables the EPA to respond to and manage site contamination when it considers that the contamination is significant enough to require remediation. The NSW EPA record of contaminated sites and records of notices (see section 12.2.1) has been developed and is managed in accordance with the CLM Act.

State Environmental Planning Policy No 55 – Remediation of Land

State Environmental Planning Policy No 55 – Remediation of Land (SEPP 55) aims to promote the remediation of contaminated land. In accordance with clause 7(1) of SEPP 55, a consent authority must not consent to carrying out development on land unless it has considered whether the land is contaminated. As described in section 12.6.1, an area for remediation has been identified. Any remediation works required would be undertaken in accordance with this SEPP.

National Environment Protection (Assessment of Site Contamination) Measure 2013

The National Environment Protection (Assessment of Site Contamination) Measure 2013 (NEPM 2013; NEPC, 2013) is approved by the EPA under section 105 of the CLM Act. It guides the methodology for site contamination assessment and provides health and ecological criteria for various land uses. The NEPM 2013 criteria for commercial/industrial land use has been used to assess site investigation results for this project. As described in section 12.6.1, remediation works required as part of the project would be undertaken in accordance with the NEPM 2013.

***National Water Quality Management Strategy* including the Australian and New Zealand Guidelines for Fresh and Marine Water Quality**

The *National Water Quality Management Strategy* (NWQMS; Australian Government 2018) includes water quality guidelines that define desirable ranges and maximum levels for certain parameters for specific uses of water or for protection of specific values. The *Australian and New Zealand Water Quality Guidelines for Fresh and Marine Water Quality* (ANZG 2018) establish a guide for setting water quality objectives. Based on these guidelines, the criteria for 90 percent protection of freshwater ecosystems (for a disturbed system) has been adopted as the main surface water criteria for the project. For bioaccumulative toxicants, a more stringent 95 percent level has been considered.

PFAS *National Environmental Management Plan*

Per- and poly-fluoroalkyl substances (PFAS) have been identified as chemicals of high concern to human health and the environment, particularly due to their persistence and bioaccumulation. The PFAS *National Environmental Management Plan* (PFAS NEMP; HEPA, 2018) provides a consistent, practical, risk-based framework for the environmental regulation of PFAS contaminated materials and sites. The health and ecological criteria for a commercial/industrial land use from the PFAS NEMP have been used to assess site investigation results for the project (see section 12.2).

Acid Sulfate Soil Manual

Acid sulfate soils (ASS) are naturally occurring soils, which if drained, excavated or exposed to air, can form sulfuric acid. The Acid Sulfate Soil Manual (ASSMAC, 1998) provides best practice guidance in the assessment and management of projects in areas potentially affected by ASS. The guidelines set out a stepwise process to decide whether ASS is present on site and how to mitigate potential impacts. The presence of ASS is described further in section 12.2.3.

Managing Asbestos in or on Soil

The *Managing Asbestos in or on Soil* guide (Safework NSW, 2014) provides general guidance on the assessment of asbestos in soil. As described in section 12.2.5, asbestos has been identified at several locations within fill material along the entire length of this section of rail corridor. The guidelines provided in the *Managing Asbestos in or on Soil* guide would be used to guide the management of this contaminant during the construction of the project.

12.1.2 Methodology

Key tasks

The contamination assessment involved:

- a preliminary assessment of potential areas of environmental concern (AEC)
- a desktop review of publicly available information (including database searches) and previous investigation reports to identify current of historical potentially contaminating land uses
- a walkover of the project site on 6 July 2018 to compare the current site conditions to the conditions documented in historical reports and to identify any additional potential sources of contamination along the alignment (see section 7 of *Technical Report 5 – Contamination Assessment*)
- preparation of a conceptual site model (CSM), which identified potential contamination sources, receptors and exposure pathways.

A detailed description of the assessment methodology is provided in section 3 of *Technical Report 5 – Contamination Assessment*.

Study areas

For the purpose of the contamination assessment (*Technical Report 5 – Contamination Assessment*), the project site was divided into two study areas:

- Area 1 (shown in blue on Figure 12.1) – extending to the east and southeast towards Port Botany from Southern Cross Drive and Mill Pond Road.
- Area 2 (shown in green on Figure 12.1) – extending west and northwest towards Alexandra Canal from Southern Cross Drive and Mill Pond Road.

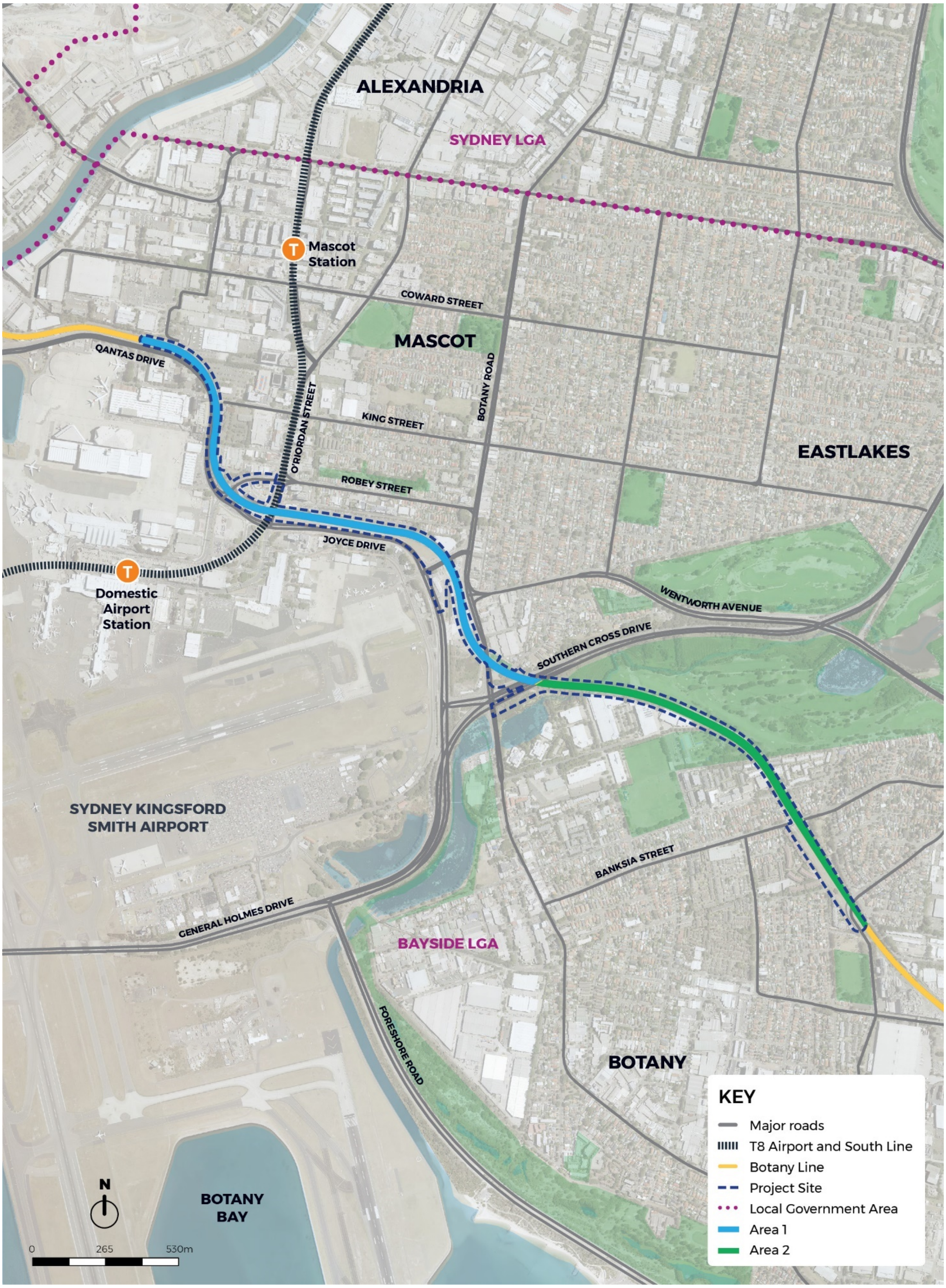


Figure 12.1 Study areas for the contamination assessment

12.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with contamination. Potential risks were considered according to the impacts that may be generated by the construction and operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology and the full results, is provided in Appendix B.

Risks with an assessed level of medium or above (without mitigation) included:

- very high for impacts associated with the disturbance of contaminated soil during construction
- medium for contamination due to spills and leaks during construction and operation.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and identified by stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 12.6.4.

12.1.4 How potential impacts have been avoided/minimised

As described in sections 6.1.2 and 7.1.1, design development and construction planning for the project has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process.

Where areas of known contamination have been identified, detailed design would seek to:

- minimise the depth and volume of excavation required, minimise the amount of soil disturbance and avoid intercepting potentially contaminated groundwater
- optimise allowance for capping of contaminated material to reduce generation of contaminated waste and reduce the ongoing risk from potential disturbance during operations.

12.2 Existing environment

12.2.1 Contaminated sites notified to the EPA within and surrounding the project site

A search of the NSW EPA Contaminated Sites Register identified that there are seven sites within 500 metres of the project site that have previously been notified to the EPA for contamination.

Five of the sites listed have not been identified as requiring regulation under the CLM Act. The two sites listed (the former Mascot Galvanising site and former Email site), which currently require regulation under the CLM Act are also listed on the NSW EPA record of notices. The NSW EPA holds records of written notices issued by the EES Group of the DPIE (formerly Office of Environment and Heritage)) under Section 58 of the CLM Act. These sites are described further in Table 12.1.

Table 12.1 Contaminated sites known to the EPA within 500 metres of the project site

SITE NAME	SITE ADDRESS	DISTANCE TO THE PROJECT SITE	NOTICE TYPE AND STATUS	CONTAMINATION TYPE
Former Mascot Galvanising	336–348 King Street, Mascot	150 m east	Site declared as a remediation site Four current remediation orders	Zinc, lead and chromium in soil and groundwater Low groundwater pH Groundwater plume migrating off site
Former Email Site	Corner of Page Street and Holloway Street, Pagewood	420 m east	Site declared as a remediation site One current voluntary management proposal	Chlorinated hydrocarbons (trichloroethene and tetrachloroethene) Groundwater plume migrating off site (to the south)

The Former Email Site located in Pagewood is unlikely to pose a potential risk during construction or operation activities due to its location across-gradient (ie not in the direction of groundwater flow) of the project site.

The former Mascot Galvanising site is hydraulically up-gradient of the project, which means that contamination from the site could migrate in the groundwater towards the project site. Since the last notice was issued for the site in 2004, the site buildings and infrastructures have been removed (as evidenced by historical aerials from 2017 and 2018) and earthworks (most likely to remediate the site) appear to have been conducted between 2005 and 2015. The site has since been redeveloped and is currently a high-rise hotel and car park. There is a potential that groundwater impacts from the former Mascot Galvanising may have migrated beneath the project site.

Under Section 308 of the POEO Act, the NSW EPA is required to record, and make available to the public, details about environmental protection licences (EPLs). There are 12 facilities within a 500 metre radius of the project site at the time of writing (see Table 12.2) that have been subject to revoked or surrendered licences, audits, notices or pollution studies associated with their EPL. Of these facilities, three (Sydney Airport, Qantas Jet Base and Industrial Galvanizers Corporation Pty Ltd) include activities which have the potential to impact soil or groundwater and are located in close proximity to the project site. There are also five licenced facilities within 500 metres of the project site that may result in potential contamination if not appropriately managed in accordance with the EPLs (see section 5.3 of *Technical Report 5 – Contamination Assessment* for more detail).

Table 12.2 Record of notices, audits, revoked or surrendered licences or pollution studies within 500 metres of the project site

FACILITY NAME	LICENCE NUMBER	ADDRESS AND DISTANCE TO THE PROJECT SITE	ACTIVITY INCIDENT TYPE	NOTICE/INCIDENT TYPE	POTENTIAL CONTAMINATION
Airport East Precinct	20851	Botany Line freight rail corridor at General Holmes Drive within the project site	Railway systems activity	Multiple licence variations (2016–2017)	Unknown (associated with construction activities)
Sydney Airport	7288	241 O'Riordan Street, Mascot 15 m north	Waste generation or storage	Multiple licence variations (2004–2005) Licence no longer in force	Hydrocarbons PFAS compounds
Botany Aquatic Centre	1791	Cnr Jasmine and Myrtle Street, Botany 50 m southwest	Miscellaneous licensed discharge to waters	Multiple licence variations (2001–2005) Licence surrendered in October 2006	Chlorine
Qantas Jet Base	12152	Sydney Airport, Mascot 80 m southwest	Waste generation or storage	Multiple licence variations (2006–2008) Licence no longer in force	Metals Acids Solvents Hydrocarbons
Industrial Galvanizers Corporation Pty Ltd	6728	342 King St, Mascot 115 m east	Waste generation or storage	Licence surrendered in 2001	Metals Acids Solven Metals Acids Solvents Cyanide Volatile hydrocarbons Cyanide Volatile hydrocarbons
Enwave Mascot Pty Ltd	20246	10 Bourke Street, Mascot 320 m northeast	Generation of electrical power from gas	Two licence variations (2014–2017) One mandatory environmental audit (pending)	Emission of gases to air
Gate Gourmet Flight Kitchen	10332	Keith Smith Avenue and Sixth Street, Mascot 400 m southwest	Waste generation or storage	Licence revoked in 2002	Unknown

FACILITY NAME	LICENCE NUMBER	ADDRESS AND DISTANCE TO THE PROJECT SITE	ACTIVITY INCIDENT TYPE	NOTICE/INCIDENT TYPE	POTENTIAL CONTAMINATION
SIMS Group Limited	2009	283 Coward Street, Mascot 400 m west	Waste generation or storage Scrap metal processing	Multiple licence variations (2001–2002) Licence surrendered in May 2004	Metals Hydrocarbons Suspended solids Acids PCBs PAHs
Kellogg (Aust) Pty Ltd	823	Swinbourne Street, Botany 400 m south	General agricultural processing Storage of clinical and related wastes permitted	Multiple licence variations (2002–2013)	Hydrocarbons, nutrients Clinical and related waste contamination
Allnex Resins Australia Pty Ltd	993	49–61 Stephen Street, Botany 450 m south	Chemical production and storage waste generation Contaminated groundwater treatment Dangerous goods production General chemical storage Toxic substances production	Multiple licence variations (2002–2018) Penalty notice (#3085765349, September 2012): breach of licence Two pollution studies: air quality assessment and remediation of toluene, ethylbenzene and xylene compounds in groundwater	Known toluene, ethylbenzene and xylene contamination plume in groundwater
Ecolab Pty Ltd	2086	3–5 Anderson St, Banksmeadow 450 m southeast	Waste storage Non-thermal treatment of liquid waste Toxic substances production Container reconditioning Chemical production and storage waste generation Dangerous goods production General chemicals storage	Multiple licence variations (2002–2016) Surrender of licence (1 Aug 2016)	Hydrocarbons Solvents Asbestos Clinical and related waste contamination

12.2.2 Acid sulfate soils

Acid sulfate soils or sediments (ASS), can result in acidic leachate when exposed to oxygen, which may affect water quality, lead to the death or disease of aquatic organisms, harm human health or damage infrastructure. ASS are typically found in estuarine, low-lying environments up to 10 metres above Australian height datum (mAHD) and generally consist of clays and sands containing pyritic material.

A search of the Australian Soil Resource Information System (CSIRO, 2014) and ASS risk map (Department of Land and Water Conservation, 1997) indicated that there is a low probability of acid sulfate soils occurrence within the project site, except for the area surrounding Mill Pond.

The ASS maps prepared for the Botany Bay LEP show that the project site has the following ASS classifications (see Table 4.1 in *Technical Report 5 – Contamination Assessment*):

- class 1 from Southern Cross Drive bridge to Mill Stream bridge
- class 2 from the western end of the project site to the O'Riordan Street bridge
- class 4 from the O'Riordan Street bridge to the western end of Southern Cross bridge and from the Mill Stream bridge to Banksia Street.

Based on the ASS assessment framework presented in the *Acid Sulfate Soil Manual* (ASSMAC, 1998), this classification indicates that work conducted in several areas of the project site would trigger the requirement for an ASS management plan (ASSMP) to be prepared.

12.2.3 Soil salinity

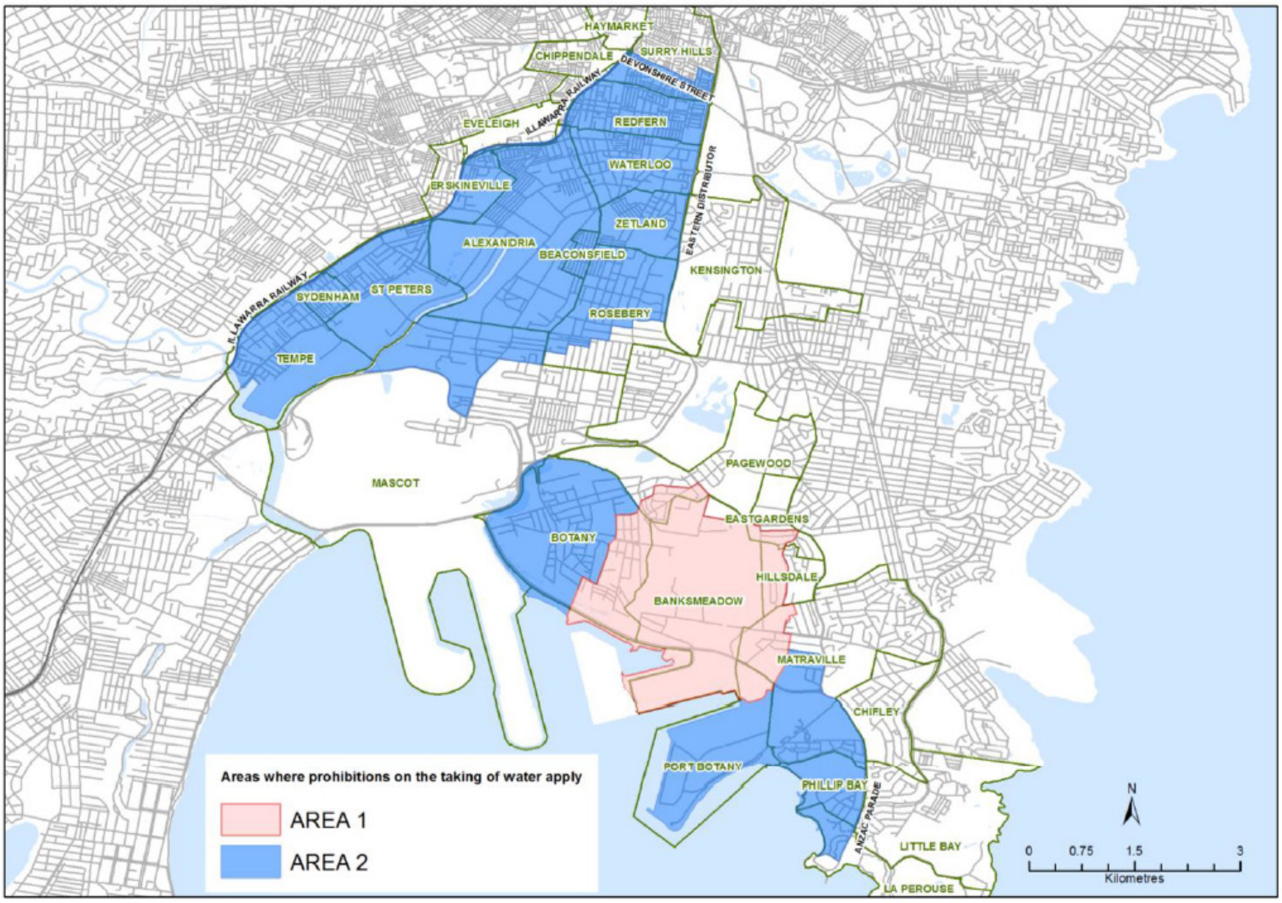
Saline soils are typically present in areas along tidal waterways, such as Alexandra Canal. A soil salinity assessment completed by Golder (2016) classified the northern portion of the project site as having a low potential for salinity. This was likely due to the high permeability soils in the area that allow for rapid drainage and flushing of salts. This is expected to be similar to the conditions present within the rest of the project site.

12.2.4 Restrictions on groundwater extraction

There are two main groundwater systems beneath the site: a deeper confined groundwater system associated with the Triassic aged, fractured/porous Hawkesbury Sandstone and a shallow, unconfined/semi-confined system within Quaternary aged marine sands (the Botany Sands aquifer). See Chapter 13 for more information on the flow of groundwater within and surrounding the project site.

In 2006, the NSW Government implemented a restriction on groundwater extraction on parts of Botany, which is underlain by the Botany Sands aquifer, due to the contamination of the aquifer from the Orica Botany site. Under the current *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2018* (issued by the NSW DPI, 2018b) (see Figure 12.2):

- In Area 1, taking of water from the Botany Sands groundwater source is prohibited.
- In Area 2 (which includes the project site), groundwater extraction is prohibited for domestic use, and requires monitoring for industrial and irrigation purposes.
- Water extracted for purposes other than remediation, temporary construction dewatering, testing or monitoring purposes, must be fit for purpose (sampled, tested and treated in accordance with a certified water testing plan and certified in writing by a consultant as being safe and suitable for its intended use).



Source: NSW DoI, 2018

Figure 12.2 Restriction areas under the current Temporary Water Restrictions Order

12.2.5 Areas of environmental concern within and surrounding the project site

Several areas of environmental concern (AECs), which may contain contamination have been identified within and surrounding the study area (see Chapter 8 in *Technical Report 5 – Contamination Assessment*). These AECs are summarised in Table 12.3 and shown in Figure 12.3.

Table 12.3 Summary of areas of environmental concern

AEC	LOCATION	CONTAMINANTS OF POTENTIAL CONCERN (COPCs)	NATURE OF CONTAMINATION
AEC1	Length of the rail corridor within Area 1	Asbestos	Asbestos has been identified at several locations within fill material along the entire length of this section of rail corridor. The asbestos is likely associated with the demolition and construction waste observed within this area.
AEC2	West of Robey Street bridge, adjacent to the wall of an existing building within Area 2	Asbestos	During a site inspection on 6 July 2018 several fragments of ACM were observed on the site surface.
AEC3	Between the rail corridor and Botany Road (near Bronti Street), off-site near Area 2	PFAS	Elevated concentrations of PFAS were recorded in groundwater samples obtained for the WestConnex Enabling Works – Airport East Project from monitoring well MW5, which is located approximately five metres east of the project site near the intersection of Bronti Street and Botany Road (EES, 2018). The perfluorooctane sulfonate (PFOS, a type of PFAS) concentrations were reported above the adopted human health and ecological criteria.
AEC4	Sydney Airport (including the Qantas Jet Base), west of the project site near Area 2	Hydrocarbons, PFAS	The potential for contamination was identified based on a review of the NSW EPA contaminated sites notices and licenses under the POEO Act, and consideration of historic and current commercial and industrial activities (see section 12.2.1).
AEC5/6	Former Mascot Galvanising site (Industrial Galvanizers Corporation Pty Ltd), east of the project site near Area 2	Metals Acids Solvents Cyanide Volatile hydrocarbons	The potential for contamination was identified based on a review of the NSW EPA contaminated sites notices and licenses under the POEO Act, and consideration of historic and current commercial and industrial activities (see section 12.2.1).

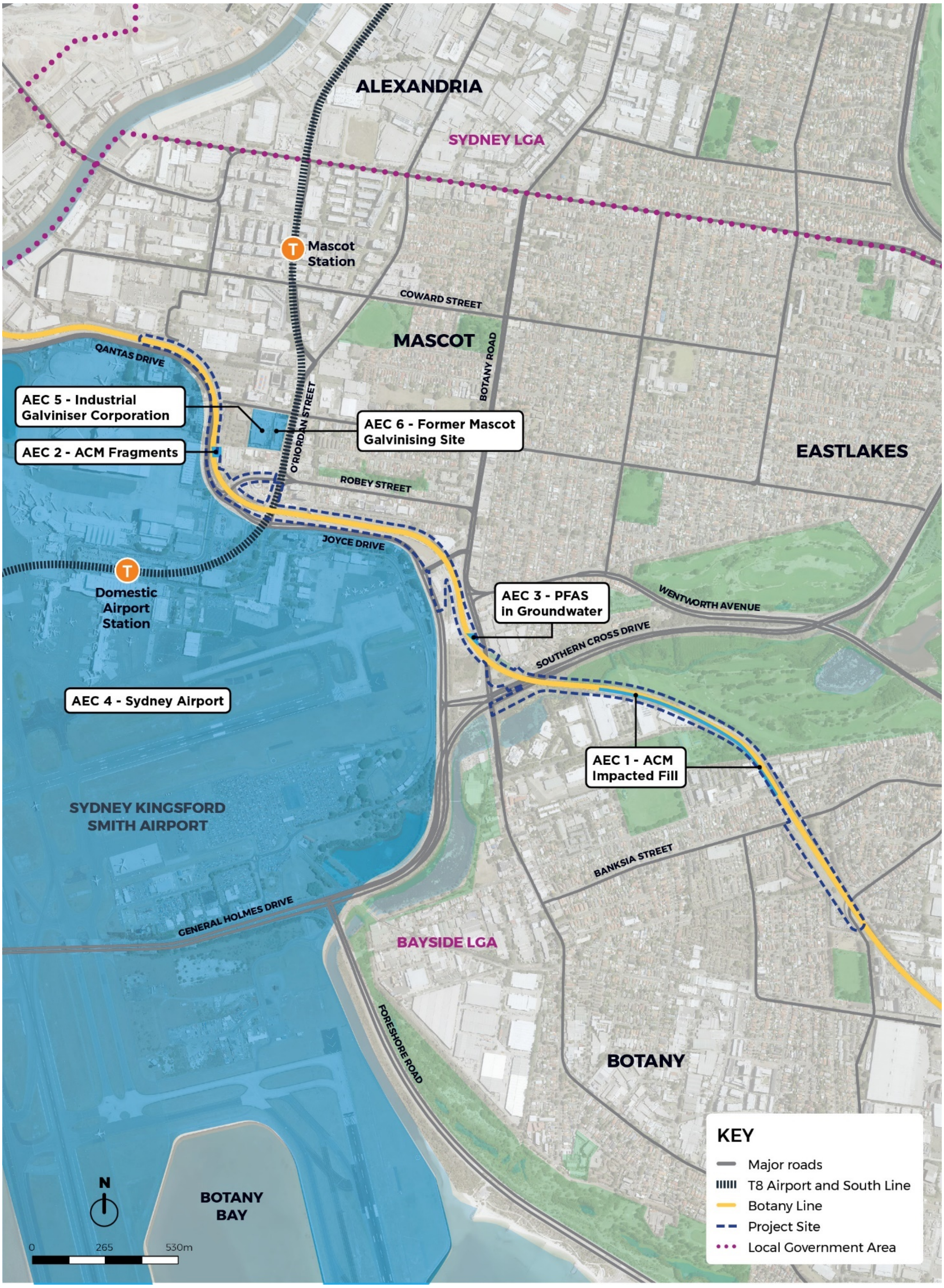


Figure 12.3 Areas of environmental concern (AEC) within and surrounding the project site

12.2.6 Conceptual site model

For contamination to result in an ecological or human health risk, there must be a plausible pollutant linkage between the source of contamination and a receptor (ie exposure pathway). Table 12.4 presents a CSM for the project, which provides the framework for identifying how potential receptors may be exposed to contamination. The CSM shows that there is an ecological risk to Mill Pond associated with ongoing elevated PFAS concentrations.

Table 12.4 Conceptual site model

SITE ASPECT	DETAILS	
Potential sources of contamination (see section 12.2.5)	• ACM in soil along Area 1 (AEC1). • Surface ACM in Area 2 (AEC2). • Off-site sources of PFAS including airport activities (south and west) (AEC4) and industrial activity (south and north) (AEC5). • Off-site former galvanising plant located on King Street in Mascot (north) (AEC6).	
Geology	**Fill material** • Various layers of fill encountered. • Area 1 – Fill generally present at depths between 1.5 mBGL and 3 mBGL. Generally, gravel and gravelly sand with building rubble observed at most locations. • Area 2 – Fill thickness is variable, generally ranging between 0.5 mBGL and 3.0 mBGL. Building rubble only observed at three locations. • Adjacent to Mill Pond – Locations either side of Mill Pond, fill recorded up to depths of 7 mBGL. Generally described as sand or gravel reworked natural material.	**Natural soils** • 1 mBGL to 20 mBGL sand, generally fine to medium grained, yellow, grey, light brown. • Intermittent clay bands encountered from 8 mBGL. • 17 mBGL to 32 mBGL clay/sandy clay, high plasticity, grey, brown. • Shale encountered at 18 mBGL (SG-BH065).
Depth and flow of groundwater	**Shallow aquifer** • Depth to groundwater on site was recorded between 3.3 mBGL and 5.2 mBGL. • Groundwater elevations within the project site ranged from 3.9 mAHD to 4.3 mAHD (AECOM, 2017). • Inferred groundwater flow is to the west/southwest. • It appears that the groundwater aquifer has a high yield. • Groundwater beneath the project site is likely to be subject to tidal influence.	
Influences on groundwater conditions at the site	• The project site intersects Mill Stream which flows into Mill Pond. • Engine Pond is located to the west of Mill Pond beyond General Holmes Drive. • Regional groundwater flow in the Botany Sands Aquifer flows predominantly towards Cooks River and Botany Bay.	
Nature of known soil contamination	**Area 1** • Asbestos in soil identified at several locations (AEC1). • PFAS concentrations recorded above the laboratory limit of reporting.	**Area 2** • ACM observed on site surface (west of Robey Street Bridge) (AEC2).

<table>
<tr><th>SITE ASPECT</th><th colspan="5">DETAILS</th></tr>
<tr><td>Nature of known groundwater contamination</td><td colspan="3">Area 1
• Elevated concentrations of manganese and arsenic.</td><td colspan="2">Area 2
• Elevated concentrations of manganese.
• PFOS in off-site monitoring well MW5 NEMP criteria (AEC3).</td></tr>
<tr><td>Nature of known surface water contamination</td><td colspan="5">PFOS concentrations above the adopted criteria have been reported in surface water samples collected from Mill Pond. Total nitrogen, phosphorus, ammonia, heavy metals, turbidity and total suspended solids exceeded the adopted guidelines (ANZECC, 2000).</td></tr>
<tr><td>Potential transport mechanisms and exposure pathways</td><td colspan="5">• Leaching of soil contaminants into groundwater.
• Lateral migration of contamination in groundwater.
• Surface water runoff.
• Outdoor inhalation of dust or fibres.
• Direct dermal contact or ingestion of contaminants in soil or groundwater.</td></tr>
<tr><td>Potential receptors</td><td>On-site ecological
• None</td><td>Off-site ecological
• Mill Pond
• Mill Stream</td><td>On-site workers
• Commercial
• Intrusive</td><td>Construction workers
• Construction
• Maintenance</td><td>Off-site community
• Commercial worker
• Residential</td></tr>
<tr><td>Existing complete source-pathway-receptor links</td><td>No</td><td>Yes, concentrations of PFAS have been recorded in Mill Pond, which could be received by the aquatic ecosystem.</td><td>Yes, ACM observed on the site surface (west of Robey Street), which could mobilise as airborne fibres and be received by construction workers on-site.</td><td>Yes, ACM identified in soil (Area 1), which could mobilise as airborne fibres and be received by construction workers.</td><td>No, groundwater extraction restricted under 2018 order.</td></tr>
<tr><td>Future source-pathway-receptor links (project influence)</td><td>None</td><td>Yes, the off-site source of PFAS is unknown. Potential for ongoing concentrations of PFAS in Mill Pond.</td><td>Yes, ACM identified in soil will be capped and retained on site, which could mobilise as airborne fibres and be received by on-site workers.</td><td>Yes, ACM identified in soil will be capped and retained on site, which could mobilise as airborne fibres and be received by on-site workers.</td><td>No, groundwater extraction restricted under 2018 order.</td></tr>
</table>

12.3 Assessment of construction impacts

Contaminated soil and groundwater within or surrounding the project site, if encountered and not managed appropriately, it could potentially impact the environment or site workers.

During construction, contamination is likely to be encountered during construction activities that involve disturbing soil or groundwater, including:

- excavation such as for trackwork and retaining wall footings
- utility adjustment or relocation
- piling for bridge construction
- vegetation clearing
- vehicle movement.

Table 12.5 provides an assessment of the potential contamination risks for the project site during construction. The potential contamination risks during construction would be dependent on the likelihood and consequence of encountering contamination. The risk classifications correspond to the following definitions:

- Low risk: impact can be managed by implementing standard construction management measures.
- Medium risk: contamination specific management plans and controls required.
- High risk: engineered controls and environmental/health monitoring required.

Table 12.5 Contamination risk associated with construction of the project

AREA	POTENTIAL CONTAMINATION IMPACT	LIKELIHOOD OF ENCOUNTERING CONTAMINATION	CONSEQUENCE (POTENTIAL FOR EXPOSURE TO CONTAMINATION)	RISK
Area 1	If not managed appropriately, disturbance of the contaminated soil could result in human health or water quality impacts from: • airborne asbestos fibres being generated by excavation, movement and stockpiling of ACM contaminated soils • dust or asbestos exposure to construction workers (through direct contact, ingestion or inhalation) • off-site transport of contaminants via dust or vehicle/plant movements • surface water runoff to surrounding waterways, such as Mill Pond or Mill Stream.	High – Contaminant (asbestos and PFAS) identified above relevant assessment criteria and widespread.	High – Exposure pathway complete during construction (without implementation of appropriate controls).	High
Area 2	If not managed appropriately, disturbance of surface ACM could result in human health impacts from: • airborne asbestos fibres being generated during construction activities • dust or asbestos exposure to construction workers.	Medium – Contaminant (asbestos) potentially present at concentrations above the relevant assessment criteria and limited in extent.	Medium – Exposure pathway potentially complete during construction (without implementation of appropriate controls).	Medium

As shown in Table 12.5, due to the widespread contamination within the project site, human health and water quality impacts associated with encountering contamination during construction are possible. The potential soil contamination risks during construction are considered to be:

- high in Area 1, due to widespread presence of asbestos and elevated concentrations of PFAS, the potential for worker exposure and the potential for runoff of these contaminants to into Mill Pond or Mill Stream
- medium in Area 2, due to ACM being observed in some locations and the potential for worker exposure.

Therefore, in accordance with the risk classifications, contamination specific controls and management plans would be required during construction to minimise the risk associated with contamination (see section 12.6).

There is also a potential for cross-contamination associated with incorrect handling or disposal of contaminated soils, or spills and leaks of fuels from construction equipment across the whole of the project site. However, this potential impact would be minimised through implementation of appropriate equipment and material storage and handling procedures during construction.

No notable impacts associated with contaminated groundwater are expected as dewatering of excavations is not expected to be required, and the potential for encountering groundwater during piling works would be minimised as far as is reasonably practicable through the choice of construction methodology. Incidental groundwater extraction and subsequent disposal and reuse would be managed in accordance with the PFAS NEMP (see section 12.6).

12.3.1 Acid sulfate soils

The exposure of ASS to oxygen during earthworks and other soil disturbing activities can lead to the generation of sulfuric acid. The subsequent acidic leachate can then lead to mobilisation of heavy metals such as aluminium and iron into water bodies. As discussed in section 12.2.2, ASS are likely to be present within the project site, particularly in the area from the Southern Cross Drive bridge to the Mill Stream bridge. Therefore, ASS needs to be managed during construction (as outlined in section 12.6) to minimise the potential for water quality and ecological impacts associated with acidic runoff into Mill Stream.

12.3.2 Salinity

Soils within the study area are generally expected to have a low salinity potential (see section 12.2.3). The project is unlikely to influence groundwater levels as such, no significant impact on soil salinity is expected.

12.4 Assessment of operational impacts

During operation, maintenance works have the potential to disturb minor amounts of soils, which could result in human health impacts on the maintenance workers if the disturbed soil is contaminated. However, users of the project (eg maintenance workers or train drivers) are not expected to be exposed to potentially contaminated soil or groundwater. This is because the project proposes, where feasible and reasonable, to contain existing contaminated soil (that has not been removed during the construction phase of the project) using capping. The capping would consist of a demarcation layer (comprising geofabric and a contrasting-coloured marking layer), a layer of clean fill material, which would be at least 0.3 metres thick, and an additional 0.15 metres of topsoil.

If this capping is not well maintained, the contaminated soil may escape containment and result in cross contamination to previously uncontaminated areas via dust migration or water runoff. However, this potential impact would likely be minor and localised within the project site, and minimised with implementation of the management and mitigation measures outlined in section 12.6.2.

The primary operational impact related to the project is the potential contamination of soil, surface water and groundwater arising from intermittent vehicle accidents, leaks and spills on the rail track. However, as the project is located within an existing operational rail corridor, this would not introduce new sources of contamination to the surrounding environment. Additionally, the increase in frequency of potential vehicle accidents, leaks and spills from more frequent trains travelling along the Botany Line within the project site during operation of the project is expected to be negligible. However, there may be an increased potential for spills of grease and oil products, which are proposed to be used for lubrication of the rail line to minimise noise generated by wheel squeal. The lubricant products, which may cause minor temporary human health impacts such as skin or eye irritation, would be stored in a reservoir next to the track. If the storage or handling of the lubricant products is inadequate, there is a risk of spills and leaks that may cause additional soil contamination within the project site. However, providing ARTC's Standard Environmental Management Measures and incident response procedures are implemented (see section 12.6.2) to contain and clean up any spills as required, the potential impact of spills and leaks would be minor.

12.5 Cumulative impacts

Major developments currently under construction in the vicinity of the project include:

- M4–M5 Link and New M5
- Sydney Metro Southwest
- Airport North upgrades – O'Riordan Street
- Airport East upgrades – General Holmes Drive, Botany Road, Joyce Drive.

Other developments in the vicinity of the project, proposed but not yet approved include the Sydney Gateway and F6 Stages 1 and 2.

As the project is primarily within the rail corridor of the existing Botany Line and surrounded by other potentially contaminating land uses (such as Sydney Airport and the Former Mascot Galvanising site, see section 12.2.5), sources of contaminants are already likely to be present and entering the receiving environment. The potential for the project to increase the existing level of contaminants is expected to be negligible. Additionally, any impacts associated with contamination during construction and operation are expected to be temporary, minor and localised. Therefore, there is not expected to be a cumulative impact with other projects.

12.6 Management of impacts

12.6.1 Approach

A Soil and Water Management Plan would be developed to manage all soil and water risks during construction of the project, including risks associated with existing and potential contamination. Specific plans required to address identified contamination risks would be integrated into this plan, including an asbestos management plan and ASSMP. The requirement for remediation has been identified in Area 1. The preferred hierarchy of options for site clean-up and management presented in the NEPM 2013 (NEPC, 2013) would be adopted for remediation of the site. The site would be confirmed to be suitable for the proposed development following remediation. The remediation would be undertaken in accordance with a remediation action plan (RAP) prepared by a suitably qualified environmental consultant.

Further details on the overall approach to management of impacts is provided in Chapter 24.

12.6.2 List of mitigation measures

The mitigation measures that would be specifically implemented to address potential contamination impacts are listed in Table 12.6. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works. As discussed in section 12.6.3, additional non-contamination specific mitigation measures relating to the handling of soil and water may also minimise contamination impacts.

Table 12.6 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Construction	Asbestos contaminated fill material	A remediation action plan (RAP) will be prepared for Area 1 in accordance with the NEPM 2013 prior to placement of the asbestos capping layer. Remediation in Area 1 will be undertaken in accordance with the endorsed RAP. Following this, a validation report will be prepared by a suitably qualified environmental consultant to validate the suitability of the project site for its proposed use. Installation of the capping layer will be done under the supervision of a suitably qualified and experienced consultant, as defined in Schedule B9 of the NEPM. The final elevation of residual contaminated soils will be surveyed prior to the installation of the marking layer and capping layers. Final levels should also be surveyed and included in the SWMP and ARTC asbestos register.	✓	✓
	Potential for unidentified ACM	West of Robey Street within Area 2, existing investigations will be supplemented with additional sampling using a test pit or trenching method in accordance with NEPM 2013 and WA Department of Health (WA-DoH) 2009, *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*. If enabling works in this area are undertaken prior to additional sampling, ACM will be assumed to be present and works will be supervised by an appropriately licensed contractor. This will be specified in site EMPs for the enabling works.	✓	
	Potential for encountering ASS	An ASSMP will be developed prior to the start of enabling works in accordance with the ASSMAC (1998) *Acid Sulfate Soils Manual* and included in the SWMP. ASS encountered during construction will be managed in accordance the ASSMP.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	ACM impacted soils	An asbestos management plan (AMP) will be prepared prior to the start of enabling works in accordance with NSW EPA guidelines (including waste guidelines), SafeWork NSW 2014, *Managing Asbestos in or on Soil* and relevant industry codes of practice. This AMP will be included in the SWMP.	✓	✓
	Surface ACM	An emu pick involving the systematic manual collection of identified asbestos surface fragments will be undertaken prior to soil disturbance in Area 1 and the section west of Robey Street in Area 2, to remove ACM fragments from the site surface. A clearance certificate will be obtained from a licensed asbestos assessor.	✓	
	Contaminated groundwater	Adopt construction techniques to avoid groundwater disturbance where practicable. If groundwater is encountered, temporarily store all extracted groundwater to be disposed of off-site in appropriate containers then ensure it is tested for potential contaminants (including PFAS). Options for final disposal of extracted groundwater include: • removal off site to a water recycling facility if the level of contaminants does not exceed the water acceptance thresholds • discharge to a sewer via a trade waste agreement with Sydney Water • treatment through a groundwater remediation system before being released to surface water (with approval from NSW EPA). For the above options, the analytical testing results will need to demonstrate compliance with the applicable licence or discharge criteria.		✓
	Spills and leaks contaminating soil or groundwater	Procedures to store, handle and use materials and equipment appropriately to prevent spills will be prepared and implemented during construction, and included in the SWMP. Immediately contain and clean up leakage of fuels, oils, chemicals and other hazardous liquids in accordance with the Safety Data Sheet and ARTC's NSW Pollution Incident Response Management Plan to prevent migration of contaminants to other parts of the site.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Stockpile management and soil handling.	Employ stockpile management procedures as per ARTC's Standard Environmental Management Measures for segregating soil and preventing cross-contamination of clean soil with contaminated soil. These will be documented in the SWMP.	✓	✓
	ACM contaminated areas	ACM impacted soil will be handled and managed in accordance with the AMP at all times during construction. Areas that are designated as ACM contaminated areas will be clearly fenced off and suitable warning signs posted prior to soil disturbance in that area. Hygiene facilities will be provided incorporating a high standard of washing facilities and storage area for contaminated clothing/footwear. These areas will only be accessible to authorised personnel and work permitted only under controlled/supervised conditions by appropriately qualified/licensed personnel.	✓	✓
	Unexpected contamination	An unexpected finds procedure will be prepared prior to start of enabling works, and included as part of the SWMP. It will identify the process to follow in the event that indicators of contamination are encountered during construction (such as odours, ACM or visually contaminated materials).	✓	✓
Operation	Spills and leaks contaminating soil or groundwater	Potential spills and/or leaks will be managed in accordance with ARTC's pollution incident response procedure (under the Environment Management System) or in accordance with an Operator's Operational Management Environmental Management Plan (OEMP) prepared in accordance with ARTC's access agreement requirements (depending on the extent and natural of the spill).	N/A – Operation	N/A – Operation
	Potential spillage from lubricant system	Biodegradable low risk non-petrogenic products will be used where appropriate.	N/A – Operation	N/A – Operation

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Containment of contaminated soils	The location and nature of any known contamination will be registered on ARTC's Contaminated Land Register and ARTCMap (internal GIS system). Prior to maintenance works in the corridor, a Task Based Environmental Assessment (TBEA) will be prepared which identifies known environmental sensitivities, including contamination. ARTC's Standard Environment Management Measures (under the Environment Management System) include procedures for no go zones for known areas of in-situ contamination, which will be implemented prior to maintenance works likely to disturb soils. ARTC's Work, Health and Safety work instructions will also be used for works near known contamination. Any required inspections of the capping layer undertaken by ARTC will be undertaken in accordance with ARTC's Asset Management System procedures. These procedures will be summarised in a site management plan in accordance with the CLM framework, which will be prepared by an environmental consultant and guide the management of residual contamination within the project site. This may be a standalone plan, or combined with site management plans that relate to adjacent areas.	N/A – Operation	N/A – Operation

12.6.3 Consideration of the interaction between measures

In addition to the measures for contamination described above, there are interactions between the mitigation measures for hydrology (Chapter 13) and soils and water quality (Chapter 14). For example, erosion and sediment control measures (as described in Chapter 14) would be implemented to prevent migration of contaminants within and surrounding the project site. All mitigation measures for the project are consolidated in Chapter 24 to ensure consistency in implementation.

12.6.4 Managing residual impacts

A residual risk analysis was undertaken taking into account the impact assessment summarised in this chapter and implementation of the mitigation measures as recommended in section 12.6.2. The residual risk levels were assessed to be medium for all potential contamination impacts (see Appendix B) including:

- disturbance of contaminated soil during construction
- contamination due to spills and leaks during construction and operation.

The reduction in risk level for the disturbance of contaminated soil or saline soils during construction from very high (prior to mitigation) to medium (with mitigation) is due to the implementation of management plans. These management plans would prescribe procedures for appropriate handling and management of contaminated soils, which are almost certain to be encountered during construction, to prevent cross-contamination and reduce the consequence of the disturbance.

13. HYDROLOGY AND FLOODING

This chapter provides a summary of the hydrology and flooding impact assessment. A full copy of the assessment report is provided as *Technical Report 6 – Flooding Impact Assessment*.

13.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment. A more detailed discussion of the guiding legislation and methodology for the flood assessment is provided in Chapter 2 and Chapter 3 of *Technical Report 6 – Flooding Impact Assessment*.

13.1.1 Legislative and policy context to the assessment

The assessment was undertaken with reference to the requirements summarised below.

Australian Rainfall and Runoff (Commonwealth)

Australian Rainfall and Runoff (ARR) is a national guideline for estimating design flood characteristics in Australia. ARR is important in providing reliable and robust estimates of design flood behaviour for projects such as the Botany Rail Duplication. The third edition of ARR was released in 1987 (ARR 1987) (Institute of Engineers Australia (IEAust), 1987), while a fourth edition of ARR was issued during the present investigation (ARR 2019) (Geoscience Australia (GA), 2019).

Hydrologic modelling for the project was based on ARR 1987, which is also consistent with the approach adopted for previous flood studies in the study area. Given the recent release of ARR 2019, a comparison was also made in the vicinity of the project between ARR 1987 and ARR 2019 on predicted flood behaviour.

Floodplain development manual (NSW)

The *Floodplain Development Manual* (FDM) (DIPNR, 2005) incorporates the NSW Government's Flood Prone Land Policy. The primary objectives of the policy are to reduce the impact of flooding and flood liability on owners and occupiers of flood prone property and to reduce public and private losses resulting from floods. The FDM promotes the concept that proposed developments be treated on their merit rather than through the imposition of rigid and prescriptive criteria.

A similar merits-based approach was adopted for the assessment of potential flood impacts associated with the project, including development of potential mitigation measures. In accordance with the FDM, the hydraulic and hazard categorisation of the floodplain was also considered when assessing the potential impacts on the project and its users.

Guideline on development controls on low risk flood areas (NSW)

The *Guideline on Development Controls on Low Flood Risk Areas* (NSW Government 2007) confirms that unless there are exceptional circumstances, councils should adopt the 1% AEP flood as the basis for deriving the Flood Planning Level (FPL) for residential development. The 1% AEP flood was therefore used as a basis for the assessment of potential flood impacts associated with the project.

Environmental Planning and Assessment Act 1979 (NSW) Section 117 Directions

In July 2009 the NSW Minister for Planning issued a list of directions to local councils under section 117(2) of the EP&A Act. *Direction 4.3 - Flood Prone Land* applies to all councils that contain flood prone land within their LGA and requires a draft LEP to contain a number of development controls associated with flooding. Controls include restrictions on development within floodway areas and on development that would result in significant impacts on other properties.

The flooding assessment has considered Ministerial Direction 4.3 when assessing the impacts and determining mitigation measures for the project.

Floodplain risk management guidelines (NSW)

The NSW Government's *Floodplain Risk Management Guideline: Practical Considerations of Climate Change* (DECC 2007) recommends that until more work is completed in relation to the climate change impacts on rainfall intensities, sensitivity analyses should be undertaken based on increases in rainfall intensities of between 10 and 30 percent. Under current climatic conditions, increasing the 1% AEP design rainfall intensities by 10 percent would produce about a 0.5% AEP flood. Increasing those rainfalls by 30 percent would produce about a 0.2% AEP flood. On current projections the increase in rainfall within the design life of the project is likely to be around 10 percent, with the higher value of 30 percent representing an upper limit. Therefore a 0.5% AEP flood and 0.2% AEP flood were modelled to represent these climate change rainfall scenarios, respectively.

In 2009 the NSW Government released its *Sea Level Rise Policy Statement* (NSW Government 2009) which supported adaptation to projected sea level rise impacts. The policy statement included sea level rise planning benchmarks for use in assessing potential impacts of projected sea level rise in coastal areas, including flood risk and coastal hazard assessment. These benchmarks were a projected rise in sea level (relative to 1990 mean sea level) of 0.4 metres by 2050 and 0.9 metres by 2100. The NSW Government recommended that these benchmark rises should be used to assess the sensitivity of flood behaviour to future sea level rise.

In the absence of a formal State Government policy on sea level rise benchmarks, the previously recommended rises in sea level of 0.4 metres by 2050 and 0.9 metres by 2100 have been adopted for assessing the impact future climate change could have on flooding conditions in the vicinity of the project.

Flood planning controls (local)

The project is located in the former Botany Bay (now Bayside) LGA. The *Botany Bay Local Environmental Plan 2013* (City of Botany Bay 2013a), which still applies to land located in the former Botany Bay LGA, does not include a 'flood planning' clause. As a result, the FPL has not been defined for development located in the vicinity of the project.

For the purpose of the flood impact assessment, it was assumed that the FPL in the vicinity of the project was equal to the peak 1% AEP flood level plus an allowance of 0.5 metres for freeboard (a safety factor to allow for uncertainties in modelling).

Drainage related standards (local)

Bayside Council relies on the *Botany Development Control Plan 2013* (City of Botany Bay 2013b) to guide development in the former Botany Bay LGA in accordance with *Botany Bay Local Environmental Plan 2013* (City of Botany Bay 2013a). These requirements include the provision of on-site detention in order to mitigate an increase in the quantity of runoff discharging into Council's receiving drainage system as a result of future development.

Notwithstanding the above council requirements, there would be a general requirement for the project to manage adverse changes to existing flow behaviour, should they occur.

13.1.2 Methodology

Key tasks

The flooding assessment involved the following tasks:

- a review of available data and existing flood studies within the catchments that are crossed by the project
- development of a set of hydrologic and hydraulic models (collectively referred to as 'flood models') of the catchments that are located within the study area
- flood modelling and preparation of maps showing flood behaviour under present day (ie pre-project) conditions for design floods with AEPs of 50%, 20%, 10%, 5%, 2%, 1% 0.5% and 0.2%, as well as the Probable Maximum Flood (PMF; the largest conceivable flood at a particular location and the area considered to be the 'floodplain')
- assessment of the potential impact that the project would have on flood behaviour for the identified design flood events (both during its construction and operation)
- assessment of the impact future climate change would have on flood behaviour under operational conditions
- assessment of the impact a partial blockage of major hydraulic structures would have on flood behaviour under operational conditions
- assessment of potential measures to mitigate the risk of flooding to the project and the project's impact on existing flood behaviour.

Study area

The project is located within the following two catchments:

- Alexandra Canal
- Mill Stream.

Alexandra Canal forms part of the larger Cooks River catchment, while the Cooks River and Mill Stream both drain to Botany Bay. The flood study incorporates drainage of water within both catchments, but the study area is defined by the flood model boundary (shown in Figure 13.1). It is in this area that flood waters can impact upon the rail line, and where the rail line (existing and proposed duplication) can influence surrounding and downstream flood conditions.

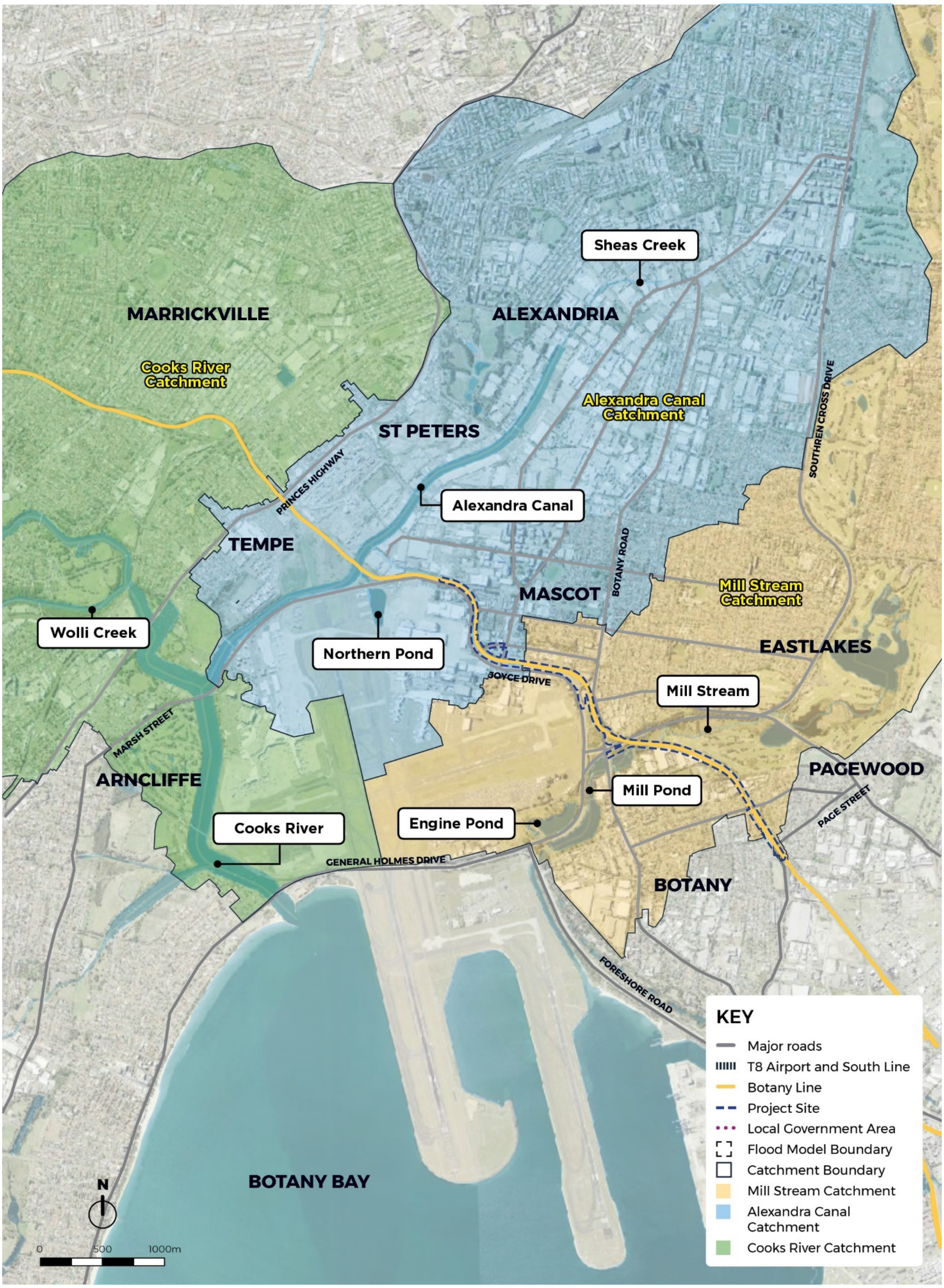


Figure 13.1 Flood study area

13.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with hydrology and flooding. Potential risks were considered according to the impacts that may be generated by the construction and/or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology, and the full results, is provided in Appendix B.

Prior to assessment and identification of mitigation measures, risks with an assessed level of medium or above include:

- High risk:
  - blockages of flow paths affecting low flows through erosion and sedimentation control measures
  - impacts upstream and downstream drainage due to the introduction of built structures such as embankments, culverts and bridges
- Medium risk:
  - changes to flow patterns and altered hydrology due to construction in watercourses
  - sedimentation and changes to geomorphology (aggradation in bed channels) in watercourses
  - temporary impact to the behaviour of local surface water systems during construction
  - presence of or change to structures associated with the project that could impact upstream and downstream local flood behaviour
  - changes to structures associated with the project and track height that could impact upstream and downstream regional flood behaviour.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 13.6.4.

13.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning for the project has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process. With respect to potential hydrology and flooding impacts, the project has sought to avoid or minimise potential impacts where possible.

Mitigation measures to protect the project from flooding impacts mainly involve locating critical infrastructure above the peak 1% AEP. Managing potential adverse impacts from the project on the surrounding environment would involve planning construction works outside of flood-prone areas and designing new and modified drainage infrastructure to avoid hazardous flood behaviour. The exact scope of the required mitigation measures would be subject to further flood assessment which would be undertaken during the detailed design phase.

13.2 Existing environment

13.2.1 Catchment description

The Alexandra Canal and Mill Stream catchments contribute runoff to the existing drainage systems and waterways located within the study area. Alexandra Canal forms part of the larger Cooks River catchment. Both the Cooks River and Mill Stream drain to Botany Bay.

Alexandra Canal catchment

Alexandra Canal is a major tributary of the Cooks River. The original creek was widened in the late 1800s over about a four kilometre length to form the Alexandra Canal. The size of the catchment draining to the canal increases from about 660 hectares at its northern (upstream) end near Sydney Park Road, to about 1,770 hectares at its confluence with the Cooks River.

The Alexandra Canal catchment is located within the suburbs of Alexandria, Rosebery, Tempe, Erskineville, Beaconsfield, Zetland, Waterloo, Redfern, Newtown, Eveleigh, Surry Hills and Moore Park.

Land use within the catchment comprises medium and high density residential, commercial and industrial development. More significant areas of open space within the overall catchment area include Sydney Park, Moore Park Playing Fields, Moore Park Golf Course, The Australian Golf Course and Alexandria Park.

The section of the project site between Lancastrian Road and about 160 metres east of O'Riordan Street is located within the Alexandra Canal catchment. The existing drainage along the rail corridor within this section of the catchment generally comprises informal open drains and overland flowpaths that convey runoff to the receiving drainage lines. An open drain exists north of the rail corridor in the Lancastrian Bridge area, while piped drainage crosses the rail corridor at the western end of King Street and through a series of pipes between Ewan Street and O'Riordan Street.

Mill Stream catchment

The Mill Stream catchment extends from Centennial Park in the north to its outlet into Botany Bay in the south. The catchment draining to Mill Stream is about 2,000 hectares at Foreshore Drive (around two kilometres to the south of the project site). The upper reach of the catchment is located within the Randwick City Council, City of Sydney and Waverley LGAs, while the lower reach is located within the Bayside Council LGA. The catchment includes the suburbs of Centennial Park, Queens Park, Kensington, Randwick, Kingsford, Daceyville, Eastlakes, Rosebery, Mascot, Pagewood and Botany.

Land use within the catchment predominantly comprises medium and high density residential and commercial development.

Mill Stream comprises a man-made channel where it runs along the eastern side of Sydney Airport from Foreshore Drive to its outlet into Botany Bay. Mill Stream comprises a vegetated channel where it runs in a southerly direction through Eastlake Golf Course from Gardeners Road and feeds a series of interconnected freshwater ponds that are referred to as the Botany Wetlands. The section of Botany Wetlands between Eastlake Golf Course and Botany Road is owned and maintained by Sydney Water under the *Plan of Management – Botany Wetlands 2018–2028* (Sydney Water, 2018).

The section of the project site between about 160 metres east of O'Riordan Street and Stephen Road (at the southern end of the project site) is located within the Mill Stream catchment. As is the case with drainage infrastructure in within the Alexandra Canal catchment, the existing drainage along the rail corridor within the Mill Stream catchment generally comprises informal open drains and overland flowpaths that convey runoff to the receiving drainage lines.

Piped drainage crosses the rail corridor north and immediately south of General Holmes Drive, eventually discharging into Mill Stream. Piped drainage also crosses the rail corridor in the area of Wentworth Avenue and Bronti Street. A vegetated channel runs along the eastern side of the existing rail line between Banksia Street and Myrtle Street, where piped drainage crosses the line and flows into Mill Stream to the north of Foreshore Drive.

13.2.2 Existing flooding and drainage behaviour

There are some locations adjacent to the rail line where both main stream flooding and major overland flow occur under pre-project conditions. These locations are summarised and described in Table 13.1 and shown in Figure 13.2.

Table 13.1 Description of existing flood behaviour

LOCATION	DESCRIPTION OF EXISTING FLOOD BEHAVIOUR (UP TO AND INCLUDING 1% AEP EVENTS)
North of rail line (Lancastrian Bridge area)	Floodwater would surcharge (ie overflow) the southern bank of the existing concrete lined channel running along the northern side of the rail corridor during a 2% AEP flood event or greater. Floodwater at this location during this event would still be around 0.3 metres below the level of the adjacent rail line.
King Street	Overflow from the stormwater drainage system in King Street would pond in a low point at its western end to a maximum depth of about 0.2 metres at this location during a 10% AEP event. During greater flood events, water would flow to the north along the western side of the rail corridor to a maximum depth of about 0.2 metres.
Ewan Street/ O’Riordan Street	Overflow from the stormwater drainage system in Ewan Street would pond in a low point adjacent to the rail corridor to a maximum depth of about 1.3 metres at this location. This would still be 1.6 metres below the level of the adjacent rail line. The depth of ponding during events greater than a 10% AEP event would be sufficient to result in hazardous flooding conditions to people and property.
Robey and O’Riordan Street underpasses	The rail line is on an elevated bridge structure where it crosses the low points in Robey Street and O’Riordan Street. Flow in excess of the capacity of the stormwater drainage system would pond at the low points in the Robey and O’Riordan Street underpasses to between 0.9 and 1.1 metres during a 1% AEP event. During a 1% AEP event the depth of ponding at the Robey Street underpass would result in water flow into the basement carpark of the Stamford Plaza Sydney Airport (Stamford Plaza) via the entrance located immediately to its east. Flooding was reported at the Robey Street underpass during a storm that occurred on 7 September 2018. A photo that was taken during the storm indicated that the depth of ponding at the low point could have been in the order of 0.2 to 0.3 metres. An analysis of the rainfall that was recorded at Sydney Airport during this event indicated the storm was equivalent to less than a 1 Exceedance per Year (EY) event (ie its intensity was less than that of a storm that occurs once every year on average). Flooding has also recently been reported at the low point in the O’Riordan Street underpass during a storm that occurred on 28 November 2018. A video taken of the flooding to the underpass indicates that the depth of ponding at the low point could have been in the order of 0.5 metres. An analysis of the rainfall that was recorded at Sydney Airport during this event shows that the storm was also equivalent to a 1 EY event or less.

