7 TRAFFIC AND TRANSPORT

Arcadis have undertaken an assessment of the traffic and transport impacts associated with the Proposal to address the SEARs. The *Construction Traffic Impact Assessment* (CTIA), *Preliminary Construction Traffic Management Plan* (PCTMP), *Operational Traffic and Transport Impact Assessment* (OTTA), and *Preliminary Operational Traffic Management Plan* (POTMP) are provided in Appendix K of this EIS. Table 7-1 provides a summary of the relevant SEARs which relate to traffic and transport and where these have been addressed in this EIS.

Table 7-1 SEARs (Traffic and transport)

SEARs	Where addressed
4. Traffic and Transport	
A Traffic Impact Assessment that assesses intersection and road network impacts, including impacts on Cambridge Avenue. The traffic assessment shall:-	
a) Take into account the RMS Guide to Traffic Generating Developments	Section 7.2
b) Undertake a realistic and justified range of peak hour generation scenarios (to be determined in consultation with TfNSW, RMS and Liverpool City Council) including assumptions about heavy vehicle movements and the percentage of deliveries by railway and road	Section 7.2
c) Undertake detailed model analysis to confirm network operation and identify intersection upgrade requirements	Section 7.2 Section 7.4.2
d) Consider the constructability constraints of proposed upgrade(s) at key intersections, such as vehicle sweep paths, geometry and sight lines	Civil drawings in Appendix P of this EIS
e) Include a draft Construction Traffic Management Plan	Appendix K of this EIS
f) Assess construction traffic impacts, which may include a draft Construction Traffic Management Plan including: i. The identification of haulage routes and the nature of existing traffic on these routes ii. As assessment of construction traffic volumes (including spoil haulage/delivery of materials and equipment to the road corridor and ancillary facilities) iii. Potential impacts to the regional and local road network (including safety and level of service) and potential disruption to existing public transport service and access to properties and businesses	Section 7.4.1 and Appendix K of this EIS

SEARs	Where addressed
g) Assess operational traffic and transport impacts on the local and regional road network, including: i. Changes to local road connectivity and impacts on local traffic arrangements, road capacity/safety; and ii. Traffic capacity of the road network and its ability to cater for predicted future growth	Section 7.4.2
h) Provide details of site accesses, internal roads and vehicular parking required as a result of the development	Section 7.3
i) Provide an updated Traffic Management and Accessibility Plan including: i. Measures to prevent heavy vehicles accessing residential streets to maintain the residential amenity of the local community ii. Public transport iii. Cyclist facilities iv. Driver code of conduct.	Appendix K of this EIS

The Concept Plan Conditions of Approval are generally consistent with the SEARs provided for the Proposal as they relate to traffic and transport (refer to Table 7-1) and have been addressed in this Section of the EIS. The compliance of the Proposal with the SEARs, Concept Plan Conditions of Approval and Statement of Commitments is provided at Appendix A of this EIS.

This Section summarises the studies undertaken for the MPE Concept Plan Approval (section 7.1) and, more recently, for the Proposal. This section of the EIS also summarises the methodology used to assess traffic and transport-related impacts of the Proposal (section 7.2), describes the existing environment as it relates to traffic and transport (section 7.3) and provides an assessment of traffic and transport impacts associated with construction and operation of the Proposal (section 7.4). Measures to mitigate potential traffic and transport impacts where they are required have been identified in Section 7.5.

7.1 Concept Plan Assessment

Several studies were undertaken to identify and assess the traffic impacts associated with the construction and operation of the Proposal, to support the Concept Plan EA, including:

- Freight Demand Modelling (Hyder Consulting, 2013)
- Transport and Accessibility Impact Assessment (Hyder Consulting, 2013)

The *Freight Demand Modelling Report* established trends in the overall movement of freight containers to and from Port Botany and defined the freight catchment that the MPE Project would service. The MPE Project would service a catchment area with a total demand of 1 million TEU throughput in the Liverpool Local Government Area, Sydney's South West Region and parts of Sydney's Industrial West. The *Freight Demand Modelling Report* identified the likely distribution of container and rigid truck movements from the MPE site, which has been accepted by TfNSW (July 2013) as representing the origin/destination of the intended freight catchment for the MPE Project.

The *Transport and Accessibility Impact Assessment* assessed the performance of the road network with and without the MPE development in both 'core' and 'inner' areas. The core and inner areas are those areas which the MPE Project is predicted to contribute to traffic growth.

A total of 13 intersections were identified as potentially being impacted by future traffic growth with or without the MPE Project within the core and inner areas. Traffic modelling and analysis found that the eight intersections outside the core area, known as the inner area, would operate with a poor level of service (LoS) during the AM and PM peak regardless of the MPE Project, and that any development would have a low impact to roads and intersections in this area. Analysis showed that in 2031, combined with background traffic growth, the MPE Project would result in a reduction in the LoS at five key intersections within the core area, being:

- Moorebank Avenue / Anzac Road
- M5 Motorway / Moorebank Avenue
- M5 Motorway / Hume Highway
- Moorebank Avenue / Heathcote Road
- Newbridge Road / Moorebank Avenue.

Mitigation measures to limit the reduction in LoS were identified and modelled. The modelling showed that road capacity improvements would mitigate the forecast impacts on the performance of the road network as a result of the MPE Project when operating a peak capacity (i.e. 1 million TEU).

Given that the MPE Project will be developed in stages, a road upgrade staging plan, along with timings for the upgrades, was proposed as part of the Concept Plan EA. This staging plan indicated that during the Proposal upgrades to Moorebank Avenue, signalling at the Moorebank Avenue / Anzac Road intersection and potentially (subject to further investigation) the M5 Motorway / Moorebank Avenue grade separated interchange would be required. These upgrades are included in the Revised Statement of Commitments.

In addition to this, an assessment of public transport needs and opportunities for the MPE Project was undertaken to identify measures to be progressively be implemented to encourage employees to travel to and from the MPE site using public transport. The report acknowledges the low use of public transport within the Liverpool LGA and high utilisation of private vehicles as the preferred mode of transport to and from the Moorebank catchment area (78%). The assessment recommended a package of measures to deliver an improved mode share of public transport.

Based on the recommendations from the aforementioned studies, the Revised Statement of Commitments committed to the following actions during development of the Proposal:

- Widen Moorebank Avenue to four lanes between the M5 Motorway / Moorebank Avenue grade separated interchange and the southern MPE site access
- Concurrent with the four lane widening on Moorebank Avenue, the Moorebank Avenue / Anzac Road signal will require some form of widening at the approach roads
- Potential upgrade works at the M5 Motorway / Moorebank Avenue grade separated interchange to cater for both background and additional MPE traffic growth

In addition to the Statement of Commitments, the Concept Plan Approval (dated 29 September 2014) included a number of additional requirements to be undertaken relating to 'Traffic and Transport' for future planning approval stages. These Conditions of Approval also included a number of conditions (1.7, 1.8 and 1.9) for the preparation of a Voluntary Planning Agreement (VPA) which would be submitted with 'any future Development Application'. A Modification Application (Concept Plan Modification 1), under Section 75W of the EP&A Act, was prepared (April, 2015) to amend the Conditions of Approval relating to the preparation of a VPA.

This modification, subject to approval by DP&E, would remove the requirement for a VPA to be prepared for any future Development Application for the MPE Project. At the time of writing, Concept Plan Modification 1 was subject to assessment and determination by NSW DP&E, with determination expected in late 2016.

7.2 Assessment Methodology

7.2.1 Study area

The traffic study area comprises two components:

- The core traffic study area, including ten key intersections, which have the most potential to be impacted by the Proposal. Detailed analysis has been conducted for these study intersections and road links in the core area and includes:
  - I-1: Moorebank Avenue / Anzac Road
  - I-2: M5 Motorway / Moorebank Avenue
  - I-3: M5 Motorway / Hume Highway
  - I-4: Moorebank Avenue / Newbridge Road
  - I-5: Moorebank Avenue / Heathcote Road
  - I-6: M5 Motorway / Heathcote Road
  - I-7: Cambridge Avenue / Glenfield Road
  - I-8: Cambridge Avenue / Canterbury Road
  - I-A: Moorebank Avenue / DJLU Access
  - I-B: Moorebank Avenue / MPE Stage 2 Site Access.
- The wider traffic study area, which includes the surrounding road network in the Liverpool local government area (LGA).

These areas are derived from investigations based on previous modelling undertaken for the MPE Stage 1 Project and the Roads and Maritime Liverpool Moorebank Arterial Road Investigations (LMARI) traffic model wider traffic study area, which is shown on Figure 7-1.

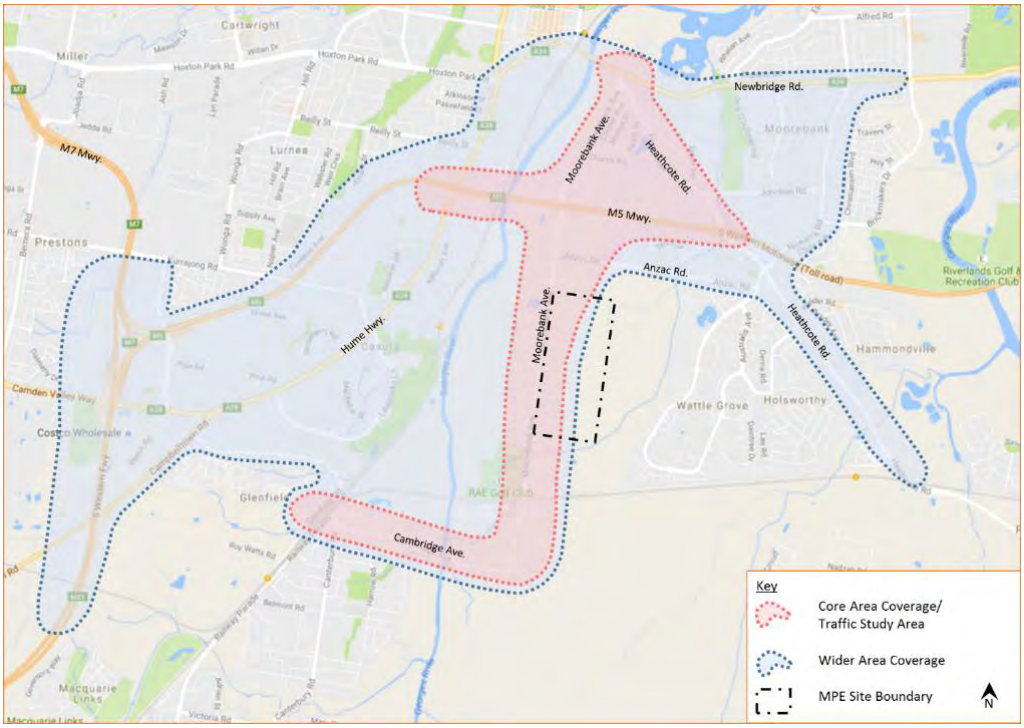

Figure 7-1 Traffic study area

7.2.2 Desktop review of previous traffic and transport assessments

A desktop review of previous traffic and transport impact assessments prepared for other development application within the MPe Project or in adjoining parcels of land was undertaken. The documents reviewed included:

- MPE Stage 1 Proposal – The Intermodal terminal facility on the MPE site as approved by the MPE Concept Plan Approval (MP 10_0913) and including the MPE Stage 1 Proposal (14-6766). This report references previous Transport and Accessibility Impact Assessment reports (2013, 2015 Arcadis previously known as Hyder Consulting) prepared for both Concept Plan Approval and Stage 1 Proposals where required.
- MPE Concept Plan Approval -
- Moorebank Precinct West (MPW) Concept Plan Approval - MPW Concept Plan and Early Works Approval (SSD 5066) granted on 3 June 2016 for the development of the MPW intermodal terminal facility at Moorebank and the undertaking of the Early Works. This report references previous Traffic and Transport Impact Assessment traffic reports (2015, WSP | Parsons Brinkerhoff previously known as Parsons Brinkerhoff) prepared for both the Concept Plan Approval and Stage 1 Proposals where required.
- Moorebank Intermodal Terminal Precinct – Traffic Generation and Underlying Assumptions, Memorandum, Parsons Brinckerhoff, September 2016.

7.2.3 Characterisation of the existing traffic and transport environment

The existing traffic and transport conditions within the study area were identified, including:

- Road network
- Existing traffic volumes
- Existing network performance
- Project background traffic growth on the road network near the Proposal
- Identifying the active and public transport near the Proposal

A summary of the existing environment as it relates to traffic and transport is provided in Section 7.3.

7.2.4 Approach to traffic modelling

Traffic modelling for the Proposal aimed to best use existing traffic counts and traffic models to:

- Determine the existing and future conditions in the study area with and without the Proposal
- Assess the performance of key intersections in the study area during construction and operation, with and without the Proposal.

Traffic modelling was undertaken to enable existing and future transport conditions and road network performance to be characterised, both with and without the Proposal.

Traffic modelling scenarios

Traffic modelling for the Proposal assessed six scenarios comprising one construction scenario and five operational scenarios.

- A proposal construction scenario (2018)
- Three operational scenarios without the Proposal:
  - The existing road network near the Proposal, based on 2015 traffic count surveys
  - The existing road network at the year of opening of the Proposal (2019)
  - The existing road network 10 years after opening of the Proposal (2029)
- Two operational scenarios with the Proposal:
  - One at the year of opening of the Proposal (2019)
  - One 10 years after the opening of the Proposal (2029)

The traffic modelling scenarios used to inform the assessment of the traffic and transport related impacts of the Proposal are summarised in Table 7-2.

Table 7-2 Traffic modelling scenarios

Model year	Without Proposal	With Proposal	Modelling scenario	Description	Impacts assessed
2015	✓		Existing	The existing road network	NA
2018		✓	Construction (Proposal only)	The current road network with construction traffic movements for the Proposal. This considers the worst case construction traffic generating scenario and includes traffic movements associated with fill importation	Construction impacts on the existing road network
2019	✓		Base case without the Proposal	The 2019 base case without the Proposal scenario includes the road network with background traffic growth. This scenario assumes that ongoing improvements will be made to the broader transport network including some new infrastructure and intersection improvements to improve capacity and to cater for traffic growth. This is considered a 'do minimum' scenario	Performance of the road network without the Proposal
2019		✓	Base case with the Proposal only	The base case with the Proposal assumes the Proposal is operational and traffic movements to and from the Proposal are undertaken on the surrounding road network	Operational impacts on the road network as a result of the Proposal
2029	✓		Future case without the Proposal	The 2029 future case without the Proposal scenario includes the road network with background traffic growth. This scenario assumes that ongoing improvements will be made to the broader transport network including some new infrastructure and intersection improvements to improve capacity and to cater for traffic growth. This is considered a 'do minimum' scenario	Performance of the future road network without the Proposal
2029		✓	Future case with the Proposal only	The future case with the Proposal assumes the Proposal is operational and traffic movements to and from the Proposal are undertaken on the surrounding road network	Operational impacts on the road network as a result of the Proposal

7.2.5 Summary of traffic modelling

Strategic and network based traffic modelling

For the purpose of this traffic and transport impact assessment, future traffic growth and modelling data was sourced from RMS' wider Liverpool Moorebank Arterial Road Investigations (LMARI) model built in AIMSUN modelling software version 8.0.9 (R35843). AIMSUM was used to provide strategic, mesoscopic and microsimulation modelling. Strategic traffic modelling was undertaken for the purpose of broad network evaluation and demand forecasting. Mesoscopic and microsimulation modelling is more detailed than strategic modelling and provides more detailed network modelling outcomes. Traditional intersection assessment tools do not provide a whole-of-network assessment and tend to work best at evaluating individual, isolated intersections. To fully evaluate operational impacts of the Proposal on the nearby road network, the mesoscopic and microsimulation capabilities of AIMSUM were used.

Network modelling at a microsimulation scale simulates the movement of individual vehicles within a defined network. Network modelling uses time-based algorithms which relate to vehicle-to-vehicle interactions on roads, including car following, lane changing and gap acceptance. The vehicle-to-vehicle interactions accounted for in network modelling provide the basis for calculating delays within a defined area or network. Network modelling is used to provide a better representation of queueing, congestion and delays in urban networks that are at or beyond their operational capacity.

The LMARI AIMSUN traffic model has been developed, calibrated and validated by Jacobs[1] and subsequently updated by GTA consultants[2] (GTA) on behalf of Road and Maritime. The LMARI model was provided by Roads and Maritime the future base model (Do Minimum) for the 2026 and 2036 operational years on 20 June 2016. For the purpose of traffic modelling for the Proposal, Arcadis used this AIMSUN traffic model provided by Roads and Maritime dated 20 June 2016.

The AIMSUM model has been supplemented with additional operational traffic modelling using SIDRA Network version 7 for the modelling of intersection performance. The SIDRA modelling was used to determine intersection layouts, signal phasing and timing, which was then integrated into the AIMSUM model to determine impacts to the surrounding road network.

The major benefit of using network modelling is the ability to assess networks with closely spaced intersections, where intersection operation is likely to be influenced by adjacent intersections. This means the queue lengths and delays modelled at intersections within the modelled area reflect the impact of congestion and result in a more accurate representation in the model.

[1] Liverpool Moorebank Arterial Road Investigations, MITRA Base Model Calibration and Validation Report, Final Revision B.0, Jacobs, 12 October 2015.
[2] Moorebank Intermodal Terminal AIMSUN Existing Conditions Model – Modelling Review Summary, Memorandum, GTA Consultants, 26 November 2015.

Moorebank Precinct traffic modelling

In addition to the above network modelling, MIC (and WSP – PB) is currently undertaking traffic modelling which also utilises the June 2016 “Do Minimum” AIMSUN (LMARI) model provided by Road and Maritime. The intent of this modelling is to verify upgrades identified to reduce traffic impacts on the surrounding road network (i.e. at 13 key intersections), which would arise as a result of the cumulative impacts of the MPW and MPE Projects at a full build development scenario. The modelling exercise consider both MPW and MPE as a precinct (herein referred to as the Precinct Model) and it is understood that this reporting would be available in December 2016; when it would be provided to the relevant agencies for review and discussion.

This section of the EIS assesses the network upgrades considered necessary to address the traffic and transport-related impacts of the Proposal, as required by the SEARs. The Precinct Model would seek to verify the upgrades for the Proposal, and also indicate other upgrades for all future stages of development of the MPW and MPE Projects cumulatively in order to guide the negotiations around the quantum of associated contributions and the triggers at which the upgrades are required to be implemented.

Intersection modelling

SIDRA Intersection software (Version 7.0.5.6563) was used to determine the performance of the key intersections within the study area during construction and operation of the Proposal, including:

A summary of the intersections modelled to assess impacts of the construction and operation of the Proposal is provided in Table 7-3.

As part of the operational assessment, intersection performance has been considered in two scenarios:

- The ‘do minimum’ scenario, which includes committed / planned road network upgrades by the State government on the wider road network
- The ‘with assumed network upgrades’ scenario, which includes network upgrades which are recommended to minimise the impacts of background traffic growth and traffic from the cumulative operation of the Proposal. The proposed network upgrades and the indicative timing for these upgrades are described in more detail in Section 7.6 and Appendix K of this EIS, and include upgrades to the following intersections:
  - Moorebank Avenue / Anzac Road
  - M5 Motorway / Moorebank Avenue
  - M5 Motorway / Hume Highway
  - Moorebank Avenue / Newbridge Road
  - Moorebank Avenue / Heathcote Road
  - M5 Motorway / Heathcote Road.

Network improvements are required to mitigate the impacts of the cumulative operational scenario at key intersections within the study area, and these are either directly as a result of the cumulative development scenario, or to cater for background traffic growth.

As these upgrades are not directly a result of the Proposal, they have been nominated as assumed network upgrades and adopted to complete the modelling for the operational traffic and transport impact assessment (refer to Section 7.6 and Appendix K for more information).

Table 7-3 Intersections modelled as part of construction and operational traffic impact assessment

Intersection	Assessed for construction impacts	Assessed for operational impacts
Moorebank Avenue / Anzac Road	✓	✓
M5 Motorway / Moorebank Avenue	✓	✓
M5 Motorway / Hume Highway		✓
Moorebank Avenue / Newbridge Road		✓
Moorebank Avenue / Heathcote Road		✓
M5 Motorway / Heathcote Road		✓
Cambridge Avenue / Glenfield Road		✓
Cambridge Avenue / Canterbury Road		✓
Moorebank Avenue / DJLU Access	✓	✓
Moorebank Avenue / MPE Stage 2 Site Access	✓	✓

7.2.6 Intersection performance and level of service

LoS is a performance measure used to describe the operational conditions and efficiency of a road or intersection and to assess operational performance. As a measure of performance, level of service is generally described in terms of service measures such as:

- Speed and travel time
- Freedom to manoeuvre
- Traffic interruptions
- Comfort and convenience
- Road safety.

There are six levels of service; level of service A to level of service F. Level of service A represents optimum operating conditions and level of service F the poorest operating conditions. When the level of service of a road or intersection falls below level of service D, investigations are generally initiated to provide suitable remediation. However, constraints in built up urban areas mean that level of service E and level of service F are regularly experienced by motorists on the Sydney road network. These conditions are generally experienced during traffic peak periods.

Average delay is often used to assess the operational performance of intersections, with level of service used as an index. In other words, an intersection is first characterised based on its level of service 'band' with a more refined assessment of performance within that band carried out based on assessment of average delay times.

A description of the level of service scale for intersection performance is provided in Table 7-4.

Table 7-4 Level of Service Criteria for Intersection Capacity Analysis

LoS	Average Delay per Vehicle (sec/veh)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity, requires other control mode
F	>70	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing

Source: *Guide to Traffic Generating Developments* (RTA, 2002)

7.3 Existing Environment

7.3.1 Road network

The existing road network surrounding the Proposal comprises State roads, regional roads and local roads owned and maintained by Roads and Maritime and LCC, and a private road owned and maintained by the Department of Defence. The hierarchy and characteristics of the key roads forming the road network surrounding the Proposal are shown in Table 7-5 and Figure 7-2.

Table 7-5 - Existing key roads on the road network adjacent to the MPE site

Road Names	Road Hierarchy	Characteristics
M5 South West Motorway (M5 Motorway)	Motorway	The M5 Motorway is a 22 km tolled road, with generally three lanes in each direction between Camden Valley Way, Prestons and King Georges Road, Beverly Hills. The M5 Motorway It is operated by Interlink Roads and forms part of the M5 transport corridor, which is the main passenger, commercial and freight route between Sydney Airport, Port Botany and south west Sydney. The M5 Motorway is also a key part of the Sydney Orbital Network; a series of interconnected roads that link key areas of the Greater Sydney Metropolitan Region (GMR).
Moorebank Avenue	Local Road / Private Road	Moorebank Avenue is currently a two lane undivided road (one lane in each direction) between the M5 Motorway and Cambridge Avenue to the south of the Proposal site. To the north of the M5 Motorway, Moorebank Avenue is generally a four lane undivided road. Moorebank Avenue provides a north-south link between Liverpool and Glenfield, and also forms a grade separated interchange with the M5 Motorway, north of the Proposal site. North of the M5 Motorway, Moorebank Avenue is a State Road. Moorebank Avenue between theM5 Motorway and Anzac Road is owned and maintained by Liverpool City Council. Moorebank Avenue between Anzac Road and Cambridge Avenue (including the portion of Moorebank Avenue in Moorebank Avenue site) is a privately owned road located on Commonwealth land that is publicly accessible.
Anzac Road	Local Road	Anzac Road is an east-west oriented local road that connects Moorebank Avenue and Heathcote Road. It provides access to Moorebank Business Park and the residential area of Wattle Grove. Anzac Road is generally a two-lane undivided road.
Bapaume Road	Local Road	Bapaume Road is an east-west local road that connects Moorebank Avenue to the industrial complex (ABB site). Bapaume Road is generally a two-lane undivided road, which is owned and maintained by Liverpool City Council.
Cambridge Avenue	Local Road	Cambridge Avenue is a local road which connects Moorebank Avenue from the south to Macquarie Fields through to Campbelltown. It is generally a two lane road (one lane each direction) and is owned and maintained by Campbelltown City Council. Cambridge Avenue crosses the Georges River via a low level narrow bridge (subject to flooding).

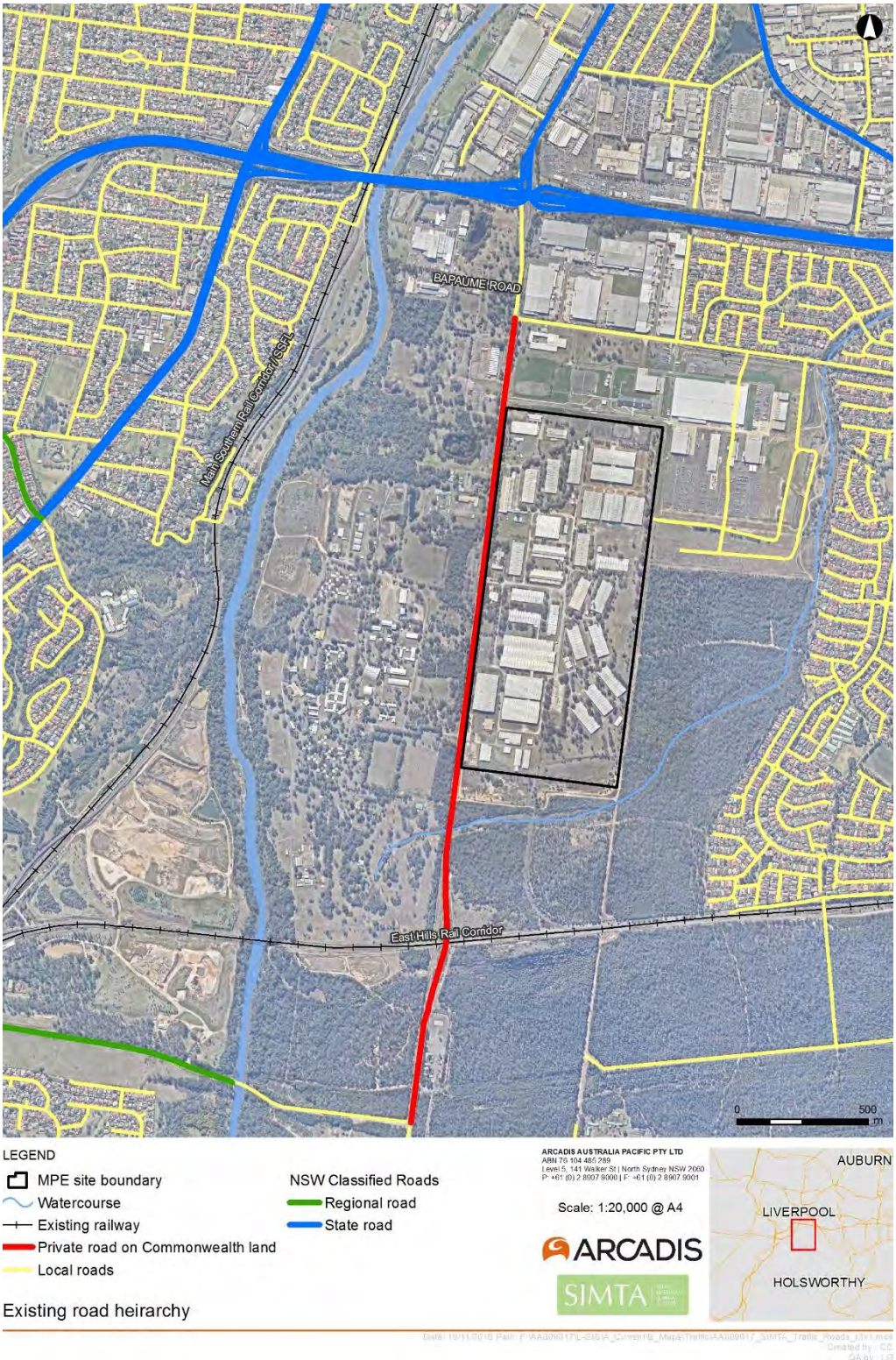

Figure 7-2 Existing road hierarchy

7.3.2 Existing Traffic Volumes

The performance of eight intersections and five key midblock locations were assessed to establish the existing traffic capacity and operational performance of intersections and the road network.

Key roads and intersections assessed, shown in Figure 7-3 and are summarised in Table 7-6 below.

Table 7-6 midblock locations and intersections assessed

Midblock locations
• M-1 Moorebank Avenue, north of Anzac Road
• M-2 Moorebank Avenue, south of Anzac Road
• M-3 Anzac Road, east of Moorebank Avenue
• M-4 Moorebank Avenue, north of Cambridge Avenue
• M-5 Cambridge Avenue, west of Moorebank Avenue
Intersections
• I-1 Moorebank Avenue / Anzac Road
• I-2 M5 Motorway / Moorebank Avenue
• I-3 M5 Motorway / Hume Highway
• I-4 Moorebank Avenue / Newbridge Road
• I-5 Moorebank Avenue / Heathcote Road
• I-6 M5 Motorway / Heathcote Road
• I-7 Cambridge Avenue / Glenfield Road
• I-8 Cambridge Avenue / Canterbury Road
• I-A Moorebank Avenue / DJLU Access
• I-B Moorebank Avenue / MPE Stage 2 Site Access

Traffic count surveys undertaken for the Roads and Maritime's LMARI traffic model study in 2015, further supplemented by 2014 traffic surveyed carried out for the MPE Stage 1 Proposal have been used to form the basis of existing base traffic count data and capacity assessment at key roads, and intersections analysed within this section. 2015 has been used as the 'existing year' rather than 2016 based on available traffic surveys and counts. Table 7-7 shows existing traffic volumes on key roads to be impacted by the Proposal.

Table 7-7 Traffic volumes on key roads impacted by the Proposal in 2015

ID	Roads/ Locations	AM Peak		PM Peak		Total Daily Traffic		
		NB/ EB	SB/ WB	NB/ EB	SB/ WB	All vehicles	Heavy vehicles	% heavy vehicles
M-1	Moorebank Avenue, north of Anzac Road	910	780	680	940	21,300	1,100	5
M-2	Moorebank Avenue, south of Anzac Road	950	430	450	840	17,200	890	5
M-3	Anzac Road, east of Moorebank Avenue	720	490	510	520	10,410	480	5
M-4	Moorebank Avenue, north of Cambridge Avenue	920	360	350	920	16,760	930	6
M-5	Cambridge Avenue, west of Moorebank Avenue	960	330	340	930	15,700	550	4

*NB – northbound, EB – Eastbound, SB – Soutbound, WB - Westbound

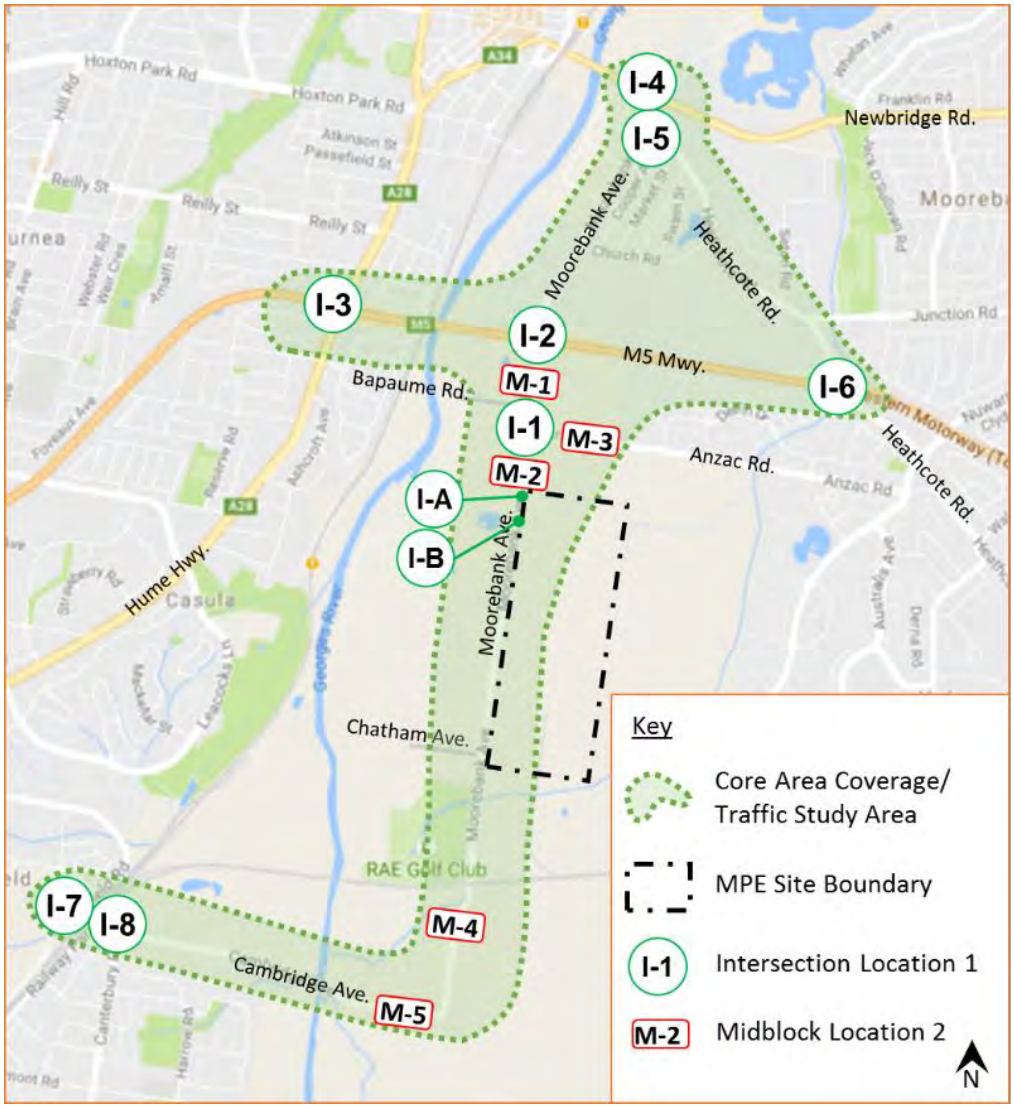

Figure 7-3 Locations of key roads and intersections around the Proposal site

7.3.3 Historical Traffic Growth

Historical traffic growth rates at key roads near the Proposal site were calculated based on available data, reported as average annual daily traffic (AADT) and average daily traffic (ADT). Historical traffic growth observed along these roads over a 13-year period between 2002 and 2015 is shown in Table 7-8.

On average, traffic volumes have increased by 1.3% per annum between 2002 and 2015. This rate of growth is considered to be consistent with the regional annual growth rate of one to two percent observed on the adjacent State road network. Other notable trends relating to roads within close proximity of the Proposal includes:

- Consistent traffic growth at about 4.3% per annum was observed on the M5 Motorway between 2002 and 2010.
- Historical traffic growth on Moorebank Avenue (between the M5 and Cambridge Avenue) has been relatively stable. This could be attributed to numerous factors including:
  - Increases in traffic due to new residential developments in nearby suburbs of Glenfield and Macquarie Fields

  - Reductions in traffic from the relocation of the DSNDC and the completion of the M5 West Widening (less "rat-running" of traffic on Moorebank Avenue due to increased motorway capacity).

- The last five years of traffic growth data suggests that traffic increases of about 1.8% per annum on Anzac Road may be attributed to the development of the nearby industrial estates at Yulong Close.

Table 7-8 Historical traffic growth at key locations between 2002 and 2015

Roads/Locations	Annual Average Growth		
	2002-2009	2002-2010	2010-2015
M5 Motorway, at bridge over Georges River	N/A	▲4.3%	N/A
Moorebank Avenue, north of Cambridge Avenue	▼0.3%	N/A	▲0.3%
Moorebank Avenue, south of Anzac Road	N/A	N/A	▼0.3%
Anzac Road, east of Moorebank Avenue	N/A	N/A	▲1.8%
Average historical traffic growth for all roads (2002-2015)	▲1.3%		

Note: N/A = Data is not available.

7.3.4 Existing Intersection Performance

The existing performance of key intersections within the core traffic study area has been modelled using SIDRA. A summary of the results of this analysis is provided in Table 7-9.

All intersections within the core traffic study area operate at an acceptable LoS during the AM and PM peak under existing conditions; however, the Moorebank Avenue / Newbridge Road and Moorebank Avenue / Heathcote Road intersections are operating at a LoS E, indicating they are operating close to capacity in the AM and PM peak.

Table 7-9 Modelled level of service for the existing conditions at key intersections in 2015

ID	Intersection	Intersection configuration	AM Peak (8-9 am)		PM Peak (5-6 pm)	
			Delay (sec)	LoS	Delay (sec)	LoS
I-1	Moorebank Avenue / Anzac Road	Existing	18	B	17	B
I-2	M5 Motorway / Moorebank Avenue	Existing	31	C	31	C
I-3	M5 Motorway / Hume Highway	Existing	48	D	36	C
I-4	Moorebank Avenue / Newbridge Road	Existing	61	E	60	E
I-5	Moorebank Avenue / Heathcote Road	Existing	66	E	63	E
I-6	M5 Motorway / Heathcote Road	Existing	24	B	53	D
I-7	Cambridge Avenue / Glenfield Road	Existing	14	B	15	B

ID	Intersection	Intersection configuration	AM Peak (8-9 am)		PM Peak (5-6 pm)	
			Delay (sec)	LoS	Delay (sec)	LoS
I-8	Cambridge Avenue / Canterbury Road	Existing	15	B	12	A
I-A	Moorebank Avenue / DJLU Access	Existing	7	A	6	A
I-B	Moorebank Avenue / MPE Stage 2 Site Access	Existing	Intersection currently not operational			

7.3.5 Public and active transport network

Figure 7-4 shows the existing public (bus) and active transport services and routes within the general vicinity of the Proposal site.

Public transport

The route 901 bus service operates as a feeder service to the Liverpool and Holsworthy train stations. As shown in Figure 7-4, the Proposal site is serviced by one bus service (route 901) which operates along Moorebank Avenue adjacent to the Proposal site, and Anzac road. There are a number of limited-service bus stops located along Moorebank Avenue, including one located at the Proposal site's frontage, which are serviced with only a single bus service during the morning and evening peak periods. Regular-service bus stops (serviced on a regular hourly basis) are located at the Moorebank Avenue / Anzac Road intersection serviced full-time, yet these bus stops are located at an unacceptable walking distance from the central and southern sections of the Proposal site. Due to poor public transport services in the wider traffic study area, a very low percentage of workers residing in the area currently use public transport to travel to work. Three train stations are also located within the vicinity of the Proposal (four to seven kilometres away).

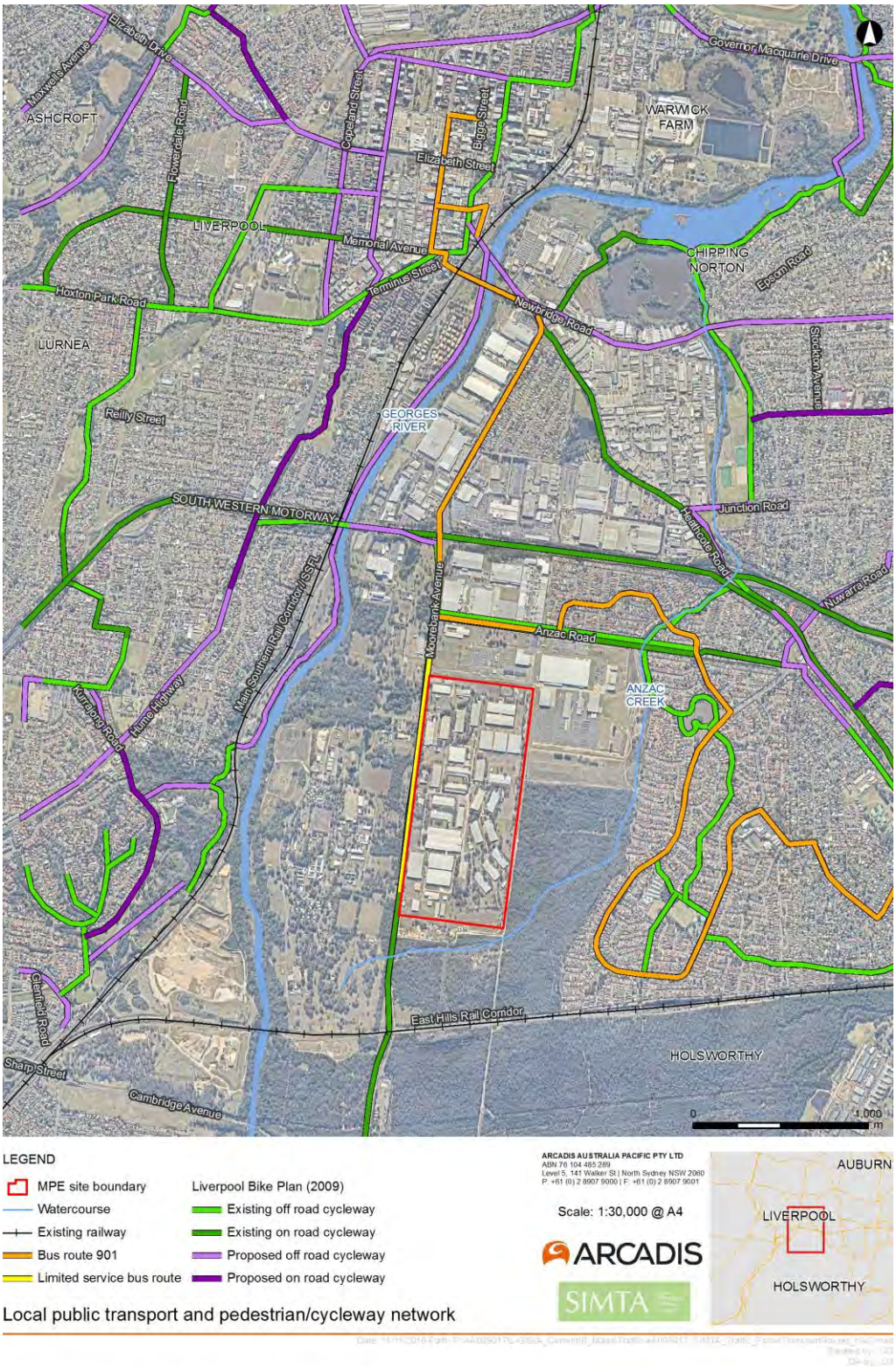

Figure 7-4 Local public transport services and pedestrian / cycleway networks within the general vicinity of the Proposal

A summary of the service details for each mode of public transport within the vicinity of the Proposal site is provided in Table 7-10.

Table 7-10 Public transport services

Mode	Bus Stop/ Railway Station location	Route description	Significant destinations on route	Service frequency
Bus	Moorebank Ave / Anzac Rd	Route 901 (standard route) Liverpool to Holsworthy	• Liverpool Station • Westfield Liverpool • Wattle Grove shops • Holsworthy Station	Regular services • 30 mins (peak) • 60 mins (off-peak)
	Moorebank Ave (site)	Route 901 (via MPE site) Liverpool to Holsworthy		Limited services One service during AM and PM peaks
Train	Liverpool Station	T2 Inner West & South Line	• Strathfield • Sydney CBD	• 8 mins (peak) • 30 mins (off-peak)
		T3 Bankstown Line	• Bankstown • Sydney CBD	• 15 min (peak) • 30 min (off peak)
		T5 Cumberland Line	• Parramatta • Blacktown • Glenfield • Campbelltown	• 30 mins (peak) • 30 mins (off-peak)
	Holsworthy Station	T2 Airport & South Line	• Airport • Sydney CBD • Glenfield • Campbelltown	• 8 mins (peak) • 20 mins (off-peak)

Source: Transport for NSW website

Active transport

Despite there being no existing cycleway along Moorebank Avenue, on-street cycling is accommodated with lane-marked shoulders of 1.5 – 2.5 metre width. In addition, Moorebank Avenue connects to a series of cycle routes in the surrounding area, as shown in Figure 7-4, in the form of either on-street cycle lanes, shared pedestrian-cycle paths or along local roads.

A number of publications also exist that outline plans to improve the region's cycle-connectivity, including:

- The NSW BikePlan (June 2010) has identified bike routes (to be constructed) around Liverpool on Moorebank Avenue, Heathcote Road and Newbridge Road
- Sydney's Cycling Future (Transport for NSW, 2013) commits to completing missing links in the existing bicycle network to the Liverpool CBD. This would include improving bicycle access to the Liverpool City Centre from the south by completing the missing sections of the off-road walking and cycling corridor along Glenfield Creek, between Casula and Liverpool.
- This improved access would integrate with the cycling routes proposed in the *Liverpool Bike Plan* (Liverpool Council, 2009). Moorebank Avenue is also considered a strategic bicycle corridor in this plan.

Pedestrians facilities include a sealed footpath provided on the western side of Moorebank Avenue with pedestrian crossing facilities located at signalised T-intersections along Moorebank Avenue, spaced approximately 250 metres to 600 metres apart (refer to Figure 7-4). Sightlines along Moorebank Avenue are generally clear, providing motorists suitable opportunity to see pedestrians.

7.3.6 Crash Data

Crash data supplied by Roads and Maritime over a five-year period between July 2010 and June 2015 inclusive for the wider road network, shows a total of 444 crashes. Of these 210 (47%) crashes resulted in injuries, 232 (52%) crashes resulted in non-casualty and two crashes (1%) were recoded as fatalities. The crash data appears to be concentrated on State Roads and the M5 Motorway including its associated interchanges with Moorebank Avenue, Hume Highway and Heathcote Road, as shown in Figure 7-5.

An analysis of the crash data between 2010 and 2015, indicates that:

- The majority of crashes were rear-end (45.7%) and concentrated on the M5 Motorway between the Hume Highway and Heathcote Road
- 27 crashes (6.1%) involved articulated vehicles, with the majority occurring on the M5 Motorway.
- 69 crashes (15.3%) involved heavy vehicles, including articulated trucks, while 98 crashes (22.1%) involved light vehicles.
- Over 93% of accidents involved privately owned cars[3].
- A low number of crashes occurred on Moorebank Avenue (south of the M5 Motorway), Anzac Road and Cambridge Avenue compared to State Roads crash sites.

[3] Note that the total percentage adds to over 100% because a crash could involve more than one type of vehicle.

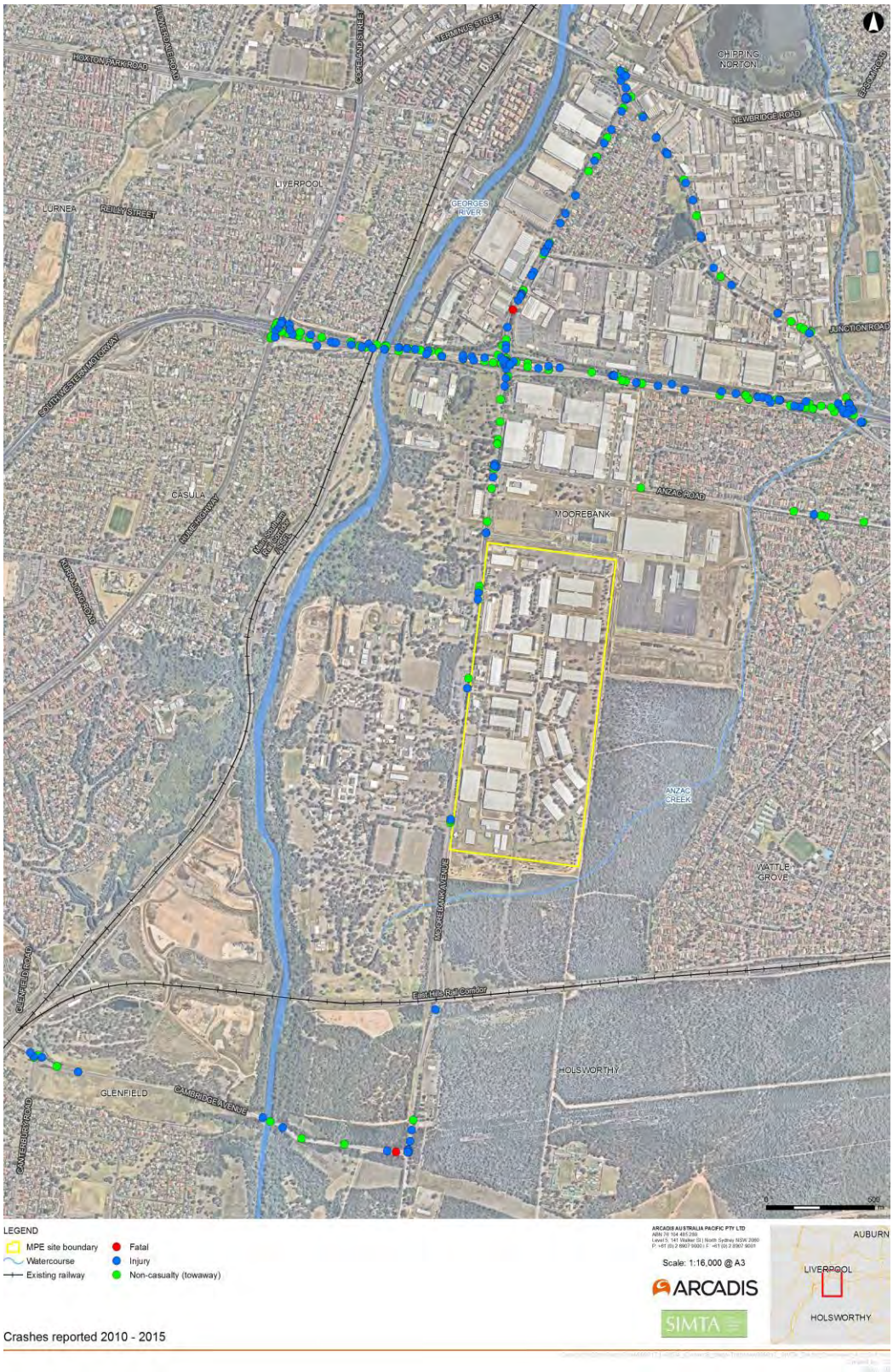

Figure 7-5 Distribution of crashes on key roads between 2010 and 2015

7.3.7 Future traffic conditions without the Proposal (2019 and 2029)

To assess the performance of the existing road network in the future (without the Proposal), forecast background traffic growth rates were applied to existing traffic volumes observed from 2015 traffic count surveys and the performance of key intersections were modelled. The impact on the road network from background traffic growth has been assessed for key intersections in the opening year (2019) and ten years after opening (2029) for the AM and PM peak periods.

The predicted LoS at key intersections within the study area without the Proposal for the AM and PM peak periods in 2019 and 2029 are summarised in Table 7-11 and Table 7-12 respectively.

SIDRA analysis indicates that during the AM peak in 2019, the M5 Motorway / Hume Highway intersection would operate at a LoS F and the M5 Motorway / Heathcote Road intersection would operate at a level of service E, indicating that it is nearly at capacity under existing traffic conditions. All key intersections would operate at an acceptable LoS during the PM peak in 2019.

Without the Proposal in 2029, all key intersections analysed would operate at or near capacity in both, or at least one of, the AM and PM Peak periods.

These results indicate the need for road and intersection upgrades to manage future traffic impacts. In particular, the following intersections require upgrades without the addition of the traffic generated by the Proposal:

- Moorebank Avenue / Anzac Road by 2029
- M5 Motorway / Moorebank Avenue by 2029
- M5 Motorway / Hume Highway in both 2019 and 2029
- Moorebank Avenue / Newbridge Road and Moorebank Avenue / Heathcote Road / M5 Motorway / Heathcote Road in both 2019 and 2029.