LOCATION	DESCRIPTION OF EXISTING FLOOD BEHAVIOUR (UP TO AND INCLUDING 1% AEP EVENTS)
Qantas Drive sag	Depths of ponding of between 0.9 and 1.1 metres would also occur at the low point in Qantas Drive located to the west of Robey Street (denoted 'Qantas Drive sag') during a 1% AEP event. Drainage overflow at the low point at Qantas Drive sag discharges in a southerly direction into an adjoining carpark within Sydney Airport. Depths of inundation in the carpark occur to a maximum of 0.6 metres during a 10% AEP design storm, increasing to a maximum of 0.9 metres during a 1% AEP design storm.
Mill Stream	The peak 1% AEP flood level at the bridge that spans Mill Stream would be about 1.5 metres below the underside of the bridge. Southern Cross Drive, where it runs under the rail line to the west of Botany Road, acts as an overland flowpath for water from Mill Stream within the Lakes Golf Club during events greater than about 2% AEP. During a 1% AEP event overland flow along Southern Cross Drive collects at the low point in Botany Road between Wentworth Avenue and Southern Cross Drive. A section of rail line about 220 metres to the east of the Mill Stream bridge would be inundated by overland flow that surcharges Mill Stream and discharges through the southern portion of the Lakes Golf Club during events greater than about 10% AEP.
West of Mill Stream	Flooding would occur at a low point on Baxter Road where water surcharges the drainage pipes that cross the rail corridor at this location. A section of the existing track that is located 140 metres to the north of General Holmes Drive would be impacted by local catchment runoff that collects at the low point in the rail corridor along its southern boundary. The rail underpass at Wentworth Avenue would be inundated by floodwater to a depth of about 0.5 metres during a 10% AEP event, increasing to 0.9 metres during a 1% AEP event. During a 1% AEP event, a 150 metre length of Botany Road between Wentworth Avenue and Southern Cross Drive would be inundated by floodwater, including the section of road that runs under the rail line to the south of Bronti Street.
East of Mill Stream	Flow that surcharges the stormwater drainage system in Banksia Street will collect at its low point to the north of the rail corridor before discharging into the rail corridor. Similarly, flow that surcharges the stormwater drainage system in Bay Street will collect at its low point to the north of the rail corridor before discharging into the vegetated channel that runs along the eastern side of the rail line during events for frequent than 50% AEP. This flow would surcharge the inlet pipe that crosses the rail corridor at Myrtle Street. This surcharge flood water will flow north toward the Eastlake Golf Course and combine with flow that surcharges Mill Stream. A section of the existing rail line that is located 150 metres to the north of Myrtle Street is impacted by local catchment runoff that collects at the low point in the rail corridor along its northern boundary. During a 10% AEP event, runoff that collects at the low point will overtop the rail line where it will discharge in a westerly direction toward Mill Stream.

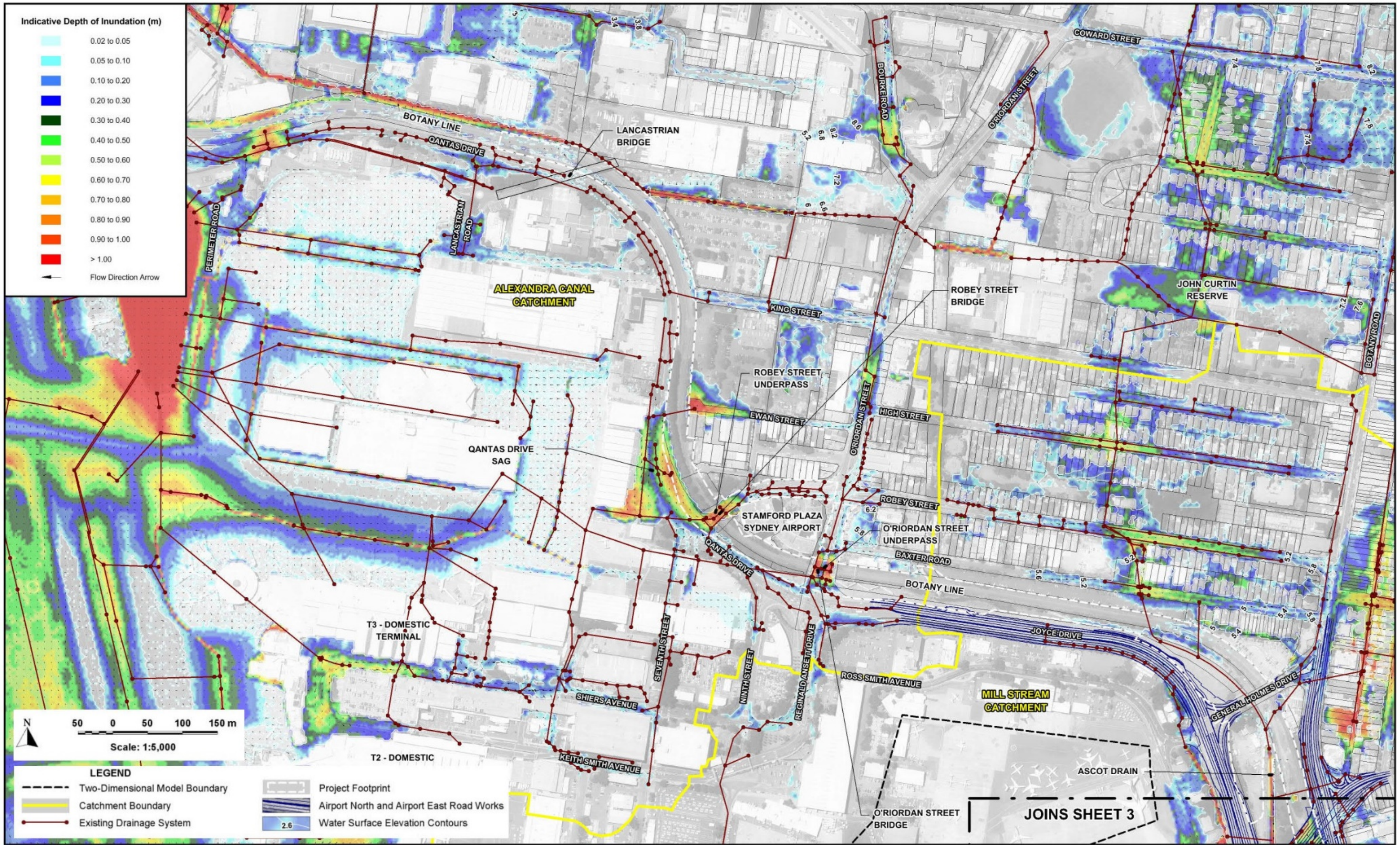


Figure 13.2a Pre-Project flooding – 1% AEP event

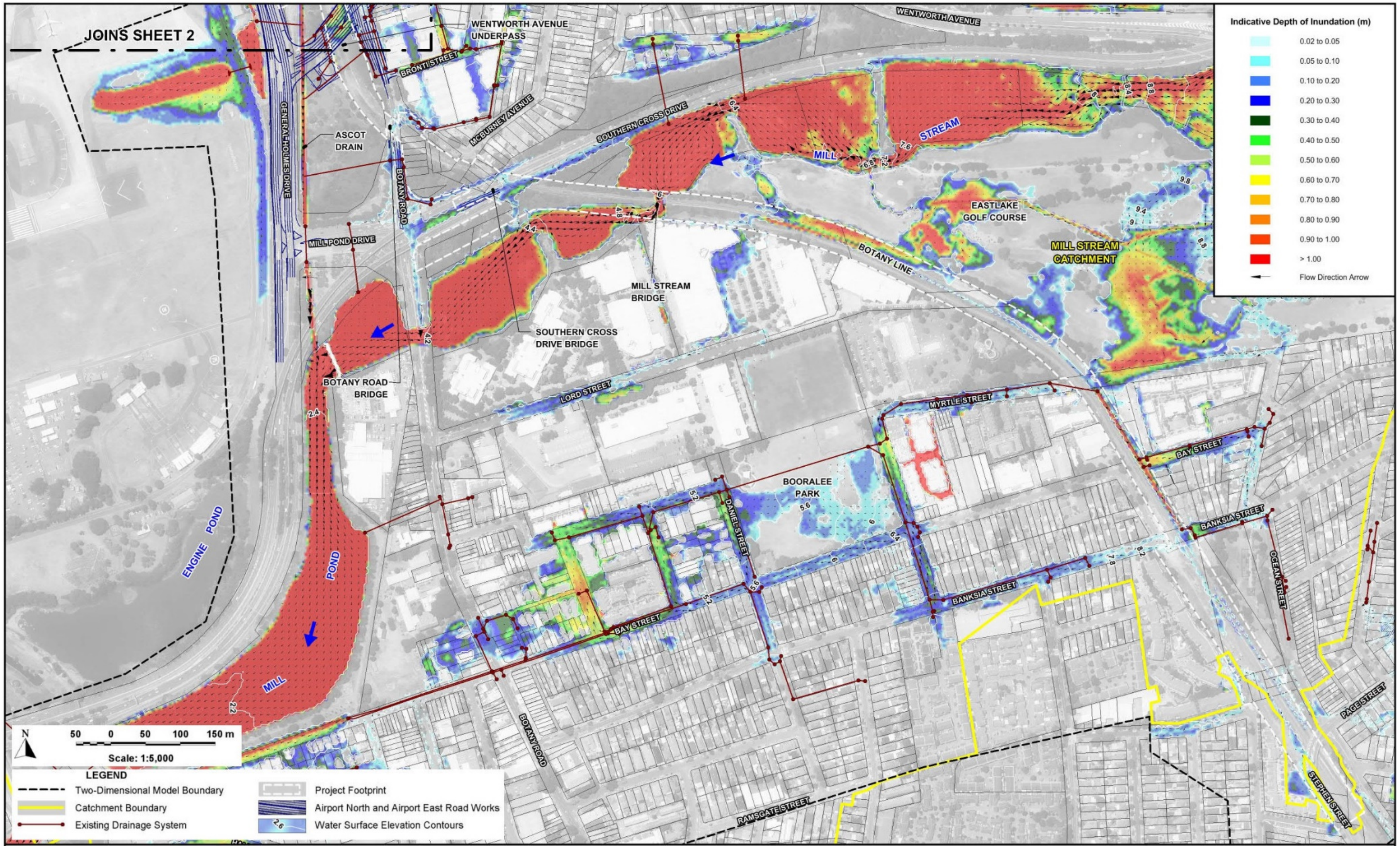


Figure 13.2b Pre-Project flooding – 1% AEP event

13.3 Assessment of construction impacts

13.3.1 Construction compounds, storage areas and earthworks

A number of construction compound sites are proposed along the length of the project site. Each compound would contain a range of site facilities that would include offices, staff amenities, parking and storage areas for plant, equipment and materials, as well as fencing and security facilities.

The inundation of the proposed construction compounds by floodwater would have the potential to:

- cause damage to the project works and delays in construction programming
- pose a safety risk to construction workers
- detrimentally impact the downstream waterways through the transport of sediments and construction materials by floodwaters
- obstruct the passage of floodwater and overland flow through the provision of temporary measures such as site sheds, bunding, stockpiles and some types of temporary fencing, which in turn could exacerbate flooding conditions in existing development located outside the construction footprint.

In addition to the identified construction compound sites, a series of additional construction areas have been identified along the project site for the storage of materials and equipment. The construction of the project would generate spoil which may also need to be temporarily stored in stockpile areas for reuse on site or haulage to an appropriately licensed facility.

Stored equipment and stockpiles located on the floodplain would have the potential to obstruct floodwater and alter flooding patterns. Inundation of stockpile areas by floodwater can also lead to significant quantities of material being washed into the receiving drainage lines and waterways.

Earthworks would be required along the length of the project site and would include excavation works for subgrade formation and fill to expand embankments and support new retaining walls and bridge abutments.

The inundation of floodwater to areas where earthworks are undertaken has the potential to cause scour of disturbed surfaces and the transport of sediment and construction materials into the receiving waterways.

13.3.2 Bridge construction

The following six bridge structures are proposed to be constructed as part of the project:

- Robey Street bridge (comprising two bridges)
- O’Riordan Street bridge (comprising two bridges)
- Southern Cross Drive bridge
- Mill Stream bridge.

Crane pads would be required at each of the proposed bridge structures to support cranes to install various bridge components including precast sections and beams. All crane pads would be in areas that are impacted by overland flow during storm events of 50% AEP or more frequent.

13.3.3 Potential impacts of construction activities on flood behaviour

The previous section covered flood impacts *on* the construction activities, whereas this section covers flood impacts *from* construction activities on the surrounding area. Construction activities have the potential to exacerbate flooding conditions when compared to both pre-project and operational conditions. This is because the construction activities typically impose a larger footprint on the floodplain due to the need to provide temporary structures, such as construction compounds, outside the operational footprint of the project, which would be removed following the completion of construction activities.

Mill Stream bridge

While all construction work areas would involve works within the floodplain, the assessment found that the greatest potential for adverse impacts on flood behaviour would occur during construction of the Mill Stream bridge and the associated Mill Stream construction compound. This would include the provision of proposed crane pads and temporary piling platforms that could impact on the flow of Mill Stream during this period. The works also have the potential to increase flow velocities and therefore scour and erosion potential in Mill Stream.

Robey Street and O'Riordan Street bridges

While the proposed crane pads for the construction of the Robey Street and O'Riordan Street bridges have the potential to obstruct overland flow that is conveyed along the roadways, the temporary crane pads would only be in place during a short-term rail possession period of around 48 hours and therefore the potential for impacts is considered to be minimal.

13.4 Assessment of operational impacts

Inundation of the project by floodwater during operation has the potential to cause damage to infrastructure, impact on train movements and pose a safety risk to rail users. The project also has the potential to exacerbate flooding and drainage conditions in adjacent development by obstructing or diverting floodwaters, displacing floodplain storage or altering runoff behaviour from the rail corridor. An assessment was undertaken of the flood risk to the project in its as-built form, as well as the impact it would have on the characteristics of flooding in adjacent areas. A summary of this assessment is provided below, with additional detail provided in *Technical Report 6 – Flooding Impact Assessment*.

13.4.1 Potential flood risk to the project

The project would provide a level of flood immunity to the 10% AEP for both the existing and new rail tracks, which is slightly greater than that of the existing rail track, resulting in the existing rail line being more resilient to flooding once construction is completed due to additions and modifications to the existing drainage system. Some sections of the rail line ballast would however still be inundated during a 1% AEP event. This would include a section of the southern track to the west of General Holmes Drive and a section of the northern track to the west of Myrtle Street. Inundation is predicted to be 0.5 metres and 0.4 metres below the top of rail levels at these locations, respectively.

The proposed bridge over Mill Stream would provide more than 0.5 metres of freeboard between the underside of the bridge structure and the peak 1% AEP flood level.

The new corridor access roads would provide a 10% AEP level of flood immunity with the exception of a section of road about 140 metres west of Myrtle Street. This location is predicted to be inundated to a maximum depth of around 0.3 metres due to local catchment runoff that ponds along the northern side of the rail corridor.

13.4.2 Impact of the project on flood behaviour

An assessment was carried out into the impact the project would have on flood behaviour due to changes in flow conveyance and a reduction of flood storage across the floodplain. The assessment found that once constructed, the project would generally have only a minor impact on flood behaviour for floods up to the PMF event, with the exception of residual flood impacts near Mill Stream and along Myrtle Street. The impact of project operation on flood behaviour for a 1% AEP event is shown in Figure 13.3a and 13.3b. Those maps show the amount of afflux, or change in flood depth, that is predicted to occur once the project is constructed, compared to pre-project conditions.

The project would generally have a minor impact on flow behaviour (ie flow depths and velocities) in the drainage systems downstream of the proposed outlets that would control runoff from the project. Additions and modifications to the drainage system will allow flows to generally behave in a similar way to pre-project conditions.

Mill Stream

Peak 1% AEP flood levels upstream of Mill Stream bridge would be increased by a maximum of around 0.1 metres. This would lead to an increase in the rate (and therefore depth) of flow that overtops the western bank of Mill Stream and is conveyed along the travel lanes of Southern Cross Drive and Botany Road. The increase in peak flood levels upstream of Mill Stream would also lead to an increase in the frequency with which flow overtops the western bank of Mill Stream onto the travel lanes of Southern Cross Drive. This would change from about a 1% AEP event under pre-project conditions to about a 2% AEP event under post-project conditions (ie twice as frequent). The road would be impacted (affecting traffic flow) approximately once every 50 years, instead of once every 100 years.

The assessment found that the project would have only a minor impact on the extent and duration of inundation of flooding within Mill Stream.

Myrtle Street (and surrounding properties)

During a 1% AEP event, operation of the project would result in an increase in peak flood levels upstream of the inlet to the 1,050 millimetre diameter pipe that crosses the rail corridor at Myrtle Street. This would also result in potential to impact the existing adjoining developments at this location.

In particular, it is predicted that peak flood levels at:

- 104 Bay Street would be increased by a maximum of around 0.02 metres (ie two centimetres). Impacts would occur in the northern portion of the development over an area that includes several units that front Myrtle Street
- 15 Begonia Street would be increased by a maximum of around 0.02 metres. Impacts would occur in the north eastern portion of the development, what appears to be the entry to basement carparking.

The modelling suggests that the properties currently experience around 0.1 metre inundation in some areas, however it is currently unknown whether it affects basement car parks or habitable rooms. Similarly, it is unknown whether the additional 0.02 metres would or would not worsen existing pre-project impacts. As such the discussion of potential social or economic impacts as a result of this assessment is qualitative and would be further understood following any additional assessment, as required. Mitigation measures provided have identified detailed floor level surveys would be undertaken to provide further understanding of where additional inundation could affect, in the event that the increase in inundation cannot be designed out.

The potential social and economic impact of this predicted increase in peak flood levels is discussed in section 19.4.5.

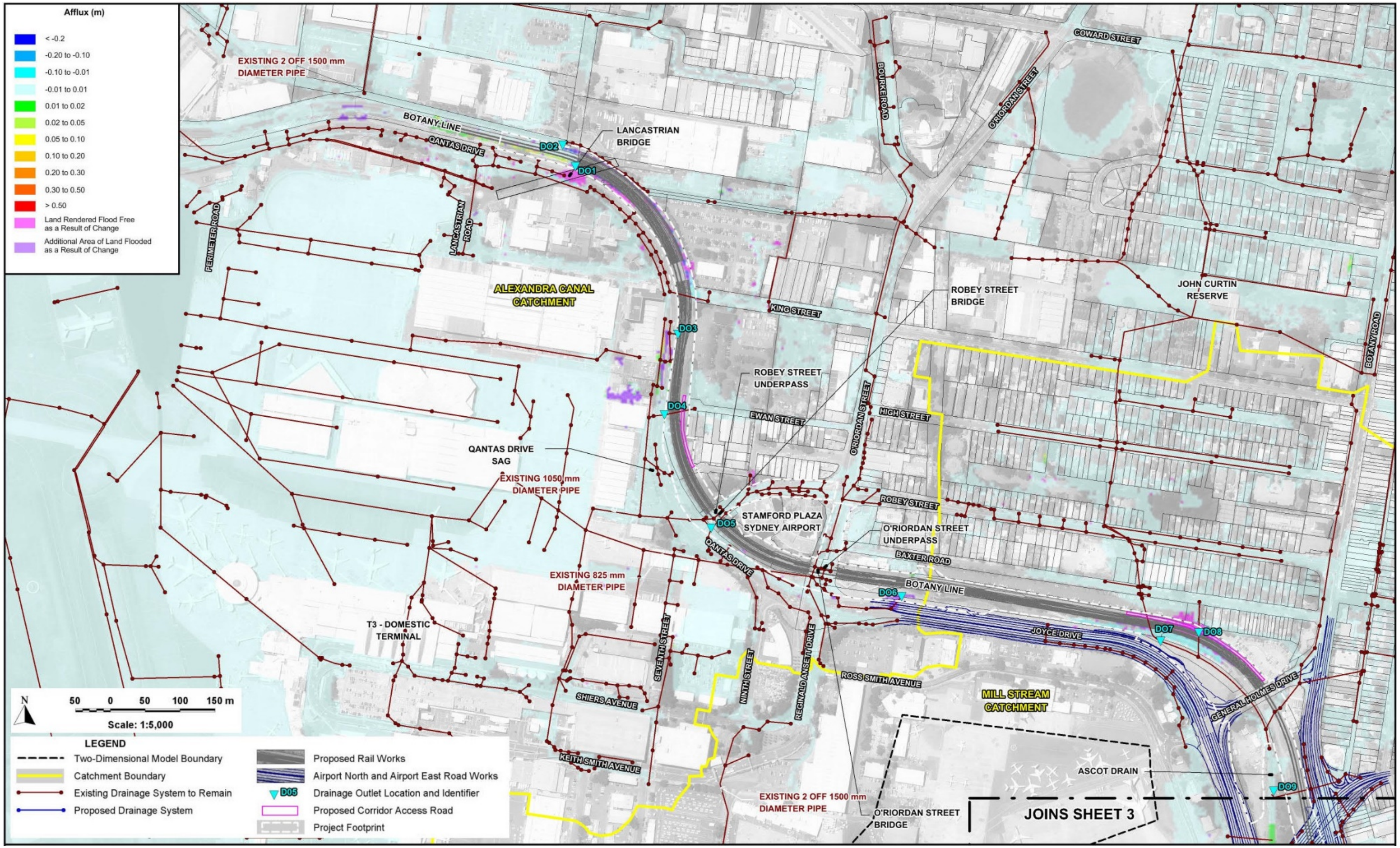


Figure 13.3a Impact of Project operation on flood behaviour – 1% AEP event

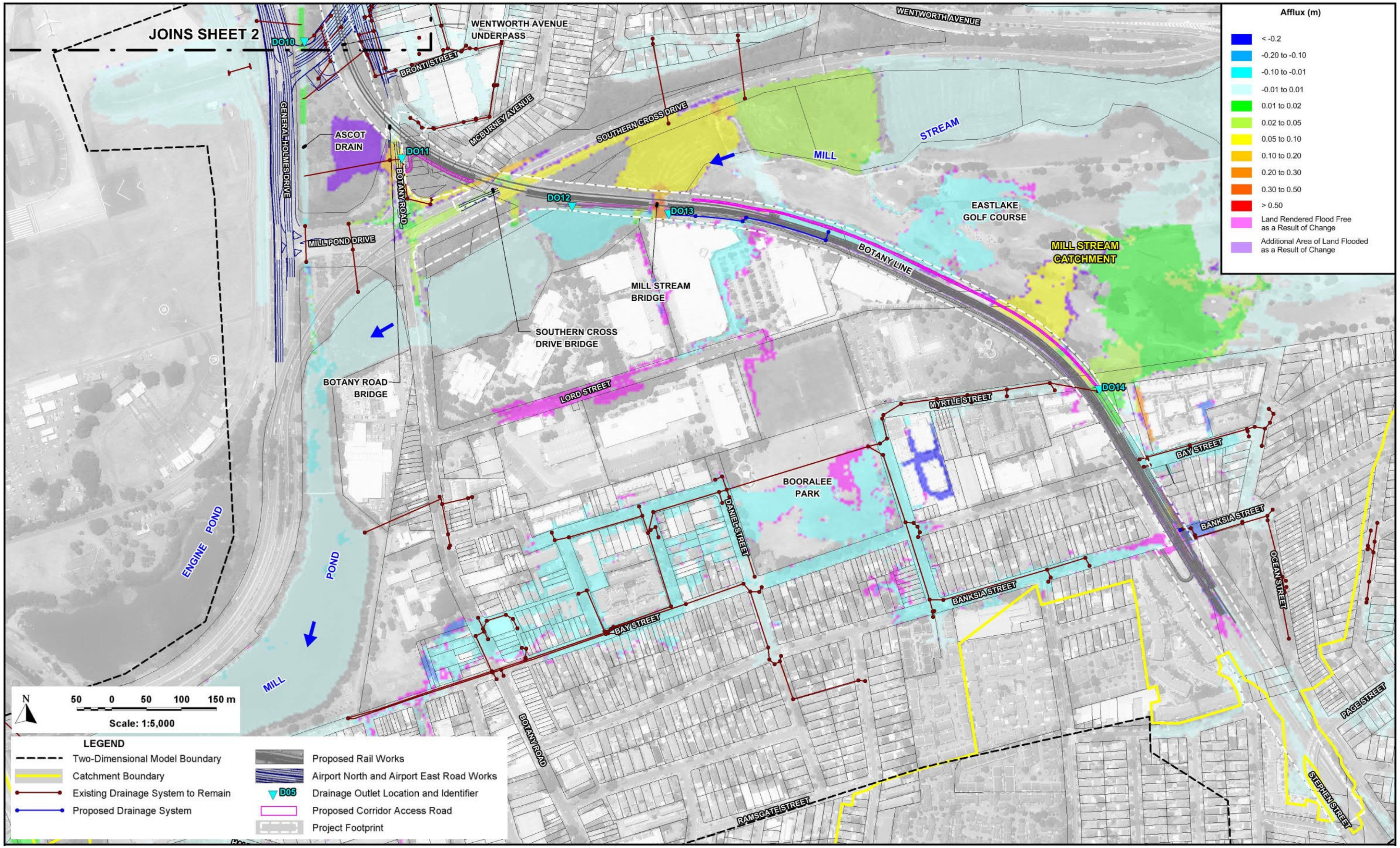


Figure 13.3b Impact of Project operation on flood behaviour – 1% AEP event

13.4.3 Impact of a partial blockage of major drainage structures on flood behaviour

The assessment showed that a partial blockage of major hydraulic structures (eg pipes crossing the rail corridor) would result in an increase in peak 1% AEP flood levels upstream of the Mill Stream bridge by a maximum of around 0.03 metres. As a result, there would be an increase in the rate and depth of flow that overflows the western bank of Mill Stream onto Southern Cross Drive.

The resulting peak flood level would however still be more than one metre below the underside of the existing and new bridge structures at Mill Stream. There would also be an increase in peak 1% AEP flood level upstream of the inlet to the 1,050 millimetre diameter pipe that crosses the rail corridor at Myrtle Street by around 0.01 metres, which would have a negligible impact on flooding to the rail line.

13.4.4 Impact of future climate change on flood behaviour

For this project 0.5% and 0.2% AEP events were adopted as proxies for assessing the sensitivity to an increase in 1% AEP design rainfall intensities of between 10 and 30 percent due to future climate change. The assessment found that there would be relatively minor increases in flood impacts attributable to the project under both the lower and upper bound future climate change scenarios.

While flooding under future climate change conditions would increase the depth of inundation to the ballast below the duplicated rail line, the depth of inundation would still be a minimum 0.25 metres below the top of rail level and is therefore unlikely to impede train operations during a climate-adjusted 1% AEP event. The increase in the frequency and depth of inundation of the ballast is likely to increase the rate of deterioration and therefore maintenance requirements of the track.

Raising the level of the rail line in order to reduce the depth of inundation to the ballast would be constrained by the level of the existing rail line and would also be likely to result in adverse impacts on flood behaviour in areas outside the rail corridor.

13.5 Cumulative impacts

13.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to hydrology and flooding are described below.

13.5.2 Cumulative construction impacts

Given the short-term nature of exposure to potential flood impacts during its construction together with the general requirement to manage adverse impacts on the existing development, cumulative construction impacts relating to hydrology and flooding were not assessed. Furthermore, the flooding assessment found that the greatest potential for impacts associated with the construction of the project would be as a result of the construction of the Mill Stream bridge, which is located in an area of the Mill Stream floodplain that is remote from the other projects in the area.

13.5.3 Cumulative operational impacts

Given the minor nature of impacts that are attributable to the project on flood behaviour in the drainage systems that control runoff from the rail (as described in section 13.4 above), it is expected that the cumulative impacts of it in combination with other projects in the area would also be minor in nature.

13.6 Management of impacts

13.6.1 Approach

The assessment of flood impacts associated with the project has provided an understanding of the scale and nature of the flood risk to the project, as well as the increased flood risks on the surrounding environment during its construction and operation. Further assessment will be undertaken during the detailed design phase of the project that will build on the flood assessment presented in this technical working paper and will be based on further design development and flood modelling where required.

A full description of the approach to environmental management and mitigation is provided Chapter 25.

13.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential flooding impacts are listed in Table 13.2. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 13.2 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Design	Rail duplication	As a minimum, the modification and duplication of the existing rail line is to be configured to ensure the existing level of flood immunity is not reduced by the project. Measures to improve the existing level of flood immunity are to be further investigated during detailed design with the goal of providing a 1% annual exceedance probability (AEP) level of flood immunity.	N/A – Design phase	N/A – Design phase
	New bridge over Mill Stream	The new bridge crossing over Mill Stream is to provide a minimum freeboard of 0.5 metres between the underside of the bridge structure and the peak 1% AEP flood level.	N/A – Design phase	N/A – Design phase
	System and control network	Rail location cabinets (LOCs) for housing communications, power and signalling equipment for the system and control network will be located a minimum 0.5 metres above the peak 1% AEP flood level in accordance with ARTC standards.	N/A – Design phase	N/A – Design phase
	New corridor access roads	A 10% AEP level of flood immunity is to be provided to the new access roads.	N/A – Design phase	N/A – Design phase

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Management of adverse flood impacts on the existing environment (design)	A detailed hydrologic and hydraulic (flood) assessment of the impacts of the project on flood behaviour and the associated measures which are required to mitigate those impacts will be undertaken during detailed design. Works within the floodplain will be designed to minimise adverse impacts on surrounding development (including roads) for flooding up to the 1% AEP event in magnitude. Assessment will also be made of impacts during floods up to the probable maximum flood (PMF) in the context of impacts on critical infrastructure and flood hazards. Subject to the flood assessment during detailed design, it may be necessary to collect detailed ground survey (including floor levels and entry levels to buildings and basement carparks) in affected areas to determine whether the project will increase flood damages in adjacent development (ie in properties where there is a potential for increases in peak flood levels for events up to 1% AEP in magnitude) or increase the flood hazard to basement carparks (ie in basement carparks where there is a potential for increases in the frequency, rate and volume of flow into basement carparks for events up to the PMF). The design of the project will need to incorporate measures that are aimed at mitigating the impact of the project on flood behaviour in properties where existing buildings will experience above-floor inundation during floods up to the 1% AEP event, or where there is the ingress of floodwater to basement carparks during storms up to the PMF. Drainage structures will be sized and positioned more precisely during detailed design to mitigate these impacts. Localised increases in flow velocities at the outlets to upgraded or, relocated, or new stormwater drainage systems will be mitigated through the provision of scour protection and energy dissipation measures.	N/A – Design phase	N/A – Design phase
Construction	Earthworks	Plan, implement and maintain measures which are aimed at: • intercepting flow from areas upstream of the project and diverting it in a controlled manner whether through or around the construction sites • implementing construction practices that minimise the potential for scour through stabilisation of disturbed surfaces.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Spoil management	Spoil stockpiles will need to be located in areas which are not subject to frequent inundation by floodwater and ideally outside the 1% AEP flood extent. The CEMP will define the flood immunity criteria for stockpiles proposed to be located in areas that are inundated during a 1% AEP event. These criteria will be based on the duration of stockpiling operations, the type of material stored, the nature of the receiving drainage lines and also the extent to which the stockpile would impact flooding conditions in adjacent areas.	✓	✓
	Site facilities and flood emergency management	As a minimum, site facilities are to be located outside high flood hazard areas based on a 1% AEP flood and ideally outside the 1% AEP flood extent. For site facilities located within the floodplain, the CEMP is to identify how risks to personal safety and damage to construction facilities and equipment will be managed. The CEMP will need to include details of: • the procedure to monitor accurate and timely weather data, and disseminate warnings to construction personnel of impending flood producing rain • an evacuation plan for construction personnel should a severe weather warning be issued.	✓	✓
	Management of adverse flood impacts on existing development (construction)	The CEMP will need to include details and procedures to manage the potential for proposed construction activities to adversely impact on flood behaviour in adjacent development. A more detailed assessment of the impact that construction activities would have on flood behaviour, as well as the scope of measures which will be required to mitigate those impacts, will need to be undertaken during the detailed design phase, with the benefit of more refined construction plans and details by the preferred construction contractor. Subject to the outcomes of further design development and flood assessment during the detailed design phase, a floor level survey may need to be undertaken of affected properties (ie in properties where there is a potential increase in flood levels) to determine whether construction activities will increase flood damages in adjacent development and if mitigation measures are required.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
		The layout of the construction compounds, material storage areas, as well as temporary crane pads and temporary piling platforms will need to be designed to: • limit the extent of works located in floodway areas • divert overland flow either through or around work areas in a controlled manner • minimise adverse impacts on flood behaviour in adjacent development. Measures to manage residual flood impacts may include: • staging construction to limit the extent and duration of temporary works on the floodplain • ensuring construction equipment and materials are removed from floodplain areas at the completion of each work activity or should a weather warning be issued of impending flood producing rain • providing temporary flood protection to properties identified as being at risk of adverse flood impacts during any stage of construction of the project developing flood emergency response procedures to remove temporary works during periods of heavy rainfall.		

13.6.3 Consideration of the interaction between measures

In addition to the measures for hydrology and flooding described above, there would be interactions between the mitigation measures for soils and water quality (Chapter 14).

All mitigation measures for the project will be consolidated and described in the relevant management plan. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures will be consolidated to ensure consistency and implementation.

13.6.4 Managing residual impacts

The flood study found that once constructed, the project would generally have only a minor impact on flood behaviour in surrounding areas for floods up to the PMF. Residual impacts at the Mill Stream bridge and along Myrtle Street referred to in section 13.4.2 would be resolved during detailed design. Possible measures identified include adjusting the span of Mill Stream bridge, refinements in drainage design (eg pipe sizes), and providing retaining walls and oversized channels in appropriate locations.

14. WATER QUALITY AND SOIL

This chapter provides a summary of the groundwater and surface water assessments. A full copy of the assessment reports are provided as *Technical Report 7 – Groundwater Impact Assessment* and *Technical Report 8 – Surface Water Impact Assessment*.

Some sections of this chapter, which relate to contamination in water and soil, were also informed by the contamination assessment, which is provided as *Technical Report 5 – Contamination Assessment* and summarised in Chapter 12 of this EIS.

14.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in *Technical Report 7 – Groundwater Impact Assessment* and *Technical Report 8 – Surface Water Impact Assessment*. Impacts associated with contaminated soils are outside the scope of this chapter and are addressed in Chapter 12 and *Technical Report 5 – Contamination Assessment.*

14.1.1 Legislative and policy context to the assessment

National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS (DAWR, 2016)) includes water quality guidelines that define desirable ranges and maximum levels for certain parameters for specific uses of waters or for protection of specific values. The NWQMS water quality guidelines include the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000) and the *Australian Drinking Water Guidelines* (NHMRC, 2011).

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000) provide water quality guidelines, objectives or guideline trigger values. These guidelines align with the NSW Water Quality and River Flow Objectives (NSW WQOs) (DECC, 2006). The ANZECC 2000 guidelines have been considered as a conservative trigger value for groundwater.

The ANZECC 2000 guidelines acknowledge that different levels of protection may be appropriate for different water bodies. The method for defining the trigger values for toxicants depends on the level of protection required for receiving aquatic ecosystems. An 80 percent protection level (95 percent for bioaccumulative toxins) for Alexandra Canal and the Cooks River is proposed, due to the highly disturbed and poor condition of this aquatic ecosystem (see section 14.2.1). A higher 95 percent protection level (99 percent for bioaccumulative toxins) is proposed for aquatic ecosystems in Mill Stream. The recommended trigger values for the project are provided in Appendix A of *Technical Report 8 – Surface Water Impact Assessment*.

The *Australian Drinking Water Guidelines* (NHMRC, 2011), which are only applied for projects where the water is suitable for drinking water or as a conservative value for human health where no other criteria is available. Given there is a restriction on groundwater extraction from the Botany Sands aquifer for domestic use (see section 12.2.4), these guidelines are not applicable to the project.

Water Act 1912 and *Water Management Act 2000*

The *Water Act 1912* governs licences from water sources in NSW. It also manages the trade of licences and water allocations. The *Water Act 1912* is progressively being replaced by the *Water Management Act 2000*.

The *Water Management Act 2000* is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. The *Water Management Act 2000* requires the development of water sharing plans to manage water use and access.

The project is located within the Greater Metropolitan Region Water Sharing Plan, as well as the water management zone for the Botany Sands Groundwater Source (see section 14.2.2). The water management zone for the Botany Sands Groundwater Source means it is at a level of more refined implementation of access and trading rules applied (see section 12.2.4).

The project is being assessed as SSI under Division 5.2 of the EP&A Act. Under section 5.23 of the EP&A Act, a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the WM Act are not required.

NSW Aquifer Interference Policy

The *NSW Aquifer Interference Policy* (AIP) (NOW, 2012a) clarifies the water licencing and approval requirements for aquifer interference activities in NSW. The AIP requires that potential impacts on groundwater sources, including their users and high priority GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the AIP. In accordance with the AIP, the predicted groundwater impacts of the project have been assessed with reference to the minimal impact considerations for highly productive groundwater sources for coastal sand water sources. The AIP water criteria requires that the beneficial use potential of the groundwater systems cannot change beyond 40 metres of the activity. As such, the project would aim to maintain the baseline groundwater quality during construction and operation, which has informed the approach to assessment of impacts (see sections 14.3 and 14.4).

Other guidelines and policies

Other legislation, guidelines and policies relevant to the water quality and soil assessment for the project include:

- Airports Act and Airports (Environment Protection) Regulations 1997, which provides guidelines and strategy documents (including the *Sydney Airport Master Plan 2039* (SACL 2019a) and the *Sydney Airport Environment Strategy 2019-2024* SACL 2019b*)*, which would need to be followed for the construction compound on Sydney Airport land.
- EPBC Act, which outlines several MNES (including threatened and migratory species), which have been considered when assessing the potential water quality related impact on downstream sensitive receivers.
- *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004), which has informed the approach to management of soil and water impacts (see section 14.6).
- Water Management (General) Regulation 2018, which states that ARTC, as a transport authority, is exempt from the requirement to hold a water access license or water use approval for ongoing take of groundwater as well as controlled activity approvals for activities on waterfront land.
- *PFAS National Environmental Plan* (PFAS NEMP) (HEPA, 2018), which provides screening criteria applicable to this project for certain PFAS analytes for aquatic ecosystems (see section 12.2.6).

- *Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008), which were considered as Botany Bay, Mill Stream and Cooks River surrounding the project site are used for a range of recreational purposes.
- *NSW Water Quality and River Flow Objectives,* which align with the ANZECC 2000 guidelines and provides water quality objectives to assess the water quality of the Botany Bay Catchment.
- *Botany Bay and Catchment Water Quality Improvement Plan* (SMCMA 2011)*,* which set targets for pollutant load reductions required to protect the condition of Botany Bay, its estuaries and waterways.
- *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales* (DEC, 2004a), which lists the sampling and analysis methods to be used when acquiring water samples.
- *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (NOW, 2012b), which was used to guide the assessment of potential impacts on GDEs.
- *NSW State Groundwater Policy Framework Document* (DLWC, 1997), which provides guidance for the assessment of impacts on groundwater quality, groundwater quantity and GDEs.
- *Landslide risk management guidelines* (Australian Geomechanics Society, 2007), which would inform the design to minimise landslide risk.
- *Soil and Landscape Issues in Environmental Impact Assessment* (DLWC, 2000), which guides assessment of soil disturbance and landscape issues.

A detailed description of the legislative and policy context for the assessment is provided in *Technical Report 7 – Groundwater Impact Assessment* and *Technical Report 8 – Surface Water Impact Assessment*.

14.1.2 Methodology

Key tasks

The groundwater assessment involved (see section 3 of *Technical Report 7 – Groundwater Impact Assessment* for a detailed description of the methodology):

- reviewing existing data to understand the groundwater management zones, existing hydrology and groundwater quality and determine the baseline groundwater conditions for the project
- establishing a conceptual hydrogeological model for the project and surrounding areas
- characterising the existing local and regional hydrogeological conditions
- inferring the magnitude of potential changes in groundwater conditions and surface flows from the conceptual model developed
- assessing the predicted changes in groundwater conditions to identify any potential adverse impacts
- identifying mitigation and management measures and monitoring requirements.

The surface water quality assessment involved (see section 3 of *Technical Report 8 – Surface Water Impact Assessment* for a detailed description of the methodology):

- reviewing existing data from the project site and its catchment to provide an understanding of existing environmental conditions, water quality data, current uses of the waterways and sensitive receivers
- applying the ANZECC 2000 framework to identify catchment and waterway specific water quality management goals for different potential pollutants (trigger values)
- identifying activities that could result in water quality impacts during construction and operation
- identifying mitigation and management measures and monitoring requirements.

No groundwater or surface water monitoring was undertaken in the preparation of the groundwater and surface water impact assessments. This desktop-based approach was adopted because:

- the magnitude of impacts is expected to be localised and temporary
- any intersection of groundwater would be managed by adopting non-dewatering techniques, in line with normal construction practice
- baseline surface water monitoring had already been undertaken for the proposed Sydney Gateway road project, which shares common catchments with the Botany Rail Duplication project (see section 3.2.1 in *Technical Report 8 – Surface Water Impact Assessment*)
- any long-term impacts are expected to be negligible relative to existing conditions.

Study area

Surface water quality impacts have been primarily assessed at two locations: Mill Stream and Alexandra Canal (see section 14.2.1), as these are the main surface water features that would receive surface water runoff from the project site. Existing surface flows to Mill Stream is from the southern portion of the project site via existing stormwater outlets and overland flow. Surface water from the northern portion of the project site currently flows to Alexandra Canal via the Upper Mascot open channel or the Sydney Airport stormwater drainage network via Northern Pond.

Groundwater impacts have primarily been assessed with respect to the Botany Sands Aquifer (see section 14.2.2), as this is the aquifer that is most likely to be intercepted by construction activities.

14.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with water quality and soils. Potential risks were considered according to the impacts that may be generated by the construction or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology, and the full results, is provided in Appendix B.

Risks with an assessed level of medium or above (prior to mitigation) include:

- reduced water quality (increased total suspended solids (TSS) and turbidity) due to earthworks and erosion and sedimentation near watercourses during construction
- impacts on water quality from contamination from spills and leaks during construction
- loss or degradation of soil quality and landform stability during earthworks
- increased erosion and sedimentation due to excavation activities and vehicle movement
- pollution of watercourses due to operation (freight materials, contaminants from train operation)
- increased potential for erosion and sedimentation due to vegetation removal and creation of embankments during operation of the project.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and identified by stakeholders (as described in Chapters 3 and 4).

14.1.4 How potential impacts have been avoided or minimised

As described in sections 6.1.2 and 7.1.2, design development and construction planning has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process. Potential water quality and soil impacts have been avoided or minimised where possible by:

- designing the Mill Stream bridge to avoid the need for instream structures
- optimising the design of the Mill Stream bridge to minimise upstream or downstream scour effects on the existing watercourse
- adopting construction techniques that avoid the need for dewatering of excavations and groundwater drawdown impacts, such as cast in situ techniques for any piling works.

14.2 Existing environment

14.2.1 Surface water

Surface water features

Figure 14.1 shows the location of surface water features within and surrounding the project site.

Surface water features north of the project site

Surface water from the northern 1.4 kilometres of the project site flows in a northwesterly direction to Alexandra Canal via the existing drainage network and the Upper Mascot Open Channel. Alexandra Canal is located within the lower reaches of the Cooks River catchment and is owned and operated by Sydney Water.

The Cooks River catchment covers an area of around 10,000 hectares in southeastern Sydney. The catchment is highly urbanised and has a history of intensive land use ranging from residential to heavy industry. Alexandra Canal was constructed through dredging and channelisation of a natural watercourse. It flows into the Cooks River near the northwestern corner of Sydney Airport before it flows into Botany Bay to the west of Sydney Airport. Alexandra Canal is tidally dominated through its connection to the Cooks River. It is around 3.9 kilometres long and 60 metres at its widest.

Surface water features south of the project site

Surface water from the southern 1.6 kilometres of the project site flows to Mill Stream, directly via overland flow or through existing drainage networks. The Mill Stream catchment is a sub catchment of the Botany Bay catchment. The Mill Stream catchment extends from Centennial Park in the north, to its outlet into Botany Bay in the south. Engine Pond and Mill Pond are located near the downstream (southwest) end of Mill Stream catchment. Mill Pond, Engine Pond and the Mill Stream are collectively known as the Sydney Airport Wetlands and are managed by Sydney Airport Corporation.

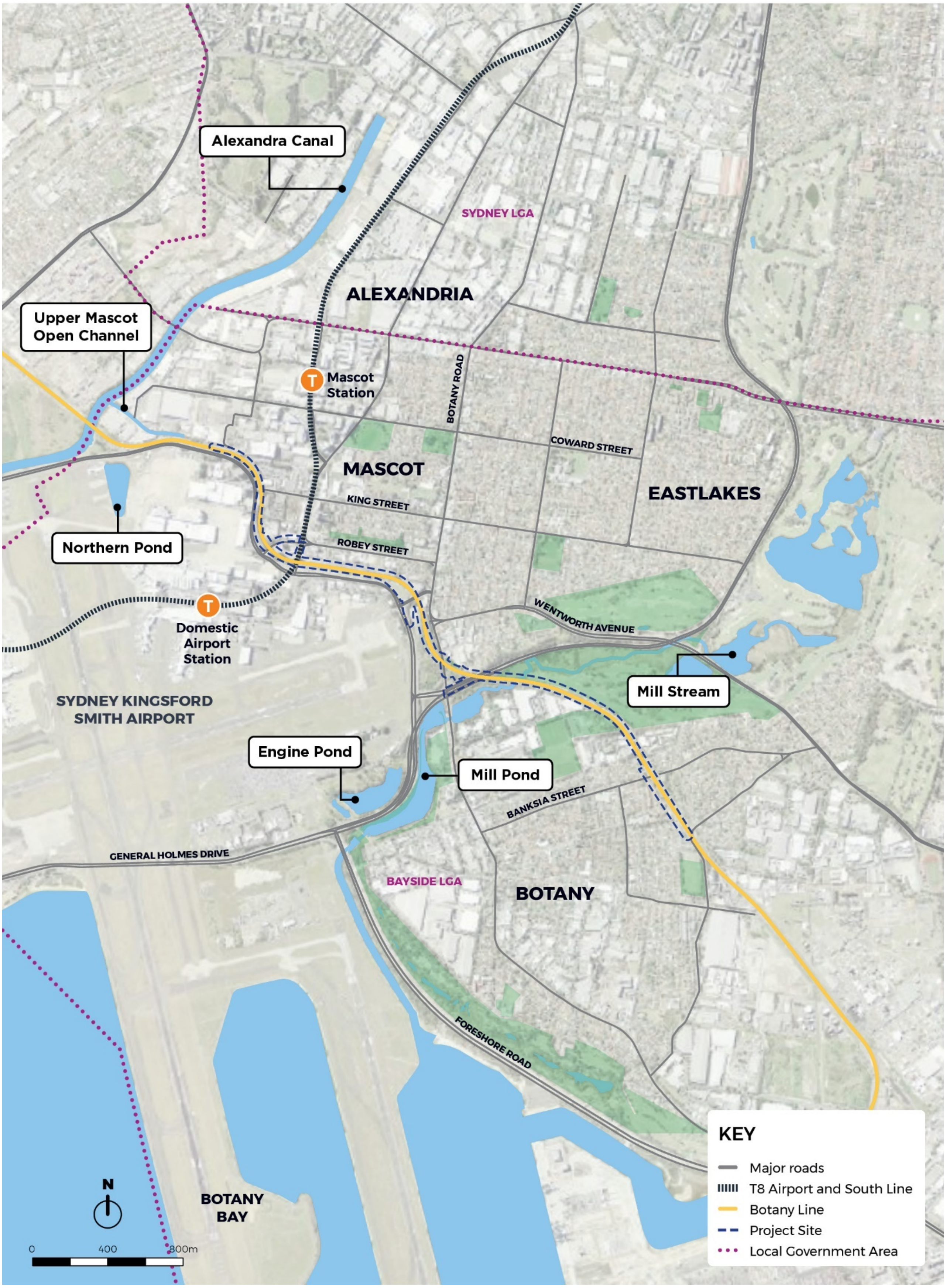


Figure 14.1 Surface water features in the vicinity of the project site

Existing surface water quality

The existing surface water quality within and surrounding the project site is relatively poor due to existing and historical land uses and activities in the area.

The Cooks River is one of the most degraded river systems in Australia, with stormwater identified as a key contributor to water quality and quantity problems. Surface water quality sampling points within the Cooks River and Alexandra Canal frequently exceed the adopted ANZECC (2000) guideline values (which align with the NSW WQOs (see section 14.1.1)) for sulfate, total dissolved solids, TSS, chloride, total nitrogen, aluminium, iron, manganese, zinc and ammonia. As such, the aquatic ecosystems in the Alexandra Canal are considered to be currently 'highly disturbed'. In 2004, the EPA issued a Remediation Order under the CLM Act with specific requirements for the sediments in the Alexandra Canal, citing:

"The bed sediments at the site have been found to be contaminated, in such a way as to present a significant risk to harm human health and the environment."

Surface water quality sampling points in Mill Stream also frequently exceed the adopted ANZECC (2000) guidelines for total nitrogen, aluminium, iron, manganese, zinc, ammonia and turbidity and the limits of accepted contamination specified in Schedule 2 of the Airports (Environment Protection) Regulations 1997.

In addition, PFAS compounds have been detected in surface water samples collected from the Cooks River, Alexandra Canal and Mill Pond. Some PFAS compounds have been globally identified as chemicals of high concern to human health and the environment, particularly due to their persistence and bioaccumulation (see section 2.1.6 in *Technical Report 5 – Contamination Assessment*).

Further information on the surface water quality results from sampling undertaken within and surrounding the project site is provided in section 4.7 in *Technical Report 8 – Surface Water Impact Assessment*.

Sensitive receiving environments

There are a number of sensitive receiving environments surrounding the project site including Mill Stream, Mill Pond, Engine Pond, Cooks River and Botany Bay.

Cooks River and Botany Bay are both identified as key fish habitats under the *Fisheries Management Act 1994.* Key fish habitats are aquatic habitats that are important for the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. Commercial fishing is prohibited in Botany Bay and Cooks River, however recreational fishing is not prohibited in or around Mill Stream or in the broader Botany Bay area.

The Botany Bay area provides summer habitat for a number of migratory wading birds that are listed under the EPBC Act, and the ponds may also be used on occasion by these species. In addition, Mill Pond, Engine Pond and Mill Stream are collectively known as the Sydney Airport Wetlands and are considered as environmentally significant areas under the *Sydney Airport Environment Strategy 2019–2024* (SACL 2019b).

14.2.2 Groundwater

Groundwater characteristics

There are two main groundwater systems beneath the project site:

- the Botany Sands aquifer, which is a shallow, unconfined and highly permeable aquifer with variable hydraulic conductivity
- the Hawkesbury Sandstone aquifer, which is a semi-confined, fractured and porous aquifer within the bedrock that extends across the Sydney Basin (see section 14.2.3).

The regional groundwater elevations generally follow the topography of the area, as groundwater is intercepted at higher elevations (up to 35 mAHD) in the northwest of the project site near Centennial Park, and at lower elevations (less than 5 mAHD) to the south of the project site near Botany Bay. Groundwater contours suggest that groundwater passing beneath the project site primarily flows southwest towards Botany Bay.

The Botany Sands aquifer primarily recharges through direct rainfall infiltration at the Centennial Parklands, Botany Wetlands and surrounding golf courses. Previous groundwater monitoring results from registered monitoring wells near the project site (see section 4.7.1 in *Technical Report 7 – Groundwater Impact Assessment*) suggests that the local groundwater elevations are generally stable, with little response to long-term climatic variations. The typical range of the local groundwater elevations is around 1–2 metres (see Figure 4.7 in *Technical Report 7 – Groundwater Impact Assessment*). Spikes in groundwater elevation levels are generally only observed in periods with above average rainfall.

The existing groundwater quality within the Botany Sands Aquifer is poor due to high levels of contamination including elevated concentrations of manganese, arsenic and PFAS exceeding the adopted water quality guidelines (see section 12.2.6 and section 4.14 in *Technical Report 7 – Groundwater Impact Assessment*).

Groundwater uses and restrictions

There are approximately 50 registered groundwater bores within a 500 metre radius of the project site. The majority of these bores are shallow (less than 15 metres in depth) and are screened within the Botany Sands aquifer. These bores are registered for domestic, irrigation, monitoring and commercial and industrial purposes.

However, as discussed in section 12.2.4, the NSW Government has implemented restrictions on groundwater extraction for parts of Botany, due to high levels of contamination in the Botany Sands aquifer. As a result, groundwater from the project site cannot be used for industrial or domestic purposes and can only be extracted for remediation, temporary construction dewatering, testing or monitoring purposes.

GDEs near the project site have also been identified based on a review of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* (NSW Government 2011b) and the BOM *Groundwater Dependent Ecosystems Atlas* (BOM 2018) (see section 11.2.1). This includes aquatic and terrestrial GDEs associated with the Botany Wetlands, which are located approximately one kilometre from the project site. Stands of Swamp Oak Forest native vegetation within the project site are also likely to be groundwater dependent, although are not currently mapped as GDEs.

14.2.3 Geology and soils

The 1:100,000 Sydney Region Geological Map (Geological Survey of NSW, 1983) states that the regional geology consists of Triassic Hawkesbury Sandstone and Ashfield Shale overlain by Quaternary sediments (unconsolidated sands with minor peat, silts and clays and hard iron-cemented layers known as waterloo rock). Bedrock is expected to be encountered within the project site between 10 and 15 mAHD. Figure 14.2 shows the geology within and surrounding the project site.

A thin layer of fill is present within the project site, as is commonly encountered in urban areas and associated with infrastructure and roadworks. Areas of thicker fill are present in landfill sites north of the project site comprising dredged estuarine sand and mud, demolition gravels and industrial and household waste. Sydney Airport located west of the project site has been constructed atop mixed Quaternary sediments and manmade fill.

Based on the Soil Landscapes of Sydney Sheet 9130 (Chapman and Murphy, 1989), the project site contains two soil landscapes – Aeolian Tuggerah (AEtg) to the east of the rail corridor, and Disturbed Terrain (DTX) extending across the airport to the west, along the Botany Wetlands, the lower reaches of the Cooks River and up Alexandra Canal to the north. Figure 14.3 shows the locations of the soil landscapes within and surrounding the project site.

There is a low probability of ASS occurrence within the project site, except for the area between Southern Cross Drive bridge to Mill Stream bridge (see section 12.2.2). ASS can result in acidic leachate when exposed to oxygen, which may affect water quality and lead to the death or disease of aquatic organisms.

Chapter 12 discusses the probability of soil salinity within the project site.

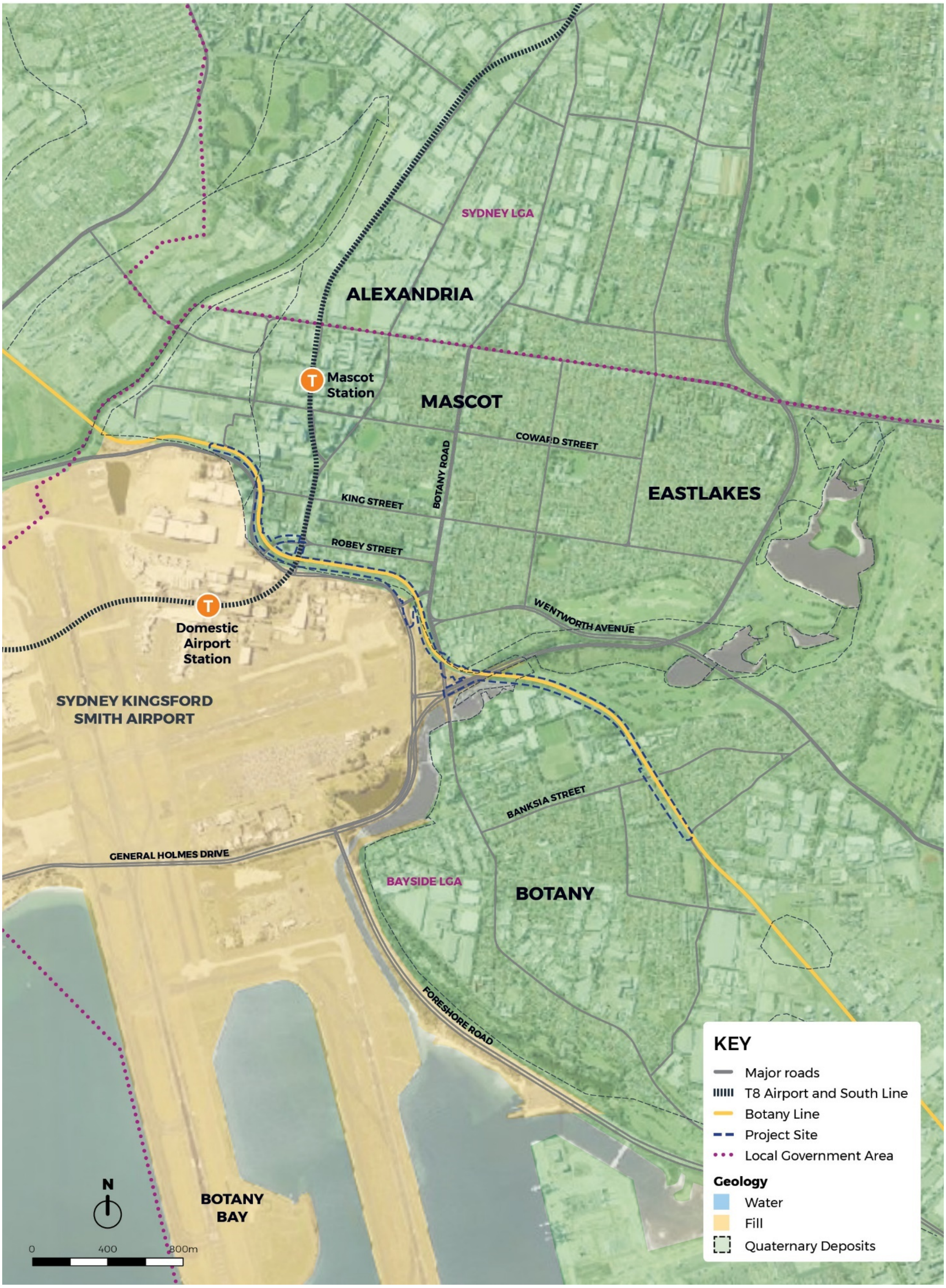


Figure 14.2 Geology within and surrounding the project site

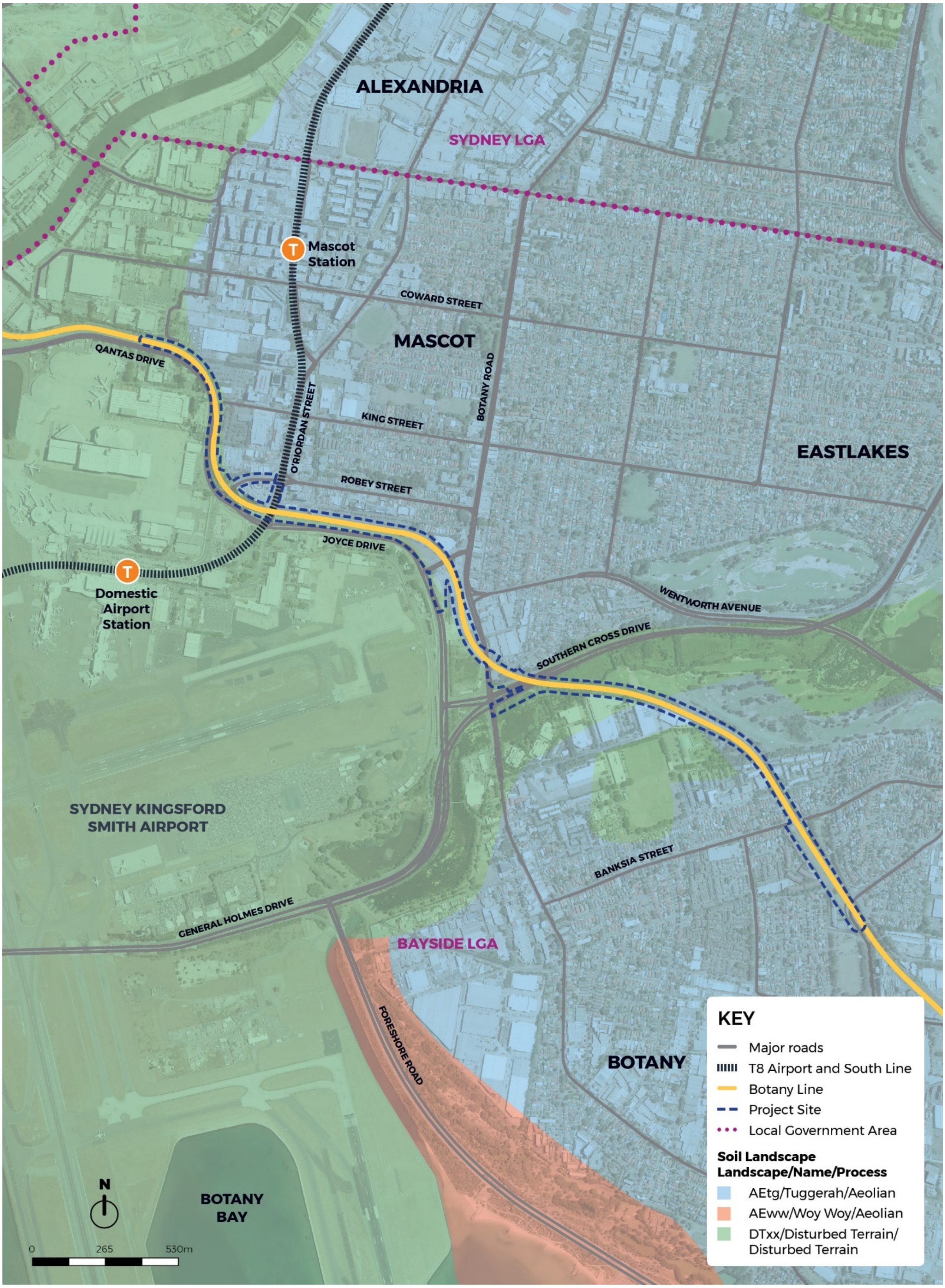


Figure 14.3 Soil classification within and surrounding the project site

14.3 Assessment of construction impacts

14.3.1 Surface water quality and soil impacts

Surface water quality and soil impacts are often interrelated, as soil erosion can result in sedimentation of waterways and increased water runoff can erode soil. Construction of the project has the potential to result in surface water quality and soil impacts from:

- use of water for construction activities including dust suppression and vehicle wash-down, which could result in runoff of polluted or sediment laden water
- vegetation clearing, earthworks and stockpiling of spoil, which would increase the amount of exposed soils that can be transported via runoff and/or erosion into surrounding waterways
- a temporary increase in impervious surfaces such as from the establishment of construction compounds, crane pads and parking areas, which would increase the volume and speed of runoff from the project site
- construction of drainage infrastructure, Mill Stream Bridge and retaining wall works, which could result in increased soil erosion and direct disturbance of waterway beds and banks
- inadequate containment of fuels and chemicals, which could result in spills or leaks of potentially contaminating materials into the surrounding environment
- litter from construction site and activities, which could be transported via runoff and/or erosion into surrounding waterways.