Table 7-11 Intersection level of service without the Proposal - 2019

ID	Intersection	Intersection configuration	2019 without the Proposal			
			AM Peak (8-9 am)		PM Peak (5-6 pm)	
			Delay (sec)	LoS	Delay (sec)	LoS
I-1	Moorebank Avenue / Anzac Road	Existing	16	B	15	B
I-2	M5 Motorway / Moorebank Avenue	Existing	24	B	25	B
I-3	M5 Motorway / Hume Highway	Existing	86	F	37	C
I-4	Moorebank Avenue / Newbridge Road[4]	Existing	36	C*	34	C

[4] The performance of the Moorebank Avenue / Newbridge Road intersection and the Moorebank Avenue / Heathcote Road intersection are inter-related and behave as one intersection due to the proximity of both intersections to one another and the high level of congestion on the road network. Therefore, the performance of the Moorebank Avenue / Newbridge Road intersection is more aptly reflected by the

ID	Intersection	Intersection configuration	2019 without the Proposal			
			AM Peak (8-9 am)		PM Peak (5-6 pm)	
			Delay (sec)	LoS	Delay (sec)	LoS
I-5	Moorebank Avenue / Heathcote Road	Existing	56	E	42	D
I-6	M5 Motorway / Heathcote Road	Existing	50	D	37	C
I-7	Cambridge Avenue / Glenfield Road	Existing	10	A	15	B
I-8	Cambridge Avenue / Canterbury Road	Existing	11	A	7	A
I-A	Moorebank Avenue / DJLU	Existing	9	A	8	A
I-B	Moorebank Avenue / MPE Stage 2 Access	Existing	Intersection currently not operational			

Table 7-12 Intersection level of service with the Proposal - 2029

ID	Intersection	Intersection configuration	2029 without the Proposal			
			AM Peak (8-9 am)		PM Peak (5-6 pm)	
			Delay (sec)	LoS	Delay (sec)	LoS
I-1	Moorebank Avenue / Anzac Road	Existing	56	E	105	F
I-2	M5 Motorway / Moorebank Avenue	Existing	53	D	141	F
I-3	M5 Motorway / Hume Highway	Existing	148	F	124	F
I-4	Moorebank Avenue / Newbridge Road	Existing	39	C	73	F
I-5	Moorebank Avenue / Heathcote Road	Existing	65	E	146	F
I-6	M5 Motorway / Heathcote Road	Existing	131	F	190	F

performance of the Moorebank Avenue / Heathcote Road intersection i.e. at LoS E in the AM and LoS D in the PM.

ID	Intersection	Intersection configuration	2029 without the Proposal			
			AM Peak (8-9 am)		PM Peak (5-6 pm)	
			Delay (sec)	LoS	Delay (sec)	LoS
I-7	Cambridge Avenue / Glenfield Road	Existing	11	A	61	E
I-8	Cambridge Avenue / Canterbury Road	Existing	19	B	60	E
I-A	Moorebank Avenue / DJLU Access	Existing	53	D	155	F
I-B	Moorebank Avenue / MPE Stage 2 Access	Existing	Intersection currently not operational			

7.4 Potential impacts

7.4.1 Construction

Construction of the Proposal may affect the surrounding road network as a result of:

- The introduction of construction vehicles, especially heavy vehicles transporting fill to the Proposal site
- Surface road works, requiring the establishment of the Moorebank diversion road and temporary traffic cyclist and / or pedestrian diversions, road occupation and temporary road closures
- Changes to speed limits.

Overview of construction traffic and vehicle routes

Construction of the project would result in the generation of additional heavy and light vehicle movements on the road network in three broad categories:

- The importation of fill to facilitate construction of the Proposal
- Heavy vehicle deliveries and other heavy vehicles involved in construction activities
- Light vehicle movements associated with construction of the Proposal.

Construction traffic for the Proposal, particularly heavy vehicles would use the existing motorway and arterial road network as much as possible, reducing traffic related impacts on local roads.

Construction traffic movements

Construction traffic volumes were predicted based on the construction staging program, activities to be undertaken within each construction works period and the materials to be transported, as presented in Section 4 of this EIS.

Construction traffic volumes have been estimated based on the construction activities that would generate the most amount of traffic. Table 7-13 below summarises the number of construction vehicle movements for the Proposal, for both heavy (truck) and light vehicles, to and from the construction site each weekday for the peak construction period.

The construction vehicle movements presented in Table 6-1 are considered representative of a worst-case construction traffic scenario, which is expected to occur in 2018 where construction works periods D, E and F overlap and construction activities on the Proposal site are assumed to peak.

During the peak construction period, there would be 1,022 two way truck movements and 428 light vehicle movements per day. Fill haulage would generate the largest amount of heavy vehicle movements of all construction activities.

Table 7-13 Estimates of Daily Construction Vehicle Movements for the Proposal

Construction activity	Construction works period				Daily Vehicle Movements for the Proposal (two-way)	
	C	D	E	F	Truck movements	Car movements
Fill Haulage for MPE Stage 2	✓	✓	✓		734	60
Raising of Moorebank Avenue		✓	✓		232	200
Warehouse Construction				✓	56	168
			Total		1,022	428

Note: Truck and car movements represent two-way daily trips

The number of hourly truck movements varies between 22 and 34 truck movements (i.e. 44 and 68 trips) depending on the time of day. The highest number of truck movements are expected to be between the hours of 7:00am and 6:00pm with 34 truck movements (i.e. 68 trips) per hour.

The estimated number of hourly car movements varies between 21 and 120 car movements depending on the time of day. The highest car movements are expected to be 120 car movements per hour between 6:00am and 7:00am.

The above traffic generation is considered to represent a conservative estimation of the traffic that would be generated where construction works periods may overlap and as such one works period could be 'ramping down' while subsequent works periods could be 'ramping up'.

Peak hour traffic generation

Table 7-14 below summarises traffic movements to and from the Proposal site during the AM and PM peak hour. During the peak construction period (i.e. concurrent undertaking of construction works periods D, E and F), it is expected that approximately 67 vehicles (all of which are heavy vehicles) would be travelling to and from the Proposal site during the AM peak hour and approximately 169 vehicles (67 trucks and 102 cars) would be travelling to and from the Proposal site during PM peak hour.

This estimation represents the predicted peak construction traffic generation for the Proposal and is considered to represent a worst case construction traffic scenario.

Table 7-14 Weekday AM and PM peak hour traffic movements for construction of the Proposal

Construction activity	AM Peak movements (8-9 am)			PM Peak movements (5-6 pm)		
	Truck	Car	Total	Truck	Car	Total
Fill Haulage for MPE Stage 2	43	0	43	43	14	57
Raising of Moorebank Avenue	19	0	19	19	48	67
Warehouse Construction	5	0	5	5	40	45
Total Peak Construction	67	0	67	67	102	169

Note: Car movements for site staff travelling to work would have arrived between 5-7 am. These movements would fall outside of the AM peak. Staff would generally leave between 3-5 pm and as such some of these movements would fall within the PM peak.

Construction traffic distribution

Light vehicle distribution

Approximately 90% of light vehicle movements would access and egress the Proposal site and travel along Moorebank Avenue to the north of the Proposal site to the M5 Motorway and surrounding road network. The remaining 10% of light vehicles are expected to use Anzac Road.

Heavy vehicle distribution and haulage routes

All heavy vehicles are expected to access and egress the Proposal site and travel along Moorebank Avenue to the north of the Proposal site to the M5 Motorway and surrounding road network. It is anticipated that heavy vehicles would use the gazetted heavy vehicle routes to access the Proposal site. No heavy vehicles would use Anzac Road. There is expected to be a small number of truck movements via Cambridge Avenue for disposal of unsuitable material to the Glenfield Waste Facility if required.

Impacts to intersection performance during peak construction

Table 7-15 and Table 7-16 provides a summary of the intersection performance at key locations near the Proposal during peak construction for the AM and PM peak periods respectively. During construction of the Proposal, the performance of intersections near the Proposal are expected to generally operate at a level of service similar to the operation of these intersections without construction in 2018. All modelled intersections near the Proposal would operate at an acceptable level of service during the AM and PM peak during peak construction.

Table 7-15 Comparison of intersection performance during construction of the Proposal – AM peak

Intersection	Without the Proposal			With construction of the Proposal only*		
	Intersection Configuration	Ave delay (secs)	LoS	Intersection Configuration	Ave delay (secs)	LoS
Moorebank Avenue / MPE Stage 2 Site	Existing	7	A	Existing	12	A
Moorebank Avenue / DJLU Access	Existing	N/A^	N/A^	Existing	4	A
Moorebank Avenue / Anzac Road	Existing	18	B	Existing	31	C
M5 Motorway / Moorebank Avenue	Existing Signal	24	B	Existing Signal	31	C

*Assessed against the peak construction period volumes shown in Table 7-13
^The existing conditions of the Moorebank Avenue / MPE Stage 2 Site Access intersection has not been modelled as the intersection is not currently operational.

Table 7-16 Comparison of intersection performance during construction of the Proposal – PM peak

Intersection	Without the Proposal			With construction of the Proposal only*		
	Intersection Configuration	Ave delay (secs)	LoS	Intersection Configuration	Ave delay (secs)	LoS
Moorebank Avenue / MPE Stage 2 Site Access	Existing	6	A	Existing	10	A
Moorebank Avenue / DJLU Access	Existing	N/A^	N/A^	Existing	5	A
Moorebank Avenue / Anzac Road	Existing	17	B	Existing	23	B
M5 Motorway / Moorebank Avenue	Existing Signal	30	C	Existing Signal	31	C

*Assessed against the peak construction period volumes shown in Table 7-13
^The existing conditions of the Moorebank Avenue / MPE Stage 2 Site Access intersection has not been modelled as the intersection is not currently operational.

Site access points/intersections

Construction access to the MPE Stage 2 site would be via the intersection proposed to be used as the operational site access point (refer to Figure 7-6 for location). Access to this intersection would be via one of the following:

- the former DSNDC intersection from Moorebank Avenue in its existing configuration
- the Moorebank Avenue diversion road, via a temporary intersection
- the final operational intersection for the MPE Stage 2 site from the upgraded Moorebank Avenue.

The configuration of this site access point would vary through each construction works period, depending on the construction activities being undertaken at the time, and the associated staging. A summary of the indicative form of access to the MPE Stage 2 site during construction is summarised in Table 7-17 below. The format of access during construction would be refined and confirmed during the detailed design phase of the Proposal and managed in accordance with a Construction Traffic Management Plan (CTMP). The indicative construction layout of the Moorebank Avenue upgrade is shown in Figure 7-7.

Table 7-17 Construction Site Access per Works Period

Works Period	Moorebank Avenue layout		
	Existing Moorebank Avenue	Moorebank Avenue diversion road	Upgraded Moorebank Avenue
Works period A – Pre-construction activities	✓		
Works period B - Site preparation activities	✓		
Works period C: Construction of the Moorebank Avenue diversion road		✓	
Works period D – Bulk earthworks, drainage and utilities		✓	
Works period E – Pavement works along Moorebank Avenue		✓	
Works period F - Warehouse construction and internal fit-out			✓
Works period G – Miscellaneous construction and finishing works			✓

Access and egress to the construction compounds is proposed off Moorebank Avenue via an existing signalised intersection show in Figure 7-6.

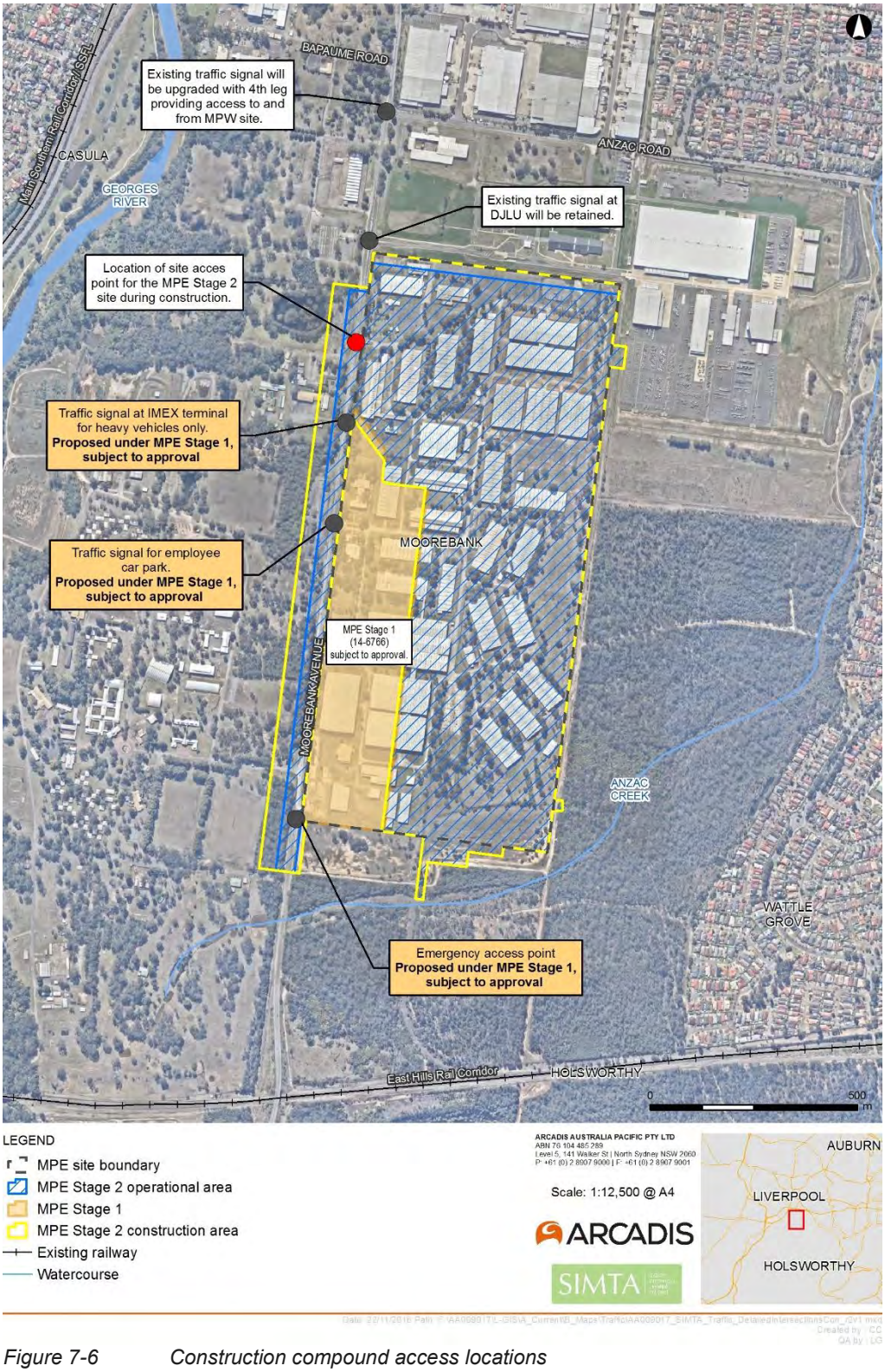

Figure 7-6 Construction compound access locations

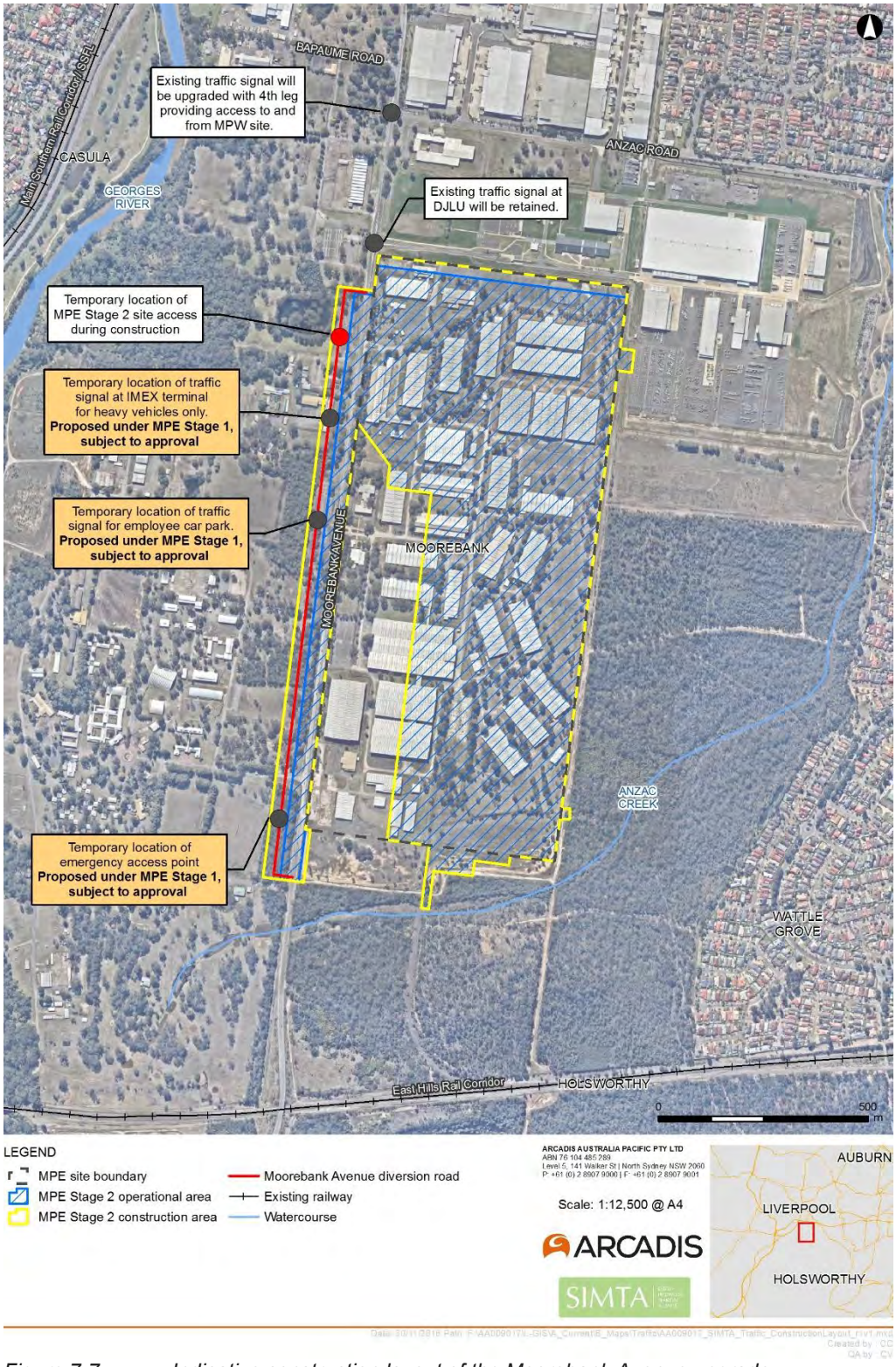

Figure 7-7 Indicative construction layout of the Moorebank Avenue upgrade

Access/egress and need for road closures

Part of Moorebank Avenue may require short term closures from time to time, to undertake diversionary works during the Moorebank Avenue upgrade. These works would be subject to a separate traffic management plan and would include signage and diversion plans to ensure the safe continued operation of the road during construction for the Moorebank Avenue through traffic.

Should a larger vehicle require access to the Proposal site, such as low loaders, a traffic controller would be used to allow larger trucks to encroach across the site access, ensuring sufficient time is provided to complete their turning manoeuvre. Sufficient signage would be installed to ensure unauthorised vehicles do not enter the site. The existing local accesses along Moorebank Avenue would be maintained during construction with mitigation measures implemented as necessary and as detailed in section 22 of this EIS.

Impacts to public transport

There is currently one bus service in the proximity of the Proposal site, with the service operating regular services north along Moorebank Avenue from Anzac Avenue, and one service in the AM and PM peak hours running past the Proposal site, south of Anzac Road. Given that the majority of construction activities would be contained on the Proposal site rather than Moorebank Avenue, and the services that do service this portion of Moorebank Avenue are limited to only two per day (one AM and one PM), it is considered unlikely that there would be any significant impacts to public transport services as a result of the Proposal.

Access for emergency vehicles

It is proposed that all access points for the site be made available for emergency vehicle access should the need arise. This would be considered as part of the site safety and incident management plans. As the works are not encroaching onto the road network, this would be an internal site consideration, and is unlikely to have an impact on the surrounding arterial road network.

7.4.2 Operation

Site access and operation

Access to and from the MPE Stage 2 site would be via the existing Moorebank Avenue intersection with the northern DSNDC site access. The MPE Stage 2 site access at this location would allow for vehicular access to warehouse and distribution facilities to enable the direct delivery and dispatch of goods to the warehouses. The MPE Stage 2 site access point is shown on Figure 4-4.

Operational traffic movements

Trip generation assumptions

The trip generation assumptions for the Proposal were sourced from the following documents, and are detailed in Table 7-18:

- *Moorebank Intermodal Terminal Precinct – Traffic Generation and Underlying Assumptions, Memorandum* (Parsons Brinckerhoff, 1 September 2016)
- *MPE Stage 2 Proposal / MPW Stage 2 Proposal – Container Handling Movements* (Neil Matthews Consulting Pty Ltd, 4 August 2016).

Table 7-18 Assumptions informing the operational trip generation for the Proposal

Proosal component	Assumptions
Warehouse	• Warehousing would operate 52 weeks of year, 7 days a week and 24 hours a day. • Containers would arrive every day of the year. In a typical week, 95% of containers would be processed on weekdays (Monday – Friday), with the remaining five per cent being processed on Saturday and Sunday. • Containers would loaded onto either B-doubles, semi-trailers or rigid trucks for dispatch from the Proposal site. On average, a semi-trailer is equivalent to 1.6 TEUs, a B-double is equivalent to 2.4 TEUs, and a rigid truck is equivalent to 0.8 TEUs • About 65% of deliveries to warehouses within the Proposal site would be made by semi-trailers, 30% would be made by rigid trucks and five per cent would be made by B-doubles.
Intermodal Terminal	• The IMT facility (within the MPE Stage 1 site) would operate 52 weeks per year, 7 days a week and 24 hours a day. • Containers would arrive every day of the year. In a typical week, 85% of containers would be processed on weekdays (Monday – Friday), with the remaining 15% being processed on Saturday and Sunday. • The containers arriving at the IMT facility by rail would be transferred onto trucks for transport on-site and off-site. In some instance containers will be unloaded from trains into the container storage area (i.e. stacked) and then transferred onto trucks. • Containers would be loaded onto either B-doubles or semi-trailers. On average a semi-trailer is equivalent to 1.6 TEUs and a B-double equivalent to 2.4 TEUs • About 80% of container deliveries would be made by semi-trailers and 20% by B-doubles.
Staff shift work	• Staff would work across three shifts per day

Daily trip generation

The Proposal includes the operation of 300,000 m^2 GFA of warehousing, which would result in the generation of 564 two-way heavy vehicle movements and 3,993 two-way light vehicle movements each weekday (Monday to Friday).

Traffic distribution
The distribution of additional traffic (both heavy and light vehicles) generated by the Proposal is a key factor in determining the impact of the Proposal on roads and intersections in the study area. The distribution of heavy and light vehicle traffic as a result of the Proposal is described below.

Heavy vehicles

Figure 7-8 shows the estimated truck (including semi-trailers, B-doubles and rigid trucks) distribution of the Proposal on roads and intersections in the study area road network in the AM peak.

About 56% of heavy vehicle movements generated by the Proposal would travel to the Proposal site via the M5 Motorway from the west. The remainder of traffic travelling to the Proposal site would be via the Hume Highway and Moorebank Avenue from the north of the M5 Motorway. Traffic travelling along Moorebank Avenue would originate from Newbridge Road.

In general, all heavy vehicles would travel to and from the Proposal site via Moorebank Avenue. No container trucks would travel to the Proposal site via Anzac Road (east of Yulong Close) or Cambridge Avenue.

The traffic distribution in the PM peak (outbound trips) is assumed to be similar to AM peak inbound trip distribution.

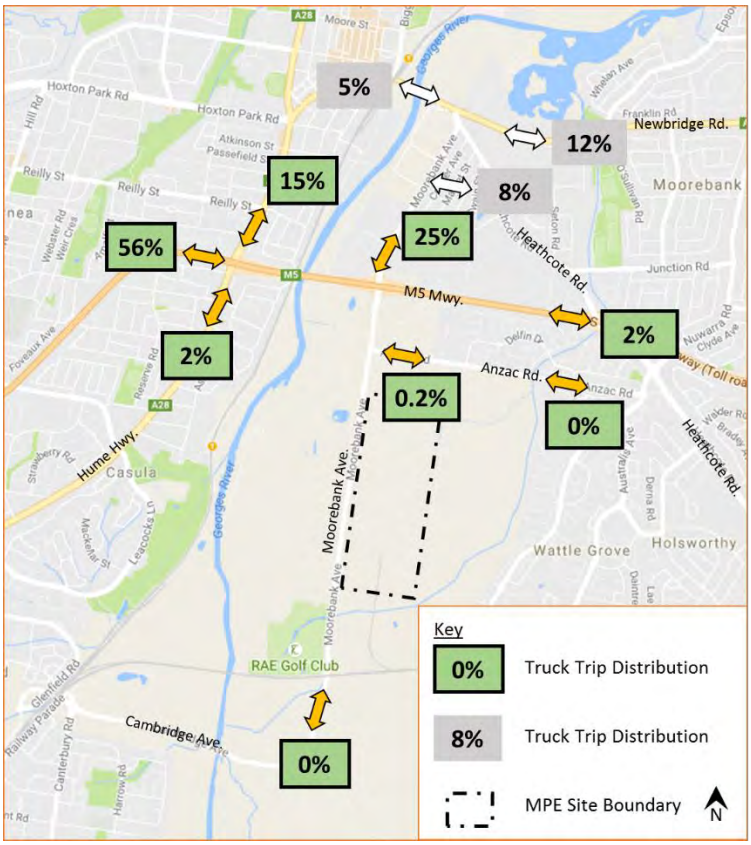

Figure 7-8 Truck Traffic Distribution to the Proposal during the AM Peak

The temporal distribution profile of heavy vehicles is shown in Figure 7-9.

Deliveries to and from warehouses would be made by B-doubles, semi-trailers and rigid trucks. The majority of deliveries are anticipated to take place outside of the AM and PM peak periods. Peak periods for deliveries to and from warehousing for semi-trailers and rigid trucks would be around 9am and around 10 pm for B-doubles.

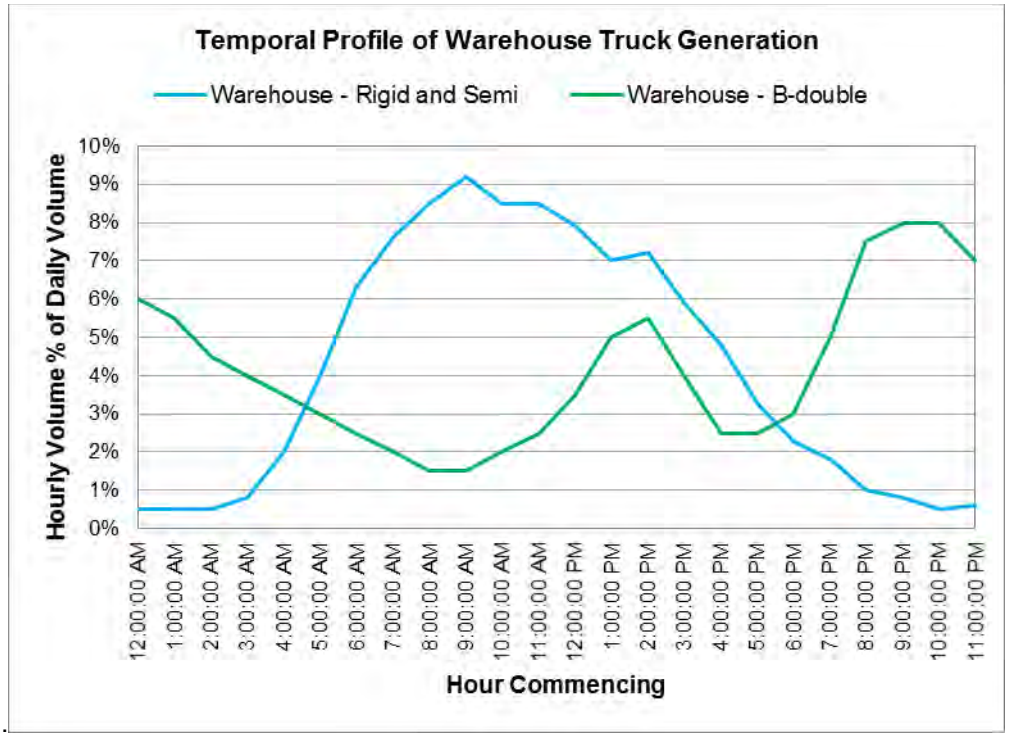

Figure 7-9 Temporal Distribution of Warehouse Truck movements

Light vehicles

Figure 7-10 shows the estimated light vehicle trip distribution in the AM peak. The majority of light vehicle traffic associated with the Proposal are forecast to travel to the Proposal site via Moorebank Avenue. More than 50% of light vehicle movements related to the Proposal are forecast to travel to the Proposal site via the M5 Motorway from the east and west, respectively. The remainder of light vehicle movements would travel via the Hume Highway from the west and Moorebank Avenue from the north during the AM peak. Minor employee car traffic is expected to travel to Proposal site via Anzac Road (8%) and Cambridge Avenue (3%).

The traffic distribution in the PM peak (outbound trips) is assumed to be similar to AM peak inbound trip distribution.

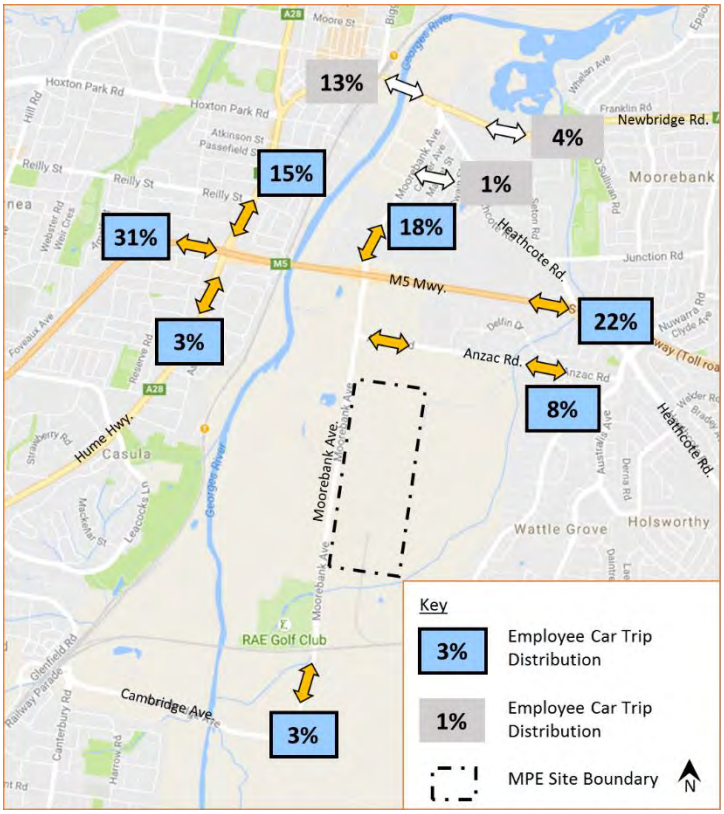

Figure 7-10 Employee Car Traffic Distribution to Precinct in the AM Peak

Figure 7-11 shows the hourly car generation profile for the Proposal with three shifts per day. The hourly data shows that the AM peak hour for car movements will occur between 5am and 6 am and the PM peak hour would be between 9pm and 10 pm. An inter-peak period would also occur for light vehicle movements between 1pm and 2 pm. During the employee AM and PM peak hour, employee car movements represent about 9% and 10% of total daily car movements on the surrounding road network, respectively.

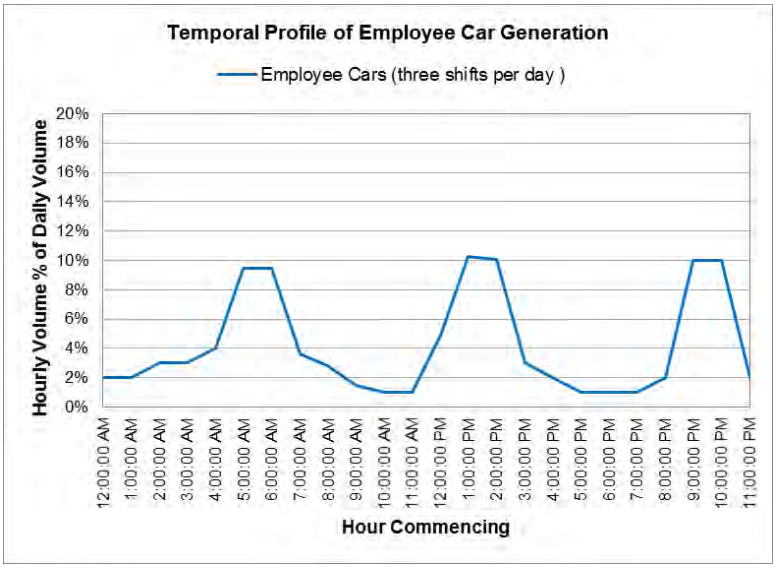

Figure 7-11 Temporal distribution of employee cars associated with the Proposal operation

Traffic volumes

Predicted daily traffic volumes along key roads

The operation of the Proposal would increase the number of traffic movements within the vicinity of the Proposal site, particularly along Moorebank Avenue to the south of the M5 interchange. The M5 interchange is the Proposal's primary point of access to the south-western Sydney freight catchment, which is located to the west of the M5 interchange.

Increases in daily traffic volumes as a result of the operation of the Proposal would be due to heavy vehicle movements for freight distribution to and from the Proposal site and for light vehicle movements for employees and visitors accessing and egressing the Proposal site.

The proportion of total traffic attributed to heavy and light vehicle movements from operation of the Proposal was determined by comparing the forecast 2019 (opening year) and 2029 (10-year horizon) daily traffic volumes on Moorebank Avenue, Anzac Road and Cambridge Avenue with and without the Proposal. The predicted daily traffic volumes along key roads near the Proposal, both with and without the Proposal in 2019 and 2029 are summarised in Table 7-19 and , respectively.

The Proposal would result in an increase in traffic volumes along all analysed roads near the Proposal site in 2019 (refer to Table 7-19). The greatest proportional increase in traffic volumes would be along Moorebank Avenue south of Anzac Road (23%). Approximately 2.5% of heavy vehicle traffic to the north of Anzac Road, and approximately 2.4% of heavy vehicle traffic to along Moorebank Avenue to the south of Anzac Road is attributable to the operation of the Proposal.

Ten years after opening (2029), the Proposal would continue to result in an increase in traffic volumes along all analysed roads near the Proposal site (refer to Table 7-19). The greatest proportional increase in traffic volumes would be along Moorebank Avenue south of Anzac Road (19%). Approximately 1.7% of heavy vehicle traffic to the north of Anzac Road, and approximately 2% of heavy vehicle traffic to along Moorebank Avenue to the south of Anzac Road is attributable to the operation of the Proposal.

The proportion of heavy vehicle traffic along key roads attributable to the Proposal in 2029 is lower than what is predicted in 2019 due to increased background traffic growth over the ten year period.

Table 7-19 Predicted daily traffic numbers with and without the Proposal in 2019

ID	Road Locations	2019 without the Proposal			2019 with the Proposal			Traffic Increase Contributed by the Proposal in 2019 (Opening year)			
		Total daily traffic	Heavy Vehicles		Total daily traffic	Heavy Vehicles		Total vehicles		Heavy vehicles	
			Total	% of total traffic		Total	% of total traffic	Change	% of total traffic	Change	% of total traffic
M-1	Moorebank Avenue, north of Anzac Road	23,200	1,200	5	27,320	1,760	6	+4,120	+18	+560	+2.5
M-2	Moorebank Avenue, south of Anzac Road	19,000	980	5	23,440	1,540	7	+4,440	+23	+560	+2.4
M-3	Anzac Road, east of Moorebank Avenue	11,100	510	5	11,420	510	4	+320	+3	0	0
M-4	Moorebank Avenue, north of Cambridge Avenue	19,000	1,050	6	19,120	1,050	5	+120	+0.6	0	0
M-5	Cambridge Avenue, west of Moorebank Avenue	17,900	630	4	18,020	630	3	+120	+0.7	0	0

Note: Traffic increase contributed by the Proposal is equal to Proposal traffic generation divided by background traffic.

Table 7-20 Predicted traffic numbers with and without the Proposal in 2029

ID	Road Locations	2029 without the Proposal			2029 with the Proposal			Traffic Increase Contributed by the Proposal in 2029 (Horizon year)			
		Total daily traffic	Heavy Vehicles		Total daily traffic	Heavy Vehicles		Total vehicles		Heavy vehicles	
			Total	% of total traffic		Total	% of total traffic	Change	% of total traffic	Change	% of total traffic
M-1	Moorebank Avenue, north of Anzac Road	28,000	1,450	5	32,120	2,010	6	4,120	15	560	1.7
M-2	Moorebank Avenue, south of Anzac Road	23,500	1,220	5	27,940	1,780	6	4,440	19	560	2
M-3	Anzac Road, east of Moorebank Avenue	12,800	590	5	13,120	590	4	320	3	0	0
M-4	Moorebank Avenue, north of Cambridge Avenue	23,600	1,310	6	23,720	1,310	6	120 0.	0.5	0	0
M-5	Cambridge Avenue, west of Moorebank Avenue	22,300	780	3	22,420	780	3	120 0.	0.5	0	0

Note: Traffic increase contributed by the Proposal is equal to Proposal traffic generation divided by background traffic.

Peak hour traffic volumes at key intersections

An analysis of the proportion of traffic at key intersections during the AM and PM peak periods that is attributable to the operation of the Proposal has been undertaken for 2019 (opening year) and 2029 (horizon year). A summary of this analysis is provided in Table 7-21.

In 2019 the Proposal would account for less than one per cent of total traffic volumes at all intersections analysed, with the exception of:

- The Moorebank Avenue / Anzac Road intersection – seven percent of traffic in the AM peak and 3.7 per cent of traffic in the PM Peak would be attributable to the Proposal
- The M5 Motorway/Moorebank Avenue intersection – four per cent of traffic in the AM peak and two per cent of traffic in the PM Peak would be attributable to the Proposal.

Similarly, in 2029, the Proposal would account for less than one per cent of total traffic volumes at all intersections analysed, with the exception of:

- The Moorebank Avenue / Anzac Road intersection – six percent of traffic in the AM peak and three per cent of traffic in the PM Peak would be attributable to the Proposal
- The M5 Motorway/Moorebank Avenue intersection – 3.5 per cent of traffic in the AM peak and 1.7 per cent of traffic in the PM Peak would be attributable to the Proposal.

The proportion of heavy vehicle traffic attributable to the Proposal at key intersection in 2029 is lower than what is predicted in 2019 due to an increase in background traffic over the ten year period.

Table 7-21 increases in traffic volumes in 2019 and 2029 during the AM and PM peak with the Proposal

ID	Intersections	Proportion of total traffic attributable to the Proposal			
		2019		2029	
		AM Peak	PM Peak	AM Peak	PM Peak
I-1	Moorebank Avenue / Anzac Road	7.0%	3.7%	6.0%	3.0%
I-2	M5 Motorway / Moorebank Avenue	4.0%	2.0%	3.5%	1.7%
I-3	M5 Motorway / Hume Highway	0.4%	0.2%	0.4%	0.2%
I-4	Moorebank Avenue / Newbridge Road	0.5%	0.2%	0.4%	0.2%
I-5	Moorebank Avenue / Heathcote Road	0.8%	0.4%	0.7%	0.3%
I-6	M5 Motorway / Heathcote Road	0.6%	0.3%	0.1%	0.1%
I-7	Cambridge Avenue / Glenfield Road	0.1%	0.01%	0.1%	0.1%
I-8	Cambridge Avenue / Canterbury Road	0.1%	0.07%	0.1%	0.1%
I-A	Moorebank Avenue / DJLU Access	9.5%	5.4%	7.8%	4.3%
I-B	Moorebank Avenue / MPE Stage 2 Site Access	9.9%	5.5%	8.2%	4.4%

Impacts to intersection performance

Eight key intersections (I-1 to I-8) have been assessed for performance using the SIDRA modelling tool (V.7) in both the 2019 and 2029 predictive scenarios. A summary of the intersection performance at key intersections in the study area in 2019 and 2029 with and without the Proposal in 2019 and 2029 during the AM and PM peak is provided in Table 7-22 (2019) and Table 7-23 (2029) respectively.

In determining the intersection improvements required to mitigate the impact of Proposal traffic, a “no-worsening of without Proposal traffic” approach has been adopted. This approach identifies improvements directly attributable to the Proposal i.e. not due to growth in background traffic. Assumed network upgrades are discussed in Section 7.6 of this EIS.

In 2019 during the AM peak, the intersection performance of key intersections in the study area would operate at a similar level of service, with and without the operation of the Proposal. During the AM peak in 2019, the M5 Motorway / Hume Highway intersection would operate at LoS F and the M5 Motorway / Heathcote Road intersection would operate at LoS E, indicating that it is nearly at capacity.

All key intersections would operate at an acceptable LoS during the PM peak in 2019 with and without the Proposal. As the LoS at all key intersections is similar in both with and without the Proposal scenarios, during the AM and PM peak in 2019, it can be concluded that no intersection improvements are required to accommodate increases in traffic volumes at these key intersections at the opening year as a result of the Proposal (2019).

The following intersections are predicted to operate at LoS F in the 2019 AM peak, both with and without the operation of the Proposal:

- M5 Motorway / Hume Highway
- M5 Motorway / Heathcote Road.

In 2029 during the AM peak, the intersection performance of key intersections in the study area would operate at a similar level of service, both with and without the operation of the Proposal.

The Moorebank Avenue / Anzac Road and Moorebank Avenue / Heathcote Road intersections would operate at a LoS E in the AM peak in 2029 with and without the Proposal, indicating that the intersection is nearly at capacity.

In 2029 during the PM peak, the intersection performance of key intersections within the study area would typically operate at a LoS F, both with and without the operation of the Proposal, with the exception of:

- Moorebank Avenue / Newbridge Road, which would perform at a LoS F without the Proposal and a LoS D with the Proposal. The performance of this intersection is predicted to improve as a result of D. The performance of the Moorebank Avenue / Newbridge Road intersection and the Moorebank Avenue / Heathcote Road intersection are inter-related and behave as one intersection due to the proximity of both intersections to one another and the high level of congestion on the road network. Therefore, the performance of the Moorebank Avenue / Newbridge Road intersection is more aptly reflected by the performance of the Moorebank Avenue / Heathcote Road intersection i.e. at LoS E in the AM and LoS D in the PM.

- Cambridge Avenue / Canterbury Road, which would perform at a LoS F without the Proposal and a LoS D with the Proposal. Cambridge Avenue / Canterbury Road, is expected to perform at LoS E without the Proposal and a LoS D with the Proposal. The performance of this intersection has been predicted to improve as a result of the variability in the performance of the intersection in a highly congested road network and is sensitive to minor changes in delays in other parts of the road network and consequent route choice. Furthermore, the predicted LoS has only dropped one level from LoS E to LoS D, which demonstrates this minor variation in intersection performance.

With the implementation of assumed network upgrades, intersection performance at all key intersections near the Proposal modelled as part of this assessment in 2029 during the PM peak would operate at an acceptable LoS, with the exception of the M5 Motorway / Heathcote Road intersection, which would continue to operate at a LoS F, although the average delay would be reduced. Although this intersection would operate at a LoS F, its performance is no worse than the performance expected in 2029 without the operation of the Proposal in the AM Peak, and is therefore considered acceptable in the context of impacts as a result of the Proposal.

Table 7-22 Comparison of intersection performance (LoS) of key intersections with and without the Proposal in 2019 during the AM peak and PM peak

ID	Intersection*	AM peak						PM peak					
		without Proposal (Do-Min)		with the Proposal (Do-Min)		with the Proposal (With assumed network upgrades)		without the Proposal (Do-Min)		with the Proposal (Do-Min)		with the Proposal (With assumed network upgrades)	
		Ave delay (secs)	LoS	Ave delay (secs)	LoS	Ave delay (secs)	LoS	Ave delay (secs)	LoS	Ave delay (secs)	LoS	Ave delay (secs)	LoS
I-1	Moorebank Avenue / Anzac Road	16	B	15	B	15	B	15	B	15	B	23	B
I-2	M5 Motorway / Moorebank Avenue	24	B	22	B	24	B	25	B	24	B	26	B
I-3	M5 Motorway / Hume Highway	86	F	83	F	32	C	37	C	32	C	35	C
I-4	Moorebank Avenue / Newbridge Road	36	C	35	C	32	C	34	C	32	C	32	C
I-5	Moorebank Avenue / Heathcote Road	56	E	57	E	52	D	42	D	52	D	37	C
I-6	M5 Motorway / Heathcote Road	50	D	47	D	41	C	37	C	41	C	41	C
I-7	Cambridge Avenue / Glenfield Road	10	A	9	A	15	B	15	B	15	B	15	B
I-8	Cambridge Avenue / Canterbury Road	11	A	8	A	6	A	7	A	6	A	6	A
I-A	Moorebank Avenue / DJLU Access	9	A	10	A	10	A	8	A	10	A	6	A
I-B	Moorebank Avenue / MPE Stage 2 Site Access	Existing signalised intersection is not operational		9	A	10	A	Existing signalised intersection is not operational		10	A	11	A

*assumed that the layout of intersections are as per existing configuration

Table 7-23 Comparison of intersection performance (LoS) of key intersections with and without the Proposal in 2029 during the AM peak and PM peak

ID	Intersection*	AM peak						PM peak					
		without Proposal (Do-Min)		with the Proposal (Do-Min)		with the Proposal (With assumed network upgrades)		without the Proposal (Do-Min)		with the Proposal (Do-Min)		with the Proposal (With assumed network upgrades)	
		Ave delay (secs)	LoS	Ave delay (secs)	LoS	Ave delay (secs)	LoS	Ave delay (secs)	LoS	Ave delay (secs)	LoS	Ave delay (secs)	LoS
I-1	Moorebank Avenue / Anzac Road	56	E	24	B	29	C	105	F	126	F	23	B
I-2	M5 Motorway / Moorebank Avenue	53	D	46	D	27	B	141	F	129	F	40	C
I-3	M5 Motorway / Hume Highway	148	F	145	F	79	F	124	F	116	F	50	D
I-4	Moorebank Avenue / Newbridge Road	39	C	39	C	32	C	73	F	56	D	36	C
I-5	Moorebank Avenue / Heathcote Road	65	E	56	E	61	E	146	F	104	F	54	D
I-6	M5 Motorway / Heathcote Road	131	F	96	F	49	D	190	F	189	F	79	F
I-7	Cambridge Avenue / Glenfield Road	11	A	8	A	7	A	61	E	79	F	8	A
I-8	Cambridge Avenue / Canterbury Road	19	B	14	B	12	A	60	E	48	D	7	A
I-A	Moorebank Avenue / DJLU Access	53	D	29	C	5	A	155	F	336	F	7	A
I-B	Moorebank Avenue / MPE Stage 2 Site Access	Existing signalised intersection is not operational		29	C	9	A	Existing signalised intersection is not operational		356	F	11	A

*assumed that the layout of intersections are as per existing configuration

Impacts to public transport

The existing service arrangements suggest poor service frequencies for the feeder bus service outside peak times, with only one service during each of the peak periods servicing Moorebank Avenue to the south of Anzac Road (refer to Section 7.3.5).

The walking distance to the regular-service bus stops along Moorebank Avenue from the Proposal site has an acceptable walking distance (i.e. 400 metres) for the north-western part of the Proposal site; however, due to the proposed location of the MPE Stage 1 IMT rail connection, the warehouses in the south-east portion of the Proposal site do not have direct accessibility to Moorebank Avenue and the limited-service bus stops in this location. To improve bus transport access and ensure minimum walking distance standards are achieved, additional regular-service bus stops are proposed along Moorebank Avenue, adjacent to the MPE Stage 2 access intersection, and on the internal roads of the Proposal. The location of bus stops would be further discussed with TfNSW during detailed design.

Whilst there would be additional heavy vehicles on Moorebank Avenue, the service frequencies of the buses are considered low and as such the Proposal is not anticipated to have any substantial impacts on bus public transport services.

Overall it is considered that improvements in bus public transport service frequencies and additional stops would be required to ensure adequate accessibility to public transport for the Proposal.

Impacts to active transport

Cycling provisions

The existing cycling infrastructure in the area is considered adequate and the Proposal is not anticipated to result in an adverse impact to the existing cycling accessibility. To accommodate cyclists, shared paths are proposed to be provided on the western side of the upgraded Moorebank Avenue. On-road cycle provisions will be provided within the Proposal site along the internal roads as appropriate. Figure 7-12 shows the proposed connectivity between the Proposal site and the surrounding cycling network.

Pedestrian provisions

Generally, the existing pedestrian infrastructure in the area is considered adequate. A sealed footpath is provided on the western side of Moorebank Avenue with pedestrian crossing facilities located at signalised T-intersections along Moorebank Avenue. Direct connection to the surrounding pedestrian paths on Moorebank Avenue and Anzac Road from the Proposal site is proposed to be through the Moorebank Avenue / MPE Stage 1 site access intersection.

The location of the rail infrastructure within the proposed MPE Stage 1 restricts pedestrian movements directly to the south eastern portion of the Proposal site from Moorebank Avenue. This restriction is to facilitate operational safety and security for the Proposal. However, pedestrians can access the Proposal site via the MPE Stage 2 Access and pedestrian paths are provided in the verges of the internal perimeter roads to facilitate safe pedestrian circulation within the Proposal (show in Figure 7-12).

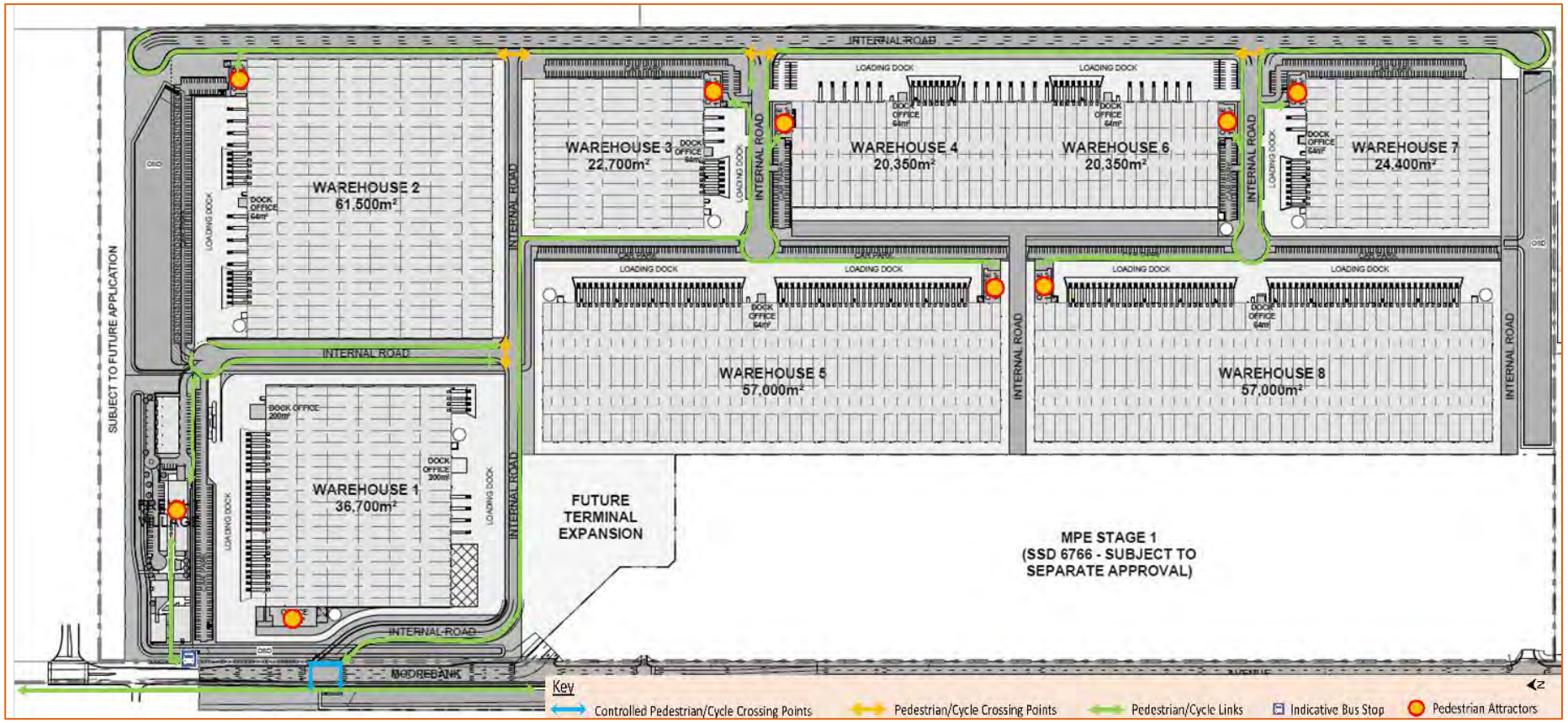

Figure 7-12 Proposed pedestrian and cyclist connectivity within and near the Proposal

Impacts to road safety

Moorebank Avenue

Between the years 2010 and 2015, a total of 51 crashes were reported on the 3.5 km section of Moorebank Avenue between the M5 Motorway interchange and Cambridge Avenue. This data translates to approximately 10.2 crashes per year, which has been interpreted as being representative of existing conditions.

The Proposal will increase daily traffic volumes on Moorebank Avenue (north of Anzac Road) by approximately 18% in 2019 and this will reduce to 15% by 2029. The analysis indicates that daily traffic volumes are expected to increase on Moorebank Avenue (north of Anzac Road) from 21,300 vehicles (2015) to 27,320 vehicles in 2019 and 32,120 vehicles in 2029, with the Proposal. This translates to approximately 4,120 additional vehicles per day predicted to use Moorebank Avenue (north of Anzac Road) due to the Proposal.

The net impact of the additional traffic generated by the Proposal, as well as the proposed access points and improvements associated with the Proposal would result in an increase from 10.2 crashes per year to 12.1 crashes per year.

Cambridge Avenue

The period between 2010 and 2015 saw a total of 25 reported crashes on the section of Cambridge Avenue between Moorebank Avenue and Canterbury Road roundabout (about 1.8 km). This translates to approximately 5 crashes per year and has been interpreted as the existing condition for assessment.

The Proposal will have minor increase on daily traffic volumes on Cambridge Avenue by less than 0.8%. Approximately 120 additional vehicles per day (employee cars) are predicted to use Cambridge Avenue as a result of the Proposal. The analysis indicates that daily traffic volumes increase on the Cambridge Avenue (east of Canterbury Road) from 15,700 vehicles (2015) to 18,020 vehicles (forecast 2019 with the Proposal) and 22,420 vehicles in 2029. With the Proposal, the crash rate on the Cambridge Avenue is forecast to increase to approximately 5.3 crashes per year.

Parking provisions

The Roads and Maritime key reference document for guidance on traffic generation and parking provision is the *Guide to Traffic Generating Development (RTA, 2002)*. The Guide makes no specific requirement for minimum parking numbers required for intermodal terminals, in which this warehousing could be included.

For warehouses, it states that “all new warehouses on undeveloped sites must provide on-site parking for all vehicles used by employees. In the case of wholly redeveloped sites each site is treated on its merit.”

For warehouse and office land uses, Roads and Maritime recommends the following car parking provision:

- 1 car space per 300 m^2 Gross Floor Area (GFA) for warehouses
- 1 car space per 40 m^2 GFA for offices/commercial
- 1 car space per 20 m^2 GFA for retail

Based on the Roads and Maritime parking standards and the proposed warehouse, and office gross floor areas (GFAs) for the Proposal, a total of 1,474 car parking spaces is proposed. A detailed breakdown of parking spaces according to warehouse is provided in Section 4.2 of this EIS.

Cyclist facilities

A review of the following relevant bicycle facilities guidelines attributed to similar types of development has been undertaken:

- Liverpool City Council DCP 2008, Part 1, General Controls for All Developments
- *City of Sydney Section 3 - General Provisions*
- DIPNR (referred to currently as the Department of Planning and Environment) *Planning Guidelines for Walking and Cycling 2004*

The Liverpool DCP was considered, however this did not break down controls into individual land uses and used a generalised approach, which is not considered suitable for this type of development.

The *City of Sydney Section 3 – General Provisions* was considered a suitable guideline in that it specified bicycle provisions for individual land uses, similar types of development and providing a standard which is mid-range (i.e. did not over or under provide). The *City of Sydney Section 3 – General Provisions* stipulates the following on-site bike parking rates for Industry or Warehouse/Distribution Centres:

- 1 bicycle rack per 10 staff/employees
- 1 personal locker for each bike parking space
- 1 shower and change cubicle for up to 10 bike parking spaces
- 2 shower and change cubicles for 11 to 20 or more bike parking spaces are provided
- 2 additional showers and cubicles for each additional 20 bike parking spaces or part thereof.

Based on the proposed warehouse and office GFAs for the Proposal, an indicative total of 47 bicycle parking spaces, 47 lockers and 5 shower/change cubicles are proposed to be included in the Proposal. Notwithstanding this, the specific number would be confirmed as part of detail design for the Proposal in accordance with the *City of Sydney Section 3 – General Provisions*.

7.5 Mitigation Measures

7.5.1 Construction

A Construction Traffic Management Plan (CTMP) would be prepared, based on the PCTMP prepared as part of this EIS (refer to Appendix K of this EIS). The CTMP would be implemented by the construction contractor for the duration of construction and would detail the management controls to be implemented to avoid, minimise and mitigate impacts of construction of the Proposal to traffic performance on the surrounding road network, pedestrian and cyclist access, and the amenity of the surrounding environment. The CTMP would include the following key initiatives:

- Review of speed restrictions along Moorebank Avenue and additional signposting of speed limitations to reinforce reduced speed limits during construction of the Proposal
- Restriction of haulage routes through signage and education to ensure, where possible, that construction vehicles do not travel through nearby residential areas to access the Proposal site, in particular Moorebank (Anzac Road) or the Wattle Grove residential areas

- Inform local residents (in conjunction with the Community Information and Awareness Strategy) of the proposed construction activities and road access restrictions that the construction traffic must adhere to and establish communication protocols for community feedback on issues relating to construction vehicle driver behaviour and construction related matters
- Installation of specific warning signs on approach to, and at entrances to, the construction site to warn existing road users of entering and exiting construction traffic
- Establishing pedestrian exclusion zones and walking routes/crossing points which integrate within the existing pedestrian network
- Distribution of day warning notices to advise local road users of scheduled construction activities and associated traffic movements.
- Installation of appropriate traffic controls and warning signs for areas identified where potential safety risk issues exist
- The promotion of car-pooling for construction staff and other shared transport initiatives during the construction phase
- Management and coordination of the transportation of materials to maximise vehicle loads and therefore minimise vehicle movements
- Monitoring of traffic on Moorebank Avenue during peak periods to ensure that queuing at intersections does not impact on other road users

Reducing, where reasonable and feasible, the volumes of construction vehicles travelling during peak periods, especially if the increase in traffic generated by construction activities impedes on the operation of Moorebank Avenue

A road Safety Audit on Cambridge Avenue is to be undertaken prior to the commencement of the Proposal Works period to identify the traffic safety risks and determine appropriate mitigations.

7.5.2 Operation

Moorebank Avenue would be upgraded for approximately 1.4 kilometres from approximately 95 metres south of the northern boundary of the MPE site to approximately 120 metres south of the southern MPE site boundary. The following intersections would also be upgraded as part of the Proposal:

- Moorebank Avenue / MPE Stage 2
- Moorebank Avenue / MPE Stage 1 northern access
- Moorebank Avenue / MPE Stage 1 central access
- Moorebank Avenue / MPE Stage 1 southern emergency access.

The funding of these upgrades would be clarified through discussions with SIMTA, Roads and Maritime and Transport for NSW (refer to Section 19.2 for more information regarding developer contributions).

A POTMP has been prepared as part of this EIS (refer to Appendix K of this EIS). It is intended that the POTMP would be further progressed and integrated into the OEMP for the Proposal. Specifically, the following key aspects would be addressed in the OTMP:

- Heavy vehicle route management
- Safety and amenity of road users and public
- Congestion management on Moorebank Avenue
- Road user delay management
- Information signage, distance information and advance warning
- Driver code of conduct
- Incident management
- Traffic monitoring

The following mitigation measures are considered suitable to address provision of public transport and active transport facilities relating to the Proposal:

- Undertake consultation with relevant bus provider(s) regarding the potential to extend the 901 bus service and additional bus stops to ensure adequate accessibility to and within the Proposal site
- Consultation with TfNSW will be conducted regarding the provision for active transport to and from the Proposal site and along the internal road network road, as part of detailed design for the Proposal.
- Bicycle and end of trip facilities would be provided in accordance with the *City of Sydney Section 3 – General Provisions.*

7.6 Assumed Network Upgrades

A summary of the intersections which would operate at a level of service which is unsatisfactory without the Proposal are provided in Table 7-24. As these intersection perform at an acceptable level of service with the Proposal traffic, and are only unsatisfactory as a result of either the growth in background traffic or the cumulative traffic (refer to section 19 of this EIS), these upgrades have been assumed for the purpose of the Proposal's Transport and Traffic Impact Assessment. These are presented as assumed road network upgrades, however they are not nominated for delivery for the Proposal

Table 7-24 Assumed Road Network Upgrades and Timing

ID	Intersection	Recommended Network Improvements to Mitigate Background and Cumulative Traffic	Indicative Timing
I-1	Moorebank Avenue / Anzac Road	1. Upgrade Moorebank Avenue/ Anzac Road signalised intersection to include lane capacity improvements on the northern and southern approaches. The current configuration on Anzac Road (eastern approach) would be retained. 2. Implement vehicle actuated signals 3. Upgraded intersection to comply with relevant RMS design standards	2019

ID	Intersection	Recommended Network Improvements to Mitigate Background and Cumulative Traffic	Indicative Timing
I-2	M5 Motorway / Moorebank Avenue	1. Provide additional capacity on M5 westbound on-ramp. 2. Provide additional capacity on M5 eastbound off-ramp 3. Increase the storage lengths of the existing (two-lane) right turn bay on Moorebank Avenue northern approach 4. Widen Moorebank Avenue to four lanes between the M5 Motorway/Moorebank Avenue intersection and Moorebank Avenue/Anzac Road intersection 5. Change the signal to vehicle actuated to improve west and north approaches 6. Upgraded intersection to comply with relevant RMS design standards	Staged upgrading starting in 2019
I-3	M5 Motorway / Hume Highway	Change the signal to vehicle actuation in the PM peak to improve traffic signal operations	2019
I-4	Moorebank Avenue / Newbridge Road	1. Add an additional right turn lane from Moorebank Avenue south approach and change the signal to vehicle actuation in the PM peak to improve traffic signal operations. 2. Upgraded intersection to comply with relevant RMS design standards	2019
I-5	Moorebank Avenue / Heathcote Road	1. Extend right turn lane from Moorebank Avenue south approach and change the signal to vehicle actuation in the PM peak to improve traffic signal operations. 2. Upgraded intersection to comply with relevant RMS design standards	2019
I-6	M5 Motorway / Heathcote Road	Change the signal to vehicle actuated in PM peak to improve traffic signal operations.	2019

8 NOISE AND VIBRATION

Wilkinson Murray have undertaken an assessment of the noise and vibration impacts associated with the construction and operation of the Proposal. The Noise and Vibration Impact Assessment for the Proposal is provided in Appendix L of this EIS. Table 8-1 provides a summary of the relevant SEARs which relate to noise and vibration, and where these have been assessed in this EIS.

Table 8-1 SEARs (Noise and Vibration)

SEARs	Where addressed
5. Noise and Vibration	
An updated assessment of the noise and vibration impacts. The assessment shall:	
a) Assess construction noise and vibration impacts associated with the construction of the proposal, including impacts from construction traffic and ancillary facilities. The assessment shall identify sensitive receivers and assess construction noise/vibration generated by representative construction scenarios focusing on high noise generating works. Where work hours outside of standard construction hours are proposed, clear justification and detailed assessment of these work hours must be provided, including alternatives considered, mitigation measures proposed and details of construction practices, work methods, compound design, etc	Section 8.3 and 8.4
b) Assess operational noise and vibration impacts and identify feasible and reasonable measures proposed to be implemented to minimise operational noise impacts of the intermodal facility and rail link, including the preparation of an Operational Noise Management and Monitoring Plan	Section 8.4 and 8.5
c) Be prepared in accordance with: NSW Industrial Noise Policy (EPA 2000), Interim Construction Noise Guideline (DECC 2009), Assessing Vibration: a technical guide (DEC 2006), the Rail Infrastructure Noise Guideline (EPA 2013), Development Near Rail Corridors and Busy Roads Interim Guideline (DoP 2008), and the NSW Road Noise Policy 2011.	Section 8.2

The Concept Plan Conditions of Approval are generally consistent with the SEARs provided for the Proposal as they relate to traffic and transport (refer to Table 8-1) and have been addressed in this Section of the EIS. The compliance of the Proposal with the SEARs, Concept Plan Conditions of Approval and Statement of Commitments is provided at Appendix A of this EIS.

This Section summarises the studies undertaken for the MPE Concept Plan Approval (section 8.1) and, more recently, for the Proposal. This section of the EIS also summarises the methodology used to assess noise and vibration-related impacts of the Proposal (section 8.2), describes the existing environment as it relates to noise and vibration (section 8.3) and provides an assessment of noise and vibration impacts associated with construction and operation of the Proposal (section 8.4). Measures to mitigate the potential noise and vibration impacts of the Proposal, where they are required have been identified in Section 8.5.

8.1 Concept Plan Assessment

A Noise and Vibration Impact Assessment was undertaken by Wilkinson Murray (2013) as part of the EA for MPE Concept Plan Approval. The assessment identified the following key characteristics relating to the existing noise environment at the MPE site and within the surrounding area:

- The following residential receiver noise catchments were identified:
  - R1 – 500m to the east in Wattle Grove
  - R2 – 500m to the north in Moorebank
  - R3 – 900m to the west in Casula
  - R4 – 1,600m to the south west in Glenfield.
- A number of non-residential sensitive receivers were also identified, being:
  - All Saints Senior College
  - Casula Powerhouse
  - DNSDC Re-location Site.

Figure 8-1 shows the location of the sensitive receivers identified in the Concept Plan.

The Noise and Vibration Impact Assessment included two rounds of unattended noise monitoring, between Tuesday 31 July and Wednesday 8 August 2012; and between Wednesday 15 May and Wednesday 22 May 2013, to establish background noise management levels (NMLs) at the residential receivers located in catchments R1-R4 in the above figure. Noise modelling was undertaken to determine the potential construction and operational noise impacts associated with the MPE Project against the following criteria:

- Operational Noise Criteria using the 'intrusiveness' and 'amenity' criteria from the *NSW Industrial Noise Policy* (INP) (Environment Protection Authority 2000)
- Sleep disturbance criteria, using the EPA's *Noise Guide for Local Government (NGLG)*
- Road traffic noise criteria, using the EPA's *NSW Road Noise Policy (RNP)*
- Rail traffic noise criteria were established using the EPA's *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* and *Rail Infrastructure Noise Guideline*. Sections of the rail link on private land were assessed against the criteria established under the INP for operational noise.
- Construction noise criteria from the EPA's *Interim Construction Noise Guidelines* (ICNG)
- Construction vibration criteria using the *EPA's Assessing Vibration: A Technical Guideline.*

During construction, noise levels were predicted to meet the established noise management levels (NMLs), except for at some residences within the R3 catchment (i.e. Casula) where exceedances of up to 9 dBA above the NML were predicted during the construction of the rail link.

A conservative approach to noise modelling was taken using the worst case operational scenario with the facility operating at peak throughput and compared to the intrusiveness and amenity criteria established in accordance with the INP. With the exception of residential receivers in the R3 catchment (i.e. in Casula), the noise modelling showed that operational noise was expected to comply with all relevant noise criteria at nearby receivers.

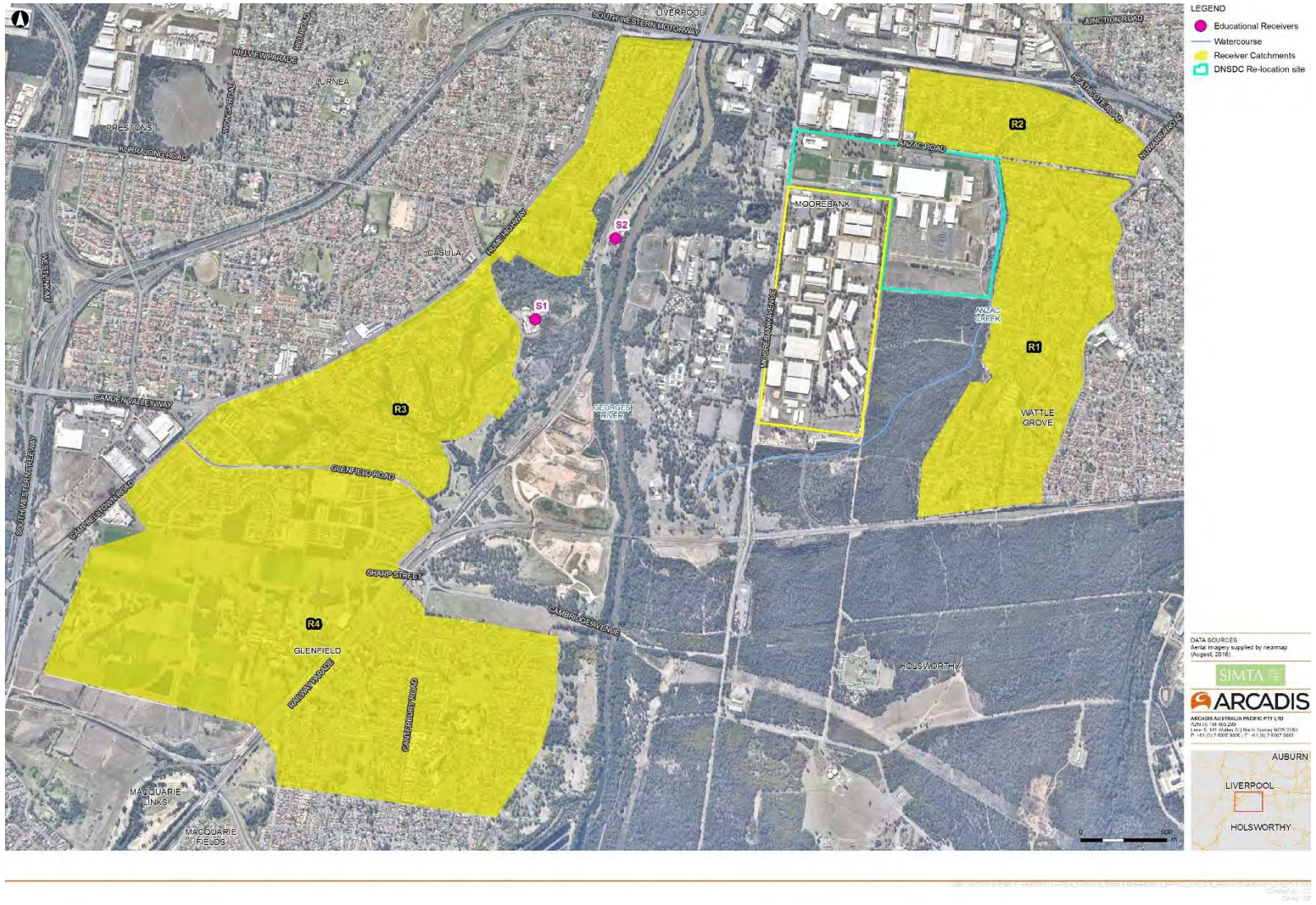

Figure 8-1 Sensitive receivers surrounding the MPE Site, Concept Plan Assessment (Wilkinson Murray, 2013)

The INP criteria was expected to be exceeded by 4dB(A) in the R3 catchment when the MPE project is operating at an annual throughput of 1,000,000 TEU with a total warehousing GFA of 300,000 m2. Analysis of the modelling results indicated that operation of trucks within MPE is the major contributor to the noise levels in the R3 catchment. Subsequent modelling with a noise barrier in place along the western boundary of the site was shown to reduce operational noise levels by 4dB(A) within the R3 catchment and hence to a compliant level with the INP criteria. This subsequent modelling was a result of the MPW Project not being considered in the MPE Concept Plan modelling as there was no publicly available information on the MPW Project at the time, so the area immediately to the west of the MPE site was assumed to be in its current form, which would have provided less sound attenuation. Since then further information has become available regarding the MPW Project, which has been considered in this assessment.

Overall, subject to the appropriate mitigation measures being employed, the MPE Project was expected to comply with all relevant noise criteria during operation.

An assessment of plant sound power levels anticipated during construction of the Proposal showed that noise levels were predicted to meet the established noise management levels. Construction vibration criteria was also predicted to be met given the distance of sensitive receivers from the Proposal site.

As a result of the noise and vibration impact assessment undertaken for the MPE Concept Plan, the following recommendations, applicable to noise and vibration impact assessment for the Concept Proposal, were included in the Revised Statement of Commitments for the MPE Concept Plan:

- *The Proponent will undertake further detailed assessments at each application stage after the MPE Concept Plan Approval to provide input to planning and confirm the need for a degree of noise mitigation required. This should be undertaken based on the most detailed information available at that stage of works. These subsequent assessments should address the DGR requirements for the MPE proposal as a minimum*
- *The Proponent will carry out detailed assessments when the MPE proposal is operation, including monitoring of operational noise levels at nearby receivers. The monitoring data should be used to validate noise models used in these assessments*
- *The Proponent shall consider locating buildings at or near the north-eastern and south-eastern boundaries of the site provide beneficial acoustic shielding to the nearest residences*
- *The Proponent shall consider locating less noise-intensive activities and operations at the north-eastern and south-eastern corners of the site where residences are closest*
- *The Proponent shall make provision for a noise barrier along the western boundary of the MPE site. The requirement for the barrier will be determined having regard to the outcomes of the operational noise monitoring*
- *The Proponent will carry out detailed assessments for the subsequent application stages and when the MPE proposal is operational, including monitoring of background noise levels at nearby receivers. The monitoring data should be used to validate noise models used in these assessments. The subsequent assessments should address the environmental assessment requirements, as determined by the approval authority, as a minimum*

- *Prior to undertaking demolition and construction on site, a Construction Noise and Vibration Management Plan should be prepared based on details of the proposed construction methodology, activities and equipment. This should identify potential noise and vibration impacts and reasonable and feasible noise mitigation measures (such as those identified in this report) that may be implemented to minimise any potential impacts, including engineering and management controls*
- *All construction activities will have regard to the standard hours of 7:00am to 6:00pm Monday to Friday and 8:00am to 1:00pm Saturday (with approval from relevant authorities). Any works undertaken outside of these hours will be undertaken in consultation with relevant authorities. Works outside these hours that may be permitted will include:*
  - *Any works which do not cause noise emissions to be audible at any nearby sensitive receptors*
  - *The delivery of materials which is required outside of these hours as requested by Police or other authorities for safety reasons. Local residents, commercial and industrial premises will be informed of the timing and duration of approved works in accordance with the notification provisions outlined in the CNMP*
  - *Emergency works to avoid the loss of lives, property and/or to prevent environmental harm*
  - *Any other work as approved through the CNMP process.*

8.2 Methodology

8.2.1 Assessment methods

Investigations were carried out by Wilkinson Murray (2016) to assess noise and vibration impacts associated with construction and operation of the Proposal, including impacts from associated traffic and ancillary facilities, in accordance with relevant guidelines, criteria, policies and best practice. The assessment identified sensitive receivers in the vicinity of the Proposal site along with existing ambient noise levels.

A construction and operational description of the Proposal, consistent with Section 4 of this EIS, was used to inform noise modelling for this assessment.

The CadnaA acoustic noise prediction model software was used to model construction noise impacts. Sound power levels were then compared against the NMLs derived from the Rating Background Levels (RBLs) and criteria set out under the NSW EPA Interim Construction Noise Guideline (DECC, 2009) (ICNG).

Operational noise impacts were assessed by firstly predicting noise impacts associated with dominant noise sources associated with the operation of the Proposal, and by developing 'worst case' operational scenarios. These scenarios were used to describe amenity and intrusive noise impacts, expressed as $LA_{eq,\ period}$ and $LA_{eq,\ 15\ min}$ respectively, and were modelled to predict the noise impacts to selected receivers. The CadnaA V4.6 acoustic noise prediction software and the CONCAWE noise prediction algorithm were used to model and predict the operational noise impacts. Sleep disturbance noise impacts were similarly assessed using 'worst case' scenarios for both adverse and calm meteorological conditions, and compared against relevant criteria.

Noise impacts associated with road traffic were assessed using available traffic data according to vehicle type and period of the day for the most affected residential receivers. The predicted increase in traffic noise was quantified using the *Calculation of Road Traffic Noise* (CORTN) algorithm.

8.2.2 Noise and Vibration Criteria

Noise and vibration criteria for the MPE site was previously presented in the MPE Concept Plan EIS. These criteria were subsequently reviewed and accepted by relevant regulatory and approval authorities, and have been retained as detailed in the following sections.

Construction noise criteria

The NSW EPA's Interim Construction Noise Guideline recommends NMLs to reduce the likelihood of noise impacts arising from construction activities. The ICNG NML for sensitive receivers are shown in Table 8-2.

Table 8-2 Construction Noise Management Levels

Time of Day	Management Level $L_{Aeq,15min}$ (dBA)	How to Apply
Recommended Standard Hours: • 7 am to 6 pm Monday to Friday • 8 am to 1 pm Saturdays • No work on Sundays or Public Holidays	Noise affected (RBL + 10dBA)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq,(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected (75dBA)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.
Outside recommended standard hours (as described above)	Noise affected (RBL + 5 dB)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.

Based on the RBL presented in Table 8-11, the NML for sensitive receivers for standard working hours are presented in Table 8-3, along with NMLs for the following out of hours work periods:

- Out of hours period 1: 6:00 am – 7:00 am weekdays
- Out of hours period 2: 6:00 pm – 10:00 pm weekdays
- Out of hours period 3: 7:00 am – 8:00 am Saturday
- Out of hours period 4: 1:00 pm – 6:00 pm Saturday.

Table 8-3 Construction Noise Management Levels by works period

Receiver	Noise Management Levels				
	Standard Hours	Out of hours period 1	Out of hours period 2	Out of hours period 3	Out of hours period 4
Wattle Grove	52	42	42	47	47
Wattle Grove North	46	41	41	41	41
Casula	51	39	42	46	46
Glenfield	54	42	49	49	49
S1, S2	55	55	55	55	55
I1, I2, I3	75	75	75	75	75

Construction vibration criteria

Human comfort vibration criteria have been used to assess potential vibration impacts from the Proposal, as vibration levels with the potential to cause damage to structures are typically more than ten times greater than those creating human disturbance. It is noted that vibration intensive construction plant are anticipated to be operated intermittently, and not continuously during the Proposal's construction period.

'Preferred' and 'maximum' vibration levels for human comfort were selected from *Assessing Vibration: A Technical Guideline* (DEC, 2006), a publication based on British Standard BS6472:1992 for vibration. Criteria for intermittent vibration, which is caused by plant such as rock breakers, are expressed as a Vibration Dose Value (VDV) and are shown in Table 8-4.

Table 8-4 Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night Time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas	0.1	0.2	0.1	0.2
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.08	1.6	0.8	1.6

1. Daytime 7:00am–10:00pm; Night 10:00pm-7:00am.

Vibration intensive equipment is likely to be used during the proposed works periods A to F. However, as the distance from vibration intensive plant to the nearest residential receiver is considered to be large (approximately 500 m), ground vibration at surrounding residential receivers would be low.

Recommended safe working distances for vibration intensive plant suggested in the Transport Construction Authority's *Construction Noise Strategy* (2012) have been adopted in this assessment to evaluate the vibration impacts. Table 8-5 sets out the recommended safe working distances for various vibration intensive plant.

Table 8-5 Recommended Safe Working Distances for Vibration Intensive Plant

Item	Description	Safe Working Distance (m)	
		Cosmetic Damage	Human Response
Small Hydraulic Hammer	(300 kg – 5 to 12t excavator)	2	7
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7	23
Pile Boring	≤ 800 mm	2 (nominal)	N/A
Jackhammer	Hand held	1 (nominal)	Avoid contact with structure

Source: *Construction Noise Strategy* (Transportation Construction Authority, 2012)

A review of the information presented in Table 8-5 indicates that human comfort vibration impacts at surrounding residences would be negligible during construction activities. The nearest residential receiver is situated far enough for impacts to be minimal in all circumstances (approximately 500 m). Therefore, no further assessment of construction vibration is warranted.

Operational noise criteria

The *NSW Industrial Noise Policy* (INP) recommends two sets of criteria, 'intrusiveness' and 'amenity', for the assessment of operational noise. Intrusiveness criteria are only applied to residential receivers. The intrusiveness and amenity criteria established for sensitive receivers near the Proposal are presented in Table 8-6 and Table 8-7 respectively.

Table 8-6 Operational Noise Criteria – Intrusiveness

Receiver	Intrusiveness Criteria ($L_{Aeq, 15min}$)		
	Daytime[1]	Evening[1]	Night Time[1]
Wattle Grove	47	42	42
Wattle Grove North	41	41	41
Casula	46	42	39
Glenfield	49	49	42

1. Daytime 7:00am–6:00pm; Evening 6:00pm–10:00pm; Night 10:00pm-7:00am.

The INP amenity criterion for educational facilities is an internal $L_{Aeq, 1hour}$ noise level of 35 dBA. For the purposes of assessment, this criterion has been converted to an equivalent external $L_{Aeq, 1hour}$ noise level. It can be conservatively assumed that the attenuation of noise from outside to inside, via partially open windows, is 10 dB. Therefore, the equivalent external amenity criterion for educational facilities is 45 dBA.

Table 8-7 Operational Noise Criteria – Amenity

Receiver	Indicative Noise Amenity Area	Time Period[1]	Amenity Criteria ($L_{Aeq, period}$)
Wattle Grove, Casula, Glenfield	Residential Suburban	Daytime	55
		Evening	45
		Night Time	40
Wattle Grove North	Residential Urban	Daytime	60
		Evening	50
		Night Time	45
S1, S2	School/Classroom	Noisiest 1-hour period (when in use)	35 (internal) (45 external)
I1, I2, I3	Industrial	When in use	70

1. Daytime 7:00am–6:00pm; Evening 6:00pm–10:00pm; Night 10:00pm-7:00am.

Sleep disturbance screening levels

Screening levels for maximum operational noise levels during the night time period (10:00pm – 7:00am) were established in accordance with the INP and are presented in Table 8-8.

Table 8-8 Sleep Disturbance Screening Levels

Catchment	Sleep Disturbance Screening Level ($L_{A,1min}$ / L_{Amax})
Wattle Grove	52
Wattle Grove North	51
Casula	49
Glenfield	52

Road noise criteria

Applicable noise criteria for proposals which have the potential to indefinitely increased traffic on roads are presented in the RNP.

The Proposal will generate additional traffic along the M5 Motorway west of Moorebank Avenue, along Moorebank Avenue from the Proposal site northwards and minor additional traffic along Anzac Road to the Yulong industrial estate (refer to Section 7 of this EIS). According to the RNP, the M5 Motorway is classified as a Freeway, while Moorebank Avenue and Anzac Road are classified as sub-arterial roads.

With regard to the permissible increase in road traffic noise from a land use development the, RNP states:

"*For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*"

The RNP assessment criteria for residential land uses are shown in Table 8-9.

Table 8-9 Road Noise Criteria

Road	Category	Assessment Criteria – dBA (external)	
		Day[1] ($L_{Aeq, 15\ hour}$)	Night[1] ($L_{Aeq, 9\ hour}$)
M5 Motorway	Freeway	60	55
Moorebank Avenue, Anzac Road	Arterial Road	60	55

1. Day – 7 am to 10 pm; Night – 10 pm to 7 am

8.3 Existing Environment

8.3.1 Sensitive receivers

Four residential receivers and five non-residential receivers (two educational and three industrial) were identified as the most potentially affected. These locations are summarised in Table 8-10 and shown in Figure 8-3.

Table 8-10 Sensitive receivers

Receiver / Suburb	Category	Distance to Proposal site (m)	
		Operational Area	Construction Area
Wattle Grove	Residential	390	390
Wattle Grove North		375	350
Casula		800	760
Glenfield		1,550	1,580
All Saints Senior College (S1)	Educational	1,220	1,250
Casula Powerhouse (S2)		850	890
MPW (I1)	Industrial	Boundary	Boundary
DJLU (I2)		Boundary	Boundary
ABB Site (I3)		475	495

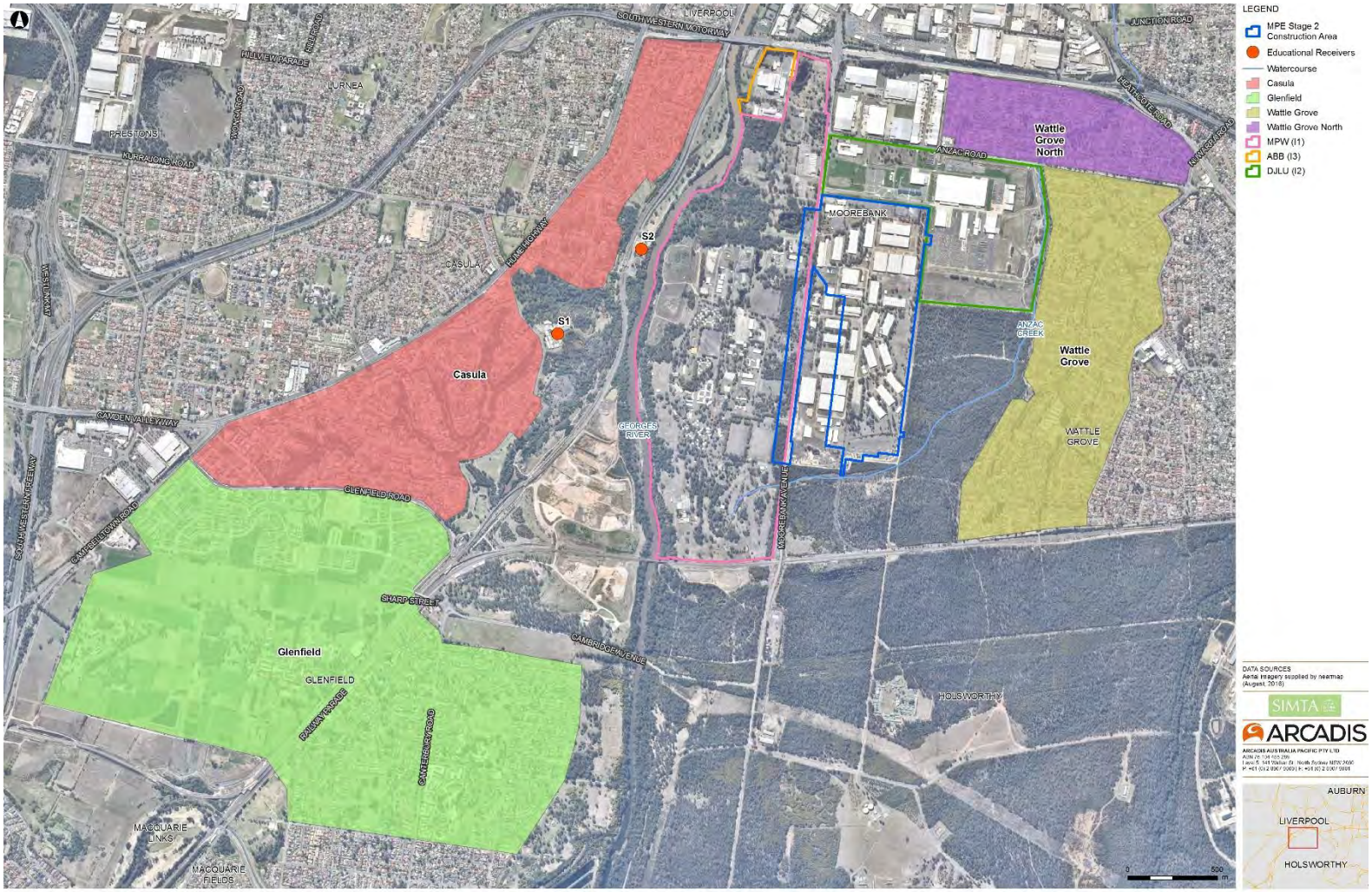

Figure 8-3 Sensitive receiver and noise monitoring locations in relation to Proposal site

8.3.2 Existing Ambient Noise Levels

The existing ambient noise environment at locations representative of the potentially most affected residential receivers in Casula, Glenfield and Wattle Grove were established through long-term background noise monitoring conducted in accordance with the INP. The existing ambient noise levels (the equivalent noise levels averaged over a time period [LAeq, period]), are presented in Table 8-11.

Table 8-11 Ambient existing noise levels at sensitive residential receivers

Suburb	Noise Levels (dBA)[1]		
	Day	Evening	Night
Casula	55	54	53
Glenfield	48	47	44
Wattle Grove	55	49	46

1. Daytime 7:00am–6:00pm; Evening 6:00pm–10:00pm; Night-time 10:00pm 7:00am.

8.3.3 Meteorological Environment

As discussed in Section 9.3.2, meteorological conditions at the Proposal site are subject to temperature inversions as a result of the predominance of stable meteorological conditions during the night time period.

In accordance with the INP, default parameters have been used in this assessment to include the effects of meteorological conditions that enhance noise levels. These parameters comprise an F-class temperature inversion during the night time period. As the potentially most affected receivers are located at heights similar to, or greater than the Proposal site, drainage winds are unlikely to occur with temperature inversions and as such have not been modelled.

There is potential for gradient winds to enhance noise levels at sensitive receivers, and such conditions have the potential to arise in any of the daytime, evening or night time periods. The default parameters for the assessment of gradient winds in accordance with the INP is a 3 m/s wind from source to receiver.

The CONCAWE noise propagation model divides the range of possible meteorological conditions into six separate “weather categories”, from Category 1 to Category 6. Weather Category 1 provides “best-case” (i.e. lowest noise level) weather conditions for the propagation of noise, whilst weather Category 6 provides “worst-case - Adverse Meteorological Conditions” (i.e. highest noise level), when source to receiver gradient winds exist and/or there are temperature inversions. For noise modelling purposes, consistent with the INP, typical daytime “calm meteorological conditions” were modelled using Category 4 and “adverse meteorological conditions” were modelled using worst-case Category 6.

8.4 Potential impacts

Noise modelling was undertaken to determine the level of impact associated with construction and operation of the Proposal on surrounding receivers, a detailed in Section 8.2.1, taking into consideration:

- Equipment noise level emissions and locations
- Shielding from structures
- Noise attenuation due to geometric spreading
- Meteorological effects (refer to comments above)
- Ground absorption
- Atmospheric absorption.

8.4.1 Construction

As discussed in Section 4, seven works periods have been identified for the construction of the Proposal, being:

- Works Period A – Pre-construction activities
- Works Period B – Site preparation activities
- Works Period C – Construction of the Moorebank Avenue diversion road
- Works Period D – Road and intersection works to facilitate the upgrade of Moorebank Avenue
- Works Period E – Bulk earthworks, drainage and utilities
- Works Period F – Construction and internal fit-out of warehousing
- Works Period G – Miscellaneous construction and finishing works.

A breakdown of the indicative sound power level (SWL) for each works period, comprising of indicative plant used is provided in Table 8-12.

Table 8-12 Indicative sound power levels per works period

Works Period	Equipment	Sound Power Level per Item (dBA) ($L_{Aeq, 15min}$)	Sound Power Level per Works Period (dBA) ($L_{Aeq, 15min}$)
A - Pre-construction activities	Static and vibratory rollers	109	117
	Mobile cranes	110	
	Excavators	110	
	20-40 tonne articulated tipper trucks	110	
	Graders	109	
	Water Trucks	105	
	Small earthmoving equipment	95	

Works Period	Equipment	Sound Power Level per Item (dBA) ($L_{Aeq, 15min}$)	Sound Power Level per Works Period (dBA) ($L_{Aeq, 15min}$)
B - Site Preparation	Loaders	112	126
	Static and vibratory rollers	109	
	Mobile cranes	110	
	Excavators	110	
	Excavators with hammers	122	
	Backhoes	105	
	Crushing plant	118	
	Concrete agitators (or similar)	105	
	Concrete pumps	103	
	Dozers	118	
	Mulchers	118	
	20-40 tonne articulated tipper trucks	110	
	Scrapers	110	
	Graders	109	
	Water Trucks	105	
C – Construction of the Moorebank Avenue diversion road	Static and vibratory rollers	109	122
	Excavators	110	
	Compactor	112	
	Dozers	118	
	Graders	109	
	Water Trucks	105	
	Road Profiler	116	
	Rubber Roller	108	
D – Road and intersection works to facilitate the Moorebank Avenue upgrade	Static and vibratory rollers	109	122
	Excavators	110	
	Compactor	112	
	Dozers	118	
	Graders	109	
	Water trucks	105	
	Road Profiler	116	
	Rubber Roller	108	

Works Period	Equipment	Sound Power Level per Item (dBA) ($L_{Aeq, 15min}$)	Sound Power Level per Works Period (dBA) ($L_{Aeq, 15min}$)
E – Bulk earthworks, drainage and utilities	Loaders	112	127
	Static and vibratory rollers	109	
	Mobile cranes	110	
	Excavators	110	
	Excavators with hammers	122	
	Backhoes	105	
	Crushing plant	118	
	Batching plant	113	
	Concrete agitator (or similar)	105	
	Concrete pumps	103	
	Concrete saws	112	
	Air compressors	100	
	Dozers	118	
	20-40 tonne articulated tipper trucks	110	
	Scrapers	110	
	Graders	109	
	Water trucks	105	
	Piling rigs	121	
	Forklifts	106	
	Small earthmoving equipment	95	
	Welder	90	
F – Construction and internal fit-out of warehousing	Loaders	112	124
	Static and vibratory rollers	109	
	Mobile cranes	110	
	Excavators	110	
	Backhoes	105	
	Batching plant	113	
	Concrete agitator (or similar)	105	
	Concrete pumps	103	
	Concrete saws	112	
	Air compressors	100	
	Jackhammers	113	
	Graders	109	
	Water trucks	105	
	Piling rigs	121	
	Forklifts	106	
	Small earthmoving equipment	95	
	Welder	90	

Works Period	Equipment	Sound Power Level per Item (dBA) ($L_{Aeq, 15min}$)	Sound Power Level per Works Period (dBA) ($L_{Aeq, 15min}$)
G - Miscellaneous construction and finishing works	Loaders	112	118
	Backhoes	105	
	Concrete agitator (or similar)	105	
	Concrete pumps	103	
	Concrete saws	112	
	Air compressors	100	
	Jackhammers	113	
	Water trucks	105	
	Forklifts	106	
	Small earthmoving equipment	95	
	Welder	90	

Predicted noise levels during standard working hours

Construction noise emissions were modelled for each of the identified construction works periods for both standard and out of hours works, which were then compared against the NMLs derived from the RBLs and criteria set out under the ICNG described in Section 8.2.2. The worst-case predicted $LA_{eq, 15\ min}$ construction noise levels at sensitive receivers during each key works period in conjunction with respective NMLs during standard work hours is provided in Table 8-13.

Results indicate that predicted $L_{Aeq, 15min}$ construction noise levels for the Proposal at all sites meet the NML for all construction works periods.

Table 8-13 Predicted construction noise levels during standard hours

Receiver	Construction Works Period							NML
	Pre-construction activities	Site preparation	Construction of the Moorebank Avenue diversion road	Road & intersection works for Moorebank Avenue upgrade	Bulk earthworks, drainage and utilities	Construction and internal fit-out of warehousing	Miscellaneous construction and finishing works	
Wattle Grove	39	48	38	38	49	46	41	52
Wattle Grove North	34	44	35	35	45	41	36	46
Casula	36	46	41	41	47	43	38	51
Glenfield	25	34	30	30	35	32	26	54
S1	34	43	39	39	44	41	35	55
S2	32	41	37	37	42	39	34	55
I1	61	71	66	66	72	68	63	75
I2	62	71	57	57	72	69	63	75
I3	40	50	41	41	51	47	42	75

Predicted noise levels during out of hours works

The assessment divided out of hours activities into two distinct groups, according to the type of construction activities expected to be conducted during the relevant out of hours period. The first group includes only out of hours period 1, which reflects the 6:00am – 7:00am timeslot on weekdays, and includes only materials delivery during the period. The second group comprises of out of hours period 2 (6:00pm – 10:00pm weekdays), out of hours period 3 (7:00am – 8:00am Saturday) and out of hours period 4 (1:00pm – 6:00pm Saturday), whereby materials delivery and direct placement or stockpiling of earthworks materials is expected to be undertaken. The following sub-sections outline construction predicted noise levels and exceedances against NMLs for each of these two groups of out of hours periods.

Out of hours period 1

For out of hours period 1, $L_{Aeq,\ 15min}$ noise levels at sensitive receivers were predicted with all plant operating simultaneously, with a modelled SWL of 117 dBA over the works area. The predicted levels are presented in Table 8-14. Results show that construction noise levels are not predicted to exceed the applicable NML at sensitive receivers during out of hours period 1.

Table 8-14 Predicted construction noise levels during out of hours period 1

Receiver	Predicted $L_{Aeq,\ 15min}$ Noise Level	NML	Exceedance
Wattle Grove	38	42	0 dB
Wattle Grove North	34	41	0 dB
Casula	36	39	0 dB
Glenfield	25	42	0 dB

Out of hours period 2, 3 and 4

For out of hours periods 2, 3 and 4, $L_{Aeq, 15min}$ noise levels at sensitive receivers were predicted with all plant operating simultaneously, with a modelled SWL of 122 dBA over the works area. Construction noise levels in Wattle Grove, Wattle Grove North and Casula are not predicted to exceed applicable NML at sensitive receivers during out of hours periods 2, 3 or 4. Predicted construction noise levels during out of hours periods 2, 3 & 4 are predicted to exceed the NML in Wattle Grove by up to 1 dBA. This exceedance is considered negligible, and does not warrant mitigation given the conservative nature of the assessment assuming that all plant would be operating simultaneously.

Table 8-15 Predicted construction noise levels during out of hours periods 2, 3 and 4

Receiver	Predicted $L_{Aeq, 15min}$ Noise Level	NML	Exceedance
Wattle Grove	43	42	1 dB
Wattle Grove North	39	41	0 dB
Casula	41	42	0 dB
Glenfield	30	49	0 dB

Road noise

During construction of the Proposal, all heavy vehicles, and the majority of light vehicles, would travel to and from the Proposal site via the M5 Motorway and Moorebank Avenue. In additionally, a small number of light vehicles would travel along Anzac Road, east of Moorebank Avenue, and along Moorebank Avenue, north of the M5 Motorway. No heavy vehicles, associated with the construction of the Proposal, would travel along Anzac Road, or along Moorebank Avenue, north of the M5 Motorway.

The existing and projected daily traffic volumes, and percentage heavy vehicles along the identified roads, for construction of the Proposal are presented in Table 8-16. It is not yet known whether heavy construction vehicles would travel to the site along the M5 Motorway from the east or the west. This would depend upon factors such as the construction contractor, and the source(s) of fill. Therefore, the projected construction traffic volumes along the M5 Motorway, presented in Table 8-16, are based on all heavy construction vehicles travelling along the M5 Motorway both east and west of Moorebank Avenue. Such a scenario would not eventuate in practice, and therefore, the assessment of construction traffic noise along the M5 Motorway is conservative.

Table 8-16 Comparison of existing traffic volumes and future construction traffic volumes, including proportion of heavy vehicles

Location	Time of day[1]	Existing (without the Proposal)		Future (with construction of the Proposal)	
		Total vehicles	Proportion of heavy vehicles	Total vehicles	Proportion of heavy vehicles
M5 Motorway – East of Moorebank Avenue	Day	106,344	9.7	107,370	10.5
	Night	21,060	13.2	21,201	13.5
M5 Motorway – West of Moorebank Avenue	Day	124,264	10.2	125,290	10.8
	Night	24,036	11.5	24,177	11.8
Moorebank Avenue – North of M5 Motorway	Day	26,892	10.0	26,953	10.0
	Night	6,308	10.0	6,345	9.9
Anzac Road – East of Moorebank Avenue	Day	8,991	4.6	9,018	4.6
	Night	2,109	4.6	2,125	4.6

1. Day = 7.00am – 10.00pm, Night = 10.00pm – 7.00am

Predicted increases in road noise due to construction of the Proposal are shown in Table 8-17. As shown in Table 8-17 increases to road noise levels along the M5 Motorway, Moorebank Avenue, and Anzac Road are considerably less than 2 dB. In accordance with the RNP, no mitigation of traffic noise levels, due to the construction of the Proposal, is warranted.

Table 8-17 Predicted increases in road noise levels during construction of the Proposal

Location	Predicted Increase in road noise(dBA) with construction of the Proposal[1]	
	Day	Night
M5 Motorway – East of Moorebank Avenue	0.1	0.0
M5 Motorway – West of Moorebank Avenue	0.2	0.1
Moorebank Avenue – North of M5 Motorway	0.0	0.1
Anzac Road – East of Moorebank Avenue	0.0	0.0

1. Day = 7.00am – 10.00pm, Night = 10.00pm – 7.00am

8.4.2 Operation

Noise shielding

Warehouses and other nearby buildings are likely to provide some noise attenuation by providing some shielding to sensitive receivers from the Proposal's noise emissions. The following noise shielding buildings and structures have been included in the operational noise model:

- Proposed warehouse buildings on the Proposal site
- Warehouse buildings on the MPW site
- Existing large buildings associated with ABB, DJLU and the industrial area to the north of the DJLU.