In addition, the project site includes several areas of known contaminated soil (see section 12.2.5), including PFAS, hydrocarbon, heavy metal and asbestos contamination. If this contaminated soil is disturbed during construction and not appropriately managed, it could be transported via wind or water into the surrounding waterways. ASS is also likely to be encountered in the area of the project site between Southern Cross Drive bridge to the Mill Stream Bridge (see section 12.3.1), which has the potential to result in acidic runoff into Mill Stream and Mill Pond.

As a result, if mitigation measures are not implemented during construction of the project, the surface waterbodies surrounding the project site may experience increased sedimentation, erosion, pollutants and contaminants, which could reduce the existing water quality and harm the aquatic ecosystems. However, these potential surface water impacts are likely to be temporary and minor, and minimised through the implementation of management and mitigation measures (see section 14.6). Additionally, no construction water discharges to local receiving waterways are proposed during construction of the project.

Moreover, as discussed in section 14.2.1, the surface water features surrounding the project site, including Cooks River, Alexandra Canal and Mill Stream, are already highly contaminated and frequently exceed the adopted ANZECC 2000 guidelines for water quality. Therefore, there would be negligible additional water quality impacts from construction of the project to those already affecting the surrounding waterways. As such, the construction of the project is unlikely to have an influence on whether the NSW WQOs are met at downstream receivers.

14.3.2 Groundwater impacts

Construction activities such as excavation and piling may intersect groundwater at isolated locations within the project site. However, this is only likely to occur during wet weather, as rainfall can recharge the Botany Sands aquifer and reduce the depth to groundwater beneath the site.

The types of groundwater impacts that may occur during construction of the project include:

- groundwater drawdown impacts, due to groundwater extraction and dewatering activities
- groundwater quality impacts, due to contaminants potentially being introduced into the groundwater.

No groundwater drawdown impacts are expected as a result of construction activities, as no significant groundwater extraction or dewatering of excavations are proposed. This is because construction techniques that do not require groundwater dewatering systems would be adopted for the project, such as cast in situ techniques for the bridge piling works. Incidental and very localised displacement of groundwater for bridge and retaining piling works are expected to occur but this would not result in groundwater drawdown. As a result, groundwater drawdown impacts are expected to be negligible.

During construction, intersection of groundwater may result in groundwater quality impacts by exposing the aquifer to new contaminants. This could impact the beneficial use potential of the groundwater at down-gradient industrial water supply wells. However, with implementation of the management and mitigation measures recommended in section 14.6.2, including the proposed groundwater monitoring program, the potential for adverse impacts under the AIP criteria is low. In addition, the Botany Sands Aquifer has high levels of existing contamination (see section 14.4.2), and therefore any additional groundwater quality impacts from construction of the project are expected to be negligible.

14.4 Assessment of operational impacts

14.4.1 Surface water quality and soil impacts

The project is located within an existing operational rail corridor. Surface water quality and soil impacts within and surrounding the project site may occur during operation as a result of:

- formation failure, which can result in increased pollutant, sediment load or organic matter entering waterways
- rail accidents, use of grease pots and friction modifiers and/or poor maintenance of equipment resulting in accidental spills or leaks of chemicals, oils and fuels, which can cause contamination of soil and waterways
- runoff from the rail corridor, which can result in soil contaminants entering the surrounding waterways.

These events represent potential sources of pollution that could flow into the waterways surrounding the site, including Mill Stream or Alexandra Canal. However, the operation of the project would involve similar maintenance and rail activities within the project site to the existing scenario. It would also not result in any substantial change to the existing surface water catchment areas, so any increase in flow volumes are expected to be minimal. Additionally, runoff from rail tracks is typically filtered by rocks and other material in the ballast, reducing the potential for pollutants to be transported beyond the rail corridor. Therefore, the operation of the project is not expected to result in additional surface water quality and soil impacts within and surrounding the project site.

However, the operation of the project may slightly increase the magnitude or frequency of the existing surface water quality and soil impacts. This would be due to the additional train movements within the project site, which would slightly increase the potential for spills or leaks, and the increased impervious surface area from the duplication of the rail track and new capping material, which would result in a minor increase in the runoff from the rail corridor. These potential impacts are expected to be negligible compared to the existing water quality impacts on Alexandra Canal and Mill Stream from current and historical land uses and activities, and would be minimised through the implementation of mitigation measures (see section 14.6.2).

As a result, the project would result in a negligible change in the quantity of pollutants in surrounding waterways and would have limited ability to influence the water quality at downstream receivers. Therefore, it is expected that where the NSW WQOs are currently being met, they would continue to be protected. However, the project is unlikely to result in the achievement of the NSW WQOs where they are not currently being met, such as at Mill Stream and Alexandra Canal (see section 14.2.1).

The overall track drainage system would continue to drain to existing drainage systems surrounding the project. At Mill Stream, there would be a new drainage pipe and headwall that would either replace or supplement the existing 1200 millimetre diameter drainage pipe and headwall. All cess drainage and final outfalls that are installed or modified as part of the project would have appropriate scour protection. Therefore, operation of the project would not result in any notable change to the existing hydrological behaviour of the catchments surrounding the project.

14.4.2 Groundwater impacts

During operation, groundwater quality impacts may result from infiltration of contaminants due to spills or leaks. However, the existing Botany Sands aquifer is also already highly contaminated and the occurrence of spills and leaks is expected to be low. The upgraded drainage system and reduced permeability across the site would further minimise the potential for infiltration of contaminants to groundwater. Therefore, the operation of the project would result in negligible groundwater quality impacts.

The project would increase the impervious surface area within the project site, which would slightly reduce rainfall infiltration and therefore groundwater recharge within the project site. However, any minor decreases in recharge within the project site are expected to be negligible compared to the overall recharge volumes, as the majority of groundwater recharge for the Botany Sands aquifer occurs at the Centennial Parklands, Botany Wetlands and surrounding golf courses. Therefore, groundwater recharge impacts during operation of the project are expected to be negligible and have no measurable effect on groundwater elevations.

There may be permanent intersection of groundwater by new infrastructure from the project (such as bridge piles), however the depth of this infrastructure would be minor relative to overall aquifer thickness. Therefore, there would be no change to groundwater elevations from subsurface barriers.

14.5 Cumulative impacts

14.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to water quality and soil are described below.

14.5.2 Cumulative construction impacts

Simultaneous construction of the Botany Rail Duplication, the Sydney Gateway road project and Airport East upgrade works has the potential to result in cumulative surface water quality impacts on Alexandra Canal and Mill Stream including increased sedimentation and potential for contaminated runoff. However, these cumulative water quality impacts would be temporary and minor, and minimised through standard construction management and mitigation measures.

Construction of other major developments within the Cooks River and Georges River catchments (such as the WestConnex M4-M5 Link, WestConnex New M5, Sydney Metro City & Southwest and Airport North projects) may also have cumulative impacts on water quality in the receiving waterways surrounding the project site. Increases in impervious area during construction and operation of other major projects may contribute to the volume and pollutant loading of surface runoff in the area. However, if mitigation requirements are applied consistently across projects, no adverse cumulative surface water impacts are anticipated. As such, the residual risk to the environment from cumulative surface water quality impacts is expected to be low.

No cumulative groundwater impacts are expected to occur, due to the negligible adverse groundwater impacts expected during construction of the project.

14.5.3 Cumulative operational impacts

The surface water and soil impacts during operation of the Botany Rail Duplication project are expected to be similar to the existing conditions. Therefore, no cumulative impacts are expected.

No cumulative groundwater impacts are expected to occur, due to the negligible adverse groundwater impacts expected during operation of the project.

14.6 Management of impacts

14.6.1 Approach

A Soil and Water Management Plan (SWMP) would be developed to manage all soil and water risks during construction of the project and included as part of the CEMP. The SWMP would be prepared in accordance with the Blue Book (Landcom, 2004) and include:

- water quality objectives for the project as outlined in Appendix C of *Technical Report 8 – Surface Water Impact Assessment*
- an erosion and sediment control plan that allows for site-specific erosion and sediment controls at all work sites. Physical controls may include sediment fences and basins, containment bunds, silt traps, turbidity barriers and diversions, dust suppression and earth compaction around stockpiles and earthworks area
- specific plans required to address identified contamination risks including an AMP and ASSMP (see section 12.6).

It is noted that there is no sediment storage capacity currently included in the construction phase design, as there is limited space within the rail corridor and project site. Physical constraints immediately adjacent to the project site also limits the ability to provide on-site sediment storage. As such, all controls would be designed to minimise the on-site erosion risk and maintain the annual sediment export rate to below 150 cubic metres of sediment at each outlet, to avoid the need for sediment basins (Landcom, 2004).

While discharge is not currently proposed during construction, in the event that the contractor determines through its construction planning that this may be necessary, a discharge impact assessment and discharge management plan would be developed. This would detail the relevant mitigation measures and monitoring program required, specific to the discharge activities proposed.

Further details on the overall approach to management of impacts is provided in Chapter 24.

14.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential water quality and soil impacts are listed in Table 14.1. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works. As discussed in section 14.6.3, additional contamination specific mitigation measures may also minimise water quality and soil impacts.

Table 14.1 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Design	Formation failure	The formations and integrated drainage will be designed to prevent formation failure. This would include designing the longitudinal drainage to direct surface water runoff away from formations.	N/A – Design phase	N/A – Design phase
	Soil erosion	Batter slope gradients, surface treatments and the construction program will be designed to minimise erosion risk so the annual sediment export rate is below 150 cubic metres at each outlet to avoid the need for sediment basins in accordance with the Blue Book.	N/A – Design phase	N/A – Design phase
	Use of water during construction	Requirements for construction water (volumes, quality, demand curves, approvals requirements and lead times) will be defined during detailed design.	N/A – Design phase	N/A – Design phase
	Potential scour and erosion impacts	Suitably designed scour and erosion control measures will be included in the detailed design where required, including at the Mill Stream drainage outlets.	N/A – Design phase	N/A – Design phase
		The detailed design of Mill Stream bridge will be optimised to minimise upstream or downstream scour effects on the existing watercourse.	N/A – Design phase	N/A – Design phase
	Groundwater impacts	A baseline groundwater monitoring program will be implemented to characterise baseline groundwater conditions as per Chapter 8 of *Technical Report 7 – Groundwater Impact Assessment*.	N/A – Design phase	N/A – Design phase
Construction	Spills and leaks causing soil or water contamination	Procedures to store, handle and use materials and equipment appropriately to prevent spills and leaks will be included in the SWMP.		✓
		Leakage of fuels, oils, chemicals and other hazardous liquids will be immediately cleaned up in accordance with the Safety Data Sheet and relevant emergency response procedures.	✓	✓
		Adequately stocked spill kits will be readily accessible to site personnel during all refuelling activities.	✓	✓
		Construction plant and equipment will be regularly inspected and maintained to prevent leaks.	✓	✓
		All potentially contaminating substances will be stored in secure, bunded and impervious locations away from surface water features and outside of the extent of the 20 year ARI design flood wherever practicable.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
		Impervious and bunded areas will be established for the on-site maintenance of construction plant and equipment.	✓	✓
	Erosion and sediment impacts	The area of exposed soils within the project site will be minimised through staging vegetation clearing and ground disturbing works across the project site. Disturbed areas and all long-term stockpiles will be protected or stabilised during periods of inactivity. Areas disturbed by construction activities will be rehabilitated and restored as soon as possible after completion of works in the area.	✓	✓
		Where feasible, construction activities will be scheduled to avoid ground disturbance works or in-stream works during periods of heavy or prolonged rainfall.	✓	✓
		Protect stockpiles of loose material from erosion due to rain and wind.	✓	✓
		Erosion and sediment control measures will be implemented prior to soil disturbance in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and included in the SWMP. Erosion and sediment controls throughout the project site will be regularly inspected and maintained.	✓	✓
		Remove all material from the site as soon as practical at the completion of work.	✓	✓
		Specific measures and procedures for works within waterways, such as the use of silt barriers will be implemented where necessary.		✓
		Instruct site workers on the need to prevent materials from washing or blowing into the stormwater system.	✓	✓
		Infiltration trenches will be installed to allow for potentially contaminated water to be collected and infiltrated back into groundwater rather than flowing to surface water.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Groundwater and surface water impacts during construction	A groundwater construction monitoring program will be prepared and implemented as per Chapter 8 of *Technical Report 7 – Groundwater Impact Assessment*. This monitoring program will verify the effectiveness of construction activities at preventing changes in the beneficial use potential of the aquifer system. A surface water quality monitoring program will be prepared and implemented for specific construction works (see section 6.2.3 of *Technical Report 8 Surface Water Impact Assessment*).		✓
	Litter polluting waterways	Bins will be provided on-site for litter. All general litter and waste collected on-site will be transported off-site to an appropriate waste facility.	✓	✓
Operation	Formation failure	Regular inspections of formation and any necessary repairs will be undertaken in accordance with ARTC's Safety Management System procedures.	N/A – Operation	N/A – Operation
	Water or soil impacts from maintenance works	The existing ARTC Standard Environmental Management Measures (under the Environment Management System) will be implemented to manage impacts from maintenance works, including potential litter.	N/A – Operation	N/A – Operation

14.6.3 Consideration of the interaction between measures

In addition to the measures for water quality and soil described above, there are interactions between the mitigation measures for biodiversity (Chapter 11), contamination (Chapter 12), hydrology and flooding (Chapter 13) and resources and waste management (Chapter 20), which would also help to minimise impacts on water quality and soil from the project.

All mitigation measures for the project are consolidated in Chapter 25 to ensure consistency in implementation.

14.6.4 Managing residual impacts

A residual risk analysis was undertaken taking into account the impact assessment summarised in this chapter and implementation of the mitigation measures as recommended in section 14.6.2. The results of the residual risk analysis are provided in Appendix B. Residual risks with an assessed level of medium or above include:

- increased erosion and sedimentation due to excavation activities and vehicle movement.

The reduction in risk levels are primarily due to the implementation of the erosion and sediment control measures and the SWMP during construction and ARTC Standard Environmental Management Measures during operation.

15. NON-ABORIGINAL HERITAGE

This chapter provides a summary of the non-Aboriginal heritage impact assessment undertaken by Artefact Heritage. A copy of the full assessment report is provided as *Technical Report 9 – Statement of Heritage Impact*.

15.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in *Technical Report 9 – Statement of Heritage Impact.*

15.1.1 Legislative and policy context to the assessment

National and commonwealth legislation

Airports Act 1996 and associated regulations

The Airports Act (and associated regulations) provides statutory controls for ongoing regulation of development activities on Commonwealth-owned land leased from the Australian Government for the operation of Sydney Airport.

As the project would require temporary use of Commonwealth owned land during the construction phase, an assessment of the consistency of the project with the Airports Act, associated Sydney Airport Master Plan 2039 and Sydney Airport Environment Strategy 2019-2093 is required.

Sydney Airport Master Plan 2039

As part of the planning framework established by the Airports Act, airport operators are required to prepare a master plan for the coordinated development of their airport.

The *Sydney Airport Master Plan 2039* (SACL 2019a) includes the following relevant heritage initiatives:

- conserve the significant places of the airport, in line with the Heritage Management Plan
- actively conserve heritage elements listed as Environmentally Significant under the Airports Act
- deliver and continually build upon the online experience centre, to tell the history of the airport site, detail its significance and its aviation history
- integrate heritage interpretation devices into new and existing Sydney Airport facilities through delivery of an interpretation strategy
- ensure that heritage items of recognised significance are recorded to an appropriate archival standard
- establish an archive of historical records of the history of Sydney Airport and the site
- implement the management plan for the fig trees and the Sydney Airport Wetlands, located in the South East Sector.

This assessment was completed in accordance with the objectives outlined in section 2.3 of the Sydney Airport Master Plan 2039, to ensure heritage items are appropriately considered and managed.

Sydney Airport Environmental Strategy 2019–2039

The Airports Act requires that airport operators provide an assessment of the environmental issues associated with implementing the airport master plan and the plan for dealing with those issues. This is documented in an environment strategy that forms part of the airport's master plan. The Sydney Airport Environment Strategy (SACL 2019b) stipulates that heritage must be appropriately considered and managed.

Technical Report 9 – Statement of Heritage Impact has been prepared in accordance with this requirement.

Airports (Environmental Protection) Regulations 1997

The objective of *the Airports (Environmental Protection) Regulations 1997* (the regulations) is to establish a system of regulation for activities at airports that generate or have potential to generate pollution or excessive noise. The regulations impose a general duty to prevent or minimise environmental pollution and have as one of their objects the promotion of improved environmental management practices at Commonwealth-leased airports.

Under Part 4 of the regulation, the operator of an undertaking must ensure that there are no adverse consequences for existing aesthetic, cultural, historical, social and scientific (including archaeological and anthropological) values of the local area.

The project would require the temporary use of Commonwealth owned land during the construction phase, therefore the provisions of the regulation apply to the project.

Environmental Protection and Biodiversity Conservation Act 1999

The (EPBC Act provides a legislative framework for the protection and management of matters of national environmental significance, including flora, fauna, ecological communities and heritage places of national and international importance. Heritage items are protected through their inscription on the World Heritage List, CHL or the NHL.

Under Part 9 of the EPBC Act, approval under the EPBC Act is required for any action occurring within, or outside, a Heritage place that has, will have, or is likely to have a 'significant impact' on the heritage values of a World, National or Commonwealth heritage listed property (referred to as a 'controlled action' under the Act). A summary of heritage listings within the study area is included in section 15.2.2 and briefly summarised below:

- *World Heritage Listing* – There are no heritage items listed on the World Heritage List within or in a 100 metre buffer zone of the project site.
- *Commonwealth Heritage List* – The curtilage of one item listed as an indicative place on the CHL (Sydney (Kingsford Smith) Airport Group) is located within the project site. Indicative places have not been formally nominated for the CHL, rather their date has been provided to, or obtained by the Heritage branch and entered into the Australian Heritage Database.
- *National Heritage List* – There are no heritage items listed on the NHL located within the study area or the 100-metre buffer zone of the project site.
- *National Trust of Australian (NSW*) – There are no heritage items listed on the NHL located within the study area or the 100 metre buffer zone.

As the project would not have a significant impact any heritage items include in the above listings, EPBC approval is not required.

State and local legislation

Environmental Planning and Assessment Act 1979

The EP&A Act establishes a framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act requires that all environmental impacts are considered prior to land development, including impacts on cultural heritage items and places as well as archaeological sites and deposits. The EP&A Act also requires that Local Governments prepare planning instruments (such as LEPs and policies such as Development Control Plans) in accordance with the EP&A Act to provide guidance on the level of environmental assessment required.

The project is being assessed as an SSI development (SSI 18_9714) under Part 5, Section 5.2 of the EP&A Act.

Heritage Act 1977

The Heritage Act is the primary piece of State legislation affording protection to heritage items (natural and cultural) in New South Wales. Under the Heritage Act, 'items of environmental heritage' include places, buildings, works, relics, moveable objects and precincts identified as significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. State significant items can be listed on the NSW State Heritage Register (SHR) and are given automatic protection under the Heritage Act against any activities that may damage an item or affect its heritage significance. The Heritage Act also protects 'relics', which can include archaeological material, features and deposits.

The project is being assessed as SSI under Division 5.2 of the EP&A Act. Under section 5.23 of the EP&A Act, an approval under Part 4 of the Heritage Act 1977 is not required.

State Heritage Register

The SHR was established under Section 22 of the Heritage Act and is a list of places and objects of particular importance to the people of NSW, including archaeological sites. The SHR is administered by the NSW Department of Premier and Cabinet (formerly NSW Heritage Division of the OEH) and includes a diverse range of over 1,500 items, in both private and public ownership. To be listed, an item must be deemed to be of heritage significance for the whole of NSW.

No heritage items listed in the SHR are located within the project site, however one item is listed within a 100-metre buffer of the project site (see section 15.2.2).

Section 170 Registers

The Heritage Act requires all government agencies to identify and manage heritage assets in their ownership and control. Under Section 170 of the Heritage Act, government instrumentalities must establish and keep a register which includes all items of environmental heritage listed on the SHR, an environmental planning instrument or which may be subject to an interim heritage order that are owned, occupied or managed by that government body.

Section 170 registered heritage items are located within the project site (see section 15.2.2).

Botany Bay LEP 2013

The Botany Bay LEP 2013 (City of Botany Bay, 2013a) applies to all land within the Botany Bay LGA, excluding some industrial zoned areas such as those covered by the State Environmental Planning Policy (Three Ports) 2013 and individual addresses in Mascot and one in Botany.

Heritage items listed under Schedule 5 of the Botany Bay LEP are located within, partially within or within 100 metres of the project site (see section 15.2.2).

Other relevant guidelines

The assessment of potential heritage impacts was also undertaken with reference to the following guidelines:

- *Statements of Heritage Impact 2002, NSW Heritage Manual 2002* (NSW Heritage Office)
- A*ssessing Significance for Historical Archaeological Sites and Relics 2009* (Heritage Branch, Dept. of Planning)
- *Burra Charter* 2013 (Australia ICOMOS)
- *Criteria for the assessment of excavation directors* (NSW Heritage Council, 2011).

A detailed description of the legislative and policy context for the assessment is provided in Chapter 2 of *Technical Report 9 – Statement of Heritage Impact.*

15.1.2 Methodology

Key tasks

The assessment of potential non-Aboriginal heritage impacts involved:

- reviewing the following heritage databases to identify whether any listed heritage items are located in the vicinity of the project site:
  - NSW State Heritage Register
  - Botany Bay Local Environmental Plan 2013
  - Heritage Conservation Development Control Plan No.37
  - Roads and Maritime s170 Register
  - Sydney Water s170 Register
  - RailCorp s170 Register
  - ARTC s170 Register
  - NSW Fire Brigade s170 Register
  - Ausgrid170 Register
  - National Heritage List
  - Commonwealth Heritage List
  - Register of the National Estate
  - National Trust Register (NSW)
  - Australian Heritage Database
  - NSW State Heritage Inventory (SHI)
  - State Heritage Register (SHR)
  - Sydney Airport Heritage Management Plan, 2009
- a review of historical research including available literature
- a review of the project description and plans
- a field survey and photographic inventory completed on 18 July 2018
- completion of a significance assessment to determine the heritage significance of items, landscapes or archaeological remains
- assessment of the potential impacts of the project, and preparation of a historical heritage impact statement, in accordance with the guidelines listed above.

A detailed description of the assessment methodology is provided in Chapter 2 of *Technical Report 9 – Statement of Heritage Impact*.

Study area

For the purpose of the non-Aboriginal heritage assessment, the study area was defined as a 100-metre buffer around the project site. The area within the project site has been divided into three sections (western, central and eastern extents) (see Figure 15.3). This chapter differentiates between the project site and the 100-metre buffer (study area) throughout.

15.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential non-Aboriginal heritage risks. Potential risks were considered according to the impacts that may be generated by the construction or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology and the full results, is provided in Appendix B.

The assessed risk prior to mitigation associated with potential non-Aboriginal heritage impacts (with a rating of medium or above) were:

- High risk:
  - impacts on listed heritage items or items with heritage values due to demolition, altered historical arrangements and access, visual amenity, landscape and vistas and curtilage.
- Medium risk:
  - damage to heritage items from vibration during construction or operation
  - disturbance of unknown or unidentified items or places of non-Aboriginal heritage significance.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and stakeholders (as described in Chapters 3 and 4).

15.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning for the project has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process. Direct impacts on known non-Aboriginal heritage impacts have been avoided or minimised where possible by providing the second track within the existing rail corridor (where possible) in order to minimise potential impacts on known heritage items adjacent to the rail corridor.

15.2 Existing environment

15.2.1 Historical context

European occupation of the project area can be broken into five phases of European occupation.

Phase 1 – Early occupation and industry (circa 1809–1862)

During the early years of settlement, land within the study area consisted of marshy swamp land and sand banks dissected by streams and creeks associated with the Botany Wetlands and Sheas Creek. The earliest land grants ranging in size from 53 to 600 acres were given from 1810, including ex-convict Simeon Lord’s 600 acre allotment.

Botany's natural environment and the area's distance from the city attracted water reliant industries such as fishing, wool washing, and grain and wool mills, which were established from the early 1800s onwards. These were often built close to the water's edge, providing hydraulic power to power the mills and large bodies of water for washing and processing wool.

The earliest flour and wool mills in the area were established by Simeon Lord in 1815, in the southern portion of the study area. The mills ran until 1855, when land was resumed by the Government for the Botany Water Pumping Station which was established in 1858. Several buildings associated with the mills were situated along Mill Stream to the northeast and southwest of the study area.

In the 1830s the first market gardens were established around Botany and Mascot, with Botany becoming known as Sydney's 'backyard vegetable garden'. The majority of gardens were established between the Alexandra Canal and O'Riordan Street.

The sandy characteristics of the areas soil meant that 'night soils' collected from cesspits and earth closets across Sydney were often used as fertiliser. These cesspits were often used to discard general household waste, meaning early market gardens were likely to include deposits of 19^{th} century household rubbish. It is not known if any Chinese or European market gardens were located within the study area during this occupation phase.

The implementation of the *Noxious Industries Act 1848* pushed many of Sydney's industries out of the city limits and into Botany, Alexandria and Waterloo. The act resulted in significant land use changes in and around the study area, which was soon being heavily utilised for wool washing, meat works, candle works, leather tanning, paper making, soap making and boiling down works.

Phase 2 – Residential development, Botany Water Pumping Station and Botany Goods Line development (1858–1925)

Botany Water Pumping Station

In 1852, the Botany Wetlands were chosen as Sydney's third fresh water source. The scheme involved damming the wetlands and directing water downstream to a large pond and pumping station near the current Sydney Airport. A total of six dams were created, all of which remain within the landscape today and are shown in Figure 15.1. Although some modifications to the wetlands were required for the dams, Mill and Engine Ponds and have retained their original form. They therefore represent intact evidence of Lord's early industrial activities in the area.

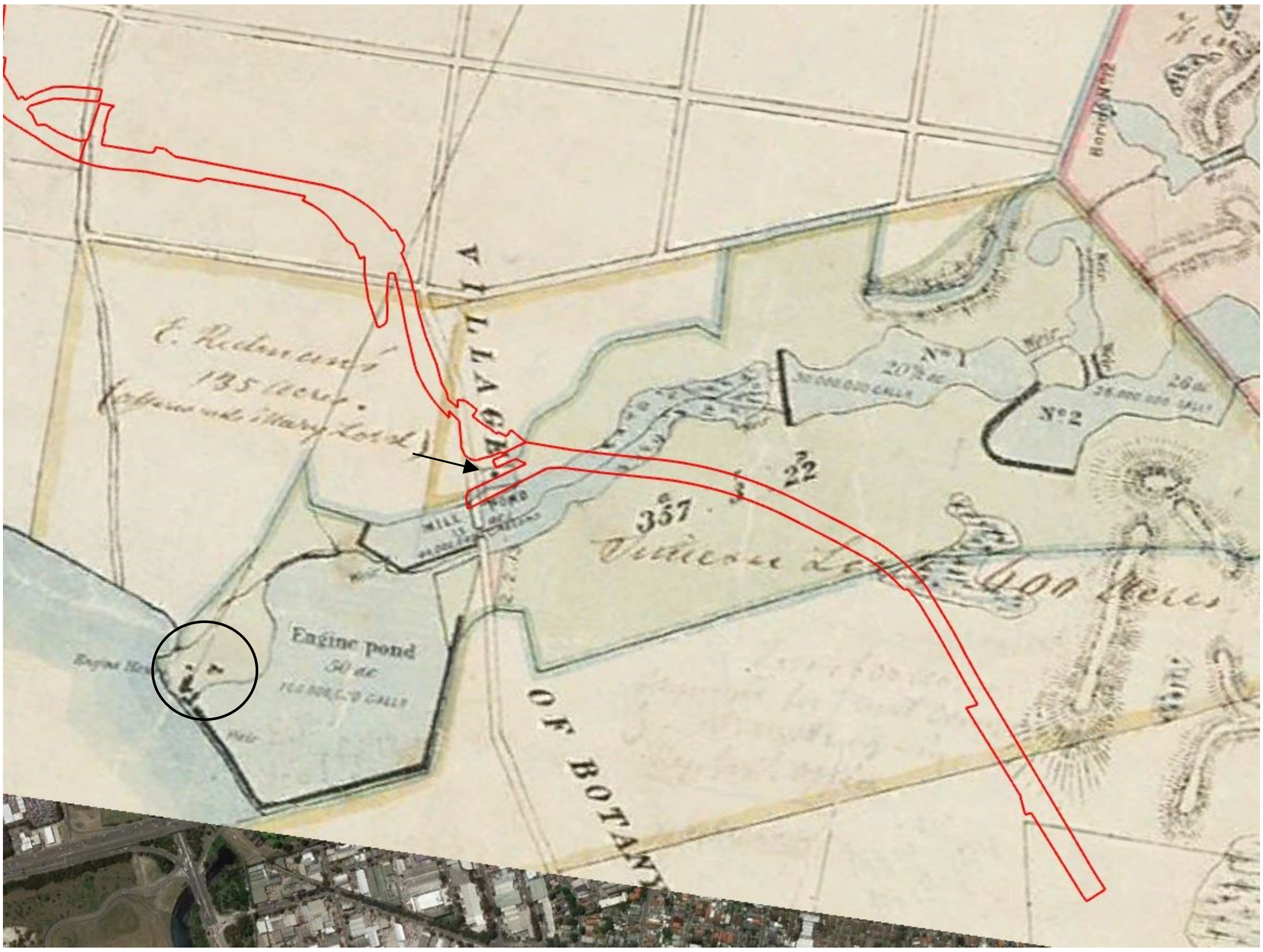
The scheme was successful for over a decade. However, by 1869 water within the wetland had become polluted and unreliable. The development of the Upper Nepean Scheme led to the decommissioning of the Botany Pumping Station in 1886. The end of the Botany Scheme was followed by a short industrial renaissance, with factories and wool washing establishments taking over land and waterways once again.

Market Gardens

The presence of early (Phase 1) market gardens in the study area cannot be confirmed. However evidence suggests the central portion of the study area between Botany Road and Robey Street was partially occupied by two market gardens.

Establishment of Municipalities

The implementation of the *Municipalities Act of 1867*, resulted in the formation of Botany, North Botany and West Botany municipalities. Later becoming the suburbs of Mascot (formerly North Botany), Rockdale (West Botany) and Botany. During this period, Botany Council invested themselves in beautifying and formalising the area through residential subdivisions, parks, sports fields and community buildings.



Source: State Library of NSW

Figure 15.1 1875 plan of the Botany and Lachlan Watersheds showing indicative location of dams in Simeon Lord's 600 acre allotment and the Engine House, just west of Engine Pond. There is one structure (indicated) reordered on the plan, north of Mill stream close to the study area

Botany Goods Line construction

The Botany Goods line, which is encompassed by the majority of the study area, was completed in 1925. The line followed Botany Road and was designed to carry goods from Sydney's western industrial sites to Port Botany.

Although partially constructed by 1915, it wasn't until an additional line linking Marrickville to Botany was completed in 1925 that the route was finally opened. The construction of all bridges, including the single line steel girder bridge over Botany Road, a reinforced concrete bridge over O'Riordan Street and a single wooden trestle bridge over mill pond, were completed by 1924. The O'Riordan Street Underbridge was the first reinforced concrete underbridge constructed in NSW.

The construction of the goods line also required the establishing of a railway embankment to the north of Mill Pond, in a water body referred to in the Botany Wetlands CMP as 'New Pond'. New Pond comprises two ponds formed by the construction of a weir along their southern extent and the c.1925 construction of the embankment for the goods line.

Phase 3 – Botany Goods Line, Sydney Airport and residential development (1925-1960)

Sydney Airport (Kingsford Smith Airport)

Sydney Airport was originally located immediately west of the study area with a small 400-acre cow paddock used as an aerodrome and leased to returned WWI service airmen Nigel Love, Harry Broadsmith and Jack Warneford by the Kensington Race Club in 1920. In 1921, an additional 161 acres was purchased by the Australian government for the construction of a formalised airport. The airport began serving regular flights in 1924 and contained three landing strips by 1938.

The advent of WWII required the airport to expand to nine times its original size. Following the war, it was once again enlarged, this time requiring the resumption of residential subdivisions, farmland, the Sydney sewage farm and two golf courses.

Botany Goods Line

Once the Botany Goods Line was complete, various private and government owned sidings were incorporated into the line to serve them. Those relevant to the study area included the Bayley and Sons siding, the Commonwealth and Hardies sidings and steel distributers, Stewart and Lloyds sidings.

Residential development

The development Sydney Airport and the Botany Rail Line encouraged scattered residential development around Botany and Mascot following the first and second world wars. After the 1940's large scale developments commenced, generally to the north east of the study area. Despite these changes, market gardens and associated structures continued to sit alongside medium density housing blocks.

Phase 4 – Post-War development (1960–2002)

Expansion of Sydney Airport, construction of Mill Pond Road and deviation of the Botany Goods Line (1955-1985) and Robey and O'Riordan Street Underbridge

In 1960, large scale expansions of Sydney Airport required that a portion of the goods line be deviated approximately 100 to 400 metres north of its original alignment between O'Riordan Street and the Alexandra Canal (located approximately 200 metres west of the study area) (Figure 15.2). This alignment represents the route of Botany Goods Line today. Prior to this, part of the line was located within what is now Sydney Airport land.

By 1965, Mill Pond Road had been established between Engine Pond and McBurney Avenue, where is continues to exist today (alongside Southern Cross Drive). Deviation of the line also required the construction of a new underbridge over Robey Street, which was the first welded steel railway bridge in the state. Although only one railway track was installed, an additional deck was provided in anticipation of any future duplication. The bridge and deck remain within the study area today.

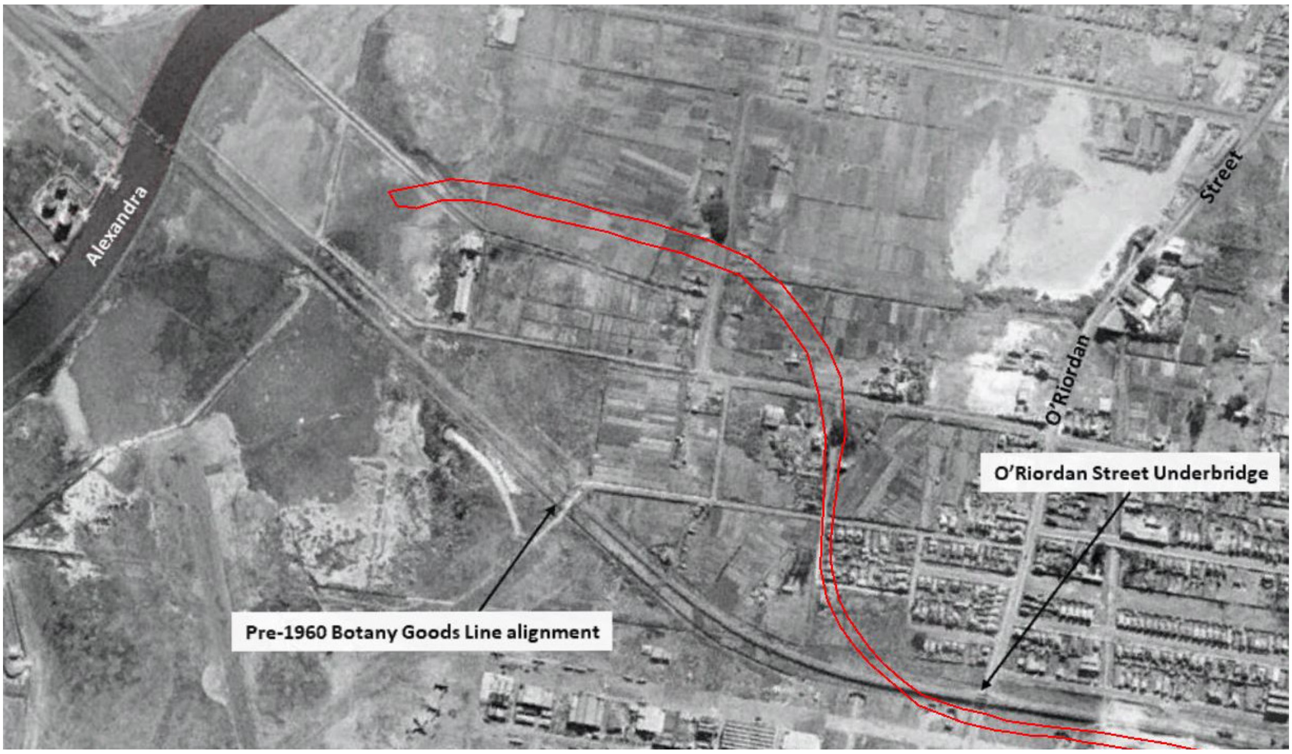


Figure 15.2 The original alignment of the Botany goods Line can be seen at the bottom of the image, prior to its deviation in 1960

Industrial sidings (1961)

In 1961 three sidings were incorporated into this new portion of the line to serve A.G. Sims Scrap Metal (which today goes by the name of Sims Metal Management), steel wholesalers J Murray Moore NSW Pty Ltd and Thomas Playfair (later known as the Australian Consolidated Glass siding). No evidence of these sidings is visible within the study area today.

Eastlake Golf Club (1960)

The Eastlake Golf Club was established to the east of the Botany Wetlands and north of the study area in 1960. Prior to this, the area comprised cleared grassy sand dunes and scattered residential development.

Southern Cross Drive and Mill Stream bridge construction (1985–1988)

Prior to 1988, road access to the city from Mascot and Botany was via Botany Road or O'Riordan Street. As the suburbs grew and airport expanded, various arterial roads were created to reduce traffic congestion and accommodate the changing shape of the area. One of these new arterial roads, Southern Cross Drive, is crossed by the study area just north of Engine and Mill Ponds. Plans for the extension of Southern Cross Drive between Wentworth Avenue to Foreshore Road began in 1984. In order to construct the road, a new concrete bridge was required for the goods line to cross Southern Cross Drive and continue onto Mascot. In order to accommodate these modifications, the c.1925 timber bridge over Mill Stream was removed and replaced with the existing concrete rail bridge.

Land now occupied by Southern Cross Drive and its associated underbridge previously comprised bare sand dunes to the west and low lying scrub to the east. The construction of Southern Cross Drive and the rail underbridge required extensive excavations and piling works to support the bridge and retaining walls on either side of the new road corridor.

Botany Operational Enhancement Project

An increase in container traffic to and from Port Botany in the 1990s and pre-Olympic Games upgrades to Sydney Airport in 1999 made it necessary to upgrade and duplicate portions of the Botany Goods Line. The majority of upgrade works took place outside of the study area, to the west.

However, re-signalling works, remote control of the line between Marrickville and Botany and duplication of the line between Botany and the Cooks River did occur. This may have resulted in some localised subsurface disturbance within the rail corridor (especially around General Holmes Drive) as well as the removal of obsolete railway infrastructure, signals and sidings. Evidence of these upgrades in the form of duplicated lines and modern concrete sleepers were identified along the western extent of the study area during the site inspection.

Phase 5 – Contemporary management and use of the Botany Goods Line (2002–present)

In July 2012, the ARTC and Transport for NSW signed an agreement transferring management and operation of Sydney's Metropolitan Freight Network (MFN) to ARTC until 2064. Under this agreement, management of the Robey Street Underbridge and O'Riordan Street Underbridge was transferred to ARTC. The railway line remains in Sydney Trains ownership.

The WestConnex and Airport East projects have been ongoing since 2015. These works were designed to ease congestions along some of Sydney's busiest roads. As part of the works, a new rail bridge (RMS ID: B11701) was constructed over Wentworth Avenue for the Airport East Works. This involved the demolition of an original underpass associated with Botany Goods Line and diversion of the existing line to the west while the bridge was under construction. Construction of the bridge required 1,000 cubic metres of concrete and included a space for future duplication of the Botany Goods Line. The bridge was completed in June 2018.

15.2.2 Heritage listed items

Heritage listed items within the study area, including their location in relation to the project site are listed in Table 15.1.

Table 15.1 Heritage listed items within the study area

LISTED ITEM	SIGNIFICANCE	REGISTER	DISTANCE FROM THE PROJECT
Mascot (O'Riordan Street) Underbridge	Local	ARTC s170 Register SHI 4801830	Within the project site
Mascot (Robey Street) Underbridge	Local	ARTC s170 Register SHI 4801848	Within the project site
Railway Bridge over Botany Road/Mascot (Botany Road) Underbridge	Local	ARTC s170 Register SHI no. 4800248 Botany Bay LEP - I153	Within the project site
Sydney (Kingsford Smith) Airport Group	State	Commonwealth Heritage List (Indicative Place) Register of the National Estate (Interim List) ID – 102669 Botany Bay LEP	The heritage curtilage for this item is partially within the project site and within the study area.
Commonwealth Water Pumping Station and Sewerage Pumping Station	State	Botany LEP– I3	The heritage curtilage for the item is partially within the project site. However, the structures themselves are located one kilometre south, west of Engine Pond and outside the study area.
Ruins of the former Botany Pumping Station	Local	Botany Bay LEP– I68	The heritage curtilage for the item is partially within the project site. However, the ruins of the pumping station are located 500 metres south and outside of the study area.
Streetscape – Verge plantings of Canary Island Date Palms (Phoenix Canariensis)	Local	Botany Bay LEP– I65	Approximately 90 metres west of the project site and within the study area.
Booralee Park	Local	Botany Bay LEP– I61	Approximately 110 metres southwest of the project site and within the study area.
Botany Water Reserves (also known as Botany Wetlands or Botany Swamps)	Local	State Heritage Register (SHR) Sydney Water s170 register Botany Bay LEP RNE – 01317, 4570025, I2 and 17854	Approximately 1–10 metres north and south of the project site and within the study area.
Beckenham Memorial Church	Local	Botany Bay LEP– I61	Approximately 40 metres east of the project site and within the study area.

Heritage listed sites within the study area are shown in Figure 15.3.

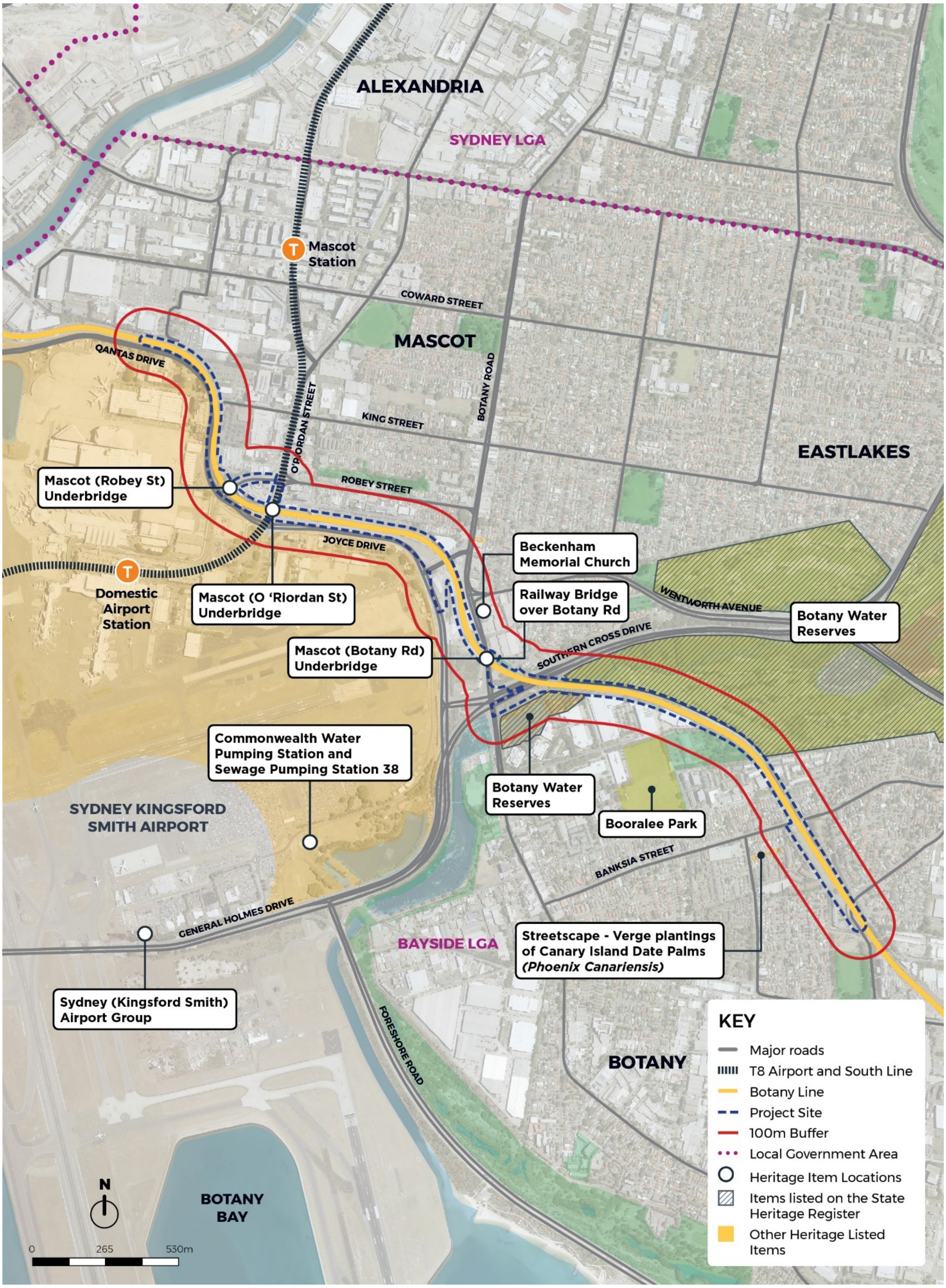


Figure 15.3 Heritage listed items within the study area

Assessment of significance

Assessment of potential impacts on non-Aboriginal heritage items first requires an understanding of the significance of each heritage item. Assessments of significance provide an understanding of why a heritage item is significant and help appropriately delineate the heritage curtilage. Many of the heritage items within the vicinity of the project already have statements of heritage significance prepared by public authorities, however based on research undertaken as part of the project, statements would be updated if required.

Summaries of the significance of individual non-Aboriginal heritage items within the study area are provided in Table 15.2. Detailed statements of significance are included in Chapter 6 of *Technical Report 9 – Statement of Heritage Impact*.

Table 15.2 Heritage listed items wholly or partially within the project site

ITEM	SUMMARY OF STATEMENT OF SIGNIFICANCE (OEH SHI, 2018c)
Mascot (O'Riordan Street) Underbridge	The original 1925 O'Riordan St Underbridge is considered significant as part of the original infrastructure of the Botany Line. Due to the high self-weight to load capacity ratio of conventionally reinforced concrete bridges their use was abandoned within the NSW rail network after few attempts. The underbridge is as a rare example of a reinforced concrete girder railway bridge construction within the NSW rail network. The 1982 additional span does not contribute to the underbridge's significance.
Mascot (Robey Street) Underbridge	The Robey Street Underbridge is of local significance as the first welded steel railway bridge on the NSW rail network. The success of the fabrication and service of the Robey Street Underbridge initiated the change over from riveted to welded steel construction, and bolts displaced rivets wherever non-welded joints were required. The bridge is a landmark structure over Robey Street; however, the significant fabric has been covered by signage, reducing its aesthetic quality.
Railway Bridge over Botany Road	The Mascot (Botany Road) Underbridge is historically significant as an integral component of the separate Botany Goods Line (1909–1925). The Goods Line is significant as part of the major Sydney goods railway expansion constructed in the early 20th Century to allow industry and shipping at Botany to be connected into the main network. The underbridge has aesthetic significance as a landmark structure over Botany Road with the brick arched piers and wing walls demonstrating fine workmanship. The bridge is unusual in its construction method, employing reinforced slabs and steel girders to accommodate the skew in the span across Botany Road.
Sydney (Kingsford Smith) Airport Group	The Kingsford Smith Airport Group is a complex cultural landscape that demonstrates strong historical, historic association, social, aesthetic and technological significance. It includes values associated with a contemporary airport as well as heritage values associated previous use of the area. The airport is also historically significant for its association with pioneers of the professional aviation industry. The airport landscape dominates the local area, and the airport is significant as the catalyst for, and provides evidence of, the significant changes it has brought to the wider Mascot and Botany areas since 1920. The Airport also demonstrates significant local heritage values that relate more directly to its influence on the course of Botany's physical, economic and social development, most notably as the catalyst for the transformation of the area from a cultural landscape dominated by noxious industries to acting as the hub for Sydney's transportation industry. Secondary businesses associated with the airport now dominate the industrial and commercial landscape of the area.

ITEM	SUMMARY OF STATEMENT OF SIGNIFICANCE (OEH SHI, 2018c)
Commonwealth Water Pumping Station and Sewerage Pumping Station No. 38	This pumping station was the first of an original group of low level Sewage Pumping Stations constructed to serve the SWOOS No.1 in 1916. It is a representative example of a simple, robust and well-proportioned Federation Free Style industrial building, the architectural expressions of which can be found in the structural detailing of the facade, superb brickwork, and roof forms. In addition, the mechanical components housed within the building have potential industrial archaeological value. Its architectural detailing makes a strong contribution to the visual catchment of the airport precinct and Botany area.
Ruins of the former Botany Pumping Station	The ruins of the Botany Pumping Station are part of a highly significant cultural landscape that remains clearly legible in its historic context despite its ruinous state and the development of the airport to the north over part of its original setting. The Pumping Station formed the centrepiece of the Botany Waterworks, and its operation facilitated the rapid expansion of Sydney's inner suburbs in the second half of the 19th century. The Waterworks is historically significant for its association with early local government authorities in NSW and its historical associated with early Colonial merchant and industrialist Simeon Lord and his attempt to secure exclusive water supply in perpetuity. The original buildings of the Waterworks are now in ruin, but the surviving footings and other fabric and the aesthetic qualities of its setting provide important and interpretable evidence. Its significance is enhanced by the survival of the series of dams and ponds that contained and supplied the water to the pumping system and which continue to provide evidence of the bountiful supply afforded by the underlying aquifer. The waterworks has had a significant impact on the course and pattern of the growth and development of the former Botany Bay area. The surviving fabric of the Waterworks (including the footings and evidence of earlier structures piled or buried in the vicinity) represents a significant archaeological deposit that has the potential to be of considerable research value for the evidence that it may provide of mid-19th century industrial structures or of the later use as a woolscour.
Botany Water Reserves	Botany Water Reserve holds considerable value for Sydney and NSW because it contains the only remaining major components of the unique water supply system that supported the expansion of the Sydney metropolis for most of the latter half of the 19th century, representing Sydney's third main water supply system since colonisation; and on account of the surviving remnants of the early 19th century industries associated with the prominent emancipist merchant Simeon Lord. Part of the original 1850s sand-cast iron water supply pipe remains within the site representing a remnant of the State's oldest main. The item is of regional environmental importance as a major recharge source for the Sydney basin aquifer. It likely holds special interest as a landmark cultural and recreational landscape for the regional community. It also has regional importance on account of the substantial infrastructure it contains of the 1910s Southern and Western Suburbs Ocean Outfall Sewer System (SWSOOS No 1) – since augmented during 1936-1941 by SWSOOS No 2 – representing one of the first major separate sewers in Sydney as well as incorporating new ventilation technologies. This infrastructure includes use of the former Engine House chimney as a sewer vent, the viaduct to carry the vent pipe, Sewage Pumping Station No 38 of 1916 near the Engine House ruins and part of the SWSOOS Nos 1 and 2 mains.

ITEM	SUMMARY OF STATEMENT OF SIGNIFICANCE (OEH SHI, 2018c)
Beckenham Memorial Church	The (former) Beckenham Uniting Church built in 1933 is of local heritage significance to the Bayside area as a fine example of a substantial Interwar church designed by significant ecclesiastical architect Arthur Layton-Clark with an unusual and distinctive radial floor plan. It has been a prominent element of the streetscape of Botany Road, and contributes significantly to the ecclesiastical precinct between Mascot and Botany. The Church is also likely to be of social heritage significance to its past and present congregations, the latter relocating to their sister church in King Street, Mascot as a result of the church's closure in 2015 following acquisition by the NSW State Government as part of the WestConnex road project.

15.2.3 Unlisted items of heritage significance

The Botany Rail Line comprises an approximately 9.2 kilometre long, single line freight corridor running from Marrickville Junction through to the wharves at Botany. The line has been upgraded and deviated over time and contains various sidings for surrounding industries. Some of these sidings have been removed to reflect changes in the occupancy and transport methods.

The Botany Rail Line has historic, associative, social, aesthetic, technical and representative significance at a local level due to its relationship with surrounding industrial development (past and present), the Metropolitan Goods Line network and the use of freight transport in NSW. The line is considered to contain research significance due to its ability to yield information regarding economic, industrial and residential growth and recession over time. In addition, the use of freight transport within areas of Sydney occupied by both residential, industrial, natural and aeronautical landscapes is becoming rare, thanks to the ongoing use of motor transport since the 1950s. A full assessment of the Botany Rail Line, and associated elements is included in section 6.3 of the *Technical Report 9 – Statement of Heritage Impact*.

15.2.4 Archaeological sites and potential

Based on the site inspection and an understanding of the historical and contemporary land use, predictions about the archaeological potential of the project site can be made. The assessment examines historical land use phases, as identified in section 15.2.1. The significance of any potential archaeological remains would inform recommendations for archaeological management throughout the project.

Table 15.3 Summary of potential archaeological remains

OCCUPATIONAL PHASE	ARCHAEOLOGICAL REMAINS	ASSESSED POTENTIAL
1 C1989–1858	**Eastern Extent** Evidence of landscape modifications and unrecorded structures associated with flour mill establishment in areas surrounding Mill Pond and south of Southern Cross Drive.	Low
	Central Extent Evidence of landscape modification, unrecorded structures and noxious industrial activities within small land grants given from 1809 onwards	Nil to low
	Western Extent Evidence of landscape modification, unrecorded structures and market gardens within small land grants given from 1809	Nil to low

OCCUPATIONAL PHASE	ARCHAEOLOGICAL REMAINS	ASSESSED POTENTIAL
2 1858–1925	**Eastern Extent** Evidence of landscape modification and unrecorded structures associated with the Botany Pumping Station in areas surrounding Mill Pond and south of Southern Cross Drive.	Nil to low
	Central Extent Evidence of landscape modification, market gardens and three structures north and south of General Holmes Drive	Market gardens and three structures to the north of General Holmes Drive – Low and moderate Remainder of central Extent – Nil to low
	Western Extent Evidence of market gardens and scattered residential development	Nil to low
3 1925–1960	**Eastern Extent** Evidence of landscape modification for the Botany Rail Line and former sidings	Moderate to High
	Central Extent Evidence of Phase 2 structures located to the north of Mill Pond and evidence of Botany Rail Line and associated sidings	Land within Southern Cross Drive – Nil Land outside Southern Cross Drive corridor – moderate to high
	Western Extent Evidence of market gardens, scattered residential development and industry along the Botany Rail Line and Robey Street	Moderate
4 1960–2002	**Eastern Extent** Evidence of former sidings	High
	Central Extent Evidence of Botany Rail Line and associated sidings	High
	Western Extent Evidence of market gardens, residential development and industry along the Botany Rail Line and Robey Street	Moderate to high
5 2002–Present	**Eastern Extent** Evidence of former sidings along the study area	High
	Central Extent Evidence of Botany Rail Line and associated sidings along the study area	High
	Western Extent Evidence of Botany Rail Line and associated sidings along the study area	High

If intact and recognisable, remains associated with Simeon Lord's industrial activities (Phase 1) such as landscape modifications and unrecorded structures were to survive in the study area, they would have historical, associative and social significance at a State level. They would also contain research potential for their ability to yield information regarding unrecorded landscape modification methods, the pre-European environment and extent of Lord's mill establishment. However the likelihood of such remains surviving in the study area is low.

The potential archaeological resource associated with **Phase 2** occupation would be associated with landscape modifications for the Botany Water Pumping Station, Chinese market gardens, early residential development and construction of the Botany Rail Line. If intact and recognisable remains were uncovered they would have historical, associative and social significance at a local level. They would also contain research potential for their ability to yield information regarding rare and early residential and agricultural activities in the Botany and Mascot area.

The potential archaeological resource associated with **Phase 3** occupation is associated with ongoing use of the Botany Line, evidence of residential occupation and the continued use of Mascot for market gardening. These remains would have historical and social significance at a local level. However, they would represent common forms of infrastructure and land use during this period and are unlikely to contain research potential. Therefore, they would not reach the threshold for local or State significance under the NSW Heritage Criteria.

Potential archaeological remains associated with **Phases 4** and **5** would not meet the threshold for local or State significance. This is primarily due to their common presence and lack of archaeological research potential (see section 7.1.2 in *Technical Report 9 – Statement of Heritage Impact*).

The locations of archaeological potential and significance within the study area are shown on Figure 15.4.

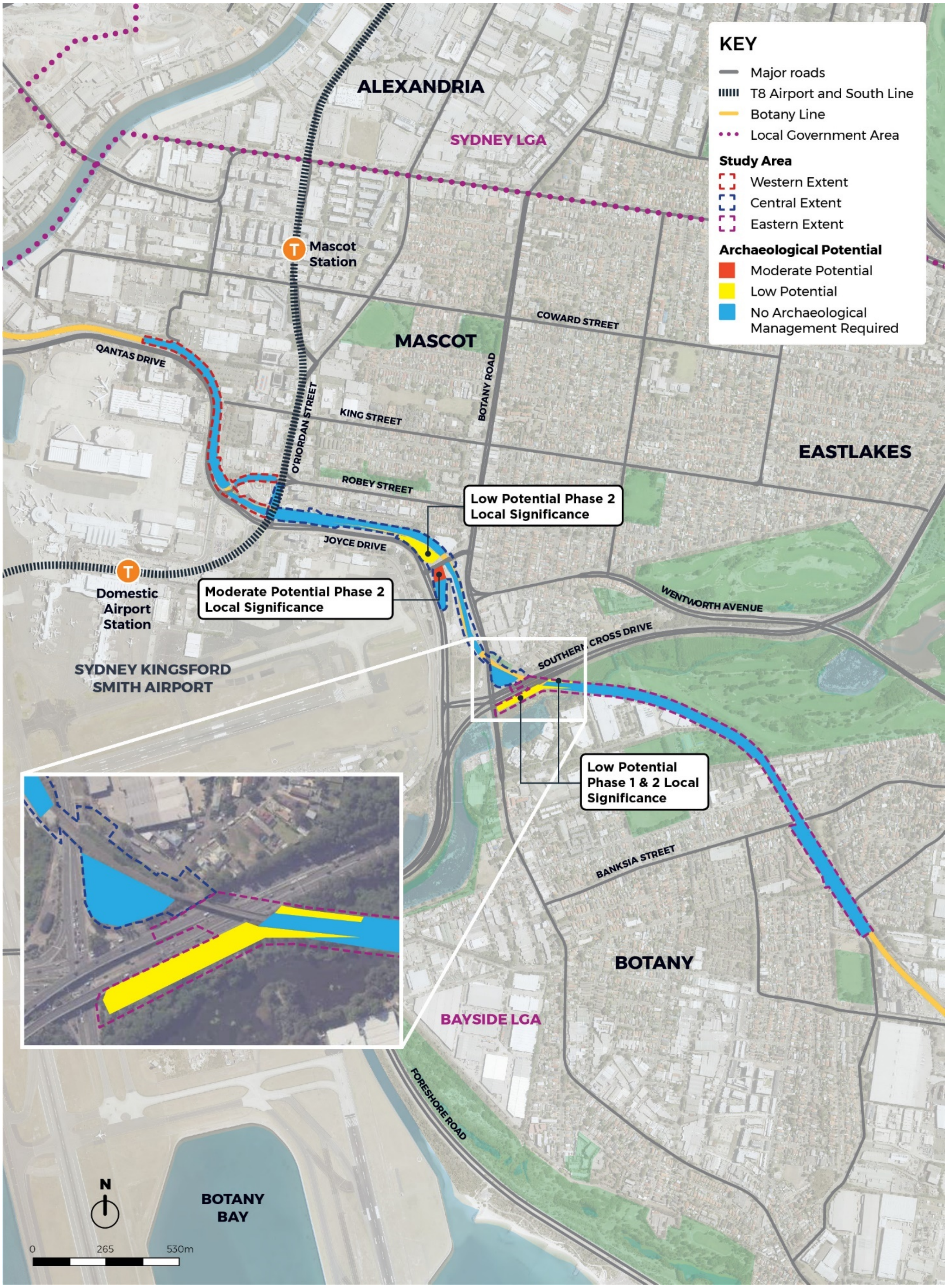


Figure 15.4 Non-Aboriginal Archaeological potential and significance with the project site

15.3 Assessment of construction impacts

15.3.1 Impacts on heritage items

The project would directly and indirectly impact a number of heritage items in the project site, as identified below in Table 15.4. The location of these items is shown in Figure 15.3.