In addition to shielding from buildings, a noise wall, approximately 5 metres high, has been proposed to be established along the western operational boundary of the MPW Stage 2 site (SSD-7709). It should be noted that this noise wall has been proposed as a result of the noise modelling for the MPW Stage 2 Proposal to address noise emissions generated as a result of the MPW Stage 2 Proposal, and as such is not related to the MPE Project or MPE Stage 2 Proposal. This noise wall has been included in the operational noise model given the benefits in mitigating potential noise impacts from the Proposal on some sensitive receiver locations.

The location and extent of the noise wall, and the footprints of buildings included in the operational noise modelling are presented in Figure 8-4.

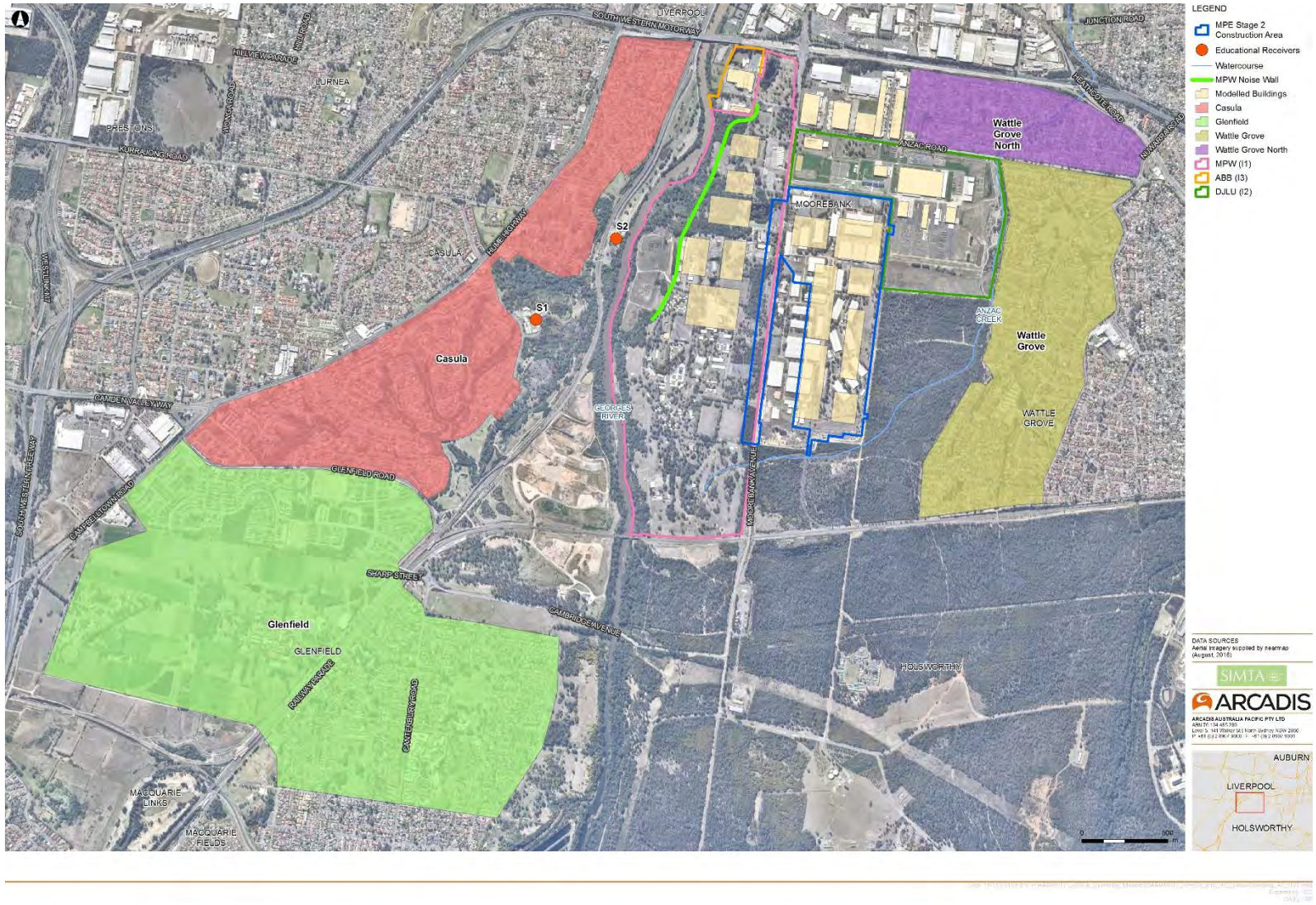

Figure 8-4 Noise shielding included in the noise model

The NVIA for the MPE Concept Plan Approval identified a potential requirement for the establishment of a noise wall along the western boundary of the MPE site. This was based on an intermodal throughput of 500,000 TEU, and the modelling at the time did not take into account any shielding from the large warehouses proposed to be established on the MPW site. It was recommended that future detailed assessments for MPE should investigate the need for such a noise wall, based on updated modelling. The detailed assessment for the Proposal has considered this requirement and the results are included in Section 8.4.

It should be noted that the proposed warehouse layout for the MPE Stage 2 site provides a significant amount of shielding to receivers located north and east of the Proposal from noise generating activities on the MPE Site, particularly those on the MPE Stage 1 site. The warehouse layout for the Proposal is considered an effective compromise between maximising the shielding of the warehouses and the efficiency of site operations.

In assessing potential operational noise impacts for the Proposal. A detailed noise model was developed, which included proposed operations on both the MPE and MPW sites; and, based on the model predictions it was determined that a noise wall is not required on the MPE site.

Operational Noise Sources and modelling scenarios

A ‘worst case scenario’ was developed to assess the amenity noise impacts associated with operation of the Proposal, which is expressed in $L_{Aeq\ period}$. A ‘worst case 15 minute scenario’, described in terms of $L_{Aeq15min,}$ was developed to assess the intrusive noise impacts of operation of the Proposal.

The dominant sources of noise associated with the operation of the Proposal comprise cars and trucks accessing the warehouses from outside the site, via the access roads, and a captive fleet of internal transfer trucks, used to transfer containers between the IMT and warehouses.

As discussed in Section 7, cars and trucks would enter the site throughout the day, bound for the warehouses. Approximately 1,936 cars (3,872 movements) and 282 trucks (564 movements) would enter the site each day. A worst case scenario of truck and car movements during the daytime, evening and night time have been modelled, based on distribution data.

Table 8-17 shows the main noise sources that would be operating on the Proposal during operational activities.

Table 8-18: Operational sound power levels

Source	Sound Power Level at Octave Band Centre Frequency									Overall SWL (dBA)
	31.5	63	125	250	500	1k	2k	4k	8k	
Car – 40 km/h	98	102	93	87	88	87	83	74	64	91
Truck – Idling	98	97	94	91	90	91	88	80	72	95
Truck – 10 km/h	100	103	101	99	98	99	96	90	79	103
Truck – 40 km/h	91	101	103	104	103	101	98	94	86	106

Regarding sleep disturbance, transient noise events with the potential to create sleep disturbance during operations include vehicle horns, tonal reversing alarms, pneumatic trailer brakes, and ’banging’ noises associated with moving containers.

Modelled outcomes

The predicted $L_{Aeq, period}$ and $L_{Aeq, 15min}$ operational noise levels at nearby sensitive receivers are presented below in Table 8-19 and Table 8-20 respectively, alongside relevant criteria recommended by the INP (refer section 8.2.2). Noise levels are presented for calm isothermal conditions and meteorological conditions that enhance noise levels.

As shown in Table 8-19 and Table 8-20 the operation of the Proposal as modelled under the assumptions listed above (indicating a worst case scenario) is not expected to result in any exceedance to either the amenity or intrusive noise criteria.

Regarding operational noise levels on sleep disturbance, the loudest L_{Amax} noise source with potential to cause sleep disturbance impacts is pneumatic trailer brakes on trucks. The L_{Amax} SWL of a truck trailer brake is up to 122 dBA. It should be noted that this is significantly louder than a tonal reversing alarm.

Table 8-19 Predicted amenity $L_{Aeq, period}$ operational noise levels

Receiver	Predicted $L_{Aeq, period}$ Noise Level (dBA)				Criteria (dBA)			Exceedance
	Day[1]	Evening[1]	Night[1]		Day[1]	Evening[1]	Night[1]	
			Calm[2]	Adverse[3]				
Wattle Grove	25	25	20	23	55	45	40	0 dB
Wattle Grove North	<20	<20	<20	<20	60	50	45	0 dB
Casula	21	21	<20	<20	55	45	40	0 dB
Glenfield	<20	<20	<20	<20	55	45	40	0 dB
S1	<20	<20	<20	<20	45 (external, when in use)			0 dB
S2	<20	<20	<20	<20	45 (external, when in use)			0 dB
I1 (MPW)	49	49	43	43	70 (external, when in use)			0 dB
I2 (DJLU)	44	44	37	38	70 (external, when in use)			0 dB
I3 (ABB)	26	26	20	24	70 (external, when in use)			0 dB

1. Daytime = 7:00am–6:00pm; Evening = 6:00pm – 10:00pm; Night = 10:00pm 7:00am.
2. CONCAWE Category 4
3. CONCAWE Category 6

Table 8-20 Predicted intrusive $LA_{eq,\ 15min}$ operational noise levels

Receiver	Predicted $L_{Aeq,15min}$ Noise Level (dBA)				Criteria (dBA)			Exceedance
	Day[1]	Evening[1]	Night[1]		Day[1]	Evening[1]	Night[1]	
			Calm[2]	Adverse[3]				
Wattle Grove	26	26	24	28	47	42	42	0 dB
Wattle Grove North	<20	<20	<20	20	41	41	41	0 dB
Casula	22	22	20	25	46	42	39	0 dB
Glenfield	<20	<20	<20	<20	49	49	42	0 dB

1. Daytime = 7:00am–6:00pm; Evening = 6:00pm – 10:00pm; Night = 10:00pm 7:00am.
2. CONCAWE Category 4.
3. CONCAWE Category 6.

The predicted L_{Amax} noise levels at nearby receivers due to pneumatic trailer brakes is shown in Table 8-21.

Table 8-21 Predicted LA_{max} noise levels at sensitive receivers

Receiver	Predicted L_{Amax} Noise Level (dBA)		Sleep Disturbance Screening Level (dBA)	Exceedance
	Calm[1]	Adverse[2]		
Wattle Grove	50	53	52	1 dB
Wattle Grove North	32	34	51	0 dB
Casula	32	35	49	0 dB
Glenfield	22	26	52	0 dB

1. CONCAWE Category 4.
2. CONCAWE Category 6.

This indicates that the predicted L_{Amax} noise levels comply with the established sleep disturbance screening criteria for receiver locations at Wattle Grove North, Casula and Glenfield, and no further assessment of sleep disturbance is warranted in these catchments.

The predicted L_{Amax} noise levels at the most affected receivers in Wattle Grove are predicted to exceed the established screening criterion by 1 dB, under adverse meteorological conditions only. However, a 1 dB exceedance is considered negligible and therefore does not require mitigation.

Road Noise

The most affected residential receivers to potential increases in road noise resulting from the Proposal operations are those situated immediately adjacent to the M5 Motorway, on Moorebank Avenue north of the M5 Interchange, and on Anzac Road east of Moorebank Avenue. No sensitive receivers are identified along Moorebank Avenue between the Proposal site and the M5 Interchange.

The section of Moorebank Avenue proposed to be upgraded is located between the MPE and MPW sites. No sensitive receivers are located adjacent to the section of Moorebank Avenue proposed to be upgraded. Therefore, the proposed upgrade of the section of Moorebank Avenue is unlikely to affect road noise levels at sensitive receivers.

For the purposes of the noise impact assessment, existing traffic volumes along Moorebank Avenue, Anzac Road and the M5 Motorway were allocated into ‘day’ and ‘night’ periods, along with the ‘mix’ of heavy vehicles expressed as a percentage. The current and predicted daily traffic volumes along the identified routes are shown in Table 8-22.

Table 8-22 Traffic distribution at locations considered representative of areas sensitive to road noise

Location	Time of day[2]	Existing (without the Proposal)		Future (with construction of the Proposal)	
		Total vehicles	Proportion of heavy vehicles (%)	Total vehicles	Proportion of heavy vehicles (%)
M5 Motorway – East of Moorebank Avenue	Day	106,344	9.7	107,195	9.7
	Night	21,060	13.2	21,148	13.2
M5 Motorway – West of Moorebank Avenue	Day	124,264	10.2	126,817	10.5
	Night	24,036	11.5	24,572	12.8
Moorebank Avenue – North of M5 Motorway	Day	26,892	10.0	27,813	10.5
	Night	6,308	10.0	6,496	11.6
Anzac Road – East of Moorebank Avenue	Day	8,991	4.6	9,294	4.4
	Night	2,109	4.6	2,212	4.4

Note: Day = 7.00am – 10.00pm, Night = 10.00pm – 7.00am

Predicted increases in road noise were calculated using the *Calculation of Road Traffic Noise* (CORTN) algorithm. Predicted increases at typical receivers with a 25 m setback along the M5 Motorway and a 12 m setback along Moorebank Avenue and Anzac Road are shown in Table 8-23.

Table 8-23 Predicted increases in road noise levels

Location	Predicted Increase (dBA)	
	Day[1]	Night[1]
M5 Motorway – East of Moorebank Avenue	0.0	0.0
M5 Motorway – West of Moorebank Avenue	0.2	0.3
Moorebank Avenue – North of M5 Motorway	0.3	0.5
Anzac Road – East of Moorebank Avenue	0.1	0.1

1. Day = 7.00am – 10.00pm, Night = 10.00pm – 7.00am

As shown in Table 8-23, increases to road noise as a result of the Proposal along the roads modelled are well below the 2 dBA noise goal outlined within the RNP (refer Section 8.2.2). As a result, the implementation of mitigation measures to avoid or minimise impacts to road noise is not considered necessary.

8.5 Mitigation measures

The above assessments of noise from the construction and operation of the Proposal indicate compliance with the established noise goals. Notwithstanding, the following sections present a range of mitigation and monitoring recommendations. These recommendations are largely considered standard practice for a development of this scale.

8.5.1 Construction

- A Construction Noise and Vibration Management Plan (CNVMP), or equivalent, would be prepared for the Proposal in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) (or equivalent), and will include the following:
  - Identification of nearby residences and other sensitive land uses
  - Description of approved hours of work
  - Description and identification of construction activities, including work areas, equipment and duration
  - Description of what work practices (generic and specific) will be applied to minimise noise and vibration
  - Consider the selection of plant and processes with reduced noise emissions
  - A complaints handling process
  - Noise and vibration monitoring procedures
  - Overview of community consultation required for identified high impact works
  - Induction and training will be provided to relevant staff and sub- contractors outlining their responsibilities with regard to noise
  - Procedure for approval of any works undertaken outside of the following hours:
  - Standard hours of construction would be 07:00 am to 18:00 pm Monday to Friday, and 08:00 am to 13:00 pm Saturdays
  - Out of hours period 1 is 6:00 am – 7:00 am weekdays; out of hours period 2 is 6:00 pm – 10:00 pm weekdays; out of hours period 3 is 7:00 am – 8:00 am Saturday; and out of hours period 4 is 1:00 pm – 6:00 pm Saturday.
- Any works undertaken outside of the hours prescribed in mitigation measure 2A would be undertaken in consultation with relevant authorities. Works outside these hours that may be permitted would include:
  - Any works which would not result in audible noise emissions at any nearby sensitive receptors.
  - The delivery of oversized plant and/or structures that police or other authorities determine require special arrangements to transport along public roads
  - Emergency work to avoid the loss of lives, property and/or to prevent environmental harm
  - Maintenance and repair of public infrastructure where disruption to essential services and/or consideration of worker safety do not allow work within standard construction hours.
  - Public infrastructure works that shorten the length of the project and are supported by noise-sensitive receivers.

  - Construction works where it can be demonstrated and justified that these works are required to be undertaken outside of standard construction hours.
  - Any other work as approved through the CNVMP.
- In the event of any noise or vibration related complaint or adverse comment from the community, noise and ground vibration levels (as relevant) would be investigated. Remedial action would be implemented where feasible and reasonable. The procedures for managing complaints would be provided within the Community Information and Awareness Strategy.

8.5.2 Operation

- An Operational Noise Management Plan (ONMP) would be prepared which includes a framework for regular monitoring of operational noise. Monitoring would begin at the commencement of the operation of the Proposal and would be conducted on an annual basis for up to 2 years (after commencement of operations of the Proposal).
- In the event of any noise or vibration related complaint or adverse comment from the community, noise and ground vibration levels (as relevant) would be investigated. Remedial action would be implemented where feasible and reasonable. The procedures for managing complaints would be provided within the Community Information and Awareness Strategy.

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9 AIR QUALITY

Ramboll Environ have undertaken an assessment of the air quality related impacts associated with the Proposal to address the SEARs. The *Air Quality Assessment* for the Proposal is provided in Appendix M of this EIS. Table 9-1 provides a summary of the relevant SEARs, which relate to Air Quality, and where these have been addressed in this EIS.

Table 9-1 SEARs (Air Quality)

SEARs		Where addressed
3. Air Quality		
A comprehensive air quality impact assessment including:		
a)	An assessment in accordance with the *Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales* (2005) (or its later version and updates)	Section 9.3 of this EIS
b)	An assessment of the construction related impacts including dust and wind erosion from exposed surfaces and proposed mitigation measures and safeguards to control dust generation and other airborne pollutants and to minimise impacts on nearby receptors	Section 9.3.1 of this EIS
c)	A review of direct and indirect greenhouse gas emissions arising from this development and associated impact mitigation requirements, in reference to the Concept Plan greenhouse assessment	Section 18 (Greenhouse Gas)

The Concept Plan Conditions of Approval are generally consistent with the SEARs provided for the Proposal as they relate to air quality (refer to Table 9-1) and have been addressed in this Section of the EIS. The compliance of the Proposal with the SEARs, Concept Plan Conditions of Approval and Statement of Commitments is provided at Appendix A of this EIS.

This Section summarises the studies undertaken for the MPE Concept Plan Approval (section 9.1) and, more recently, for the Proposal. This section of the EIS also summarises the methodology used to assess air quality-related impacts of the Proposal (section 9.2), describes the existing environment as it relates to air quality (section 9.3) and provides an assessment of air quality-related impacts associated with construction and operation of the Proposal (section 9.4). Measures to mitigate potential air quality impacts where they are required have been identified in Section 9.5.

9.1 Concept Plan Assessment

An Air Quality Impact Assessment (Pacific Environment, 2011) was prepared as part of the EA for MPE Concept Plan Approval, which takes into account all stages of the MPE Project. This assessment identified the following key characteristics relating to the existing air environment for the MPE Project and within the surrounding area:

- January is the warmest month, with a mean maximum of 28.1°C, while July is the coldest month with a mean maximum of 17.2°C
- Rainfall data from the Bankstown Airport shows that February is the wettest month of the year with 108.5mm on average, the annual average for the area is 869.3mm

- The annual average PM_{10} concentrations at Liverpool are consistently below the EPA's annual average PM_{10} criterion of 30µg/m^3
- Nitrogen dioxide (NO_2) data highlighted that for greater than 95% of the year the ambient concentrations are less than 20% of the air quality goal
- Carbon monoxide (CO) data showed that ambient concentrations are generally very low, and for the majority of the year (>90%) are less than 10% of the air quality goal
- The maximum 1-hour average ozone concentration was 0.15ppm and for the 4-hour averaging period the maximum concentration was 0.09ppm. Ozone concentrations display seasonal variations, with higher concentrations observed during the summer months.

A number of discrete residential sensitive receptors were identified in the Air Quality Impact Assessment as shown in Figure 9-1 and detailed in Table 9-2.

Table 9-2 Sensitive receptor locations

Receptor number	Description	Location
1	Residential area	Yallum Court, Wattle Grove
2	Commercial property	Corner of Anzac Road and Delfin Drive, Wattle Grove
3	Residential area	Martindale Court Wattle Grove,
4	Residential area	Goodenough Street, Glenfield
5	Residential area	Leacocks Lane, Casula
6	Residential area	Buckland Road, Casula
7	Residential area	Church Road, Moorebank

The Air Quality Impact Assessment provided a modelling scenario for the operation of the MPE Project. This was based on a conceptual busiest hour of operations for the MPE Project once operating at an annual throughput of one million TEU[1], Pollutant emissions from the following sources were estimated and used to predict the impacts from the operation of the MPE Project:

- Locomotives idling on-site during container unloading and loading
- Trucks travelling along Moorebank Avenue and moving and idling within the MPE site
- Container handling equipment (forklifts, gantry cranes) unloading/loading containers
- Forklifts operating within warehouse areas.

[1] Although this assessment was for one million TEU throughput the MPE Concept Plan Approval limited the MPE Project to movement of container freight by road to 500,000 TEU.

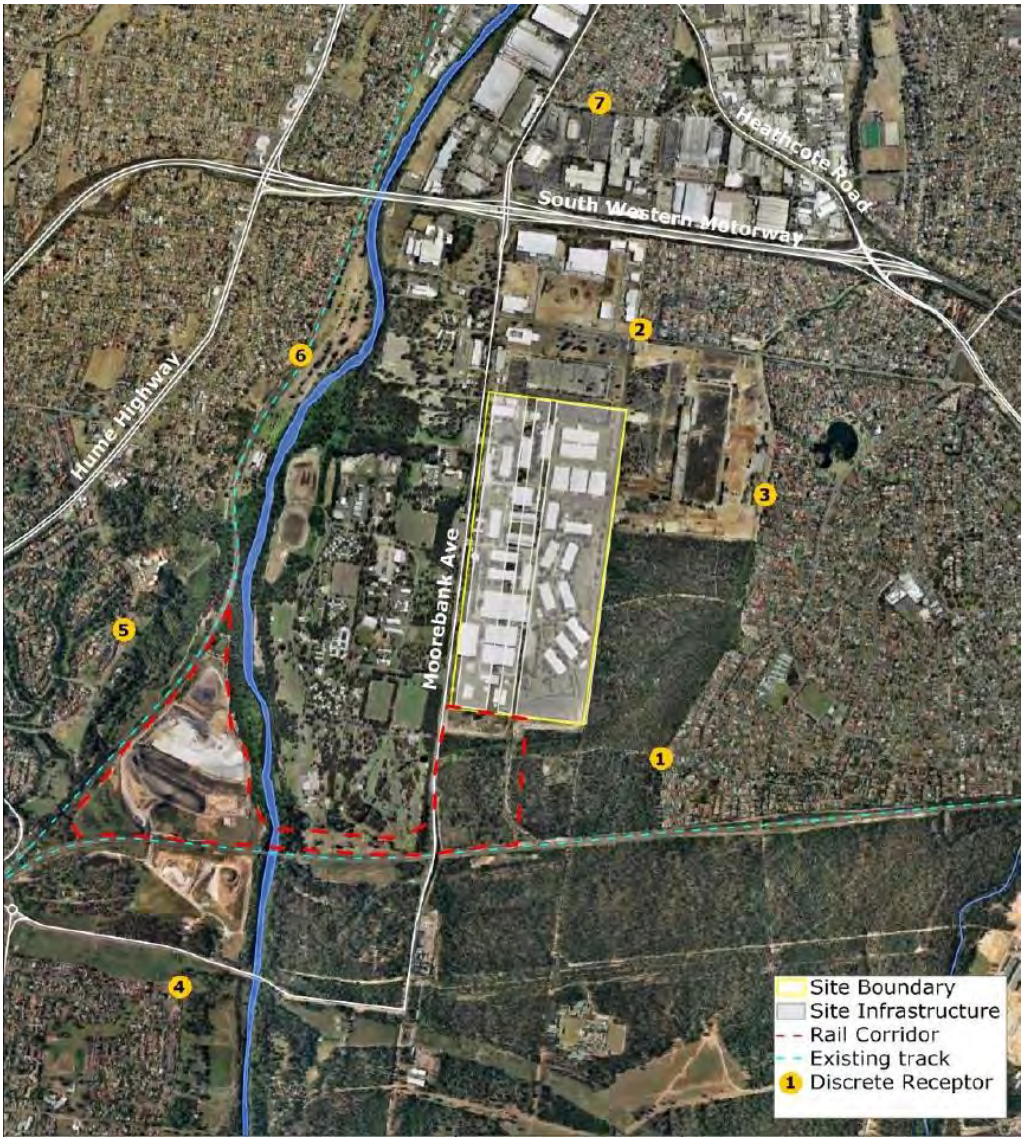

Figure 9-1 Air quality sensitive receivers identified in the Concept Plan EA (Air Quality Impact Assessment, Pacific Environment, 2011)

Dispersion modelling was undertaken using Ausplume to predict potential off-site impacts from the operation of the MPE Project. The results of the modelling indicated that operations for the MPE Project at maximum capacity (i.e. 1,000,000 TEU throughput) would not result in exceedances of the relevant impact assessment criteria for nitrogen dioxide, for all averaging periods and at all receptors.

Particulate Matter (PM) modelling predictions were made based on the maximum operating capacity of the MPE Project compared against air quality indicators for coarse particulate (PM_{10}) and fine particulate ($PM_{2.5}$). The modelling indicated that maximum predicted incremental 24-hour PM concentrations at sensitive receivers would be approximately 8 µg/m3, which equates to 16% of the impact assessment criteria for PM_{10} and 32% of the advisory reporting standard for $PM_{2.5}$.

Cumulative particulate matter concentrations for PM_{10} and $PM_{2.5}$ were modelled to determine the impact the MPE Project would have on air quality when combined with background levels. The analysis showed that the MPE Project would not result in any additional exceedances of the impact assessment criteria for PM_{10} or advisory reporting standards for $PM_{2.5}$.

Based on the recommendations of the Air Quality Impact Assessment, the Revised Statement of Commitments, included in the Response to Submissions for the Concept Plan (2014), committed the following actions applicable to the Proposal:

- *The Proponent will undertake an air quality monitoring programme during the initial phases of both construction and operation of the SIMTA site in accordance with the Air Quality Impact Assessment and include:*
  - *Nuisance Dust*
  - *Air emissions – PM_{10} and nitrogen dioxide*
- *The Proponent shall consider the need to develop a vehicle efficiency and emissions reduction program for the facility to encourage good maintenance and efficient vehicle selection, taking into account the result of the air quality monitoring programme*
- *The Proponent commits to the preparation of a Construction Environmental Management Plan prior to the construction of each stage to provide air quality and dust management/mitigation procedures to be adopted during each of the construction phases of the development*

9.2 Methodology

The NSW Environment Protection Authority (EPA) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales ("the approved methods")* (NSW EPA, 2005) outlines guidelines, reflective of Australian community standards, intended to protect the community against the adverse effects of air pollutants. Guidelines are largely derived from epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion (National Environment Protection Council (NEPC), 2003).

Localised air quality impacts as a result of the Proposal have been assessed using a Level 2 assessment approach in general accordance with the Approved Methods. An overview of the approach to the assessment is as follows:

- Emissions were estimated for Proposal related activities, using best practice emission estimation techniques
- Dispersion modelling was undertaken using a regulatory dispersion model to predict ground level concentrations for key pollutants as a result of the Proposal at nearby sensitive receivers
- Assessment of cumulative impacts, taking into account the combined effect of existing baseline air quality, other local sources of emissions, reasonably foreseeable future emissions and any indirect or induced effects on air quality.

9.2.1 Pollutant indicators

Key emissions considered for the construction of the Proposal are fugitive dust or particulate matter (PM) generated during demolition, site clearing and earthworks activities.

The key emissions considered during operations would be associated with the combustion of diesel and other fossil fuel. Indicators for each of these emissions sources are shown in Table 9-3.

Table 9-3 Air Quality indicators for assessment

Phase	Emission source	Air quality indicator
Construction	Fugitive dust	Particulate matter (TSP, PM_{10} and $PM_{2.5}$)
		Nuisance dust (dust deposition)
Operation	Diesel and fossil fuel combustion	PM_{10} and $PM_{2.5}$
		Oxides of nitrogen (NO_x)
		Sulphur dioxide (SO_2)
		Carbon monoxide (CO)
		Volatile organic compounds (VOCs)

9.2.2 Assessment criteria for particulate matter and dust

Under the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM), national reporting standards were initially prescribed for 24-hour average PM_{10} concentrations (National Environmental Protection Council (NEPC), 1998). The AAQ NEPM was revised in 2003 to include 'advisory reporting standards' for $PM_{2.5}$ (NEPC, 2003) and again in 2015 to adopt these 'advisory reporting standards' as formal standards for $PM_{2.5}$ (NEPC, 2015). The latest variation also introduces an annual reporting standard for PM_{10} and establishes long term goals for $PM_{2.5}$, to be achieved by 2025 (NEPC, 2015).

The purpose of the AAQ NEPM is to attain *'ambient air quality that allows for the adequate protection of human health and wellbeing',* and compliance is assessed through the collection and reporting of air quality monitoring data by each state and territory. These standards are therefore not necessarily applicable to the assessment of impacts of emissions sources on individual sensitive receptors and for the purpose of this report, impacts have been preferentially assessed against the NSW EPA's impact assessment criteria. In the case of $PM_{2.5}$, where impact assessment criteria do not exist, impacts are reported against the latest AAQ NEPM standards.

The NSW EPA's impact assessment criteria and AAQ NEPM national reporting standards for particulate matter, against which the potential impacts of the Proposal have been assessed, is provided below in Table 9-4.

Table 9-4 Impact assessment criteria and AAQ NEPM national reporting standards for PM

PM metric	Averaging period	Concentration ($\mu g/m^3$)	Purpose
TSP	Annual	90	NSW EPA impact assessment criteria
PM_{10}	24 hour	50	NSW EPA impact assessment criteria
		50	AAQ NEPM national reporting standard
	Annual	30	NSW EPA impact assessment criteria
		25	AAQ NEPM national reporting standard
$PM_{2.5}$	24 hour	25	AAQ NEPM national reporting standard
		20	AAQ NEPM national reporting standard
	Annual	8	AAQ NEPM goal for 2025
		7	AAQ NEPM goal for 2025

For the assessment of nuisance dust during construction, the NSW EPA impact assessment criteria for dust deposition were selected, reflecting the maximum acceptable increase and total dust deposition rates to minimise the impacts of construction dust on sensitive receivers as much as possible.

Cumulative annual average dust deposition rates within residential areas, which are in excess of 4 g/m^2/month are considered to constitute dust nuisance, reflected below in Table 9-5.

Table 9-5 Nuisance dust assessment criteria

Pollutant	Maximum Increase in Dust Deposition	Maximum Total Dust Deposition Level
Deposited dust	2 g/m^2/month	4 g/m^2/month

9.2.3 Assessment criteria of gaseous pollutants

Volatile Organic Compounds (VOC) Speciation

While many VOC species are emitted from combustion of fossil fuels, benzene, 1,3-butadiene and polycyclic aromatic hydrocarbons (PAHs) have been considered in this assessment as they are categorised in the Approved Methods as “principal toxic air pollutants” and are among the species with the most stringent impact assessment criteria (refer to Table 9-6).

Speciation profiles of individual VOCs used in the *NSW GMR emissions inventory* (2007) were used for the assessment. Emissions of benzene, 1,3-butadiene, and PAHs as a result of the Proposal have been derived based on the percentage of total VOCs for each species.

Table 9-6 Speciation profiles for VOCs

Source	Proportion of total VOC (%)		
	Benzene	1,3-butadiene	PAHs
Warehousing*	1.6%	0.7%	0.1%
Light vehicles**	4.95%	1.27%	0.56%
Trucks***	1.07%	0.4%	1.65%

*Based on speciated emission factors outlined in AP42 3.2 Natural Gas-fired Reciprocating Engines
**Based on speciation profiles for petrol vehicles in Table D1 of NSW EPA (2012)
***Based on speciation profiles for diesel vehicles in Table D4 of NSW EPA (2012)

Impact assessment criteria for gaseous pollutants

Impact assessment criteria have been formulated for ‘criteria pollutants[2]’, at the nearest sensitive receptor to the Proposal site, and compared against the highest dispersion modelling prediction (100th percentile). Impact assessment for air toxics (i.e. VOC components of diesel exhaust emissions) are applied at, and beyond the site boundary as the 99.9th percentile of dispersion modelling predictions to yield the most stringent (i.e. worst case) criteria.

[2] Criteria pollutants refers to air pollutants that are commonly regulated and typically used as indicators for air quality. In the Approved Methods the criteria pollutants are TSP, PM_{10}, NO_2, SO_2, CO, ozone (O_3), deposition dust, hydrogen fluoride and lead.

Table 9-7 Impact assessment criteria for gaseous pollutants

Pollutant	Averaging period	Concentration	
		µg/m³ *	Pphm**
NO_2	1-hour	246	12
	Annual	62	3
SO_2	10-minute	712	25
	1-hour	570	20
	24-hour	228	8
	Annual	60	2
CO	15-minute	100,000	8,700
	1-hour	30,000	2,500
	8-hour	10,000	900
1,3-butadiene	1-hour***	40	1.8
Benzene	1-hour***	29	0.9
PAHs (as BaP)	1-hour***	0.4	-

*Gas volumes for criteria pollutants expressed at 0°C and 1 atmosphere, and principal toxics at 25°C

**pphm – parts per hundred million

***Expressed as the 99.9th Percentile Value.

9.2.4 Operational data inputs and assumptions

Emissions from traffic

The following data inputs and assumptions were made to quantify air emissions generated by operational traffic for the Proposal:

- The following average daily traffic volumes are anticipated:
  - Warehouse traffic to external network: 3,872 (LV) and 564 (HV)
  - Terminal to warehouse (via internal transfer roads): 582 (HV)
- Emission factors for vehicles in travel mode are expressed in g/km. The distance travelled in a given hour (or day) is based on the number of truck movements and total travel distance per trip
- For warehouse traffic, the travel distance is assumed to be 1 km (from Proposal site entrance to the junction of the M5 and Moorebank Avenue) plus an internal travel distance of 1.5 km for each trip on the perimeter road of the warehousing area
- For internal transfer from the terminal to the warehouses, a distance of 0.2 km is assumed for the two internal transfer roads
- Truck emissions (in travel mode) were calculated using aggregated emission factors developed by the NSW EPA for the 2008 GMR emissions inventory (NSW EPA, 2012). These factors were refined using the Air Quality Appraisal Tool (PAE Homes, 2013), and based on available fleet data for the projected year 2021. Emissions calculations assumed a commercial arterial road, 2% grade and a speed limit of 50 km/hr for external roads and 20 km/hr for internal roads

- Idling emissions are expected to be accounted for by trucks in travel mode, and thus weren't considered separately
- For warehouse HV travelling on the external network, it is assumed 30% are rigid trucks and 70% are articulated trucks
- For LV, the following splits are assumed:
  - 75% petrol passenger vehicles
  - 5% diesel passenger vehicles
  - 10% light duty commercial petrol vehicles
  - 5% light duty commercial diesel vehicles
  - 5% heavy duty commercial petrol vehicles.

Emissions from warehousing

It is assumed that warehousing operations would employ the use of up to 24 LNG forklifts, operating at 50% utilisation.

Predicted emissions generated from warehouse heating/cooling have been estimated based on an emissions factor of 150 MJ/m^2/year and a warehousing area of 300,000 m^2. The National Pollution Inventory (NPI) *Emission Estimation Manual for Combustion in Boilers* (≤30 MW wall fired boilers) was used to convert predicted energy usage into estimated emissions generated.

9.3 Existing Environment

9.3.1 Sensitive Receptors

Ramboll (2016) reviewed the residential and sensitive receiver locations within the vicinity of the Proposal, located in the neighbouring suburbs of Wattle Grove, Moorebank, Casula and Glenfield. Forty-one sensitive receivers were located in total[3]. These locations are identified in Table 9-8, and defined geographically below in Figure 9-2.

Table 9-8 Identification of sensitive receivers surrounding the site

Name/Location	ID
Lakewood Crescent, Casula	R1
St Andrews Boulevard, Casula	R2
Buckland Road, Casula	R3
Dunmore Crescent, Casula	R4
Leacocks Lane, Casula	R5
Leacocks Lane, Casula	R6
Slessor Road, Casula	R7
Canterbury Road, Glenfield	R8
Ferguson Street, Glenfield	R9

[3] R33 is now located within the MPE site. It is therefore no longer considered to be a sensitive receiver regarding air quality and is not considered further in this assessment.

Name/Location	ID
Goodenough Street, Glenfield	R10
Wallcliff Court, Wattle Grove	R11
Corryton Court, Wattle Grove	R12
Martindale Court, Wattle Grove	R13
Anzac Road, Wattle Grove	R14
Cambridge Avenue, Glenfield	R15
Guise Public School	R16
Yallum Court, Wattle Grove	R17
Church Road, Liverpool	R18
Glenwood Public School, Glenfield	R19
Glenfield Public School, Glenfield	R20
Hurlstone Agricultural School	R21
Wattle Grove Public School	R22
St Marks Coptic College, Wattle Grove	R23
Maple Grove Retirement Village, Casula	R24
All Saints Catholic College	R25
Casula High School	R26
Casula Primary School, Casula	R27
Lurnea High School	R28
St Francis Xaviers Catholic Church	R29
Impact Church Liverpool	R30
Liverpool West Public School	R31
Liverpool Public School / TAFE NSW	R32
Glenfield Rise Development, Glenfield	R34
DJLU Facility	R35
Playground Learning Centre Glenfield	R36
Wattle Grove Long Day Care Centre	R37
Casula Powerhouse Arts Centre	R38
Little Peters Child Care	R39
Anzac Village Pre School	R40
St Christophers. Holsworthy	R41
Learn and Play Pre School	R42

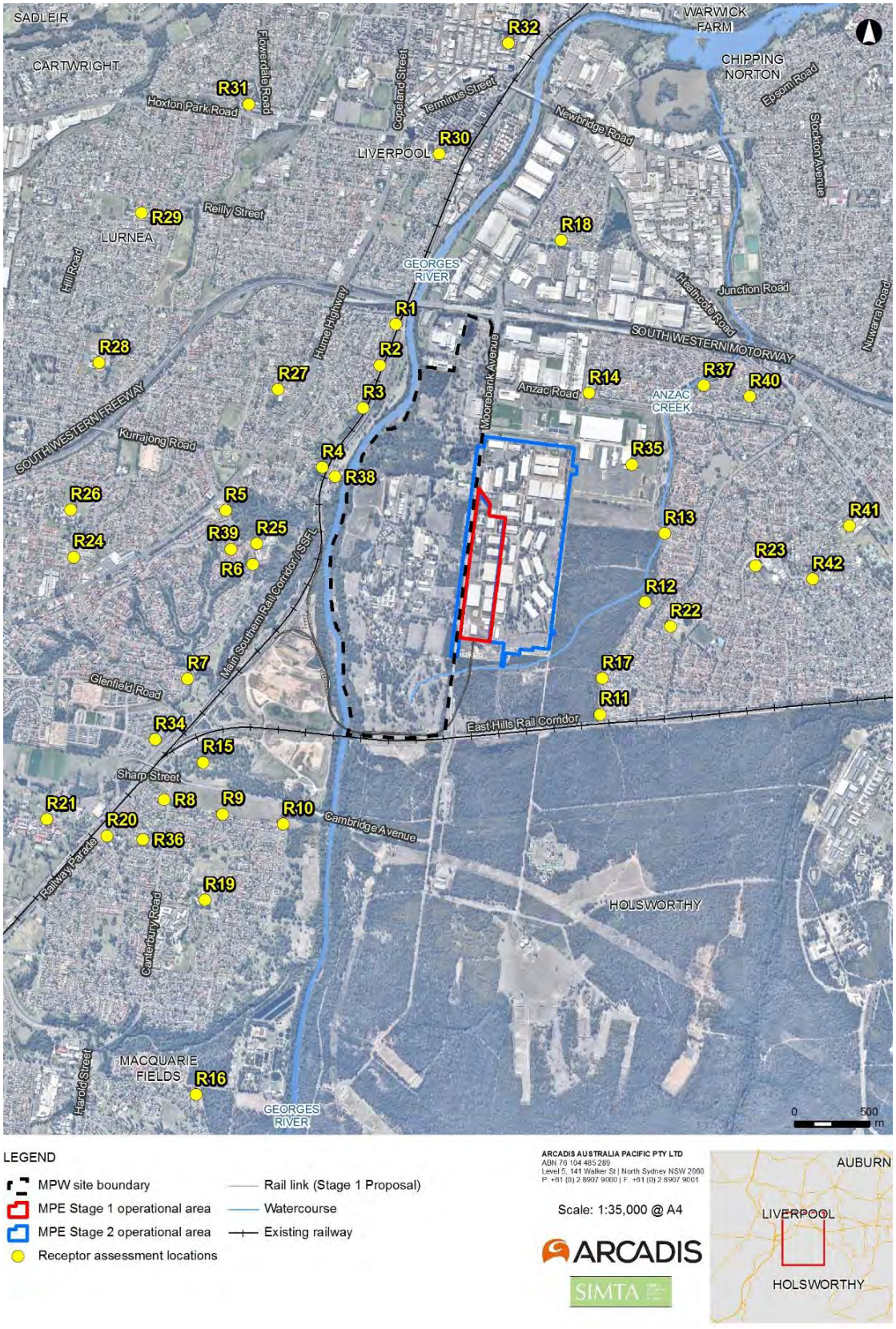

Figure 9-2 Sensitive receptor areas (Air Quality Impact Assessment, Ramboll Environ 2016)

9.3.2 Climate and meteorology

Meteorological mechanisms govern the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. The Liverpool monitoring site operated by the OEH is considered representative of the conditions of the Proposal site, given its close proximity and similar topography.

An analysis of wind data from this site between 2011 and 2015 revealed relatively little inter-annual variability in wind speed and direction. The 2013 meteorological dataset used in the MPE Stage 1 EIS (ENVIRON, 2015) assessment was retained for this assessment for the Proposal.

Prevailing winds

The annual recorded wind pattern within the vicinity of the Proposal site is dominated by southwest to westerly airflow. The highest wind speeds recorded at the location are most frequently experienced from the southwest to westerly direction. The average recorded wind speed for 2013 was approximately 2 m/s, with calm conditions (wind speeds less than 0.5 m/s) occurring approximately 12 % of the time. Figure 9-3 shows the annual wind rose of recorded wind speed and direction data from the OEH Liverpool station during 2013, demonstrating the prevailing wind conditions in the area.

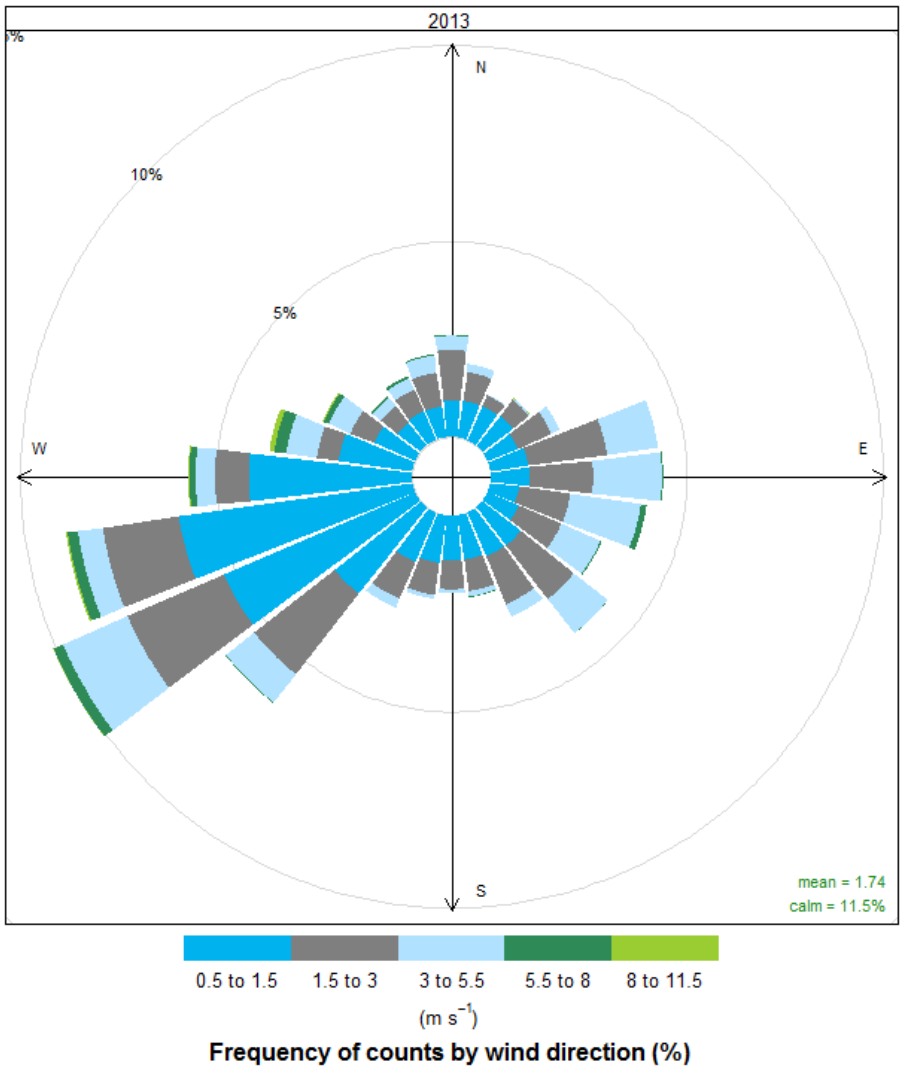

Figure 9-3 Annual wind rose - OEH Liverpool, 2013

Seasonal variation in wind speed and direction is evident with the dominant southwest to westerly component evident in the autumn, winter and spring months, while an easterly flow is evident in summer months. Mean wind speeds are higher during day time hours and the occurrence of calm wind conditions are more frequent at night.

Ambient Temperature

Monthly mean temperatures range between 5°C to 18°C, with monthly mean maximum temperatures of 17°C to 28°C[4]. The highest temperatures are typically experienced during the summer months, while the lowest are generally experienced between May and September. Analysis comparing monthly temperature variation data during 2013 at the OEH Liverpool station with the long-term trends (recorded regional mean, minimum and maximum temperatures) at the BoM Bankstown Airport Automatic Weather Station (AWS) indicate that the 2013 dataset is representative of the typical conditions experienced in the region.

Rainfall

Precipitation has the potential to impact on dust generation and removal of atmospheric pollutants, and is therefore an important factor in quantifying predicted air emissions. Historical data recorded at Bankstown Airport since 1968 indicates the region is characterised by moderate rainfall, with a mean annual rainfall of 870mm, and an annual rainfall range between 493 and 1,398mm.

There is typically significant variation in monthly rainfall within the area, with the wettest periods usually during the summer and autumn months. In order to make a conservative (upper-bound) estimate of the air pollution generated as part of this assessment, wet deposition (the removal of atmospheric particles by rain) was excluded from the dispersion modelling simulations undertaken.

Atmospheric stability and boundary layer depth

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere, and is directly affected by the Earth's surface through the frictional drag of airflow or as a result of convective mixing[5]. The atmospheric boundary layer during the day is characterised by thermal turbulence via the sun heating the Earth's surface and the extension of the mixing layer to the lowest elevated subsidence inversion. Conversely, the atmospheric boundary layer during the night times are typically characterised by weak to no vertical mixing and the predominance of stable conditions. These conditions are usually associated with lower wind speeds and hence lower dilution potentials.

The Monon-Obukhov length[6] (L) provides a measure of the atmospheric stability of the surface layer. AERMET, a meteorological data processor, was used to determine the diurnal variation of atmospheric stability of the Proposal area. Figure 9-4 illustrates that atmospheric instability increases during the daytime as convective energy increases, and declines during the night time, when atmospheric conditions are more stable. This suggests that the greatest potential for atmospheric dispersion of emissions at the Proposal site would be during daylight hours, and lowest during the night.

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[4] Based on the long-term average record from the BoM Bankstown Airport AWS

[5] The result of the heat and moisture exchanges that take place at the Earth's surface

[6] The Monin-Obukhov length is that height at which turbulence is generated more by buoyancy than by wind shear.

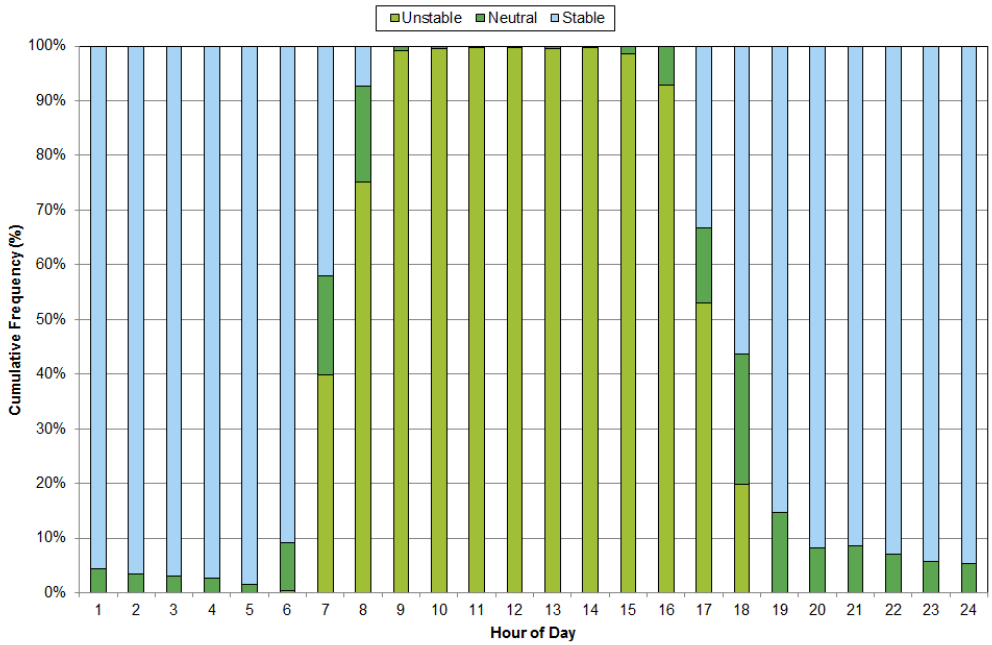

Figure 9-4 Diurnal variation in AERMET generated atmospheric stability

Note: Boxes indicate 25th percentile, Median and 75th percentile of AERMET-generated mixing height data while upper and lower whiskers indicate maximum and minimum values.

9.3.3 Baseline ambient air quality

A number of existing and potential future air emission sources contribute toward the condition of the local air shed, affecting ambient background air quality, including:

- Traffic emissions from the wider road network, including the South Western Motorway (M5)
- Emissions from diesel locomotives using the Southern Sydney Freight Line (SSFL) and the East Hills rail line
- Existing commercial and industrial facilities, including the Greenhills Industrial Estate and Moorebank Business Park to the north
- Emissions from aircraft at Bankstown Airport to the northeast.

Baseline data regarding PM_{10}, $PM_{2.5}$, NO_2, O_3 and CO from the Liverpool OEH monitoring station has been used as being representative of the Proposal site ambient air conditions[7]. SO_2 monitoring data was extracted from the Chullora OEH monitoring site, located approximately 12 km northeast of the Proposal site.

[7] Ambient air quality monitoring was undertaken at the Proposal site as part of the MPW Concept EIS (Parsons Brinckerhoff, 2014a), yet was deem insufficient to adequately describe baseline air quality conditions for the purposes of this assessment. Monitoring that was carried out at the Proposal site was however considered sufficient to compare with data from the OEH Liverpool station, to conclude concentrations of pollutants at the OEH Liverpool station are generally higher and a more conservative baseline dataset for subsequent assessments.

9.3.4 Adopted background air quality

Air quality statistics for gaseous pollutants and air toxics were analysed over a five year period. The following findings were made with regard to concentration ranges and exceedances of standards:

- Annual mean PM_{10} concentrations range from 18 µg/m³ to 21 µg/m³ and on average over the past 5 years baseline concentrations are 77% of the AAQ NEPM standard
- Annual mean $PM_{2.5}$ concentrations range from 6 µg/m³ to 9 µg/m³ and on average over the past 5 years baseline concentrations are 103% of the AAQ NEPM standard
- Exceedances of the 24-hour average reporting standards for both PM_{10} and $PM_{2.5}$ have occurred in three of the past five years
- There have been no exceedances in the air quality standards over the past five years for NO_2, SO_2 and CO and in general the background air quality for these pollutants is considered good[8].

The following key considerations were made for respective air pollutants in compiling background values for the assessment, presented in Table 9-9.

- Background annual average PM_{10}, $PM_{2.5}$ and NO_2 emissions were derived by averaging out data over a five year period at the nearby OEH Liverpool monitoring station between 2011 and 2015
- For short term impacts, daily varying PM_{10} and $PM_{2.5}$ concentrations and hourly varying concentrations for NO_2 are paired with modelling predictions for assessment of cumulative impacts
- Background $PM_{2.5}$ concentrations already exceed the NEPM AAQ reporting standard. Assessment of impacts will therefore be discussed in the context on the incremental increase generated by the Proposal[9]
- The adopted background values relating to CO and SO_2 values is based on the maximum background concentration recorded over the five year period 2011 and 2015. This conservative approach is considered appropriate given the relatively low background concentrations recorded for these pollutants
- The annual average TSP concentrations for the Proposal site are derived upon ratios established linking concentrations of TSP from PM_{10} (ratios for urban areas generally range from 0.4 to 0.5)[10]
- Monitoring for dust deposition as part of the MPW Concept Approval was conducted at three locations across the suburbs of Wattle Grove, Casula and Glenfield. Background dust deposition levels recorded range from 0.6 g/m^2/month and 0.8 g/m^2/month, expressed as an annual average (insoluble solids).

Background air quality concentrations for the Proposal site and surrounds for key pollutants is summarised in Table 9-9.

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[8] On average, baseline concentrations for NO_2 are 33% of the AAQ NEPM standard for annual mean and 42% for maximum 1 hour average. Baseline concentrations for CO and SO_2 are even lower. For example, maximum 1-hour baseline concentrations are 12% of the AAQ NEPM standard for CO and 10% for SO_2.

[9] For $PM_{2.5}$ the monthly profile shows that $PM_{2.5}$ concentrations are highest in cooler months, which is evidence of the influence of wood heater emissions. Regulatory initiatives such as wood heater compliance programs and improvements in vehicle emission standards are expected to play a role in driving down ambient concentrations in the medium term.

[10] Reported in Quarterly Air Quality Monitoring Reports - http://www.environment.nsw.gov.au/aqms/datareports.htm#quarterlies

Table 9-9 Adopted background air quality concentrations for the Proposal site

Pollutant	Averaging period	Adopted background value
PM_{10}	24-hour average	Daily varying
	Annual average	19.4 µg/m³
$PM_{2.5}$	24-hour average	Daily varying
	Annual average	8.2 µg/m³
NO_2	1-hour average	Hourly varying
	Annual average	20.4 µg/m³
CO	1-hour average	5.0 mg/m³
	8-hour average	30 mg/m³
SO_2	1-hour average	74.4 µg/m³
	24-hour average	13.6 µg/m³
	Annual average	2.6 µg/m³
TSP	Annual average	48.4 µg/m³
Dust deposition	Annual average	1 g/m²/month

9.4 Potential impacts

The approach to assess potential air impacts generated by the Proposal follows the guidelines recommended in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ("the Approved Methods") (NSW EPA, 2005). A detailed outline regarding the nature of the various pollutants assessed, and their potential to impact upon human health can be found in the Human Health Section (refer to Section 10) of this EIS.

9.4.1 Construction

Emission inventory

Particulate matter and fugitive dust emissions are anticipated to generate the greatest impact with regard to air quality of the Proposal site and surrounds (refer to Table 9-2) during the bulk earthworks and construction activities associated with Moorebank Avenue upgrades.

Expressed in terms of TSP, PM_{10} and $PM_{2.5}$ an emissions inventory was calculated for key Proposal construction activities using emission factors developed by the US EPA[11], and a number of assumptions relating to material quantities, utilisation of plant and equipment and the use of water carts along unsealed pavement areas. Diesel exhaust emissions associated with on-road trucks are also estimated using aggregated emission factors developed by the NSW EPA for the 2008 Greater Metropolitan Region emissions inventory (NSW EPA, 2012b) which are incorporated into the EPA's Air Quality Appraisal Tool (AQAT) (PAEHolmes, 2013).

[11] United States Environmental Protection Agency (US EPA) AP-42 Compilation of Air Pollutant Emission Factors (US EPA, 1998b, US EPA, 2004, US EPA, 2006).

A summary of the estimated emissions for the duration of the Proposal is presented in Table 9-10.

Table 9-10 Emissions estimates for Proposal construction (kg/annum)

Source / Activity	TSP (kg/annum)	PM_{10} (kg/annum)	$PM_{2.5}$ (kg/annum)
Hauling on unsealed roads	22,447	7,210	577
Trucks unloading fill	456	216	32.7
Material handling (excavators, FEL, stockpiles)	456	863	32.7
Dozers (vegetation stripping, topsoil clearing, fill)	10,483	4,421	1,101
Crushing	238	107	19.8
Screening	436	147	9.9
Graders on road construction	4,963	1,734	154
Wind erosion	29,750	14,875	2,231
Diesel combustion (onsite equipment)	733	733	692
On-road trucks diesel combustion	36.5	36.5	35.4
Total	**69,998**	**30,342**	**4,885**

Dispersion modelling results

The Proposal construction activities have been assessed in terms of potential impacts arising from dust, TSP, PM_{10} and $PM_{2.5}$ generation. Dispersion modelling was undertaken using AERMOD modelling system to predict ground level concentrations of key pollutants generated by the Proposal at surrounding sensitive receivers, based on atmospheric conditions.

The modelling results indicate that the predicted construction phase emissions comply with all relevant impact assessment criteria. As shown in Table 9-11 the maximum predicted increase in annual average PM_{10} (0.4 µg/m³), $PM_{2.5}$ (0.1 µg/m³), TSP (0.6 µg/m³) and dust deposition (0.3 g/m^2/month) are considered minor when compared against existing background conditions. The highest predicted short-term impacts occur at the DJLU facility (corresponding to receptor R35) with a maximum 24-hour PM_{10} of 4.2 µg/m³ and maximum 24-hour $PM_{2.5}$ of 1.3 µg/m³.

It is important to note that the modelling predictions are conservative, particularly for short-term impacts, as it considers the annual emission total and apportions this evenly across the year and excludes wet deposition modelling (refer to Section 9.3.2 of this EIS). Construction activities will be staged and therefore only a proportion of the annual emission totals would be generated during each stage, resulting in conservatively high short-term (24-hour) predictions.

The background dataset contains existing exceedances of the impact assessment criteria (three days for PM_{10} and two days for $PM_{2.5}$) that correspond to natural weather events that, if included, would skew the average background air pollution levels. The 24-hour average PM_{10} is therefore presented as the 4th highest (excluding the three days already over) and the 24-hour average $PM_{2.5}$ is presented as the 3rd highest (excluding the two days already over). The results indicate that the construction for the Proposal would result in no additional days over the criteria.

Table 9-11 Construction phase - maximum modelling predictions for sensitive receptors

Pollutant	Period		Air quality goal criteria	Receptor maximum	Receptor
PM_{10} ($\mu g/m^3$)	24 hour maximum	Incremental increase	50 $\mu g/m^3$	4.2 $\mu g/m^3$	R35
	Annual average	Incremental increase	30 $\mu g/m^3$	0.4 $\mu g/m^3$	R35
$PM_{2.5}$ ($\mu g/m^3$)	24 hour maximum	Incremental increase	25 $\mu g/m^3$	1.3 $\mu g/m^3$	R35
	Annual average	Incremental increase	8 $\mu g/m^3$	0.1 $\mu g/m^3$	R35
TSP ($\mu g/m^3$)	Annual average	Incremental increase	90 $\mu g/m^3$	0.6 $\mu g/m^3$	R35
Dust deposition	Annual average	Incremental increase	2 $g/m^2/m$	0.3 $g/m^2/m$	R35

9.4.2 Operation

Operational impacts to air quality as a result of the Proposal have been considered with regards to PM_{10}, $PM_{2.5}$, NO_x, CO, SO_2 and VOCs. The predicted PM_{10} and $PM_{2.5}$ concentrations are presented in Table 9-12.

As outlined in Section 9.2.1 of this EIS, key pollutants assessed for the operational phase of the Proposal considered to have the greatest potential impacts are associated with diesel and fossil fuel combustion. Pollutants assessed include the following:

- PM_{10} and $PM_{2.5}$
- Oxides of nitrogen (NO_x)
- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- Speciated HC / VOCs – benzene, 1-3-butadiene and PAHs.

Onsite activities associated with Proposal operation, anticipated to generate the above air pollutant types mentioned include:

- External light vehicles (LV) and heavy vehicles (HV) servicing the Proposal
- Internal transfer trucks, transferring containers from the IMT to warehouses
- LNG forklifts operating within the warehousing areas
- Warehouse cooling and heating (using gas fired boilers).

The development of emission estimates requires detailed activity data, including truck numbers, fleet composition, distances travelled, times in mode, equipment types, fuel usage etc.). Based on published emission factors, this data is subsequently used to derive emission estimates for each activity, presented in the following sections.

Emissions from traffic

The emission estimates for trucks and light vehicles are presented inTable 9-12.

Table 9-12 Emission estimates for vehicle movements (kg/annum)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Warehouse traffic - HV	298	69	4,515	106	102	-	73
Warehouse traffic - LV	12,020	781	2,006	77	74	-	822
Terminal transfer to warehouse	80	10	411	10	10	-	10

Note: Emissions of SO_2 are proportional to the sulphur content of the fuel and emissions can be estimated if fuel consumption is known. In the absence of data on fuel consumption, we have assumed SO_2 emissions to be negligible, a reasonable assumption given that the regulated sulphur fuel content in Australia is very low.

Emissions from warehousing

The primary sources of emissions arising from the operation of warehousing on the Proposal site include:

- LNG forklifts operating within the warehousing area
- Warehouse office heating and cooling, which are assumed to utilise natural gas boilers.

It is assumed that warehousing operations would employ the use of up to 24 LNG forklifts, operating at 50% utilisation. The forklift emission estimates shown below in Table 9-13 can be calculated using the US EPA emission factors for forklifts (US EPA, 2010).

Table 9-13 US EPA emission factors for forklifts (g/kWh)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2
Forklifts	2.9	1.2	0.7	0.04	0.04	0.08

A summary of emissions generated by warehousing operations is provided below in Table 9-14.

Table 9-14 Predicted emissions generated by warehousing operations for the Proposal (kg/annum)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
LNG forklifts	13,716	5,493	3,114	175	170	387	5,785
Heating/cooling	5,535	-	6,561	486	486	8.6	362
Total	**19,251**	**5,493**	**9,675**	**661**	**656**	**396**	**6,146**

Operational emissions summary

A summary of the annual operational emissions generated by the Proposal is provided in Table 9-15.

Table 9-15 Summary of annual operational emissions for the Proposal (tonnes/annum)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Warehouse traffic - HV	298	69	4,515	106	102	-	73
Warehouse traffic - LV	12,020	781	2,006	77	74	-	822
Terminal transfer to warehouse	80	10	411	10	10	-	10
Warehouse forklifts	13,716	5,493	3,114	175	170	387	5,785
Warehouse heating/cooling	5,535	-	6,561	486	486	8.6	362
Total	**31,650**	**6,353**	**16,608**	**853**	**842**	**396**	**7,051**

Emissions source contributions for various key pollutants is presented in Figure 9-5. Based on emission factors and activity data assumptions used in this report, warehouse heating and cooling and the operation of warehouse forklifts are the largest emissions sources.

It is noted that the annual summary is based on the assumption (for a worst case modelling assessment) that all 24 forklifts would operate at an average 50% load, for the entire year. In reality this would not be the case and the actual emissions across the major sources may be more evenly distributed.

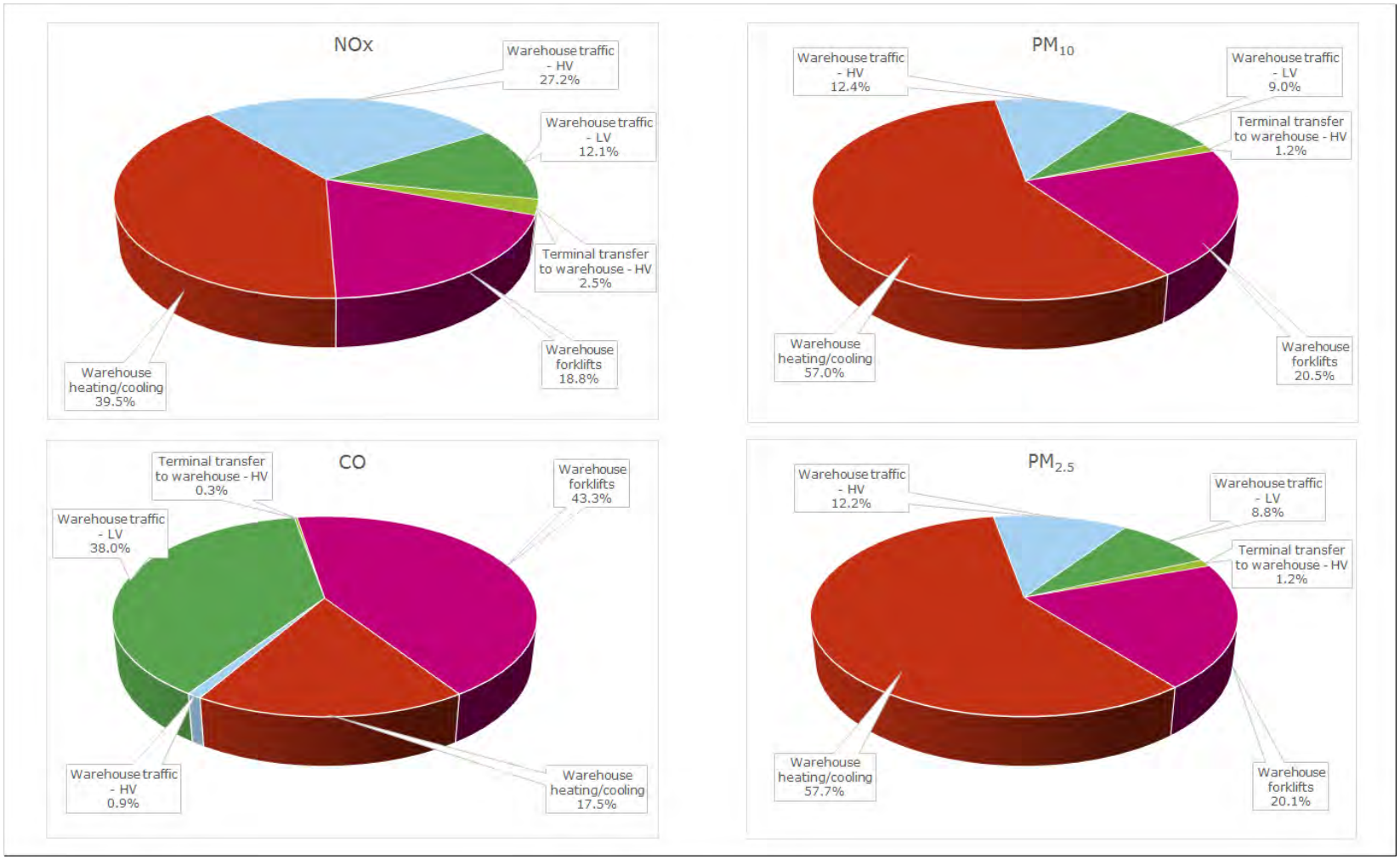

Figure 9-5: Summary of annual operational emissions by source

Dispersion modelling results

The operational phase of the Proposal was assessed in terms of PM_{10}, $PM_{2.5}$, NO_x, CO, SO_2 and VOCs. The AERMOD modelling system was used to model the dispersion of pollutants associated with Proposal operation to measure the impact of the emissions at the various sensitive receptors.

Predictive operational concentrations for $PM_{2.5}$ and PM_{10} are presented in Table 9-16. The maximum increase in annual average PM_{10} and $PM_{2.5}$ (0.1 µg/m³) and 24-hour average PM_{10} and $PM_{2.5}$ (0.3 µg/m³) is minor when compared to existing background conditions. In consideration of these values to background air conditions, no additional exceedances of the short-term impact assessment criteria are anticipated to be recorded.

The annual average background concentrations of $PM_{2.5}$ already exceeds the NEPM AAQ reporting standard, meaning that predictions are also above the standard at all receptors. It is noted, however, that the Proposal results in a relatively minor increase in annual average $PM_{2.5}$ (0.1 µg/m³ at all sensitive receptors), when compared to background concentration levels.

Table 9-16 Summary of PM_{10} and $PM_{2.5}$ modelling predictions at selected sensitive receivers

Pollutant	Period	Scenario	Air quality goal criteria	Receptor maximum	Receptor(s)
PM_{10} ($\mu g/m^3$)	24 hour maximum	Incremental increase	50 $\mu g/m^3$	0.3 $\mu g/m^3$	R14, R35
	Annual average	Incremental increase	30 $\mu g/m^3$	0.1 $\mu g/m^3$	R1-3, R11-14, R17, R22, R35, R37, R38
$PM_{2.5}$ ($\mu g/m^3$)	24 hour maximum	Incremental increase	25 $\mu g/m^3$	0.3 $\mu g/m^3$	R14, R35
	Annual average	Incremental increase	8 $\mu g/m^3$	0.1 $\mu g/m^3$	R2, R3, R11-14, R17, R22, R35, R37, R38

Predictive operational concentrations of NO_2[12], CO and SO_2 are presented in Table 9-17.

The assessment assumed that the maximum modelled concentration occurs at the same time as the maximum background. Notwithstanding this conservative assumption, all predicted concentrations are well below the impact assessment criteria.

[12] NO_2 concentrations are based on the conservative assumption that 100% of NO is converted to NO_2, both for short-term and annual average predictions. This simplified (and conservative) conversion method can be applied in this case because predictions are well below the relevant impact assessment criteria.

Table 9-17 Summary of NO_2, CO and SO_2 modelling predictions at selected sensitive receivers

Pollutant	Period	Scenario	Air quality goal criteria	Receptor maximum	Receptor(s)
NO_2 ($\mu g/m^3$)	1 hour maximum	Incremental increase	246 $\mu g/m^3$	39.4 $\mu g/m^3$	R14
	Annual average	Incremental increase	62 $\mu g/m^3$	2.8 $\mu g/m^3$	R35
CO (mg/m^3)	1 hour maximum	Incremental increase	30 mg/m^3	0.06 $\mu g/m^3$	R14, R35
	8 hour maximum	Incremental increase	10 mg/m^3	0.02 $\mu g/m^3$	R12-14, R35
SO_2 ($\mu g/m^3$)	1 hour maximum	Incremental increase	570 ($\mu g/m^3$)	0.62 $\mu g/m^3$	R14, R35
	24 hour maximum	Incremental increase	228 ($\mu g/m^3$)	0.16 $\mu g/m^3$	R35
	Annual average	Incremental increase	60 ($\mu g/m^3$)	0.07 $\mu g/m^3$	R35

In summary, the modelling predictions indicate that the risk of adverse air quality impacts generated by the Proposal are low, and that incremental increases in key pollutants at surrounding residential receivers would be largely indistinguishable from the existing background and the Proposal. It is therefore considered that air quality monitoring is not warranted.

Assessment of VOCs

The maximum predicted incremental concentrations of 1,3-butadiene, benzene and PAHs (expressed as 99.9th percentiles) are presented in Table 9-18. Impact assessment criteria were applied at and beyond the site boundary, representing the highest prediction across the modelling grid. The results therefore can be used to determine compliance. The results show that all VOCs are below the relevant assessment criteria.

Table 9-18 Assessment of VOC concentrations

Pollutant	Criteria ($\mu g/m^3$)	Predicted concentration ($\mu g/m^3$)	
		Receptor maximum	Grid maximum
1,3 Butadiene	40	0.06	0.32
Benzene	29	0.17	0.88
PAH (as BaP)	0.4	0.01	0.07

Assessment of regional impacts

The MPE Concept Plan EA included an assessment of regional air impacts. The assessment considered regional air quality impacts arising as a result of the MPE Project at full build, by comparing the effects of the MPE Project with respect to container transport on emissions from heavy truck and rail movements throughout the Sydney region.

Whilst sufficient details were not available at the time to quantify the improvements to air quality, it was determined that the replacement of road freight transport by rail is expected to achieve a reduction in the mass of key pollutants including NO_x and particulate matter release into the airshed.

As the Proposal would account for significantly less emissions than the MPE Project at full build, no further assessment of regional air quality was considered necessary as the impact of the Proposal on a regional scale would also be negligible.

9.4.3 Summary

In summary, the modelling results indicate that the predicted construction phase emissions comply with all relevant impact assessment criteria and the risk of adverse air quality impacts generated by the operation of the Proposal are low.

An assessment of cumulative air quality impacts (i.e including the Proposal, existing ambient air quality, MPE Stage 1 and MPW Stage 2) has been undertaken as part of the cumulative impact assessment and the results are reported in Section 18 of this EIS.

9.5 Mitigation Measures

9.5.1 Construction

The Air Quality Management Plan (Ramboll, 2016), included within Appendix M of this EIS, would be further progressed and incorporated into the CEMP for the Proposal. Specifically, the following key aspects would be addressed in the CEMP:

- Procedures for controlling/managing dust
- Roles, responsibilities and reporting requirements
- Contingency measures for dust control where standard measures are deemed ineffective.

9.5.2 Operation

The Air Quality Management Plan (Ramboll, 2016), included within Appendix M of this EIS would be further progressed and integrated into the OEMP for the Proposal. In accordance with the Air Quality Management Plan the following key aspects would be addressed in the OEMP:

- Implementation and communication of anti-idling policy for trucks
- Complaints line for the community to report on excessive idling and smoky vehicles
- Procedures to reject excessively smoky trucks visiting the site based on visual inspection.

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10 HUMAN HEALTH

Ramboll Environ have undertaken an assessment of the human health impacts associated with the Proposal to address the SEARs. The Health Risk Assessment (HRA) (Ramboll Environ, 2016) is provided in Appendix N of this EIS. Table 10-1 provides a summary of the relevant SEARs which relate to human health and where these have been addressed in this EIS.

Table 10-1 SEARs (Human Health)

SEARs	Where addressed
General requirements	
Where relevant, the assessment of the key issues below, and any other significant issues identified in the risk assessment, must include: • A health impact assessment of local and regional impacts associated with the development, including those health risks associated with relevant key issues. The assessment should be undertaken with reference to the Centre for Health Equity Training, Research, an Evaluations' practical guide to impact assessment (August 2007) and shall include: – A discussion of the known potential developments in the local region – An assessment of the impact on the environmental values of public health – An assessment of local and regional impacts including health risks	Section 10 of this EIS

The Concept Plan Conditions of Approval are generally consistent with the SEARs provided for the Proposal as they relate to human health (refer to Table 10-1) and have been addressed in this Section of the EIS. The compliance of the Proposal with the SEARs, Concept Plan Conditions of Approval and Statement of Commitments is provided at Appendix A of this EIS.

This Section summarises the studies undertaken for the MPE Concept Plan Approval (section 10.1) and, more recently, for the Proposal. This section of the EIS also summarises the methodology used to assess human health-related impacts of the Proposal (section 10.2), describes the existing environment as it relates to human health (section 10.3) and provides an assessment of human health impacts associated with construction and operation of the Proposal (section 10.4). Measures to mitigate potential human health impacts where they are required have been identified in Section 10.5.

10.1 Concept Plan Assessment

A *Preliminary screening level health risk assessment and literature review* (Screening HRA) was prepared by Toxikos (2012) for the MPE Concept Plan Approval. The Screening HRA assesses the health impacts associated with airborne particulates, and considers potential impacts of the proposed MPE Project on air quality in the surrounding residential areas. For the purposes of the Screening HRA a conservative approach was adopted, where it was assumed that the MPE Project would be operating consistent with the busiest hour of operation at ultimate capacity (1,000,000 TEU).

The estimation of exposure to airborne particulates was derived from air dispersion modelling undertaken as part of the Air Quality Impact Assessment (PAE, 2012). The results were then compared to the health based guidelines that are derived from epidemiological studies and that measure the association between specific pollutants and health outcomes.

The Screening HRA concluded that emissions from the MPE Project were unlikely to have acute or chronic health impacts on the community. The emissions of major importance for possible health impacts are fine particulate matter ($PM_{2.5}$) while nitrogen dioxide (NO_2) does not contribute to the overall acute or chronic health risk for the Proposal. Overall PM_{10}, $PM_{2.5}$ and NO_2 from MPE were assessed as having negligible potential impact on the health of people in the surrounding area, either on their own or in combination.

While not covered by the Screening HRA, potential construction and operational noise was considered as part of the Noise Impact Assessment prepared for the MPE Concept Plan Approval (Wilkinson Murray, 2013). The Noise Impact Assessment concluded that direct negative health impacts associated with operational noise from the MPE Project are unlikely because, with appropriate mitigation, the applicable criteria for operational, road traffic and rail traffic noise are predicted to be met.

To ensure the potential health impacts associated with MPE are well understood, the Revised Statement of Commitments committed to the following actions:

- *The Proponent will undertake further health impact assessment for lodgement with each of the detailed planning applications for the three major stages of the development, including:*
  - *Discussion of the known and potential developments in the local region*
  - *Assessment of the impact on the environmental values of public health*
  - *Assessment of local and regional impacts including health risks*
- *Health impact assessments will be undertaken with reference to the Centre for Health Equity Training, Research, and Evaluations' practical guide to impact assessment (August 2007).*

10.2 Methodology

The HRA for the Proposal includes the following five components:

- **Issue Identification** – Identifies issues that can be assessed through a risk assessment and assists in establishing a context for the risk assessment
- **Exposure Assessment** – Identifies the groups of people who may be exposed to hazardous agents and quantifies the exposure concentrations
- **Toxicity Assessment** – Identifies hazards and health endpoints associated with exposure to hazardous agents and provides a review of the current understanding of the toxicity and risk relationship of the exposure of humans to the hazards
- **Risk Characterisation** – Provides the quantitative evaluation of potential risks to human health. The characterisation of risk is based on the review of exposure-response relationship and the assessment of the magnitude of exposure
- **Uncertainty Assessment** – Identifies potential sources of uncertainty and qualitative discussion of the magnitude of uncertainty and expected effects on risk estimates.

The following guidelines and standards have been consulted and followed where appropriate in the preparation of the assessment conducted:

- *Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards* (enHealth. 2012a)
- *Exposure Factors Guide* (enHealth. 2012b.)
- *Approach to Hazard Assessment for Air Quality* (National Health and Medical Research Council (NHMRC), 2006)
- *Methodology for Setting Air Quality Standards in Australia* (National Environment Protection Council (NEPC), 2011).

10.2.1 Air Quality

The air quality component of the HRA focusses on the health impacts to nearby residential and other sensitive locations (refer to Section 9 of this EIS) incurred due to emissions generated by the operational phase of the Proposal. Emissions to air from construction sources were not evaluated by the HRA because they would be temporary, appropriately managed (Section 9 of this EIS) and compliant with relevant air quality standards.

Emissions sources

Operational emissions sources associated with the Proposal would be primarily from diesel and other fossil fuel consumption. Accordingly, the assessment of impacts to air quality was focused on health hazards associated with combustion emissions, particularly the following key air pollutants:

- PM_{10} and $PM_{2.5}$
- Nitrogen oxides (in particular NO_2)
- SO_2
- CO
- Volatile organic compounds (VOCs)
- Polycyclic aromatic hydrocarbons (PAHs).

Air quality modelling

The populations that may be exposed to air emissions from the Proposal are communities in the surrounding suburbs of Casula, Moorebank, Glenfield, and Wattle Grove. A total of 41 locations representative of the surrounding suburbs and other sensitive receptors (e.g., schools, day care centres, and aged care homes/facilities) were identified, selected as discrete sensitive receptors and modelled. The air quality modelling and assessment methodology is explained further in Chapter 9 of this EIS and in the Air Quality Impact Assessment (AQIA) included in Appendix M of this EIS.

Health risk assessment methodology

As explained above, the HRA for the proposal has five key components including issue identification, exposure assessment, toxicity assessment, risk characterisation and uncertainty assessment. Key assumptions and assessment steps are summarised below:

- A conceptual site model was developed to describe the chemical source(s), the pathway(s) by which chemicals may migrate through the environmental media, and the populations that may potentially be exposed
- Key air pollutants evaluated in the AQIA were considered as chemicals of potential concern (COPCs) in the HRA (refer above and to Chapter 9 of this EIS). From a toxicity perspective, the VOCs most relevant to the HRA were identified as benzene and 1,3-butadiene. Carcinogenic PAHs were assessed as a group using the toxicity equivalent factor (TEF) approach, consistent with the NEPM (NEPC, 2013). Diesel particulate matter (DPM) was not specifically modelled, but DPM was part of the $PM_{2.5}$ assessment for emissions from diesel trucks and non-diesel light vehicles. The HRA conservatively assumed that 100 percent of the incremental $PM_{2.5}$ is derived from diesel sources, even though the Proposal includes emissions from light vehicles and natural gas combustion associated with warehousing. The HRA also assumes that all NOx is NO_2, which is again a conservative approach because ambient NO_2 is typically only about 70 percent of NO_x
- The human receptors considered for the HRA included commercial/industrial workers, residents, school or day care students, and recreational users located in the vicinity of the Proposal. For residents, it was assumed that they may live all day every day in the local area for 35 years, with exposure occurring 24 hours per day, 365 days per year. For school or day care students the same assumptions were also applied because they may live and attend school all day every day in the local area. For commercial/industrial workers, it was assumed that exposure may occur eight hours per day, 240 days per year for 30 years (NEPC, 2013). For recreational users, it was assumed that exposure may occur four hours per day, 104 days per year (two days per week) for 35 years
- Transport mechanisms for COPCs are atmospheric emissions to air and deposition to soil and surface water. An exposure pathway assessment determined that inhalation of air was the main pathway of potential risk associated to human health with the Proposal and therefore, inhalation of air was the only exposure route quantitatively evaluated. This approach is consistent with the previous risk assessments for the MPE Stage 1 Proposal
- Annual average ground level concentrations (GLCs) for COPCs were calculated by averaging the predicted air concentrations (concentrations over the minimum actual time period of operation) from the source over a continuous time period of 24 hours per day and 365 days per year. All activities associated with the Proposal would occur 24/7, therefore the annual average GLCs are equal to the predicted air concentrations from the source and used directly as exposure point concentrations (EPCs) for all human receptors (i.e. residents, school or day care students, commercial/industrial workers, recreational users).
- At each sensitive receptor location, the EPCs from all the sources were added together to obtain the EPCs from the operation of the Proposal

- Based on the available information, the most robust health endpoints (i.e. effects and outcomes) for the assessment of inhalation exposure to COPCs were identified, and the exposure-response relationships for these endpoints were derived from published peer-reviewed sources. The health endpoints and associated exposure-response relationships adopted for the HRA are consistent with those used in the MPE Stage 1 HIA, approved by NSW Health as part of the consultation undertaken for the MPE Project
- The health effects of both short-term and long-term exposure to PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO were assessed for increased annual incidence, in terms of the health endpoints of mortality and morbidity. A linear exposure-response was assumed (Burgers and Walsh 2002, Ostro 2004, USEPA 2005, 2010)
- The excess lifetime cancer risks from inhalation exposures to air toxics, such as DPM, benzene, 1,3-butadiene, and PAHs (as BAP TEQ) were calculated for the human receptors in the local area consistent with USEPA (2009)
- Consistent with the previous risk assessments for the MPE Project, the excess lifetime cancer risks were considered acceptable in the range of 10^{-6} to 10^{-4}. (i.e.1 in 1,000,000 to 1 in 10,000)
- The increased annual incidence of mortality or morbidity endpoints were considered to be negligible when it was less than one case per year, which is not detectable above the normal fluctuations in health statistics
- An assessment of uncertainty was conducted for baseline health incidence, EPCs, health endpoints, exposure-response functions and risk factors for DPM.

10.2.2 Noise

The noise component of the HRA was undertaken to evaluate potential health risks to surrounding residential communities from exposure to noise resulting from the operation of the Proposal. Noise from construction sources were not evaluated by the HRA because construction noise would be temporary and addressed by the mitigation measures detailed in Section 8 of this EIS.

The assessment adopted the following approach:

- The existing ambient noise environment at locations representative of the potentially most affected residential receivers (sensitive receivers) in Casula, Glenfield and Wattle Grove were established through long-term background noise monitoring conducted in accordance with the *NSW Industrial Noise Policy* (Environment Protection Authority, 2000) (refer to Appendix L of this EIS)
- Potentially affected non-residential receivers were assessed, including All Saints Senior College and the Casula Powerhouse (located to the west of the Proposal site across the Georges River) and the nearest industrial receiver, the DJLU (located immediately to the north of the Proposal site)
- Operational noise levels ($L_{Aeq,\ period}$) experienced at key receivers were extrapolated from modelling undertaken as part of the Noise Impact Assessment (Wilkinson Murray, 2016). The L_{Amax} noise levels during the night time associated with transient noise from Proposal operation were also extrapolated from this source and included in the assessment
- Predicted noise levels were compared with guideline criteria for health provided by the World Health Organisation (WHO). The WHO guidelines for community noise are designed to protect against the key health effects of annoyance, sleep disturbance, and cognitive impairment (WHO, 1999). The WHO guidelines are summarised in Table 10-2

- The ratio of the predicted noise level to the guidelines is termed the hazard quotient, with a hazard quotient of less than one considered to be an acceptable level of risk. A hazard quotient was calculated for each sensitive receiver to gauge whether or not operational noise from the Proposal would pose a risk from a human health perspective.

Table 10-2 WHO guidelines for community noise

Specific Environment	Critical health effect	$L_{Aeq, period}$ (dBA)	Time Base (hour)	L_{Amax} (dBA)
Outdoor Living Area	Serious annoyance, daytime and evening	55	16	--
	Moderate annoyance, daytime and evening	50	16	--
Dwelling, Indoor	Disturbance of speech intelligibility and moderate annoyance, daytime and evening	35	16	--
Inside Bedrooms (Indoor)	Sleep disturbance, night time	30	8	45
Outside Bedrooms (Outdoor)	Sleep disturbance, window open, night time	45	8	60
School/Preschool Classrooms, Indoor	Disturbance of speech intelligibility, information extraction, and message communications, daytime	35	During class	--
Preschool Bedrooms, Indoor	Sleep disturbance, sleep time	30	During sleep	45
School Playground, Outdoor	Annoyance, during play, daytime	55	During play	--

10.3 Existing Environment

The HRA has considered the key air and noise pollution sources associated with the Proposal. For both air and noise aspects, there are a large number of other sources[1] within proximity to the Proposal that have the potential to affect the health of local communities. Furthermore, it is also recognised that community health is influenced by a complex range of socioeconomic factors[2]. Hence, a review of the existing health statistics, air quality and ambient noise levels for the local area surrounding the Proposal was undertaken, and compared to general regional statistics to appropriately evaluate the susceptibility of the community to potential health risks imposed by the Proposal.

[1] Including other combustion sources, noise from road and rail, local construction/earthworks, and personal exposures (such as smoking)

[2] Including age, socio-economic status, social capital, behaviours, beliefs and lifestyle, life experiences, country of origin, genetic predisposition, and access to health and social care.

Surrounding area

The Proposal site is located within the Liverpool LGA in the Sydney south-western region. The local air shed and modelled locations used for the assessment were extrapolated from the AQIA (Appendix M of this EIS), presented in Section 9 of this EIS.

Existing baseline noise levels were extrapolated to represent the most potentially affected residential receivers in nearby suburbs including Casula, Wattle Grove and Glenfield. These levels were determined from the Noise and Vibration Impact Assessment (Appendix L of this EIS), presented in Section 8 of this EIS.

Population statistics and health

Population statistics for the surrounding suburbs of Casula, Glenfield, Wattle Grove, and Moorebank were obtained from the Australian Bureau of Statistics (ABS) for the census year 2011. These figures are summarised below in Table 10-3.

Table 10-3 Population statistics summary for surrounding areas to the Proposal

Location	Total population	% of population by key age group				
		< 5 years	5-14 years	15-64 years	65+ years	30+ years
Casula	14,696	7.9	15	67	10	49
Wattle Grove	8,192	8.7	18	69	5.2	45
Moorebank	7,595	8.4	13	66	13	60
Glenfield	7,558	6.6	12	67	14	67
Sydney South West	360,166	7.1	15	68	11	50
Greater Sydney	4,391,674	6.8	12	68	13	60
Rest of NSW (excluding Sydney)	2,512,949	6.3	13	63	18	63

As shown above in Table 10-3, the population composition in the suburbs of Moorebank, Casula, and Glenfield are largely similar to Sydney Southwest and Greater Sydney. Wattle Grove is characterised by a lower proportion of people aged 65 years and over.

According to the Liverpool Community Health Profile (South Western Sydney Local Health District [SWSLHD] 2014), the population in the Liverpool LGA is predicted to increase significantly from 188,143 people in 2011 to 288,959 in 2031. The predicted population growth in various age groups is shown in Figure 10-1. Population growth is predicted at a faster rate for younger people (people less than 69 years of age).

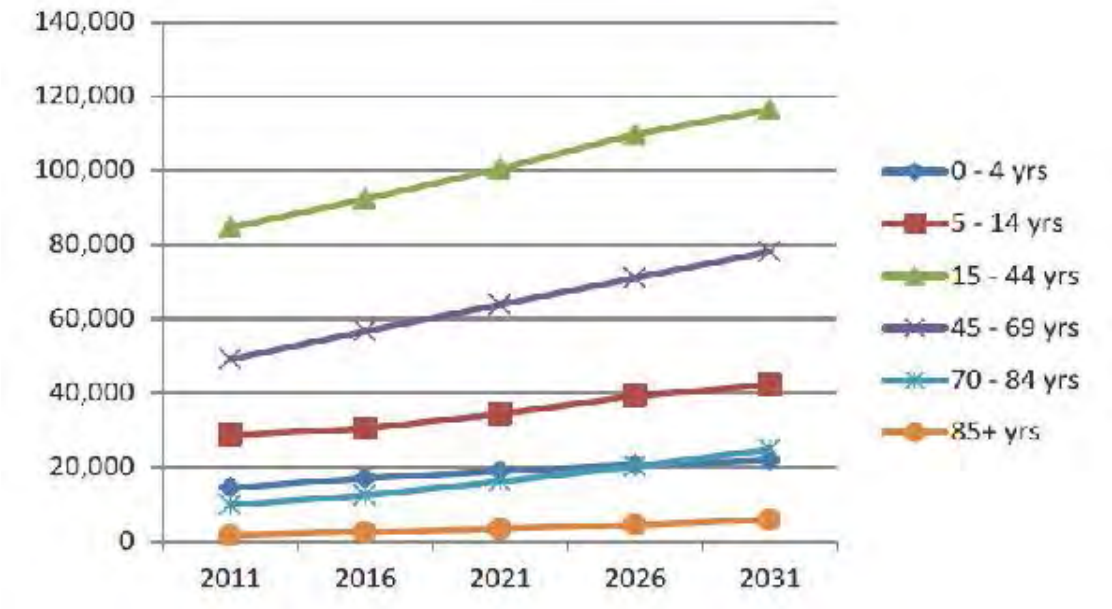

Figure 10-1 Projected population growth for the Liverpool LGA (2011-2031) (Source: SWSLHD, 2014)

Available health statistics from larger regional areas incorporating the health study area (Liverpool LGA, the larger Sydney South West Area, Greater Sydney, and NSW) were assessed alongside similar statistics for the local Liverpool LGA region, as shown in Table 10-4. The data presented suggests the baseline health status, measured in terms of chronic disease incidence, of the local population (Liverpool LGA) does not differ significantly from the data for NSW as a whole.

Of particular note, according to the SWSLHD, the prevalence rate of asthma is 6.3% in people over 16 years of age in the area. This is lower than the NSW average for the same age group.

Table 10-4 Summary of baseline health incidence for Liverpool LGA and regional areas

Health indicator	Incidence for population (rate per 100,000 population)							
	Liverpool LGA		Sydney South West Area		Greater Sydney		NSW	
Mortality								
All causes-all ages	556	a	543	b	587	c	529	b
All causes-30+ years	--	--	--	--	--	--	1065	b
Cardiovascular disease- all ages1	162	a	160	a	--	--	155	b
Cardiovascular disease- 30+ years2	--	--	--	--	--	--	299	b
Cardiopulmonary 30+ years	--	--	--	--	--	--	490	d
Ischemic heart disease 30+ years3	71	a	72	a	--	--	67	b
Respiratory disease all ages	--	--	52	e	--	--	50	f
Respiratory disease 30+ years4	--	--	52	e	--	--	50	f

Health indicator	Incidence for population (rate per 100,000 population)							
	Liverpool LGA		Sydney South West Area		Greater Sydney		NSW	
Lung cancer 30+ years5	38	g	36	f	--	--	35	f
Hospital Admissions								
Respiratory disease 65+ years	--	--	--	--	--	--	4476	h
Respiratory disease 15-64 years6	--	--	--	--	--	--	899	h
Cardiac disease 65+ years7	--	--	--	--	--	--	9159	h
Cardiovascular disease 65+ years1	--	--	--	--	--	--	9159	h
Pneumonia and bronchitis 65+ years8	--	--	--	--	--	--	1236	h
Ischemic heart disease 65+ years9	--	--	2805	h	--	--	3331	h
COPD 65+ years	1678	i	1482	h	1194	j	1489	h
Asthma								
ED Visits 1-14 years[10]	--	--	--	--	--	--	804	b

Notes:

1. Used circulatory disease mortality data.
2. Used circulatory disease mortality data for 25+ years
3. Used coronary heart disease mortality data for all ages.
4. Used respiratory disease mortality data for all ages.
5. Used lung cancer mortality data for all ages.
6. Used respiratory disease hospitalisation data for 17-64 years.
7. Used data for cardiovascular disease hospitalisation data for 65+ years.
8. Used all pneumonia and influenza hospitalisation data.
9. Used coronary heart disease hospitalisation data for 75+ years.
10. Used ED presentations for asthma data for 0-17 years.

[a] 2012-2013 data (NSW HealthStats[3])
[b] 2013 data (NSW HealthStats).
[c] 2006-2007 data (Table 2.3 in EnRisks 2014a).
[d] 2005-2007 data (Table 2.3 in EnRisks 2014a).
[e] 2010-2011 data (NSW HealthStats).
[f] 2011 data (NSW HealthStats).
[g] 2004-2008 data (SWS LHD 2014).
[h] 2013-2014 data (NSW HealthStats).
[i] 2009-2011 data (Table 2.3 in EnRisks 2014a).
[j] 2010-2011 data (Table 2.3 in EnRisks 2014a).

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease; ED: Emergency Department; LGA: Local Government Area; SWS LHD: South Western Sydney Local Health District

Given the above data, it is assumed that there are no underlying health issues that would make the local communities more vulnerable to the effects of environmental factors from the Proposal than the rest of Sydney and NSW.

[3] Available at: http://www.healthstats.nsw.gov.au/

Existing air quality

Existing air quality in the local area has been evaluated by the AQIA prepared for the Proposal (refer to Chapter 9 and Appendix M of this EIS). Local air quality is influenced by a number of industrial and non-industrial sources, vehicle emissions from the existing road network, locomotive emissions from the East Hills Rail Line (south of the site) and the SSFL / Main Southern rail line (to the west), and emissions from aircraft using Bankstown Airport (northeast of the site).

Background air quality data (for particulate matter (PM_{10} and $PM_{2.5}$), oxides of nitrogen (NOx), ozone (O_3) and carbon monoxide (CO)) is available from a NSW Office of Environment and Heritage (OEH) monitoring station located in the Council depot, off Rose Street, Liverpool. The Liverpool OEH monitoring site does not collect data for sulphur dioxide (SO_2) and reference is therefore also made to the OEH monitoring site at Chullora, located approximately 12 km northeast of the Proposal site.

Annual mean PM_{10} concentrations range from 18 µg/m³ to 21 µg/m³ and on average over the past 5 years baseline concentrations are 77% of the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) standards. Annual mean $PM_{2.5}$ concentrations range from 6 µg/m³ to 9 µg/m³ and on average over the past 5 years baseline concentrations are 103% of the AAQ NEPM standard. Exceedances of the 24-hour average reporting standards for both PM_{10} and $PM_{2.5}$ have occurred in three of the past five years. Existing concentrations of PM_{10} and $PM_{2.5}$ for the Liverpool area are strongly influenced by vehicle emissions and wood heaters.

Although $PM_{2.5}$ concentrations for Liverpool do not currently comply with the NEPM AAQ standards, regulatory initiatives such as the NSW EPA Clean Air Plan outline potential actions for wood heaters and transport emission are expected to play a role in reducing ambient concentrations by 2027.

For NO_2, SO_2 and CO there have been no exceedances of the air quality standards for the previous five years and in general background air quality for these pollutants is considered good. On average over the past five years, baseline concentrations for NO_2 are 33% of the AAQ NEPM standard for annual mean and 42% for maximum 1 hour average. Relative to the AAQ NEPM standards, baseline concentrations for CO and SO2 are even lower, with maximum 1-hour baseline concentrations 12% of the AAQ NEPM standard for CO and 10% for SO_2.

Existing ambient noise levels

The existing ambient noise environment at locations representative of the potentially most affected residential receivers in Casula, Glenfield and Wattle Grove were established through long-term background noise monitoring conducted in accordance with the *NSW Industrial Noise Policy* (Environment Protection Authority 2000). The existing ambient noise levels (the equivalent noise levels averaged over a time period [$LA_{eq,\ period}$]), used for the HRA are presented in Table 10-5.

Table 10-5 Existing ambient noise levels

Suburb	LAeq, period (dBA)		
	Day	Evening	Night Time
Casula	55	54	53
Glenfield	48	47	44
Wattle Grove	55	49	46

Note: Daytime 7:00am–6:00pm; Evening 6:00pm–10:00pm; Night time 10:00pm 7:00am.

The hazard quotient equation presented in Section 10.2.2 of this EIS was applied to the existing established ambient noise levels to identify the existing hazard quotient at each sensitive receiver for annoyance, sleep disturbance and cognitive impairment. These are presented below in Table 10-6 and show that existing noise levels in at these receivers already exceed the hazard quotient of one.

Table 10-6 Hazard quotients for existing ambient noise

Suburb	Annoyance	Sleep Disturbance	Cognitive Impairment
	$LA_{eq, period}$	$LA_{eq, period}$	$L_{Aeq, period}$
Casula	1.3	1.4	1.3
Glenfield	1.1	1.1	1.1
Wattle Grove	1.3	1.2	1.3

Note: All exceedances have been expressed in **bold lettering**

10.4 Potential impacts

10.4.1 Air quality

The following sections summarise the findings of the HRA for each of the key air pollutants of concern identified during the consultation process undertaken as part of the MPE Project. As noted above, emissions to air from construction sources were not evaluated because they would be temporary, appropriately managed (Section 9 of this EIS) and compliant with relevant air quality standards.

Particulate Matter – PM_{10} and $PM_{2.5}$

Increased annual incidences for health end points relating to PM_{10} and $PM_{2.5}$ emissions for the Proposal is shown in Table 10-7 and Table 10-8 respectively.

The increased annual incidences for the health endpoints due to Proposal related PM_{10} and $PM_{2.5}$ exposure were all well below one case per year. For the most sensitive health endpoint of PM_{10}, the highest incidence is an additional 0.01 asthma-related emergency department visit per year among 1-14 year-olds in Wattle Grove (equivalent to one additional emergency department visits per 100 years).

For the most sensitive health endpoints of $PM_{2.5}$, there would be an additional 0.02 hospital admission per year associated with cardiac disease among 65+ year-olds in Moorebank (equivalent to two additional hospital admissions per 100 years), which may be attributed to daily exposure to emissions of $PM_{2.5}$ from the operation of the Proposal.

Based on the estimated increased annual incidence for multiple health endpoints contributing to mortality and morbidity for the Proposal, there are no significant adverse health effects expected in relation to short-term and long-term exposure to PM_{10} and $PM_{2.5}$ in the surrounding local area.

Table 10-7 Summary of increased annual incidence concerning PM_{10} emissions from the operation of the Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	0.005	0.004	0.009	0.007
All-cause mortality all ages	24-Hour Average	0.003	0.002	0.004	0.004
Mortality cardiovascular disease all ages	24-Hour Average	0.0008	0.0005	0.001	0.001
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.003	0.003	0.006	0.003
Hospital admissions cardiac disease 65+ years	24-Hour Average	0.005	0.004	0.008	0.003
Hospital admissions pneumonia and bronchitis 65+ years	24-Hour Average	0.0004	0.0003	0.0007	0.0003
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.004	0.003	0.006	0.007
ED visits asthma 1-14 years	24-Hour Average	0.007	0.003	0.009	0.01

Abbreviations: ED: Emergency Department. PM: Particulate Matter

Table 10-8 Summary of increased annual incidence concerning $PM_{2.5}$ emissions from the operation of the Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	0.008	0.006	0.01	0.01
Cardiopulmonary mortality 30+	Annual Average	0.008	0.007	0.01	0.01
Mortality ischemic heart disease 30+ years	Annual Average	0.002	0.002	0.003	0.003
Mortality lung cancer 30+ years	Annual Average	0.0006	0.0003	0.001	0.0008
All-cause mortality all ages	24-Hour Average	0.003	0.002	0.004	0.004
Mortality cardiovascular disease- all ages	24-Hour Average	0.0005	0.0003	0.0007	0.0007

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.004	0.004	0.008	0.003
Hospital admissions cardiac disease 65+ years	24-Hour Average	0.01	0.009	0.02	0.009
Hospital admissions cardiovascular disease 65+ years	24-Hour Average	0.007	0.006	0.01	0.005
Hospital admissions ischemic heart disease 65+ years	24-Hour Average	0.003	0.003	0.006	0.002
Hospital admissions COPD 65+ years	24-Hour Average	0.001	0.001	0.003	0.001
Hospital admissions pneumonia and bronchitis 65+ years	24-Hour Average	0.002	0.001	0.003	0.001
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.004	0.003	0.006	0.007
ED visits asthma 1-14 years	24-Hour Average	0.0007	0.0003	0.0009	0.001

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease. ED: Emergency Department. PM: Particulate Matter

Nitrogen Dioxide – NO_2

The increased annual incidences for health end points relating to NO_2 emissions for the Proposal are shown in Table 10-9.