Table 15.4 Heritage Listed items within the study area

ITEM NAME AND SIGNIFICANCE	LOCATION	PROPOSED IMPACTS	IMPACT		
			Impact to fabric	Visual impact	Archaeological impact
Mascot (O'Riordan Street) Underbridge Local	Within the project site	The Mascot (O'Riordan Street) Underbridge would be demolished and replaced with a dual carriageway rail underbridge	Major	N/A	N/A
Mascot (Robey Street) Underbridge Local	Within the project site	The Mascot (Robey Street) Underbridge would be demolished and replaced with a dual carriageway rail underbridge	Major	N/A	N/A
Mascot (Botany Road) Underbridge Local	Within the project site	The Mascot (Botany Road) Underbridge would undergo some minor remediation works to the abutments and headstock of the existing bridge. The existing bridge would however be retained as part of the project.	Minor	Minor	N/A
Botany Water Reserves (also known as Botany Wetlands or Botany Swamps) State	Immediately adjacent to the project site	The construction boundary for the proposed works would not extend into the curtilage of the Botany Waters Reserve. Although the proposed works would be located outside of the heritage curtilage for the item, visual impacts associated with the addition of a new rail bridge over Mill Pond, retaining walls and embankments would result in a minor visual impact to the Botany Water Reserves. Due to the location of the proposed works within the existing rail corridor between the two sections of the reserve, no alternative options were considered to be viable to minimise the potential minor visual impacts.	Nil	Minor	Nil

ITEM NAME AND SIGNIFICANCE	LOCATION	PROPOSED IMPACTS	IMPACT		
			Impact to fabric	Visual impact	Archaeological impact
		Where possible, ARTC would seek to reinstate any vegetation within the existing corridor (where space and operational requirements permit).			
Sydney (Kingsford Smith) Airport Group State	Portions of the project site are located within the curtilage for this item	The construction boundary for the proposed works would extend five to 20 metres within the heritage curtilage for the item, along its eastern boundary. Works within the curtilage may involve vegetation clearing and would include the establishment of stockpile areas and temporary crane pads.	Minor	Minor	Minor
Ruins of the former Botany Pumping Station Local	The project site is located 870 metres northeast of the item	The project would not involve direct or indirect impacts on the item.	Nil	Nil	Nil
Commonwealth Water Pumping Station and Sewerage Pumping Station No 38 Local	The project site is located 870 metres northeast of the item	The project would not involve direct or indirect impacts on the item.	Nil	Nil	Nil
Beckenham Memorial Church Local	40 metres east of the project site	The project would not involve direct impact to heritage fabric associated with the item. However, works will alter existing views towards the Botany Rail Line from the item. However, this is unlikely to impact the item's heritage significance.	Nil	Negligible	Nil
Booralee Park Local	110 metres southwest of the project site	No direct impacts on the park would occur as part of the project. Views towards the study area from the park are obstructed by trees and buildings, therefore no visual impacts are anticipated as a result of the project.	Nil	Nil	Nil

ITEM NAME AND SIGNIFICANCE	LOCATION	PROPOSED IMPACTS	IMPACT		
			Impact to fabric	Visual impact	Archaeological impact
Botany Rail Line Local	Within the project site	Impacts would involve the removal and modification of modern and historic fabric in the way of underbridges and signal hut/signal location cases associated with the Botany Rail Line. These items have been assessed as having moderate to high significance as contributing elements to the Botany Rail Line. These would be replaced with modern materials and infrastructure. The existing character of the line would also be altered due to the proposed duplication of the line. However, it should be noted that the Botany Rail Line was always intended to be a dual carriage corridor and the local significance of the item is likely to be retained.	Moderate	Moderate	Minor

15.3.2 Impacts on archaeology

The project has potential to have a moderate impact to State and locally significant archaeological remains associated with Phase 1, 2 and 3 occupation, as identified in Table 15.5.

Table 15.5 Potential impacts on archaeological remains within the project site

PHASE OF WORKS AND SIGNIFICANCE	LOCATION	PROPOSED IMPACTS	POTENTIAL ARCHAEOLOGICAL IMPACT
Phase 1 (c1809–1858) – State Potential archaeological evidence of landscape modifications and unrecorded structures associated with Simeon Lord's Mill.	Within the project site	There is low potential for remains associated within Phase 1 occupation of the study area to survive within a small portion of the study area adjacent to the Botany Wetlands. The proposed installation of drainage lines, CSR routes, compound sites, materials storage and laydown areas, bridges and retaining walls all have potential to impact Phase 1 archaeological remains near the Botany Wetlands.	Negligible to minor (depending on the location/extent of proposed works and nature of archaeological remains)

PHASE OF WORKS AND SIGNIFICANCE	LOCATION	PROPOSED IMPACTS	POTENTIAL ARCHAEOLOGICAL IMPACT
Phase 2 (1858–1925) – Local Potential archaeological remains associated with early market gardens, residential development and construction of the Botany Goods Line	Within the project site	The proposed establishment of the compound sites, and materials storage and laydown area to the north and south of General Holmes Drive have the potential to impact Phase 2 archaeological remains. However, it is unlikely that major subsurface excavations will occur within these portions of the study area. Archaeological remains would include evidence of market gardens and associated structures. These may have local significance.	Negligible to minor (depending on the location /extent of proposed works and nature of archaeological remains)
Phase 3 (1925–1960) – Not Significant Potential archaeological remains associated with 20th century residential occupation, market gardens and the Botany Goods Line.	Within the project site	The proposed installation of drainage lines, CSR routes, compound sites, bridges and retaining walls all have potential to impact Phase 3 archaeological remains, including evidence of 20th century residential development and the Botany Rail Line These remains are not considered to meet the criteria for 'relics' under the Heritage Act as they do not contain research potential and their removal would not impact the overall heritage significance of the area.	Nil
Phase 4 (1960–2002) – Not Significant Modern redevelopment associated with airport expansion and demolition of Phase 2 and 3 buildings.	Within the project site	The proposed installation of drainage lines, CSR routes, compound sites, bridges and retaining walls all have potential to impact Phase 4 archaeological remains, including evidence of 20th century residential development and the Botany Rail Line. However, these remains would represent modern development and land use and do not contain research potential. Therefore, they would not meet the criteria for 'relics' under the Heritage Act and their removal would not impact the overall heritage significance of the area.	Nil

PHASE OF WORKS AND SIGNIFICANCE	LOCATION	PROPOSED IMPACTS	POTENTIAL ARCHAEOLOGICAL IMPACT
Phase 5 (2002–present) – Not Significant Modern development and land use	Within the project site	The proposed installation of drainage lines, CSR routes, compound sites, bridges and retaining walls all have potential to impact Phase 5 remains. However, these remains would represent modern development and land use and do not contain research potential. Therefore, they would not meet the criteria for 'relics' under the Heritage Act and their removal would not impact the overall heritage significance of the area.	Nil

15.4 Assessment of operational impacts

15.4.1 Impacts on heritage items

As the project would not result in any major changes to the operation of the existing Botany Rail Line with the exception of an increase in freight train movements, the project is not expected to have any non-Aboriginal heritage impacts.

15.4.2 Impacts on archaeology

As the project would not result in any major changes to the operation of the existing Botany Rail Line with the exception of an increase in freight train movements, the project is not expected to have any impacts on non-Aboriginal archaeology.

15.5 Cumulative impacts

15.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to non-Aboriginal heritage are described below.

15.5.2 Cumulative construction impacts

The Botany Rail Duplication, Sydney Gateway Road, M4-M5 Link, New M5, WestConnex Enabling Works – Sydney Airport East and Airport North will result in the following impacts:

- direct impacts on three heritage listed underbridges
- indirect impacts on two heritage listed underbridges
- demolition of heritage listed and/or heritage significant buildings
- modifications to the Botany Rail Line which is an unlisted item assessed as having local significance
- impacts on potentially significant State or local archaeological remains.

Cumulatively these works will result in moderate and irreversible impact to significant items, view lines and potential archaeological remains within the combined project sites. The cumulative impacts of the project are considered to be moderate to minor.

A summary of non-Aboriginal heritage impacts on nearby projects is included in Table 15.6 and included in *Technical Report 9 – Statement of Heritage Impact.*

Table 15.6 Summary of non-Aboriginal heritage impacts of nearby projects

PROJECT	HERITAGE IMPACT
WestConnex Enabling works (Airport East)	Most relevant to the Botany Rail Duplication, due to its close proximity to the project site, are the WestConnex enabling works (Airport east) along Wentworth Avenue. Works have involved the demolition and partial acquisition of four items listed on the Botany Bay LEP 2013, which are located within view of the project site, removal of two unlisted heritage items and partial acquisition of land within the Botany Bay LEP, RNC and CHL listed Sydney (Kingsford Smith) Airport Group (I170). The works also included the construction of a new underpass and rail overbridge over the Botany Rail Line. These impacts have already slightly modified the landscape within and surrounding the Botany Rail Line, through the loss of heritage values associated with the item.
Sydney Gateway – road project	The Sydney Gateway road project will occur adjacent to and northwest of the project site. The most significant impact on non-Aboriginal heritage values relate to the construction of four bridges over SHR-listed Alexandra canal (considered a major impact on the heritage significance of the item). Other impacts include: • demolition of eleven existing structures, their associated landscapes and mature fig trees within the Sydney (Kingsford Smith) Airport Group's heritage curtilage • construction of three bridges and overpasses over the existing Botany Rail Line • visual impacts on the Mascot (Sheas Ck) Underbridge • potential impacts on State and locally significant archaeology.
WestConnex M4-M5	The WestConnex M4-M5 Link project is occurring approximately 2.5 kilometres north of the study area. It has resulted in the following heritage impacts relevant to the project: • removal of street trees including Moreton Bay Figs and contributory trees. Although the total number is not known, satellite imagery suggest at least forty trees were removed for the works • demolition of sixteen locally-listed or s170 listed heritage items and ten potential heritage items • demolition of contributory items within the Powell's Estate and Haberfield heritage conservation areas • impacts to archaeological relics within eleven historical archaeological management units • encroachment on existing public recreational areas/parklands, namely Sydney Park.
WestConnex New M5	WestConnex New M5 project is occurring approximately 2.5 kilometres north of the study area. It has or will result in the following heritage impacts relevant to project: • direct and indirect impacts on 57 non-Aboriginal heritage items • demolition of three heritage listed buildings • modifications to the SHR, s170, RNE and LEP listed Alexandra Canal (due to the addition of crossings over the canal), RNE listed St Peters Brickpit Geological Site, LEP listed Service Garage and LEP listed Goodsell Estate Conservation Area • partial and direct impact to eight conservation areas • construction vibration impacts on 23 heritage listed items • construction of two bridges over the Alexandra Canal • visual impacts on 21 heritage listed items.

15.5.3 Cumulative operational impacts

As the project will not result in any major changes to the operation of the existing Botany Rail Line with the exception of an increase in freight train movements, the project is not expected to have any cumulative non-Aboriginal heritage impacts.

15.6 Management of impacts

15.6.1 Approach

The new track alignment across both the Mascot (Robey Street) Underbridge and Mascot (O'Riordan Street) Underbridge requires the demolition and reconstruction of both bridges. Alternative options regarding this demolition of these underbridges have been considered.

Due to the new track alignment, headroom requirements and the significant difficulties in retaining/ strengthening the existing bridges to comply with the construction requirements, retaining the current structures is not a feasible option, and each bridge must be replaced.

To reduce the impacts of the demolition of these heritage items and other identified and unidentified heritage items, the mitigation measures outlined in section 15.6.2 would be followed.

15.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential non-Aboriginal heritage impacts during construction of the project are listed in Table 15.7. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 15.7 Mitigation measures

STAGE	ISSUE	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Design	Avoidance of heritage impacts	Impacts to significant fabric, locally and State significant archaeological remains and landscapes (including trees, plantings and public recreation areas) within and adjacent to the project site will be avoided, where possible. Designs will also endeavour to reduce visual impacts by considering sympathetic and unobtrusive fabric, colour, form and size for new built elements. Appropriate impact avoidance measures will be considered during the detailed design phase and included in the Construction Environment Management Plan (CEMP) for the project where required.	N/A – Design phase	N/A – Design phase

STAGE	ISSUE	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Heritage Interpretation	A Heritage Interpretation Plan (HIP) including a heritage interpretation strategy will be prepared in accordance with the *NSW Heritage Manual, the NSW Heritage Office's Interpreting Heritage Places and Items: Guidelines* (NSW Heritage Office, 2005), and the *NSW Heritage Council's Heritage Interpretation Policy* (Heritage Council of NSW, 2005). The HIP will focus on the study areas historic development and target items considered to contain heritage significance within the project site including: • Mascot (Botany Road) Underbridge • Mascot (O'Riordan Street) Underbridge • Mascot (Robey Street) Underbridge • Botany Rail Line and its associations with the development of industry and land use in the Botany and Mascot areas. The HIP will be prepared in consultation with: • Bayside Council • NSW Heritage Council • Randwick and District Historical Society.	N/A – Design phase	N/A – Design phase
Construction	Significant items within, and outside of, the study area	For the Botany Water Reserves (also known as Botany Wetlands or Botany Swamps), the following site specific management measures will be implemented: • establishment of fenced exclusion zones around the item's SHR curtilage to prevent inadvertent impacts to the item prior to, and during construction of the project • engagement of an arborist to ensure significant plant species are not impacted during the construction phase if impacts outside of the project footprint are proposed • archaeological monitoring in areas assessed as containing low potential for Phase 1 archaeological remains where subsurface impacts are proposed. This would be carried out in accordance with recommendations set out in Section 11.5 of *Technical Report 9 – Statement of Heritage Impact.*	✓	✓
	Significant items within, and outside of, the study area	The CEMP will identify measures to specifically minimise the potential impact to the bridge during the construction phase of the project. This may include establishment of protective barriers or pads around elements of the bridge to ensure impacts to fabric are avoided.	✓	✓

STAGE	ISSUE	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Significant items within, and outside of, the study area	The CEMP will include measures to prevent inadvertent impacts to fabric within the curtilage of the Sydney Airport Group south of Qantas Drive. This may include establishment of an exclusion zone around the LEP curtilage for the item. The inclusion of the exclusion zone in the ECMs would be appropriate.	✓	✓
	Significant items within, and outside of, the study area	For the potential archaeological remains shown in Figure 15.4, archaeological monitoring or testing will be undertaken (where required) in accordance with recommendations set out in Section 11.5 of *Technical Report 9 – Statement of Heritage Impact*	✓	✓
	Photographic archival recording	Photographic archival recording and reporting will be carried out in accordance with the NSW Heritage Office's *How to Prepare Archival Records of Heritage Items* (1998), and *Photographic Recording of Heritage Items Using Film or Digital Capture* (NSW Heritage Office 2006) for the following items: • Mascot (Botany Road) Underbridge • Mascot (O'Riordan Street) Underbridge • Mascot (Robey Street) Underbridge • existing nature and elements of the Botany Rail Line located within the study area. The relevant record will be prepared by a suitably qualified heritage consultant using archival-quality material prior to the demolition or modification of each bridge, and main construction works to Botany Line. Additional recording may also take place during bridge removal. Records for LEP-listed items would be held by the local Council and local library. A copy of the record will be held by the owner of the asset.		✓
	S170 notification	As the items listed on the ARTC s170 register will be demolished, a s170 notification will be provided to Sydney Trains and the NSW Heritage Division prior to the demolition of: • Mascot (O'Riordan Street) Underbridge • Mascot (Robey Street) Underbridge.		✓

STAGE	ISSUE	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Archaeological management	The location of subsurface excavations will be designed, where possible to avoid areas containing low or moderate potential for State and locally significant Phase 1 and 2 resources. If these impacts cannot be avoided, a Historical Archaeological Assessment and Research Design (HAARD) and Excavation Methodology would be prepared once designs for the project have been finalised and the extent and depth of subsurface excavations are known. Likely recommended archaeological management includes: • East: Land surrounding Mill Pond and immediately south of Southern Cross Drive – archaeological monitoring and recording with potential salvage. • Central: Land to the north and south of General Holmes Drive, west of the Botany Rail Line – archaeological test excavations or monitoring and recording to the south and archaeological monitoring and recording to the north, both with the potential for salvage. • West: No archaeological resources considered to contain local or State significance are located in this portion of the study area – unexpected finds protocol. The HAARD will recommend appropriate archaeological management and research questions based on final detailed design. It will also include a requirement that all archaeological monitoring and test excavations be led by a suitably qualified heritage consultant who meets the NSW Heritage Council's Excavation Director criterial.	✓	✓
	Heritage induction	The project environmental induction will include making contractors aware of areas of high/moderate archaeological potential, areas containing highly significant fabric, relevant strategies to minimise potential impacts on archaeological remains and heritage fabric, information regarding the identification and management of unexpected archaeological and heritage finds and their obligations under NSW heritage legislation and the conditions of approval for the project. The induction will be provided to relevant contractors and subcontractors and its preparation overseen and approved by a suitably qualified heritage professional.	✓	✓

STAGE	ISSUE	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Unexpected finds	An Unexpected Finds Procedure will be established and implemented in the case of unexpected structural and archaeological finds in areas not considered to contain archaeological potential for local or state significant remains.	✓	✓
	Unexpected finds	The Heritage Council will be notified if a relic is uncovered during construction.	✓	✓
Operation	Unexpected finds	The existing ARTC Standard Environmental Management Measures (under the Environmental Management System) will be implemented to manage the potential for unexpected non-Aboriginal heritage finds.	N/A – Operation	N/A – Operation

15.6.3 Consideration of the interaction between measures

In addition to the measures for non-Aboriginal heritage described above, there are interactions between the mitigation measures for Aboriginal heritage (Chapter 16). For example, unexpected finds protocols would be implemented to minimise damage to unidentified archaeological relics of both non-Aboriginal and Aboriginal heritage within the project site. All mitigation measures for the project are consolidated in Chapter 25 to ensure consistency in implementation.

15.6.4 Managing residual impacts

A residual risk analysis was undertaken taking into account the impact assessment summarised in this chapter and implementation of the mitigation measures as recommended in 15.6.2.

Due to the demolition of two heritage items of local significance and modifications to one heritage item of local significance (see Table 15.4), the residual risk level remain remains high for impacts on non-Aboriginal heritage (see Appendix B).

All detail on mitigation measures would be transferred to ARTC's asset management system for ongoing management.

16. ABORIGINAL HERITAGE

This chapter provides a summary of the *Aboriginal Archaeological Survey Report* undertaken by Artefact Heritage. A full copy of the assessment report is provided as *Technical Report 10 – Aboriginal Archaeological Survey Report.*

16.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach, and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in *Technical Report 10 – Aboriginal Archaeological Survey Report.*

16.1.1 Legislative and policy context to the assessment

State legislation

Environmental Planning and Assessment Act 1979

The EP&A Act establishes the framework for cultural heritage values to be formally assessed in the land use planning, development assessment and environmental impact assessment processes. The EP&A Act consists of three main parts of direct relevance to Aboriginal cultural heritage: Part 3, which governs the preparation of planning instruments, Part 4, which relates to development assessment processes for local government (consent) authorities and Part 5, which relates to activity approvals by governing (determining) authorities.

Part 3, Division 3.4 deals with the development of LEPs. Planning decisions within LGAs are guided by LEPs. Each LGA is required to develop and maintain an LEP that includes Aboriginal and historical heritage items which are protected under the EP&A Act and the Heritage Act. The study area is located within the boundary of the Bayside LGA and is covered by the Botany Bay LEP.

No Aboriginal heritage items listed on the Botany Bay LEP are located within the study area.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides statutory protection for all Aboriginal 'objects' (consisting of any material evidence of the Aboriginal occupation of NSW) under section 90 of the NPW Act, and for 'Aboriginal Places' (areas of cultural significance to the Aboriginal community) under section 84.

The protection provided to Aboriginal objects applies irrespective of the level of their significance or issues of land tenure. However, areas are only gazetted as Aboriginal Places if the Minister for the Environment is satisfied that sufficient evidence exists to demonstrate that the location was and/or is of special significance to Aboriginal culture.

There are no gazetted Aboriginal Places in the study area. All Aboriginal objects, whether recorded or not, are protected under the NPW Act.

An Aboriginal Heritage Impact Permit (AHIP) is the statutory instrument that is issued under section 90 of the NPW Act to manage harm or potential harm to Aboriginal objects and places. Various factors are considered in the AHIP application process, such as site significance, Aboriginal consultation requirements, Ecological Sustainable Development (ESD) principles, project justification and consideration of alternatives.

The project is being assessed as SSI under Division 5.2 of the EP&A Act. Under section 5.23 of the EP&A Act, an AHIP under section 90 the NPW Act 1974 is not required.

Native Title Act 1994

The (state) *Native Title Act 1994* was introduced to work in conjunction with the Commonwealth *Native Title Act 1993*. Native Title claims, registers and Indigenous Land Use Agreements are administered under the Act.

There are no registered Native Title claims identified for the study area.

Aboriginal Land Rights Act 1983

The *Aboriginal Land Rights Act 1983* (ALR Act) established LALCs at State and Local levels. Under Division 1A section 52(4) of the ALR Act, these bodies have a statutory obligation to:

- take action to protect the culture and heritage of Aboriginal persons in the council's area, subject to any other law
- promote awareness in the community of the culture and heritage of Aboriginal persons in the council's area.

The study area is within the boundary of the La Perouse LALC.

The ALR Act also provides a statutory pathway for LALCs to make an ownership claim over Crown land. There are no Registered Aboriginal Owners pursuant to Part 9, Division 3 of the ALR Act for the study area.

Commonwealth legislation

Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act is administered by the Australian Department of the Environment and Energy (DoEE) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES).

The EPBC Act includes 'national heritage' as a MNES and protects listed places to the fullest extent under the Constitution. It also establishes the NHL and the CHL.

There are no CHL listed or NHL listed places in the study area.

Aboriginal and Torres Strait Islander Heritage Protection Act 1994

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth), deals with Aboriginal cultural property (intangible heritage) in a wider sense. Such intangible heritage includes any places, objects and folklore that "are of particular significance to Aboriginals in accordance with Aboriginal tradition". These values are not currently protected under the NPW Act.

Where an Aboriginal individual or organisation is concerned that intangible values within the proposal are not being adequately protected, they can apply to the Minister for a declaration over a place.

No intangible places or values were identified during the heritage investigations undertaken for the study area.

Native Title Act 1993

The main purpose of the *Native Title Act 1993* (Commonwealth) is to recognise and protect native title. Native title is the rights and interests in land and waters that Aboriginal and Torres Strait Islanders have under their traditional laws and customs.

Section 24KA of the *Native Title Act 1993*, requires that native title claimants are notified of any 'future act' which may result in a change in land use for Crown lands affected by claims. 'Future act' is defined in section 233 of the Act as a proposed activity or development on land and/or waters that may affect native title, by extinguishing (removing) it or creating interests that are inconsistent with the existence or exercise of native title. If after one month (from notification) there was no response, then the proponent is deemed to have fulfilled their obligations under the Act.

There are no native title claims currently registered in the study area.

Airports Act 1996

The Airports Act and associated regulations (discussed below) provide the assessment and approval process for development on Commonwealth-owned land leased from the Australian Government for the operation of Sydney Airport.

Section 70 of the Airports Act requires that any major airport development must be consistent with the master plan approved by the Minister for Infrastructure and Transport. Part 5 of the Act also requires the development of an environmental strategy (included in the master plan), against which compliance is required by Sydney Airport and all persons carrying out activities on airport land.

The study area includes areas of Commonwealth-owned land leased by Sydney Airport Corporation Limited.

Sydney Airport Master Plan 2039

As part of the planning framework established by the Airports Act, airport operators are required to prepare a master plan for the coordinated development of their airport. The Sydney Airport Master Plan 2039 (SACL 2019a) outlines the strategic direction for Sydney Airport's operations and development over the next 20 years. It acknowledges that the continued growth of Sydney Airport is vital to achieving local, state and national employment, tourism and development objectives.

The Master Plan 2039 includes the following relevant heritage initiatives:

- conserve the significant places of the airport, in line with the Heritage Management Plan
- actively conserve heritage elements listed as Environmentally Significant under the Airports Act
- deliver and continually build upon the online experience centre, to tell the history of the airport site, detail its significance and its aviation history
- integrate heritage interpretation devices into new and existing Sydney Airport facilities, through delivery of an interpretation strategy
- ensure that heritage items of recognised significance are recorded to an appropriate archival standard
- establish an archive of historical records of the history of Sydney Airport and the site
- implement the management plan for the fig trees and the Sydney Airport Wetlands, located in the South East Sector.

This assessment was completed in accordance with the objectives outlined in section 2.3 of the Sydney Airport Master Plan 2039, to ensure heritage items are appropriately considered and managed.

Sydney Airport Environmental Strategy 2019–2039

The Airports Act requires that airport operators provide an assessment of the environmental issues associated with implementing the airport master plan and the plan for dealing with those issues. This is documented in an environment strategy that forms part of the airport's master plan. The Sydney Airport Environment Strategy 2019–2024 (the Environment Strategy) (SACL 2019b), which forms part of Master Plan 2039, provides strategic direction for the environmental performance and management of Sydney Airport for the five-year period between 2019 and 2024.

The Environment Strategy stipulates that heritage must be appropriately considered and managed. The Archaeological Survey Report completed for the project was prepared in accordance with this requirement.

Airports (Environment Protection) Regulations 1997

The objective of the Airports (Environmental Protection) Regulations 1997 (Commonwealth) (the Airports regulations) is to:

- establish a system of regulation for activities at airports that generate or have potential to generate pollution or excessive noise
- to promote improving environmental management practices for activities carried out at airport sites.

Under Part 4 of the regulation, the operator of an undertaking must ensure that there are no adverse consequences for existing aesthetic, cultural, historical, social and scientific (including archaeological and anthropological) values of the local area, and there are no adverse consequences for sites of indigenous significance on the airport site.

The study area includes areas of Commonwealth-owned land leased by Sydney Airport Corporation Limited.

16.1.2 Other relevant guidelines

To meet the SEARs SSI 18_9714, an Aboriginal Archaeological Survey Report has been completed in accordance with Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales. Other guidelines and regulations included in the project SEARs include the following statutory guidelines:

- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011)
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (Department of Environment Climate Change and Water [DECCW] 2010)

In accordance with the SEARs SSI 18_9714 (Key issue 5 Requirement 4), further investigation under the Guide and the Consultation Requirements is only required where impacts on Aboriginal objects or places are proposed. The *Aboriginal Archaeological Survey Report (Technical Report 10)* has determined that impacts on Aboriginal objects and places as a result of the project are unlikely. Therefore, these guidelines are not relevant to this assessment, as no Aboriginal objects or places will be impacted by the proposed works.

A detailed description of the legislative and policy context for the assessment is provided in section 2 of the *Technical Report 10 – Aboriginal Archaeological Survey Report.*

16.1.3 Methodology

Key tasks

Key tasks undertaken for this Aboriginal Heritage assessment have included:

- a review of the legislative and policy context including relevant guidelines and procedures
- a desktop review of relevant background literature, search registers including the Aboriginal Information Management systems (AHIMS), and previous archaeological investigations in the broader study area
- a review of previous archaeological surveys at the project site, including the archaeological survey undertaken by Kelleher Nightingale Consulting (KNC) on 14 and 21 September 2016
- a site inspection by Artefact Heritage on 18 July 2018 (to substantiate the findings of the KNC), and a follow up site inspection on 8 November 2018, including follow-up consultation with La Perouse LALC who were not available to attend the site visit
- consideration for the need to undertake archaeological significance assessments for identified Aboriginal sites
- the completion of an archaeological significance assessment
- review of project impacts, and relevant mitigation measures to reduce any identified potential impacts on Aboriginal cultural heritage, including PADs.

Further information on key tasks is included in the *Technical Report 10 – Aboriginal Archaeological Survey Report*.

Study area

Technical Report 10 – Aboriginal Archaeological Survey Report used a number of approaches to define the study area. These include:

- Board study area – used to define areas included in board scale database searches and previous archaeological investigations.
- Study area – used to define the boundaries of site surveys which includes the project site and land immediately adjacent.
- Project site – used to define land within project boundaries.

Archaeological Investigations were divided into three survey units, and one additional investigation area, (shown in Figure 16.1):

- Survey Unit 1 – encompassed land from Banksia Street to Southern Cross Drive, Botany. The survey unit included the Botany Line and the southern boundary of the Eastlake Golf Course.
- Survey Unit 2 – encompassed Southern Cross Drive to the Alexandra Canal. The survey unit contained a combination of land occupied by the Botany Line, adjacent urban areas, road corridors and the riparian areas adjacent to Mill Stream and Mill Pond.
- Survey Unit 3 – encompassed an area from Alexandra Canal west to the boundary of the suburbs St Peters and Tempe. The survey included the Botany Line and adjacent industrial areas, however it should be noted that this area was outside the project site.
- An additional area within the Botany rail line, south of Banksia Street, Botany.

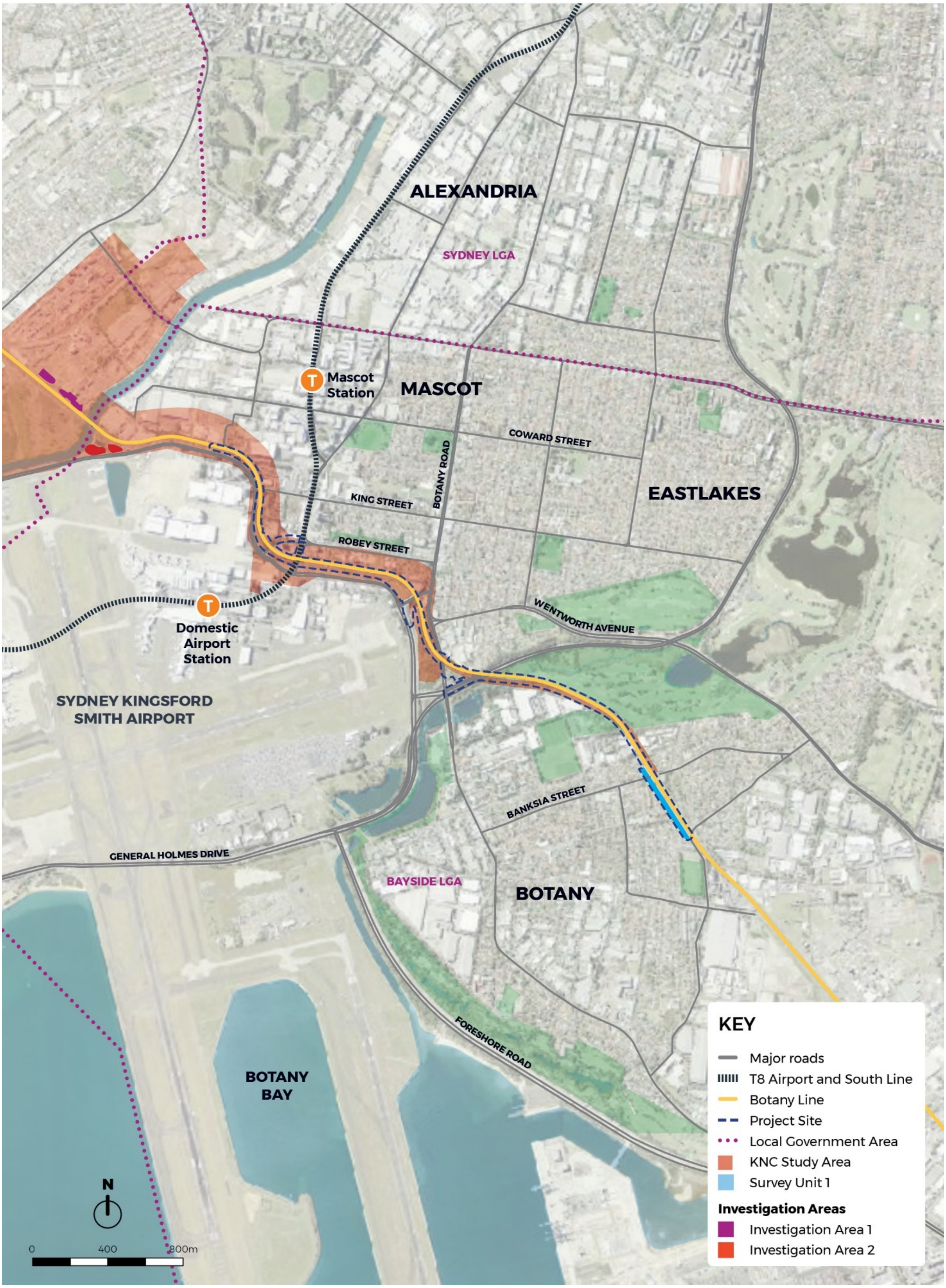


Figure 16.1 Aboriginal Archaeological Survey Report study areas

16.1.4 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with Aboriginal heritage. Potential risks were considered according to the impacts that may be generated by the construction and operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology and the full results, is provided in Appendix B.

The assessed risk levels prior to mitigation associated with potential Aboriginal impacts were:

- disturbance of known or unidentified items or places of Aboriginal heritage significance.

This potential risk and impact were considered as part of the assessment. The assessment also considered matters identified by the SEARs and identified by stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 16.6.4.

16.2 Existing environment

16.2.1 Aboriginal historical and landscape context

The archaeological understanding of the early Aboriginal settlement of the Sydney Basin and surrounds is constantly expanding and developing.

Prior to European colonisation in 1788, the areas surrounding Sydney were occupied by the Eora people. The Eora inhabited a territory boarded by the coast to the east, Pittwater and the mouth of the Hawksbury River to the north and the Georges River and Botany Bay to the south. Due to their geographical location, the Eora subsisted generally on a marine based diet. Their occupation is evident today from various middens, rock shelter art and engravings along the coastline.

Estimates of the population of the Eora range from 1000 to 5000 individuals, a number that was irreversibly reduced due to the arrival of Europeans. The Eora were distributed into a number of different family and clan groups, with the Gadaigal people occupying the land closely associated with the project site. Their traditional occupation of the area is believed to be for at least 20,000 years prior to European arrival in 1788.

The project site is located within an area that was rich with resources, with the Cooks River and Gumbramorra Swamp a likely source of reliable fish and fresh water. Additionally, the Hawkesbury sandstone around the Cooks River would have provided shelter and the surrounding environment ample materials for tools and other material culture.

Observations of Aboriginal people living on the Cooks River made early after the British arrival in Australia indicate the importance of these riverine and estuarine environments for Aboriginal people. Watkin Tench noted a camp consisting of twelve huts near the Cooks River in 1788 (Muir 2013), while another account by James Backhouse details the construction of canoes using heat from fires in the 1830s (Backhouse 1838). Other accounts observed Aboriginal people in canoes and shell middens indicate the procurement of fish and shell fish for food (Backhouse 1838). The discovery of butchered dugong bones during the excavation of Alexandra Canal in the late 19th century highlights the ways in which Aboriginal people took advantage of their environments particularly during periods of climate change around 6,000 years ago (Etheridge et al. 1896).

16.2.2 Registered Aboriginal sites

The AHIMS register provides records of Aboriginal objects reported to Department of Premier and Cabinet in accordance with section 89A of the NPW Act. It contains information about Aboriginal places which have been declared by the Minister for the Environment to have special significance with respect to Aboriginal culture. Previously reordered objects and declared Aboriginal places are referred to by AHIMS as 'Aboriginal sites'.

An AHIMS search was undertaken on 4 December 2018 for a broad study area approximately 14 kilometres by 14 kilometres' centres on the project site. A total of 88 sites were identified. The closest Aboriginal site to the project site is the Bouy Botany Shell Midden AHIMS ID 45-6-0629), located 750 metres to the south west.

The results of the AHIMS search are described in Table 16.1.

Table 16.1 AHIMS search results by frequency

SITE TYPE	NUMBER OF SITES	PERCENTAGE OF SITES
Shell, artefact	26	28.41
PAD	22	22.73
Artefact	18	20.45
Art (pigment or engraved)	13	14.77
Artefact, PAD	3	3.41
Art (pigment or engraved), Artefact	1	1.14
Artefact, Aboriginal resource and gathering, non-human bone and organic material	1	1.14
Shell	2	1.14
Unknown (PAD?)	2	2.27
Aboriginal resource and gathering	1	1.14
Artefact, shell, burial	1	1.14
Aboriginal ceremony and dreaming, artefact, shell	1	1.14
Shell, artefact, art (pigment or engraved)	1	1.14
Total	**88**	**100.00**

16.2.3 Previous archaeological investigations

A number of archaeological investigations have been conducted in broad study area, including in the suburbs of Mascot, Marrickville, Tempe and Undercliff. A full summary of investigations is included in *Technical Report 10 – Aboriginal Archaeological Survey Report*.

In summary, the project site was originally part of Wangal clan territory. Aboriginal people would have utilised the rich resources of the estuarine environment and would likely have camped on the estuary's margins. Although there are no registered Aboriginal sites within the project site, Sheas Creek Dugong (AHIMS Botany ID 45-6-0751) is located around 800 metres to the north. Partial remains of a dugong skeleton, with cut marks, were identified during an excavation in 1896. The site also featured stone axes. The findings at this site demonstrate the use of marine resources by Aboriginal people in the area.

16.2.4 Archaeological survey

KNC Survey (2018)

In 2018, KNC completed an Aboriginal heritage assessment which included the project site. The assessment involved an archaeological survey (undertaken on 14 and 21 September 2016) and consultation with the La Perouse LALC and the Metropolitan LALC.

The survey extent included the following areas:

- Banksia Street to Southern Cross Drive, including the Botany Line and the southern boundary of the Eastlake Golf course
- Southern Cross Drive to Alexandra Canal, including the Botany Line, adjacent urban areas, road corridors, and riparian areas adjacent to Mill Stream
- Alexandra Canal to eastern areas of the suburbs of St Peters and Tempe (not within the project site).

The survey identified two areas with no visible disturbance to the ground surface and where intact sub-surface deposits could be present. These two areas are located to the west of Alexandra canal, outside the extent of the project site. The remainder of the assessment area was determined to be unlikely to contain Aboriginal objects or PADs.

Artefact Heritage Site Visits (2018)

In July 2018, Artefact Heritage completed a site visit of the study area. The site visit was considered a 'ground truthing' exercise. Subsequently a second site visit was undertaken on 8 November 2018 (including a representative of the Metropolitan LALC). This site visit confirmed the results of the KNC site survey and identified the southern section of the study area had not been included in the 2018 KNC assessment.

Artefact Heritage Survey (2019)

In 2019, Artefact Heritage completed an Aboriginal heritage assessment that included the previously unassessed southern section of the study area. The purpose was to ensure all areas potentially impacted by the project were assessed. The survey took place within Botany Line corridor, south of the pedestrian overpass at Banksia Road and north of Railway Road. A site officer representing the La Perouse LALC was invited to attend but was not available to participate.

The study area was restricted to within the rail corridor south of the pedestrian overpass at Banksia Road and north of Railway Road. The study area is located across a truncated sloping landform. The area has been levelled to accommodate the rail infrastructure. The general slope of the area is northeast to southwest towards Botany Bay. The original landscape would have been rolling coastal dunes, which is evident by the disturbed sands visible at the site. The vegetation has been cleared and replaced with gravel, ballast and grass cover. There is remnant or regrowth vegetation around the perimeter of the study area, none of sufficient age to have cultural markings.

Visibility in the survey unit was limited to areas along the western half that has been experiencing motor vehicle traffic and along the edge of the rail infrastructure that experiences foot traffic and is kept clear of vegetation. The entire landform has been heavily modified to accommodate its existing rail infrastructure. The slope has been truncated in the east of the site and built up in the west. Gas pipelines and electrical cables run the length of the site.

No new Aboriginal sites or areas of PAD were identified during the survey.

Following the completion of the 2019 survey, the LALC was contact to discuss the results of the survey and provided with photos taken during the survey. Comments from (Uncle) David Ingrey confirmed that the survey undertaken by Artefact Heritage was sufficient, and they did not require an additional site visit due to the level of disturbance. No intangible cultural heritage values were identified.

16.2.5 Local archaeological context

No Aboriginal archaeological objects or areas of PAD were identified within the study area. However, archaeological evidence indicates that Botany Bay, the Cooks River and its tributaries were a focus for intensive Aboriginal occupation, due to the combination of maritime, estuarine and terrestrial resources available in the area (KNC 2018). The terraces surrounding these waterways are likely to have functioned as camp sites from which past Aboriginal people could have exploited these resources. The survivability of this archaeological evidence is dependent on low levels of soil disturbance (from both natural and anthropogenic factors) (KNC 2018).

16.2.6 Archaeological significance assessment

The archaeological surveys did not result in the identification of any Aboriginal sites or areas of PAD. Therefore, the study area is not considered to be of archaeological significance.

Unexpected Aboriginal archaeological material may however be present within the fill layer. Any Aboriginal objects retrieved from the fill would likely be assessed as holding low scientific significance due to a lack of archaeological context and integrity.

16.3 Assessment of construction impacts

No Aboriginal places or objects were identified within the project site. Furthermore, due to the highly disturbed nature of the ground, intact archaeological deposits are not likely to be present below the ground surface. Therefore, the proposed development is unlikely to impact any Aboriginal heritage items or places, potential Aboriginal archaeology or intangible cultural heritage values.

16.4 Assessment of operational impacts

No Aboriginal places or objects were identified within the project site. The project is unlikely to have any operational impacts on Aboriginal places, objects, potential Aboriginal archaeology or intangible cultural heritage values.

16.5 Cumulative impacts

As no Aboriginal places or objects have been identified within the project site, cumulative impacts on Aboriginal places or objects are considered unlikely.

16.6 Management of impacts

16.6.1 Approach

ARTC is committed to minimising the environmental impact of the project, including Aboriginal heritage values. Due to the majority of the project being confined to the highly disturbed rail corridor, impacts on Aboriginal heritage values are unlikely. Based on the outcomes of *Technical Report 10 – Aboriginal Archaeological Survey Report*, there have been no necessary project alterations to avoid or minimise impacts on Aboriginal sites or areas of archaeological potential, as the current project scope and area would not impact any known Aboriginal sites.

Further details on the approach to management of environmental impacts is provided in Chapter 24.

16.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential Aboriginal heritage impacts are listed in Table 16.2. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 16.2 Aboriginal cultural heritage mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Construction	Unexpected discovery of Aboriginal objects	An unexpected finds procedure will be prepared and include requirements for: • protecting any unexpected finds (including Aboriginal heritage items and human skeletal remains) encountered during construction activities • procedures to manage reporting and investigation when unexpected finds are encountered.	✓	✓
	Unexpected discovery of human remains	If suspected human skeletal remains are uncovered at any time throughout undertaking the proposed works, the unexpected finds procedure will be implemented.	✓	✓
Operation	Unexpected discovery of Aboriginal objects	The existing ARTC Standard Environmental Management Measures (under the Environmental Management System) will be implemented to manage the potential for unexpected discovery of Aboriginal objects or human remains.	N/A – Operation	N/A – Operation

16.6.3 Consideration of the interaction between measures

In addition to the measures for Aboriginal heritage described above, there are interactions between the mitigation measures for Non-Aboriginal heritage (Chapter 15). For example, unexpected finds protocols are both designed to prevent the damage or destruction of Aboriginal heritage and non-Aboriginal heritage items. All mitigation measures for the project are consolidated in Chapter 24 to ensure consistency in implementation.

16.6.4 Managing residual impacts

A residual risk analysis was undertaken taking into account the impact assessment summarised in this chapter and implementation of the mitigation measures as recommended in section 16.6.2. The residual risk levels were assessed to be low for the potential disturbance of known or unidentified items or places of Aboriginal heritage significance, given the project site has been significantly disturbed and no Aboriginal sites or PADs were identified in this assessment (see Appendix B).

17. LAND USE AND PROPERTY

17.1 Assessment approach

The approach to the land use and property assessment is provided in this section, including the guidelines and policies driving the approach and the methodology used to undertake the assessment.

17.1.1 Legislative and policy context to the assessment

Lands Acquisition (Just Terms Compensation) Act 1991

The *Lands Acquisition (Just Terms Compensation) Act 1991* provides a mechanism for the acquisition of land on just terms by state authorities. The act ensures compensation in line with market value for the acquisition of land, provides the establishment of procedures for the compulsory and temporary acquisition of land by state authorities to simplify and expedite the acquisition process, and encourages the acquisition of land by agreement rather than compulsory processes.

The Botany Rail Duplication Project requires widening of some sections of the existing rail corridor, necessitating a limited amount of property acquisition. The existing rail corridor is owned by the NSW Government (RailCorp) and leased by ARTC. Under the act, RailCorp would be the acquiring authority of the required land acquisition. This assessment outlines the requirement for the permanent and temporary acquisition of land for the purpose of construction and operation of the project.

Other plans and policies

The strategic context for the project is influenced by a number of strategic plans for transport, land use and freight undertaken at a national, state and regional level. Those strategies relevant to land use planning at a local and regional level include:

- NSW Ports' 30 Year Master Plan (NSW Ports, 2015)
- A Metropolis of Three Cities – the Greater Sydney Region Plan (Greater Sydney Commission, 2018a)
- Eastern City District Plan (Greater Sydney Commission, 2018b)
- Greater Sydney Services and Infrastructure Plan (Transport for NSW, 2018c)
- Sydney Airport Master Plan (SAMP) (SACL, 2019a).

A further discussion of the relevant strategies is included in section 5.1.3 and E1 in Chapter 5.

17.1.2 Methodology

Key tasks

The assessment of potential land use impacts associated with the construction and operation of the project involved:

- reviewing environmental planning instruments, policies and strategies
- reviewing, identifying, and mapping existing land uses within the study area based on a desktop review of GIS spatial data and aerial photography, including:
  - local land use zoning maps located within the Botany LEP
  - local land use zoning maps located within the State Environmental Planning Policy (Three Ports) SEPP (NSW Government, 2013)
  - *Sydney Airport Master Plan (2039)* (SACL 2019a) including land use zoning maps on Commonwealth land within the airport
  - properties or landholdings
- consideration of the potential for impacts on other land uses during construction and operation
- providing measures to mitigate and manage the impacts identified.

17.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential land use and property risks. Potential risks were considered according to the impacts that may be generated by the construction and operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology, and the full results, is provided in Appendix B.

The assessed risk level for the majority of potential land use and property risks was medium to high. Risks with an assessed level of medium to high included:

- impacts on land use as a result of property acquisition
- impacts on land use due to billboard modification/relocation
- impacts on businesses due to temporary road closures, particularly full road closures associated with bridge closures
- impacts associated with the establishment of compound sites on adjacent private property.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and identified by stakeholders (as described in Chapter 4). Issues raised by the stakeholders relating to land use and property included impacts on property acquisitions, adjustments and property values.

17.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 to 7, design development and construction planning has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process.

Potential land use and property impacts have been avoided or minimised where possible by:

- confining direct works, proposed ancillary compounds and staging areas to the existing rail corridor to avoid the need for temporary and permanent property acquisitions
- considering the location and positioning of construction compounds, utilisation of existing access points to the rail corridor and minimising impacts associated with the private property
- limiting the timing of construction works to minimise impact on billboards, and consideration of permanent reinstatement in appropriate locations.

17.2 Existing environment

A description of the project site for the purpose of the Environmental Impact Statement is provided in Chapter 2. Section 17.2.2 describes existing land uses and properties within and immediately surrounding the project site. Future land uses are described in section 17.2.3.

17.2.1 Regional and local context

The project site is located about eight kilometres south of the Sydney CBD, traversing the suburbs of Mascot, Botany and Pagewood within the Bayside LGA. The land near the project site consists of a variety of relatively dense land use that includes major transport corridors (such as M1 and M5 Motorways), Sydney Airport, Port Botany and large areas of supporting industrial and commercial land uses.

Areas of medium to high density residential land use (including multi story apartment buildings) are located predominantly to the northwestern end of the project site. Lower density residential areas (mainly detached housing and low rise apartment buildings) are located towards the southeastern end of the project site. Large areas of recreational land uses (including golf courses, parks and open space) are also present in the area, predominantly to the east of the project site. The single biggest land use near the project is Sydney Airport which lies to the south, southwest and west of the project site and has a significant influence on the surrounding development.

The location of major land use features is included on Figure 17.1.

17.2.2 Existing land uses and zoning

Land use zones

Land use zonings within and near the project site are set by the following land use planning instruments, as shown on Figure 17.1.

Botany Bay Local Environmental Plan

Most of the project site is located within an active rail corridor used for transport (freight rail) purposes. Under the Botany Bay LEP, the project site is predominantly located on land zoned Infrastructure (SP2), with an area zoned Business Development (B5) adjacent to Joyce Drive (Figure 17.1).

The objectives of the SP2 (Infrastructure) land zoning is to provide for transport infrastructure and related land use. The objectives of B5 (business development) land zoning is to enable a mix of business and warehouse uses.

Land use zoning near the project site highlights the diverse land use in the suburbs of Botany, Mascot and Pagewood. Land use zoning within the area potentially influenced by the project includes Low to Medium Density Residential (RE2 and RE3), Public Recreation (RE1), General Industrial (IN1), Light Industrial (IN2), Special Activities (SP2) and Local Centre (B2).

Sydney Airport Master Plan 2039

Part of the project site is located on Commonwealth-owned land leased from the Australian Government for the operation of Sydney Airport. Therefore, the project would need to be consistent with the SAMP 2039, which provides a planning framework for the coordinated development of Sydney Airport (SACL 2019a). The area of the project site on Sydney Airport land would only be used during construction and would not form part of the operational land required by the project. Under the SAMP 2039, the area is zoned for business development (BD1) and Airport Terminal and Support Services (AD2).

Areas zoned BD1 have been identified as surplus to aviation requirements and thus reserved for the purpose of providing employment opportunities in accessible locations, supporting the local workforce and locating suitable business along significant corridors.

Areas zoned AD2 make up around 21 percent of Sydney Airport, and are designated to provide development to facilitate the growth of international, domestic and regional air traffic.

SEPP (Three Ports) 2013

The *State Environmental Planning Policy (Three Ports) 2013* land use zoning applies to land to the south of the project site. The Three Ports SEPP does not apply to any part of the project site.

Land uses within the project site

The project site consists primarily of the existing rail line between Mascot and Botany, which is owned by NSW Government and leased, managed and operated by ARTC. The project site includes some additional areas outside the rail corridor which are primarily required for construction activities and site compounds. The areas located outside the rail corridor consist of the following land uses:

- areas of landscaping located on the southern side of the rail corridor north of Qantas Drive between Robey Street and General Holmes Drive containing billboards as shown on Figure 17.1
- airport land located between General Holmes Drive and the rail corridor which is currently being leased for the purpose of a site compound for the Airport East works, as discussed in section 7.4.2
- road reserves (including roadways) of Robey Street, O'Riordan Street and General Holmes Drive
- vacant land south of the rail corridor which is bound by the rail corridor, Botany Road and Southern Cross Drive
- vegetated areas associated with Mill Stream and the Botany Wetlands east of Southern Cross Drive.

Land uses near the project site

There are a range of land uses near the project site, which have the potential to interact or be influenced by the project. These are described further below.

Transport and freight related uses

Sydney Airport is generally located to the south and west of the project site. Since 1921, when the Commonwealth Government purchased land in Mascot for the purpose of creating a public airfield, the airport has been progressively modified and expanded. Sydney Airport now occupies an area of around 907 hectares. The northwestern end of the project site adjoins Qantas and Joyce drives, which are located on Sydney Airport land. Development and land use within Sydney Airport land must occur in accordance with the Sydney Airport Master Plan (SACL, 2019a).

Other transport and freight related land uses in the vicinity of the project site include roads, passenger rail (the Sydney Trains T8 Airport and South Line which travel below ground across the project site) and Port Botany which is located about 2.5 kilometres south of the project site.

Commercial and industrial

A range of commercial and industrial land uses, including a number of airline and freight related businesses and premises, are located in the northwestern part of the study area in Mascot, broadly to the east of Alexandra Canal, north of the rail corridor and west of O'Riordan Street. Other commercial/light industrial areas in the vicinity of the project site are located in:

- Mascot – to the east of the project site in the area bounded by Wentworth Avenue, Botany Road and McBurney Avenue
- Botany – to the south of the project site in the area bounded by Mill Stream, Botany Road, Lord Street and the rail corridor (the Sir Joseph Banks Corporate Park)
- Banksmeadow – to the south of the southern end of the project site.

Accommodation

A number of hotels are located directly adjacent or close to the project site in Mascot. In the immediate vicinity of the project site these include:

- Stamford Plaza, located at the intersection of Qantas Drive and O'Riordan Street on the northern side of the rail corridor
- Citadines Connect and Quest hotels, located close to the project site on Robey Street and Baxter Road
- Branksome Hotel & Residences, located close to the project site on Baxter Road.

The locations of these and other hotels in the vicinity of the project site are shown on Figure 17.1.

Residential

The main residential areas are located near the northwestern end of the project site in Mascot and at southeastern end in Botany and Pagewood. The nearest residential land uses are:

- in Mascot, north of the rail corridor on Baxter Road (about 10–30 metres from the project site), east of the rail corridor on Botany Road (about 40 metres from the project site) and north of the rail corridor on McBurney Avenue (about 30 metres from the project site)
- in Botany, west of the rail corridor between Myrtle and Victoria streets (about 20 metres from the project site)
- in Pagewood, east of the rail corridor between Myrtle and Page streets (about 20 metres from the project site).

In Mascot, areas of low density housing interspersed with low rise apartment buildings are located to the east of O'Riordan Street. Areas to the west of O'Riordan Street, particularly in the vicinity of Mascot Station, are undergoing urban renewal, with a number of apartment and mixed use buildings developed, proposed or under construction. South of Southern Cross Drive, residential land uses consist mainly of low density housing interspersed with low rise apartment buildings.

Open space/recreation

An area of Botany Wetlands, managed by Sydney Water, is located on either side of the project site just to the south of Southern Cross Drive. Other areas of open space and recreation facilities are located south of Mill Stream at the southeastern end of the project site in Botany and Pagewood. These include Eastlake Golf Club, Botany Aquatic Centre, The Lakes and Bonnie Doon golf courses, Booralee Park, Gaiarine Gardens and Garnet Jackson Reserve.

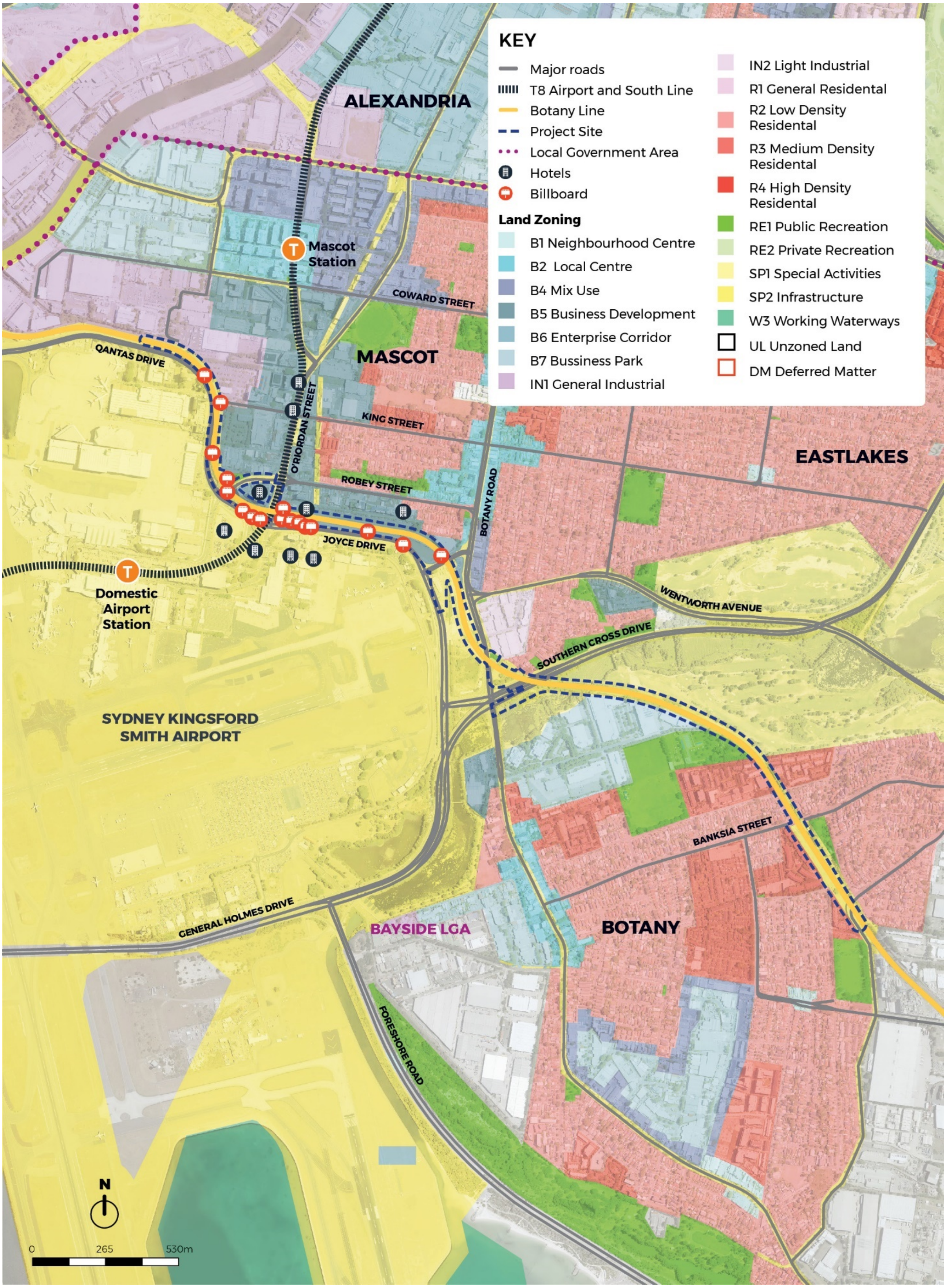


Figure 17.1 Land use

17.2.3 Future land uses

Relevant strategies directing future land use planning for the study area are summarised in section 5.1 (Strategic context).

Within project site

As identified in section 17.2.2, part of the project site is located within Sydney Airport and is therefore subject to the SAMP 2039 (SACL 2019a). This land is zoned for business development (BD1) and Airport Terminal and Support Services (AD2).

No specific proposals are identified for these areas, however the SAMP states that the northeast sector (adjacent to the rail corridor) can accommodate demand for 120,000 square metres of new hotel, office and commercial developments.

The remainder of the project site is located within an existing rail corridor.

Adjacent to project site

Future land uses in Mascot, Botany and Pagewood

The area to the north of the project around Mascot Station is currently subject to urban renewal and redevelopment of a number of sites. This area has been identified as part of the eastern economic corridor under the Eastern District Plan (Greater Sydney Commission, 2018b).

Redevelopment of this area has seen the development of growth areas around Green Square and Mascot. This redevelopment would likely continue to occur into former industrial areas located on the edge of this commercial core. This redevelopment has and will continue to also see an increase in residential dwellings predominately in the form of high densities close to Mascot.

With the redevelopment of areas around Mascot there is potential for further changes in land uses closer to the project site, such changes in land use have already started to occur in close proximity to the project with the new Branksome Hotel and Residences being developed between Robey Street and Baxter Road. The area previously consisted of a mixture of residential dwellings and some low scale commercial development.

A number of known future developments have been identified near the project site, including:

- the Sydney Gateway road project which includes the construction of new sections of high capacity limited road access linking the Sydney motorway network to Sydney Airport
- the WestConnex project which includes increases in capacity of the M5, connects the M5 with the M4, and provides connections to a future Sydney gateway road project
- the relocation of the Qantas Flight Training Centre from its location within Sydney Airport to landholdings in Mascot, immediately to the north of the Port Botany Rail Line
- the King Apartments, a proposed 12 story mixed use building including public car park, hotel and commercial offices located at 324 King Street Mascot, to the north of the Port Botany Rail Line.

Development within Sydney Airport

Development within the areas of the airport located to the south of the project is guided by the SAMP 2039. Under the plan, the northeast sector of the airport (which includes Terminals 2/3, would be subject to a wide range of developments including airside upgrade, relocation of support facilities and the development of further commercial spaces.

The SAMP 2039 also notes the provision of about 120,000 square metres of commercial development in the northeast sector of the airport near the project site. However, the only known and identified future development currently identified in the plan is a future approved 430 room hotel development located within the northeast sector, at the corner of Ninth Avenue and Qantas Drive.

17.2.4 Land ownership and property information

The existing rail corridor is owned by the NSW Government (Rail Corp) and leased by ARTC. The majority of the project would be undertaken within the existing rail corridor or on land for which ARTC has existing access agreements.

The project would also require works on land outside the corridor for both permanent and temporary use. This land is owned by a range of private landowners including SACL.

Land subject to acquisition as a result of the project has previously been identified in Table 6.5 in Chapter 6 of this EIS.