The increased annual incidences for the health endpoints due to Proposal related NO_2 were below one case per year for all health endpoints and in all locations. The highest increased annual incidence would be 0.2 for all-cause mortality among 30+ year-olds and hospital admissions for cardiovascular and respiratory disease among 65+ year-olds in Moorebank.

Based on the estimated increased annual incidence for multiple health endpoints contributing to mortality and morbidity, there are no significant adverse health effects expected in relation to short-term and long-term exposure to NO_2 for the Proposal in the surrounding local area.

Table 10-9 Summary of increased annual incidence concerning NO_2 emissions from the operation of the Proposal

Health endpoint	Averaging period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	0.1	0.07	0.2	0.1
Cardiovascular mortality 30+ years	Annual Average	0.03	0.02	0.05	0.03
Respiratory mortality 30+ years	Annual Average	0.005	0.003	0.008	0.006
All-cause mortality all ages	24-Hour Average	0.04	0.02	0.05	0.05
Mortality respiratory disease	24-Hour Average	0.008	0.004	0.01	0.01
Mortality cardiovascular disease all ages	24-Hour Average	0.01	0.006	0.02	0.01
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.1	0.07	0.2	0.06
Hospital admissions cardiovascular disease 65+ years	24-Hour Average	0.09	0.07	0.2	0.06
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.04	0.02	0.06	0.06
ED visits asthma 1-14 years	24-Hour Average	0.008	0.003	0.01	0.01

Sulfur Dioxide – SO_2

The increased annual incidences for health end points relating to SO_2 emissions for the Proposal are shown in Table 10-10.

The increased annual incidences for the health endpoints due to Proposal related SO_2 exposure were all well below one case per year. For the most sensitive health endpoint, there would be an additional 0.004 asthma-related emergency department visit per year among 1-14 year-olds in Wattle Grove (equivalent to four additional emergency department visits per 1,000 years), which may be attributed to daily exposure to emissions of SO_2 from the operation of the Proposal.

Based on the estimated increased annual incidence for multiple health endpoints contributing to mortality and morbidity, there are no significant adverse health effects expected in relation to short-term exposure to SO_2 from the Proposal in the surrounding local area.

Table 10-10 Summary of increased annual incidence concerning SO_2 emissions from the operation of the Proposal

Health endpoint	Averaging period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality all ages	24-Hour Average	0.0005	0.0003	0.0007	0.0008
Mortality respiratory disease- all ages	24-Hour Average	0.0001	0.00007	0.0002	0.0002
Mortality cardiovascular disease- all ages	24-Hour Average	0.0002	0.0001	0.0003	0.0003
Hospital admissions respiratory disease 65+ years	1- Hour Maximum	0.002	0.001	0.003	0.003
ED visits asthma 1-14 years	24-Hour Average	0.002	0.001	0.003	0.004

Carbon Monoxide - CO

The increased annual incidences for health end points relating to CO emissions for the Proposal are shown in Table 10-11.

The increased annual incidences for the health endpoints evaluated due to Proposal related CO exposure were all well below one case per year. For the most sensitive health endpoint, there would be an additional 0.0006 hospital admission per year associated with cardiac disease among 65+ year-olds in Moorebank (equivalent to six additional hospital admission per 10,000 years), which may be attributed to 8-hour exposure to emissions of CO from the operation of the Proposal.

Based on the estimated increased annual incidence for multiple health endpoints contributing to mortality and morbidity, there are no significant adverse health effects expected in relation to short-term exposure to CO from the Proposal in the surrounding local area.

Table 10-11 Summary of increased annual incidence concerning CO emissions from the operation of the Proposal

Health endpoint	Averaging period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	8-Hour Average	0.00006	0.00005	0.0001	0.00009
Hospital admissions cardiac disease 65+ years	8-Hour Average	0.0003	0.0003	0.0006	0.0003
Hospital admissions cardiovascular disease 65+ years	8-Hour Average	0.00002	0.00002	0.00004	0.00002

Air toxics

Table 10-12 provides a summary of the excess lifetime cancer risks associated with the Proposal related exposure to benzene, 1,3-butadiene, and PAHs in consideration of the most exposed receptor identified within proximity to the Proposal (residential/school, commercial/industrial, or recreational).

Excess lifetime cancer risks associated with the Proposal related exposure to benzene, 1,3-butadiene, and PAHs (as BAP TEQ) were all below the acceptable risk range of 10^{-6} to 10^{-4}. The excess lifetime cancer risks associated with the Proposal related DPM exposure were all within the acceptable risk range of 10^{-6} to 10^{-4}.

Therefore, there are no unacceptable cancer risks expected in relation to long-term exposure to VOCs, DPM and PAHs in the surrounding local area.

Table 10-12 Summary of excess lifetime cancer risks associated with exposure to Benzene, 1,3-Butadiene, PAHs, and DPM from the operation of the Proposal

Chemical	Excess lifetime cancer risk at maximum exposed receptor		
	Residential/ School	Recreational	Commercial/ Industrial
Benzene	2.6E-07	4.2E-09	3.8E-08
1,3-Butadiene	6.3E-07	1.0E-08	9.4E-08
DPM	1.3E-05	2.5E-07	2.2E-06
PAHs (as BaP TEQ)	3.2E-09	6.2E-11	5.2E-10

Regional impacts

Regional air quality has been previously considered for the MPE Concept Plan Approval. It is expected that changes in regional air quality (e.g. assessment of photochemical smog on a regional scale) as a result of the operation of the Proposal would be negligible and therefore further assessment as part of this EIS was not considered necessary.

Summary

There are no significant adverse health effects expected in relation to short-term and long-term exposure to key Proposal related air pollutants in the surrounding communities. The increased annual incidences for the health endpoints evaluated were all below or equal to the acceptable risk of one additional case per year. The excess lifetime cancer risks were also within or below the acceptable risk range of 10^{-6} to 10^{-4}.

The HRA acknowledges that the Proposal would interact with the MPE Stage 1 Proposal and would operate simultaneously with the MPW Stage 2 Proposal and therefore considered cumulative impacts. The results of the cumulative assessment are reported in Section 18 of this EIS.

10.4.2 Noise

Exposure to noise can be associated with direct auditory and non-auditory health effects, including cardiovascular disease, cognitive impairment, sleep disturbance, tinnitus, annoyance and hearing impairment (WHO, 2011). Sleep disturbance is one of the most common complaints raised by noise exposed communities and can have a significant impact on health and quality of life. Guidelines for community noise, as formulated by the WHO and outlined in Table 10-2 are designed to protect communities against key health effects associated with noise.

Predicted operational noise levels at key sensitive receivers for the Proposal were determined from the Noise and Vibration Assessment (Appendix L of this EIS) and presented in Section 8 of this EIS. Construction phase impacts for the Proposal were not considered for this assessment as they would be temporary and are demonstrated in the Noise and Vibration Impact Assessment to comply with the relevant standards.

The existing noise levels are higher than those predicted for the operation of the Proposal. Table 10-13 shows that all hazard quotients for operational noise from the Proposal are less than or equal to 1 at all receivers, indicating that the operational noise from the Proposal does not pose an unacceptable risk to the health of these communities.

Table 10-13 Hazard quotients for operational noise from the Proposal

Receiver/ Suburb	Annoyance	Sleep Disturbance		Cognitive Impairment
	$LA_{eq,\ period}$	$LA_{eq,\ period}$	L_{Amax}	$L_{Aeq,\ period}$
Casula	0.4	0.4	0.6	0.3
Glenfield	0.4	0.4	0.4	0.3
Wattle Grove	0.5	0.5	1.0	0.4
All Saints Senior College (S1)	0.4	NA	NA	0.3
Casula Powerhouse (S2)	0.4	NA	NA	0.3
DJLU (I2)	1.0	N/A	N/A	1.0

Summary

In summary, the noise from the Proposal operation meets the WHO community noise guidelines at all receivers and does not pose an unacceptable risk to the health of nearby communities.

An assessment of total noise (i.e including the Proposal, existing ambient noise, MPE Stage 1 and MPW Stage 2) has been undertaken as part of the cumulative impact assessment and the results are reported in Section 18 of this EIS.

10.5 Mitigation Measures

With regard to air quality, the results from the assessment found that increases in risk due to air emissions caused by the Proposal are low and in many cases negligible, and are in accordance with relevant guidelines. The excess lifetime cancer risks were below or within the acceptable risk range. Therefore, there are no significant adverse health effects expected in relation to acute and chronic exposure to key air pollutants associated with the operation of the Proposal in the surrounding communities.

With regard to noise, the assessment found that WHO community noise guidelines would be met at all receivers. Further, as existing noise levels are higher than those predicted for the operation of the Proposal, a difference between Proposal related operational noise and the existing ambient noise level would not be detectable.

Mitigation measures prescribed within Section 8 (for Noise) and 9 (for Air Quality) of this EIS respectively are to be implemented to further reduce the air and noise impacts generated as a result of the operation of the Proposal.

11 BIODIVERSITY

Arcadis have undertaken an assessment of biodiversity impacts associated with the Proposal in accordance with OEH's Framework for Biodiversity Assessment (FBA) under the NSW Biodiversity Offsets Policy for Major Projects and to address the SEARs. The *Biodiversity Assessment Report (BAR)* is included in Appendix O of this EIS.

Table 11-1 provides a summary of the relevant SEARs which relate to biodiversity and where these have been addressed in this EIS.

Table 11-1 SEARs (Biodiversity)

SEARs	Where addressed
Biodiversity	
Including but not limited to a Flora and Fauna assessment. The assessment shall:	
a) assess the impacts on the biodiversity values of the site and adjoining areas, including Endangered Ecological Communities and threatened flora and fauna species and their habitat, groundwater dependent ecosystems, impacts on wildlife and habitat corridors, riparian land, and habitat fragmentation and details of mitigation measures. The assessment shall be undertaken in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the Threatened Species Conservation Act 1995	Section 11
b) consider the OEH's Threatened Species Survey and Assessment Guidelines (www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm), any relevant draft or final recovery plans, and Commonwealth Significant Impact Guidelines	Section 11.2
c) assess and document impacts related to the proposed project in accordance with the Framework for Biodiversity Assessment (OEH 2014), unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the Threatened Species Conservation Act 1995	Section 11
d) include a comprehensive offset strategy, or provide an updated strategy, in accordance with the NSW Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise or offset' principle	Section 11.5 Section 11.6

The Concept Plan Conditions of Approval are generally consistent with the SEARs provided for the Proposal as they relate to biodiversity (refer to Table 11-1) and have been addressed in this Section of the EIS. The compliance of the Proposal with the SEARs, Concept Plan Conditions of Approval and Statement of Commitments is provided at Appendix A of this EIS.

This Section summarises the studies undertaken for the MPE Concept Plan Approval (section 11.1) and, more recently, for the Proposal. This section of the EIS also summarises the methodology used to assess biodiversity related impacts of the Proposal (section 11.2), describes the existing environment as it relates to biodiversity (section 11.3) and provides and assessment of biodiversity impacts associated with construction and operation of the Proposal (section 11.4). Measures to mitigate potential biodiversity impacts where they are required have identified section 11.5.

11.1 Concept Plan Assessment

Impacts on biodiversity associated with construction and operation of the MPE Project were assessed in the MPE Concept Plan Approval in the Flora and Fauna Assessment (Hyder Consulting, 2013a). The study area for the Concept Plan Flora and Fauna Assessment is shown in Figure 11-1.

Five vegetation types were identified within the study area, of which four correspond with threatened ecological communities (TECs) listed under the *NSW Threatened Species Conservation Act 1995* (TSC Act), based on analysis of existing vegetation maps and ground truthing:

- Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion
- Castlereagh Swamp Woodland
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions

The fifth vegetation type, and only type not listed as a threatened ecological community, identified in the Concept Plan study area was ‘urban/exotic’.

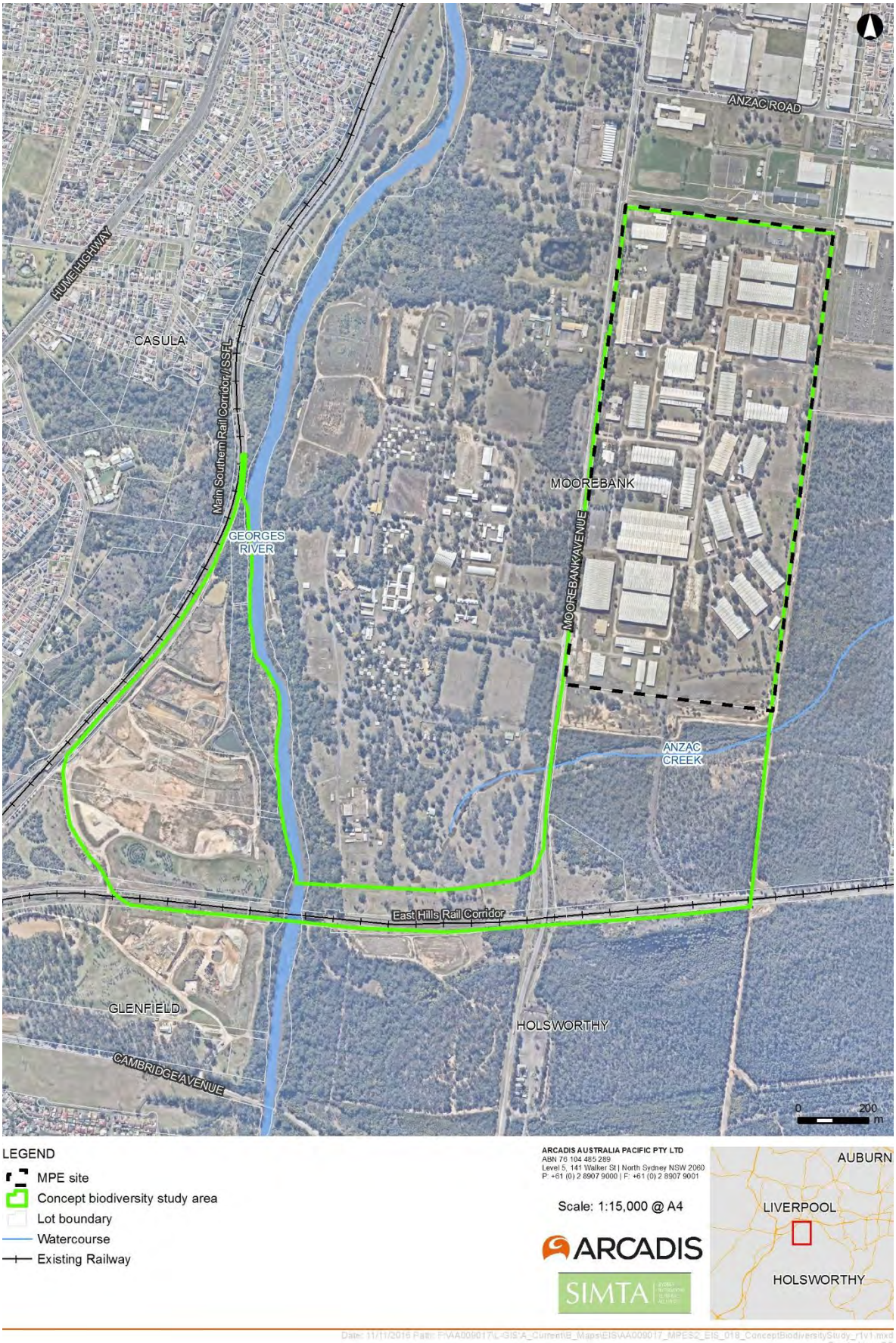

Figure 11-1 Study area for the Concept Plan Flora and Fauna Assessment

Two threatened flora species list under the EPBC Act and TSC Act were recorded within the study area:

- *Persoonia nutans* (Nodding Geebung), listed as Endangered under the EPBC Act and on Schedule 1 of the TSC Act
- *Grevilla parviflora subsp. parviflora* (Small-flower Grevillea), is listed as Vulnerable under the EPBC Act and on Schedule 2 of the TSC Act

Another threatened species, *Acacia pubescens* (Downy Wattle), was recorded at the edge of bushland to the east of the MPE site. *Acacia pubescens* is listed as Vulnerable under the EPBC Act and on Schedule 2 of the TSC Act.

Four threatened fauna species listed under the TSC Act and/ or EPBC Act were also recorded:

- Eastern Bent-wing Bat (*Miniopterus schreibersii*)
- Southern Myotis (*Myotis macropus*)
- Eastern Free-tail Bat (*Mormopterus norfolkensis*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*).

Other species of concern that were not recorded but were identified as having the potential to occur within the study area included:

- the Green and Golden Bell Frog (L*itorea aurea*),
- Spotted-tail Quoll (*Dasyurus maculatus*)
- Macquarie Perch (*Macquaria australasica*).

These species were specifically addressed in the Flora and Fauna Assessment and were identified as not being impacted by the MPE Project.

The study area as assessed contains, and is bound by, significant barriers to fauna movement, including Moorebank Avenue, the East Hills Railway line and chain-mesh fencing surrounding the MPE site, Royal Australian Engineers Golf Course and Glenfield Waste Disposal Facility. This would limit movement into and through the study area to small terrestrial mammals, reptiles, amphibians, bats and birds.

The following biodiversity values were assessed as likely to be impacted as a result of the MPE Project:

- Two threatened flora species listed under the EPBC Act and TSC Act
- Four TECs listed under the TSC Act
- Four threatened fauna species, of which one is listed under the EPBC Act and TSC Act and three are listed under the TSC Act
- Habitat for threatened flora species
- Habitat for locally occurring fauna species
- Potential habitat for threatened terrestrial and aquatic fauna species.

Assessments of significance were prepared for threatened flora and fauna species and ecological communities known or likely to be impacted by the MPE Project. In accordance with the EIS guidelines, assessment of seven particular threatened species and communities listed under the EPBC Act that are known or likely to be present in the vicinity of the proposed development was also undertaken. These assessments concluded that the four threatened ecological communities, four threatened terrestrial fauna species and one aquatic fauna species would not be significantly impacted by the MPE Project. Impacts on these threatened species and communities can be adequately managed through the mitigation measures proposed in Section 11.5 of this EIS. The threatened plant species *Grevillea parviflora* subsp.

parviflora was also considered unlikely to be significantly impacted by the MPE Project. The Assessment of Significance for *Persoonia nutans* concluded that this endangered species would be significantly impacted as a result of the MPE Project due to the construction of the rail corridor, which subsequently further assessed under the MPE Stage 1 Proposal and therefore not relevant to the MPE Stage 2 Proposal.

A range of measures were recommended to mitigate impacts on the biodiversity values during construction and operation.

Based on the recommendations of the *Flora and Fauna Assessment* (Hyder Consulting, 2013a), the Revised Statement of Commitments committed to the following actions to be undertaken during the future planning applications related to MPE:

Aquatic Flora and Fauna

- *The Proponent will implement the following measures to protect the aquatic flora and fauna as part of the applications for the detailed planning applications (where relevant and applicable):*
  - *Implementation of Construction and Operation Management Plans for maintenance of structures in riparian and aquatic zones*
  - *Minimise siltation of the Georges River during construction through implementing the water quality mitigation measures detailed within the Stormwater and Flooding section of the Statement of Commitments*
  - *Thorough assessment of any development within the Anzac Creek Castlereagh Swamp Woodland community, including potential impacts on groundwater quality and quantity*
  - *Lantana removal within nominated construction zones to reduce degradation of streamside vegetation and offset any potential impacts to aquatic biodiversity*

Riparian

- *The riparian setback for Anzac Creek, as specified by NSW Office of Water, is 30 metres (20 metre CRZ and 10 metre VB), while the Georges River riparian setback is likely to be a minimum of 50 metres (40 metre CRZ and 10 metre VB)*
- *Riparian corridors will be appropriately revegetated to restore and/or maintain ecological, functional and habitat values and impede surface flows and drop sediment before it reaches the waterways*
- *Water quality and quantity issues will be managed during the construction phase through the implementation, inspection and maintenance of best practice soil and water management techniques which will be defined in the CEMP for sedimentation and erosion control during construction*
- *Water quality and quantity issues will be managed during the operation phase through the implementation, inspection and maintenance of Water Sensitive Urban Design (WSUD) measures such as rainwater tanks, grass filter strips, swales and bio retention.*

In addition to the Statement of Commitments, the MPE Concept Plan Approval included a number of requirements to be undertaken for biodiversity for future approvals. The Conditions of Approval are generally consistent with the SEARs provided for the Proposal and have been addressed in this Section. A complete compliance table of this EIS with the SEARs, Statement of Commitments and Conditions of Approval is provided in Appendix A of this EIS.

The proposed development of MPE Stage 1 incorporates most of the biodiversity impacts assessed for the MPE Concept Plan Approval, as these impacts primarily result from the construction of the Rail link through areas of native vegetation south of the MPE site (within the Boot Lands). These impacts were assessed in detail in the

Biodiversity Assessment Report prepared for the MPE Stage 1 EIS (Hyder Consulting 2015). As assessed in the Concept Plan, the majority of the current Proposal site is located within cleared and disturbed land, with no native vegetation communities and low habitat values for flora and fauna.

Further a Biodiversity Offset Strategy (BOS) is currently under preparation to offset the impacts of the MPE Project and MPW Project. This BOS is to be submitted in accordance with the Conditions of Approval for the MPW Project (SSD 5066) and also Draft Conditions of Approval for the MPE Stage 1 Proposal (SSD 14-6766).

11.2 Methodology

The methodology for the BAR has been prepared in accordance with OEH's FBA under the NSW Biodiversity Offsets Policy for Major Projects. The study area for the biodiversity assessment encompasses the Proposal site. The 'Proposal site' refers to all areas to be impacted by construction of the Proposal (Under the FBA, this area is referred to as the 'development site'). The Proposal site area is shown on Figure 11-2. Areas of the Proposal site on the western side of Moorebank Avenue would be cleared during Stage 1 and Stage 2 of the MPW Project. Impacts to biodiversity in this area have been assessed in accordance with the FBA and NSW Biodiversity Offsets Policy for Major Projects as part of the MPW Stage 1 EIS (Parsons Brinckerhoff, 2014) and MPW Stage 2 EIS (Arcadis, 2016).

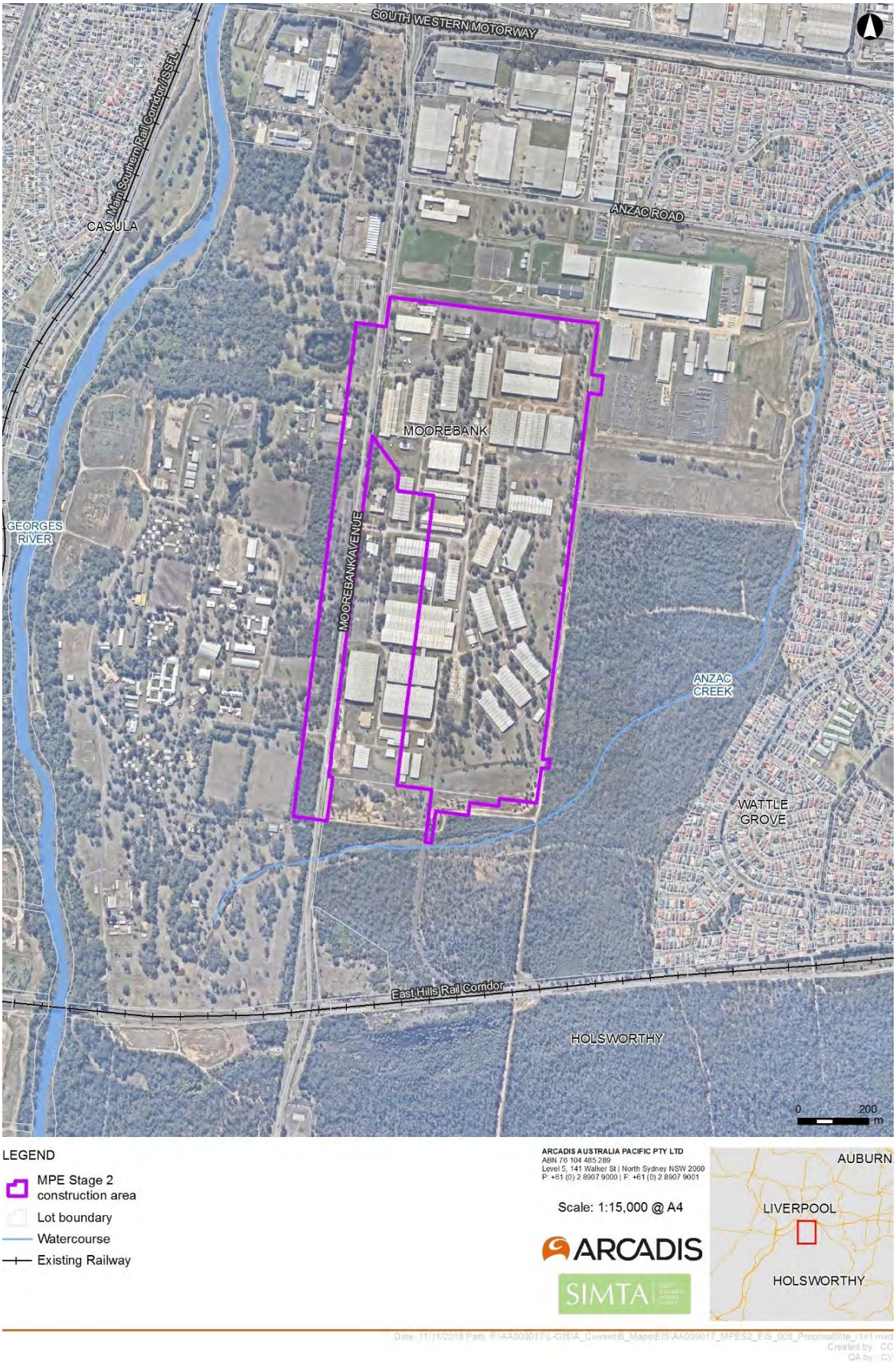

Figure 11-2 The Proposal site

11.2.1 Database interrogation

Database searches were undertaken to identify State and Commonwealth records of threatened entities and Commonwealth matters of national environmental significance (MNES). Databases interrogated for this purpose were:

- The NSW Threatened Species Profile Database (TSPD), which is managed by OEH
- The Vegetation Information System (VIS) classification database, which is managed by OEH
- The over-cleared landscapes database (Mitchell landscapes), which is managed by OEH
- The Directory of Important Wetlands of Australia (DIWA), maintained by the Australian Government.

11.2.2 Literature / mapping review

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the Proposal site and wider region. Reports, vegetation maps, topographic maps, aerial photography and literature reviewed included, but were not limited to, the following:

- *Soil Landscapes of the Penrith 1:100 000 Sheet* (Bannerman & Hazelton 1990).
- *SIMTA Stage 1: Biodiversity Assessment Report* (Hyder Consulting 2015)
- *Assessment of the Sydney Intermodal Terminal Facility, Moorebank: Aquatic Ecology* (ALS (2011)
- *Moorebank Intermodal Terminal: Biodiversity Offset Areas Biodiversity Assessment Report* (Parsons Brinckerhoff 2015).
- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (OEH 2013).

11.2.3 Field surveys

Field assessment of the biodiversity values of the Proposal site has been conducted on a number of occasions between May 2011 and October 2016. More recent field investigations were undertaken to quantify any changes in site conditions, account for additional impact areas and assess vegetation. Field investigations were undertaken during daylight hours by Arcadis ecologists Jane Rodd and Laura Hoffman on 21 June 2016 and Jane Rodd and Kate Carroll on 13 October 2016.

Methodology for field surveys generally involved:

- Vegetation plots
- Tree surveys
- Targeted threatened species surveys
- Fauna surveys.

11.3 Existing Environment

11.3.1 Landscape Assessment

The FBA requires the assessment of landscape features to describe the biodiversity values of the study area and assess the impacts of the Proposal. Landscape features relevant to the FBA calculations are shown on Figure 11-3 and summarised below in Table 11-2.

The Proposal is a site-based development; as such, the landscape value has been assessed in accordance with the methodology in Appendix 4 of the FBA (OEH 2014). Two assessment circles were mapped to enable assessment of landscape values, including the percent current extent of native vegetation cover within and adjacent to the Proposal site. In accordance with the allowable combinations of inner and outer assessment circles in Table 8 of the FBA, an inner circle of 100 ha and an outer circle of 1000 ha were used. Both circles were centred on the Proposal site and are shown on Figure 11-3.

Table 11-2 Landscape features

Landscape feature	Proposal site
IBRA (Interim Biogeographic Regionalisation for Australia) bioregions and subregions	The Proposal site is located within the Sydney Basin Bioregion and the Cumberland Subregion classified under IBRA.
Major Catchment Area	The Proposal site is located within the Sydney Metropolitan CMA and the Cumberland CMA subregion.
Mitchell landscapes	The Proposal site is located within the Georges River Alluvial Plain Mitchell landscape. This Mitchell Landscape is not currently listed in the credit calculator, so the Cumberland Plain Mitchell Landscape was used following advice from OEH (pers. comm. Biobanking Team, OEH, 25 August 2015).
Rivers, streams and estuaries	The Proposal site is located within the Georges River catchment. The Georges River is located between 600 metres to one kilometre west of the Proposal site, where it flows to the north then meanders south-east from Chipping Norton before draining into Botany Bay. Anzac Creek originates from the MPW site west of Moorebank Avenue and extends to the north-east and south of the Proposal site. A drainage swale for the Proposal site would feed into Anzac Creek at its southern boundary. The creek flows north past the adjoining suburbs of Wattle Grove and Moorebank before draining into Lake Moore in Chipping Norton, which flows into the Georges River. The section of Anzac Creek to the south of the Proposal site is considered to be a 3rd order stream. In addition to these named watercourses, there is a network of formalised drainage channels located in the south of the Proposal site. These channels drain into the native vegetation to the east of the MPE site.

Landscape feature	Proposal site
Wetlands	No local or important wetlands occur in the outer assessment circle. Watercourses and wetlands in the locality are mapped in Figure 11-3.
Native vegetation cover in landscape	The native vegetation cover in the landscape was determined with reference to the regional vegetation mapping by OEH (2013). All native vegetation types mapped by OEH (2013) within the inner and outer assessment circles were considered to represent the current native vegetation cover. Native vegetation cover percentages were calculated as a proportion of all land within each assessment circle that contains mapped native vegetation. The current percent native vegetation cover in both the inner and outer assessment circles is 25-30%; the respective scores for native vegetation cover are 4.5 for the inner circle and 7.5 for the outer circle. The Proposal would result in a negligible reduction in the percent native vegetation cover in both the inner and outer assessment circles, and the future percent native vegetation cover in both circles remains at 25-30%. As the scores would remain unchanged, the value for native vegetation in the landscape is 0.
Connectivity value	One connecting link has been identified immediately adjacent to the Proposal site, in the 'Boot Land'. The vegetation in this area represents native vegetation in moderate to good condition, has a patch size greater than one hectare and minimal cleared or hostile land features between patches of vegetation. The Proposal has very minor overlap with the Boot Land, and would not alter the existing connectivity values, sever native vegetation or form a hard barrier within the connecting link. As the Proposal would not decrease the corridor width or the overstorey and understorey benchmark values, the score for connectivity value is 0.
Patch size	The size of the largest patch of native vegetation occurring within the majority of the Proposal site is 0.1 hectares. The very small (0.05 hectare and 0.01 hectare) areas of vegetation within the Boot Land that the Proposal site overlaps connects to larger areas of bushland within Holsworthy Military Area to the south, which comprises approximately 18,000 hectares of continuous native vegetation. As such, the vegetation in the Proposal site has been assigned the maximum patch size of 1001 hectares. In accordance with the criteria in Table 15 of Appendix 4 of the FBA, the patch size class is considered to be *very large* with a corresponding patch size score of 12.
Landscape value score	The landscape value score for the Proposal is 12. This score comprises: ▪ Native vegetation cover – 0 (based on the deduction of the future percent native vegetation cover scores from the current percent native vegetation cover scores ▪ Connectivity value – 0 ▪ Patch size - 12.

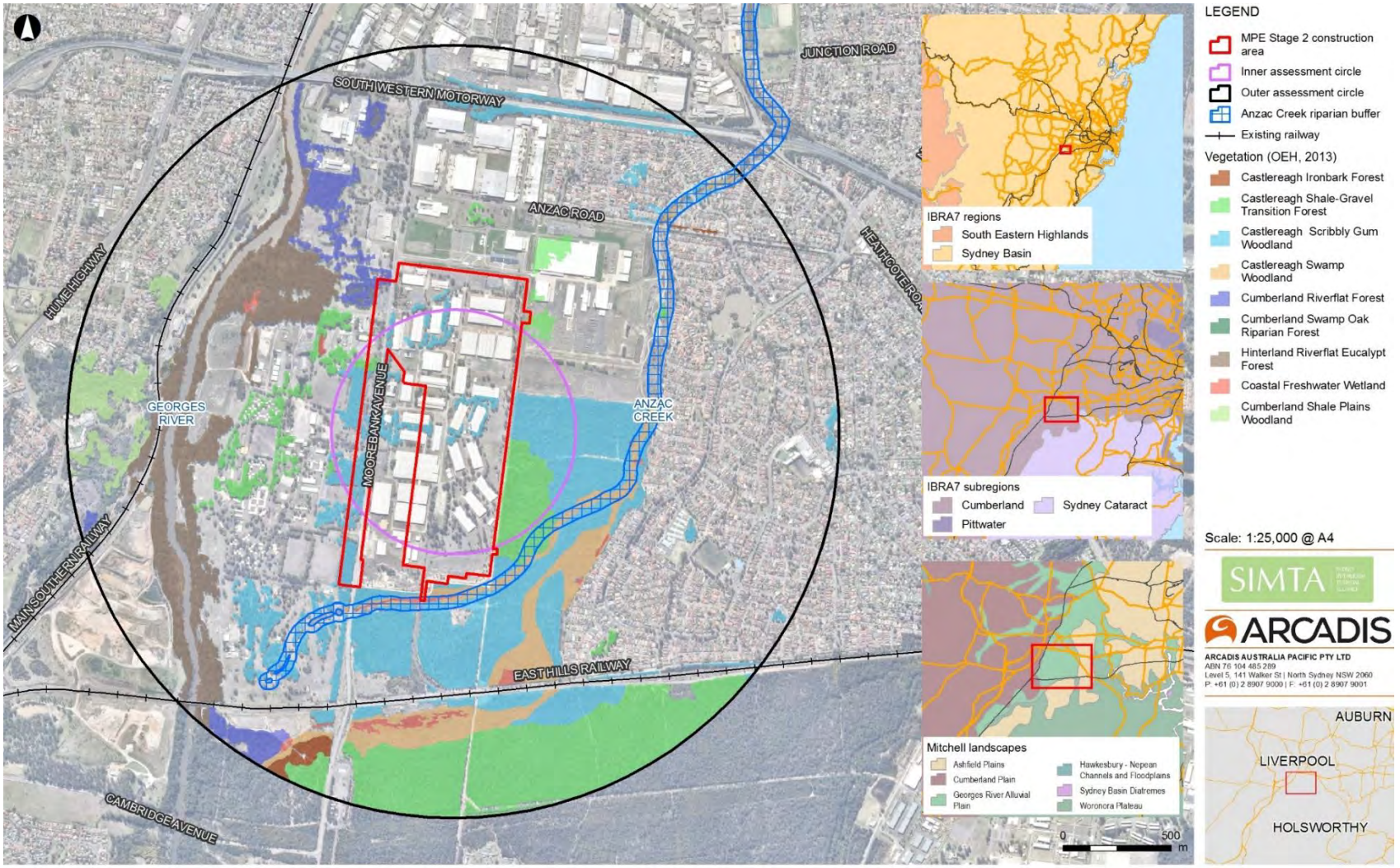

Figure 11-3 Landscape features

11.3.2 Native vegetation

The vegetation within the Proposal site consists predominantly of planted landscaped areas and mown/slashed grassland, with native vegetation predominantly cleared. The small area of native vegetation that persists is an isolated fragment amongst expanses of mown exotic and native grasses. The native vegetation within and adjoining the Proposal site to the south and east is representative of threatened ecological communities listed in Schedule 1 and 2 of the TSC Act.

Plant community types

Regional vegetation mapping prepared by OEH (2013) and mapping of the Boot Land by Parsons Brinckerhoff (2014) within the Proposal site were reviewed and ground truthed during field surveys.

Three vegetation types were identified within the Proposal site: two native vegetation communities (Disturbed Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland and Broad-leaved Ironbark - Melaleuca decora shrubby open forest) and one modified vegetation type, Planted and disturbed vegetation.

Details of the two native Plant Community Types (PCTs) are provided in Table 11-3 and are shown in Figure 11-4.

Table 11-3 Plant community types identified on the Proposal site

Vegetation Class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement	Area (ha) within Proposal site
Sydney Sand Flats Dry Sclerophyll Forests	ME003	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	50%	0.1 ha
Cumberland Dry Sclerophyll Forests	ME002	Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	95%	0.05 ha
Coastal Freshwater Lagoons	ME007	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	70%	0.01 ha

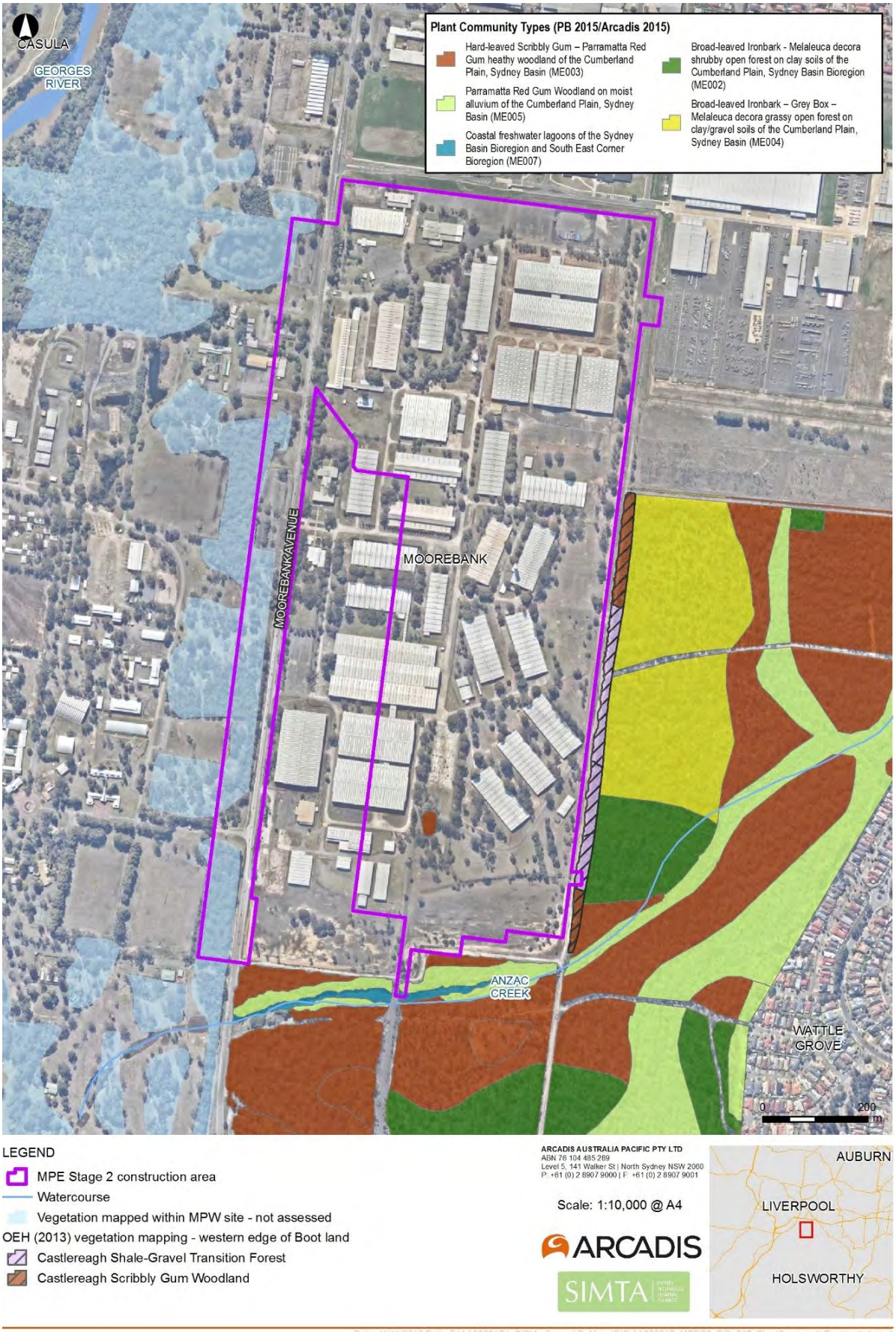

Figure 11-4 Revised PCTs on the Proposal site

Threatened ecological communities

The two PCTs identified in the Proposal site are included within the definitions of threatened ecological communities listed under the TSC Act and/or EPBC Act, as per Table 11-4.

Table 11-4 Threatened ecological communities on the Proposal site

Plant Community Type	Equivalent TEC	TSC Act Status	EPBC Act Status
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable	Endangered
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (ME002)	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Endangered	Critically Endangered
Coastal freshwater lagoons of the Sydney Basin and South-east Corner (ME007)	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered	Not listed

Vegetation condition

For the purpose of the FBA assessment the Proposal site contained two plant community types in the moderate to good condition category. The vegetation zones identified in the Proposal site are listed in Table 11-5. The site value score for each vegetation zone identified in the Proposal site was determined through assessment of site attribute data collected in vegetation plots.

Table 11-5 Area and site value score for each vegetation zone

Vegetation Zone	Area mapped in Proposal site	Site value score
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good (ME003)	0.1 ha	68.23
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (ME002)	0.05 ha	74.48
Coastal freshwater lagoons of the Sydney Basin and South-east Corner (ME007)	0.01 ha	64.10

Groundwater dependent ecosystems

It is probable, due to local hydrogeology, that groundwater across the Proposal site and the wider region is interconnected. As such, if stygofauna were present they are unlikely to be isolated to the vicinity of the Proposal site.

A search of the Australian Government's Atlas of Groundwater Dependent Ecosystems was undertaken on 7 April 2016. No data on subterranean groundwater-dependent ecosystems (GDEs) is available for the locality. Notwithstanding this, several GDEs with potential reliance on subsurface groundwater were identified in the locality including in the Proposal site (Bureau of Meteorology 2016). In particular, the vegetation adjoining Anzac Creek to the south of the Proposal site, which has been identified as having high potential for groundwater interaction. Results are mapped in Figure 11-5.

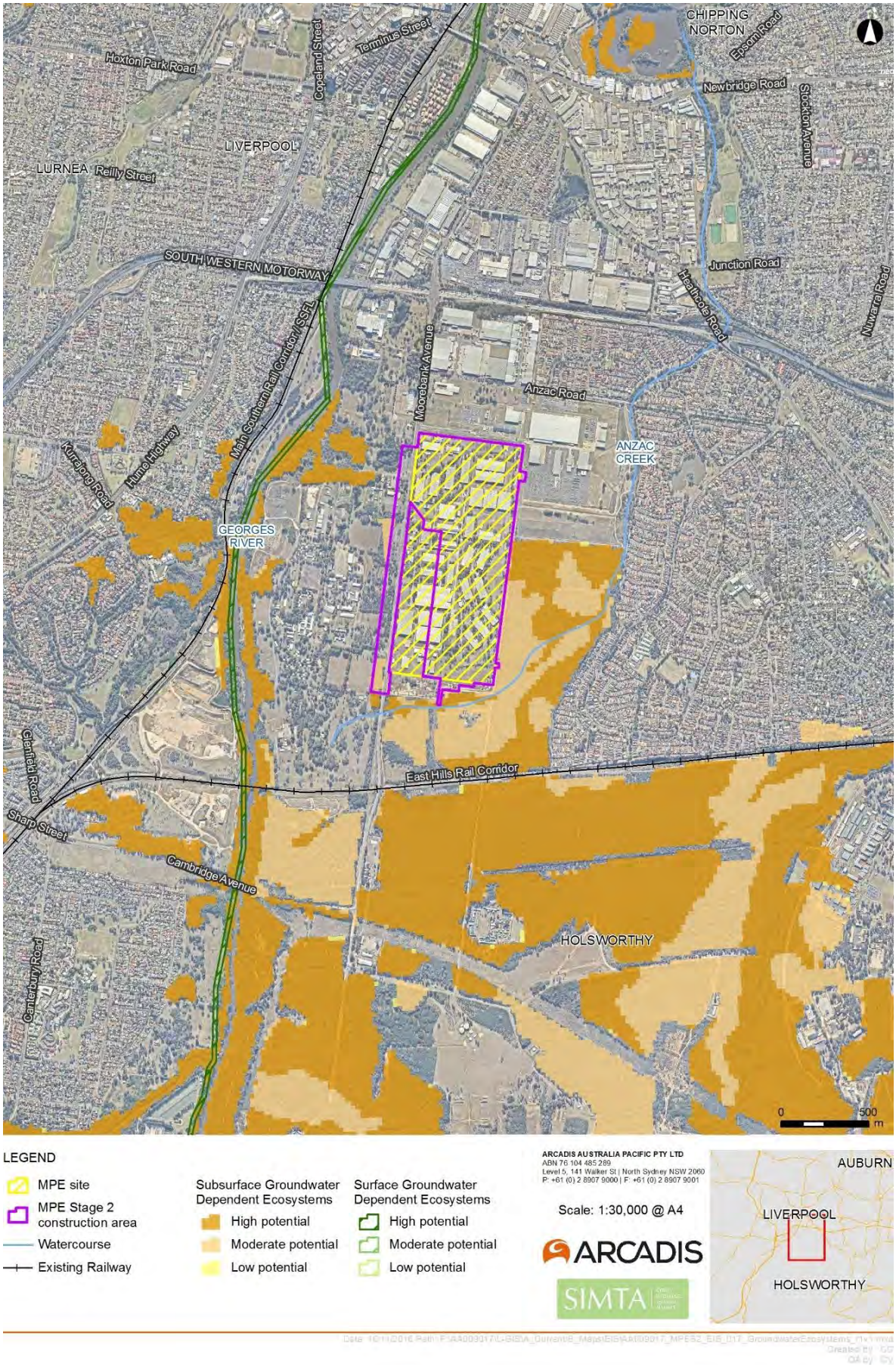

Figure 11-5 Groundwater dependent ecosystems

Fauna habitats

The majority of the Proposal site is comprised of landscaped areas. Native vegetation has been predominantly cleared from these areas and persists as isolated trees amongst expanses of mown exotic and native grasses. Potential fauna habitats within the Proposal site include:

- Isolated trees – offering potential sheltering, roosting and nesting sites for birds and foraging habitat for flying foxes
- Cleared and disturbed areas – potential habitat of a diversity of microchiropteran bat species. Seven eucalypts in the Moorebank Avenue road reserve were also identified as containing small hollows or bark fissures that represent habitat for microbats
- Open grassy areas – provides potential foraging habitat for ground-feeding birds
- Scattered native and exotic shrubs and trees associated with the formalised drainage channels in the south of the Proposal site - offer foraging, sheltering and roosting habitat for birds.

Aquatic habitats

There is a network of formalised drainage channels in the south of the Proposal site. These channels do not all support permanent water; some flow only ephemerally following rain. Channels in the south of the Proposal site support aquatic and fringing vegetation, such as *Typha sp*, and offer habitat for reptiles and amphibians.

Habitat types of Anzac Creek within the Proposal site include soft substrate pools with static, shallow water that are heavily vegetated with floating and emergent macrophytes. Anzac Creek is classified as Class 3 (Minimal Fish Habitat) in accordance with Fairfull and Witheridge (2003).

Fish passage within Anzac Creek is generally only possible during periods of rain when the creek is flowing. At other times the creek forms stagnant pools with dense emergent vegetation that restrict fish passage.

11.3.3 Threatened species

Ecosystem credit species

A total of 23 threatened fauna species were derived from the PCTs identified on the Proposal site as predicted ecosystem credit species. Each species has been assessed for potential presence in each of the vegetation zones in the Proposal site using information obtained from the Threatened Species Profiles Database (TSPD). The assessment found that two species have a high likelihood of occurrence and 10 have a moderate likelihood of occurrence within the Proposal site.

Table 11-6 Predicted ecosystem credit species

Predicted ecosystem credit species	TSC Act Status	EPBC Act Status	Likelihood of occurrence on Proposal site
Australian Painted Snipe (Rostratula australis)	Endangered	Endangered	Moderate
Barking Owl (*Ninox connivens*)	Vulnerable	n/a	Moderate
Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis* subsp. *gularis*)	Vulnerable	n/a	Moderate
Black-tailed Godwit (*Limosa limosa*)	Vulnerable	n/a	Unlikely
Brown Treecreeper (eastern subspecies *(Climacteris picumnus* subsp. *victoriae*)	Vulnerable	n/a	Unlikely
Bush Stone-curlew (*Burhinus grallarius*)	Endangered	n/a	Unlikely
Diamond Firetail (*Stagonopleura guttata*)	Vulnerable	n/a	Unlikely
Eastern False Pipistrelle *(Falsistrellus tasmaniensis*)	Vulnerable	n/a	Unlikely
Eastern Freetail-bat (*Mormopterus norfolkensis*)	Vulnerable	n/a	High
Flame Robin (*Petroica phoenicea*)	Vulnerable	n/a	Unlikely
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	Vulnerable	n/a	Moderate
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	Vulnerable	n/a	Moderate
Hooded Robin (south-eastern form) (*Melanodryas cucullata* subsp. *cucullata*)	Vulnerable	n/a	Unlikely
Little Eagle (*Hieraaetus morphnoides*)	Vulnerable	n/a	Moderate
Little Lorikeet (*Glossopsitta pusilla*)	Vulnerable	n/a	High
New Holland Mouse (*Pseudomys novaehollandiae*)	Vulnerable	n/a	Unlikely
Painted Honeyeater (*Grantiella picta*)	Vulnerable	n/a	Unlikely
Powerful Owl (*Ninox strenua*)	Vulnerable	n/a	Moderate
Scarlet Robin (*Petroica boodang*)	Vulnerable	n/a	Moderate

Predicted ecosystem credit species	TSC Act Status	EPBC Act Status	Likelihood of occurrence on Proposal site
Speckled Warbler (*Chthonicola sagittata*)	Vulnerable	n/a	Unlikely
Spotted Harrier (*Circus assimilis*)	Vulnerable	n/a	Unlikely
Spotted-tailed Quoll (*Dasyurus maculatus*)	Vulnerable	Endangered	Unlikely
Swift Parrot (*Lathamus discolour*)	Endangered	Critically Endangered	Moderate
Varied Sittella (*Daphoenositta chrysoptera*)	Vulnerable	n/a	Moderate
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	Vulnerable	n/a	Moderate

Species credit species

Flora

Twelve threatened flora species listed under the TSC Act were identified in the credit calculator as predicted flora species credit species. None of the predicted threatened flora species credit species were recorded on the Proposal site.

Four of the threatened flora species credit species identified by the credit calculator were recorded in the Boot Land to the south and east of the Proposal site: *Acacia bynoeana, Acacia pubescens, Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora.* Another threatened species not identified by the calculator, *Hibbertia puberula* subsp. *puberula,* was also recorded in the Boot Land. Given the marginal habitat present and following targeted surveys, it is considered unlikely that any of these threatened flora species occur on the Proposal site.

The Proposal site represents low quality habitat for threatened flora species, with highly modified and fragmented native vegetation. Targeted searches for the threatened flora species identified in the calculator, with particular focus on those recorded to the south and east in the Boot land, were conducted in areas of marginal habitat in the south of the Proposal site in June and October 2016. No threatened flora species were identified and are considered unlikely to occur.

Three threatened flora populations were also identified in the credit calculator as potentially occurring:

- *Acacia prominens* (Gosford Wattle) population, Hurstville and Kogarah local government areas
- *Pomaderris prunifolia* (Plum-leaf Pomaderris) population, Parramatta, Auburn, Strathfield and Bankstown local government areas
- *Wahlenbergia multicaulis* (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strtahfield local government areas.

None of the identified threatened populations occur within the Liverpool local government area (Liverpool City Council), in which the Proposal site is located.

Fauna

Six threatened fauna species were identified in the credit calculator as predicted fauna species credit species. None of the predicted threatened fauna species credit species were recorded or are considered likely to occur on the Proposal site,

11.4 Potential impacts

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the construction of the Proposal. The impacts specified in point 11a) of the SEARs are considered below.

11.4.1 Endangered (and vulnerable) ecological communities

The Proposal will require clearing of all vegetation within the Proposal site, including threatened ecological communities. The threatened ecological communities to be directly impacted and the total areas of impact are listed in Table 11-7.

Table 11-7 Areas of direct impact to threatened ecological communities

Plant Community Type	Equivalent TEC	Conservation status	Area of impact
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable (TSC Act) Endangered (EPBC Act)	0.1 ha
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Endangered (TSC Act) Critically Endangered (EPBC Act)	0.05 ha

11.4.2 Threatened flora and fauna species and their habitat

The Proposal will have minimal impact on threatened flora species listed under the TSC Act and EPBC Act. Populations of several threatened plant species have been identified in the Boot Land, to the east and south of the Proposal site. Potential habitat for these species in the Proposal site is poor quality, and subject to fragmentation and/or edge effects. Targeted surveys did not identify any threatened flora species in the Proposal site.

The clearing of vegetation will result in the loss of specific fauna habitat components, including live trees, tree hollows, foraging resources, and groundlayer habitats such as ground timber and minor leaf litter. These resources offer sheltering, foraging, nesting and roosting habitat to a variety of fauna, including threatened fauna, occurring within the locality. The Proposal will require removal of seven trees identified as containing small hollows or bark fissures, all of which are located in the Moorebank Avenue road reserve.

The assessment of ecosystem credit species associated with PCTs on the Proposal site found that two threatened fauna species have a high likelihood of occurrence and 11 have a moderate likelihood of occurrence. Given the modified and fragmented nature of fauna habitat in the Proposal site, potential impacts on these species are considered likely to be minimal, and mainly comprise removal of marginal foraging, sheltering and roosting habitat.

11.4.3 Groundwater dependent ecosystems

Groundwater is anticipated to be deeper than the expected bulk excavations required during construction. There is potential for groundwater to be encountered within the depth of bored piles, if used (the requirement for piles would be determined during detailed design). Groundwater may also be encountered within excavations undertaken towards the south-eastern corner of the Proposal site (i.e. in proximity to Anzac Creek) for depths greater than approximately 1.5m.

The temporary nature of construction works and the limited extent of potential disturbance to groundwater means that prolonged impacts on groundwater are not anticipated as a result of the Proposal. Whilst the proposed redevelopment of the site would make the Proposal site more impervious, recharge to groundwater systems would be minimally impacted. Subsequently, impacts to potential GDEs in the vicinity of the Proposal site from changes to groundwater are anticipated to be minimal as groundwater levels and quality are unlikely to change significantly.

11.4.4 Impacts on wildlife and habitat corridors and habitat fragmentation

The small areas of habitat to be removed from within the Proposal site for the Proposal are currently fragmented by the existing development. There is good quality fauna habitat immediately adjacent to the Proposal site, in the Boot Land. The Boot Land contains approximately 83 hectares of native vegetation in moderate to good condition.

The Proposal has very minor overlap with the Boot Land, and would not alter the existing connectivity values, further sever native vegetation or form a hard barrier within the connecting link.

11.4.5 Riparian land

Provision of a drainage swale in the southern portion of the Proposal site in proximity to Anzac Creek has the potential to adversely affect aquatic habitat. Approximately 0.01 hectares of instream vegetation within Anzac Creek may be removed for construction of the drainage swale. Other minor areas of aquatic habitat would be lost, such as the formalised channels/swales in the south of the Proposal site that support aquatic and fringing vegetation and, offer habitat for reptiles and amphibians such as Common Eastern Froglet (*Crinia signifera*).

Anzac Creek generally only flows in periods of rain within the study area and forms large stagnant pools with dense emergent vegetation. Fish passage is unlikely to be impacted during the works at Anzac Creek, but could be affected if flow is high due to recent rainfall and as such construction activities would be timed to avoid high flow and times when rain is forecast.

The construction of the swale is unlikely to increase the volumes of sediments carried downstream or reduce water quality downstream.

11.5 Mitigation Measures

The design development of the Proposal has avoided biodiversity impacts where possible, however in some areas impacts are evident. As such, the measures in this section should be implemented to mitigate these impacts during construction and operation.

11.5.1 Construction

- A Construction Flora and Fauna Management Plan (CFFMP) would be prepared as part of the CEMP for the Proposal. Native vegetation clearing for southern and eastern swales located outside of the MPE site would not occur until the Flora and Fauna Management Plan is approved. This would include the following:
  - Clear identification of vegetation exclusion zones
  - Site induction procedure, including briefings regarding the local threatened flora and local fauna of the site and protocols to be undertaken if they are encountered
  - A pre-start up check for sheltering native fauna of all infrastructure, plant and equipment and/or during relocation of stored construction materials
  - Application of speed limits in areas adjacent to native vegetation
- The threatened plant populations identified to the south of the Proposal site would be protected by a minimum 10 metre buffer between the edge of the area of occupied habitat and the Proposal site.
- Potential bat roosting locations in buildings to be demolished would be checked, as far as is practicable, by a qualified ecologist or wildlife carer for presence of bats prior to demolition. Any bats found would be relocated.
- A two-stage approach would be undertaken to clearing:
  - Remove non-hollow bearing trees at least 48 hours before habitat trees are removed.
  - Hollow bearing trees are to be knocked with an excavator bucket or other machinery to encourage fauna to evacuate the tree immediately prior to felling.
  - Felled trees must be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further processing of the trees.
  - Felled hollow bearing trees must be inspected by an ecologist as soon as possible (not longer than 2 hours after felling).
- Directional lighting will be used where lighting is required in construction areas to avoid impact on fauna.
- Should any animal be injured, the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery would be contacted as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by:
  - Handling fauna with care and as little as possible.
  - Covering larger animals with a towel or blanket and placing in a large cardboard box.
  - Placing small animals in a cotton bag, tied at the top.
  - Keeping the animal in a quiet, warm, ventilated and dark location.

11.5.2 Operation

- Should any animal be injured, the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery would be contacted as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by:
  - Handling fauna with care and as little as possible.
  - Covering larger animals with a towel or blanket and placing in a large cardboard box.
  - Placing small animals in a cotton bag, tied at the top.
  - Keeping the animal in a quiet, warm, ventilated and dark location.
- A Flora and Fauna Management Plan would be prepared as part of the OEMP for the Proposal. This FFMP would focus on minimising impacts on biodiversity values on the adjacent Boot Land.
- A Flora and Fauna Management Plan would be prepared as part of the OEMP for the Proposal. This FFMP would focus on minimising impacts on biodiversity values on the adjacent Boot Land.

11.5.3 Offsetting impacts

A comprehensive Biodiversity Offset Strategy (BOS) for the MPE Project is required to be prepared and implemented under the MPE Stage 1 Proposal. The BOS is currently under preparation in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* including the Framework for Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise or offset' principle. The BOS considers and offsets the impacts of the Proposal and therefore a separate BOS has not been provided as part of this EIS.

11.5.4 Offset credit requirements

Under the *NSW Biodiversity Offsets Policy for Major Projects*, a biobanking agreement is required to be used to secure an offset site. The ecosystem and species credit offset requirements for the biodiversity impacts of the Proposal are detailed below.

Impacts on native vegetation

Loss of landscape and site value for each PCT identified on the Proposal site and its associated ecosystem species, as determined using the credit calculator, is presented in Table 11-8. The PCTs to be offset are shown in Figure 11-4.

Table 11-8 Impact summary for PCTs and associated ecosystem credit species requiring offsets and their required credits

Vegetation zone	Associated EECs and/or Threatened Species	Loss in landscape value	Loss in site value score	Number of Ecosystems credits required
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003): Moderate/Good	Castlereagh Scribbly Gum Woodland of the Sydney Basin bioregion (VEC)	12	68.23	4
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (ME002): Moderate/Good	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion	12	74.48	3
Coastal freshwater lagoons of the Sydney Basin and South-east Corner (ME007): Moderate/Good	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	12	64.10	1

12 STORMWATER AND FLOODING

Arcadis have undertaken an assessment of the stormwater and flooding impacts associated with the Proposal to address the SEARs. The *Stormwater and Flooding Environmental Assessment* is included in Appendix P of this EIS.

Table 12-1 provides a summary of the relevant SEARs which related to stormwater and flooding and where these have been addressed in this EIS.

Table 12-1 SEARs (Stormwater and Flooding)

SEARs	Where addressed
7. Soil and Water	
a) assess the impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on Georges River and Anzac Creek	Section 12.3 Section 13 (for impacts to groundwater)
b) assess flooding impacts and characteristics, to and from the project, with an assessment of the potential changes to flooding behaviour (levels, velocities and direction) and impacts on bed and bank stability, through flood modelling including i. hydraulic modelling for a range of flood events ii. description, justification and assessment of design objectives (including bridge, culvert and embankment design) iii. an assessment of afflux and flood duration (inundation period) on property iv. consideration of the effects of climate change, including changes to rainfall frequency and/or intensity, including an assessment of the capacity of stormwater drainage structures v. relevant provisions for the NSW Floodplain Development Manual 2005	Section 12.3
c) assess effects of downstream rivers, wetlands, estuaries, marine waters and floodplain areas, water dependent fauna and flora (including Ground Dependent Ecosystems)	Section 12.3 Section 11 (for impacts to Groundwater depend ecosystems)
d) describe any changes to environmental availability	Section 12.3.2
e) describe any mitigating effects of the proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options	Section 12.3.2
f) identification of proposed monitoring of hydrological attributes	Section 12.3.2
g) include a detailed and consolidated site water balance	Section 12.3.2 Appendix P
h) address drainage issues associated with the development / site, including the incorporation of Water Sensitive Urban Design measures, stormwater and drainage infrastructure	Section 12.3.2

SEARs		Where addressed
	such as on-site detention systems to ensure peak discharges and flow velocities post development shall not exceed existing peak flows and velocities	
i)	undertake an assessment of surface water quality during construction (including reference to water quality objectives for the relevant catchment where objectives have been determined), including an identification of works that may impact water quality, and a summary of proposed monitoring and mitigation measures in accordance with Managing Urban Stormwater – Soils & Construction Volume 1 2004 (Landcom) and Volume 2 (DECC 2008)	Section 12.3.1 Section 12.4
j)	consideration of stormwater quality and management (including monitoring) during operation of the site with the objective to maintaining or improving existing water quality talking into account the Water Quality Objectives	Section 12.3.2
k)	consider whether the existing sewerage system can cater for the proposal and whether environmental performance of the existing system will be impacted	Section 19

This Section summarises the studies undertaken previously for the MPE Concept Plan Approval and, more recently, the Proposal. An assessment of potential impacts resulting from the changes to hydrology and flooding regimes as a result of the Proposal as assessed in the *Stormwater and Flooding Impact Assessment* (2016) is also outlined below. Measures to mitigate impacts have also been identified where they are required.

The Concept Plan Conditions of Approval are generally consistent with the SEARs provided for the Proposal as they relate to stormwater and flooding (refer to Table 12-1) and have been addressed in this Section of the EIS. The compliance of the Proposal with the SEARs, Concept Plan Conditions of Approval and Statement of Commitments is provided at Appendix A of this EIS.

This Section summarises the studies undertaken for the MPE Concept Plan Approval (section 12.1) and, more recently, for the Proposal. This section of the EIS also describes the existing environment as it relates to stormwater and flooding (section 12.2) and provides an assessment of stormwater and flooding impacts associated with stormwater and flooding impacts where they are required have been identified in Section 12.4.

12.1 Concept Plan Assessment

The Concept Plan stormwater and flooding assessment for the MPE Project was undertaken having regard to the site context, and potential impacts of the proposal. It identified three catchments that discharge from the site, two eastwards towards Anzac Creek and one westward into the Georges River.

The Flood Study and Stormwater Management report, prepared as part of the Concept Plan, determined the peak flows leaving the site and concluded that the proposed volume of detention storage would adequately mitigate additional site run-off for the required range of storm durations.

The study identified two areas of flooding risk being:

- Flooding risk associated with the development of the warehousing and distribution
- Flooding risk associated with the placement of structures within or across Anzac Creek associated with the Stage 1 development.

Water quality was also assessed with the Georges River and Anzac Creek being classified as lowland aquatic ecosystems of south-eastern Australia (ANZECC, 2000). Water quality parameters were found to be within the guidelines with the exception of pH and dissolved oxygen (DO). Spot measurements within the Georges River and Anzac Creek demonstrated pH 6.06 and 5.62 respectively (guideline value 6.50) and DO below the lower guideline value of 60% saturation in both locations. (ALS Water Sciences, 2011)

Based on the recommendations of the Stormwater and Flooding Environmental Assessment and the Flood Impact Assessment, the Revised Statement of Commitments committed to the following actions:

- *The Proponent will incorporate stormwater quantity and quality management measures into the detailed applications in accordance with the objectives and performance standards outlined in the Stormwater and Flooding Environmental Assessment report including:*
  - *Preparation of a Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP) for both construction and operation phases*
  - *Implementation of management plan strategies prior to commencement of the staged construction phase*
  - *Monitor and review performance of sediment and water control structures during construction and operation phases*
- *The Proponent will prepare and update a flood emergency response plan as necessary to address the staged development of the site. Details are to be provided prior to the construction of each of the three major stages to development*
- *Water quality and quantity measures will be managed during the construction phase through the implementation, inspection and maintenance of best practice soil and water management techniques which will be defined in the CEMP for sedimentation and erosion control during construction*
- *Water quality and quantity issues will be managed during the operation phase through the implementation, inspection and maintenance of Water Sensitive Urban Design (WSUD) measures such as rainwater tanks, grass filter strips, swales and bio retention*

In addition to the Revised Statement of Commitments, the MPE Concept Plan Approval (dated 29 September 2014) included a number of requirements to be undertaken for ‘Soil and Water’ (i.e. stormwater and flooding) for future approvals.

12.2 Existing Environment

12.2.1 Regional environment

The Proposal is bisected in a north-south direction by a catchment boundary with the eastern portion discharging to Anzac Creek (approximately 50 metres to the southeast of the Proposal site) and the western portion discharging to the Georges River (approximately 450 metres to the west of the Proposal site).

Anzac Creek is a small tributary of the Georges River, which flows to the north, discharging to the Georges River approximately 2.5 kilometres to the north-east of the

Proposal site (See Figure 12-1). A flood study of the area (BMT WBM 2008) indicated that the Anzac Creek catchment covers an area of 10.6 km^2 and is 4 km long, forming in the MPW site and flowing north past the suburb of Wattle Grove and underneath the M5 Motorway at the intersection with Heathcote Road. From there, the creek continues northwards, through Ernie Smith Recreation Reserve, fringed by the Moorebank Industrial Area to the west and the suburb of Moorebank to the east, under Newbridge Road and through McMillan Park, into Lake Moore at Chipping Norton. Anzac Creek is classified as a first order stream, having a defined channel where water flows intermittently.

The Georges River enters the Liverpool LGA from the south on the western side of the Defence lands at Holsworthy and flows to the north, meeting with Glenfield Creek at Casula. The river then continues to flow north past the Liverpool City Centre, under Newbridge Road, past Lighthorse Park and over the Liverpool Weir. Downstream of the Liverpool Weir, the Georges River becomes brackish and is subject to tidal influences.

Groundwater within the region and potential impacts to groundwater from construction and operation of the Proposal is provided in Section 13.

12.2.2 Local surface water

Surface water quantity

As shown in Figure 12-1, there are three existing formal stormwater discharge outlets from the Proposal site.

Currently, stormwater generated on the Proposal site is carried through formal open grass lined channels to three discharge points. Flows on the eastern portion of the Proposal site move in an eastward direction to pipes and headwalls under Greenhills Road, discharging to Anzac Creek through two points (Outlet A and B).

Stormwater flows on the western portion of the site (from both the eastern and western side of Moorebank Avenue) are collected in a formal concrete lined channel which runs within the site parallel to Moorebank Avenue. These channel flows discharge via a culvert under Moorebank Avenue (Outlet C) into a channel which leads to Georges River.

A rainfall runoff model was developed using DRAINS to assess the performance of the existing site drainage. Further details on model inputs are provided in Appendix P of this EIS. The model calculated flows at each of the discharge points during the 5 year, and 100 year average recurrence intervals (ARIs) and probable maximum precipitation (PMP) events. A summary of the modelling outputs is provided in Table 12-2.

Table 12-2 Existing site condition – peak flows

Discharge location	Site Condition	Catchment Area (ha)	Flow (m^3/s)		
			5y ARI	100y ARI	PMP
Outlet A (Greenhills Road Nth)	Existing	21.76	3.4	4.1	23
Outlet B (Greenhills Road Sth)	Existing	27.45	0.5	3	15
Outlet C (Moorebank Avenue)	Existing	59.95	6.9	12.9	75

Water quality

A calculation of the existing stormwater quality from the Proposal site was undertaken using MUSIC modelling. Further details on the model are provided in Appendix P of this EIS. The model combined existing land uses with imperviousness values (the percentage of impervious surfaces as a part of the whole Proposal site) to identified existing conditions. Table 12-3 provides a summary of the existing annual stormwater pollutant loads for the Proposal site as calculated by the MUSIC model.

Table 12-3 Existing stormwater quality from the Proposal site

Pollutant type	Exising pollutant load (kg/year)
Gross pollutants	14,000
Total suspended solids (TSS)	93,200
Total phosphorus (TP)	182
Total nitrogen (TN)	1200

12.2.3 Flooding

Existing flooding risk along Anzac Creek corridor has been previously identified by Liverpool City Council through a floodplain risk management study (BTM WBM, 2008). Modelling for the study identified that upstream of the M5 Motorway flooding for events up to the 100-year ARI is generally confined to the main channel of Anzac Creek, resulting in very little floodplain inundation and no inundation of residential properties within the suburb of Wattle Grove (located adjacent to Anzac Creek).

Flood modelling commissioned by Liverpool City Council (BTM WBM, 2008) indicates that the 100 year ARI and larger events along Anzac Creek would impact on the Proposal site. However, existing culverts beneath the M5 Motorway could adequately convey flood waters to the downstream reaches of the catchment without significant retention and/or backwater accumulation impacting the Proposal site.

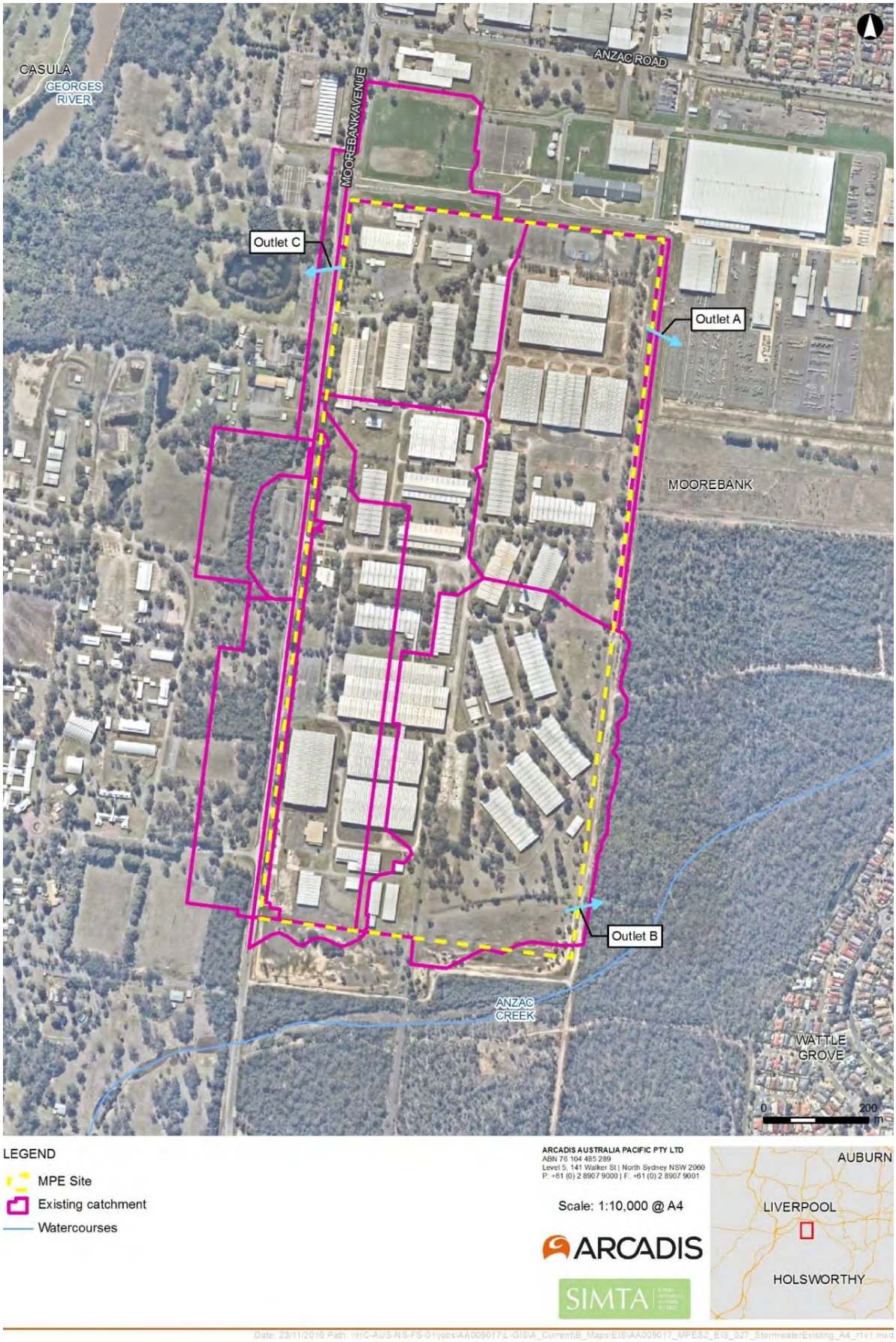

Figure 12-1 Existing stormwater discharge points and approximate catchments

12.3 Potential impacts

12.3.1 Construction

Stormwater quantity

During the construction phase, surface water volumes and velocities would be dependent upon the location and timing of the works. Within the Proposal site, the removal of existing stormwater management structures, during construction, such as pipes and open grass lined channels, may result in an increase of surface flows volume and velocity across the site which has the potential to increase the mobilisation of debris and soils. This increase in surface flow has the potential to contribute to increased erosion, surface scouring and scouring of water channels, as well as the transportation of sand silt and clay off-site into adjacent vegetation and waterways.

Retained or constructed hardstand areas and drainage structures within the Proposal would naturally accelerate surface flows across the construction areas, while disturbed areas provide a rougher surface that assist in slowing surface water runoff and encourages infiltration of water into the soil profile. Permanent and temporary stormwater management structures would be installed as early as practicable in the construction phase to minimise adverse impacts on site hydrology.

Stormwater quality

During the construction of the Proposal, and in particular the vegetation clearing and bulk earthworks phases, there is potential for soil to be eroded from the Construction area and deposited onto nearby lands or downstream of either Georges River or Anzac Creek. Construction activities on the site that have the potential to impact water quality, predominantly through the disturbance of the ground surface, include:

- Removal of vegetation
- Alteration of the topography and associated water catchment areas of the Proposal site
- Changing of the soil profile on site to expose potentially more reactive soils
- Removal or modification of existing drainage, retention or diversion structures
- Transport of noxious weeds
- Alteration or removal of drainage pathways across the Construction area
- Concentration of surface water flows
- Spills or leaks of substances such as oil, hydraulic fluids and fuels.

The soils and topography of the Proposal site have been calculated to pose a low erosion hazard (see Section 13 and the standard erosion and control measures defined in Managing Urban Stormwater (Landcom, 2004) would be implemented at the site. The soils are generally classed as Type F soils which are fine grained and require a relatively long residence time in sediment basins to achieve the TSS concentrations suitable for discharge off site.

Preliminary erosion and sediment control plans (ESCPs) have been developed for the Proposal and are included in the Drawings associated with the Stormwater and Flooding Assessment Report (Appendix P of this EIS). Further details of management strategies are provided in Section 12.4.

Flooding

Construction of the Proposal, in particular adjusting the building formation of the Proposal site, would have the potential to cause flooding impacts on surrounding properties during a significant rainfall event, in the absence of flood management measures. Flood risk to nearby properties and to the site itself may occur through the failure of existing or temporary water containment measures, or through a rainfall event exceeding that for which the controls for construction activities were designed to protect flood related impacts.

Measures to mitigate potential flood risks during construction are provided in Section 12.4.1.

12.3.2 Operation

Development of the Proposal would result in changes to the catchment boundaries within the MPE site and the Proposal site. The Proposal would increase the impervious surfaces on the site potentially resulting in an increase in surface water runoff and changes to the flood regime within the Proposal site and surrounding area. The amended catchments and a conceptual layout of the proposed stormwater system are shown in Figure 12-2 with further detailed plans included in Appendix P of this EIS.

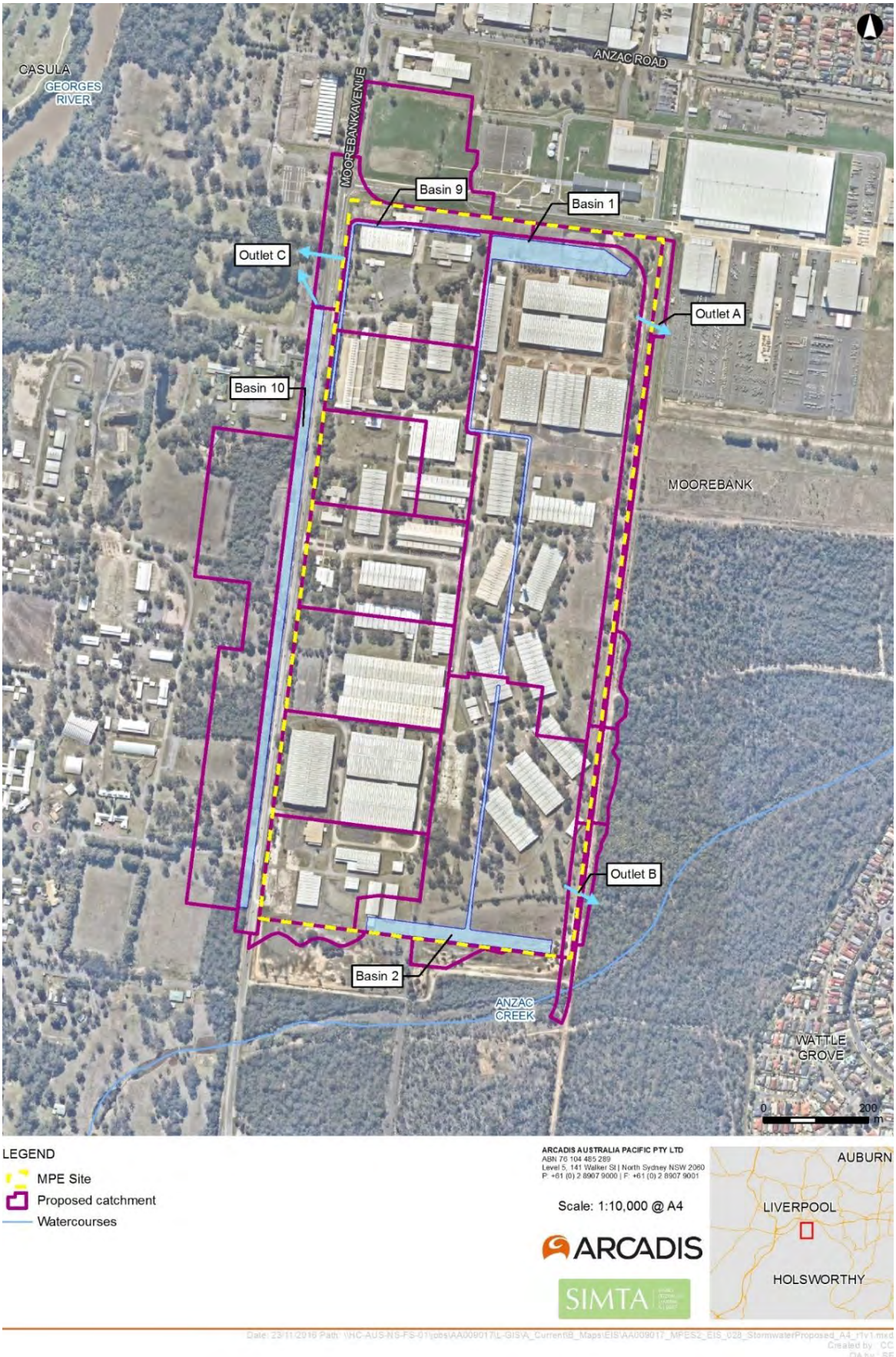

Figure 12-2 Post development catchments and conceptual drainage and detention storage system

Stormwater quantity

Changes in stormwater quantity are predicted as a result of the Proposal, due to changes in the area of impervious surfaces. A site water balance has been developed for the Proposal site to identify any potential impacts on surface water from the Proposal.

MUSIC modelling was used to identify changes to stormwater quantity generation on the Proposal site as a result of the Proposal. The proposed conditions for the Proposal site are predominantly warehouse roofs and paved surfaces. It is assumed to be approximately 95% impervious, allowing for some pervious landscaped areas. The model indicated that of the 590 ML of rainfall received at the site each year, 515 ML would leave the site as runoff, with the remaining leaving the site through evapotranspiration (70 ML). Figure 12-3 summarises the site water balance assessment undertaken for the Proposal.

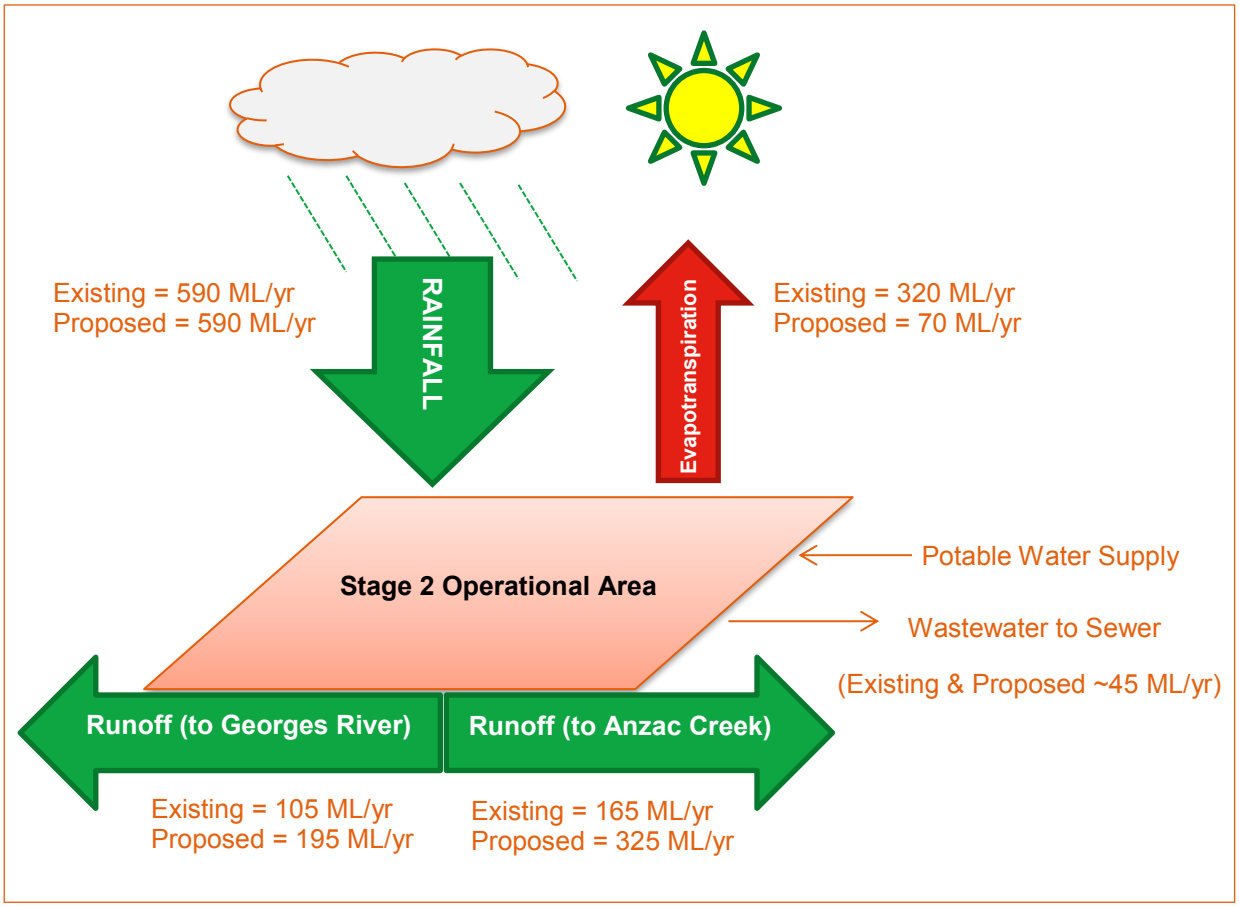

Figure 12-3 Site water balance (average annual volumes) for existing and proposed conditions

As shown in Figure 12-3, the Proposal would result in an increase in surface water generation as a result of the increase in impervious surfaces. The capture and reuse of rainwater has the potential to reduce the Proposal potable water demands as well as stormwater volumes leaving the site and associated impacts to Anzac Creek. Opportunities to capture and reuse rainwater would be further investigated during detailed design.

Demand for water at the site is estimated to be a maximum of approximately 45,000 kL per year with 36,000 kL of this returning to sewer as wastewater. The water demands and wastewater generation associated with the previous land use for the site (i.e. as the DNSDC) are unknown. However, given the previous and proposed land uses are relatively similar, while previous water demands and wastewater

generation are most likely less than for the proposed conditions, they would be a similar order of magnitude for the purpose of the water balance assessment.

Changes to stormwater flows leaving the site as a result of operation of the Proposal were calculated using the DRAINS rainfall runoff model. The existing condition DRAINs model was adjusted to represent a 95% impervious surface scenario and to reflect the changes to the Proposal site sub-catchment and stormwater drainage design. The design of the stormwater detention systems (shown in Figure 12-2), was also included in the model to confirm their ability to mitigate potential flooding impacts. The outcomes of the modelling for the existing case and developed case are shown in Table 12-4.

Table 12-4 Comparison of existing and developed case – peak discharge

Discharge location	Site Condition	Catchment Area (ha)	Flow (m^3/s)		
			5y ARI	100y ARI	PMP
Outlet A (Greenhills Road Nth)	Existing	21.76	3.4	4.1	23
	Proposed	**29.49**	**1.4**	**1.9**	**32**
Outlet B (Greenhills Road Sth)	Existing	27.45	0.5	3	15
	Proposed	**17.79**	**0.3**	**1.8**	**21**
Outlet C (Moorebank Avenue)	Existing	59.95	6.9	12.9	75
	Proposed	**61.72**	**4.7**	**6.9**	**120**

The DRAINS modelling demonstrates that the proposed OSD design and stormwater management system would adequately mitigate the increase in peak flows leaving the Proposal site as a result of the increase in impervious surfaces.

The discharge of surface water from the Proposal site would not alter the environmental availability of water to Anzac Creek and the Georges River.

Stormwater quality

Operation of the Proposal has the potential to reduce stormwater quality as rainfall. As a result of rain falling on the increased area of the Proposal site that is covered by impervious surfaces, stormwater would have the potential to pick up pollutants such as litter, sediments and nutrients used as fertiliser. MUSIC modelling was used to determine the potential pollutant loads that would be generated by the Proposal site and to identify measures to reduce the pollutant load. Table 12-5 shows the estimated pollutant loads that would be generated on the Proposal site during operation.

Table 12-5 Modelled pollutant levels from the Proposal (MUSIC model)

Scenario	Pollutant loads (kg/year)			
	Gross pollutants	TSS	TP	TN
Existing	5,550	24,800	62.3	564
Proposal (no treatment)	14,000	93,200	182	1200
Percentage increase	152	276	192	113

MUSIC modelling demonstrates that without mitigation the Proposal would lead to a significant increase in pollutant loads released from the site.

Water quality guidelines applicable to the Proposal site operational area include:

- Liverpool Development Control Plan 2008 – provides general objectives and controls that apply to development within Liverpool LGA.
- Georges River Estuary Coastal Zone Management Plan – provides objectives and targets specifically for the Georges River Estuary and its catchment.
- SEARs for MPE – Stage 2 SSD – prescribe that stormwater management for the operational phase of the Proposal should seek to maintain or improve existing water quality. Also referred to as Neutral or Beneficial Effect (NorBE).

Table 12-6 shows the water quality performance targets for the Proposal site. Targets expressed as a percentage are a percentage reduction target, relative to the post development pollutant load, prior to treatment. Values in bold are the adopted targets for the Proposal Operational Area. Whether NorBE is more stringent than the percentage reduction targets depends on the existing water quality conditions. Therefore the performance of the proposed water sensitive urban design (WSUD)strategy would be checked against both targets to ensure the most stringent targets are met.

Percentage reduction targets have not been applied to the roof areas of the Proposal site. Where significant roof areas are proposed, it is considered inappropriate to apply percentage reduction targets due to the significant difficulties in implementation and consideration of the appropriateness of treating relatively clean water to achieve these targets. In these cases, the adoption of the NorBE target is considered appropriate.

Table 12-6 Water quality performance targets for the Proposal

Pollutants	Liverpool DCP 2008	Georges River Estuary CZMP 2013	SEARs May 2016 (Item 7. h)
Total Suspended Solids (TSS)	80%	**85%**	**NorBE**
Total Phosphorus (TP)	45%	**60%**	**NorBE**
Total Nitrogen (TN)	45%	**45%**	**NorBE**
Gross Pollutants (GP)	90%	**90%**	**NorBE**

To achieve the adopted performance targets for the Proposal Operational Area, WSUD principles and a treatment train approach have been applied. The two key measures proposed for the Proposal Operational Area are:

- Gross Pollutant Traps (GPTs): these are primary stormwater treatment measures used as the first measure in a stormwater treatment train. For the purposes of the modelling, a device with continuous deflection screens and hydrodynamic separation to target TSS was included.
- Rain gardens: these act as bio-retention systems and comprise of a combination of vegetation and filter substrate and treat stormwater through the processes of settling, filtration and biological uptake of nutrients. For the Proposal Operational Area, it is proposed that rain gardens would form the base of the OSD basin / channel.

MUSIC modelling was undertaken to assess the effectiveness of the proposed stormwater treatment measures against the adopted targets. Table 12-7 provides a summary of stormwater quality performance, with and without treatment.

Table 12-7 Summary of stormwater quality performance – with and without treatment

Scenario	Pollutant loads (kg/year)			
	Gross pollutants	TSS	TP	TN
Proposal (no treatment)	14,000	93,200	182	1,200
Proposal (with treatment)	0	9,460	38.2	501
Percentage reduction achieved	100%	90%	79%	58%
Percentage reduction target	90%	85%	60%	45%
Existing	5,550	24,800	62.3	564
Reduction achieved from existing	5,550	15,340	24.1	63

The water quality assessment demonstrated that, through the implementation of the treatment trains proposed the Proposal would achieve the water quality performance targets adopted for the Proposal, both in terms of percentage reduction for key water quality parameters and providing a beneficial effect.

The modelling has demonstrated that with the implementation of mitigation on the Proposal site, including rain gardens and gross pollutant traps, the Proposal would result in an improvement in water quality being discharged to Anzac Creek and the Georges River. As such, it is not expected that ongoing water quality monitoring of the Proposal is required.

Flooding

Proposal site

Modelling was undertaken for the Proposal site including the Climate Change Scenario for the 100 year ARI event. The modelling demonstrated that sufficient capacity can be provided within the stormwater structures proposed to effectively drain the site in a 100 year ARI event, including during the Climate Change Scenario.

The climate change scenario modelled as part of the assessment included consideration of a 10 per cent and 20 per cent increase in rainfall intensity during a 100 year ARI. A summary of the increase in OSD water levels with the application of these sensitivities is provided in Table 12-8 below.

Table 12-8 Increases in OSD water levels with a 10% and 20% increase in rainfall sensitivity during a 100 year ARI event

OSD Basin	Increase in depth of water in OSDs during a 100 year ARI event (metres)	
	10% increase in rainfall intensity	20% increase in rainfall intensity
1	0.1	0.2
2	0.05	0.15
9	0.2	0.4
10	0.25	0.5

Based on the sensitivity results in Table 12-8 above, OSD water levels when considered in the context of an increase in rainfall sensitivity should be considered when setting the minimum floor levels for the Proposal (discussed further in Section 4.2.5.7).

In doing so, it should be noted that a 10% increase in rainfall intensity is considered representative of potential climate change impacts for the Sydney metropolitan area, being consistent with projected rainfall increases in accordance with the *Floodplain Risk Management Guideline Practical Consideration of Climate Change* (New South Wales Department of Environment and Climate Change (DECC), 2007).

Furthermore, the intended design life of the Proposal should be taken into consideration during the detailed design of the Proposal with regards to final OSD design in the context of climate change risks associated with increased rainfall intensities. The provision of flood protection across the Proposals site should consider increases in water levels in OSDs

For example, should OSDs be sized for a 100 year design life, the application of a climate change sensitivity to the drainage capacity of these OSDs of 10% would be appropriate for providing site floor level flood protection

Proposed filling will adjust the operational area above the regional PMF levels. However, areas not impacted by regional flooding can still be affected by local PMF flow regimes. It is noted that the Proposal site is located within the upper catchment areas of the Georges River and there would be little warning time available for people to evacuate the site in the event of a PMF event. As such, an evacuation and refuge plan should be prepared and it should include safe refuge within the site (above PMF flood levels) until hazardous flows have subsided and safe evacuation is possible.

Anzac Creek

Existing flooding risk along Anzac Creek corridor have been previously identified by Liverpool City Council through a floodplain risk management study (BTM WBM, 2008). The study utilised RAFTs and TUFLOW modelling was used to determine the existing flood extent along Anzac Creek floodplain within the vicinity of the Proposal site.

The Liverpool City Council modelling was updated as part of the Stormwater and Flooding technical assessment (Appendix P of this EIS). Specific refinements incorporated into the Council model modified the digital elevation model (DEM) to include:

- Recent redevelopment of the Defence Joint Logistics Unit (DJLU), neighbouring the north-east corner of the Proposal site.
- MPE Stage 1 operational area (assumed completed)
- MPE Stage 1 rail link across the Anzac Creek floodplain
- DRAINS data developed as part of this assessment.

The adjusted existing conditions model has been adopted as a base for comparing potential impacts in Anzac Creek due to the development of the Proposal site.

Modelling indicates that with respect to potential flood impacts:

- There is no increase in flood levels in the100 year ARI nine hour event.
- For the PMF one hour event, the proposed adjustment of the building formation would generally result in no increase in flood levels along the broader Anzac Creek floodplain. However, local flood level increases adjacent to the proposal area of approximately 0.2 metre immediately south of the site, and approximately 0.3 metre increase in the area to the north-east of the proposal area would result.

The modelling demonstrates that potential adverse flood impacts from the Proposal have been adequately mitigated along the Anzac Creek floodplain up to 100 year events, and generally along the overall floodplain for events greater than the 100 year. While the modelling indicates that there may be local flood level increases impacting on the neighbouring property immediately to the north-east of the proposal area, these impacts would be limited to the open vehicular parking areas, and would only occur in extremely rare events (of greater than 100 year ARI).

12.4 Mitigation Measures

12.4.1 Construction

- A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be incorporated into the CEMP for the construction of the Proposal. The SWMP and ESCPs would be developed in accordance with the principles and requirements of Managing Urban Stormwater – Soils & Construction Volume 1 (‘Blue Book’) (Landcom, 2004) and Volume 2 (DECC 2008) and consider the Preliminary ESCPs (Appendix P of this EIS). The following aspects would be addressed within the SWMP and ESCPs:
  - Construction traffic restricted to delineated access tracks, and maintained until construction complete
  - Appropriate sediment and erosion controls to be implemented prior to soil disturbance
  - Stormwater management to avoid flow over exposed soils which may result in erosion and impacts to water quality
  - Location of stockpiles outside of flow paths on appropriate impermeable surfaces as well as outside of riparian corridors
  - Inspection of all permanent and temporary erosion and sedimentation control works prior to and post rainfall events and prior to closure of the construction area

  - Wheel wash or rumble grid systems installed at exit points to minimise dirt on roads.
- To minimise potential flood impacts as a result of construction of the Proposal, the following measures would be implemented and documented in the SWMP:
  - The existing site catchment and sub-catchment boundaries would be maintained as far as practicable
  - To the extent practicable, site imperviousness and grades should be limited to the extent of existing imperviousness and grades under existing development conditions.
- A Flood Emergency Response and Evacuation Plan, or equivalent, would be prepared and implemented for the construction phase of the Proposal to allow work sites to be safely evacuated and secured in advance of flooding occurring at the Proposal site.
- Stormwater quality improvement devices management measures would be designed and installed on site as presented in the Stormwater and Flooding Environmental Assessment (Appendix P of this EIS), including:
  - Gross Pollutant Traps (GPTs) at Section 6.2.1
  - Rain gardens in the base of the OSD channels, as shown in Figure 6-1 of Appendix P of this EIS. Stormwater quality improvement devices would be designed to meet the performance targets identified in Georges River Estuary CZMP.

12.4.2 Operation

- A water quality monitoring program for the operational phase of the Proposal would be prepared as part of the OEMP for the Proposal and would detail:
  - The frequency and duration of sampling
  - Background water quality conditions
  - Sampling methodology
  - Reporting requirements

  Water quality monitoring would be undertaken for both Anzac Creek and the Georges River and would include the following parameters:
  - Total suspended solids
  - Total phosphorous
  - Total nitrogen
  - Oils and grease.
- A Flood Emergency Response Plan (FERP) would be developed for operational phase of the Proposal. The FERP would take into consideration, site flooding and broader flood emergency response plans for the Georges River and Anzac Creek floodplains and Moorebank area. The FERP would also include the identification of an area of safe refuge within the Proposal site that would allow people to wait until hazardous flows have receded and safe evacuation is possible.

13 GEOLOGY, SOILS AND CONTAMINATION

Golder Associates and JBS&G have undertaken geotechnical investigations and contamination reporting respectively to determine the suitability of the site for the construction and operation of the Proposal and to address the SEARs. The *Geotechnical Interpretive Report* (Golder Associates, 2016) and the *Contamination Assessment* (JBS&G, 2016) are included in Appendix Q of this EIS.

Table 13-1 provides a summary of the relevant SEARs which relate to geology, soils and contamination and where these have been addressed in this EIS.

Table 13-1 SEARs (Geology, Soils and Contamination)

SEARs		Where addressed
7. Soil and Water		
l)	Identify and assess the soil characteristics and properties that may impact or be impacted by the project, including acid sulfate soils, salinity, erodibility, unstable or unsuitable ground and unrippable rock	Section 13.1
m)	Include a bulk earthworks strategy detailing the volume of spoil to be extracted from the site, planned reuse and amount of general fill material to be imported	Section 4
n)	Include a contamination assessment in accordance with the guidelines made under the *Contaminated Land Management Act 1997*	Section 13.2 and Appendix Q
o)	Include an assessment of potentially contaminated areas in accordance with the *National Environment Protection Measure 2013* in addition to an assessment of potential areas of Perfluorinated Compounds	Section 13.2
12. Contamination		
A contamination assessment in accordance with the guidelines under the *Contaminated Land Management Act 1997*. The assessment shall include the potential environmental and human health risks of site contamination on the project site, a Remedial Action Plan (if required), and consideration of implications of proposed remediation actions on the project design and timing (if relevant).		Section 13.2 and Appendix Q

The Concept Plan Conditions of Approval are generally consistent with the SEARs provided for the Proposal as they relate to geology, soils and contamination (refer to Table 13-1) and have been addressed in this section of the EIS. The compliance of the Proposal with the SEARs, Concept Plan Conditions of Approval and Statement of Commitments is provided at Appendix A of this EIS.

This section summarises the studies undertaken for the MPE Concept Plan Approval (section 13.1.1) and, more recently, for the Proposal. This section of the EIS also describes the existing environment as it relates to geology, soils and contamination (section 13.1.2 and 13.2.3) and provides an assessment of geology, soils and contamination impacts associated with construction and operation of the Proposal (section 13.1.3, 13.2.4 and 13.2.5). Measures to mitigate potential geology, soils and contamination impacts where they are required have been identified in section 13.3.

13.1 Geology and soils

13.1.1 Concept Plan Assessment

Investigations undertaken for the MPE Concept Plan Approval showed that the underlying geology of the MPE site was Tertiary alluvium. Soils were identified from the Soil Landscapes of Penrith 1:100 000 sheet and are shown in Table 13-2.

Table 13-2 - Soils of the Proposal

Name	Description	Location
Berkshire Park	Fluvial soil landscape on gently undulating Tertiary terraces of the Georges River. Soils are weakly pedal orange heavy clays and clayey sands, often mottled. Ironstone nodules are common and large, silicrete boulders may be present where drainage is poor. Red podzolic and chocolate soils are present on flats and drainage lines	MPE site
Disturbed terrain	Topography varies from level plains to undulating terrain. Has been disturbed by human activity to a depth of at least 1m. Landfill includes soil, rock, building and waste material	Northern portion of MPE site

The Proposal site is considered to have a low erosion hazard and it was noted that the site had been subject to filling operations, generally up to 1 metre in depth but in some cases up to 2.5 metres.

Studies undertaken for the MPE Concept Plan Approval did not find significant contamination issues which would preclude the development of the MPE site however recommended further studies be undertaken based on the detailed design of the various stages of the MPE project.