17.3 Assessment of construction impacts

17.3.1 Land use

Impacts to land use during construction would be associated with the change in land use to a construction work site and other construction facilities (such as compounds and material stockpile areas).

The majority of the project site is currently used as a transport corridor (ie Botany Line). Construction of the project would result in impacts on the use of the rail corridor. Due to the importance of the Botany Line, the project would be staged to avoid any potential impacts on the operation of the line, with any works impacting on the use of the corridor to be undertaken during designated possession periods when trains do not run along the line. This staging of the works would ensure that impacts on this transport corridor are kept to a minimum. Further discussion regarding the staging of the project is provided in Chapter 7 of this Environmental Impact Statement.

Construction works within the project site would result in impacts on a number of properties located outside the rail corridor. Impacts to land use during construction are considered to be minimal as the majority impacted properties are not used for any specific land use (including landscaped areas) and in many cases, are vacant. All proposed areas are also directly adjacent to the rail corridor. The temporary use of these properties is not considered to result in any land use impacts due to these areas not being used for any specific purposes currently. Following construction, these areas would be returned to the owners.

A number of existing advertising structures (used to support large advertising signs/billboards) would also be impacted by the project along Airport Drive and Qantas Drive. The location of billboards and likely extent of impact have been shown previously in Figure 6.7 in Chapter 6. Of the nineteen billboards located along Qantas Drive, and Joyce Drive, it is currently proposed that six would be retained, seven would be removed during construction and relocated at the completion of works, and the impacts on an additional six would be assessed during ongoing design and in consultation with owners of the land, lessors and lessees.

Further consideration of the business impacts of the billboard modifications are discussed in Chapter 19.

17.3.2 Property impacts

Property and land requirements for construction

As described in Chapter 6, the project would require the partial permanent land acquisition of seven properties to accommodate a wider rail corridor. These properties are located adjacent to the southern side of the rail corridor to the north of Qantas Drive and Joyce Drive. Property and land acquisition details are included in Table 17.1 with the location of properties shown on Figure 6.7 (Chapter 6).

The impacted land is largely vacant with the exception of some large advertising billboards (impacts on billboards is discussed in section 17.3.1) located on select parcels. The parcels have limited development potential due to their size (ie narrow) and positioning between the rail corridor and Qantas Drive–Joyce Drive. As such, any future developments of land impacted by the project are likely limited to developments such as the existing billboards. The minor reduction of the size of these parcels of land is not considered to result in any impacts on the current development potential due to the current restriction on this land because of its size and location between major transport infrastructure.

Overall the permanent partial acquisition of properties is not considered to result in any substantial property impacts as development potential of these properties would largely be unchanged due to the existing nature of the properties which currently limited the development potential of the land. The acquisition of privately owned land would be managed in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.

Table 17.1 Permanent land acquisition requirements

LOT/DP	TOTAL AREA (m^2)	APPROX. IMPACTED AREA (m^2)	EXISTING LAND ZONING	OWNER
Lot 2 DP 1039806	18,110	400	B5 – Business development	Private
Lot 1 DP 1039806	29,970	580	B5 – Business development	Private
Lot 401 DP 1215182	1,778	250	B5 – Business development	Private
Lot 52 DP1097377	7,086	270	B5 – Business development	Private
Lot 201 DP 777213	2,917	160	B5 – Business development	Private

Temporary occupation requirements for construction

As described in Chapter 7, construction of the project would require the temporary occupation of some land to facilitate construction. Temporary leases would be in the form of construction easements which would allow the use of these areas during construction, including for the use of construction compounds (such as those currently being used for the Airport East project adjacent to General Holmes Drive), crane pads and temporary billboard removal (and replacement activities). Land considered for temporary occupation would typically be located adjacent to the existing rail corridor and in generally cleared areas. The land would be rehabilitated and returned to the respective landowners on completion of the project. The location of proposed construction work areas and compounds are shown on Figure 7.7 in section 7.4.

The occupation of these properties in general would result in temporary land use and property impacts. Following construction, all land would be rehabilitated to its original condition and returned to the affected land owners.

Site access

A number of access locations would be established along the project site, these would either use existing locations or proposed access locations, where necessary. The location of existing and proposed new access gates is shown on Figure 7.2 in Chapter 7. New access locations include, adjacent to Robey Street bridge, Qantas Drive and Joyce Drive. The construction of these access gates would require the construction of new driveway access from the adjacent road network.

17.3.3 Cumulative impacts

The project would result in limited changes in land use in the long term and therefore would not contribute to any cumulative land use changes in the region. Any short-term impacts on land use would also be limited, with the majority of the project located within the rail corridor, not resulting in a substantial change to existing land uses.

17.4 Assessment of operational impacts

17.4.1 Land use

Direct impacts on land use

Operation of the project would result in minimal direct impacts on land use. The project would involve the continued use of a rail corridor for transport purposes. Direct operational impacts on land use would relate to the required property acquisition described in section 17.3.2. By maximising the use of existing rail corridor land, the need for property acquisition has been minimised.

The impacts due to changes of land use associated with the acquisition of land as part of the project are generally considered to be minimal. The majority of land to be impacted is currently unoccupied (with the exception of the billboards), directly adjacent to the rail corridor and is of a size which means use of this land for any other purposes is limited.

Impacts on future land use

The operation of the project would not result in any substantial impacts on the future land use opportunities in the study area.

17.4.2 Property impacts

While permanent land acquisitions are required to allow operation of the project, property acquisition would occur during the project planning and pre-construction phases of the project.

A number of additional corridor access roads are proposed to be used for maintenance access to the corridor. The location of these access roads is included in Table 6.4 in Chapter 6. The provision of new access roads is unlikely to have property impacts as the gates are located with access to the existing road network.

17.4.3 Cumulative impacts

The assessment of potential cumulative impacts, summarised in Chapter 24 (Cumulative impacts), considered the potential for impacts taking into account other projects being undertaken.

The project would result in limited changes in land use in the long term and therefore does not contribute to any cumulative land use changes in the region. Any short-term impacts on land use would also be limited, with the majority of the project located within the rail corridor, not resulting in a substantial changes to existing land uses.

17.5 Management of impacts

17.5.1 Approach

ARTC is committed to minimising the environmental impact of the project and is investigating opportunities to reduce actual impact areas where practicable. Due to the majority of the project being confined to the rail corridor, there is limited impact on land use and properties throughout much of the project area. However, due to the temporary and permanent partial land acquisitions required during both construction and operational stages, and modifications/relocations of billboards, there are opportunities to minimise impacts and disruptions.

ARTC has, where possible, sought to minimise impacts on land use and property through a number of measures including design considerations to minimise permanent impacts on private property outside the rail corridor, consideration of the location and positioning of construction compounds, utilisation of existing access points to the rail corridor, and minimising impacts associated with the billboards including reinstatement and any required relocations.

17.5.2 List of mitigation measures

The mitigation measures that would be implemented to address potential land use and property impacts are listed in Table 17.2. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 17.2 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Design	Property acquisition	The overall disturbance footprint will continue to be refined during detailed design to identify areas where it could be minimised to reduce impacts on existing land uses. Detailed staging of the project will also be determined during detailed design and will aim to minimise the time that affected land uses are impacted during construction.	N/A – Design phase	N/A – Design phase
	Property acquisition	The relevant property owners will be consulted in relation to the acquisition of properties required to facilitate the project. All acquisitions required for the project will be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and the land acquisition reforms announced by the NSW Government in 2016.	N/A – Design phase	N/A – Design phase

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Establishment of compound sites within private property	Temporary occupation of required site compounds will be negotiated under legal agreement with property owners. On completion of the project, the land will be returned to the owners for continued future use.	N/A – Design phase	N/A – Design phase
	Billboard modification/ relocation	The overall disturbance footprint will be refined during detailed design to identify areas where the footprint could be minimised to reduce impacts on billboards and to minimise modification or relocation where possible.	N/A – Design phase	N/A – Design phase
Construction	Billboard modification/ relocation	The removal, and reinstatement of billboards will be undertaken in consultation with land owners and billboard owners.	✓	✓
	Billboard modification/ relocation	As a priority, billboards will be replaced like for like. If replacement and relocation are not available, the affected parties will be appropriately compensated under the *Land Acquisition (Just terms Compensation) Act 1991.*	✓	✓
	Access to private property/ businesses/ Sydney Airport	Consultation will be carried throughout construction with the surrounding businesses, the local community and key stakeholders including Bayside Local Council, Sydney Airport and other potentially impacted stakeholders to advise them in advance of proposed works and any temporary access arrangements that may be required.	✓	✓
	Access to private property/ businesses/ Sydney Airport	Prior to any impact on access, alternative arrangements will be negotiated with the affected parties in order to enable continued access and to minimise disruption as much as reasonably possible.	✓	✓
	General construction activities	Affected property owners and businesses will be provided with advanced notification of relevant project schedules, construction works and changes to access arrangements.	✓	✓

17.5.3 Consideration of the interaction between measures

Mitigation measures to manage the potential for air quality, noise, dust, socio-economic, waste, and health and safety impacts would also assist in minimising the potential for land use and property impacts in relation to any amenity impact on properties.

17.5.4 Managing residual impacts

Due to the limited changes in land use and the majority of the works being positioned within the existing rail corridor, any residual land use impacts are considered minimal.

18. LANDSCAPE AND VISUAL

This chapter provides a summary of the landscape character and visual impact assessment undertaken by IRIS Visual Planning + Design. The full assessment is provided as *Technical Report 11 – Landscape and Visual Impact Assessment*.

18.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies guiding the approach and the methodology used to undertake the assessment.

18.1.1 Legislative and policy context to the assessment

The assessment was undertaken with reference to the requirements summarised below.

Better Placed, Office of the NSW State Government Architect

The Office of the NSW State Government Architect has prepared a suite of documents under the title, 'Better Placed' that aim to improve the urban design quality of places in NSW. These documents include:

- *Better Placed: An integrated design policy for the built environment of NSW, State Government Architect NSW* (2018a)
- *Better Placed: Draft Good Urban Design Strategies for realising Better Placed objectives in the design of the built environment, State Government Architect NSW* (2018a)
- *Better Methods: Evaluating Good Design, Implementing Better Placed design objectives into projects* (2018c).

These documents are intended to inform those involved in the design, planning, and development of the built environment in NSW. The overriding policy establishes the objectives and expectations in relation to design and creating good places.

Botany Bay Local Environmental Plan, 2013

This Plan (City of Botany Bay 2013a) aims to make local environmental planning provisions for land in the City of Botany Bay LGA. Relevant aims include:

"(d) to identify and conserve those items and localities that contribute to the local built form and the environmental and cultural heritage of Botany Bay,
(e) to protect and enhance the natural and cultural landscapes in Botany Bay,
(f) to create a highly liveable urban place through the promotion of design excellence in all elements of the built environment and public domain,
(g) to protect residential amenity. (clause 1.2.2)".

Botany Bay Development Control Plan, 2013

The DCP (City of Botany Bay 2013b) aims to guide future development within the Bayside Council LGA.

The objectives of this DCP include several references to amenity, liveability and public domain quality, including:

- *"to create a highly liveable urban place, through promotion of design excellence in all elements of the built environment and public domain*
- *to minimise negative impacts of development on the amenity of adjoining properties, in particular to reduce the land use conflict between residential and non-residential uses*
- *to ensure that new development protects and enhances the public domain".*

The DCP identifies nine character precincts in the council area. The Botany Line traverses three of these character precincts, which are: Mascot, Botany and Pagewood.

EIA-N04 Guidelines for Landscape Character and Visual Impact Assessment, NSW State Government, Roads and Maritime Services (2018)

This guideline includes a detailed methodology for landscape character and visual impact assessment of road infrastructure projects. The methodology used for the assessment was based generally upon the principles contained in this guideline.

The Guidance Note for Landscape and Visual Assessment (GNLVA), Australian Institute of Landscape Architects Queensland (2018)

This industry document offers guidance including definitions of key terms used for landscape and visual assessment. This document has been used to provide general principles and guidance for the scoping element of the landscape character and visual assessment.

Other guidance

The following guidelines provide useful definitions and design standards with regard to visual impact at night:

- *AS4282 Control of the obtrusive effects of outdoor lighting, Standards Australia* (1997)
- *Guidance for the reduction of obtrusive light, Institution of Lighting Engineers* (UK) (2011).

18.1.2 Methodology

Key tasks

The landscape and visual impact assessment included the following key tasks:

- identification of the existing visual environment, including identification of landscape character areas and the sensitivity of key receptors. A site inspection was completed to select viewpoints and take photographs
- an assessment of the impact on landscape character during construction and operation
- an assessment of the daytime visual impact during construction and operation
- an assessment of night time visual impact during construction and operation (including light spill)
- identification of mitigation measures.

Landscape character impact assessment

Landscape character in the urban context refers to the overall character and function of a place. It includes all elements within the public realm and the interrelationship between these elements and the people who use it.

Landscape character can be directly or indirectly impacted by a project. To address these impacts, an assessment was carried out by identifying the landscape character, the sensitivity of the character area and the likely magnitude of change expected as a result of the project (ie the visual modification). An overall assessment of the level of impact was then made based on the sensitivity and modification levels based on the assessment matrix shown in Table 18.1.

Landscape sensitivity refers to the value placed on a landscape and the level of service it provides to the community. The landscape sensitivity criteria were defined as follows:

- **National** – Precinct containing a landscape feature protected with national or international legislation.
- **State** – Precinct containing a landscape feature or urban place that is heavily used or is iconic to the State.
- **Regional –** Precinct containing a landscape feature or urban place that is heavily used and valued by residents of a major portion of a city or a non-metropolitan region.
- **Local** – Precinct containing a landscape feature or urban place valued and experienced by concentrations of residents or local recreational users, or providing a considerable service to the community.
- **Neighbourhood** – Precinct containing a landscape feature valued and appreciated primarily by a small number of residents or providing a noticeable service to the community.

Landscape modification refers to the change to the landscape character that would occur as a result of the project. The landscape modification criteria were defined as follows:

- **Considerable reduction or improvement** – Substantial portion of the landscape is changed.
- **Noticeable reduction or improvement** – A portion of the landscape is changed.
- **No perceived reduction or improvement** – Either the landscape quality is unchanged or, if it is, it is largely mitigated by proposed public realm improvements.

Visual impact assessment

Visual impact assessment considers visual amenity as experienced by the users of the study area. It aims to identify the range of views to the site which may be impacted, including views from residential areas, commercial areas, parks and streets.

An assessment was carried out identifying visual receivers, the sensitivity of the receivers and the likely visual modification expected as a result of the project. An overall assessment of the level of impact was then made based on the sensitivity and modification levels contained in the assessment matrix shown in Table 18.1.

Sensitivity criteria for visual receivers were defined as follows:

- **National** – Heavily experienced view to a national icon.
- **State** – Heavily experienced view to a feature or landscape that is iconic to the State.
- **Regional –** Heavily experienced view to a feature or landscape that is iconic to a major portion of a city or a non-metropolitan region, or an important view from an area of regional open space.
- **Local** – High quality view experienced by concentrations of residents, local recreational users, local commercial areas or large numbers of road or rail users.
- **Neighbourhood** – Views where visual amenity is not particularly valued by the wider community. This would include views from private residences and local streets.

Visual modification describes the extent of change resulting from the project and the visual compatibility of these new elements with the surrounding landscape. The criteria for visual modification were defined as follows:

- **Considerable reduction or improvement** – Substantial part of the view is altered.
- **Noticeable reduction or improvement** – Alteration to the view is clearly visible.
- **No perceived reduction or improvement** – Either the view is unchanged or, if it is, the change in the view is generally unlikely to be perceived by viewers.

The assessment matrix for landscape and visual impact levels is shown in Table 18.1.

Table 18.1 Landscape and visual impact levels

		SENSITIVITY LEVEL				
		National	**State**	**Regional**	**Local**	**Neighbourhood**
MODIFICATION LEVEL	**Considerable reduction**	Very high adverse	Very high adverse	High adverse	Moderate adverse	Minor adverse
	Noticeable reduction	Very high adverse	High adverse	Moderate adverse	Minor adverse	Negligible
	No perceived change	Negligible	Negligible	Negligible	Negligible	Negligible
	Noticeable improvement	Very high beneficial	High beneficial	Moderate beneficial	Minor beneficial	Negligible
	Considerable improvement	Very high beneficial	Very high beneficial	High beneficial	Moderate beneficial	Minor beneficial

The assessment of night time impact also considered the *Guidance for the reduction of obtrusive light, Institution of Lighting Engineers (UK)* (2011), as well as *AS4282 Control of the obtrusive effects of outdoor lighting*, Standards Australia (1997).

Study area

The study area for the landscape character and visual impact assessment is the potential visual catchment of the project, extending generally from areas along the existing Botany Line from Mascot in the northwest, to Botany and Pagewood in the southeast. The study area is shown on Figure 18.1.

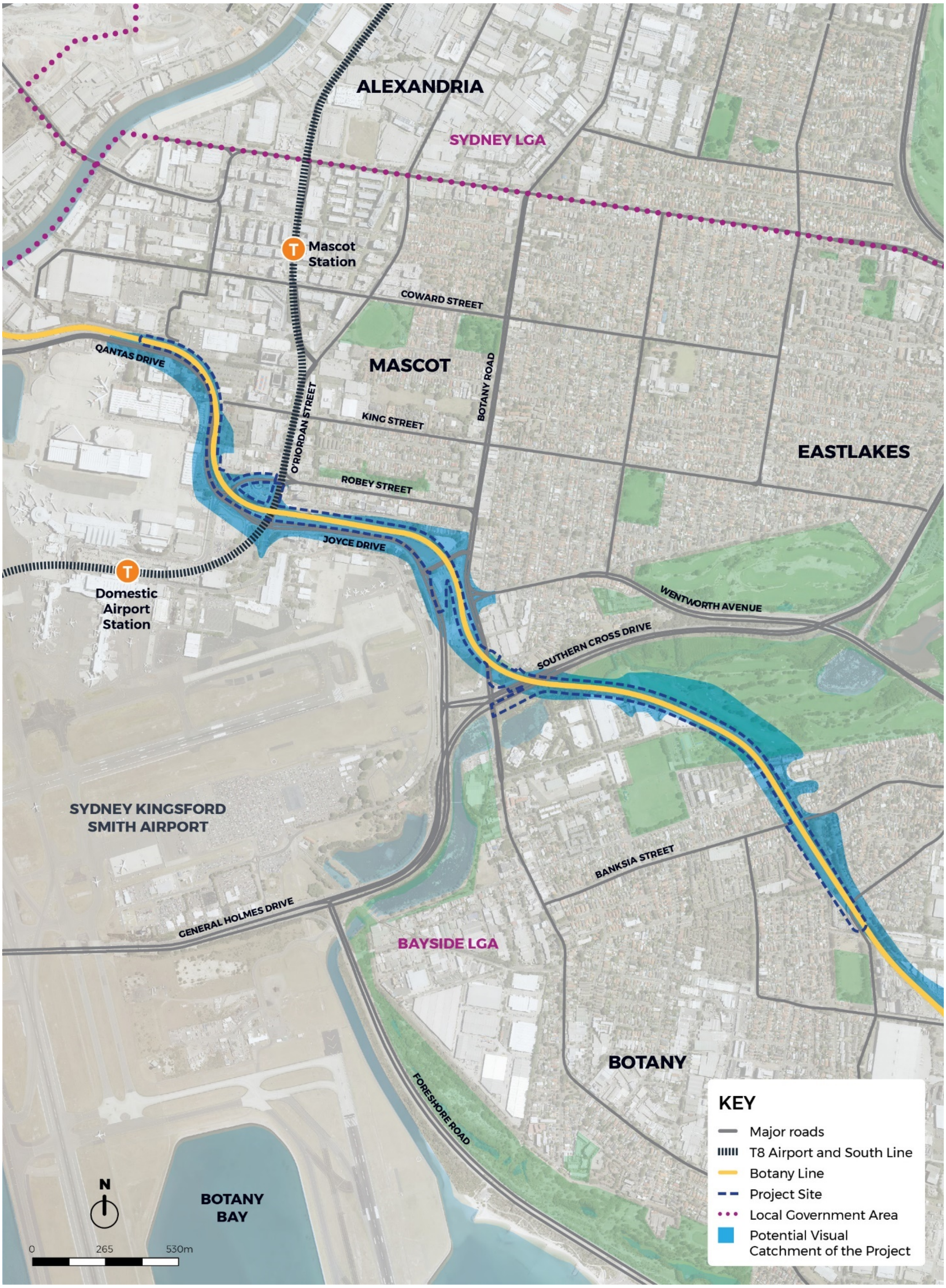


Figure 18.1 Landscape character and visual impact assessment study area

18.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with landscape character and existing views. Potential risks were considered according to the impacts that may be generated by the construction or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology and the full results, is provided in Appendix B.

Prior to assessment and identification of mitigation measures, risks with an assessed level of medium or above include:

- visual impacts on nearby residents and business owners due to the presence of construction compounds and work areas
- light impacts from out-of-hours work during construction
- adverse impacts on landscape character during construction
- impacts on visual amenity due to the introduction of built elements, including new bridges and embankments, and the removal of vegetation which currently provides some screening.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 18.6.4.

18.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning for the project has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process. This included:

- the location of construction compounds and other construction areas to avoid impacts on areas of sensitive landscape character and visual amenity. Where possible, these areas have been positioned to avoid trees and within previously disturbed areas
- where construction compounds and other construction areas have been identified outside the rail corridor, these sites have been selected to be positioned within public land wherever possible or areas which have previously been disturbed and therefore are locations with less sensitive landscape character and visual amenity
- the construction methodology for the project, in combination with the rail alignment for the project, seeks to minimise impacts on existing billboards during construction.

18.2 Existing environment

The project passes through the Bayside LGA between Sydney Airport in the northwest and Botany Bay in the southeast. The Botany Line travels through the mixed-use suburbs of Mascot and Botany with industrial, commercial and residential uses and the mainly residential suburb of Pagewood.

The landscape character and visual environment of the study area is characterised by its highly developed urban nature. The landscape is dominated by Sydney Airport and its facilities, which include large expanses of open and paved areas (the runways and surrounding land), roads, large terminal and freight facilities, and various other buildings and infrastructure. The airport is highly visible from numerous viewpoints in the study area.

The rail corridor, along with the existing motorways, creates strong dividing lines through the area, physically and visually separating the airport from the medium to high density hotel and commercial precinct of Mascot.

As the Botany Line crosses over Southern Cross Drive (M1 motorway) into Botany, it interfaces with the Eastlake golf course to the north and industrial uses to the south. The rail line passes residential areas south of Myrtle Street to Botany.

The project site is predominantly located within and adjacent to the existing rail corridor and views to the site are limited.

18.2.1 Landscape character precincts

Several landscape character precincts were identified for the Botany Bay area in the *Botany Bay Development Control Plan 2013* (City of Botany Bay 2013b). These were adopted as the landscape character areas for the assessment as they accurately reflect the different landscape characteristics of the study area. The precincts are:

- Mascot character precinct
- Botany character precinct
- Pagewood character precinct.

These character precincts are discussed further in this section and their locations are shown on Figure 18.2.

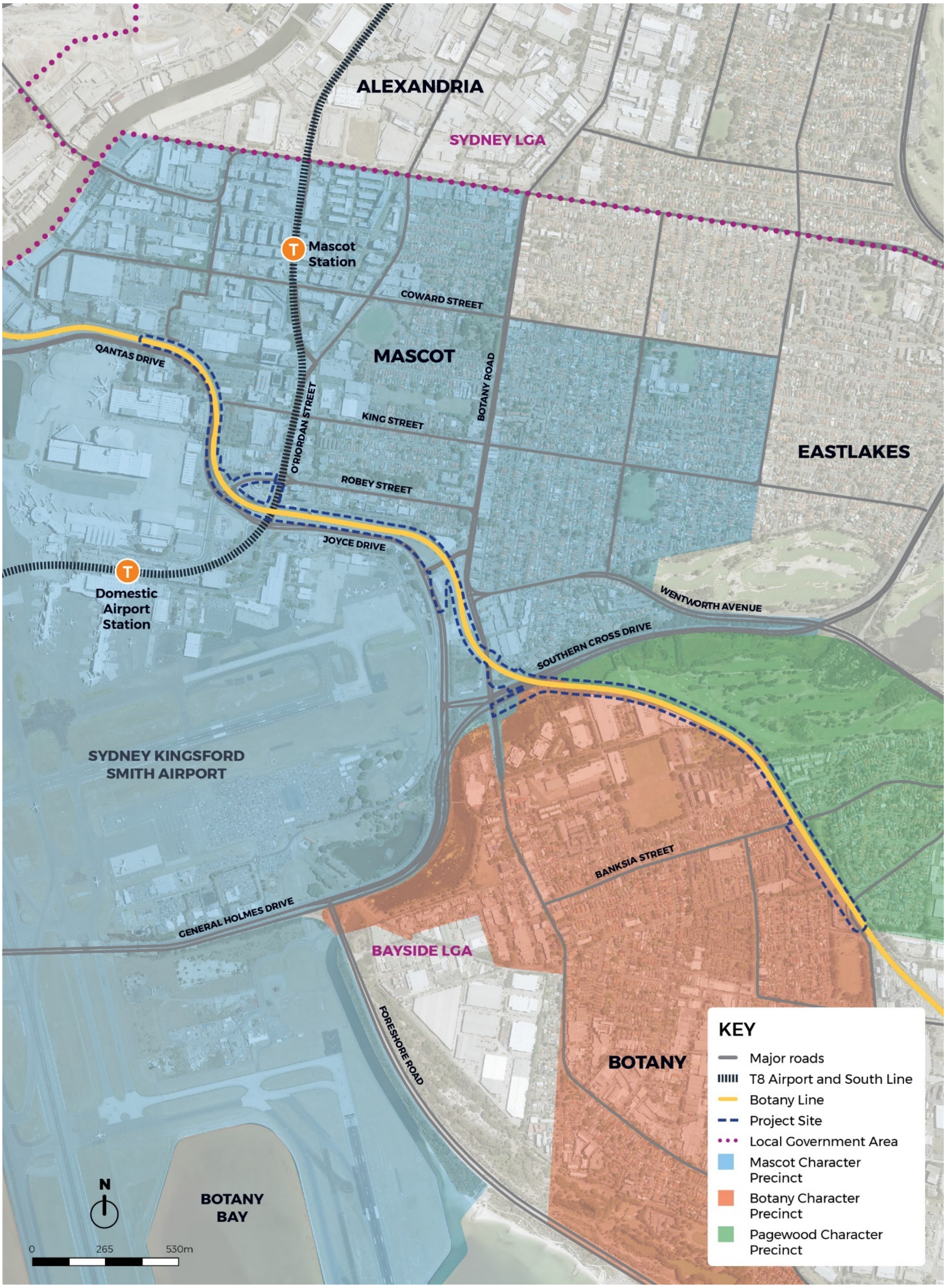


Figure 18.2 Location of project and character precincts

Mascot character precinct

This precinct includes Sydney Airport and nearby commercial, light industrial and retail development associated with the airport. It extends to the north of Southern Cross Drive across an area of detached and semi-detached single storey dwellings set among high-rise airport-related developments, including hotels and multi-storey car parks and office buildings. O'Riordan Street, Robey Street and Botany Road include shops, cafes and restaurants. There are also offices located along main routes leading to the airport.

Corridors of mature trees are positioned along and adjacent to the existing rail corridor, including between O'Riordan Street and Robey Street and along Qantas Drive. These trees provide a visual separation between the airport and adjacent residential, commercial and retail development. They also provide amenity within this otherwise densely urban landscape.

The existing rail corridor consists of a single track on an embankment. There are a mix of bridges and level crossings at road intersections. The O'Riordan Street, Robey Street and Botany Road underbridges are listed on the Transport for NSW S170 Heritage Register, providing visual reminders of early welding techniques for steel bridge and reinforced concrete construction. These bridges are considered to have aesthetic significance. However, a substantial part of the fabric of these bridges has been covered by advertising signage, reducing their aesthetic quality.

This character area is dominated by vehicles resulting in low street tree cover, disjointed footpaths with broad signalised pedestrian crossings. Construction works currently underway have diverted footpaths in several locations in the vicinity of O'Riordan Street, reducing legibility and comfort for pedestrians. The scale of the airport and associated facilities, mix of uses in this precinct and existing character of large-scale linear infrastructure create a relatively high visual absorption capacity (the potential for a landscape or scene to absorb a particular change without a noticeable loss of valued attributes).

Botany character precinct

The Botany Wetlands and Water Reserves landscape is listed on the State Heritage Register and consists of a series of interconnected open freshwater ponds, former water supply dams, some shallow swamp areas and adjacent lands used for recreation (golf). The wetlands, including distinctive freshwater wetlands and Banksia scrub, are an integral part of this precinct and have special interest as a landmark cultural and recreational landscape for the regional community. This reserve represents a substantial tract of greenspace with important landscape attributes including extensive areas of water, wetlands, plantings, archaeological features, dunes, remnant indigenous vegetation and fauna – providing notable scenery.

Much of the wetlands landscape in this precinct is inaccessible for public recreation. The vegetation in and adjacent to the wetlands largely encloses views and provides a visual buffer between the project and adjacent industrial, commercial and residential uses, particularly at Mill Pond. The project site passes through the wetlands and Mill Stream via a bridge, consisting of a single-track concrete bridge with three-spans of rail planks.

South of the wetlands, there is a mixture of land uses. This includes light industry along Lord Street, an Aquatic Centre along Myrtle Street and medium density residential precincts along the railway line between Myrtle Street and Bay Street, and between Banksia and Morgan streets. The heritage listed Booralee Park is a focal point for a precinct of low density residential development south and east of Bay Street.

Low density residential properties along Ellis Street are located opposite the rail corridor. A footbridge, with stairs and large ramping structures, provides a connection to Banksia Street and areas to the north.

Publicly accessible areas of the Botany character area are dominated by large roads with low street tree cover, disjointed footpaths with broad signalised pedestrian crossings. The existing rail corridor forms a strong north and eastern border to this precinct. The presence of the existing freight rail corridor and the mix of existing uses increases the absorption capacity of this landscape to accommodate development.

Pagewood character precinct

This precinct is predominantly low density residential development, extending northeast from the Botany Line. This includes mainly one and two storey detached dwellings of varying architectural styles and periods. There are several low–medium rise apartment blocks and townhouse developments along Myrtle and Bay streets, adjacent to the rail corridor. Those along Myrtle Street overlook Eastlake golf course.

The precinct contains a large area of open space, including Eastlake golf course, Botany Wetlands and water reserves and Gaiarine Gardens. The Botany Line is located along the south and eastern boundary of the precinct. The rail corridor forms a strong visual edge to this precinct, which is otherwise relatively coherent in its residential character with leafy gardens and parkland. The absorption capacity of this landscape to accommodate development is lessened by the finer grained development and consistency of built form type.

18.2.2 Existing views

The following viewing locations were selected as representative of the range of views to the project (see Figure 18.3 for viewpoint locations). They include views to represent groups of receivers including adjacent residents and users of hotels, parks, footpaths and roads.

Representative viewpoints:

1. View north across the intersection of Joyce Drive and O’Riordan Street intersection
2. View south along Robey Street
3. View south along O’Riordan street
4. View from upper café level of the Citadines Connect Sydney Airport Hotel
5. View southwest from Baxter Road
6. View along Myrtle Street (east of track)
7. View along Myrtle Street (west of track)
8. View along Bay Street (east of track)
9. View east from Ellis Street
10. View south from Banksia Street footbridge
11. View west from Gaiarine Gardens
12. View west from Ocean Street.

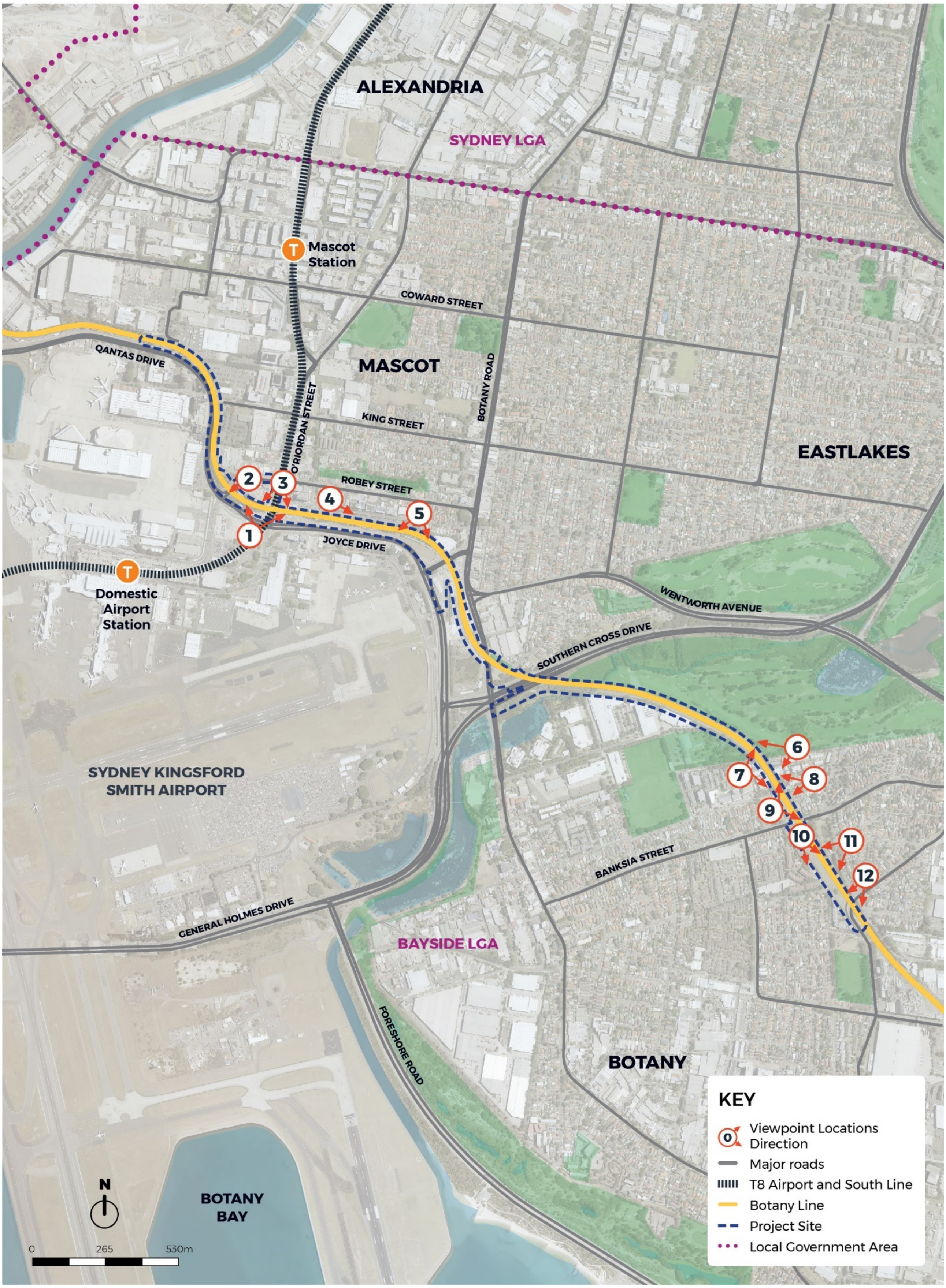


Figure 18.3 Viewpoint location plan

18.2.3 Visual conditions at night

Existing night time conditions can be described using the environmental zones identified in *Guidance for the reduction of obtrusive light* (Institution of Lighting Engineers UK, 2011), which are:

- E0: Protected dark landscapes
- E1: Intrinsically dark landscapes
- E2: Low district brightness areas
- E3: Medium district brightness areas
- E4: High district brightness areas.

The existing visual night time conditions of the character precincts for the project are discussed below.

Mascot character precinct

This precinct is an area of E4: High district brightness due to the concentration of lighting at Sydney Airport and adjacent brightly lit commercial, light industrial and retail buildings within Mascot. The major roads of Botany Road, Joyce and Qantas Drives, and O'Riordan Street are brightly lit with streetlights, billboard lighting and vehicle headlights all contributing to the dynamic night time scene. There would also be train headlights from existing freight train movements along the Botany Line.

Botany character precinct

This precinct is an area of E3: Medium district brightness, where there is a lower level of lighting associated with the predominantly low and medium rise residential development in Botany. The headlights of trains passing along the existing Botany Line would increase the night time brightness of areas in close proximity to the rail corridor. This precinct also includes light industrial and commercial uses at Lord and Bay Streets, and the Botany Aquatic Centre beside the Botany Line, which would be brightly lit at night. However, the northern part of this precinct at Mill Stream and the golf course would be predominantly dark at night. The street lighting and vehicle headlights from adjacent roads (Southern Cross Drive and Botany Road) would spill into these open space areas.

Pagewood character precinct

This precinct is an area of E3: Medium district brightness, it is located to the east of the existing Botany Line, including the Eastlake golf course and low and medium rise residential buildings at Pagewood. Streetlights within the residential areas and the train headlights along the existing Botany Line would further add to the night scene. Mature vegetation along the edge of the rail corridor would assist with reducing the light spill to adjacent residential areas. The lighting from residential areas contrasts with the low-lit natural area along Mill Stream and adjacent golf course, in the northern part of the precinct.

18.3 Assessment of construction impacts

A number of early and enabling works would be required to be undertaken prior to the main civil and track work. The enabling works relevant to landscape and visual impacts are:

- construction works related to track realignment/slewing track, utility service relocation and protection compound site set up
- temporary removal of billboards
- vegetation removal along and adjacent to the existing rail corridor through Mascot and Botany.

The construction works relevant to landscape character and visual impact are:

- construction of the new and upgraded track, drainage and signalling
- demolition and construction of new bridges and retaining walls
- reinstatement of billboards and signage infrastructure.

18.3.1 Landscape impact

Table 18.2 provides a summary of the assessment of landscape impacts of each character precinct during construction.

This shows that due to the scale of work within the Mascot character precinct and its sensitivity, there would be a moderate adverse landscape character impact during construction and there would be minor adverse landscape character impacts in the Botany and Pagewood character precincts.

Table 18.2 Summary assessment of landscape impacts during construction

CHARACTER PRECINCT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Mascot character precinct	Regional	Noticeable reduction	Moderate adverse	Construction works within the Mascot character precinct, includes widening of the rail corridor, installation of retaining walls and new track, several bridge replacements, the removal of trees along the southern side of the rail corridor, and the location of site compounds and material storage areas at prominent intersections. Overall, the level of modification would result in a noticeable reduction in the landscape quality of this precinct during construction. While this precinct has a relatively high visual absorption capacity, the character of the construction works would reduce the quality of the landscape particularly where the trees are removed, and new bridges constructed. As this is a landscape of regional sensitivity, this would result in a **moderate adverse landscape** impact during construction.

CHARACTER PRECINCT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Botany character precinct	Local	Noticeable reduction	Minor adverse	Construction activities within this precinct would be generally located within and adjacent to the existing rail corridor. It would include removal of vegetation, widening of earth embankments, construction of retaining walls and establishment of site compounds, material storage areas and site compounds. The scale of work would be greater in the vicinity of the urban road corridors of Botany Road and Southern Cross Drive, where it is compatible with the scale of the urban road corridors. Works to construct the Mill Stream bridge would be visually contained by the surrounding open space and vegetation, as would the works along the rail corridor in the vicinity of the industrial areas of Botany around Lord Street. It is expected that there would be a noticeable reduction in the character of this precinct during construction. As this precinct is of local sensitivity, this would result in a **minor adverse landscape impact** during construction.
Pagewood character precinct	Neighbourhood	Considerable reduction	Minor adverse	Works within this precinct includes installation of an access track, removal of a small amount of vegetation and establishment of a material storage and laydown area. It is expected that there would be a considerable reduction in the landscape character of the southern edge of this precinct due to the introduction of construction activities in close proximity to neighbouring properties. As this precinct is of neighbourhood sensitivity, there would be a **minor adverse landscape impact** during construction.

18.3.2 Visual impact

Table 18.3 provides a summary of the assessment of visual impacts at each representative viewpoint during construction.

This indicates that during construction there would be a moderate adverse impact in views in the vicinity of the airport including from the Joyce Drive and O’Riordan Street intersection, Robey Street and O’Riordan Street. This is due to the removal of trees, and the scale of works required for bridgeworks, retaining walls and embankment construction occurring on the south and west of the existing rail corridor. In these locations construction activity and site compounds would comprise a large portion of these views.

In views generally from Botany Road east to the residential areas of Botany, there would be minor adverse visual impacts during construction. This includes views from adjacent roads, residential and recreation areas. In these areas the works would be of a smaller scale and contained within the rail corridor. There would also be more vegetation retained along the interface with the open space areas.

Table 18.3 Summary assessment of visual impacts during construction

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 1: View north across the Joyce Drive and O'Riordan Street intersection  	Regional	Noticeable reduction	Moderate adverse	Construction activity would extend across much of this view. This would include establishment of the construction work area (including site fencing and hoarding), construction compound, removal of existing billboards, installation of a concrete retaining wall and removal of some trees along the rail corridor in this vicinity. After the bridge, tracks, retaining walls and signalling have been installed, finishing works would be visible. Due to the absorption capacity of this urban landscape, the project would create a noticeable reduction in the amenity of this view, which is of regional sensitivity, resulting in a **moderate adverse visual impact** during construction.
Viewpoint 2: View south along Robey Street 	Local	Considerable reduction	Moderate adverse	Construction activity such as establishment of the construction work area (including site fencing and hoarding) and removal of some trees and vegetation alongside the Stamford Hotel would be visible in this view. Other modifications would include a new access gate alongside the southern bridge abutment and demolition of the Robey Street bridge. Construction of the proposed twin single span concrete bridge would also be seen, along with retaining walls. After the bridge, tracks, retaining walls and signalling have been installed, finishing works would be visible. Due to the scale of the works, removal of trees and the close proximity to the adjacent commercial and retail areas of Mascot, there would be a considerable reduction in the amenity of this view. As this is a view of local sensitivity, this would result in a **moderate adverse visual impact** during construction.

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 3: View south along O’Riordan Street 	Local	Considerable reduction	Moderate adverse	Construction activity such as establishment of the construction work area (including site fencing and hoarding) and removal of billboard signs which would be seen in this view. Other modifications would include demolition of the O’Riordan Street bridge and replacement with a twin single span concrete bridge. After completion of the bridges, tracks and signalling would be installed, and the finishing works, including works to rectify the adjacent roads, foot and cycle paths would be visible. The works would introduce a construction character that would extend across much of this view. Overall this change would create a considerable reduction in the amenity of this view, which is of local sensitivity, resulting in a **moderate adverse visual impact** during construction.
Viewpoint 4: View from upper café level of the Citadines Connect Sydney Airport Hotel 	Neighbourhood	Noticeable reduction	Negligible	The construction activity would be seen in the background of views from the hotels to the north of the rail corridor such as the Citadines Connect Sydney Airport Hotel. The existing trees along the southern side of the rail corridor would be removed during enabling works. The billboard extending over the rail corridor would, be retained. This construction activity would be seen from the upper level café and hotel rooms facing the rail corridor. Overall, this change would create a noticeable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **negligible visual impact** during construction.

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 5: View southwest from Baxter Road 	Neighbourhood	Noticeable reduction	Negligible	Construction activity would be visible in the middle to background of this view, including fencing and hoarding and the associated removal of some vegetation along the existing rail embankment. Works to construct embankments to widen the rail corridor and install the new track would be visible through the existing foreground elements. This activity would be seen from the road corridor, footpaths and from adjacent south facing rooms from adjacent residences, offices and hotel rooms. Overall, this change would create a noticeable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **negligible visual impact** during construction.
Viewpoint 6: View along Myrtle Street (east of track) 	Neighbourhood	Considerable reduction	Minor adverse	Construction activity such as establishment of the construction work area (including site fencing and hoarding) would be visible at the end of Myrtle Street. Other modification would include installation of a material storage and laydown area within the rail corridor north of Myrtle Street, trimming of vegetation which overhangs the rail corridor in this section of the project site and installation of a new access road alongside the golf course. Construction of the rail corridor embankments to widen and install the new track would occur on the western side of the rail corridor. Overall this construction activity would create a considerable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **minor adverse visual impact** during construction.

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 7: View along Myrtle Street (west of track) 	Neighbourhood	Considerable reduction	Minor adverse	Construction activity such as establishment of the construction work area (including site fencing and hoarding) would be visible at the end of Myrtle Street. A new access gate would be installed at the end of Myrtle Street and vehicles, machinery and plant would be seen accessing the site, and within the work area undertaking construction activities to widen the existing embankment to the west (towards Myrtle Street) and install the new track. Overall this construction activity would create a considerable reduction in the amenity of this view of adjacent residences, which is of neighbourhood sensitivity, resulting in a **minor adverse visual impact** during construction.
Viewpoint 8: View along Bay Street (east of track) 	Neighbourhood	Considerable reduction	Minor adverse	Construction activity such as establishment of the construction work area (including site fencing and hoarding) would be seen at the end of Bay Street, in the middle ground of the view. Some construction vehicles would be seen entering the project site in this view. Earthworks and vegetation clearing to widen the rail embankment and install a new access road would be seen in close proximity from rooms and balconies at the second and third level of properties adjacent to the rail corridor. Overall this construction activity would create a considerable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **minor adverse visual impact** during construction.

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 9: View east from Ellis Street 	Neighbourhood	Considerable reduction	Minor adverse	Construction activity including heavy vehicles, machinery and plant travelling along Ellis Street, entering the work area and within the rail corridor would be visible from this view. Construction activity visible in this area would also include earthworks and clearing of vegetation to widen the rail embankment and install the new track and construction of access roads on both sides of the track. Traffic management controls would be seen along Ellis Street, and may include temporary lane closure. Overall, this construction activity would create a considerable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **minor adverse visual impact** during construction.
Viewpoint 10: View south from Banksia Street footbridge 	Neighbourhood	Considerable reduction	Minor adverse	Construction activity within the rail corridor, including fencing, hoarding and a storage and compound area, would be seen in this view. The storage and compound area would extend approximately 200 metres along the western side of the rail corridor towards the Stephen Road overbridge. Construction of the new track would also be visible, merging into the existing track, to the east. Installation of a new access track would also be seen to the west of the track, in a U-turn formation towards the main site access gate at the corner of Banksia and Ellis Street. The vegetation alongside the track perimeter would be retained and filter views from adjacent properties, including the residences between Banksia and Morgan Streets and visitors to Gaiarine Gardens. Overall, this construction activity would create a considerable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **minor adverse visual impact** during construction.

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 11: View west from Gaiarine Gardens 	Local	Noticeable reduction	Minor adverse	The existing rail corridor would be partly converted to a work area and would be seen in the background of this view. Site fencing and hoarding would be visible along the site perimeter. A storage and compound area would extend approximately 200 metres along the western side of the rail corridor. The vegetation along the rail corridor boundary and within the park would be retained and would continue to filter views to the rail corridor. However, due to the close proximity of construction activity, there would be a noticeable reduction in the amenity of this view, which is of local sensitivity, and a **minor adverse visual impact** during construction.
Viewpoint 12: View west from Ocean Street 	Neighbourhood	Noticeable reduction	Negligible	Construction activity at the western side of the Botany Line would be visible in the middle to background of the view. This would include a major compound and materials storage area with site offices and staff parking, internal access road, storage of construction equipment and stockpiles. Vegetation along the edge of the rail corridor, in the foreground of this view, would be retained and filter views to the compound in the background. Overall, this construction activity would create a noticeable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **negligible visual impact** during construction.

18.3.3 Visual impact at night

Table 18.4 provides a summary of the assessment of night time visual impacts during construction.

This indicates that at night there would be a negligible visual impact on views to the site from within the Mascot character precinct. Although there would be night works undertaken for bridge and road works, the setting is brightly lit and there would be a high capacity for this work to be absorbed. There would, however, be a minor adverse visual impact on the Botany and Pagewood landscape character precincts during night works. This is due to a greater contrast between the existing night setting and the potential lighting of the night works.

Table 18.4 Summary assessment of night time visual impacts during construction

CHARACTER PRECINCT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Mascot character precinct	High district brightness (E4)	Noticeable reduction	Negligible	There would be lighting visible above the hoardings surrounding the construction work areas and site compound. This lighting would be seen from adjacent streets, residential and commercial areas as well as hotels that have elevated views over the work area. The brightly lit areas of Botany Road, Joyce and Qantas Drives, and O'Riordan Street, would assist in the absorption of the lighting. Overall, the works would result in a noticeable change to the surrounding night scene. As this precinct is of high district brightness environment, the proposed lighting would result in a **negligible visual impact** at night.
Botany character precinct	Medium district brightness (E3)	Noticeable reduction	Minor adverse	There would be some lighting above the work area and compound between Banksia Street and the Stephen Road overbridge which is likely to be seen from Myrtle and Ellis streets, and from the adjacent commercial and residential buildings to the west of the Botany Line. This lighting may also be seen from the upper levels of adjacent buildings and residences between the Banksia Street and the Stephen Road overbridge. There would also be 24-hour deliveries of large equipment, accompanied by traffic control crews with lighting. Overall, the works would result in a noticeable change to the amenity of the views at night in the vicinity to the Botany Line. As this precinct is of medium district brightness environment, the proposed lighting would result in a **minor adverse visual impact** at night.

CHARACTER PRECINCT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Pagewood character precinct	Medium district brightness (E3)	Noticeable reduction	Minor adverse	Some lighting would be visible above the hoardings and fencing surrounding the construction work area and compound between Banksia Street and the Stephen Road overbridge. However, the upper levels of adjacent residential buildings to the east of the Botany Line may have elevated views over the work area and compound. Overall, there would be a noticeable reduction in the amenity of views from areas adjacent to the site. As this precinct is of medium district brightness environment, the proposed lighting would result in a **minor adverse visual impact** at night.

18.4 Assessment of operational impacts

The main sources of landscape character and visual impact during operation would be:

- wider rail corridor including new rail infrastructure
- additional train movements
- service roads and access.

18.4.1 Landscape impact

Table 18.5 provides a summary of the assessment of landscape impacts of each character precinct during operation.

This shows that the Mascot character precinct would have a moderate adverse landscape impact. This precinct is important to the region as an entry to Sydney and to the airport, and therefore has a higher landscape character sensitivity. The loss of vegetation along the rail corridor, which contributes to the character of the arrival experience, would adversely impact the character of this precinct. The Botany character precinct would have a minor adverse impact on landscape character due to the close proximity of new structures to residential areas and loss of vegetation in the Botany Wetlands.

The project would be more readily absorbed into the Pagewood character precinct, as widening of the existing rail corridor in this precinct would represent an incremental increase in change from the existing character.

Table 18.5 Summary assessment of landscape impacts during operation

CHARACTER PRECINCT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Mascot character precinct	Regional	Noticeable reduction	Moderate adverse	The project would be located within an area with a strong character of linear infrastructure associated with the existing rail corridor, Qantas and Joyce Drive. The existing mature vegetation would be replaced by a retaining wall and new access gate and the visual influence of the freight rail on the character of this precinct would be slightly increased in this area. Overall, it is expected that there would be a noticeable reduction in the landscape character of this precinct, which is a landscape of regional sensitivity, resulting in a **moderate adverse landscape impact** during operation.

CHARACTER PRECINCT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Botany character precinct	Local	Noticeable reduction	Minor adverse	The project would generally be built on the southern side of the existing rail corridor. The higher concentration of rail elements within the existing rail corridor would have a greater influence within the precinct, reinforcing the strong line of the rail corridor as a northern boundary to this precinct. The existing Mill Stream bridge would be retained and there would be a new bridge located alongside the existing bridge. Overall, it is expected that there would be a noticeable reduction in the character of this precinct during operation. As this is a landscape of local sensitivity, there would be a **minor adverse landscape impact** during operation.
Pagewood character precinct	Neighbourhood	Noticeable reduction	Negligible	Works include widening of the existing rail corridor and a new access track along the eastern side of the rail corridor. While being consistent with the existing rail corridor use, there would be an increase in the amount of freight activity within the existing rail corridor. The material storage and laydown area would be reinstated as rail reserve and cleared areas would be revegetated similar to the preconstruction environment. There would be an ongoing reduction in amenity due to the trees having been removed during construction to accommodate the works. Overall, it is expected that there would be a noticeable reduction in the landscape character of this precinct during operation. As this is a landscape of neighbourhood sensitivity, there would be a **negligible landscape impact** during operation.

18.4.2 Visual impact

Table 18.6 provides a summary of the assessment of visual impacts during operation.

This shows that during operation, the project would be largely absorbed into the character of views, due to the existing highly urban character of areas to the west of the site and the reinstatement of the billboards, which largely screen views the bridges at Robey Road and O'Riordan Street. This would result in negligible visual impacts in views to the site from adjacent residential areas, open space and roads. There would be a minor adverse visual impact from Robey Street due to the removal of both vegetation and the Robey Street underbridge.

Table 18.6 Summary assessment of visual impacts during operation

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 1: View north across the Joyce Drive and O'Riordan Street intersection	Regional	No perceived change	Negligible	The proposed O'Riordan Street bridge would be seen in the middle ground of this view. It would be a twin single span concrete bridge with large concrete beams spanning across O'Riordan Street. The new structures would be similar in appearance to the existing bridge. Freight trains would be seen in this view, crossing the new twin bridges. There may be some limited trees and understorey streetscape planting reinstated along the verge of Qantas and Joyce Drive. The impacted billboards would be reinstated generally in the same location, where feasible, as they are currently located, situated to maximise views towards them. Overall, this change would result in no perceived change in the amenity of this view, which is of regional sensitivity, resulting in a **negligible visual impact** during operation.
Viewpoint 2: View south along Robey Street	Local	Noticeable reduction	Minor adverse	The proposed Robey Street bridge would be visible in the centre of this view, including two large precast concrete beams spanning across Robey Street with concrete headstocks and abutments. The new structures would be similar in scale and appearance to the existing bridge. Freight trains would be seen intermittently, travelling across the new twin bridges. Concrete retaining walls extending from the bridge abutments would be visible either side of the bridge. The new bridges would be more visually prominent in the view due to the additional width of two bridges which would be more visually heavy engineering style structures. New fencing would also be seen along the rail corridor, with new planting installed where feasible to visually integrate the retaining walls and embankments into the existing setting and screen views from adjacent commercial properties. The existing trees on the southern side of the track would continue to filter views to the airport at the background of the view. Overall, there would be a noticeable reduction in the amenity of this view which is of local sensitivity, resulting in a **minor adverse visual impact** during operation.

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 3: View south along O'Riordan Street	Local	No perceived change	Negligible	The billboard would be reinstated on the proposed O'Riordan Street bridge subject to consultation with the owner. This billboard would be reinstated generally in the same location and replaced like for like. Although the O'Riordan Street bridge would be replaced, the works would be largely screened by the reinstated billboard and absorbed into this highly urban view. This would result in no perceived change in the amenity of this view, which is of local sensitivity, and a **negligible visual impact** during operation. If the billboards cannot be replaced on the bridge or in its immediate vicinity, it would be relocated along the existing rail corridor and combined with existing structures (such as bridges) where practicable in order to minimise the potential to introduce structures in areas where there are minimal existing structures and infrastructure. In this instance, the O'Riordan Street bridge would be visible from this location. However, due to the high visual absorption capacity of this urban view, which includes heavily trafficked roads and the existing rail corridor, this outcome would not reduce the amenity of this view. Therefore, there would be no perceived change in the amenity of the view, which is of local sensitivity, resulting in a **negligible visual impact** during operation.
Viewpoint 4: View from upper café level of the Citadines Connect Sydney Airport Hotel	Neighbourhood	Noticeable reduction	Negligible	Additional freight trains would be seen in the background of this view, travelling along the widened rail corridor. The existing vegetation would remain. The view to additional rail infrastructure would be seen at a distance and would be consistent in character with the existing rail corridor and freight train activity in the view. As only a relatively small area of this view would be modified, the works would be largely absorbed into this highly urban view. This would result in no perceived change in the amenity of this view which is of neighbourhood sensitivity, and a **negligible visual impact** during operation.

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 5: View southwest from Baxter Road	Neighbourhood	Noticeable reduction	Negligible	The widened rail corridor on an embankment would be visible in the background of view, with trains seen travelling across the view and would be consistent in character with the existing rail corridor and freight train activity in the view. These elements would be closer to the viewer. There would also be unobstructed, elevated views over the rail corridor from the south-facing rooms and balconies of the medium rise hotel development in Baxter Road and would be consistent in character with the existing rail corridor and freight train activity in the view. Overall, this would result in a noticeable reduction in the amenity of this view, which is of local sensitivity, resulting in a **negligible visual impact** during operation.
Viewpoint 6: View along Myrtle Street (east of track)	Neighbourhood	Noticeable reduction	Negligible	Additional freight trains may be seen in the middle ground of this view, filtered through the existing vegetation. The materials storage and laydown area would be reinstated and revegetated. Overall this would result in a noticeable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **negligible visual impact** during operation.
Viewpoint 7: View along Myrtle Street (west of track)	Neighbourhood	Noticeable reduction	Negligible	Additional freight trains may be seen in the middle ground of this view, filtered through the existing vegetation. The materials storage and laydown area would be reinstated and revegetated. Overall this would result in a noticeable reduction in the amenity of this view, which is of neighbourhood sensitivity, resulting in a **negligible visual impact** during operation.
Viewpoint 8: View along Bay Street (east of track)	Neighbourhood	Noticeable reduction	Negligible	The project would be visible from the rooms and balconies at the second and third level of properties adjacent to the rail corridor, with no vegetation filtering these views. There would be views across a wider rail embankment, with two tracks carrying additional trains. On balance, there would be a noticeable reduction to the amenity of this view, which is of neighbourhood sensitivity, resulting in a **negligible visual impact** during operation.
Viewpoint 9: View east from Ellis Street	Neighbourhood	Noticeable reduction	Negligible	There would be views across a wider rail embankment in the foreground of this view, with additional tracks and trains. The project would be visible from the street as well as the gardens, rooms and balconies at the first and second level of properties adjacent to the rail corridor. The rail corridor and trains would be closer to these residential properties, however, the existing vegetation would filter these views. Overall, there would be a noticeable reduction to the amenity of this view, which is of neighbourhood sensitivity, resulting in a **negligible visual impact** during operation.

VIEWPOINT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Viewpoint 10: View south from Banksia Street footbridge	Neighbourhood	No perceived change	Negligible	The project would be seen in the centre of this view, merging with the existing track beside Gaiarine Gardens. A new access track would be seen to the west of the track (left of view), in a U-turn formation leading to the main site access gate at the corner of Banksia and Ellis Street (out of view). The remainder of the site compound and materials storage area would be reinstated as grassed rail verge. The vegetation along the rail corridor boundaries would be retained and continue to filter views from adjacent uses, including residences between Banksia and Morgan Streets (right of view) and visitors to Gaiarine Gardens (left of view). Although a wider rail corridor and more freight trains would be seen in this view, travelling along both tracks, there would be no perceived reduction to the amenity of this view. This is a view of neighbourhood sensitivity, resulting in a **negligible visual impact** during operation.
Viewpoint 11: View west from Gaiarine Gardens	Local	No perceived change	Negligible	The dense, mature vegetation at the boundary of the existing rail corridor and Gaiarine Gardens would continue to filter and screen views to the rail corridor. There would be glimpses to additional freight trains travelling along the Botany Line in the background of this view, beyond the vegetation. Overall, there would be no perceived reduction to the amenity of this view, which is of local sensitivity, resulting in a **negligible visual impact** during operation.
Viewpoint 12: View west from Ocean Street	Neighbourhood	No perceived change	Negligible	The compound to the west of the existing rail corridor would be reinstated, following the completion of construction. The additional track would not be visible from this location. Overall, there would be no perceived reduction to the amenity of this view. This is a view of neighbourhood sensitivity, resulting in a **negligible visual impact** during operation.

18.4.3 Visual impact at night

Table 18.7 provides a summary of the assessment of night time visual impacts during operation.

This indicates that during operation, the project would be largely absorbed into the character of views, due to the existing highly urban character of areas to the west of the site, and the reinstatement of the billboards, which would largely screen views of the proposed bridges at Robey Road and O'Riordan Street. This would result in negligible visual impacts in views to the site from adjacent residential areas, open space, roads. There would be a minor adverse visual impact from Robey Street due to the removal of both vegetation and the Robey Street underbridge.

Table 18.7 Summary assessment of night time visual impacts during operation

CHARACTER PRECINCT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Mascot character precinct	High district brightness (E4)	Noticeable reduction	Negligible	The Mascot character area in the vicinity of the project site is well lit and there are existing trains with headlights moving along the existing rail corridor. However, the project would result in additional trains with vehicle headlights seen travelling on the widened, dual track Botany Line between Mascot and Southern Cross Drive in Botany. Views to the train headlights would be filtered in some areas by existing street trees. Overall, it is expected there would be a noticeable reduction in the amenity of views at night due to the additional trains that might be seen during operation of the project. As this is a high district brightness environment, these would be a **negligible visual impact** to this precinct at night.
Botany character precinct	Medium district brightness (E3)	Noticeable reduction	Minor adverse	Headlights from increased train movements along the Botany Line may be visible from adjacent residential, light industrial and commercial buildings to the west of the Botany Line. Some views to the trains at night would be partly filtered through retained vegetation along the edge of the rail corridor. The new bridges at Mill Stream and Southern Cross Drive would require some removal of vegetation, opening up views to the trains in adjacent light industrial and commercial buildings along Lord Street. Overall, it is expected that during operation there would be a noticeable reduction in the amenity of views at night in the Botany character precinct. As this is a medium district brightness environment, there would be a **minor adverse visual impact** overall.

CHARACTER PRECINCT	SENSITIVITY	MAGNITUDE	IMPACT	COMMENTS
Pagewood character precinct	Medium district brightness (E3)	Noticeable reduction	Minor adverse	Headlights from increased train movements along the Botany Line may be visible from between Southern Cross Drive and Page Street. The residences adjacent to the Botany Line between Myrtle and Banksia streets would have views to the trains, filtered through any retained vegetation along the rail corridor. As the golf course would not be used at night, and the club house is located approximately 800 metres northeast of the Botany Line, this part of the precinct would be unaffected. Overall, this work would result in a noticeable change in the amenity of views at night, particularly from the residential areas along the rail corridor. As this is a medium district brightness environment, there would be a **minor adverse visual impact** to this precinct at night.

18.5 Cumulative impacts

18.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to landscape character and visual amenity are described below.

18.5.2 Cumulative construction impacts

Landscape character

The Botany landscape character would be further changed by the proposed Sydney Gateway road project and completion of the Airport East and Airport North Projects. The Airport East and North Projects would be completed prior to construction of the project. The scale of these upgraded works is consistent with the highly urban character of the precinct and complex road system in the vicinity of the Airport.

If approved, construction of the Sydney Gateway road project would be concurrent with the construction of the project, increasing the influence of construction activity on the Botany character precinct in the western areas of the project, particularly in the vicinity of the bridge replacement and retaining wall works in Robey Street, O’Riordan Street and Qantas Drive. This would increase the adverse landscape character impact on this precinct.

Visual impact

If approved, construction of the Sydney Gateway road project would be seen in views to construction of the project, adding to the scale and extent of construction activity seen in views from Qantas Drive, Robey Street, and Qantas Drive. The location of the Sydney Gateway road project would inhibit the reinstatement of vegetation on Joyce Street between Robey Street and O’Riordan Street. These views would impact road users, including the arrival experience to Sydney from the Airport, adjacent commercial areas and hotels.

18.5.3 Cumulative operational impacts

Landscape character

During operation, the Sydney Gateway road project and the project combined would contribute to the intensification of the urban character of this area of the site. The Sydney Gateway road project would reduce the space available to the project to reinstate vegetation along the rail corridor along Qantas Drive between Robey and O'Riordan Streets, that would otherwise have softened and screened views to the project. Therefore, the combined effect of these projects would result in an increased adverse landscape character impact.

Visual impact

Upon completion, the Sydney Gateway project and this project would combine to alter views to the vehicular entry to Sydney from the airport. In the areas where both the project and Sydney Gateway road project would be seen, there would be an increased adverse visual impact.

18.6 Management of impacts

18.6.1 Approach

As described in Chapter 6 (Project features and operation) and Chapter 7 (Construction), design development and construction planning has focused on avoiding or minimising the potential for environmental impacts during all key phases of the process.

The urban design and landscaping principles would incorporate specific measures to respond to the identified landscape character and visual impacts. In addition, this project would be aligned with the urban design concepts of the Sydney Gateway road project where the projects interface.

A full description of the approach to environmental management and mitigation is provided Chapter 25.

18.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential landscape character and visual impacts are listed in Table 18.8. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 18.8 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Design	Landscape character and visual impact of proposed retaining walls	Proposed retaining wall finishes will be selected to align with the projects urban design and landscaping principles and aim to minimise adverse visual impact. These treatments will be aligned with the urban design concepts of the Sydney Gateway road project between O'Riordan and Robey Streets.	N/A – Design phase	N/A – Design phase
	Landscape character and visual impact of proposed bridges	The proposed twin bridges at Robey and O'Riordan Streets and Southern Cross Drive will be designed to minimise visual clutter. All bridges will incorporate measures to discourage graffiti.	N/A – Design phase	N/A – Design phase
	Landscape impact from relocation of Billboards	As a priority, billboards will be replaced like for like. Where they cannot be replaced like for like, they would be shifted in space to allow like for like placement on a new location in immediate vicinity of their current location. Where they cannot be placed in their immediate vicinity, they would be relocated along the existing rail corridor and combined with existing structures (such as bridges), where practicable, in order to minimise potential to introduce structures in areas where there are minimal structures and infrastructure (ie clustering instead of introducing impacts on higher sensitivity areas).	N/A – Design phase	N/A – Design phase
Construction	Landscape character and visual impact from residential properties	Shade cloth screening on site boundary fencing will be provided where works or compound sites are being undertaken in close proximity to residential areas to screen street level views into the construction site, such as: • Myrtle Street • Bay Street • Ellis Street • Banksia to Morgan Street.	✓	✓
	Visual impact from construction lighting at night	Temporary lighting required during the construction period will be sited and designed to avoid light spill into residential properties. Particular consideration will be given to works near Baxter Road, McBurney Avenue and between Myrtle Street and Stephen Road which are located close to residential properties and hotels.	✓	✓

18.6.3 Consideration of the interaction between measures

In addition to the measures for managing impacts on landscape character and visual amenity described above, there are interactions between the mitigation measures for land use and property (Chapter 17) and social impacts (Chapter 19).

All mitigation measures for the project will be consolidated and described in the relevant management plan. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures will be consolidated to ensure consistency and implementation.

18.6.4 Managing residual impacts

A residual risk analysis was undertaken following the impact assessment summarised in this chapter. The results of the residual risk analysis are provided in Appendix B. Residual risks with an assessed level of medium or above are summarised below:

- visual impacts on nearby residents and business owners due to the presence of construction compounds and work areas
- adverse impacts on landscape character during construction.

Despite measures taken to avoid and mitigate impacts, the project would result in some unavoidable residual adverse impacts. These impacts relate to the construction phase and would therefore be temporary.
The mitigation and management measures proposed are expected to manage the potential for landscape character and visual impacts.

19. SOCIAL

This chapter provides a summary of the social impact assessment. A full copy of the assessment is provided as *Technical Report 12 – Social Impact Assessment*.

19.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in *Technical Report 12 – Social Impact Assessment*.

19.1.1 Policy context to the assessment

Social Impact Assessment Guidelines

Social Impact Assessment Guidelines for State significant mining, petroleum production, and extractive industry development (Department of Planning and Environment (DPE), 2017b) provide the definition for social impact based on the *SIA principles and methods endorsed by the International Association for Impact Assessment* (Vanclay, 2003 and Vanclay F, et al, 2015). This guidance provides a discussion which identifies that all issues which affect people, both directly and indirectly as a result of a project, are relevant to a robust social impact assessment. The guideline defines social impact as "a consequence experienced by people, due to changes associated with a State significant project" (DPE, 2017b). This social impact assessment has considered the definitions and issues raised in this guidance.

Environmental Impact Assessment Practice Note: Socio-economic assessment

Environmental Impact Assessment Practice Note: Socio-economic assessment (Roads and Maritime Services, 2013) provides a practical method for scoping the potential social issues of a project. This method has been used as a guide in identifying potential issues and impacts.

19.1.2 Methodology

Key tasks

The assessment involved:

- confirming the study area for the purposes of the assessment
- describing the existing social environment of the study area, including developing a demographic profile for communities in the study area with the potential to be affected by the project
- identifying and mapping community infrastructure and facilities with the potential to be affected by the project
- reviewing information on the project, including the indicative construction methodology and the proposed operational features and details
- reviewing other technical papers prepared for the EIS to understand the nature, scale and significance of potential impacts and identify resultant social impacts
- assessing the potential social impacts and benefits of the project in accordance with the SEARs and relevant principles and guidelines
- taking into account issues raised by the community and relevant stakeholders (described in Chapter 4 (Consultation))
- identifying measures to mitigate the potential impacts.

A detailed description of the assessment methodology is provided in Chapter 3 of *Technical Report 12 – Social Impact Assessment*.

Study area

The project site and its surrounds were analysed to identify the study area for this social impact assessment. The study area is based on consideration of the communities that live, work and visit this area and are therefore considered most likely to be impacted by the project. The study area for assessing demographic characteristics and values of the local community included:

- Bayside LGA
- the following suburbs:
  - Mascot
  - Pagewood
  - Botany.

In addition the community infrastructure facilities such as parks, health and education centres within 500 metres of the project site were identified.

19.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with social impacts. Potential risks were considered according to the impacts that may be generated by the construction and operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology and the full results, is provided in Appendix B.

Prior to assessment and identification of mitigation measures, risks with an assessed level of medium or above include:

- impacts on businesses (and deliveries) due to road closures, particularly full road closures associated with bridge works
- business impacts due to changes to advertising billboards located along Qantas Drive and Joyce Drive
- impacts on local amenity due to increased frequency of trains.

These potential risks and impacts were considered as part of the assessment. The assessment also considered matters identified by the SEARs and stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 19.6.

19.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning for the project has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process. Measures taken to avoid or minimise impacts which relate to the social environment include:

- where possible, the construction access points and construction traffic routes would be directed away from sensitive areas and would consider these land uses when defining the use and operation of specific construction compounds
- the potential for construction noise and vibration impacts have been minimised by:
  - locating the construction access points and construction traffic routes away from sensitive areas
  - considering the surrounding land uses when defining the use and operation of specific construction compounds
  - locating construction compounds and other construction areas within the existing rail corridor wherever possible
  - potential noise and vibration impacts during operation have been minimised by proposing a lubrication procedure to reduce high frequency wheel squeal from operational trains. The procedure would involve the application of a friction modifying agent (lubricant) to the top running surface of the rail where it would be picked up by the wheels of passing trains.

19.2 Existing environment

19.2.1 Overview of the existing social environment

The study area is located within Bayside LGA and incorporates three suburbs: Mascot, Pagewood and Botany. The LGA contains diverse land uses, including Botany Wetlands, Port Botany, and Sydney Airport. Mascot and Botany feature a mix of residential, commercial and industrial areas, while Pagewood is primarily residential. A demographic profile for each suburb is provided in *Technical Report 12 – Social Impact Assessment*.

Bayside LGA is one of the fastest growing areas of Sydney, with suburbs in the LGA experiencing significant recent population growth. In recent years Mascot has experienced increasing levels of high density development, particularly in areas close to Sydney Airport and Mascot Train Station. Residential areas in the LGA have developed around these dedicated land uses, resulting in the interface between residential and industrial areas in some parts of the LGA. This is particularly noticeable in the residential areas close to industries that require 24-hour access, such as Port Botany and Sydney Airport, and their supporting infrastructure.

Mascot accommodates culturally and linguistically diverse people while Pagewood has high levels of social housing, as well as a slightly higher proportion of people who identify as needing assistance. Both Pagewood and Botany have a high proportion of households occupied by couples with children and single parents with children.

19.2.2 Connectivity

Bayside LGA currently experiences large volumes of traffic on local roads associated with Port and Sydney Airport, as well as regional through traffic and local area traffic. The study area is heavily connected with roads and freight and passenger rail routes.

There are several cycle ways identified by Roads and Maritime Services on the Cycleway Finder website (Roads and Maritime Services, 2018a) which travel through Mascot and Botany. These are identified as low difficulty, on-road cycle options for local residents, and provide access to city-bound cycle routes. The closest shared use paths are Alexandra Canal (one kilometre to the west of the project site) and Bourke Road Cycleway (about 600 metres north of the project site) shared use path, both located in Mascot.

Pedestrian footpaths are available alongside most roads within the study area. A footbridge crosses over the Botany Line on Banksia Street linking Botany and Pagewood residential areas.

19.2.3 Economic centres within the LGA

Sydney Airport and Port Botany support a significant workforce and associated businesses in the local and wider region. Based on worker data for Bayside LGA, the LGA employs around 74,000 workers, with 23.9 percent who are also residents in the area.

From a social perspective, the port is a major source of employment supporting 21,000 jobs (NSW Ports, 2015) and supplies goods to businesses in metropolitan Sydney and the Greater Sydney Region (Transport for NSW, 2018d, ARTC, 2018) which also support employment.

19.2.4 Community values

Community values refer to tangible and intangible characteristics and aspects of a community, such as amenity, character, lifestyle, access, connectivity, community cohesion, and community health and safety. A project may affect these aspects by changing noise levels, visual amenity, traffic conditions and access, movement across the community, the use and enjoyment of community spaces, and by requiring relocation as a result of property acquisition.

According to the *Botany Bay Planning Strategy 2031* (City of Botany Bay, 2009) and consultation on the *Community Strategic Plan 2030* (Bayside Council, 2018) the local community values the heritage character, good quality urban design and amenity of local residential areas. The community aspires to have more walking paths, cycling routes and transport corridors throughout the LGA to support local connectivity. Currently, Bayside Council does not have any active transport plans or strategies publicly available. The strategy (City of Botany Bay, 2009) recognises the potential challenge presented to residential amenity by future expansion of airport and port activities, and the resulting truck and rail freight.

19.2.5 Community infrastructure

Community infrastructure near the project is primarily pocket parks and larger recreation spaces, including golf courses and sports facilities. The area also contains a high number of accommodation facilities (hotels), due to the proximity of the project to Sydney Airport. Other available facilities are typical of an urban area including health facilities, emergency services, places of worship, community centres, education and child care services. Table 19.1 list the community facilities within around 500 metres of the project site.

Table 19.1 Community infrastructure

FACILITY TYPE	FACILITY NAME	MAP REF	FACILITY TYPE	FACILITY NAME	MAP REF
Emergency services	Fire and Rescue NSW Botany Fire Station	25	Education and child care services	Botany Public School	32
Recreation facilities	Botany Aquatic Club	26		Hippo's Friends Child Care Centre	33
	Eastlake Golf Club	27		Botany Bay Pre-School	34
	The Lakes Golf Club	1		All Star Early Learners	35
Open space	Dransfield Avenue Reserve	3		John Brotchie Memorial Nursery School	36
	Gaiarine Gardens	28		Pagewood Kindergarten	37
	Booralee Park	29		Pagewood Public School	38
	Coleman Reserve	4		Toybox Early Learning	22
	L'Estrange Park	2	Health services	Mascot Medical and Dental Services	24
	John Curtin Memorial Park	6	Accommodation facilities	Stamford Plaza Sydney Airport	10
	McBurney Avenue Reserve	5		8Hotels – Felix Hotel	11
	Botany Wetlands	30		Ibis Budget Sydney Airport	12
	Garnet Jackson Reserve	31		Mantra Hotel and Sydney Airport	13
	Robey Street Reserve	7		Quest Mascot	14
Community centres	Komuniteti Shqiptar Ne Sydney	8		Holiday Inn Sydney Airport	15
	Mascot Library	9		Ibis Sydney Airport	16
Places of Worship	Life Passion Church	39		Adina Apartments	17
	St Matthew's Anglican in Botany	40		Travelodge Hotel Sydney Airport	18
	Citygate Fellowship Church	21		Pullman Hotel Sydney Airport	19
				The Branksome Hotel	20

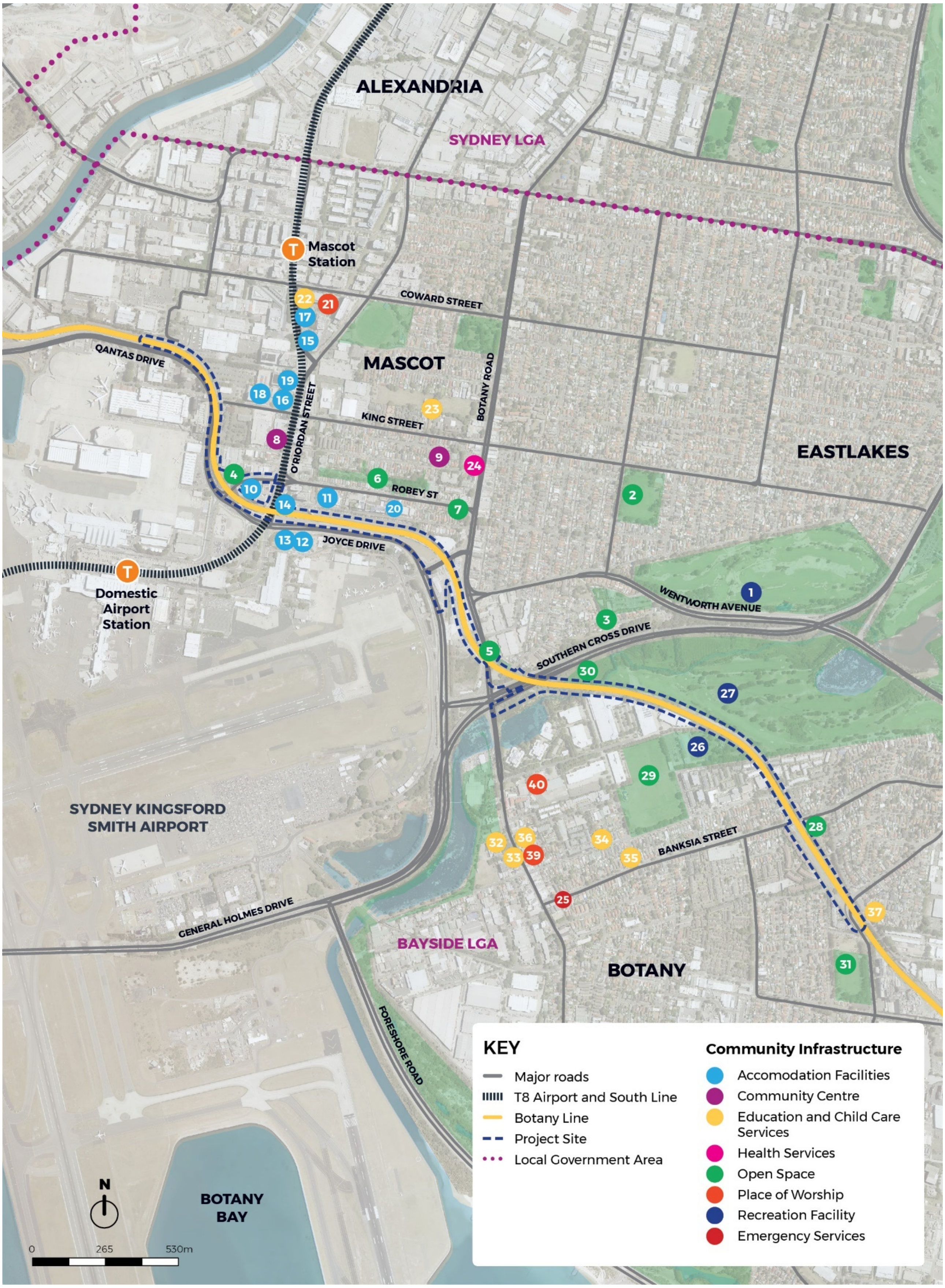


Figure 19.1 Location of community infrastructure

19.3 Assessment of construction impacts

19.3.1 Employment and economy

The peak construction workforce is estimated to be about 270 people during non-possession work and about 405 people during possession work. This would result in direct employment opportunities for skilled workers across Greater Sydney including roles such as engineers, designers and construction workers in the short term. Skilled workers in the local study area may benefit from these employment opportunities.

As an indirect result of the increase in construction workers in the local study area, there may be increased expenditure at local businesses, such as food, beverage and retail services close to the project site. An increase in patronage has the potential to provide increased income generation opportunities to these types of local businesses, benefitting business owners in the short term.

A number of billboards are located near Sydney Airport between Qantas Drive and Joyce Drive benefitting advertising agencies and Sydney Airport Corporation Limited through leasing arrangements. As discussed in section 6.6, some billboards may need to be removed during construction. Following completion of construction, all of the impacted billboards would be reinstated generally in the same location as they are currently positioned. No social impact is expected as a result of this change.

The additional workforce in the local study area would place pressure on availability of existing parking spaces. This may affect some local business owners and workers who drive to work. This may also reduce availability of street parking for customers of some businesses that do not have dedicated parking spaces, which could reduce income for business owners. Additional off-site parking for the construction workforce will be made available to reduce these impacts.

19.3.2 Amenity

'Amenity' refers to the pleasant or normally satisfactory aspects of a location which contribute to its overall character and the enjoyment of residents or visitors. Construction of the project may result in the following amenity impacts being experienced by members of the community surrounding the project site:

- increase in noise levels as a result of construction plant and equipment, including during out of standard construction hours such as on Sundays and during the night
- increase in traffic movements and congestion (and associated road traffic noise), around the project site and construction haulage routes
- increase in dust generated during construction
- changes in the visual outlook in the vicinity of compounds and construction work areas.

These potential impacts and relevant mitigation measures are considered in Chapter 8 (Traffic, transport and access), Chapter 9 (Noise and vibration), Chapter 10 (Air quality) and Chapter 18 (Landscape and visual amenity). Amenity impacts would be temporary and managed by the mitigation measures outlined in these chapters.

19.3.3 Access

As described in Chapter 8 (Traffic, transport and access), construction of the project would result in temporary impacts on traffic and access within the study area, and an increase in both heavy and light vehicle movements on the local and regional road network. This would impact existing access for residents, visitors, customers, businesses, and service providers along and around the project site. These impacts would include:

- changes to access for pedestrians and cyclists around the construction work areas
- altered movement patterns and traffic routes in some areas due to temporary road closures and diversions
- changed access or increased travel time to community places and facilities.

Changes to traffic, pedestrian and cyclist access could result in a temporary increase in the distance travelled, increased travel times, inconvenience and delays for some community members.

These potential impacts would be temporary and would be minimised as far as possible by the implementation of the construction traffic, transport, and access management measures provided in section 8.5.

19.3.4 Community infrastructure

Several open spaces and recreation facilities are located adjacent to or near the project site, including: Coleman Reserve, McBurney Avenue Reserve at Botany Road, Botany Wetlands, Booralee Park, Garnet Jackson Reserve, Gaiarine Gardens, Eastlake Golf Club and Botany Aquatic Centre (see Figure 19.1). Construction activities would likely affect the amenity of these facilities including temporary increased noise, vibration and dust as well as changes to the visual environment such as views of construction activities and removal of vegetation within the existing rail corridor. This may cause nuisance and reduce some people's ability to utilise the outdoor spaces at optimum function or enjoyment. These sites are, however, already impacted by noise from the airport and adjacent roads. Overall, given the existing amenity of these open spaces, the above changes are expected to result in a minor social impact for users of the reserves.

McBurney Avenue Reserve is a small passive open space that provides connectivity between McBurney Avenue and Botany Road. The reserve is likely to be used as a pedestrian thoroughfare, and may also be used by local residents and workers for passive recreation. The reserve is being considered as a material storage area during construction. If the reserve is utilised as a storage area, public access would be restricted to the existing walking paths only. Users may not be able use the park for passive recreation, and may choose to visit an alternate park.

Several education and child care services are located along proposed haulage routes which would experience increased heavy vehicle movements. These include Botany Public School, Hippo's Friends Child Care Centre, Botany Bay Pre-School, All Star Early Learners and John Brotchie Memorial Nursery School. As these facilities are located either adjacent to or near these routes, there is potential for concerns about actual or perceived safety risks to students and children at these facilities.

19.3.5 Summary of social impacts during construction

Table 19.2 summarises the potential social impacts during construction and indicates the potential nature, type, duration and predicted level of impact.

Table 19.2 Summary of social impacts during construction

SOCIAL IMPACT CATEGORY	SOURCE OF IMPACT	POTENTIAL SOCIAL IMPACT	NATURE, TYPE AND DURATION OF IMPACT	LEVEL OF IMPACT
Employment and economy	Construction workforce required for the project (about 270 people during non-possession work and about 405 people during possession work).	Direct employment opportunities for skilled workers across Greater Sydney.	Positive Direct Short term	N/A
Employment and economy	Spending by construction workforce at local businesses, such as food, beverage and retail services close to the project site.	Increased income generation for local businesses.	Positive Indirect Short term	N/A
Employment and economy	Parking restrictions for local business owners, employees, and customers of the business.	Potential increase in time it takes to park, and added nuisance for local business owners' employees and customers to the business, which could reduce income.	Negative Direct Short term	Negligible to Minor.
Amenity	Temporary and sporadic increased noise at residential properties and local businesses near Joyce Drive and Botany Road, as well as in Botany and Pagewood, from construction activities within the existing rail corridor and construction compounds.as well as heavy vehicles along haulage routes on local roads.	Reduced amenity of nearby residential properties and local businesses could reduce the enjoyment of outdoor areas.	Negative Direct Temporary	Minor impact on residents, owners and employees of local businesses, with potential for medium-minor impact on vulnerable groups.
Amenity	Temporary and sporadic increased noise at some accommodation facilities in Mascot, from construction activities within the existing rail corridor.	Reduced amenity for users of accommodation facilities could reduce the enjoyment of outdoor areas and result in people closing windows while indoors.	Negative Direct Temporary	Negligible intermittent impact on users of accommodation facilities.
Amenity	Temporary and sporadic vibration that exceeds human comfort in residential areas adjacent to the project corridor.	Reduced amenity of nearby residential properties, local businesses and accommodation facilities.	Negative Direct Temporary	Minor and intermittent, with potential for medium-minor impact on vulnerable groups.

SOCIAL IMPACT CATEGORY	SOURCE OF IMPACT	POTENTIAL SOCIAL IMPACT	NATURE, TYPE AND DURATION OF IMPACT	LEVEL OF IMPACT
Amenity	Temporary and sporadic noise and vibration at residential areas adjacent to the rail corridor, as well as accommodation facilities, due to construction works during the night time.	Potential sleep disturbance for some residents and hotel guest.	Negative Direct Temporary	Medium-minor on residents and hotel users, with potential for medium impact on vulnerable groups.
Amenity	Nearby residential areas would experience changes to visual amenity as a result of direct views of construction activities, equipment and compounds, and the removal of vegetation within the existing rail corridor which may currently screen some of these views from residences.	It is likely that residents currently experience views of the rail corridor and passing trains and therefore may not be as sensitive to visual changes during construction such as views of construction infrastructure. However, the removal of screening trees and vegetation may be a more obvious change. This may affect the values of some of these residents, in particular residents of Botany and Pagewood where the character change will be most noticeable.	Negative Direct Short term	Minor impact.
Amenity	Dust may be generated by construction activities and heavy vehicle movements.	Increased dust may lead to some residents altering their way of life, such as closing windows of houses or vehicles, or spending limited time in backyards or on balconies. Residents and employees of local businesses may also need to spend more time cleaning indoor or outdoor surfaces due to settling dust. This may lead to a temporary nuisance.	Negative Direct Temporary	Minor impact with potential for medium-minor impact on vulnerable groups.
Access	Construction would result in increased construction traffic, road or lane closures, and changes to access arrangements near construction compounds.	Access changes are likely to temporarily increase travel times for people’s daily commutes or usual trips.	Negative Direct Temporary	Minor impact.

SOCIAL IMPACT CATEGORY	SOURCE OF IMPACT	POTENTIAL SOCIAL IMPACT	NATURE, TYPE AND DURATION OF IMPACT	LEVEL OF IMPACT
Access	Construction would result in changes to increased construction traffic, road or lane closures and changes to access arrangements near construction compounds.	Access changes are likely to temporarily increase travel times for people’s commutes and trips by bus and cycling. Increased travel times may reduce time that people can spend undertaking activities that are important to them.	Negative Direct Temporary	Minor impact.
Access	Construction would result in temporary footpath closures/diversions as well as road traffic changes.	Appropriate diversions would be provided to maintain pedestrian access along roads affected by the project. At times, changed traffic conditions could deter some people, particularly vulnerable groups, from taking usual routes or making some trips at certain times. Vulnerable groups such as children, older people and people with a need for assistance may have less capacity to adapt to or navigate the changes.	Negative Direct Temporary	Minor impact on residents, employees of local businesses and community members, with potential for medium-minor impact on vulnerable groups.
Access	Sufficient parking for construction workers would be provided within the project site.	Alternate parking sites would decrease the demand for street parking by construction workers near the project site and reduce the potential for nuisance to local Mascot, Botany and Pagewood residents who utilise street parking.	Negative Direct Temporary	Negligible
Community infrastructure	McBurney Avenue Reserve potentially utilised for alternative parking and staff facilities for construction workforce.	Restricted or loss of public access may lead to reduced access for users of the reserve.	Negative Direct Temporary	Negligible
Community infrastructure	Increased construction traffic along haulage routes located adjacent or near education and childcare facilities.	Potential for concerns about actual or perceived safety risks to students and children at education and childcare facilities located along haulage routes due to increased heavy vehicle movements.	Negative Direct Temporary	Minor

SOCIAL IMPACT CATEGORY	SOURCE OF IMPACT	POTENTIAL SOCIAL IMPACT	NATURE, TYPE AND DURATION OF IMPACT	LEVEL OF IMPACT
Community infrastructure	Construction activities would likely affect the amenity of open space and recreation facilities including temporary increased noise, vibration and dust as well as changes to the visual environment. Construction would also result in changes to access for road users visiting Booralee Park, Garnet Jackson Reserve, Gaiarine Gardens and Botany Aquatic Centre, including increased traffic, road or lane closures, and changes to access arrangements near construction compounds.	Temporary amenity changes could reduce the enjoyment for some users particularly for passive and leisure activities. Increased travel times could inconvenience private vehicles, public or active transport. This could potentially deter some local users, particularly vulnerable users living in Botany and Pagewood, from accessing some facilities due to real or perceived barriers to travel generated by increased construction traffic.	Negative Direct Temporary	Minor impact to users within some areas of Booralee Park, Garnet Jackson Reserve, Gaiarine Gardens, Botany Aquatic Centre and Eastlake Golf Club.

19.4 Assessment of operational impacts

19.4.1 Employment and economy

The duplication of the Botany Line would unlock additional rail network capacity (with improved freight travel times along the Botany Line), resulting in a potential increase in the number of freight rail services supporting the movement of goods. The increased rail capacity has the potential to reduce the number of trucks in the region. The reduction of heavy vehicle traffic on the road network would have the potential to improve road network capacity for general traffic, which may also result in potential road safety advantages (due to reduced truck movements).

Based on the above, the project is expected to result in employment and economic benefits to Greater Sydney communities. According to the *Port Botany Duplication Development Phase Project Proposal Report* (ARTC, 2018), the resulting efficiency to the freight network would streamline costs in the supply chains for businesses across NSW.

Less congestion on the local road network would benefit the many workers who currently travel by road through the local study area, including those employed in airport and port-related industries, surrounding employment areas as well as passengers travelling via the airport for business purposes. The removal of trucks from the road network also leads to economic benefits, saving on accident costs and reducing local pollution (ARTC, 2018).

19.4.2 Amenity

There is the potential for operational noise impacts at selected locations adjacent to the rail corridor. Several locations have been identified (see section 9.4) where noise levels were predicted to exceed relevant noise criteria. The urban nature of the study area means that many receivers are close to major existing sources of transportation noise and already subject to relatively high existing noise levels.

The project is predicted to result in increased rail noise levels in study area, due to increased train speeds, higher frequency of trains and as a result of the new track being closer to certain receivers. The increased noise levels result in a number of areas where receivers are predicted to exceed relevant noise criteria. These areas are generally near curved track and include:

- around King Street
- near Baxter Road
- near Botany Road and McBurney Avenue
- along Myrtle Street.

There are social impacts associated with changes to the views from receivers near the project (ie visual impacts) that include:

- views of additional rail infrastructure
- loss of vegetation – where vegetation is re-instated, it is expected that the visual change would be lessened over time as the vegetation matures.

Changes to air quality during the operation of this project are not anticipated (see section 10.4).

19.4.3 Access

Given that the project would be within the existing rail corridor, changes to access and connectivity of residents, employees of local businesses and general community members are not expected.

Changes to the road network and on-road cycle routes that occur during construction would be restored to their condition prior to the construction of the project. There would be no permanent impact to existing active transport routes and the project would not preclude future links within the study area.

19.4.4 Community infrastructure

Community infrastructure close to the project site is already impacted by rail noise. Noise generated by additional train movements during operation is unlikely to affect users of the open space or education and child care services facilities near the project site.

19.4.5 Flooding

Flooding impacts have the potential to result in social impacts associated with the risk of floods to people as well as economic impacts from flood related damages to buildings, vehicles and other stored material.

The current design for the project may result in an increase of peak flood levels of around two centimetres for the northern portion of the development at 104 Bay Street and the north-eastern portion of the development at 15 Begonia Street (see section 13.4.2).

As discussed in section 13.4.2, the potential flooding impacts and associated social or economic costs from a two-centimetre increase in peak flood levels (compared to the existing scenario) are difficult to quantify. A small increase in flood levels may be sufficient to create an impact (where there was previously none) or change the degree of impact, for example if the water height reaches doorways or basement carpark entry points or results in an increase in depths of above-floor inundation, or leads to an increase in water volume or flow into basement carparks. Further design development will be undertaken in detailed design to mitigate the identified potential flooding impacts, and in doing so, avoid the potential for additional social and economic impacts due to the project (see section 13.6.2). Table 19.3 summarises the potential social impacts during operation and indicates the potential nature, type, duration and predicted level of impact.

Table 19.3 Summary of social impacts during operation

SOCIAL IMPACT CATEGORY	SOURCE OF IMPACT	POTENTIAL SOCIAL IMPACT	NATURE, TYPE AND DURATION OF IMPACT	LEVEL OF IMPACT
Employment and economy	Increased freight rail efficiency and improved efficiency of Sydney's and the wider economic supply chain and movements of goods to businesses in Greater Sydney and the wider region.	Indirect benefit to business owners and employees in the Greater Sydney region through increased productivity, leading to regional economic growth.	Positive Indirect Long term	N/A
Amenity	Increased noise and vibration generated by train movements during the daytime.	Nearby residents and employees of local businesses already experience noise and vibration from the existing rail operations and may not be as sensitive to the amenity change from additional train movements during the day time. For some residents and employees of local businesses, the gradual increase in the number of occurrences could be noticeable and cause nuisance.	Negative Direct Long term	Minor impact.
Amenity	Increased noise and vibration generated by train movements during the night time.	Potential sleep disturbance for some residents and users of accommodation facilities can lead to tiredness.	Negative Direct Long term	Medium-minor impact, with the potential for medium impact on vulnerable groups.
Amenity	Decrease in noise associated with idling locomotives during day and night.	Potential improvement to the noise levels associated with freight movements, due to the lack of idling freight trains. However, this is not likely to be noticeable to the local community as there will be an increase in noise associated with the increase in number of freight trains.	Positive Indirect Long term	N/A
Amenity	Visual changes resulting from the new second track within the rail corridor, and increased number of trains that may be visible to nearby residential areas and accommodation facilities.	Where reinstated vegetation is not possible, some residents' views overlooking the rail corridor would be permanently altered.	Negative Direct Long term	Negligible impact.

SOCIAL IMPACT CATEGORY	SOURCE OF IMPACT	POTENTIAL SOCIAL IMPACT	NATURE, TYPE AND DURATION OF IMPACT	LEVEL OF IMPACT
Amenity	Operational impacts on air quality are not expected as a result of the project.	Negligible social impacts on residents and vulnerable groups as a result of the operation of the project.	Negative Direct Long term	Negligible impact.
Access	Container movements transported by heavy road vehicles is expected to reduce due to an increase in rail capacity, leading to less congestion on the local road network.	Less congestion could improve traffic flow and increase people's connectivity to various destinations in the local study area for personal and business purposes, including visiting the airport, port, employment areas, community infrastructure and social networks.	Positive Indirect N/A	N/A
Community infrastructure	Amenity of community infrastructure, located adjacent to the project site as a result of noise generated by additional train movements during operation.	Increased number of noise occurrences due to additional train movements is unlikely to affect users of local community facilities.	Negative Direct Long term	Negligible impact.
Flooding	Increase of peak flood levels by two centimetres at residential developments.	Potential risk of floods to people as well as economic impacts from flood related damages to buildings, vehicles and other stored material due to additional peak flood levels.	Negative Direct Long term	Negligible impact.

19.5 Cumulative impacts

19.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to the social context of the study area are described below.

19.5.2 Cumulative construction impacts

Should the construction of the project occur concurrently with other major developments, there is potential for several cumulative social impacts to occur:

- increased demand for construction workforce due to resourcing across projects, which would lead to more job and income generation opportunities available to residents across Greater Sydney
- further demand for services and increased expenditure at local and regional businesses through purchases made by the combined construction workforce and procurement of local goods and services for construction, which would benefit business owners
- increased noise and vibration on residential properties and accommodation facilities near O'Riordan Street, Baxter Road and Joyce Drive from the concurrent construction with Sydney Airport developments and Sydney Gateway road project, which could lead to further nuisance and annoyance felt by these residents
- increased occurrence of delays on roads due to combined construction vehicle movements affecting road users on the local road network.

In the event the construction of the project occurs after construction of other major developments in the vicinity have completed construction, there is a potential for the affected community to experience construction fatigue. This is likely to impact the residents and workers in Mascot, who may have the highest exposure to construction related activities from consecutive or concurrent projects in their area. There is potential for these social impacts to be greater on vulnerable groups, who may be more sensitive to changes.

19.5.3 Cumulative operational impacts

Operation of the Botany Rail Duplication project together with Sydney Gateway road project would lead to increased freight efficiency to both Sydney Airport and Port Botany, which would likely increase the economic benefits for Greater Sydney and the wider region. This includes indirect economic benefits for supporting industries, such as intermodal terminals and logistics businesses, through the increase in rail freight efficiency.

Residences and accommodation facilities located near the Joyce Drive and O'Riordan Street intersection would potentially be affected by operational noise from both Botany Rail Duplication and Sydney Gateway road project. Community members may perceive noise impacts, which can affect people's sense of pride and enjoyment of their properties and surroundings.

The operation of the Botany Rail Duplication project and other developments in the local area would result in increased local and regional connectivity due to new road connections and extensions, combined with the increase in rail modal share for freight movements. Reduced traffic congestion and improved connectivity on the local road network due to decreased freight truck movements may lead to shorter travel times for local residents and community.

Local businesses, in particular those located in town centres such as Mascot, and businesses along Botany Road may benefit from improved amenity as a result of reduced freight truck movements and the remaining freight trucks taking an alternate route and bypassing the Mascot town centre. This may benefit owners, employers and customers by creating a more pleasant environment in the area.

19.6 Management of impacts

19.6.1 Approach

The project site is primarily located in a semi-industrial and commercial area of Sydney with few urban residential areas and community uses nearby. The project's social impacts are therefore less than would be associated with a densely populated residential project area. The project has purposely been designed to avoid or minimise social impacts where possible (see section 19.1.4).

Based on the outcomes of the impact assessment, most impacts generated by the project are expected to result from construction activities. Construction impacts would mainly relate to reduced amenity due to noise near residential properties and community infrastructure facilities, dust, visual impacts, as well as access changes leading to inconvenience for road users on the local road network. Amenity impacts would be temporary, and managed by the mitigation measures outlined in Chapter 8 (Traffic, transport and access), Chapter 9 (Noise and vibration), Chapter 10 (Air quality) and Chapter 18 (Landscape and visual amenity).

A full description of the approach to environmental management and mitigation is provided in Chapter 25.

19.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential social impacts are listed in Table 19.4. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 19.4 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Construction	Changes to amenity and access due to construction	The community will be informed about changes to amenity and access through the community and stakeholder engagement plan. The plan will include: • communication with residents to provide an overview of the project and the likely nature, extent and duration of amenity and access changes as a result of construction. Particular attention will be given to ensuring any vulnerable groups are appropriately targeted. These may include families with children, people with need for assistance, older people, people with disability, people with mobility difficulties or medical conditions, and culturally and linguistically diverse people in Mascot • communication of measures to minimise construction fatigue experienced by residents, businesses and general community members (such as construction respite periods associated with out of standard construction hours works, if required) • communication of the complaints and enquiry procedure through which community members can contact the project to raise any concerns regarding amenity and access changes, such as the ARTC Enviroline.	✓	✓
	Amenity and access changes affecting community infrastructure facilities and users due to construction	Targeted communication on measures to minimise impacts on amenity and access will be carried out with the following stakeholders: • Bayside Council, about timing of the most noise intensive works and changed traffic conditions that may affect public open space areas and active transport routes within the LGA • community infrastructure and accommodation facilities (hotels) if direct impacts are identified such as temporary changes to access or utility services.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Operation	Amenity change (noise) due to operation	The operational noise and vibration review (ONVR) will include a consultation strategy to seek feedback from directly affected landowners on the noise and vibration mitigation measures. This would the use of the Enviroline mechanism for communication with local residents and businesses impacted by at-property noise mitigation measures.	N/A – Operation	N/A – Operation

19.6.3 Consideration of the interaction between measures

In addition to the measures to minimise the social impacts described above, there are interactions between the mitigation measures for Chapter 8 (Traffic, transport and access), Chapter 9 (Noise and vibration), Chapter 10 (Air quality), Chapter 13 (Hydrology and flooding) and Chapter 18 (Landscape and visual amenity).

All mitigation measures for the project will be consolidated and described in the appropriate management plan. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures will be consolidated to ensure consistency and implementation.

19.6.4 Managing residual impacts

A residual risk analysis was undertaken following the social impact assessment summarised in this chapter. The results of the residual risk analysis are provided in Appendix B. Residual risks relating to noise impacts are discussed in section 9.6. No other residual risks have been identified with an assessed level of medium or above.

Despite measures proposed to avoid and mitigate impacts, the project would still result in some minor unavoidable residual adverse impacts. These impacts mainly relate to the construction phase and would be temporary.

20. RESOURCES AND WASTE MANAGEMENT

20.1 Assessment approach

The approach to the resources and waste management assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment.

20.1.1 Legislative and policy context to the assessment

The main legislation relevant to the management of waste are the POEO Act, the Protection of the Environment Operations (Waste) Regulation 2014 (the Waste Regulation) made under the POEO Act, and the *Waste Avoidance and Resource Recovery Act 2007* (WARR Act).

The POEO Act establishes the procedures for environmental control, and for issuing environmental protection licences regarding matters such as waste, air, water and noise.

Schedule 5 of the POEO Act defines waste as:

a. any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment
b. any discarded, rejected, unwanted, surplus or abandoned substance
c. any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, processing, recovery or purification by a separate operation from that which produced the substance
d. any processed, recycled, reused or recovered substance produced wholly or partly from waste that is applied to land, or used as fuel, but only in the circumstances prescribed by the regulations
e. any substance prescribed by the regulations to be waste.

The Waste Regulation controls matters such as the obligations of consignors (producers and agents), transporters and receivers of waste in relation to waste transport licensing and tracking requirements.

Under the Waste Regulation, the NSW EPA has issued ‘The Australian Rail Track Corporation excavated material order 2019’ and ‘The Australian Rail Track Corporation excavated material exemption 2019’. This order and exemption applies to ARTC excavated material (soils, sand, ballast, rock or aggregate derived through activities within the ARTC rail corridor) for application to land for the purposes of certain earthworks, building or maintenance of railway infrastructure and certain public road related activities.

It is an offence under the Waste Regulation to transport waste generated in NSW more than 150 kilometres from the place of generation for disposal, unless the waste is transported to one of the two lawful disposal facilities nearest the place of generation.

The WARR Act aims to ensure that waste management options are considered against the following waste management hierarchy:

1. avoidance of unnecessary resource consumption
2. resource recovery (including reuse, reprocessing, recycling and energy recovery)
3. disposal.

The movement of controlled waste is also regulated by the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998, made under the *National Environment Protection Council Act 1994*.

The Australian Dangerous Goods Code (National Transport Commission, 2015) defines a set of requirements for the transport of dangerous goods defined in the code. In NSW, the Dangerous Goods (Road and Rail Transport) Regulation 2009 gives effect to the Australian Dangerous Goods Code.

Waste classification

The classifications that apply to waste in NSW and the descriptions of each are provided by the POEO Act, the Waste Regulation and supporting guidelines, including the Waste Classification Guidelines (EPA, 2014a). Many waste types are pre-classified under the POEO Act and do not require testing. However, if a waste is not pre-classified, it may need to be tested to determine its classification.

NSW Waste Avoidance and Resource Recovery Strategy 2014–21

Consideration was given to the *NSW Waste Avoidance and Resource Recovery Strategy 2014–21* (EPA, 2014b). The primary goal of this strategy is to enable NSW to improve environment and community well-being by reducing the environmental impact of waste and using resources more efficiently. This strategy is informed and driven by the waste hierarchy defined in the WARR Act. It is supported by various regulations and policies including the POEO Act and Waste Regulation. To support the primary goal of the strategy, the project would be constructed and operated with consideration to the waste hierarchy. Additionally, any waste generated from the project would be disposed of in accordance with regulatory requirements.

20.1.2 Methodology

The assessment involved:

- reviewing the regulatory framework for waste management
- identifying potential waste generating activities
- identifying the likely classification of waste generated by the project in accordance with relevant legislation and guidelines
- estimating quantities of waste, where feasible
- identifying available waste management options
- identifying waste management measures for construction and operation.

It is noted that the waste types and quantities estimated as an outcome of this assessment are indicative, and have been identified for the purpose of determining potential waste impacts and waste management options. Although the quantities of waste actually generated by the project may differ from the estimates made, the identified waste management options are variable and would be appropriate to the final waste quantities.

20.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (summarised in Appendix B) included potential risks associated with resources and waste management. Potential risks were considered according to the impacts that may be generated by the construction and/or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology, and the full results, is provided in Appendix B.

Prior to assessment and identification of mitigation measures, the following risks were identified with an assessed level of medium or above:

- increased electricity and fuel use during construction and operation
- increased demand on local and regional resources during construction.

The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 20.5.4.

20.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning have included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process.

Potential resource and waste management impacts have been avoided or minimised where possible by maximising the amount of on-site reuse of spoil, where practicable and subject to testing for contaminants. In addition, the project design seeks to optimise the capping of existing asbestos containing material to minimise the generation of contaminated waste (due to excavation/disturbance of the identified asbestos contaminated fill material) and therefore minimise the quantity of contaminated waste requiring off-site disposal.

Utility management has adopted a risk-based approach to avoiding or minimising impacts associated with the relocation or adjustment of services. Where adjustments have been avoided there has been a reduction in associated waste and stockpiling of materials.

20.2 Assessment of construction impacts

20.2.1 Resource use

Construction of the project would require various materials and pre-cast elements. Major construction materials required would include:

- structural/embankment fill material
- capping material
- ballast
- concrete sleepers
- rail, rail weld and rail fastening materials (metals)
- bedding materials for trenches and pits
- aggregate for concrete, asphalt and bitumen
- cement and concrete
- steel – reinforcing steel and structural steel
- wood for use in formwork and other temporary structures
- water
- precast concrete including pipes, culvert segments, pits and barriers
- mechanical and electrical equipment for rail signals
- plastic rail pads and insulators
- conduits and cables – optical fibre
- pre-fabricated metal handrails.

Materials would be sourced from appropriately licensed facilities and commercial suppliers in nearby areas. None of the materials proposed to be used are considered to be in short supply. Material quantities would be determined throughout the detailed design phase prior to start of construction and reduced where possible through efficient design, construction and procurement processes.

It is estimated that the project will require around:

- 5,000 concrete sleepers
- 9,370 cubic metres (m^3) ballast
- 55 rail lengths (at 110 metres per length)
- 5,700 m^3 capping material
- 14,400 m^3 structural/embankment fill material
- 8,000 m^3 concrete
- 1,700 tonnes steel (reinforcing and structural)
- 12 beams, 12 through girders, 3,000 square metres pre-cast elements
- 415 lineal metres reinforced concrete pipe and 22 reinforced concrete pits.

Equipment and vehicles on the construction site would consume a large quantity of fuel. It is estimated that the following would be used for construction during the enabling and main works:

- Diesel combustion, stationary energy purposes – diesel use has been estimated at around 6,500 L/week for the duration of the construction period for mobile and stationary plant and equipment. This equates to around 1,200 kL over the 3.5 year construction period. This covers construction of the track works, bridge works and ancillary infrastructure.
- Diesel combustion, transport purposes – diesel use for employee commuting was estimated at around 345 kL over the construction period, based on number of employees during possession and non-possession periods.
- Diesel use for transporting plant and equipment to site was estimated as 478 kL over the construction period, based on average heavy truck movements.

Electricity needs on site would be minor and connection of the construction site offices to the local power grid would be sufficient. A generator would be used where it is not possible to obtain power from the local grid. It is estimated that around 1,100 kilowatt hours of power would be used to construct the project. Some generators may be necessary for emergency power supply.

Construction of the project would require water for the following activities:

- dust suppression
- compaction of excavated fill material
- road sweepers
- potable use in office amenities.

Non-potable and potable water would be used to construct the project. This would be sourced from reusable non-potable water on site where possible (eg harvested rainwater), or from local potable water sources (eg water mains via metered standpipes or temporary piped water supply). No surface or groundwater would be extracted for construction.

20.2.2 Waste generation and management

Waste generation and classification

The key waste generating activities during construction along with potential key waste streams and likely classification of waste streams is provided in Table 20.1. Some waste streams such as excavated soil, spoil and aggregates would be subject to sampling and analysis in accordance with the *Waste Classification Guidelines* (EPA, 2014a) to confirm the waste classification of the material, whether it meets the criteria for virgin excavated natural material (VENM), excavated natural material (ENM) or waste exemptions (see section 20.1.1) and the appropriate disposal method.

Waste would be generated in all stages of construction. The types of waste and quantities would vary depending on the activity type.

The overall volumes of typical construction waste streams are expected to be comparable to other similar infrastructure projects. Standard waste management strategies (which address waste generation, storage, disposal and reuse) would be implemented during construction, and would aim to reduce the generation of construction waste and reuse waste where possible. Table 20.1 provides the details of potential waste streams and estimates of waste quantities (where possible), noting that it is difficult to quantify potential waste streams with certainty at this stage in the project, and particularly given opportunities for waste minimisation and reuse will be prioritised over disposal but require assessment on a case-by-case basis during construction (such as for reuse of topsoil).

Table 20.1 Expected wastes to be generated during construction

ACTIVITY	POTENTIAL WASTE STREAMS	INDICATIVE VOLUMES	LIKELY CLASSIFICATION OF WASTE STREAMS
Activities at construction offices and compounds	Putrescibles (food and other organic waste)	< 10 tonnes (based on average waste consumption per staff for the duration of project)	General solid waste (putrescible)
	Paper, cardboard, plastics, glass and printer cartridges and other office waste	< 6 tonnes	General solid waste (non-putrescible)
	Grey water, sewerage	< 800 litres	Liquid waste
Maintenance of construction plant, vehicles and equipment	Adhesives, lubricants, waste fuels and oils, engine coolant, containers, batteries, hoses	< 2 tonnes	General solid waste (non-putrescible) Hazardous waste Liquid waste
	Plastic film wrap and other packaging	Minimal	General solid waste (non-putrescible)
Early and enabling work			
Track realignment/slewing	Metals (cut rail, welding offcuts)	2.9 km of new track (2 x rails) and 100 m of crossovers	General solid waste (non-putrescible)
	Spoil comprising VENM or ENM	See below as part of total spoil volume.	General solid waste (non-putrescible)[1]
	Contaminated soils (including asbestos contaminated soil) and acid sulfate soils	4,000 m^3	Restricted solid waste or general solid waste (non-putrescible)[1]
	Ballast	TBC as part of detailed design	General solid waste (non-putrescible) or restricted solid waste[1]
	Rail clips, pads and insulators	Clips: 2.9 km / 0.6 m x 4 Pads and insulators: 2.9 km / 0.6 m x 2	General solid waste (non-putrescible)
	Plastic film wrap and other packaging	Minimal	General solid waste (non-putrescible)

ACTIVITY	POTENTIAL WASTE STREAMS	INDICATIVE VOLUMES	LIKELY CLASSIFICATION OF WASTE STREAMS
Utility service relocation and/or protection	Vegetation/green waste	TBC as part of detailed design	General solid waste (non-putrescible)
	Aggregates	See below as part of total spoil volume	General solid waste (non-putrescible)[1]
	Pipe/conduit and cable offcuts	Minimal	General solid waste (non-putrescible)
	Excess spoil comprising VENMENM	See below as part of total spoil volume	General solid waste (non-putrescible)[1]
	Contaminated soils and acid sulfate soils	See below as part of total spoil volume	Restricted solid waste or general solid waste[1]
	Concrete ground level troughing segments	2.9 km	General solid waste (non-putrescible)
	Concrete, metal framed utilities pit lids	60	General solid waste (non-putrescible)
	Plastic film wrap and other packaging	Minimal	General solid waste (non-putrescible)
Billboard removal	Billboard materials (wood, paper, plastic)	None	General solid waste (non-putrescible)
	Reinforcing steel, concrete, structural steel	15 tonnes	General solid waste (non-putrescible)
	Concrete footings or structures	10 m^3	General solid waste (non-putrescible)
	Plastic film wrap and other packaging	Minimal	General solid waste (non-putrescible)
Site establishment	Vegetation/green waste	TBC as part of detailed design	General solid waste (non-putrescible)
	Top soil	Will be reused where possible. See below as part of total spoil volume for soil not reusable.	General solid waste (non-putrescible)[1]
	General debris/litter	Minimal	General solid waste (non-putrescible)
	Plastic film wrap and other packaging	Minimal	General solid waste (non-putrescible)

ACTIVITY	POTENTIAL WASTE STREAMS	INDICATIVE VOLUMES	LIKELY CLASSIFICATION OF WASTE STREAMS
Main construction and commissioning works including track and bridge work			
Installation of new track, upgrade of existing track and installation of new crossovers	Excess spoil comprising VENMENM	See below as part of total spoil volume	General solid waste (non-putrescible)[1]
	Metals (cut rail, metal offcuts)	Included for track / slewing	General solid waste (non-putrescible)
	Wood (formwork)	Minimal	General solid waste (non-putrescible)
	Aggregates	See below as part of total spoil volume	General solid waste (non-putrescible)
	Concrete, asphalt and aggregate	See below as part of total spoil volume	General solid waste (non-putrescible)
	Plastic film wrap and other packaging	Minimal	General solid waste (non-putrescible)
Construction of new bridges and demolition of existing bridges	Excess spoil comprising VENMENM	See below as part of total spoil volume	General solid waste (non-putrescible)[1]
	Contaminated soils and acid sulfate soils	See below as part of total spoil volume	Restricted solid waste or general solid waste[1]
	Metals, steel reinforcement	150 kg for existing O'Riordan bridge quantities	General solid waste (non-putrescible)
	Concrete, asphalt and aggregate	TBC as part of detailed design	General solid waste (non-putrescible)
	Bricks and mortar	Minimal	General solid waste (non-putrescible)
	Structural steel	TBC as part of detailed design	General solid waste (non-putrescible)
	Plastic film wrap and other packaging	Minimal	General solid waste (non-putrescible)
Signalling and electrical work	Pipe/conduit offcuts Electrical/cable offcuts	Minimal	General solid waste (non-putrescible)
	Electrical and signalling components	TBC as part of detailed design	General solid waste (non-putrescible)
	Metal signal cabinets	10 (approximately)	General solid waste (non-putrescible)
	Concrete and steel reinforcement	10 m^3	General solid waste (non-putrescible)
	Plastic film wrap and other packaging	Minimal	General solid waste (non-putrescible)

ACTIVITY	POTENTIAL WASTE STREAMS	INDICATIVE VOLUMES	LIKELY CLASSIFICATION OF WASTE STREAMS
Finishing and rehabilitation work			
Finishing work	Metals (damaged fencing, work signs)	TBC as part of detailed design	General solid waste (non-putrescible)
	Vegetation/green waste	TBC as part of detailed design	General solid waste (non-putrescible

1 This would be confirmed through sampling and analysis in accordance with the *Waste Classification Guidelines* (EPA, 2014a)

Based on the current estimated proposed cut (31,600 m^3) and fill (15,120 m^3 of fill and 14,400 m^3 structural fill) requirements for the project, there may be an excess of spoil material, subject to confirmation of the reusability of the cut material (around 380 m^3). Spoil excavated as part of the project would be tested and classified.

It is estimated that around 4,000 m^3 of potentially contaminated (asbestos) material would be excavated, which would require disposal at an appropriately licensed facility that is lawfully able to accept it.

Waste handling and management

Relevant legislation and policies outline the requirements which would be adopted for construction waste management, see section 20.1.1. The proposed waste handling and management measures for construction waste streams are provided in Table 20.2.

Table 20.2 Management of construction waste

WASTE TYPE	MANAGEMENT
Spoil comprising virgin excavated natural material (VENM) or excavated natural material (ENM)	Excavated materials would be reused on site or in other projects off site as engineering fill where practicable and where it meets the VENM and ENM criteria. Where excavated materials cannot be reused (on site or in other projects off site) or reinstated, it would be classified and taken off site to a waste management facility that is lawfully permitted to accept that type of waste for reuse, recycling or disposal.
Contaminated spoil and acid sulfate soils	In situ testing of soils in areas of potential contamination concern would be undertaken to determine the appropriate waste classification. Acid sulphate soils would be managed in accordance with the Acid Sulfate Soil Management Plan (ASSMP) that would be developed for the project. This management plan is described in section 12.5. Soils contaminated with asbestos would be managed in accordance with the asbestos management plan (AMP) that would be developed for the project. This includes removal of some material and the remaining in situ portion to be capped with a layer of material. The AMP is described further in section 12.5.

WASTE TYPE	MANAGEMENT
General construction waste (concrete, asphalt, timber formwork, scrap metals, cable and packaging materials etc)	General construction waste would be managed in accordance with the waste hierarchy. Waste would be segregated and stockpiled on site, with materials such as concrete, asphalt, timber, plastic, and metals separated for reuse or recycling. Electrical waste would be stored for collection by an authorised contractor for recycling off site, where feasible, or disposal at an appropriately licenced facility. All construction waste would be classified in accordance with the *Waste Classification Guidelines* and directed to a waste management facility that is lawfully permitted to accept that type of waste or reused in other projects in accordance with the requirements of any applicable resource recovery order and exemption.
Ballast material from existing tracks	Where possible, ballast from existing tracks would be reused elsewhere on ARTC network or within the project site as capping on access tracks. Otherwise, depending on the level of contamination, ballast would be sent to a construction and demolition waste recycling facility or disposed of at an appropriately licenced facility.
Plain track concrete sleepers removed for crossover/turnout bearers	Where possible, concrete sleepers would be reused elsewhere on the ARTC network. Otherwise they would be sent to a construction and demolition waste recycling facility or reused in other projects in accordance with the requirements of any applicable resource recovery order and exemption.
Timber sleepers and bearers removed for plain track concrete sleepers or concrete/timber turnout bearers.	Timber sleepers would be recycled in accordance with ARTC resource recovery order and exemption.
Liquid waste	Sewage and grey water would be disposed of in sewers or transported to an appropriately licenced liquid waste treatment facility.
Adhesives, lubricants, waste fuels and oils, engine coolant	Waste from construction vehicle and plant maintenance activities would be collected and stored in designated waste storage areas for collection by an authorised contractor for off-site disposal. Where feasible, containers holding oil, grease and lubricants would be washed prior to disposal or stored separately for disposal as hazardous waste. Waste oil and oil filters would be stored in recycling bins and collected by an authorised contractor and recycled off site, where feasible.
Paint and containers – spray cans, paint tins etc	Used paint and paint containers would be stored in an appropriately bunded area for collection by an authorised contractor for disposal.
Office waste including kitchen waste, paper, cardboard, plastics, glass	Waste containing food would be stored appropriately (covered), and regularly removed from site for disposal to reduce the likelihood of attracting pests and vermin (including birds). Recyclable materials such as paper, cardboard, plastics, glass, ferrous, and non-ferrous containers would be stored at recycling bins for collection by an authorised contractor, and recycled off site. Where recycling is not feasible, waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for off-site disposal at a licenced waste facility.

WASTE TYPE	MANAGEMENT
Green waste	As far as practicable, green waste would be chipped, mulched and reused for vegetation management or dust suppression on site, reused in other projects in accordance with the requirements of any applicable resource recovery order and exemption or collected by an authorised contractor and recycled off site. Noxious weeds would be disposed of in accordance with relevant guidelines/requirements.
Top soil	As far as practicable and subject to suitability, topsoil would be reused in rehabilitation/reinstatement work or reused in other projects in accordance with the requirements of any applicable resource recovery order and exemption.

Off-site recycling and disposal locations

There are a number of options for recycling and disposal of construction waste generated by the project. Waste facilities in Sydney licensed to lawfully accept general solid waste (putrescible) include (but are not limited to):

- Clyde Transfer Terminal
- Eastern Creek Resource Recovery Park
- Kemps Creek Advanced Resource Recovery Park
- Lucas Heights Resource Recovery Park
- a number of waste transfer stations such as the Rockdale Transfer Station.

A larger number of licenced facilities in Sydney are lawfully able to accept general solid waste (non-putrescible) and vegetation/green waste. Waste facilities in Sydney licenced to lawfully accept special waste such as asbestos include:

- Elizabeth Drive Landfill, Kemps Creek
- Genesis Xero Waste – Landfill and Recycling
- Horsley Park Waste Management Facility
- Jacks Gully Waste and Recycling Centre
- Kimbriki Recycling and Waste Disposal Centre
- Lucas Heights Resource Recovery Park
- Wetherill Park Resource Recovery Facility.

The Kemps Creek Resource Recovery Park is the only facility in Sydney lawfully able to accept restricted solid waste.

A specialist contractor would be used for the collection and treatment/disposal of any hazardous waste.

Recyclables such as containers (plastics, glass, cans, etc), paper and cardboard would be collected by an authorised contractor for off-site recycling. There are a number of materials recovery facilities in Sydney. The recycling facility would be determined by the contractor engaged to collect the material.

Specific facilities and collection contractors would be selected during the later stages of the project and documented in the construction environmental management plan.

Stockpile management

Stockpiling would be restricted to material storage and laydown areas shown in Figure 7.7a to d. Stockpile management would be in accordance with *Managing Urban Stormwater – Soils and Construction* (Landcom 2004). The size of stockpiles would be determined by material quantity requirements, space availability, stockpile stability and safety, indicative volumes and restrictions are outlined in Table 20.3. Stockpile siting and management would include the following parameters:

- will be no higher than three metres
- will be sited as far as practical from sensitive receivers and where possible equipment i.e. site compound buildings, sited between the stockpile and receiver
- will be located in areas which are not subject to frequent inundation by floodwater and ideally outside the 1% AEP flood extent
- will not be sited next to schools or day care facilities
- will be temporary and material not needed for ongoing maintenance will be removed at completion of construction.

Table 20.3 Indicative stockpile volumes and constraints

PROJECT WORK AREA	
Cooks Loop to O'Riordan Street (see Figure 7.7a)	Limited opportunity for stockpiles due constraints from adjacent land and roads.
O'Riordan Street to Botany Road (see Figure 7.7b)	There would typically be space for a volume of material storage of up to 2,500 m^3 available in the laydown area to the west of General Holmes Drive. This could comprise a combination of structural fill, capping or ballast and also be utilised for sleeper/drainage pipe/CSR conduit or GST storage.
Botany Road to Myrtle Street (see Figure 7.7c)	There would typically be space for a volume of material storage of up to 3,500 m^3 available in the Botany Road triangle storage and compound area. This could comprise a combination of structural fill, capping or ballast and could be sleeper storage once the earthworks are completed or materials such as rail clips, conduits, drainage pits etc.
Myrtle Street to Stephen Road (see Figure 7.7d)	There would typically be space for a volume of material storage of up to 3,500 m^3 available in the Banksia Street storage and compound site. This could comprise a combination of structural fill, capping or ballast or could be concrete sleeper storage once the earthworks are completed.
Other areas within the project site	The remaining areas of the project site are extremely spatially constrained and would unlikely be suitable to store large quantities of materials such as stockpiles.

20.3 Assessment of operational impacts

20.3.1 Resource use

During operation, the project would consume electricity as a result of:

- rail operations
- rail signals
- minor maintenance activities.

20.3.2 Waste generation and management

Waste generation

Standard ARTC maintenance activities would be undertaken during operations. Typically, these activities would include minor maintenance works, such as bridge and culvert inspections, rail grinding and track tamping, through to major maintenance, such as reconditioning of track and topping up of ballast as required.

Table 20.4 summarises the expected wastes to be generated during operation and their likely waste classification. Volume is anticipated to be low and similar to existing maintenance activities.

Table 20.4 Expected wastes to be generated during operation

ACTIVITY	POTENTIAL WASTE STREAMS	LIKELY CLASSIFICATION OF WASTE STREAMS
Regular weekly maintenance	Sleepers	General solid waste (non-putrescible)
	Rail jewellery – pads, clips, screws, insulators associated with replaced sleepers	General solid waste (non-putrescible)
	Scrap rail and associated weld kit rubbish	General solid waste (non-putrescible)
Quarterly maintenance	Sleepers	General solid waste (non-putrescible)
	Rail jewellery – pads, clips, screws, biscuits associated with replaced sleepers	General solid waste (non-putrescible)
	Rail dust, scrap rail and associated weld kit rubbish	General solid waste (non-putrescible)
Major works	Fouled ballast/capping/general fill	General solid waste (non-putrescible) or restricted solid waste[1]
	Worn rail, turnout components on a larger scale	General solid waste (non-putrescible)
	Sleepers and associated jewellery	General solid waste (non-putrescible)

1 This would be confirmed through sampling and analysis in accordance with the *Waste Classification Guidelines* (EPA, 2014a)

Waste handling and management

All operational waste would be managed in accordance with relevant legislative and policy requirements, as outlined in section 20.1.1. The proposed waste handling and management measures for operational waste streams are provided in Table 20.5.

Table 20.5 Management of operational waste

WASTE TYPE	MANAGEMENT
Concrete sleepers	Waste concrete sleepers would be segregated and sent to a construction and demolition waste recycling facility for recovery.
Timber sleepers	Timber sleepers would be disposed of or recycled in accordance with ARTC resource recovery order and exemption.
Rail jewellery including plates, fasteners, pads and insulators	Where practicable, rail jewellery would be sorted to separate potentially recyclable materials such as metals. Recyclable materials would be stored in separate recycling bins for collection by an authorised contractor, and recycled off site. Where recycling is not feasible, waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for off-site disposal at a licenced waste facility.
Scrap rail, rail dust, turnout components	As far as practicable, used/damaged rails would be segregated and collected by an authorised contractor and recycled off site at a metals recycling facility. Where recycling is not feasible, waste would be collected by an authorised contractor for off-site disposal at a licenced waste facility.
Fouled ballast/ capping/general fill	Where possible, ballast would be reused elsewhere on ARTC network as: • bottom ballast for track work • capping on access tracks. Otherwise ballast would be sent to a construction and demolition waste recycling facility.

Off-site recycling and disposal locations

The options for recycling and disposal of construction waste would also apply for operational waste. These are described in section 20.2.2.

20.4 Cumulative impacts

20.4.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered is detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to waste and resource use is described below.

20.4.2 Cumulative construction impacts

Other projects and activities occurring locally and regionally would also generate demand for resources. However, none of the resources proposed to be used are considered to be in short supply.

Similarly, other projects and activities would also generate demand for resource recovery, recycling and disposal capacity, such as excess spoil. However, as discussed in section 20.2.2, there are numerous facilities lawfully able to accept waste from this and other projects. These facilities are considered to have significant capacity.

Therefore, no significant impact is expected as a result of the interaction of the construction of the project with other proposed activities (including projects) locally and regionally.

20.4.3 Cumulative operational impacts

Operational resource use and waste generation are expected to be minimal and therefore no issues are expected as a result of the interaction of the operation of the project and other proposed activities (including projects) locally and regionally.

20.5 Management of impacts

20.5.1 Approach

Waste would be managed in accordance with the construction environmental management plan for the project. The construction environmental management plan will include the following:

- strategies to reduce waste volumes
- waste management, segregation and handling measures
- spoil disposal locations (within the corridor where possible, or at appropriate external disposal sites)
- procedures for the assessment, classification, management and disposal of all waste in accordance with the *Waste Classification Guidelines* (EPA, 2014a)
- responsibilities of key project personnel
- waste monitoring requirements
- compliance record generation and management
- reporting requirements.

Further details on the approach to management is provided in Chapter 24.

20.5.2 List of mitigation measures

The mitigation measures that would be implemented to manage resources and waste are listed in Table 20.6. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 20.6 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Design	Spoil generation	Measures to minimise excess spoil generation will be investigated at detailed design. This would include a focus on optimising the design to minimise spoil volumes and the reuse of material on-site.	N/A – Design phase	N/A – Design phase
Construction	Resource use	Where feasible and practicable, construction material will be sourced from within the Sydney region.	✓	✓
	Stockpile management	The size of stockpiles will be determined by material quantity requirements, space availability, stockpile stability and safety, indicative volumes and restrictions. Stockpile siting and management will include the following parameters: • will be no higher than three metres • will be sited as far as practical from sensitive receivers and where possible equipment i.e. site compound buildings, sited between the stockpile and receiver • will be located in areas which are not subject to frequent inundation by floodwater and ideally outside the 1% AEP flood extent • will not be sited next to schools or day care facilities • will be temporary and material not needed for ongoing maintenance will be removed at completion of construction.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Enabling works waste generation and resource use	Site EMPs will be prepared before any enabling works begin. The Site EMPs will detail how waste would be managed during enabling works activities that could generate significant waste eg billboard removal and vegetation clearance. The Site EMPs will include: • all key early and enabling works waste streams • classification of waste streams in accordance with the *Waste Classification Guidelines* (EPA, 2014a) • applicable resource recovery orders and exemptions including the existing 'The Australian Rail Track Corporation excavated material order 2019' and 'The Australian Rail Track Corporation excavated material exemption 2019' • waste identification, handling and segregation procedures • proposed waste reuse, recovery, recycling and disposal measures • waste tracking, record keeping and reporting requirements • key sources of construction related resource use • energy conservation and energy efficiency practices to be implemented.	✓	
	Main construction works waste generation and resource use	The CEMP will consider management of all construction waste including spoil in accordance with the waste management hierarchy. The CEMP will include: • all key construction waste streams • classification of waste streams in accordance with the *Waste Classification Guidelines* (EPA, 2014a) • applicable resource recovery orders and exemptions including the existing 'The Australian Rail Track Corporation excavated material order 2019' and 'The Australian Rail Track Corporation excavated material exemption 2019' • waste identification, handling and segregation procedures • spoil disposal locations, on-site spoil management and off-site transport protocols • proposed waste reuse, recovery and recycling and disposal measures • waste tracking, record keeping and reporting requirements • key sources of construction related resource use • energy conservation and energy efficiency practices to be implemented.		✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Main construction works waste generation and resource use	Construction waste will be minimised by accurately calculating materials brought to the site and limiting materials packaging.	✓	✓
	Main construction works waste generation and resource use	All waste will be assessed, classified, managed and disposed of in accordance with the *Waste Classification Guidelines* (EPA, 2014a).	✓	✓
	General waste management	Waste and recycling segregation bins will be located at various locations within the project site, if space permits, to facilitate segregation and prevent cross contamination.	✓	✓
Operation	Operational waste generation	The existing ARTC Standard Environmental Management Measures (under the Environment Management System), which include measures for identification, classification, management and disposal of waste will be implemented to manage operational waste generation.	N/A – Operation	N/A – Operation
		All waste would be assessed, classified, managed and disposed of in accordance with the *Waste Classification Guidelines* (EPA, 2014a).	N/A – Operation	N/A – Operation

20.5.3 Consideration of the interaction between measures

There are interactions between the mitigation measures for waste management and contamination (provided in Chapter 12), soils and water quality (provided in Chapter 14) and air quality (provided in Chapter 10). The project specific sustainability initiatives described in Chapter 24 are also relevant to the management of waste. Together, all these measures would ensure appropriate handling of waste materials to minimise the potential for impacts on the community and environment.

20.5.4 Managing residual impacts

A residual risk analysis was undertaken following the impact assessment summarised in this chapter. The results of the residual risk analysis are provided in Appendix B and summarised below. No residual risks were identified with an assessed level of medium or above.

Classifications and reuse/recycling/disposal locations would be confirmed during detailed design. However, it is recognised that in the event of an unexpected find relating to contaminated land, there is potential for a change in the anticipated volumes of potentially contaminated spoil to be generated. All spoil material would be assessed in accordance with *Waste Classification Guidelines* (EPA, 2014a) and reused or disposed of at a licenced waste management facility in accordance with its waste classification.

There are a number of solid waste landfills in Sydney that are licensed to accept contaminated soils. It is anticipated that the volumes of contaminated spoil generated by the project could be readily accommodated at these facilities.

21. RISKS, HEALTH AND SAFETY

This chapter considers potential risk, health and safety impacts on the local community and Sydney Airport. This chapter provides a summary of the following three technical reports: *Technical Report 13 – Health Impact Assessment*, *Technical Report 14 – Hazard and Risk Assessment* and *Technical Report 15 – Airport Operations Assessment*.

21.1 Assessment approach

A summary of the approach to the assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment. A more detailed description of the approach and methodology is provided in the relevant technical report (as specified in the sections below).

21.1.1 Legislative and policy context to the assessment

The assessments were undertaken with reference to the following legislation, policy and guidelines.

Department of Planning, NSW, 2011, Applying SEPP 33: Hazardous and Offensive Development Application Guidelines

Department of Planning NSW (DoP 2011a), Applying SEPP 33: Hazardous and Offensive Development Application Guidelines (Applying SEPP 33) provides the process for assessing if developments are potentially hazardous or offensive, including threshold levels that trigger the potentially hazardous or offensive status.

As the project is State Significant Infrastructure, Applying SEPP 33 (DoP 2011a) does not apply to the project. These guidelines provide a process of identifying a potentially hazardous development by ascertaining storage and transport screening thresholds that is used in this assessment and is detailed in *Technical Report 14 – Hazard and Risk Assessment*.

Department of Planning, NSW, 2011, Hazardous Industry Planning Advisory Paper No 4 – Risk Criteria for Land Use Safety Planning and Hazardous Industry Planning Advisory Paper No 6 – Guidelines for Hazard Analysis

Department of Planning, NSW, 2011, Hazardous Industry Planning Advisory Paper No 4 – Risk Criteria for Land Use Safety Planning (HIPAP No 4) and *Hazardous Industry Planning Advisory Paper No 6 – Guidelines for Hazard Analysis* (HIPAP No 6) are only used if Applying SEPP 33 (DoP 2011) indicates a development is potentially hazardous.

Standards Australia, 2018, AS/NZS 2885.6, Pipelines – gas and liquid petroleum, part 6: Pipeline safety management

Standards Australia, 2018, AS/NZS 2885.6, Pipelines – gas and liquid petroleum, part 6: Pipeline safety management (AS/NZS 2885.6) describes how an owner of a dangerous goods transport pipeline should design, operate and maintain a pipeline in a safe manner. This document is relevant to the project, as AS/NZS 2885.6 indicates that any development in the vicinity of a pipeline is considered a threat and requires management through completion of a safety management study. This is considered in the management and mitigation approach to the project and is detailed in *Technical Report – 14 Hazard and Risk Assessment*.

Airports Act 1996 and regulations

The project construction includes temporary construction compounds on areas of Commonwealth-owned land leased by Sydney Airport. The Airports Act and associated regulations provide the assessment and approval process for development on Commonwealth-owned land for the operation of Sydney Airport. *Sydney Airport Curfew Act 1995* establishes a curfew period for Sydney Airport. This exists from 11 pm until 6 am on the following day. The assessment detailed in *Technical Report 15 – Airport Operations Assessment* has considered the requirements of the Acts in relation to the project and relevant consultation and consents and how the curfew period may affect the construction period of the project.

Airports (Protection of Airspace) Regulations 1996

Under the *Airports (Protection of Airspace) Regulations 1996*, a system has been established for the protection of airspace at and around regulated airports in the interests of the safety, efficiency or regularity of existing or future air transport operations. The regulations define prescribed airspace for an airport, which includes the airspace above any part of either an obstacle limitation surface or procedures for air navigation services – aircraft operations surfaces (PANS-OPS). These regulations apply to both on-airport and off-airport developments.

This assessment detailed in *Technical Report 15 – Airport Operations Assessment* considers potential activities or equipment from the project during construction or operation which may impact the obstacle limitation surface.

Civil Aviation Act 1988 and regulations

The *Civil Aviation Act 1988* establishes a regulatory framework for maintaining, enhancing and promoting the safety of civil aviation and establishing CASA. The *Civil Aviation Regulations 1988* and *Civil Aviation Safety Regulations 1998* are administered by CASA. They provide regulatory controls over civil aviation safety. *Manual of Standards Part 139 – Aerodromes* and *Part 172 – Air Traffic Services* are relevant to the project and have been considered in this assessment.

Regulation 94 of the *Civil Aviation Regulation 1989* also provides CASA the authority to require lights in the neighbourhood of an aerodrome, which may cause confusion, distraction or glare to pilots in the air, to be extinguished or modified. This may apply to either the project's construction lighting or to operational lighting from train movements or maintenance activities. Impacts from lighting are detailed in *Technical Report 15 – Airport Operations Assessment*.

Sydney Airport Master Plan 2039

Sydney Airport Master Plan 2039 (Sydney Airport 2019), outlines the strategic direction for development of the airport over the next 20 years. The project has been assessed for consistency with the master plan (see *Technical Report 15 – Airport Operations Assessment*).

National Airports Safeguarding Framework

The *Australian Government Department of Infrastructure, Regional Development and Cites* (DIRDC) (no date) *National Airports Safeguarding Framework* (NASF) is a national land use planning framework. The NASF provides guidance to state, local and territory governments on assessment and approvals for land use and development on and around airports.

The project passes under the approach and departure paths for one of the runways at Sydney Airport. The guidelines B, C, E, F, G and I are considered in this assessment. The potential impacts of the project have been reviewed against the guidelines and assessment made of any mitigation measures that may reduce or eliminate impacts (see *Technical Report 15 – Airport Operations Assessment*).

Sydney Airport Wildlife Management Plan

Sydney Airport has implemented a Wildlife Management Plan which provides guidance to minimise the hazard to aircraft operations created by the presence of wildlife on or in the vicinity of the airport. This plan is considered when assessing the construction and operational activities for project features which may encourage wildlife that could cause a risk to airport operations (see *Technical Report 15 – Airport Operations Assessment*).

EnHealth Health Impact Assessment Guidelines

EnHealth Health Impact Assessment Guidelines (enHealth 2017) provides an introduction to the health impact assessment process, the different types of assessments that can be undertaken, the principles that may need to be addressed in an assessment, the roles of those involved in an assessment and general information on the preparation of a health impact assessment. This guidance has informed the content and the methodology selected for this assessment and is described further in *Technical Report 13 – Health Impact Assessment*.

EnHealth Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards

EnHealth Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012) provides an Australian framework and approach for the conduct of the assessment of environmental health risks. This approach has been used for this assessment and is described further in *Technical Report 13 – Health Impact Assessment*.

Health Impact Assessment: A Practical Guide

Health Impact Assessment: A Practical Guide (Harris 2007) provides a more practical overview of the health impact assessment process in Australia. The document outlines the key phases and steps involved in conducting an assessment, the key concepts and the different levels of assessment. This guide has provided background information to the assessment process and is described further in *Technical Report 13 – Health Impact Assessment*.

21.1.2 Methodology

Key tasks

A desktop level assessment was undertaken to identify potential impacts on the health and safety of the surrounding community and operations of Sydney Airport as a result of the construction and operation of the project. The assessment involved:

- reviewing the relevant regulatory framework and applicable guidelines
- describing the existing environment, specifically the key characteristics relevant to understanding the existing health of the community surrounding the project, existing infrastructure including relevant Sydney Airport operations
- assessing the impacts of constructing and operating the project on the health of the community. In particular impacts associated with changes in air quality, noise and other impacts that have the potential to affect the health and wellbeing of the community (see *Technical Report 13 – Health Impact Assessment*)

— assessing the key hazards and risks associated with the use of dangerous goods and transportation of dangerous goods through high pressure pipelines during construction and operation of the project as defined in Applying SEPP 33 (DoP 2011a) and AS/NZS 2885.6 (see *Technical Report 14 – Hazard and Risk Assessment*)

— assessing the potential impacts from the construction and operation of the project on airport operations at Sydney Airport (see *Technical Report 15 – Airport Operations Assessment*)

— providing mitigation measures for implementation during construction and operation.

The assessment focuses on those construction and operational activities with the potential to result in health and safety impacts on surrounding communities, land uses, and the environment (also known as 'off-site receivers'). The assessment does not take into account potential health and safety risks to on-site workers associated with normal construction operations, as these are regulated by workplace health and safety legislation (including the *Work Health and Safety Act 2011*) and are not relevant to approval of the project under Division 5.2 of the of the EP&A Act.

Study area

As the health impact assessment has relied on the assessments undertaken as part of other technical studies, the study areas evaluated in relation to health impacts are the same as the study areas considered in each of the individual technical studies (see Chapters 8, 9, 10, 12 and 19).

The study area for key hazards and risks associated with the use of dangerous goods and transportation of dangerous goods through high pressure pipelines has considered utility infrastructure and use of materials within and immediately adjacent to the project site (see *Technical Report 14 – Hazard and Risk Assessment*).

The project site is located close to Sydney Airport. The study area considered in *Technical Report 15 – Airport Operations Assessment* includes the project site and the area above the project site in relation to Sydney Airport obstacle limitation surface.

21.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included potential risks associated with hazards, health and safety. Potential risks were considered according to the impacts that may be generated by the construction or operation of the project. The likelihood, consequence and overall risk level of each potential risk were assessed, with avoidance and management measures defined for each potential risk. Further information on the risk assessment, including the approach, methodology and the full results, is provided in Appendix B.

Prior to assessment and identification of mitigation measures, risks with an assessed level of medium or above include:

- impacts from transport, storage and use of hazardous substances and dangerous goods
- impact from spills or accidents during the transport, storage and use of hazardous substances and dangerous goods
- impact on utilities including pipelines
- reduced safety for road users and pedestrians during construction particularly in the vicinity of houses and businesses.

These potential risks were considered as part of the assessment, which also considered matters identified by the SEARs and stakeholders (as described in Chapters 3 and 4). The residual risk levels, following implementation of the mitigation measures proposed in this EIS, are discussed in section 21.6.4.

21.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning for the project has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process.

Potential hazard and risk impacts have been avoided or minimised where possible by the current design for the project adopting a risk-based approach associated with the relocation and adjustment of public utilities affected by the project. The framework approach includes a hierarchy of:

- avoiding impacts
- protecting utilities in their current location
- utilities relocation or adjustment.

21.2 Existing environment

The existing environment with regards to traffic and access, noise, air quality, contamination and social impacts is described in Chapters 8 (traffic and transport), 9 (Noise and vibration), 10 (Air quality), 12 (Contamination) and 19 (Social) respectively. Other aspects relevant to the consideration of health and safety impacts are discussed below.

Section 8.2 provides a description of the existing rail operations within the project site.

21.2.1 Sensitive receivers

Sensitive receivers include members of the community travelling through the study area or residents or businesses situated in close proximity to the project site and operational rail corridor.

When considering potential health impacts within a community, health impact assessment considers the whole population as well as specific sensitive or vulnerable groups within the population. These communities and their related sensitive or vulnerable groups are:

- community groups:
  - residents
  - recreational users (such as cyclists and users of recreational open space)
  - commercial and industrial (eg businesses within the project area that may be directly impacted by property acquisitions)
- sensitive and vulnerable groups within the community groups:
  - young children (in particular children under the age of 5 years, but also including children up to 14 years)
  - older populations (greater than 65 years of age)
  - disabled and those with pre-existing medical conditions
  - disadvantaged (socio-economically disadvantaged).

A detailed profile of the local communities is provided in section 19.2.

21.2.2 Existing health of the population

The population considered in this assessment includes all individuals who live, work or attend schools (or child care facilities) within the study area. The study area covers a large number of individual suburbs that sit within the following densely populated urban LGAs:

- Bayside (amalgamation of former Bayside and Rockdale LGAs)
- Randwick
- Sydney
- Inner West (amalgamation of former Ashfield, Leichhardt and Marrickville LGAs)
- Canterbury Bankstown
- Georges River.

When considering the health of a local community there are a large number of factors to consider. The health of the community is influenced by a complex range of interacting factors including age, socio-economic status, social networks, behaviours, beliefs and lifestyle, life experiences, country of origin, genetic predisposition and access to health and social care.

Information relevant to the health of populations in NSW is available from NSW Health for populations grouped by local health districts. The project site is located in the South Eastern Sydney Local Health District and Sydney Local Health District. This assessment compared the mortality and hospitalisation indicator data between 2011 and 2016 for all causes, potentially avoidable, chronic obstructive airways disease, lung cancer, cardiovascular disease and asthma.

The rate of mortality indicators for the South Eastern Sydney and Sydney local health districts are significantly lower than that reported for NSW, except for chronic obstructive airways disease and lung cancer which was not significant for the Sydney Local Health District.

The rate of hospitalisations indicators presented in the South Eastern Sydney and Sydney local health districts is significantly lower than that reported for NSW, with the exception of cardiovascular disease hospitalisations in South Eastern Sydney, which is similar to the rate for NSW.

In relation to mental health, data from NSW Health indicates the following for adults:

- The rate of high or very high psychological distress reported in 2017 in the South Eastern Sydney local health district (11.2 percent) is a little lower than the state average (15.1 percent). The rate for the Sydney local health district (15.3 percent) is essentially the same as the state average.
- The rate of high or very high psychological distress in Sydney Local Health District has varied between 10.9 and 15.3 percent between 2003 and 2017. In the South Eastern Sydney Local Health District, the rate has generally declined from around 14.1 percent in 2003 to less than 10 percent in 2015 and 11.2 percent in 2017.

Where health data was available for the LGAs in the study area, these have been compared with available data for the South Eastern Sydney Local Health District, Sydney Local Health District, Sydney and NSW. A review of the available health statistics indicate that for the LGA population in study area, the mortality rates and hospitalisation rates are variable but generally similar to those reported in the larger local health districts of South Eastern Sydney, Sydney and the wider Sydney metropolitan area and slightly lower than the whole of NSW.

21.2.3 Utilities within the study area

A number of utilities are located within and adjacent to the project site and are listed in Table 21.1. The location of high pressure gas pipelines in the vicinity of the project are shown in Figure 21.1.

Table 21.1 Utilities within the study area

COMPANY NAME	UTILITY TYPE	DANGEROUS GOOD TRANSPORTER OR SAFETY/ ENVIRONMENTAL IMPACT POTENTIAL	LOCATION
APA	Ethane Gas Pipeline (Moomba to Sydney Pipeline)	Yes – dangerous good transporter (high pressure ethane gas)	Banksia Street to Southern Cross Drive
Qenos	Ethylene Gas Pipeline (Nitrogen charged)	Potentially – dangerous good transporter (high pressure ethylene gas), although pipeline not currently in use	Banksia Street to King Street
Jemena	Natural Gas (Multiple services: 100 mm DIA sub-main, 550 mm DIA primary main, 100 mm DIA, 32 mm DIA)	Yes – dangerous good transporter (high pressure natural gas)	Multiple locations – local service
AusGrid	Electricity (Multiple services: LV 415 V, auxiliary, HV 11 kV, 33 kV, 132 kV)	Yes – potential safety impact	Banksia Street to King Street
Sydney Water	Stormwater (Multiple services)	Yes – environmental impact	Banksia Street to King Street
Sydney Water	Sewer (Reinforced concrete box culverts)	Yes – environmental and health impact	Banksia Street to King Street
Sydney Water	Potable Water (Iron, steel pipe)	Yes – environmental impact	Banksia Street to King Street
Bayside Council	Stormwater (Multiple services)	Yes – environmental impact	Banksia Street to King Street
Roads and Maritime Services (RMS)	Intelligent Traffic Systems (ITS) – Electrical, telecommunications	Yes – potential safety impact	O'Riordan Street to Robey Street
Sydney Airport	Electricity (Multiple services)	Yes – potential safety impact	O'Riordan Street to King Street
Telstra	Telecommunications (Optical fibre and copper)	No	Banksia Street to King Street
Optus	Telecommunications (Optical fibre and copper)	No	Banksia Street to Bay Street

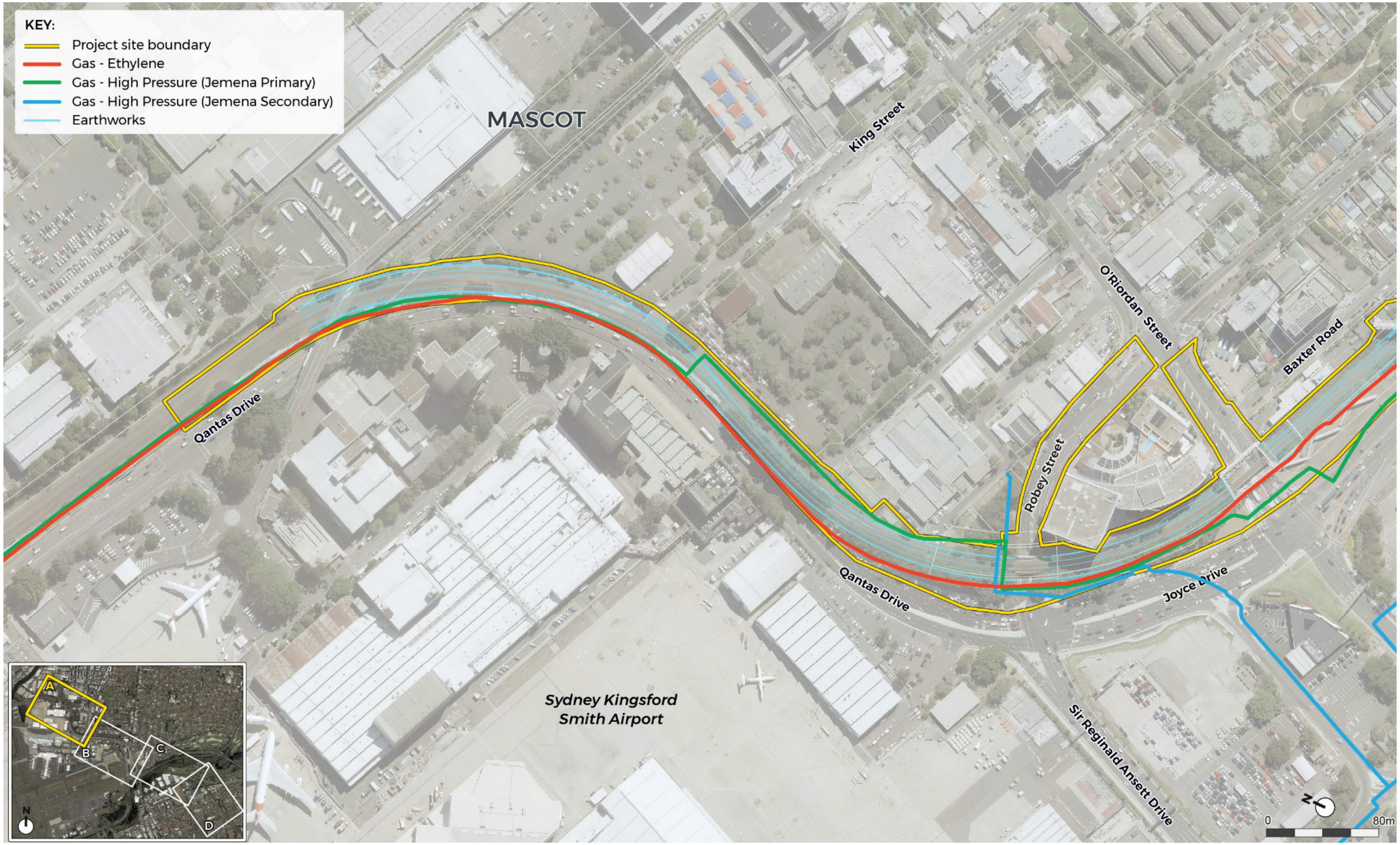


Figure 21.1a High pressure gas pipelines in the vicinity of the project

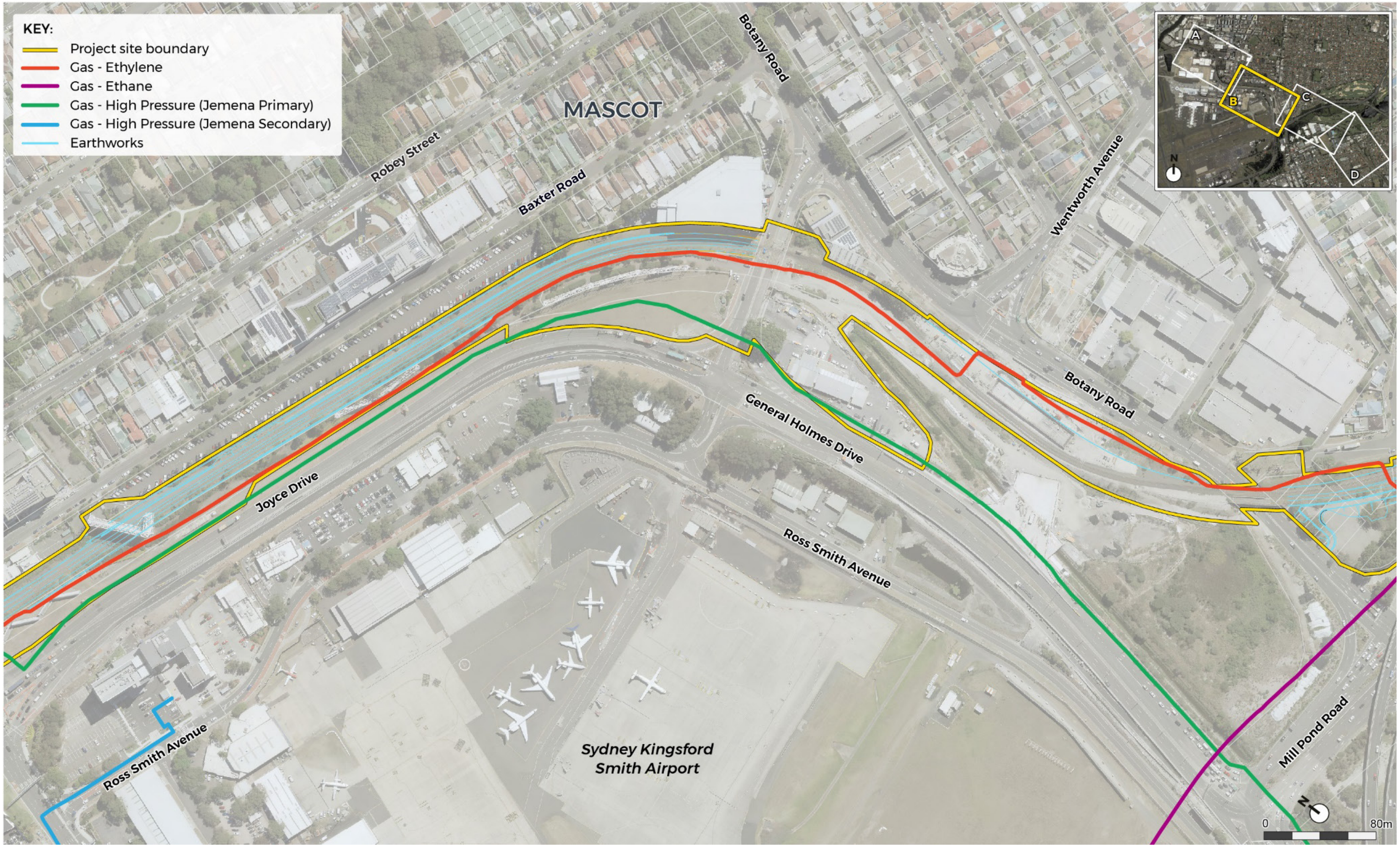


Figure 21.1b High pressure gas pipelines in the vicinity of the project

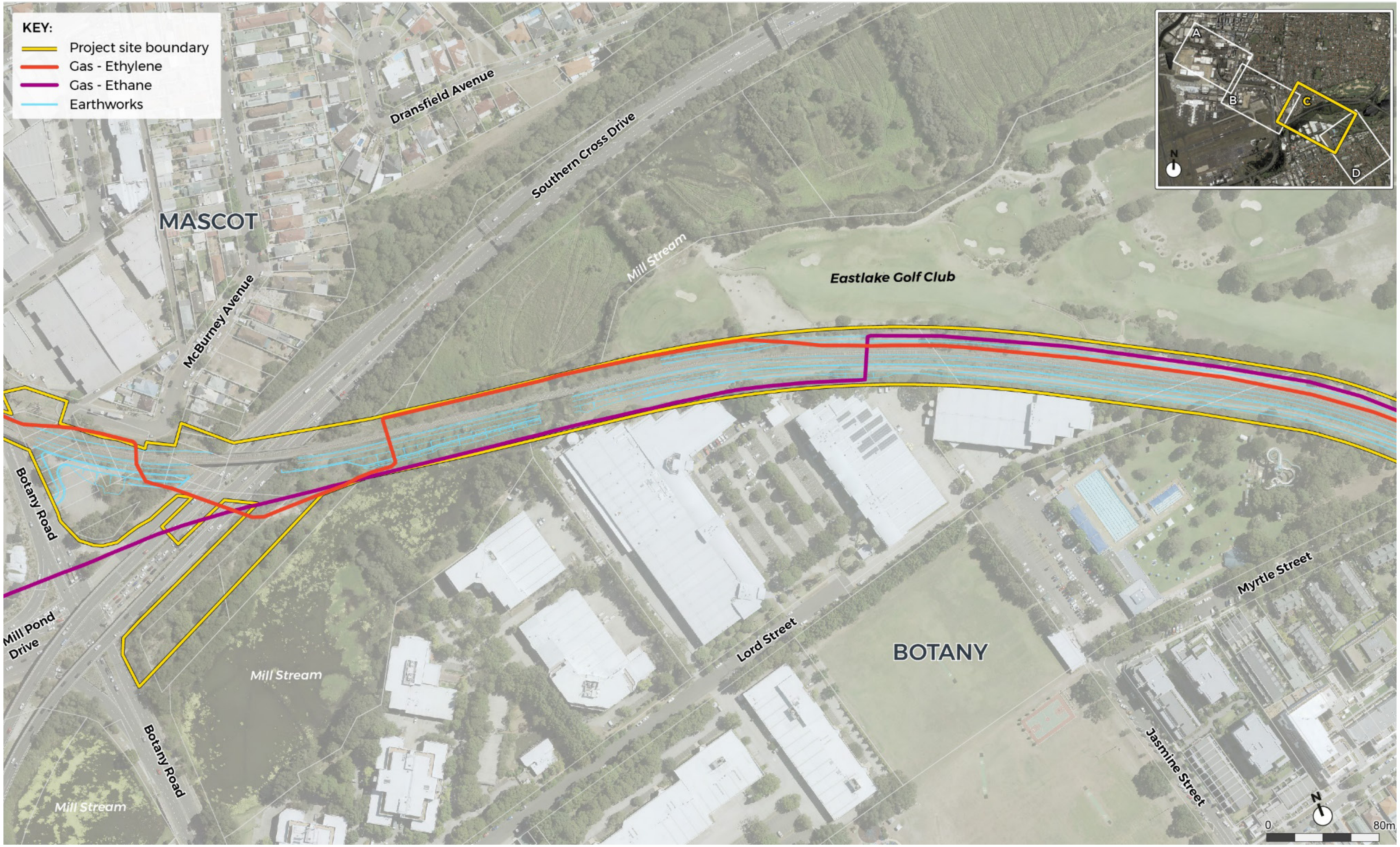


Figure 21.1c High pressure gas pipelines in the vicinity of the project

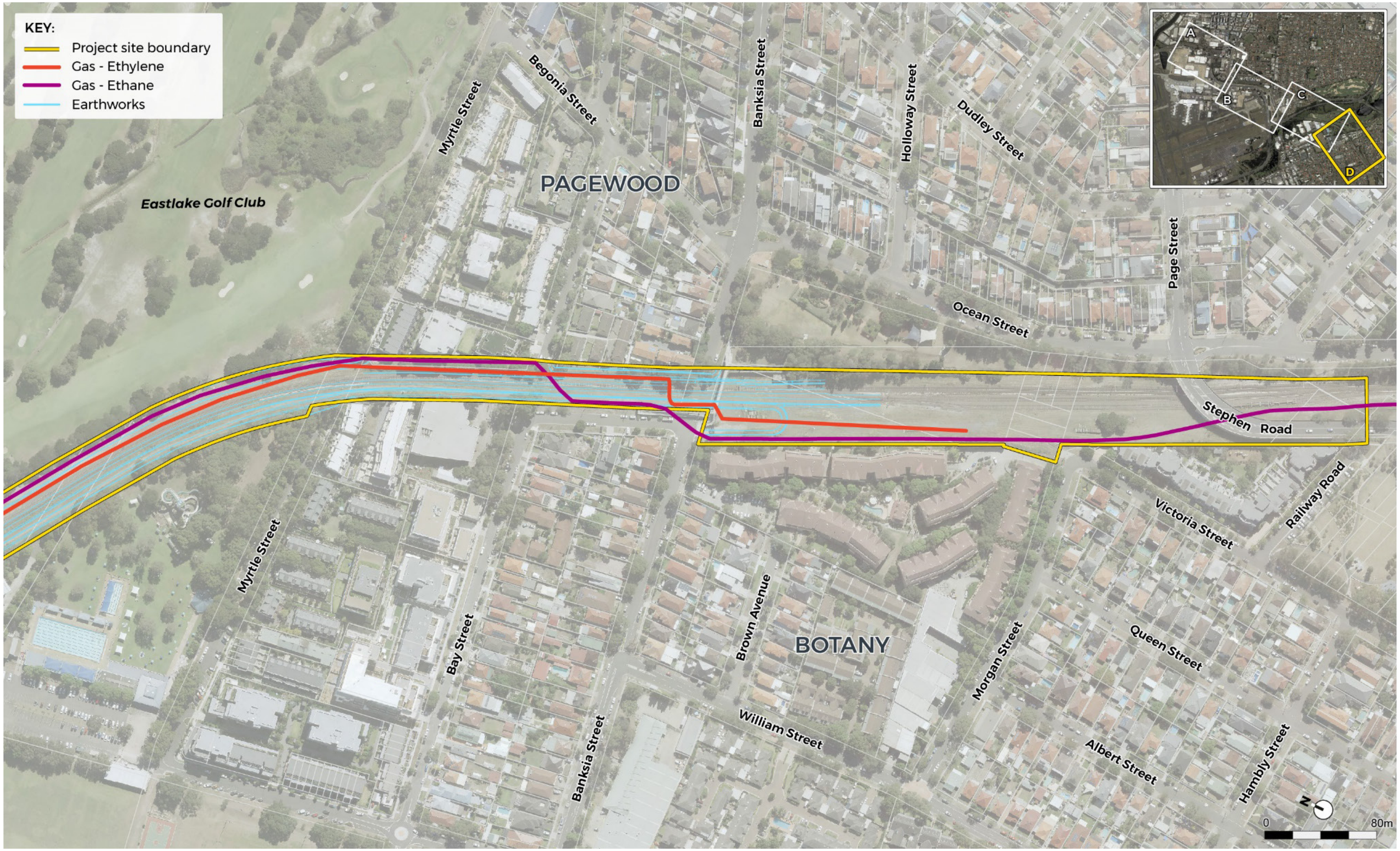


Figure 21.1d High pressure gas pipelines in the vicinity of the project

21.2.4 Sydney airport

Airport operations

Sydney Airport has three runways, comprising two parallel runways on an approximate north−south alignment (Runways 16R/34L and 16L/34R) and a cross runway on an east−west alignment (Runway 07/25) (see Figure 21.2). The airport operates in accordance with the *Sydney Airport Curfew Act 1995*, which restricts operations between 11 pm and 6 am the following day.

The obstacle limitation surface at Sydney Airport spans a radius of about 15 kilometres from the runway ends and is part of the prescribed airspace as defined in the *Airports (Protection of Airspace) Regulations 1996*. The obstacle limitation surface is a series of heights associated with each runway at an airport, that define the desirable limits to which objects may project into the airspace around the airport so that aircraft operations may be conducted safely. The obstacle limitation surface is primarily related to operations where pilots are flying in good visibility and using visual cues. Infrastructure and terrain within this area is required to be at a height below the obstacle limitation surface to avoid becoming a hazard to aircraft operations.

The lowest point of the obstacle limitation surface over the project site occurs in the approach and departure path for Runway 07/25. Runway 07/25 is the cross runway on an approximate east−west alignment through the centre of the airport (see Figure 21.2). The obstacle limitation surface model provided by Sydney Airport Corporation Limited shows that this lowest point is at 12.48 metres Australian height datum (mAHD), with the corresponding level of the project at 11.36 mAHD.

Airport safety

The Australian Transport Safety Bureau reports on aircraft incidents. The Bureau reported for 2017 (ATSB, 2018), that aircraft control, followed by terrain collisions, were the most common incident type for aircraft involved in commercial air transport operations for all airports. Wildlife strikes, including bird strike, were the most common type of incident involving both commercial air transport and general aviation operations. Runway events and aircraft control incidents were the most common types of incident reported for recreational aviation.

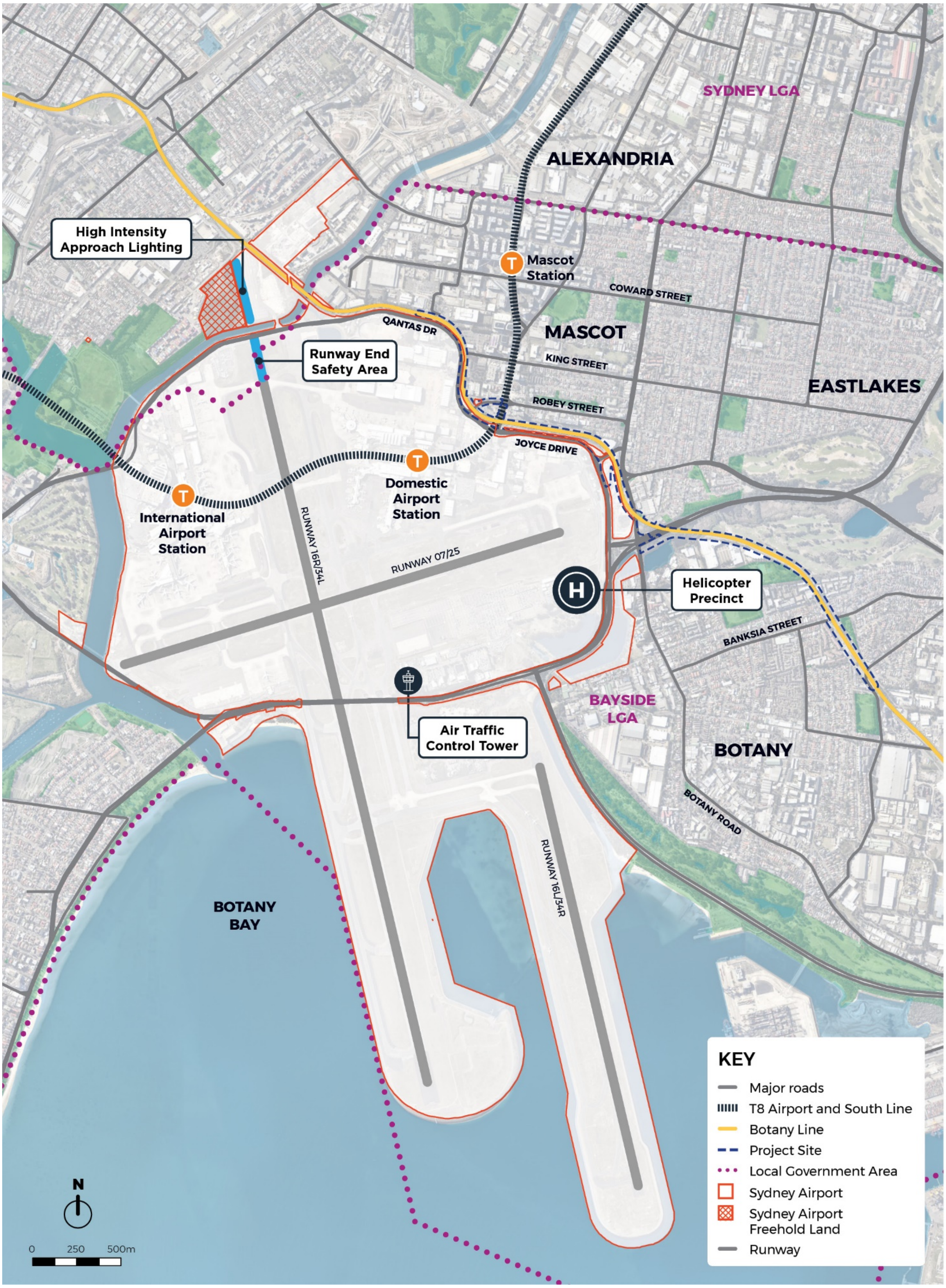


Figure 21.2 Location of key facilities at Sydney Airport

21.3 Assessment of construction impacts

21.3.1 Public safety

Construction of the project would require construction traffic to access the project site and the temporary closure and diversion of some transport routes. Section 7.6 details the potential construction traffic volumes and routes and the temporary road, pedestrian and cyclist route closures and detours during construction.

These changes could result in the following impacts and risks:

- confusion about available routes and access, resulting in traffic collisions between road users, pedestrians and cyclists crossing at unsafe locations or taking the wrong routes
- injury to pedestrians, cyclists or vehicles users passing construction areas from falling objects, collapse of structures such as walls or materials being dropped during loading/unloading
- injury to pedestrians, cyclists, vehicles users or property damage from collision with construction vehicles.

Site management plans would be prepared prior to the commencement of the enabling works and a construction traffic and access management plan (CTAMP) to manage construction traffic for the main construction works. The aim of the management plans would be to ensure appropriate practices are adopted to maintain the safety of road users within and near the site. This would include providing safe movement of traffic for both the general public and construction workers through defined routes, diversions, signage, safe crossing points for pedestrians and cyclists and the allocation of traffic management staff, if needed. Deliveries and loading/unloading activities would be restricted to areas specified within the construction traffic management plan and separated from the general public and transport routes.

Standard mitigation measures relating to construction methodology, layout of compounds sites and hoardings would be detailed in the relevant management plan. Construction methodologies would include avoiding lifting of equipment above pedestrian routes and appropriate hoarding to contain construction activities within the project site.

The potential for the above activities to cause safety impacts is considered to be low, based on works being undertaken in accordance with NSW workplace safety laws. These laws require construction sites to have adequate site security, which includes fencing and hoarding to separate construction activities from the community. Where impacts are not mitigated through the use of hoarding (separating the person from the risk) active traffic management would be used to minimise the potential for impacts as construction vehicles and equipment access the project site.

A number of other construction activities could result in impacts on the safety of the local community if not properly managed. These include:

- items falling off vehicles during the transportation of equipment and materials to and from the project site
- potential for risks to pedestrian/public safety resulting from unauthorised access to construction work areas including the rail corridor.

Safety risks during construction and transportation of materials by road or rail would be managed through the relevant management plans. These would include the implementation of standard workplace health and safety requirements including the requirements of the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2017). The risk of an incident is considered unlikely.

The potential for unauthorised access to result in safety risks is considered unlikely, based on NSW workplace safety laws. This requires construction sites to have adequate site security, which includes appropriate fencing and access restrictions. The construction contractor would need to ensure that construction sites are secure at all times, construction plant and equipment could not be activated by unauthorised persons and take all possible actions to prevent entry by unauthorised persons. Security fencing along the rail corridor would be maintained during the construction phase.

21.3.2 Transportation and handling of dangerous goods

Hazardous materials are defined by Applying SEPP 33 (DoP 2011a) for substances falling within the classification of the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2017). Dangerous goods are substances that, because of their physical, chemical (physicochemical) or acute toxicity properties, present a risk to people, property or the environment. *Technical Report 14 – Hazard and Risk Assessment* details the assessment of transportation and handling of dangerous goods and a summary is provided below.

Materials required for construction are outlined in section 7.5.3. This may include a number of dangerous goods used during construction of the project. Dangerous goods used and stored on the project construction compound would be those typically expected for a civil/rail construction site and include:

- spray paint, marker paint
- acetylene gas for metal/rail cutting and welding
- liquid propane gas (LPG)
- fuels (diesel, petrol, two-stroke)
- epoxy and resin based concrete repair and adhesives
- mechanical fluids for plant and equipment (oils, lubricants, grease, degreaser, coolants, etc)
- oxygen gas for metal/rail cutting and welding
- cleaning products
- safe-working rail detonators (for worksite protection)
- rail weld kits (thermit igniters)
- cement, grout, ready-mix concrete
- concrete curing compounds and formwork de-bonding
- sealants and joint fillers.

The transportation of dangerous goods for construction would be in quantities below the Applying SEPP 33 (DoP 2011a) transport screening thresholds. Given the frequency of traffic movement of dangerous goods would be low, the potential for an incident is considered unlikely. Mitigation measures for the transportation and handling of dangerous goods are provided in section 21.6.2.

According to Applying SEPP 33 (DoP 2011a), if any of the screening thresholds are exceeded then the proposed development would be considered a ‘potentially hazardous industry’ and a preliminary hazard analysis is required. The results of the dangerous goods and transport screening indicate that the project would not result in any of the thresholds being exceeded. As a result, the project is not considered to be ‘potentially hazardous’ and a preliminary hazard analysis is not required.

An assessment of the air quality, noise and vibration of the project has been completed as part of the EIS. These assessments determined that the project would meet the relevant amenity criteria throughout the life of the project with the implementation of appropriate management measures.

On this basis, the project is not considered to be ‘potentially offensive’.

21.3.3 Utilities

Initial consultation with key utility stakeholders regarding route alignment, access tracks and preliminary design has already occurred with the aim to limit impact to utility services. This process will continue throughout the remaining project phases. *Technical Report 14 – Hazard and Risk Assessment* details the assessment of utilities and a summary is provided below.

Some works to utilities are considered to be temporary, during construction only, whereas some would be permanent. As part of the project, existing agreements and deeds with utilities providers will be utilised where relevant to manage the interface between utilities and ensure the design, construction and ongoing maintenance of the utilities can be undertaken effectively and efficiently.

Utility service relocation or protection works would be undertaken during the enabling works. A description of the methodology for utilities works is provided in Chapter 7 of the EIS. Table 21.2 provides the findings of the utility hazard identification process. Mitigation measures to minimise the risks are provided in section 21.6.2.

Table 21.2 Utility hazard identification

EVENT	CAUSE(S)	POTENTIAL RESULT(S)	CONSEQUENCE	LIKELIHOOD	RISK PRIOR TO MITIGATION
Telecommunication Utility Strike	Impact during construction	1. Telecommunication service disruption, including customer complaints	1. Minor	1. Unlikely	1. Low
Water Utility Strike – water and sewer	Impact during construction	1. Flooding, including environmental damage/ sink holes 2. Health/personal injury 3. Service disruption, including customer complaints	1. Minor 2. Minor 3. Minor	1. Unlikely 2. Possible 3. Unlikely	1. Low 2. Medium 3. Low
Power Utility Strike – gas	Impact during construction	1. Flammable gas release, no ignition but area evacuation. 2. Flammable gas release, immediate ignition and multiple fatalities 3. Flammable gas release, delayed ignition and multiple fatalities 4. Property damage 5. Gas service disruption, including customer complaints	1. Moderate 2. Extreme 3. Extreme 4. Major 5. Minor	1. Unlikely 2. Rare 3. Rare 4. Rare 5. Unlikely	1. Medium 2. Medium 3. Medium 4. Medium 5. Low
Power Utility Strike – Dangerous goods pipelines	Impact during construction	1. Flammable liquid release, no ignition but area evacuation 2. Flammable liquid release, immediate ignition and multiple fatalities 3. Property damage 4. Soil contamination 5. Fuel service disruption, including customer complaints	1. Moderate 2. Extreme 3. Major 4. Moderate 5. Minor	1. Unlikely 2. Rare 3. Rare 4. Possible 5. Unlikely	1. Medium 2. Medium 3. Medium 4. Medium 5. Low

EVENT	CAUSE(S)	POTENTIAL RESULT(S)	CONSEQUENCE	LIKELIHOOD	RISK PRIOR TO MITIGATION
Power Utility Strike – electricity (below ground)	Impact during construction	1. Electrocution and single fatality 2. Electricity service disruption, including customer complaints	1. Extreme 2. Minor	1. Rare 2. Unlikely	1. Medium 2. Low
Power Utility Strike – electricity (above ground	Impact during construction	1. Electrocution and single fatality 2. Electricity service disruption, including customer complaints	1. Extreme 2. Minor	1. Rare 2. Unlikely	1. Medium 2. Low

Utility infrastructure that transports high pressure dangerous goods, such as fuels or natural gas, have the largest risk, as a release of these materials, if ignited, could result in a fire or explosion that impacts areas well beyond the study area.

21.3.4 Human health impacts

A health impact assessment is detailed in *Technical Report 13 – Health Impact Assessment* and a summary is provided below.

Air quality impacts

Construction activities associated with vehicle movements, groundworks, vegetation removal, bridge demolition and construction works may cause emissions of dust to be dispersed into the atmosphere. The air quality impact assessment (see Chapter 10) identified dust as the principle risk during construction and outlines the guidelines and criteria which relate to dust emissions. For the assessment of potential health impacts during construction, use of these guidelines and criteria is appropriate and sufficiently protective of health. Where there are impacts predicted during construction that result in exceedance of these guidelines, there is the potential for health impacts.

It is predicted that air quality impacts from dust during construction will meet the criteria within seven metres of the site boundary. There is a low potential for dust generated during construction to exceed these guidelines within the community, particularly where mitigation measures are implemented. Therefore, the potential for health impacts are considered to be low.

The implementation of management measures relating to air quality during construction as outlined in section 10.6 are appropriate for minimising dust impacts to protect health. While health impacts are expected to be low with the implementation of proposed mitigation measures, there may still be some nuisance dust that is noticeable by the community on occasions.

Noise and vibration

The enabling works, main construction works and associated vehicle movements would result in increases in noise and vibration, with the potential to affect surrounding sensitive receivers.

Unlike chemical pollution, noise energy does not accumulate either in the body or in the environment, but it can have both short-term and long-term adverse effects on people. These health effects include (WHO 1999, 2011, 2018):

- sleep disturbance (sleep fragmentation that can affect psychomotor performance, memory consolidation, creativity, risk-taking behaviour and risk of accidents)
- cardiovascular health
- annoyance
- hearing impairment and tinnitus
- cognitive impairment (effects on reading and oral comprehension, short and long-term memory deficits, attention deficit).

Often, annoyance is a major consideration because it reflects the community's dislike of noise and their concerns about the full range of potential negative effects, and it affects the greatest number of people in the population (I-INCE 2011; WHO 2011, 2018).

A number of exceedances of construction noise criteria have been identified for residential and non-residential receptors during the day, evening and night-time periods, for a range of activities. This includes exceedances of the noise criteria by more than 20 dBA. Some receivers are located within the minimum vibration working distance criteria for human comfort. Occupants of these buildings may be able to perceive vibration impacts at times when vibration intensive equipment is in use. These impacts are likely to only occur for relatively short durations. Details of the construction noise and vibration assessment are provided in section 9.3 and mitigation measures for noise impacts provided in section 9.6.

Where the proposed management measures are implemented, the potential for construction noise and vibration to adversely impact community health is minimised. Where mitigation measures are implemented, some noise impacts may occur where works occur close to sensitive receivers. These impacts are expected to be of short duration, but annoyance and potentially sleep disturbance may occur on occasions.

Other potential impacts on health and wellbeing of the community

Changes in the urban environment associated with the project have the potential to result in a range of impacts on health and wellbeing of the community. The potential for changes to result in impacts on health and wellbeing is complex. Changes that may occur have the potential to result in both positive and negative impacts on community health and may include:

- contamination
- increase in traffic
- access and amenity of public facilities such as green space
- visual impact
- economic changes.

Chapter 12 discusses potential contamination risks during construction works. Where the mitigation measures outlined in section 12.4 are implemented, there are no issues of concern in relation to community health.

The project would require the temporary closure of major roads (Robey Street and O'Riordan Street) and some lane closures (including to Southern Cross Drive) to facilitate construction works. These activities would result in delays in the local road network including to bus services and potentially contribute to reduced cohesion and community severance where access to local amenities and social networks is disrupted.

Increased levels of congestion and longer travel times have the potential to increase levels of stress and anxiety in local commuters as well as those that commute to the area for work or travel. Network changes and construction traffic would also affect pedestrian and cycle routes in those areas. Management plans would be developed to manage impacts and minimise delays. While it is unlikely that there would be no delays to traffic in the local area, where the impacts are managed and mitigated as proposed, the potential impacts on community health are expected to be minimal.

Construction of the project may impact the use of green space through temporary impacts relating to noise or visual amenity and the use of McBurney Avenue Reserve as a material storage area during construction. Impacts are anticipated to be minor and no positive or negative impacts expected on community health in relation to project impacts on green space.

Construction of the project will result in some visual changes, with some vegetation being removed and some areas having views of construction compounds and activities. For some individuals, changes in visual amenity can increase levels of stress and anxiety. These impacts, however, are typically of short duration as most people adapt to changes in the visual landscape, particularly within an already urbanised area. As a result, most changes in visual impacts are not expected to have a significant impact on the health of the community.

The economic aspects of the project are where there is the potential to benefit community health. During construction, the peak employment workforce is estimated to be about 270 to 405 people, with indirect benefits on local businesses also identified. These economic benefits are a factor influencing community health with lowered levels of stress and anxiety related to congestion (an improved access to travel and transport) and employment opportunities.

21.3.5 Sydney Airport operations

Construction works have the ability to impact airport operations due to either height of construction plant, construction lighting, or dust production affecting visibility. All these factors can present hazards to arriving and departing aircraft. A full description of the construction assessment relating to Sydney Airport is provided in *Technical Report 15 – Airport Operations Assessment*.

Construction plant

During construction works, it is anticipated that there will be some intrusions into the obstacle limitation surface. This would include activities such as piling, embankment/retaining wall works and cranes required for bridge construction, as well as any other construction activity where plant and equipment is required to be placed within the obstacle limitation surface zone of Sydney Airport (see section 21.2.4).

The track work and backfilling of the retaining walls would require plant (hi-rail dump trucks, excavators, cranes) that would encroach on the obstacle limitation surface. Dump trucks would also be required to operate at full lift while excavators can be operated with height restrictors. The 'Processing Applications under the *Airports (Protection of Airspace) Regulations 1996* Guideline for Operations of Federal Airports' requires any such operations to be approved by the airport operator.

Construction plant associated with the project site, including cranes and piling rigs, would remain below the obstacle limitation surface wherever possible. Where the work area requires cranes to operate within the obstacle limitation surface, a Crane Enquiry Form (Application for Approval of Crane Operation), in line with Sections s.182, 183, the Airports Act, and *Airports (Protection of Airspace) Regulations 1996* – Reg 7 must be completed and submitted to Sydney Airport Corporation Limited.

A number of temporary crane zones would be established where large cranes are required to work. These comprise the Robey Street, O'Riordan Street bridge, Southern Cross Drive and Mill Stream work locations and also at the General Holmes Drive work area. These areas would only be in use during short periods when cranes are required. Some activities that intrude the obstacle limitation surface would be required to be undertaken during the curfew hours of Sydney Airport (between 11 pm and 6 am). Where work is required to be undertaken outside of this time, consultation will be carried out with Sydney Airport Corporation Limited to seek relevant approval exemptions and crane permits (as required).

The construction methodology (described in Chapter 7) identifies where there are operations likely to cause short term intrusion into the airspace. These will be considered further during detailed design in consultation with Sydney Airport Corporation Limited and the relevant approval process followed.

Construction lighting

The Civil Aviation Safety Authority has the power through regulation 94 of the *Civil Aviation Regulations 1988* to require lights, which may cause confusion, distraction or glare to pilots in the air, to be extinguished or modified. The area around Sydney Airport is zoned into maximum lighting intensities protection areas where glare may cause distraction of pilots and the allowed lighting intensity is restricted.

The project site is located within several lighting zones. Flood lighting in the site compounds, which are to operate 24 hours a day, will need to be compliant with the lighting zones and shielded as necessary.

Construction dust, noise and vibration

There is potential for air quality emissions to occur during the construction of the project. The principle activities which may result in emissions include:

- dust and particulate matter emissions from earth working activities
- combustion and pollutant emissions from construction vehicle and plant exhaust.

During construction there is a risk of excessive dust production. Section 10.3 discusses the potential impacts from dust and section 10.6 identifies mitigation measures to minimise impacts from dust. To maintain visibility in the airspace surrounding the airport, dust levels would be kept at a minimal level.

The main potential sources of vibration from the construction works are vibratory rollers and rockbreakers. Impacts are discussed in detail in section 9.3. Construction noise and vibration would not have any impact on aviation operations.

Wildlife strikes

Wildlife strikes, including bird strikes, are a hazard to air transport and general aviation operations. Construction activities may lead to accumulation of waste that attracts birds. Relevant management plans would address and avoid this risk through waste management strategies. Temporary site drainage would be required to avoid ponding water that could attract birds.

Overall, the risk of attracting wildlife during the construction phase of the project is considered negligible.

21.4 Assessment of operational impacts

21.4.1 Public safety

Following completion of construction of the project, road, pedestrian and cycle facilities would be reinstated in a similar or same location, as described in section 6.1. Therefore, there would be no additional impacts on the safety of road users, pedestrians and cyclists from operation of the project.

The new rail bridges over Robey Street bridge, O'Riordan Street bridge, Southern Cross Drive bridge and Mill Stream bridge would extend the existing road, cycle and pedestrian routes which go under the rail bridges. The lighting design for the connections under the bridges would achieve adequate illumination during the night time.

The new structures such as bridges, embankments and retaining walls would be designed with appropriate tolerances to windshear, scour and potential collapse and would meet appropriate standards. Therefore, any safety issues related to collapse of structures is considered to be low.

21.4.2 Dangerous goods

The transportation to the project site of dangerous goods needed for maintenance activities would be infrequent and would be in quantities below the Applying SEPP 33 (DoP 2011a) transport screening thresholds. Given the traffic movement of these dangerous goods would be low, the potential risk during transportation is not considered to be significant. There would be no storage of dangerous goods in the project site during the operation and maintenance of the project. Therefore, there are no operational or maintenance impacts to be considered.

Management of the rolling stock and goods transported would continue to be managed by the rail operators, as is currently done.

21.4.3 Utilities

The key risk and hazard aspects to the project are related to the utility services. Utility protection from maintenance activities during operation would be considered in the Pipeline Safety Management Study (SMS). This will occur during the detailed design phase of the project, once design has reached a level that enables completion of a compliant AS 2885.6 process.

21.4.4 Human health impacts

A health impact assessment is detailed in *Technical Report 13 – Health Impact Assessment* and a summary is provided below.

Air quality

The principle source of air emissions during operation of the project would be from the diesel exhaust of locomotives. The data used to evaluate health impacts relates to key pollutants derived from locomotives, which are benzene, CO, SO_2, NO_2, $PM_{2.5}$ PM_{10}. Where air quality modelling has predicted increases in pollutant concentrations (relevant to emissions from diesel locomotives), these were low and were not considered to be of significance or of concern in relation to community health. Details are provided in *Technical Report 13 – Health Impact Assessment* and are summarised below:

- Maximum concentration of hydrocarbons from the project are only 1.6 percent of the NSW EPA criteria (for benzene). On this basis, there are no community health impacts of concern for hydrocarbon emissions and no further detailed assessment of potential health impacts has been undertaken.
- All the concentrations of carbon monoxide identified are well below the relevant health based standards/guidelines. The contribution from the project is very small. Therefore, there are no health impacts of concern in relation to the project.
- All predicted concentrations of SO_2 are well below the adopted health based criteria. There are no health issues of concern in relation to all (acute and chronic) exposures to SO_2 in the local community.
- The calculated risks for community exposures to nitrogen dioxide indicate that all risks are considered to be within an acceptable threshold. On this basis there are no health risk issues of concern in relation to changes in nitrogen dioxide in the community.
- Concentrations of $PM_{2.5}$ and PM_{10} are essentially unchanged within the local community with the operation of the project. On this basis, there are no health risk issues of concern in relation to $PM_{2.5}$ and PM_{10} in the community.

Noise

Rail noise is caused by the combination of rolling noise (noise from wheels on the rails, including squealing of wheels) and idling/propulsion noise (from locomotives). The main health effects that can arise from this noise impact include annoyance, sleep disturbance, cardiovascular disease, stroke and memory/ concentration (cognitive) effects.

Without mitigation there are a number of residential and other properties where noise levels exceed the adopted operational noise criteria that are designed to be protective of health. Section 9.4 details the operation noise assessment. In summary, predicted noise levels would exceed noise criteria thresholds (daytime and night-time) at a number of locations:

- around King Street
- near Baxter Road
- near Botany Road and McBurney Avenue
- along Myrtle Street.

The predicted increases in noise levels during the day and night-time periods from rail noise are below a level where health impacts from annoyance and sleep disturbance are considered to be unacceptable. Therefore, noise increases predicted in these areas are unlikely to be associated with unacceptable increases in health impacts.

The total noise levels in these areas, which includes the maximum noise levels, exceed the following thresholds suggested by the WHO (2018):

- thresholds for adverse health effects related to environmental noise
- thresholds for minimising rail noise impacts.

Minimising noise impacts from rail noise will therefore minimise health impacts within the community.

The use of at-property noise management treatments (such as higher performance windows, doors and seals), which are suggested as a final mitigation measure, can have a number of subsequent impacts on residential amenity. Negative impacts which may arise from at-property treatment include:

- the measure only mitigates the impact within a building. This does not reduce the impact to outside areas (such as balconies or gardens) potentially leading to a reduction in the use and enjoyment of outdoor areas due to increased noise. This may result in increased levels of stress at individual properties
- at-property treatment relies on correct usage. Where incorrectly used, such as opening windows, there remains the potential for adverse health effects, particularly annoyance and sleep disturbance, to occur.

Therefore treatment at or near the source (such as track lubrication treatments) should be the preferred option.

Other potential impacts on health and wellbeing of the community

The project would unlock additional rail network capacity, with improved travel times through the Botany Line resulting in a potential increase in the number of freight rail services supporting the movement of goods. The increased rail capacity has the potential to reduce the number of trucks in the region. The reduction of heavy vehicle traffic on the road network would not only free up capacity for general traffic, it also has the potential to provide road safety advantages. These impacts have the potential to improve health and wellbeing within the community through the provision of employment, easier access to employment, reduced levels of stress and anxiety.

The project would have no impact on the road network or public transport network upon completion. Therefore, there would be no health impacts.

Once operational the project would not affect existing community access or cohesion in the local area and would therefore not contribute to community severance.

The operation of the project will result in some visual changes to the project site. This includes a second rail line and increased rail movements. Once construction is complete, the project would reinstate, where feasible, to provide visual screening. This may result in some visual changes in some areas. These visual changes are not significant and would not be expected to significantly impact on community wellbeing.

21.4.5 Sydney airport operations

Operation of the Botany Rail Duplication project could create further hazards to airport and aircraft operations. A full description of the assessment relating to Sydney Airport is provided in *Technical Report 15 – Airport Operations Assessment*.

Potential hazards could include:

- light glare from train headlights distracting or confusing pilots
- train heights, and other rail infrastructure heights, infringing the obstacle limitation surface
- maintenance activities infringing the obstacle limitation surface
- bridge structures creating changes in wind turbulence within the airspace
- drainage and landscaping creating attractive habitats for wildlife, increasing risk of wildlife strikes or avoidance manoeuvres.

The following *National Airports Safeguarding Framework Guidelines* (DIRDC, no date) apply to the operational impacts of the Botany Rail Duplication project:

- Guideline B – Managing the risk of building generated windshear and turbulence at airports.
- Guideline C – Managing the risk of wildlife strikes in the vicinity of airports.
- Guideline E – Managing the risk of distractions to pilots from lighting in the vicinity of airports.
- Guideline F – Managing the risk of intrusions into the protected operational airspace of airports.

The potential operational impacts are discussed below.

Light glare

Light glare from train headlights has the potential to distract or confuse pilots as they are arriving or leaving Sydney Airport. The operational project site is located within a light management zone for the airport. Train headlights are currently used on the existing Botany Line and managed within the requirements of the maximum lighting intensities for each lighting zone.

As the trains that will operate on the new line are the same as the current, it is unlikely that there will be a significant change to the direction or type of current light spill. Furthermore, as the trains will not be running parallel to the runway centreline, the risk of pilot confusion is reduced.

Rail and train heights and control tower line of sight

The finished height of the rail line would be below the obstacle limitation surface.

Freight trains currently traveling along the existing Botany Line alignment are classified as transient obstacles that protrude through the obstacle limitation surface for the existing approach to Runway 25 and the existing take-off area for Runway 07. These transient obstacles are currently declared in the Sydney Airport *En Route Supplement Australia* (ERSA) as infringing the obstacle limitation surface by a maximum of 15 feet (4.57 metres) above ground level. The new rail line is adjacent to, and at a similar level as the existing, and therefore trains operating on it will also form transient obstacles.

The project would result in an increase in the frequency of trains on the Botany Line. Consultation with Sydney Airport Corporation Limited, CASA and Airservices Australia will continue with any additional requirements relating to transient obstacles. The information contained in the ERSA may require an update by Airservices Australia and this would be reviewed during detailed design of the project.

The project will not impact on the line of sight of the air traffic control tower to any part of Sydney Airport aircraft movement areas as all works are outside of this area.

Windshear

Turbulence is caused by a disruption to the smooth flow of air. Turbulence in the lower atmosphere is generally created by air flow around an obstacle such as buildings. In accordance with NASF Guideline B, where any developments are proposed in proximity to runways, they should be assessed for potential to create windshear and turbulence that could affect the safety of aircraft.

As there are no significant structures associated with the project, and no significant changes to topography, the windshear or turbulence is not expected to change from the current situation.

Wildlife strikes

Drainage and landscaping within the project site has the ability to attract wildlife that may not have been present in the area previously.

The majority of the project is located within the existing rail corridor and therefore landscaping will be limited to revegetation of cleared areas. The project also requires removal of vegetation rather than creation of new areas of landscaping. Overall, the risk of attracting wildlife during the operational phase of the project is considered negligible.

21.5 Cumulative impacts

21.5.1 Overview

The methodology of the cumulative impact assessment and details of other projects considered are detailed in Chapter 24. A summary of the predicted cumulative impacts which relate to hazards, health and safety are described below.

21.5.2 Cumulative construction impacts

Dangerous goods cumulative impacts could occur if large quantities of dangerous goods are located in close proximity. Due to the small quantity of dangerous goods expected to be associated with other proposals (see section 23.1 for a list), it is not anticipated that there are any cumulative impacts from the use or transportation of dangerous goods in combination with other projects.

Due to the co-location of some project areas, a cumulative impact associated the Sydney Gateway road project exists. This cumulative impact is associated with the disturbance of utility services. Co-ordination of utility relocations would be considered as some utilities have relocation requirements for both projects.

The Sydney Gateway road project includes the following potential impacts on airport operations, in relation to Runway 16R/34L (see Figure 21.2):

- intrusion into prescribed airspace during construction phase
- potential lighting glare during construction, and from vehicle headlights during operation.

Similar to the Botany Rail Duplication, these issues are not expected to result in impacts on aviation safety, as it is expected that relevant legislation and other guidelines would be followed. Consultation would be carried out with Sydney Airport Corporation Limited to seek relevant approval exemptions and crane permits (as required).

Impacts on health that are of particular importance relate to construction fatigue. Fatigue can be caused when communities are impacted concurrently and consecutively by multiple projects impacting the same area. When considering construction fatigue, the main concerns include dust generation, noise and vibration, traffic and transport (including congestion, pedestrian access and cycle access) and visual amenity. Where these impacts occur for extended periods of time, there is the potential that increased levels of stress and anxiety may also continue for extended periods of time.

21.5.3 Cumulative operational impacts

It is not anticipated the project in combination with other projects would provide any cumulative impacts with the project in relation to hazards and risk, provided all proposed mitigation measures are implemented.

Other approved infrastructure projects in the local area are aimed at improving infrastructure, connections and access within the urban environment. Therefore on a broader scale, Botany Rail Duplication and the other longer-term projects, may assist in reducing stress and physiological and mental health impacts associated with living and working within the urban environment.

21.6 Management of impacts

21.6.1 Approach

As described in the EIS Chapter 6 (Project features and operation) and Chapter 7 (Construction), design development and construction planning has focussed on avoiding or minimising the potential for environmental impacts during all key phases of the process. Measures taken to avoid or minimise impacts which relate to airport operations include:

- design in conjunction with the Sydney Airport protected airspace data
- construction method statements to be developed in conjunction with legislation, policies and guidelines, in particular the National Airports Safeguarding Framework.

In order to manage the risk to high pressure pipeline, a series of AS 2885.6 safety management study workshops with impacted pipeline owners would be conducted, to demonstrate threats to each pipeline can be appropriately managed during construction and operation. The safety management study workshops will be conducted once design has reached a level that enables completion of a compliant AS 2885.6 process.

A full description of the approach to environmental management and mitigation is provided in Chapter 24.

21.6.2 List of mitigation measures

The mitigation measures that would be implemented to address potential hazards, health and safety impacts are listed in Table 21.3. This table also outlines which mitigation measures (during the construction stage) would be implemented during the enabling works and main construction works.

Table 21.3 Mitigation measures

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
Design	High pressure flammable material released from pipeline	Independently facilitated AS 2885.6 SMS workshops will be completed with each high pressure pipeline owner and the construction contractor. The SMS workshops will be conducted once design has reached a level that enables completion of a compliant AS 2885.6 process. This level is considered to be detailed design for construction and will be completed before construction relating to the relevant utilities commence.	N/A – Design phase	N/A – Design phase
	Disruption of utility services	The location of key utility infrastructure which relate to the project site and proposed construction works will be identified and documented in the relevant design drawings and reports, prior to construction works commencing.	N/A – Design phase	N/A – Design phase
	Disruption of utility services	Details of proposed works for key utilities, such as relocate or protect will be confirmed prior to construction works commencing.	N/A – Design phase	N/A – Design phase
	Wind shear and turbulence due to new constructions in the vicinity of the airport	Based on the current design, detailed windshear assessment is not warranted. Consultation with Sydney Airport Corporation Limited is required to confirm any need for detailed assessment in accordance with *National Airports Safeguarding Framework Guideline B* during detailed design.	N/A – Design phase	N/A – Design phase
	Light glare distracting and confusing Sydney Airport aircraft pilots	Lighting associated with operation and maintenance of the rail line, including train headlights, will comply with the CASA Manual of Standards 139 section 9.21 and National Airports Safeguarding Framework Guideline E.	N/A – Design phase	N/A – Design phase
	Rail and train heights infringing the Sydney Airport obstacle limitation surface	The rail alignment has been designed in conjunction with the protected airspace associated with Sydney Airport to minimise the intrusions into the airspace. Consultation with Sydney Airport Corporation Limited will be undertaken during detailed design on the final rail alignments and heights. Consultation with Airservices Australia will be undertaken during detailed design for assessment of any required updates to the ERSA.	N/A – Design phase	N/A – Design phase

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Wildlife strikes to Sydney Airport aircraft due to increased wildlife activity in the vicinity of the airport	Drainage and revegetation has been designed so as not to create high risk environments for attracting additional wildlife. Any changes to the drainage or revegetation design made during detailed design will ensure that no high risk environments for attracting additional wildlife are created.	N/A – Design phase	N/A – Design phase
	Cumulative impacts on utility services (Sydney Gateway road project)	Coordination of utility relocations will be considered before enabling works commence.	N/A – Design phase	N/A – Design phase
Construction	Risks to infrastructure from utility works during enabling works	The site EMPs will include a section specific to utility management and utility protection.	✓	
	Risks to public safety from general construction activities	Construction-related risks related to public safety from general construction activities (listed in section 21.3.1) will be incorporated into the relevant management plans with measures to minimise and manage risks.	✓	✓
	Chemical and explosive management	The management of all chemicals and detonators used during construction will comply with the relevant Australian Standard.	✓	✓
	Dangerous goods use and storage quantities exceeded	The relevant management plan will include a review of the required dangerous goods quantities to be used and stored during construction to validate Applying SEPP 33 (DoP 2011a) screening assessment. If the Applying SEPP 33 (DoP 2011a) thresholds levels are not exceeded, no further work is needed. If the Applying SEPP 33 (DoP 2011a) thresholds are exceeded, a preliminary hazard analysis will be completed and provided to DPIE for reference.	✓	✓
	Construction plant infringing Sydney Airport obstacle limitation surface	Management plans will be developed and implemented for the project to ensure that the necessary approvals are sought, particularly for the use of cranes. Use of cranes will comply with *National Airports Safeguarding Framework Guideline F* (DIRDC, no date) Where necessary, use of cranes that would infringe the obstacle limitation surface will be limited to curfew hours and permits obtained from Sydney Airport.	✓	✓

STAGE	IMPACT	MEASURE	ENABLING WORKS	MAIN CONSTRUCTION
	Construction lighting producing light spill in the direction of incoming Sydney Airport aircraft	Management plans will be developed and implemented for the project to ensure the lights proposed for use comply with CASA Manual of Standards 139 section 9.21, and *National Airports Safeguarding Framework Guideline E* (DIRDC, no date).	✓	✓
	Dust production causing visibility issues in the Sydney Airport airspace surrounding the airport	Management plans will be developed and implemented for the project to ensure the construction methods used do not produce excessive amounts of dust, as detailed in section 10.6).	✓	✓
	Risk of wildlife strikes to Sydney Airport aircraft due to attraction of wildlife to areas near airport operations	Management plans will include measures to minimise waste attracting wildlife, particularly birdlife. These will include, but not be limited to: • food waste being stored in covered bins • waste being regularly removed from site	✓	✓
Operation	Disruption of utility services or rail services	Communication with utility service providers during maintenance (both rail and utility) will be undertaken in accordance with the ARTC Safety Management System.	N/A – Operation	N/A – Operation
	Personal injury (within the community) relating to maintenance activities around utilities	Utility maintenance works will be undertaken in accordance with safety protocols prescribed in ARTC's Safety Management System, ARTC's Safety Management System includes requirements for safe work method statements, which will be prepared as required for utility maintenance works.	N/A – Operation	N/A – Operation

21.6.3 Consideration of the interaction between measures

Mitigation measures to control impacts on health and safety of the community and Sydney Airport may replicate mitigation measures proposed for the control of impacts associated with noise, air quality, water quality, contamination, traffic and access, social impacts and waste management.

All mitigation measures for the project would be consolidated and described in the relevant management plan. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and ease of implementation.

21.6.4 Managing residual impacts

A residual risk analysis was undertaken following the impact assessment summarised in this chapter. The results of the residual risk analysis are provided in Appendix B. Residual risks with an assessed level of medium or above are summarised below:

- impact to utilities including pipelines.

Utility service relocation or protection will be carried out during the enabling works for the project. Prior to construction of enabling works, a site environmental management plan will be completed by the construction company. The purpose of this management plan is to describe how the construction company will manage and verify the safety compliance and risk aspects of the project works for the construction and completion phases of the utility works, including reviewing and updating the construction hazard assessment (provided in *Technical Report 14 – Hazard and Risk Assessment*), as required.

The construction hazard assessment will be updated to provide a detailed methodology of the site construction and installation for hazardous situations. The detailed methodology will indicate the potential hazards and the control measures required to mitigate risks to as low as reasonably practicable during the construction stage.

The construction hazard assessment will update and confirm the risk register, which will be treated as a live document to be regularly reviewed during the construction phase. Any information considered to be relevant to the operational phase will be carried forward in the risk register.

22. CLIMATE CHANGE RISK

This chapter provides the climate change risk assessment for the project. A full copy of the assessment report is provided as *Technical Report 16 – Climate Change Assessment*.

22.1 Assessment approach

A summary of the approach to the climate change risk assessment is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessment.

22.1.1 Legislative and policy context to the assessment

Relevant legislation, policies, guidelines and standards include:

- *National Climate Resilience and Adaptation Strategy* (Department of the Environment, 2015), which is a Commonwealth guideline that recommends a risk management approach to guide climate resilience building and adaptation. This approach was used to inform the methodology of the climate change risk assessment (see section 22.1.20).
- *The NSW Climate Change Policy Framework* (NSW Government, 2016), which guides NSW climate change policy and programs, outlines that the NSW Government will provide targeted information to assist in climate risk management. This framework led to the NSW Government's NSW and ACT Regional Climate Modelling project (NARCliM), which provides the climate change projections that were adopted for the climate change risk assessment (see Table 22.1).
- *Sea Level Rise Policy Statement* (NSW Government, 2009), which provides the sea level rise benchmarks that were adopted for the climate change risk assessment (5334:2013 Climate change adaptation for settlements and infrastructure, a risk based approach, which follows AS/NZS ISO 31000:2009 (AS/NZS 2009) Risk management – principles and guidelines, was used as the basis for the methodology for the climate change risk assessment (see section 22.1.2).
- *Floodplain Risk Management Guideline: Practical Considerations of Climate Change* (DECC, 2007), which provides guidance for undertaking flood modelling sensitivity analysis. The flood modelling undertaken for *Technical Report 6 – Flooding Impact Assessment* was in line with this guideline and has been used to inform the climate change risk assessment (see section 22.2).

Further discussion regarding the relevant policies and guidelines with respect to climate change are provided in section 3 of *Technical Report 16 – Climate Change Assessment*.

22.1.2 Methodology

Key tasks

The assessment involved undertaking a climate change risk assessment in line with the approach outlined in AS 5334 *'Climate change adaptation for settlements and infrastructure – A risk based approach'.* The assessment involved:

- establishing the climate change context of the project by undertaking a review of the NARCliM and CSIRO climate change projections for climate change variables that are considered relevant to this project and historical baseline data
- undertaking a project-specific risk assessment, which included:
  - risk identification through:
    - reviewing the project design in consultation with a multidisciplinary team of designers and environmental specialists
    - reviewing previous climate change risk assessments undertaken for similar asset types
    - consideration of potential impacts that different climate change variables may have on the project components
  - risk analysis through consideration of the likelihood and consequence of the risks identified
  - risk evaluation through combining the likelihood and consequence into an overall risk rating using a risk level matrix
- proposing risk treatment/adaptations for the extreme, high and medium risks identified.

To assist with risk identification, flood modelling was undertaken by Lyall & Associates to assess the potential impacts of increases in rainfall intensity and sea level rise due to climate change on the project (see *Technical Report 6 – Flooding Impact Assessment*). The scenarios modelled were:

- **Scenario 1** – based on an assumed 10 percent increase in currently adopted design rainfall intensities, together with a rise in sea level of 0.4 metres.
- **Scenario 2** – based on an assumed 30 percent increase in currently adopted design rainfall intensities, together with a rise in sea level of 0.9 metres.

A review of risks assessments undertaken for similar asset types was also undertaken to inform this assessment.

More information on the flood modelling that was undertaken to inform this climate change risk assessment is provided in *Technical Report 6 – Flooding Impact Assessment* and section 4.3 of *Technical Report 16 – Climate Change Assessment.*

A detailed description of the overall climate change risk assessment methodology is provided in section 3 of *Technical Report 16 – Climate Change Assessment*.

Study area

The study area for the climate change risk assessment is defined by the resolution of the climate change projections adopted, which are used to determine how the climate at the project site is likely to change in the future.

Where possible, the climate change projections from the *Metropolitan Sydney Climate Change Snapshot* (OEH, 2014) have been used in the climate change risk assessment. The *Metropolitan Sydney Climate Change Snapshot* summarises NARCliM projections for the Metropolitan Sydney Region for two timescales; the years 2030 and 2070. These two timescales have been used to assess the 'near future' and 'far future' climate change impacts on the project.

However, for climate change variables not covered by NARCliM, the CSIRO projections for the wider East Coast Cluster Region (which includes Sydney) were adopted (Dowdy, A et al. 2015).

22.1.3 Risks identified

The preliminary environmental risk assessment undertaken for the project (provided in Appendix B) included a potential climate change risk associated with impacts on infrastructure due to increased heat, rainfall and flooding. Prior to the identification and assessment of mitigation measures, this risk was assessed to be a medium level risk. Further information on the risk assessment, including the approach, methodology and the results, is provided in Appendix B. This potential risk and its associated impacts were considered as part of the climate change risk assessment. The assessment also considered matters identified by the SEARs (as described in Chapter 3. The residual risk levels, following further risk assessment (as per *Technical Report 16 – Climate Change Assessment*) based on the implementation of the mitigation measures proposed in this EIS, are discussed in section 22.4.4.

22.1.4 How potential impacts have been avoided or minimised

As described in Chapters 6 and 7, design development and construction planning has included a focus on avoiding or minimising the potential for environmental impacts during all key phases of the process.
As discussed in section 22.4, potential climate change risks would be minimised through implementation of design treatments and adaptation measures.

22.1.5 Existing and future environment

Existing climate

Historic data from the closest Bureau of Meteorology weather station to the project site, the Sydney Airport weather station, which is located within a four kilometre distance of the project site, shows that for the project site:

- most of the annual rainfall occurs in the first six months of the year, with June being the wettest month
- the highest recorded daily rainfall was 216.2 mm, which occurred on 3 Feb 1990
- the mean maximum temperatures during summer range from 25.9°C to 26.6°C
- the mean maximum temperatures during winter range from 17.1°C to 18.4°C
- the highest temperature recorded was 46.4°C, which occurred on 18 January 2013.

Further information on the local climate is provided in section 4.1.2 of *Technical Report 16 – Climate Change Assessment*.

Climate change projections

Climate change has the potential to alter the frequency, intensity and distribution of extreme weather related natural hazards, including more intense and frequent heat waves, droughts, floods and storm surges.

Table 22.1 summarises the adopted climate change projections for the project site in the near future (2030) and far future (2070).

Table 22.1 Climate change projections adopted

	2030	2070	SOURCE
Projected temperature changes			
Maximum Temperature	Maximum temperatures are projected to increase in the near future by 0.7°C (0.3–1.0°C)	Maximum temperatures are projected to increase in the far future by 1.9°C (1.6–2.5°C)	NARCliM
Minimum Temperatures	Minimum temperatures are projected to increase in the near future by 0.6°C (0.4–0.8°C)	Minimum temperatures are projected to increase in the far future by 2.0°C (1.4–2.5°C)	NARCliM
Hot days	The number of hot days will increase in the near future	The number of hot days will increase in the far future	NARCliM
	Average change +4 hot days per annum above 35°C	Average change +11 hot days per annum above 35°C	NARCliM
Cold nights	The number of cold nights will decrease in the near future	The number of cold nights will decrease in the far future	NARCliM
	Average change of 5 fewer cold nights per annum below 2°C	Average change of 12 fewer cold nights per annum below 2°C	NARCliM
Projected rainfall changes			
Mean Rainfall	Rainfall is projected to decrease in spring and increase in autumn	Rainfall is projected to decrease in spring and winter. Rainfall is projected to increase in summer and autumn	NARCliM
Rainfall Intensity	The intensity of rainfall events is projected to increase in the far future*		CSIRO
Projected sea level rise changes			
Sea level is projected to increase 0.08 to 0.18 m above 1986–2005 levels in the near future*		Sea level is projected to increase 0.4–0.55 m above 1986–2005 levels in the far future*	CSIRO
Projected forest fire danger index (FFDI) changes			
Average fire weather is projected to increase in spring in the near future		Severe fire weather days are projected to increase in summer and spring in the near future	NARCliM
Projected wind speed changes			
Minimal change in mean surface wind speed with an increase in the frequency of high intensity east coast lows that result in damaging winds in the near future.		Minimal change in mean surface wind speed with an increase in the frequency of high intensity east coast lows that result in damaging winds in the far future.	NARCliM CSIRO
Lightning			
The frequency of lightning strikes is predicted to increase in the near and far future.			DECCW

* See section 4.3 in *Technical Report 16 – Climate Change Assessment* for an explanation of the rainfall intensity and sea level rise scenarios considered in this assessment

Source: NARCliM projections from Metropolitan Sydney Climate Change Snapshot, OEH, 2013b

Source: CSIRO projections from East Coast Cluster Report, (Dowdy, A et al. 2015)

22.2 Assessment results

The potential climate change risks during construction are considered to be minimal, as the climate would not change noticeably within the short-term. Therefore, the focus of the climate change risk assessment was to identify and assess potential climate change risks relevant to the operation of the project.

Table 22.2 summarises the key climate change risks that may result in impacts during operation of the project (see section 5.2 in *Technical Report 16 – Climate Change Assessment* for further detail). A revised risk rating has also been provided to illustrate the likely residual climate change risk if the proposed treatment/adaptation measures are implemented (see section 22.4).

Table 22.2 Potential climate change risks identified during operation of the project

CLIMATE VARIABLE/ HAZARD	DESCRIPTION OF POTENTIAL IMPACT ON PROJECT	RISK RATING WITHOUT ADAPTATION MEASURES	RISK RATING WITH ADAPTATION MEASURES
Increase in rainfall intensity combined with sea level rise	Localised flooding resulting in inundation of the rail tracks on sections of the Botany Line.	Low – Direct risk on operations	Low – Direct risk on operations
	Localised flooding causing scour of the track formation and ballast, requiring replacement and increasing the need for maintenance.	Medium – Direct risk on operations and maintenance	Medium – Direct risk on operations and maintenance
	Flooding of the corridor access road near Southern Cross Drive and between Botany Road and Southern Cross Drive, resulting in access restrictions for maintenance vehicles during significant rainfall events.	Low – Direct risk on operations and maintenance	Low – Direct risk on operations and maintenance
	Reduced performance of surface drainage systems caused by increased rainfall intensity and localised flooding.	Medium – Direct risk on operations and maintenance	Low – Direct risk on operations and maintenance
	Damage to the communication and signalling equipment due to flooding, requiring replacement of equipment and causing disruptions to services.	High – Direct risk on operations and maintenance	Medium – Direct risk on operations and maintenance
Extreme high temperatures (and increased mean maximum temperature)	Track buckling and potential derailment of trains.	Medium – Direct risk on operations and maintenance	Medium – Direct risk on operations and maintenance
	Increased frequency of reduced track speeds and rail track inspections due to increased risk of track buckling.	Medium – Direct risk on operations	Medium – Direct risk on operations
	More frequent malfunctioning of communication and signalling systems resulting in delays on the rail network.	Medium – Direct risk on operations and maintenance	Low – Direct risk on operations and maintenance
	High demand on the wider electricity grid leading to blackouts of the overall network and back-up supply, disruption to signalling systems and delays on the rail network.	Medium – Indirect risk on operations and maintenance	Low – Indirect risk on operations and maintenance
	Increased frequency of thunderstorms and associated lightning strikes resulting in damage and potential failure of signalling systems.	Medium – Indirect risk on operations and maintenance	Low – Indirect risk on operations and maintenance

CLIMATE VARIABLE/ HAZARD	DESCRIPTION OF POTENTIAL IMPACT ON PROJECT	RISK RATING WITHOUT ADAPTATION MEASURES	RISK RATING WITH ADAPTATION MEASURES
	Maintenance staff unable to performance maintenance tasks due to extreme temperature events.	Medium – Direct risk on operations and maintenance	Low – Direct risk on operations and maintenance
	Extreme heat resulting in heat stress and adverse health effects for maintenance staff.	Medium – Direct risk on operations and maintenance	Medium – Direct risk on operations and maintenance
More frequent extreme wind events	Increased likelihood of damage to signalling infrastructure, lighting and large billboards that span across the corridor resulting in debris on the rail line causing delays.	Low – Direct risk on operations and maintenance	Low – Direct risk on operations and maintenance
	Damage to vegetation adjacent to the alignment which can become a hazard on the trail tracks.	Medium – Direct risk on operations and maintenance	Low – Direct risk on operations and maintenance
Increased frequency of bushfires	Increased frequency of bushfires in bushland areas causing smoke, low visibility for drivers and adverse health impacts for operational and maintenance staff.	Low – Indirect risk on operations and maintenance	Low – Indirect risk on operations and maintenance
	Increased frequency of bushfires leading to damage of the electricity grid resulting in blackouts of the overall network and back-up supply, disruption to signalling systems and delays on the rail network.	Low – Indirect risk on operations and maintenance	Low – Indirect risk on operations and maintenance

As identified in Table 22.2, no extreme risks were identified in the climate risk assessment. One high risk was identified in relation to the failure of communications and signalling systems caused by flooding, as a result of an increase in rainfall intensity combined with sea level rise.

22.3 Cumulative impacts

Cumulative climate change impacts are typically related to cumulative flooding impacts, which may be worsened under future climate change conditions. *Technical Report 6 – Flooding Impact Assessment* determined that the project is likely to result in localised and minor flooding impacts under current climate conditions, which would result in negligible to minor cumulative flooding impacts. As the flooding impacts from the project would only be slightly increased under future climate conditions (see section 13.4.4), the cumulative flooding impacts associated with climate change (during operation of the project in the future) are expected to be minor.

Other climate change related impacts on the project, such as those associated with extreme high temperatures, more frequent extreme wind events or increased frequency of bushfires (see section 22.2), would not interact with aspects beyond the project site, and are therefore unlikely to result in cumulative impacts.

22.4 Management of impacts

22.4.1 Approach

The project has been designed and would be constructed and operated to be resilient to the future impacts of climate change. Adaptation strategies would be further developed and incorporated into the detailed design of the project to futureproof the assets. A list of potential adaptation measures to minimise climate change related risks during operation of the project has been provided in section 5.2 of *Technical Report 16 – Climate Change Assessment* and Table 22.3.

22.4.2 List of mitigation measures

The mitigation measures that would be implemented to address potential climate change impacts are listed in Table 22.3 (see section 5.2 in *Technical Report 16 – Climate Change Assessment* for more detail). No mitigation measures are proposed for the construction phase of the project, as the effects of climate change would not be noticeable in the short-term (see section 22.2).

Table 22.3 Mitigation measures

STAGE	IMPACT	MEASURE
Design	Climate change resulting in a range of potential impacts on the asset that can be mitigated through design	Measures to mitigate any extreme, high and medium climate change risks will be further refined and included in the detailed design to ensure there are no residual extreme or high climate risks, and minimise medium risks where practicable. The following potential measures will be considered: • designing drainage systems to consider the increase in rainfall intensity due to climate change • locating new rail systems infrastructure above predicted climate change flood levels, where practicable • placing cable routes outside climate change flood inundation zones where feasible • adjusting the neutral point when specifications are prepared for the stressing of steel rail to account for likely temperature variations and increases in average maximum temperatures • selecting equipment that is resilient to the projected temperature changes over its design life • designing ventilation systems for signalling equipment rooms/location cases to account for increased temperatures due to climate change • connecting to existing system at the site where UPS changeovers are provided to bridge power supply when changing from electricity network to critical infrastructure back-up supply to reduce risk of power failure • limiting outside exposure of cables where possible, ensure the installation of surge protection and provide a redundant power source to reduce likelihood and impacts of lightning strikes to exposed cables • reducing the number of signalling cabinets to reduce the amount of exposed cabling.

STAGE	IMPACT	MEASURE
Operation	Risk of extreme weather event affecting infrastructure and operations	ARTC's Asset Management System includes provision for regular inspections and maintenance. In accordance with ARTC's Asset Management System. Inspections of drainage infrastructure will be undertaken, to ensure operating at design capacity.
	Risk of extreme weather event affecting infrastructure and operations	Equipment rooms will be designed in accordance with the relevant standards and to consider future extreme heat events due to climate change. Response to such events will be in accordance with ARTC's safety management system and standard operating procedures.
	Risk of extreme weather event affecting infrastructure and operations	Where infrastructure is to be replaced during maintenance, it will be undertaken in accordance with the relevant standards and will consider the most up to date climate change projections. Response to such events will be in accordance with ARTC's standard operating procedures.
	Risk of extreme weather event affecting infrastructure and operations	Weather forecasting will be taken into consideration when planning maintenance works in accordance with ARTC’s Standard Management Measures (under the Environmental Management System).

22.4.3 Consideration of the interaction between measures

In addition to the measures for climate change described above, there are interactions between the mitigation measures for hydrology and flooding (Chapter 13), which may also reduce the potential climate change risk during operation of the project.

All mitigation measures for the project are consolidated in Chapter 24 to ensure consistency in implementation.

22.4.4 Managing residual impacts

A residual risk analysis was undertaken following the impact assessment summarised in this chapter, which further defined and assessed the potential climate change risks and implementation of the mitigation measures as recommended in section 22.4.2. The results of the residual risk analysis are outlined in section 5.2 of *Technical Report 16 – Climate Change Assessment*.

In summary, at the end of detailed design there should be no residual extreme or high climate change risks. Residual risks with an assessed level of medium (following implementation of adaptation measures) include:

- increased rainfall intensity combined with sea level rise potentially resulting in:
    - localised flooding causing scour of the track formation and ballast
    - failure of communications and signalling systems caused by flooding
- increases in average annual temperatures and the number of extreme heat days potentially resulting in:
    - track buckling increasing operational and maintenance costs, causing delays and potential derailments
    - heat stress and adverse health effects for maintenance staff
- increases in the frequency of extreme wind events resulting in:
    - damage to vegetation adjacent to the alignment which can become a hazard on the rail tracks.

23. CUMULATIVE AND RESIDUAL IMPACTS

This chapter provides an assessment of the potential cumulative impacts. It describes other projects in the study area and identifies where there is the potential for cumulative impacts to occur. It also provides an assessment of the potential for residual impacts following implementation of the mitigation measures provided in chapters 8 to 22.

23.1 Assessment approach

When a project is assessed in isolation, the environmental impacts and benefits may not be considered large. However, when combined with other projects, the resultant cumulative effects may result in a greater extent, magnitude or duration of impact. Identifying the potential for cumulative impacts assists in guiding the development of appropriate mitigation measures.

The selection of proposed developments assessed as part of this cumulative impact assessment was based on a number of criteria including:

- the proximity of the project to the Botany Rail Duplication project
- the likelihood of the project being constructed during a similar time as the Botany Rail Duplication project
- the size of the project and the potential to result in substantial changes to identified key issues (such as traffic, air quality noise and vibration etc) or substantial changes to the existing land use of the area
- the likelihood of the project being constructed given its pre-approval status and support from relevant government planning strategies and local environmental plans.

Other projects with the potential for cumulative impacts with the Botany Rail Duplication project were identified during internal workshop discussions, consultation with technical specialists and a review of publicly available information and environmental impact assessments from the following databases:

- NSW Major Projects website (NSW Government, 2019)
- Bayside Council – Development Application search tool (Bayside Council, 2019)
- Australian Government – Department of Environment and Energy, EPBC Public notices list (Australian Government, 2019).

The cumulative assessment has been predominantly qualitative, due to information available at the time of the assessment, with the exception of the following:

- *Technical Report 1 – Traffic and Transport Impact Assessment*, which considered, construction of the Sydney Gateway – Road project, proposed construction staging (and opening of WestConnex) and the completion of key road network upgrades at Airport North and Airport East, in the 2022 future baseline assessment.
- *Technical Report 2 – Noise and Vibration Impact Assessment*, which considered the likelihood of overlapping construction works, and an increase in theoretical worst-case noise levels of around three decibels in modelling. The assessment is based on the assumption, when two construction activities occur at the same time, the resulting increase in noise is three decibels greater than a single noise source.

Projects considered to have the potential for cumulative impact with the Botany Rail Duplication project are listed in Table 23.1 and shown in Figure 24.1.

Table 23.1 Projects with the potential for cumulative impacts

PROJECT/ PROPONENT	DETAILS (INCLUDING PROPONENT)	STATUS (AUGUST 2019)	CONSTRUCTION TIMEFRAME (INDICATIVE)	NEAREST PROJECT LOCATION
Sydney Gateway – Road *Roads and Maritime*	Proposal to build new direct high capacity road connections linking the Sydney motorway network at St Peters interchange with Terminal 1 and Airport Drive in the south and Qantas Drive and Terminals 2/3 in the east.	Proposed	3.5 years from approval	Qantas Drive (immediately adjacent to the project site)
Qantas Training Facility *Qantas*	Proposal to construct a new training centre, internal road network and car parking facilities in Mascot.	Proposed	2019–2021	King Street, Mascot (immediately adjacent to the Project site)
Airport East *Roads and Maritime*	Upgrading of roads to the east of Sydney airport including the removal of the General Holmes Drive rail crossing and the replacement with a road underpass.	Under construction	2015–2020	General Holmes Drive (immediately to the east of the project site)
Airport North *Roads and Maritime*	Upgrading of roads to the north of Sydney airport including the reconfiguration of O'Riordan and Robey Streets.	Under construction	2015–2019	O'Riordan and Robey Streets (immediately adjacent to the project site)
Sydney Airport T2/T3 Ground Access Solutions and Hotel *Sydney Airport*	Proposed staged construction of Ground Access Solutions in the T2/T3 precinct in the north west of the airport. The proposal includes vehicle access modifications, construction of car parking and pedestrian access, a multi-level Ground Transportation Interchange and a 340-room hotel.	Approved – Under Construction	Staged construction 2015–2020, commensurate with demand and planned for completion with WestConnex Enabling works.	Sydney Airport (50 metres to the south of the project site)
WestConnex – New M5 *Roads and Maritime*	Construction of the new M5 consisting of twin underground motorway tunnels, nine kilometres long, from Kingsgrove to a new St Peters Interchange at the site of the old Alexandria landfill facility.	Under construction	2016–2020	St Peters (one kilometre northeast of the project site)
WestConnex M4-M5 *Roads and Maritime*	Construction of a new multi-lane road link (motorway tunnels) between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters.	Under construction	2016–2023	St Peters (1.5 kilometres northeast of the project site)

PROJECT/ PROPONENT	DETAILS (INCLUDING PROPONENT)	STATUS (AUGUST 2019)	CONSTRUCTION TIMEFRAME (INDICATIVE)	NEAREST PROJECT LOCATION
F6 Expansion – Stage 1 *Roads and Maritime*	Proposed multi lane road (via tunnels) between the New M5 Motorway at Arncliffe and President Avenue Kogarah.	Proposed	2020–2024	Marsh Street, Wolli Creek (2.4 kilometres from the project site)
Sydney Metro – City and Southwest *Transport for NSW*	Proposed new 30 km metro line extending from the end of Sydney Metro Northwest at Chatswood, under Sydney Harbor, through the CBD and south west to Bankstown. From Sydenham to Bankstown project construction will be carried out at surface within the existing heavy rail corridor, while from Chatswood to Sydenham construction will be largely underground.	Under construction	2017–2024	Sydenham Railway Station (2.3 kilometres to the northwest of the project site)
Mascot Intersection *Roads and Maritime*	Intersection upgrades in the suburb of Mascot to help manage congestion and safety, and help address growing freight and travel demand.	Proposed	2019–Unknown	Mascot (multiple locations 850 metres to the north of the project site)
King Apartments *Vanovac Tuon Architects*	Proposed 12 story mixed use building including public car park, hotel and commercial offices located at 324 King Street Mascot.	Approved	Unknown, not identified in DA planning documents.	King Street Mascot (146 metres to the north and east of the project site)

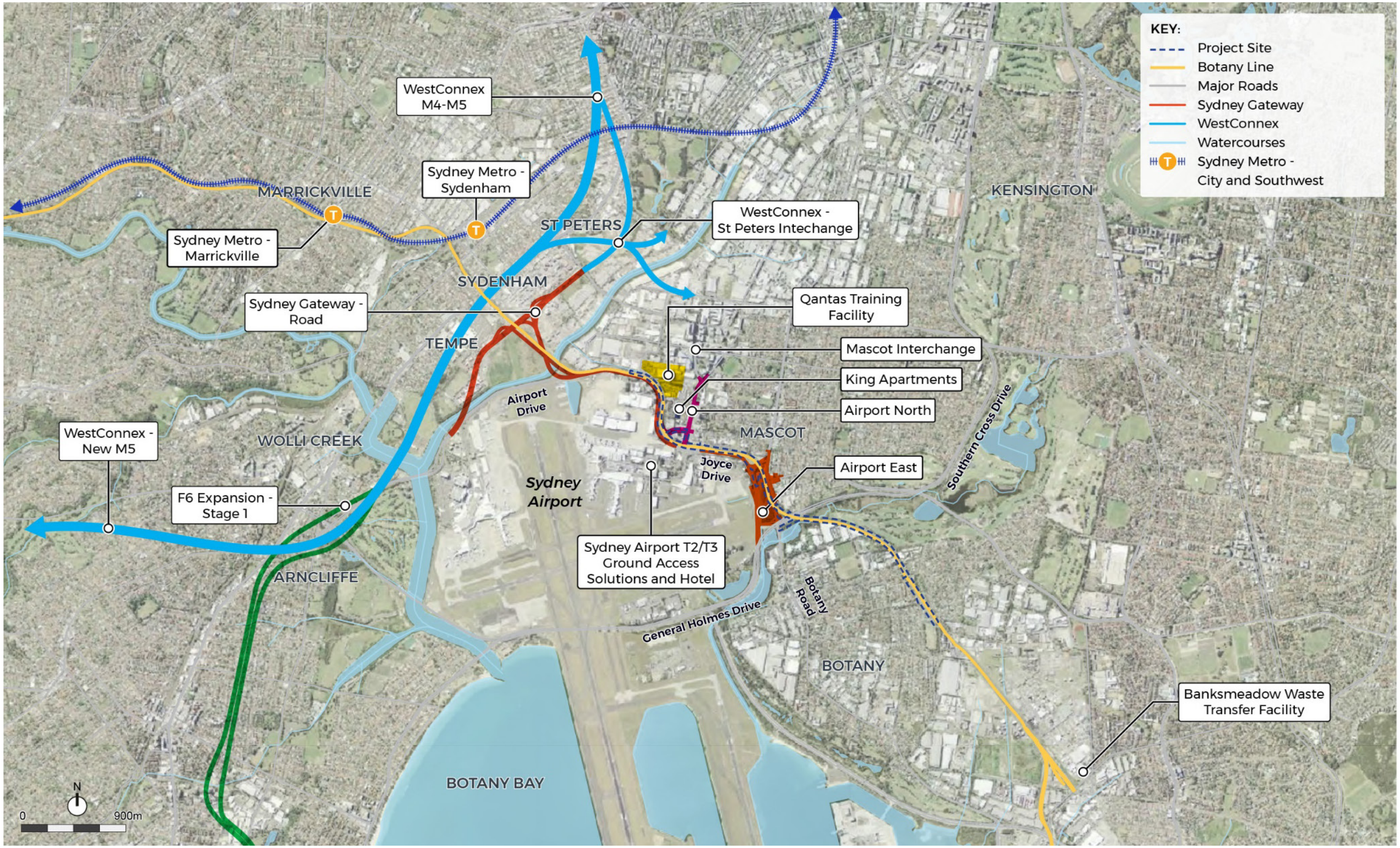


Figure 23.1 Projects with the potential for cumulative impacts with the Botany Rail Duplication project

23.2 Cumulative impacts

This section provides an overview of the cumulative impacts that may occur during the construction and operation of the Botany Rail Duplication project and other major developments.

Of the projects listed in Table 23.1 and shown in Figure 23.1, the Sydney Gateway road and the Qantas Training Facility are the only other major projects considered to result in cumulative impacts due to the potential overlap of construction periods, location of projects and magnitude of potential impacts.

23.2.1 Sydney Gateway road project

Project details

Transport for NSW proposes to build the Sydney Gateway road project to provide a new direct high capacity road connection, linking Sydney Airport and the Sydney Motorway network at St Peters in the north, Terminal 1 and Airport Drive in the south and Qantas drive in the east.

Key features of the Sydney Gateway road project include:

- Terminal 1 connection – a new grade separated section of road connecting Terminal 1 and the Sydney motorway network via St Peters interchange, including a new bridge over Alexandra canal.
- Qantas Drive upgrade and extension – widening and upgrading Qantas Drive and providing a new grade-separated section of road connecting the Sydney motorway network and Terminals 2/3 via a new high-level bridge over Alexandra Canal.
- St Peters interchange connection – a new grade-separated section of road connecting Qantas Drive and the Terminal 1 connection with St Peters interchange.
- Terminal links – two new grade separated sections of road linking Terminal 1 and Terminals 2/3, including a new bridge over Alexandra Canal.
- Terminals 2/3 access – a new grade-separated road connection to Terminals 2/3 from the upgraded Qantas Drive.
- Active transport facilities – realigning the existing shared path and providing connections to other shared paths around Alexandra Canal, Tempe and Mascot.
- Ancillary works – including new sections of road to provide access to airport land, new drainage infrastructure, signage and lighting, protecting/relocating utilities and relocating/adjusting advertising billboards (if required).

Location with respect to the Botany Rail Duplication project

The eastern portion of the Sydney Gateway road project is located immediately adjacent to the northern portion of the Botany Rail Duplication project (shown in Figure 23.1). The existing Botany Line is located parallel to Qantas Drive, where proposed upgrades including widening to accommodate a proposed grade separated road accessing Terminals 2/3.

Timing

It is expected construction of the Sydney Gateway road project and Port Botany Rail Duplication project will overlap. Table 23.2 outlines the indicative construction programs for Sydney Gateway road and Botany Rail Duplication projects. The construction timing would be carefully planned to consider the Sydney Gateway road project with particular emphasis on construction activities around the Robey Street and O'Riordan Street bridges. ARTC would complete ongoing consultation with Transport for NSW regarding the proposed construction program of the projects.

Table 23.2 Indicative construction programs for Sydney Gateway road and Botany Rail Duplication projects

PROJECT	2020				2021				2022				2023				2024			
Botany Rail Duplication																				
Sydney Gateway road project																				

Cumulative impacts

Potential cumulative impacts (assessed as greater than minor in relevant technical reports) that may arise as a result of both projects are summarised in Table 23.3. Key issues where no cumulative impacts are expected have been excluded. A discussion of cumulative impacts (including justification of no cumulative impacts where relevant) is provided in the relevant technical report and chapters.

Table 23.3 Summary of cumulative impact potential of the Sydney Gateway road and Botany Rail Duplication projects

ENVIRONMENTAL IMPACT	POTENTIAL CUMULATIVE IMPACTS WITHOUT MITIGATION
Construction Air Quality	There is potential for a temporary reduction in air quality during construction as a result of emissions and dust from construction vehicle movements in and around the project sites.
Operational Air Quality	There is potential for changes to air quality due to the operation of the two projects, however impacts from the Botany Rail Duplication are likely to be localised and available information pertaining to operational air quality from the Sydney Gateway road project was limited at the time of the assessment.
Construction Noise and Vibration	The construction scenarios for the Sydney Gateway road project are likely to be similar to the construction scenarios assessed in this report. Where construction works for both projects are being undertaken concurrently, nearby receivers in the surrounding area of Mascot (refer to sensitive receivers NCA01, NCA02 and NCA03 in Figure 9.10) may experience a theoretical increase in noise levels of around three decibels when compared with the construction of the Botany Rail Duplication only. However, the most likely outcome of the concurrent construction of the two projects is expected to be an increase in the duration of noise impacts (ie more periods with an impact from either project) experienced by receivers in NCA01, NCA02 and NCA03, rather than an increase in worst-case noise levels.
Operational Noise and Vibration	During operation, receivers near the Joyce Drive and O'Riordan Street intersection would potentially be affected by operational noise from both the Botany Rail Duplication and Sydney Gateway road project associated with a greater number of trains and cars using the area. However, operational noise from different types of transportation (ie road and rail) have different characteristics and result in different annoyance responses from affected communities. A quantitative cumulative assessment of the combined operational noise impacts from the two projects is not possible as the criteria for road and rail noise impacts are different.

ENVIRONMENTAL IMPACT	POTENTIAL CUMULATIVE IMPACTS WITHOUT MITIGATION
Construction Traffic and Transport	Construction of the two projects is likely to increase the overall level of traffic using the existing road network, increasing the potential impact and duration of the traffic delays and other impacts experienced by drivers, pedestrians and cyclists. Construction of the projects would result in traffic detours at the following intersections on up to 10 occasions over three years: • Qantas Drive/Robey Street/Seventh Street where the Level of Service would deteriorate from D to F with an increase in delay of 142 seconds. • General Holmes Drive/Wentworth Avenue where the Level of Service would deteriorate from B to F with an increase in delay of 59 seconds. • Botany Road/Wentworth Avenue where the Level of Service would deteriorate from C to F with an increase in delay of 146 seconds (due to performance changes due to the Robey or O'Riordan Street closure during a weekend works period).
Biodiversity	Construction of the projects would result in the removal of mainly planted vegetation and associated habitat, and would result in the loss of limited natural biodiversity values within restricted and highly modified environments.
Hydrology	Construction of the projects may result in an increased potential for cumulative groundwater quality impacts from increased rainfall infiltration.
Water quality	The projects have an overlapping drainage network, with around 500 metres of the drainage network proposed to be used by both projects, flowing to Alexandra Canal. Given the Botany Rail Duplication project is expected to have a negligible change in flow and water quality conditions, and is not proposed to impact sediments of Alexandra Canal or Mill Stream, the cumulative impact of the project and the Gateway road project would be only marginally worse than the impacts of the Gateway road project alone.
Non-Aboriginal Heritage	The cumulative impacts of the two projects is considered to be moderate to minor. While the two projects will have both direct and indirect impacts on individual heritage items, the cumulative impacts on non-aboriginal heritage relates to a general regional loss of heritage values within an area that has been subject to a high level of modification. The Sydney Gateway road project would result in the following heritage impacts: • construction of four bridges over the SHR-listed Alexandra Canal (considered a major impact to the heritage significance of the item) • demolition of eleven existing structures, their associated landscapes and mature fig trees within the Sydney (Kingsford Smith) Airport Group's heritage curtilage • construction of new road corridors and road connections in the suburbs of Tempe, St Peters and Mascot • construction of three bridges and overpasses over the existing Botany Line • visual impacts on the Mascot (Sheas Creek) Underbridge • potential impacts on State and locally significant archaeology The Botany Rail Duplication project would result in the following heritage impacts: • demolition of two section 170 listed heritage bridges on the Botany Line (considered a major impact to the heritage significance of the item) • remediation of one section 170 listed heritage bridge on the Botany Line • vegetation clearing within Sydney (Kingsford Smith) Airport Group's heritage curtilage • potential vibration impacts (minor) to the locally listed Beckenham Memorial Church • potential impacts on State and locally significant archaeology.

ENVIRONMENTAL IMPACT	POTENTIAL CUMULATIVE IMPACTS WITHOUT MITIGATION
Landscape Character	The cumulative impacts of the projects would increase the influence of the construction activity on the landscape character, particularly in Mascot, near the bridge replacements and retaining wall work at Robey and O'Riordan Streets. The cumulative impacts of the operation of the projects would result in the intensification of the urban character, particularly in the Mascot area. The Sydney Gateway road project would also limit the amount of available space to reinstate vegetation cleared as a result of the Botany Rail Duplication Project between Qantas Drive and the rail corridor.
Visual	The construction of the projects concurrently would increase the scale and extent of the visible construction activity. The removal and limitations on the replacement of vegetation between Qantas Drive and the Botany Line would impact views of road users including the arrival experience to Sydney, adjacent commercial areas and hotels. The operation of the projects would combine to alter views to the vehicular entry to Sydney from the airport. In the areas where both the project and Sydney Gateway road project would be seen, there would be an increased adverse visual impact. It should be noted that the influence of this visual impact as a result of the Botany Rail Duplication is considered minimal due to the presence of the existing rail line and scale of the duplication.
Socio Economic	The concurrent construction of the two projects has the potential to result in the following impacts: • increased demand for construction workforce due to resourcing across projects • further demand for services and increased expenditure at local and regional businesses • increased noise and vibration on residential properties and accommodation facilities near O'Riordan Street, Baxter Road and Joyce Drive • increased occurrence of delays affecting road users on the local road network including: o Qantas Drive, Robey Street and Seventh Street o General Holmes drive and Wentworth Avenue o Botany Road and Wentworth Avenue.
Hazard and Risk	The projects would have a cumulative impact associated with the disturbance of utility services.
Flooding	The future Sydney Gateway road project would involve the upgrade of the section of Qantas Drive to the south of the rail corridor within the Alexandra Canal catchment that, in combination with the project, has the potential for cumulative impacts on flood behaviour. While subject to future design development and environmental approvals, the Sydney Gateway Road project is likely to include surface earthworks and widening of the existing section of Qantas Drive between O'Riordan Street and Lancastrian Road, which may impact on flow behaviour in the drainage systems that run across Qantas Drive and through Sydney Airport between O'Riordan Street and Lancastrian Road. Given the minor nature of impacts on flow behaviour in the drainage systems that run through Sydney Airport that are attributable to the project, it is expected that the cumulative impacts of it in combination with the Sydney Gateway Road project would also be minor in nature.

23.2.2 Qantas training facility

Project details

Qantas is proposing to construct a new flight training centre on land directly adjacent to the northwestern end of the Botany Rail Duplication project in Mascot. The requirement for the new centre is a direct result of the proposed Sydney Gateway Road project, which requires the relocation of the existing flight training centre from within Sydney Airport. The proposal includes the following activities:

- remediation of the site
- removal of vegetation
- construction of new driveways and multi deck car park
- construction of the new flight training facility
- landscaping and general site improvements.

Location with respect to the Botany Rail Duplication

The proposed Qantas training facility is located at 297 King Street Mascot and shares a border (immediately to the west) of around 320 metres with the Botany Rail Duplication project.

Timing

It is expected construction of the Qantas Training Facility should be nearing completion prior to the commencement of construction of the Botany Rail Duplication project. However, some construction activities may overlap. Table 23.4 outlines the indicative construction programs for both projects.

Table 23.4 Indicative construction programs for Qantas Training facility and Botany Rail Duplication projects

PROJECT	2019	2020	2021	2022	2023	2024
Botany Rail Duplication						
Qantas Training Facility						

Cumulative Impacts

Potential cumulative impacts (assessed as greater than minor in relevant technical reports) that may arise as a result of both projects are summarised in Table 23.5. Key issues where no cumulative impacts are expected have been excluded. A discussion of cumulative impacts (including justification of no cumulative impacts where relevant) is provided in the relevant technical reports and chapters.

Table 23.5 Cumulative impacts of the Qantas Training Facility and Port Botany Rail Duplication

ENVIRONMENTAL IMPACT	POTENTIAL CUMULATIVE IMPACTS WITHOUT MITIGATION
Noise and Vibration	The projects share a number of commercial sensitive receivers, including accommodation providers, the Travelodge and King Apartments (an approved residential development). Construction works at the site of the proposed Qantas Flight Training Centre would be much closer to these receivers than Botany Rail Duplication project, meaning that if concurrent works were to occur on both projects, the noise levels from construction of the Qantas Flight Training Centre would likely be dominant over the noise levels from the Botany Rail Duplication project.

23.2.3 WestConnex (M4-M5)

Project details

The WestConnex M4-M5 link (currently under construction) is part of the WestConnex program of work. The M4-M5 link would provide connections to a future western harbour tunnel and Beaches Link, the Sydney Gateway (via the St Peters interchange) and the F6 extension (via the new M5). The project includes the construction of two motorway tunnels and associated connections between the M4 motorway and the New M5 Motorway (St Peters interchange).

Location with respect to the Botany Rail Duplication project

The nearest component of the WestConnex M4-M5 project to the Botany Rail Duplication is the St Peters interchange, located around one kilometre to the north of the northwestern extent of the project. The projects are separated by commercial land use in the suburb of Mascot and the Alexandra Canal.

Timing

At the time of preparation of this EIS, the WestConnex M4-M5 project was at around 50% completion, with an expected completion date or early 2023. It is expected construction of the WestConnex M4-M5 and Botany Rail Duplication projects would overlap. Table 23.6 outlines the indicative construction programs for both projects.

Table 23.6 Indicative construction programs for the WestConnex M4-M5 and Botany Rail Duplication projects

PROJECT	2018	2019	2020	2021	2022	2023	2024
Botany Rail Duplication							
WestConnex M4-M5							

Cumulative impacts

Potential cumulative impacts (assessed as greater than minor in relevant technical reports) that may arise as a result of both projects are summarised in Table 23.7. Key issues where no cumulative impacts are expected have been excluded. A discussion of cumulative impacts (including justification of no cumulative impacts where relevant) is provided in the relevant technical reports and chapters.

Table 23.7 Cumulative impacts of the WestConnex M4-M5 and Botany Rail Duplication projects

ENVIRONMENTAL IMPACT	POTENTIAL CUMULATIVE IMPACTS WITHOUT MITIGATION
Traffic and Transport	The proposed opening of WestConnex Stage 3a (the M4–M5 Link) would have notable network impacts with the construction of portions of the Sydney Gateway – Road project. The opening of WestConnex (M4-M5) also coincides with the Botany Rail Duplication bridge construction works at Robey Street, O'Riordan Street and Southern Cross Drive. Construction (and subsequent operation) of the Botany Rail Duplication, WestConnex (M4-M5) and Sydney Gateway – Road projects would have the potential to result in modifications to general traffic in the local area.

23.2.4 Other projects

Potential cumulative impacts may occur as a result of construction activities occurring simultaneously with other smaller developments within the vicinity of the project site. Potential cumulative impacts could include:

- increased construction traffic travelling through the project site and on the surrounding road network
- increased construction noise and vibration, including road traffic noise
- reduced visual amenity
- increased dust emissions.

23.3 Management of impacts

Mitigation measures that would be implemented to address potential cumulative impacts listed in section 24.2 are addressed in Chapters 8 to 22.

23.3.1 Managing residual impacts

Despite the measures identified in Chapters 8 to 22, a number of residual impacts associated with the Botany Rail Duplication and surrounding projects remain. A discussion of residual impacts of the Botany Rail Duplication and their management is included in relevant chapters.

The main residual cumulative impact is the potential for ‘construction fatigue’, a term used to describe the combined effect of multiple construction projects occurring simultaneously, or in quick succession in a geographical area.

While there are long-term benefits associated with the projects identified in Table 23.1, such as increases in local and regional connectivity, reduced congestion and improvements to the amenity of local commercial areas. General construction activities in the local area, regardless of the overlap of construction activities is likely to result in fatigue within the affected community, with particular emphasis on residents, workers and business in Mascot, Botany and around Sydney Airport. Construction fatigue may result in annoyance from construction related activities such as dust, noise and vibration, or changes to road or pedestrian access.

Due to the location of the Botany Rail Duplication and other major projects near Sydney Airport, construction fatigue also has the potential to include regional road users, travellers, workers and businesses that use, or operate out of, or around Sydney Airport.

To mitigate residual cumulative impacts from the Botany Rail Duplication and surrounding projects (with particular emphasis on Sydney Gateway – road project), further consideration during detailed design of the communities’ tolerance of construction impacts (including noise and vibration) would be considered. The approach to construction would be managed through the implementation of relevant site management plans, and in consultation with Transport for NSW and Sydney Airport.