Based on the recommendations from the MPE Concept Plan Approval specialist assessments, the Revised Statement of Commitments committed to the following actions:

- *Water quality and quantity issues will be managed during the construction phase through the implementation, inspection and maintenance of best practice soil and water management techniques which will be defined in the CEMP for sedimentation and erosion control*
- *The Proponent will incorporate stormwater quantity and quality management measures into the detailed applications in accordance with the objectives and performance standards outlined in the Stormwater and Flooding Environmental Assessment report including:*
  - *Preparation of a Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP) for both construction and operations phases*
  - *Monitoring and review performance of sediment and water control structures during the construction and operation phases*
- *Confirming what, if any, action were taken in regards to the Milsearch (2000) recommendations and the associated low risk ordnance issues*

- *Undertaking further investigations in the areas of environmental concern likely to be impacted by the proposed development. These investigations will be based on the detailed design of the proposed development to identify the extent of contamination, and what, if any, remediation activities are needed. The remediation of areas of the site (if any) would be best matched to the development of the site and considered as part of the future design*
- *Developing a Contamination Management Plan with detailed procedures on:*
  - *Handling, stockpiling and assessing potentially contaminated materials encountered during the development works*
  - *Landfill gas management during excavation, handling, and stockpiling of waste materials, if excavation is required during the development, in the area of Glenfield Quarry and Landfill*
  - *Assessment, classification and disposal of waste in accordance with relevant legislation*
  - *A contingency plan for unexpected contaminated materials, such as material that is odorous, stained or containing anthropogenic material, that may be encountered during site works*

13.1.2 Existing Environment

Geology

Geological investigations were undertaken by Golder (2016) to confirm the existing geology and soils of the Proposal site. Investigations included site works, comprising of boreholes, test pits, cone penetration tests (CPT) and Dynamic Cone Penetrometer (DCP) tests.

Regional geological mapping and site investigations have been combined to develop a generalised soil and rock profile for the Proposal site. The profile has been categorised into units and sub-units and is shown in Table 13-3.

Table 13-3 Geotechnical model of the proposal site

Unit		Sub-unit	
1	Surficial Soils and Pavement	1A	Topsoil/Fill
		1B	Anthropogenic Fill
		1C	Granular Fill
		1D	Cohesive Fill
		1E	Existing Pavement
2	Recent Alluvium	2A	Sand – not observed in Stage 2 investigations
		2B	Clay – not observed in Stage 2 investigations
3	Older Alluvium	3A	Sand
		3B	Clay
4	Shale	4A	Residual Shale Soil
		4B	Extremely Low to Low Strength Shale
		4C	Shale of medium strength or higher
5	Sandstone	5A	Residual Sandstone Soil – not observed in Stage 2 investigations
		5B	Very Low to Low Strength Sandstone
		5C	Sandstone of medium strength or higher

Generally, the geological characteristics of the site include:

- Away from paved areas, materials generally comprise a layer of topsoil overlying fill, below which tertiary alluvial soils are underlain by residual soil.
- Alluvial soils are present extensively across the site and have their greatest depth at the northern, southern and western flanks of the site. Thicker residual soil layers are encountered to the east and over the central portion of the site (i.e. towards the elevated central eastern portion of the site).
- The greater extents of alluvial soils are typically found over the lower lying portions of the site.
- Bedrock is typically shale, which is underlain by sandstone. However, towards the south of the site, sandstone was encountered immediately below the soil.

Hydrogeology

Two main aquifer systems are present across the MPE site, a perched system within alluvial soils and a deeper aquifer within the bedrock. Groundwater in the shallow alluvial aquifer is expected to flow towards the Georges River.

Groundwater is typically present at approximately 4 metres to 7 metres below the existing ground levels across the majority of the Stage 2 site with the exception of the region in the south-east of the Proposal site, near Anzac Creek where groundwater was identified at depths greater than 1.5 metres.

Groundwater within the deeper aquifer would vary depending on bedrock characteristics. Ashfield Shale has a very low rock mass permeability and may act as an aquitard (barrier to groundwater flow). This unit has the potential to reduce the infiltration of groundwater into the underlying sandstone, although some groundwater may flow within this unit through joints or faults. Groundwater in the Shale unit is typically saline and hard, with salinity levels up to 3100 mg/l having been recorded in the region.

Hawkesbury Sandstone generally has a low rock mass permeability with groundwater flow generally controlled by joints, faults and bedding partings. High permeability is also likely along near-vertical dykes, sheared zones or open joints at relatively low cover below valleys and/or paleo channels. Groundwater in sandstone is generally of reasonable quality typically being mildly acidic with high iron content and salinity: between 200 to 2000 mg/L.

Soils

The Penrith Soils Landscape Map (Soil Conservation Service of NSW, 1989) indicates the soils within the Proposal site are of the Berkshire Park Group. These are soils generally produced upon alluvial landscapes, commonly on elevated Tertiary terraces. They are comprised of shallow clayey sand soils, with frequent ironstone nodules. These soils typically are very prone to wind, sheet and rill erosion if exposed.

A topsoil layer is present across most areas of the site where pavements or structures are not present. The topsoil has a recorded thickness varying from 0 to 0.4 m but was typically 0.1 m thick. The topsoil is typically underlain by fill but in some locations has developed naturally above alluvial or residual soils. The topsoil encountered was typically dry, fine to medium-grained silty sand with fine to medium sub-angular igneous gravel. However, some topsoil of a dominantly clay composition was encountered. Isolated occurrences of man-made waste materials, such as plastic bags and brick, were identified in topsoil during the Stage 2 investigations.

The majority of fill encountered beneath the topsoil was granular and was typically a dry, silty sand. Where cohesive fill was encountered it was typically a medium to high

plasticity clay, dry of the plastic limit and is inferred to have likely been re-worked site won material. The fill layer typically extends to depths of 0.3m to 0.5m. The potential for contamination with uncontrolled fill is discussed in Section 13.2.

Where investigations extended beneath the Unit 1 fills, older alluvial soils were typically encountered. The thickness of alluvium recorded varied significantly between locations with the deepest layers occurring at the northern, western and southern flanks of the site. At the northern and southern extent of the site, the thickness of alluvium was approximately 20 metres with a maximum depth of up to 23 metres. The depth of alluvium recorded reduced to approximately 5 metres within the central portion of the site and less than 1 metre thick at the eastern fringe. The alluvium is typically a high plasticity clay with some granular and lower plasticity zones, particularly at the southern extent of the site. The alluvial clay contains ironstone nodules and is typically very stiff or hard consistency.

13.1.3 Potential impacts

Construction

The greatest risk to soils on the Proposal site would be during the construction phase of the
Proposal, when ground disturbance would be required. Construction of the Proposal would
involve disturbance to the Proposal site, resulting in exposure of soils and increasing the risk of erosion. Given the large area of disturbance required at the site, there is a high potential for erosion, even though the site has low sloping topography and a low erosion hazard risk.

Overall, approximately 690,000 cubic metres of clean general fill would need to be imported to the site to achieve the finished surface levels. The areas of the site where there would be adjustment of the building formation level would be made ready for receival of materials through stripping of topsoil, levelling the site and removal of contaminated material. Material brought to site would be placed and compacted within the primary earthworks area, to achieve final site levels. Stockpiling of clean fill material would also occur in this area.

Groundwater is found at approximately 4 metres to 7 metres below the existing ground levels across the majority of the Stage 2 site and is anticipated to be deeper than the expected depth of bulk excavations. However, groundwater is likely to be encountered within the depth of bored piles, if used (the requirement for piles would be determined during detailed design). Groundwater may also be encountered within excavations undertaken towards the south-eastern corner of the Proposal site (i.e. in proximity to Anzac Creek) for depths greater than approximately 1.5m. Should bulk excavation to such depths (or greater) be required in this area, consideration will need to be given to the potential for, and management of, groundwater inflows during construction.

Erosion and sediment impacts

The importation and placement of clean general fill material to adjust the building formation of the site has the potential to create the following impacts across the site:

- Erosion of the levelled site
- Generation of sediment laden runoff and potential impacts on Anzac Creek and Georges River
- Dust generation during periods of rain and/or high winds, thereby degrading the quality of surrounding environments.

The following risk factors contribute to the potential for soil erosion on the Proposal site:

- Soil erodibility – The soils of the Proposal site are of the Berkshire Park Group, and have very high wind erosion potential if stripped of vegetation
- The scale of earthworks – The Proposal consists of very large scale earthworks
- The gradient of the site – The Proposal site is generally flat.

The large area of disturbance required at the site and timeframe of construction for the Proposal means there is a high potential for erosion from the Proposal site, if not properly managed.

Operation

The design of the operational Proposal would include stabilising works including fill materials, hardstands areas and landscaping which would significantly reduce the risk of on-site erosion. As such, operation of the Proposal is not anticipated to have a significant impact on soils.

13.2 Land contamination

13.2.1 Concept Plan Assessment

A Preliminary Environmental Site Assessment (Preliminary ESA) was prepared to support the Concept Plan EA for the MPE Project. A review of relevant background documentation was undertaken as part of these studies to identify the potential for contamination to have occurred as a result of prior land uses.

The Preliminary ESA did not identify 'significant environmental issues which would preclude the currently proposed development of the MPE site'. The ESA recommended further detailed investigation of areas of environmental concern (AECs) based on the detailed design of subsequent stages of the MPE Project, with the aim to identify the extent of contamination and remediation actions required, matching these requirements to the development of the site. The Proposal site is not located within AECs identified in the Preliminary ESA.

Based on the recommendations of the Preliminary ESA, the Revised Statement of Commitments included in the Response to Submissions for the Concept Plan (2014) committed to the following actions:

The following tasks will be undertaken in association with the detailed planning applications for the staged redevelopment of the SIMTA site:

- *Confirming what, if any, actions were taken in regards to the Milsearch (2002) recommendations and the associated low risk ordnance issues.*
- *Undertaking further investigations in the areas of environmental concern likely to be impacted upon by the proposed development. These investigations will be based on the detailed design of the proposed development to identify the extent of contamination, and what, if any, remediation activities are needed. The remediation of areas of the site (if any) would be best matched to the development of the site and considered as part of the future design.*

The Revised Statement of Commitments also commits to the preparation of a Contamination Management Plan, as part of the CEMP for managing expected and unexpectedly contaminated materials encountered during construction.

In addition to the Statement of Commitments, the MPE Concept Plan Approval (dated 29 September 2014) included a number of additional requirements to be undertaken for 'Soil and Water' for future approvals (refer to comments provided above). The Conditions of Approval, and the SEARs, provided for the Proposal (refer to Table 13-1) and have been addressed in this Section.

13.2.2 Methodology

The methodology for the Contamination Summary Report (JBS&G, 2016) comprised:

- Review of existing site investigation information including previous investigation reports
- Review of available background information pertaining to the environmental setting
- A site inspection to provide information on current site conditions to assist in understanding previous investigations and the environmental setting and to aid in development of an appropriate investigation program.

A Section A Site Audit Statement (SAS) and Site Audit Report developed by JBS&G in September 2016 certified that the site was suitable for commercial/industrial use and that further contamination investigations (i.e. a Phase 2 contamination assessment) were not required. The report noted that construction works on the site should be undertaken in accordance with the Environmental Management Plan (EMP) developed for the site (GHD, 2016), including procedures to control exposure to potential human health and environmental receptors from residual contaminated soil, ACM and potential UXO.

13.2.3 Existing Environment

Potential areas and substances of environmental concern

Based on the site history review, potential areas and aspects of concern and associated contaminants of potential concern have been identified and are presented in Table 13-4.

Table 13-4 Areas of environmental concern and associated contaminants of concern

Area/aspect of environmental Concern	Location	Contaminants of Potential Concern (COPCs)
General site areas where filling and burial/burning of waste material may have occurred.	General site areas, identified former building areas, fill material. Burial/burn pits were anecdotally identified in the north eastern and south eastern corners of the site.	• Metals (Arsenic (As), Cadmium (Cd), chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Zinc (Zn)) • Asbestos • Total petroleum hydrocarbons (TPH • Benzene, toluene, ethylbenzene, xylenes (BTEX) • Polycyclic aromatic hydrocarbons (PAHs)

Area/aspect of environmental Concern	Location	Contaminants of Potential Concern (COPCs)
Potential soil and groundwater impacts from the storage of dangerous goods, radiation, explosives, magnetics, electrical equipment, impact result from the drainage collection and work areas	Dangerous Goods stores (B25, B26) including the former storage area to the west of B22, Radiation store (B27), explosives store (B32), Magnetics storage yard (east of B40), Electrical store (B73), Radiac store (north west corner of B50), and the former Palletted Store (eastern portion of B7).	• TPH • Volatile organic compounds (VOCs) • Semi-volatile organic compounds (SVOCs) • PAHS, • Phenols • Metals (Arsenic (As), Cadmium (Cd), chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Zinc (Zn)) • Perfluorinated compounds (PFCs)
Fill around building footprint and leakage/potential spills from waste oil pits associated with mechanical and battery repairs and maintenance, impacting soil and groundwater	Battery service centre (B49), General equipment armament company workshop (B80), Mechanical Equipment store (B75), former T&P areas (north east of B16), waste oil UST (B79)	• TPH • PAHs • VOCs • Phenols • Polychlorinated biphenyls (PCBs) • Asbestos • Metals
Former storage areas for vehicles, heavy machinery and containers.	Northern portion of the site, and south west area (associated with previous Stage 1 works)	• Metals (Arsenic (As), Cadmium (Cd), chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Zinc (Zn)) • pH • TPH • VOCs/SVOCs
Potential asbestos and lead paint impacts from demolition of former structures. Illegal waste dumping	Proposal site area	• Asbestos in soil • ACM • Metals (Arsenic (As), Cadmium (Cd), chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Zinc (Zn)) • TPH, BTEX, PAH, OCP, PCB
Potential exploded ordnance waste (EOW) from former grenade range	South-eastern corner of the site	• UXO/EOW/EO • Explosive residues

Previous investigations

A review of historical investigations for the site was undertaken to further assess the likelihood of contaminants of potential concern being present with the Proposal site. The review identified that:

- Previous investigations have investigated potential contamination risk at the Proposal. No evidence of widespread residual contamination at the site has been reported, however isolated areas of the site have been reported to be impacted by lead, ACM, UXO, and EOW.
- There is no indication that groundwater at the site requires remediation or management under the proposed commercial / industrial land uses.
- The site has been certified by a NSW EPA-accredited Site Auditor to be suitable for commercial / industrial use subject to all works being carried out in accordance with 2016 GHD EMP.

Perfluorinated Compounds

The potential for Perfluorinated compounds (PFCs) on the DNSDC site (including the Proposal site) was investigated during intrusive site investigations (GHD, 2015). The investigation noted aqueous film forming foam (AFFF) compounds, which contain PFCs were present in soils and groundwater at some locations, however, concentrations were typically low and below the nominated investigation levels.

Potentially contaminated media

Potentially contaminated media present on the site may include:

- Fill material, including buried wastes - A review of the site history and previous investigations has identified the potential for uncontrolled filling across the site as well as unidentified buried wastes. As such, fill is considered a potentially contaminated medium.
- Surface soil (potential dust) - Due to the potential presence of asbestos fibres / bonded material in fill in unsealed areas, surface soils which could become wind-blown dust have the potential to be a contaminated media.
- Natural soils - Natural soils at the site underlie fill materials, and are known to have been contaminated by historic site activities at some locations (e.g. waste oil storage). Given the identified presence of contaminated soil and groundwater in soils in previous investigations, the natural soils across the site are considered a potentially contaminated medium.
- Groundwater - Groundwater systems have been reported as impacted by various contaminants within previous investigations. While groundwater impacts may not necessarily impact on the development and future use of the site, groundwater is nevertheless considered a potentially contaminated medium.
- Stormwater/surface water – Given the potential for contamination of surface soils and the presence of unsealed surfaces in some areas, there is the potential for contamination of stormwater / surface water flows. As such, surface water is considered a potentially contaminated medium.

13.2.4 Construction

There are no specific areas requiring direct remediation within the Proposal site. However, various contamination aspects of potential concern could impact on the Proposal site should they not be managed appropriately.

Contamination risks and impacts can be broadly divided into two main categories:

- Those that presently exist onsite and have built up over time
- Those that may be induced or created from the Proposal, either through construction or operational activities (managed through onsite management and monitoring methods).

Construction of the Proposal will have the potential to release and/or expose existing sources of contamination into the surrounding environment through disturbance of soils and groundwater. Potential exposure pathways for contamination may include:

- Direct dermal contact with contaminated soil or groundwater during construction or operation of the Proposal
- Inhalation of contaminated dust or vapour during construction or maintenance of the Proposal
- Ingestion of contaminated dust during construction or maintenance of the Proposal
- Mobilisation and/or exposure of contaminants in soil or groundwater through construction activities.

Construction activities may also pose a risk of causing contamination if not managed appropriately. During construction, fuels and chemicals required for construction would be stored on the Proposal site and within construction compounds. There is potential for fuels and chemicals to spread to the surrounding environment through spills and leaks.

Mitigation measures have been provided in Section 13.3 of this EIS to minimise the potential risk of contaminants on human health and the environment.

13.2.5 Operation

The Proposal site is considered to be suitable for the desired commercial / industrial land use and there are no specific areas requiring direct remediation prior to operation of the Proposal. The risk to workers and the environment from potential contamination existing once the Proposal is operational is considered to be low.

Oils, fuels, lubricants and other chemical substances would be required for vehicles plant and machinery during operation of the Proposal. Five classes of dangerous goods would also be transported to or from, and stored within warehouses on the Proposal site (see Section 14 for further details on the storage, handling and risks associated with dangerous goods).

Accidental spills and leaks within the Proposal site have the potential to result in contaminants being transported into the surrounding environment and groundwater. As the majority of the Proposal site would be hardstand, the potential for the migration of fuels and chemicals to soil and groundwater is considered to be low. Materials would be stored appropriately to minimise the risk of on or off site contamination

Measures to mitigate the potential for contamination during operation of the Proposal are set out in Section 13.3.

13.3 Mitigation Measures

13.3.1 Construction

- Excavated material would be reused on site where possible. Any excavated material that requires disposal would be subject to waste classification under the *Waste Classification Guidelines 2014* (NSW EPA, 2014) and would be disposed of at an appropriate licensed facility.
- The construction contractor would progress the Bulk Earthworks strategy (to be included within the CEMP) which would outline the volumes of imported and exported material, any buffer areas, temporary soil stockpiling areas and fencing of excavations, as required.
- A Contamination Management Plan (CMP) (or equivalent) would be prepared and included within the CEMP for the Proposal. The CMP would be prepared in consideration of the outcomes of the Environmental Management Plan (GHD, 2016) and Site Audit Statement and Site Audit Report (JBS&G, 2016) and would contain procedures on the following:
  - Handling, stockpiling and assessing potentially contaminated materials encountered during the development works.
  - A management tracking system for excavated potentially contaminated materials to ensure the proper management material movements at the Proposal site, particularly during excavation
  - Assessment, classification and disposal of waste in accordance with relevant legislation
  - A contingency plan for unexpected contaminated materials (unexpected finds protocol), such as materials that are odorous, stained or containing anthropogenic materials, that may be encountered during construction.
- A site-wide UXO, EO, and EOW Management Plan (or equivalent) would be developed for the Proposal site. This plan would be included within the CEMP and address the unexpected discovery of UXO, EO or EOW during construction.

13.3.2 Operation

- An Emergency Response Plan would be prepared and implemented. The plan would meet the requirements of Clause 153C of the POEO Act and the POEO (General) Regulation (Cl. 98B) and specify the procedure to be followed in the event of a spill, including the notification requirements and use of absorbent material to contain the spill. A spill kit would be provided on the Proposal site at all times.

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14 HAZARDS AND RISKS

Arcadis have undertaken an assessment of the hazards and risks associated with the the Proposal to address the SEARs. A preliminary risk screening has been prepared in accordance with the requirements of SEPP 33 and is included below.

Table 14-1 provides a summary of the relevant SEARs which relate to hazards and risks, and where they have been addressed in this EIS.

Table 14-1 SEARs - Hazard and Risk

SEARs	Where addressed in this EIS
13. Hazards and Risks	
Including, but not limited to: A preliminary risk screening completed in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* and *Applying SEPP 33* (DoP 2011), with a clear indication of class, quantity and location of all dangerous goods and hazardous materials associated with the proposal. Should preliminary screening indicate that the proposal is 'potentially hazardous,' a Preliminary Hazard Analysis (PHA) must be prepared in accordance with *Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis* (DoP 2011) *and Multi-Level Risk Assessment* (DoP 2011).	Section 14.4 of this EIS.
The PHA should: a) Estimate the risks from the facility; b) Be set in the context of the existing risk profiles for the intermodal facility and demonstrate that the proposal does not increase the overall risk of the area to unacceptable levels; and c) Demonstrate that the proposal complies with the criteria set out in the *Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning*.	Section 14.4 of this EIS

The management of asbestos in the soil, and the potential for other soil and groundwater contamination is addressed in Chapter 13. The identification of potential risks associated with bushfire and the management of this risk is addressed in Section 19.1.

The Concept Plan Conditions of Approval are generally consistent with the SEARs provided for the Proposal as they relate to hazards and risks (refer to Table 14-1) and have been addressed in this Section of the EIS. The compliance of the Proposal with the SEARs, Concept Plan Conditions of Approval and Statement of Commitments is provided at Appendix A of this EIS.

This section summarises the studies undertaken for the MPE Concept Plan Approval (section 14.1) and, more recently, for the Proposal. This section of the EIS also summarises the methodology used to assess hazards and risks related impacts of the Proposal (section 14.2), describes the existing environment as it relates to hazards and risks (section 14.3) and provides an assessment of hazards and risks impacts associated with construction and operation of the Proposal (section 14.4). Measures to mitigate potential hazards and risks impacts where they are required have been identified in section 14.5.

14.1 Concept Plan Assessment

A *Potential Hazard and Risks Assessment* (Hyder, 2011) was prepared as part of the MPE Concept Plan Approval EA, and included an assessment of the potential hazards and risks associated with the development of an IMT facility, warehouse and distribution facilities and ancillary services. The assessment included:

- Identification of key potential hazards and risks associated with the construction and operation of the MPE Project
- Identification of key legislative requirements associated with the management and mitigation of potential hazards and risks
- A review of key construction risks and mitigation measures to reduce risks in light of legislative requirements
- A review of operational hazards and risks and recommended management strategies and mitigation measures to reduce these risks in light of legislative requirements.

The MPE Concept Plan EA identified the following key potential hazards and risks as potentially arising during the construction and operation of the MPE Project, including during the Proposal:

- Presence of asbestos in existing structures and soil on the MPE site
- Potential for soil and groundwater contamination as a result of previous activities on the MPE site (including unexploded ordnance (refer to Chapter 13 (Soils, groundwater and contamination) for more information)
- Potential transport, storage and handling of dangerous goods
- Bushfire (discussed in Section 19.1 of this EIS).

The *Hazards and Risks Assessment* provided a number of conclusions and recommendations to be implemented during construction and operation of the MPE Project, including a number of management procedures, and some further investigations to address the potential risks and hazards identified.

Hazards and risk-related recommendations from the *Hazards and Risks Assessment* prepared as part of the MPE Concept Plan EA, relevant to the Proposal include:

- A Phase 2 ESA and Phase 3 risk assessment would be undertaken where required prior to the commencement of construction to delineate the presence and/or extent of soil and groundwater contamination present. Where required, approval would be obtained in accordance with SEPP 55 for remedial works (refer to Chapter 13 (Soils, groundwater and contamination) for more information)
- An asbestos management plan will be developed, containing a risk assessment undertaken in accordance with the Code of Practice for the Safe Removal of Asbestos (NOHSC, 2005), including the development of an asbestos removal control plan and emergency plan (refer to Section 14.5 for more information)
- A preliminary hazard assessment (PHA) would be undertaken during project application approval stages or by tenants during the operational phase of the development, as required by SEPP 33. Once the level of risk has been identified, the aim would be to reduce the risk to as low as reasonably possible through the application of specific operational management procedures that would form part of a framework for managing risks, captured within the facility's Hazard and Risk Management Plan and Emergency Response Plan. Should unacceptable levels of risk be identified during the PHA, future potential tenants would be required to demonstrate the measures to reduce the risk to an acceptable level prior to acceptance of tenancy (refer to Section 14.4 for more information).

- SIMTA as the Proponent would be required to disclose the type and quantity of goods entering the MPE site, prior to the commencement of tenancy. Prior to the lease (of any warehouse) on the MPE site, all tenants that would handle dangerous goods would be required to sign on to SIMTA's Hazard and Risk Management Plan and the Emergency Response Plan for the MPE site. These plans would be reviewed regularly and updated as goods entering the MPE site change with tenancies. As a minimum, the requirements in the Code of Practice for storage and handling of dangerous goods (WorkCover NSW, 2005) would be adopted in these plans (refer to 14.5 for more information regarding operational mitigation measures).

The *Hazards and Risks Assessment* acknowledged that it is not possible to quantify the operational risks relating to the transport, storage and handling of dangerous goods to, from and within the MPE site in the absence of further details regarding proposed tenancies. Where possible, the operational hazards and risks associated with the Proposal have been updated and are described in 14.4 below.

14.2 Methodology

The hazards and risks assessment for the Proposal has included the following key activities:

- A desktop review and collection of background information to identify potential hazards and risks associated with the Proposal in the context of the broader MPE site and surrounding environment.
- A preliminary risk screening of the Proposal in accordance with Applying SEPP 33: Hazardous and Offensive Development Application Guidelines (Department of Planning, 2011).

14.2.1 Desktop review and collection of background information

A desktop review and collection of background information relevant to the Proposal was undertaken. This included an examination of existing reports, aerial imagery and site investigation data relevant to the Proposal site and surrounds to identify existing site conditions that may present hazards during construction of the Proposal and nearby development and sensitive receivers.

To effectively apply the risk screening method prescribed in SEPP 33, a range of information is required including:

- Details of all dangerous goods and otherwise hazardous materials involved in the proposed development
- Dangerous goods classifications for all Dangerous Goods held onsite
- Quantities of dangerous goods and otherwise hazardous materials involved in the proposed development
- Distance from the boundary for each hazardous substance
- Distance to the nearest residential property.

14.2.2 Preliminary risk screening

As discussed in Section 5.3.3, SEPP 33 links the permissibility of an industrial development to its safety and environmental performance. Activities involving the handling, storage or processing of a range of materials, which, in the absence of controls may create risk outside of operational borders to people. Property or the environment are defined by SEPP 33 as ‘potentially hazardous industry’ and/or ‘potentially offensive industry’.

Under clause 12 of SEPP 33, industries or projects determined to be hazardous or potentially hazardous require the preparation of a PHA.

To determine if the Proposal is defined as potentially hazardous industry and/or potentially offensive industry under the provisions of SEPP 33, and therefore requires the preparation of a PHA, a preliminary risk screening was undertaken in accordance with Figure 4 of *Applying SEPP 33: Hazardous and Offensive Development Application Guidelines* (Department of Planning, 2011).

14.3 Existing environment

14.3.1 Proximity of the Proposal site to sensitive receivers

The Proposal site, including the MPE Stage 2 site and the Moorebank Avenue site is located approximately 2.5 km south of the Liverpool City Centre, 800 m south of the Moorebank Avenue/M5 Motorway interchange and one kilometre to the east of the SSFL providing convenient access to and from the site for rail freight (via dedicated freight rail line) and for trucks via the Sydney Motorway Network. The local context of the Proposal site is shown on Figure 2-2.

The majority of land surrounding the MPE site is owned and operated by the Commonwealth and comprises:

- The MPW site, formerly the School of Military Engineering (SME), on the western side of Moorebank Avenue directly adjacent to the SIMTA site (subject to the MPW Concept Approval)
- The Holsworthy Military Reserve, to the south of the MPE site on the southern side of the Sydney Trains East Hills Rail Corridor
- Residual Commonwealth Land (known as the Boot Land), to the east of the MPE site between the site boundary and the Wattle Grove residential area.

The MPE site is located near a number of significant industrial areas, including: Moorebank and Warwick Farm to the north, Chipping Norton to the north-east, Prestons to the west and Glenfield and Ingleburn to the south-west. The industrial area at Moorebank is the closest industrial precinct to the Proposal, comprising around 200 hectares of industrial development, the majority of which is located to the north of the M5 South West between Newbridge Road, the Georges River and Anzac Creek. The Moorebank Industrial Area supports a range of industrial and commercial uses, including freight and logistics, heavy and light manufacturing, offices and business park developments.

A number of residential suburbs are located in proximity to the Proposal site. The approximate distances of these suburbs to the MPE Stage 2 site and the Moorebank Avenue site are provided in Table 14-2 below.

Table 14-2 Distance to residential suburbs from the Proposal site

Suburb	Distance to MPE Stage 2 site	Distance to Moorebank Avenue site
Wattle Grove	360 m to the north-east	865 m to the north-east
Moorebank	1300 m to the north	1430 m to the north
Casula	820 m to the west	760 m to the west
Glenfield	1830 m to the south-west	1540 m to the south-west

14.3.2 Existing hazards present at the Proposal site

The desktop review and collection of background information identified the following existing hazards as being potentially present within the Proposal site:

- Asbestos containing material (ACM) in existing structures and soil
- Soil and groundwater contamination from previous activities. An assessment of the potential soil and groundwater contamination impacts associated with the Proposal has been provided in Chapter 13 (Soils, groundwater and contamination) of this EIS.

Asbestos

Asbestos is a naturally occurring fibrous material that has typically been used for its insulation and fire resistant properties, as well as roof and wall cladding for building structures. Over time, bonded fibres may be worn down and released to the environment. Breathing in asbestos fibres in high concentrations and/or exposure over a long period of time has the potential to cause asbestosis, lung cancer and mesothelioma.

A survey for hazardous building materials was undertaken by AGC Woodward-Clyde Pty Ltd and Hibbs And Associates Pty Ltd in October 1999 (AGC/H&A survey) on the MPE site. From this survey, an asbestos register was developed for the MPE site.

Asbestos was found to be present in approximately 15 percent of all existing buildings present on the MPE site at the time. In 2002, an audit of the MPE site and asbestos register was undertaken by Hibbs and Associated Pty Ltd along with a qualitative assessment of the risk to occupants of the buildings in which asbestos was identified.

The qualitative assessment of the hazard posed by the asbestos in its location and with continued building use used the following condition priority ratings:

- Condition Priority A1 - Immediate Elevated Risk Level: Friable material, which due to its present condition and location, presents an immediate health risk. Immediate control measures are required and the area containing this material should be isolated from personnel. Abatement of this particular hazard is strongly recommended at the earliest practicable time.
- Condition Priority A2 - Potential Elevated Risk Level: Damaged or unstable material that if disturbed is likely to present an immediate health risk, with the likelihood that contamination may spread to other areas. Control measures to stabilise this material should be initiated immediately, with formal abatement of the hazard being considered.
- Condition Priority A3 - Low Risk Requiring Minor Maintenance: Non-friable or stable material that has some minor areas of damage requiring remedial action or is likely to be subject to damage or to degrade due to environmental conditions. It is recommended that maintenance work be performed to stabilise and repair damaged areas. Controls must be implemented to protect these materials from further damage or degrading factors.
- Condition Priority A4 - Negligible Risk Under Present Conditions: Non-friable or stable material, which is unlikely to present a risk to health unless damaged, tooled, cut, sanded, abraded or machined. It is recommended that these materials be maintained in good order. Reassessment of the priority rating will be required if planned works are likely to have an impact on these materials.

The H&A Audit found asbestos to be present in eight of the buildings located within the Proposal site. A summary of the buildings and their condition priority rating is provided in Table 14-3. The other building identified in the audit as containing asbestos would be demolished as part of the MPE Stage 1 Proposal.

Table 14-3 Summary of asbestos material identified on the Proposal site

Building No.	Location	Description	Condition priority rating
32	Stores – Store 32N03	Possible flat AC sheets as awning lining	A4
43	Office/lunch room – building exterior	Eaves	A4
49	Battery store and offices – toilet and washroom ceiling	Ceiling lining	A4
62	Mechanics workshop – main workshop	Space heaters – gasket/seal	A4
63	Compressor room – Electrical switchboard	Electrical backing board	A4
67	Warehouse – No. 11 compressor room	Supply air duct electrical heater banks lined with asbestos millboard	A1
	Firing range – fire door	Possible asbestos fire door core	A4
	Phosphate line – space heater	Gasket/flange joint	A4
	Welding and power coat storage area	Gasket – plate seal	A4
	Drying oven for powder coats	Gasket – plate seal	A4
	Storage Area (11) Flammable liquids portable	Asbestos rope door seal	A4
	No. 11 Compressor room	Spare/disused asbestos gasket & flange joint gaskets	A4
80	Warehouse – west side	Asbestos pipe lagging debris on top of GE/electrical office and ASM GE/ARMT office	A1
	Main workshop – 4 Dravo space heaters	Gasket/seal	A4
91	Main workshop – 4 Dravo space heaters	Gasket/seal	A4
	Offices and toilet block – building interior	Ceiling lining – flat AC sheet	A4
	Building exterior	Eaves lining – flat AC sheet	A4

Asbestos and other contaminants that have been identified in, or on, the ground (i.e. not in buildings) has been discussed and assessed in Chapter 13 (Soils, groundwater and contamination) of this EIS.

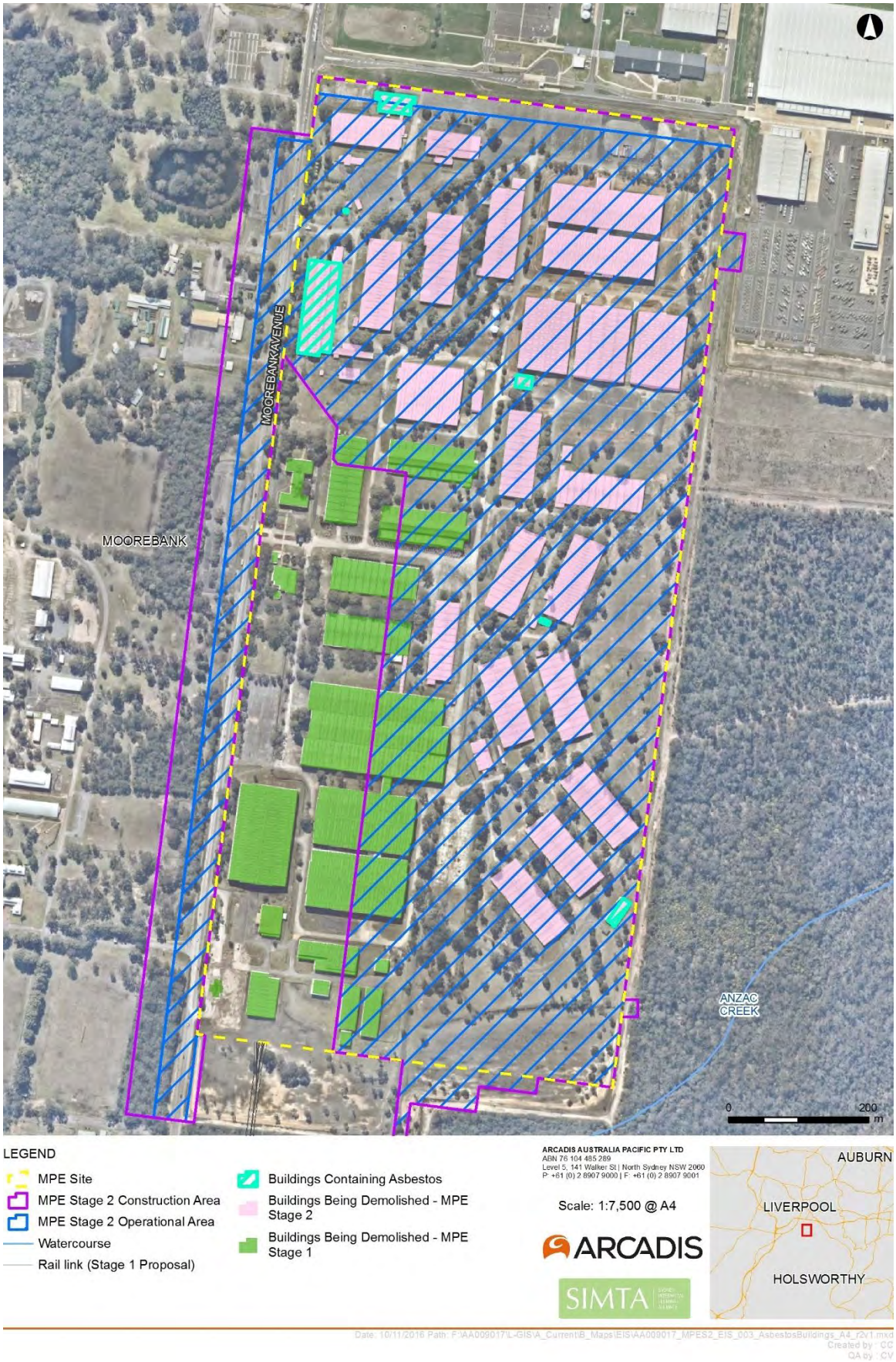

Figure 14-1 Existing buildings containing asbestos to be demolished during construction

14.4 Potential impacts

14.4.1 Construction

The following hazards and risks would be associated with construction of the Proposal:

- Potential impacts on human health and/or the environment resulting from the accidental release or improper transport, handling and storage of hazardous substances relating to the Proposal.
- The potential for asbestos fibres to become airborne during demolition and excavation activities.

Hazardous materials

Hazardous materials that may be transported to and used on the Proposal site to facilitate construction may include, but not be limited to:

- Diesel fuels
- Oil, grease and lubricants
- Gases (oxy-Acetylene) (Class 2.1)
- Bitumen (Class 3 PGIII)
- Paints and epoxies (Class 3 PGII and Class 3 PGIII)
- Herbicides (Class 6.1 PGII).

The above dangerous goods classifications have been determined using the 'Australian Code for the Transport of Dangerous Goods by Road and Rail' (7th edition) (the ADG Code) (National Transport Commission, 2007).

The majority of these compounds would be stored within the Main Warehousing Compound (refer to Figure 4-6 for location). The storage, handling and use of these materials would be undertaken in accordance with the *Work Health and Safety Regulation 2011* and the 'Storage and Handling of Dangerous Goods Code of Practice' (WorkCover NSW, 2005).

Asbestos

Asbestos has been identified within the construction footprint of the Proposal. The available information on asbestos at the Proposal site has been reviewed and is summarised in Section 14.3.2. The following construction activities have the potential to cause asbestos fibres to become airborne, thereby posing a risk to human health:

- The demolition of the existing buildings known to contain asbestos (i.e. building no. 32, 43, 49, 62, 63, 80 and 91, refer to Table 18-4 and Figure 18-1 for more information))
- Any excavation or disturbance of soil potentially containing asbestos

The excavation, movement and disposal of ACM would be undertaken in strict accordance with procedures detailed in an Asbestos Management Plan and the *Work Health and Safety Regulation 2011* and its regulations.

Mitigation measures to be implemented during construction of the Proposal to manage potential impacts associated with Asbestos are provided in Section 14.5.

14.4.2 Operation

Dangerous goods screening

As described in *Applying SEPP 33* the first stage of determining the SEPP 33 procedural requirements for the Proposal, and in particular to determine if a PHA is required, is to undertake screening tests, such as dangerous goods quantity / distance thresholds. Hazardous materials are defined as substances which fall within the classification of the ADG Code.

In identifying the dangerous goods classes for which there are screening thresholds, the following considerations were reviewed to determine the dangerous goods classes that would be included and excluded in the Proposal:

- **Dangerous goods that cannot be transported in containers**: all cargo entering and exiting the MPE Stage 2 site would be imported/exported in shipping containers from an overseas origin. Where the risk screening threshold for a class of dangerous goods is above the quantity of what could be transported by container (i.e. greater than 20 tonnes) and/or require to be transported in a gas tanker, this has been excluded from the screening
- **Storage on site**: some dangerous goods thresholds apply only if the material is to be stored on site. Should dangerous goods be stored within warehouses on the MPE Stage 2 site, this would be confirmed once tenancy arrangements have been identified. At this stage, the preliminary risk screening would be revisited.
- **Operational decisions**: the applicant has made a decision that these classes of goods would not be transported to and from the Proposal.

The dangerous goods classes for which there are screening thresholds (and trigger the requirement for a PHA) are presented in Table 14-4. The classes and threshold quantities to be excluded from the MPE Stage 2 site, and the rationale for their exclusion are also presented.

The dangerous goods likely to be stored and/or transported to and from the Proposal site in quantities greater than the screening threshold are shaded in grey.

Table 14-4 Rationale for exclusion/inclusion of dangerous goods

ADG Code Class	Description	Screening threshold quantity	Description of screening test	Below threshold quantities on Proposal site	Rationale for exclusion or inclusion
1.2	Explosives - Substances and articles which have a projection hazard but not a mass explosion hazard	5 tonnes	Or within 100 m residential area	Yes	Class 1.2 Explosives are not carried on the SSFL and would therefore not be transported to and from, or stored within the Proposal site.
1.3	Explosives - Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both	10 tonnes	Or within 100 m residential area	Yes	Class 1.3 Explosives are not carried on the SSFL and would therefore not be transported to and from, or stored within the Proposal site.
2.1	Gases - Flammable gases (LPG)	LPG Only – not including automotive and retail outlets			
		10 tonnes or 16 m^3	Above ground	Yes	LPG not stored or transported in a containerised manner therefore would not be transported to and from or stored within the Proposal site.
		40 tonnes or 64 m^3	Underground	Yes	LPG not stored or transported in a containerised manner therefore would not be transported to and from or stored within the Proposal site.
2.1	Gases – Flammable gasses (non-LPG)	25-90 metres (dependent on tank size)	Liquefied Under Pressure > 500 kg	Yes	DG Class 2.1 flammable gasses may be transported to and from, and stored within the Proposal site.

ADG Code Class	Description	Screening threshold quantity	Description of screening test	Below threshold quantities on Proposal site	Rationale for exclusion or inclusion
2.3	Gases – Toxic gases	5 tonnes	Anhydrous ammonia	Yes	Operational decision that this dangerous good would not be transported to and from or stored within the Proposal site.
		1 tonne	Chlorine & sulphur dioxide in liquefied gas containers < 100 kg	Yes	This dangerous good is not stored or transported in a containerised manner; therefore would not be transported to and from or stored within the Proposal site.
		2.5 tonnes	Chlorine & sulphur dioxide in liquefied gas containers < 100 kg	Yes	This dangerous good is not stored or transported in a containerised manner; therefore would not be transported to and from or stored within the Proposal site.
		100 kilograms	Liquefied gas	Yes	Liquefied gas is not stored or transported in a containerised manner therefore would not be transported to and from or stored within the Proposal site.
		100 kilograms	Other poisonous gases	Yes	Operational decision that this dangerous good would not be transported to and from or stored within the Proposal site.

ADG Code Class	Description	Screening threshold quantity	Description of screening test	Below threshold quantities on Proposal site	Rationale for exclusion or inclusion
3	Flammable liquids	*	3PGI	No	DG Class 3PG I flammable liquids may be transported to and from, and stored within the Proposal site
		*	3PGII	No	DG Class 3PG II flammable liquids may be transported to and from, and stored within the Proposal site
		*	3PGIII	No	DG Class 3PG III flammable liquids may be transported to and from, and stored within the Proposal site
4.1	Flammable solids	5 tonnes	-	Yes	Class 4.1 flammable solids are not carried on the SSFL and would therefore not be transported to and from, or stored within the Proposal site.
4.2	Substances liable to spontaneous combustion	1 tonne	-	Yes	Class 4.2 substances are not carried on the SSFL and would therefore not be transported to and from, or stored within the Proposal site.
4.3	Substances that in contact with water emit flammable gases	1 tonne	-	Yes	Class 4.3 substances are not carried on the SSFL and would therefore not be transported to and from, or stored within the Proposal site.
5.1	Oxidising agents	25 tonnes	Ammonium nitrate	Yes	Operational decision that this dangerous good would not be transported to and from or stored

ADG Code Class	Description	Screening threshold quantity	Description of screening test	Below threshold quantities on Proposal site	Rationale for exclusion or inclusion
					within the Proposal site, given the likely minimal demand within the freight catchment.
		5 tonnes	Any class other than dry chlorine (and chlorine stored at a dedicated pool shop)	No	Class 5.1 oxidising agents may be transported to and from, and stored within the Proposal site
5.2	Organic peroxides	10 tonnes	-	No	Class 5.2 organic peroxides may be transported to and from, and stored within the Proposal site
6.1	Toxic substances	0.5 tonnes	Packing group I	No	Class 6.1, Packing Group I toxic substances may be transported to and from, and stored within the Proposal site
		2.5 tonnes	Packing group II & III	No	Class 6.1, Packing Group II & III toxic substances may be transported to and from, and stored within the Proposal site
6.2	Infectious substances	0.5 tonnes	Includes clinical waste	Yes	Class 6.2 substances are not carried on the SSFL and would therefore not be transported to and from, or stored within the Proposal site.

ADG Code Class	Description	Screening threshold quantity	Description of screening test	Below threshold quantities on Proposal site	Rationale for exclusion or inclusion
7	Radioactive material	All	-	Yes	Class 7 radioactive material is not carried on the SSFL and would therefore not be transported to and from, or stored within the Proposal site.
8	Corrosive substances	5 tonnes	Packing group I	No	Class 8, Packing Group I corrosive substances may be transported to and from, and stored within the Proposal site.
		25 tonnes	Packing group II	Yes	This substance is not stored or transported in a containerised manner therefore would not be transported to and from or stored within the Proposal site.
		50 tonnes	Packing group III	Yes	This substance is not stored or transported in a containerised manner therefore would not be transported to and from or stored within the Proposal site.

* Class 3 flammable liquids do not have a screening threshold.

As detailed in Table 14-4, there is the potential for six classes of dangerous goods to be transported to or from, and stored within, warehouses on the MPE Stage 2 site. Notwithstanding this, in accordance with the MPE Concept Plan Approval an operational decision has been made by SIMTA as the Proponent that the Proposal would not receive or store the six classes of dangerous goods identified in Table 14-4 in quantities greater than the screening thresholds identified in *Applying SEPP 33*. On this basis, a PHA is not required for the Proposal at this stage.

Dangerous good transport and storage

The Proposal has the potential to result in the transport of dangerous goods by road. The criteria used to determine whether substances are classified as dangerous goods are contained in the ADG Code, which also contains a list of substances classified as dangerous goods.

If not handled correctly, dangerous goods pose a risk to the health and safety of employees and contractors working on the MPE Stage 2 site and the community surrounding the site, as they may be explosive, flammable, combustible, spontaneously combustible, oxidising, water-reactive, toxic or corrosive. The transport and storage of dangerous goods is recognised as a high-risk activity involving heavy vehicles on the public road and rail network (ADG Code, National Transport Commission, 2007).

The Proposal involves the operation of warehouses and distribution facilities, namely infrastructure to support container freight transport to and from the MPE site. As such, there is the potential for the Proposal to require the transport of dangerous goods:

- To and from the MPE Stage 2 site
- Between the MPE Stage 2 site and the IMT facility (i.e. MPE Stage 1)
- Temporarily within warehouses on the MPE Stage 2 site prior to distribution.

As part of the Proposal, full containers would be transferred from the MPE Stage 1 site to the warehouses on the MPE Stage 2 site by trucks, where the contents would be unloaded in the warehouses by means determined by the tenant. The goods stored within the warehouses would then be transported to market via other heavy vehicles which would enter the site and be packed separately.

As the customers and proposed tenancies of warehouses have yet to be confirmed, the quantities and types of goods transported to, and stored temporarily on the site cannot currently be quantified, nor the possibility of transport or storage of dangerous goods at the MPE Stage 2 site be excluded. Depending on their type and quantity, dangerous goods have the potential to pose a risk to the health and safety of employees and contractors on the MPE Stage 2 site, the local community and the environment if not handled correctly, as they may be explosive, flammable, combustible, spontaneously combustible, oxidising, water-reactive, toxic or corrosive.

The handling of chemicals on the MPE Stage 2 site would constitute the greatest hazard with regards to the transport and storage of dangerous goods. The NSW Ports Trade report 2012 /2013 notes that in 2012 / 2013, Port Botany handles 144,779 TEU of containerised chemicals, an increase of 6.8 % from 2011/2012, and represented 13.6 % of total imported commodities for 2012/2013. Of these chemicals, the most prominent imported commodities were:

- Plastic materials and artificial resins – 53,896 TEUs
- Oils, perfumes and cleaning materials – 33,840 TEUs
- Chemical materials and products – 20,738 TEUs.

In the PHA for the Port Botany Expansion EIS (SPC/URS, 2003), an analysis of dangerous goods trade passing through Port Botany showed that approximately

96 per cent of containers did not carry dangerous goods. On this basis, only four per cent of containers did carry dangerous goods.

The more recent NSW Freight and Ports Strategy (Transport for NSW, 2013) notes that rail is used for 14 per cent of the container movement task to and from Port Botany.

As SIMTA represents one of several existing and proposed IMTs within the Sydney region, the quantity of containers carrying dangerous goods would be small and would present a low risk to site personnel, the local community and the environment.

Hazard Identification

A hazard is anything or any situation with a potential for causing damage to people, property or the biophysical environment. Operational hazards associated with the Proposal have been undertaken based on a review of the proposed operational activities, and considering the hazards associated with each of the dangerous goods proposed to be stored within the MPE Stage 2 site (refer to Table 18-6).

Potential hazards and risks associated with the operation of the Proposal have been identified, including:

- **Spills and loss of containment of flammable/combustible or corrosive liquids:** This includes liquid and solid spills that may arise from impact, unloading, operational error or equipment failure. Depending on the material and circumstance, spills may result in damage to skin, membranes and airways as well as physical impact and injury. Spills also have potential to cause harm to the environment, particularly if liquid spills of toxic and hazardous substances enter waterways or groundwater and/or come into contact with soil.
- **Fire and Explosion:** Fire and explosion has the potential to cause human injury and damage to property and equipment. Fire may be caused by a number of factors including; bushfires or fire initiated onsite (e.g. from a vehicle accident or equipment)
- **Vehicle movements and machinery use:** Heavy vehicles and machinery (e.g. reach stackers and manual handling equipment) movements on the MPE Stage 2 site present potential hazard in terms of incidents between vehicles and other vehicles, between vehicles and pedestrians, and between vehicles and property
- **Dangerous goods storage and transport:** Hazardous materials are substances falling within the classification of the ADG. The main type of dangerous goods used onsite include dangerous goods involved in the operational processes of the Proposal, such as chemicals associated with operations, plant and vehicle maintenance
- **Gas leaks (natural gas and LNG):** As a result of weld/cylinder failure, equipment failure, impact, corrosion, drive-away during loading or refuelling, other operational error, malicious damage or sabotage.

Materials

Materials likely to be handled on the MPE Stage 2 site, which could potentially be involved in an accident causing exposure of the materials to the surrounding environment and the potential scenarios are shown in Table 14-5.

Table 14-5 Potential scenarios associated with dangerous goods to be present on the MPE Stage 2 site

ADG Code class	Description	Potential Scenario
3	Flammable liquids	Fire or explosion
5.1	Oxidising agents	Fire or explosion
5.2	Organic peroxides	Fire or explosion
6.1	Toxic substances	Fire involving this material
8	Corrosives	Spill causing injury

As mentioned earlier, as the customers and proposed tenancies of warehouses have yet to be confirmed, the quantities and types of goods transported to, and stored temporarily on the MPE Stage 2 site cannot currently be quantified, nor the possibility of transport or storage of dangerous goods at the MPE Stage 2 site be excluded. As a result, it is unknown whether the above substances will be handled within the MPE Stage 2 site in quantities that exceed the screening threshold.[1]

Regardless of the quantities of dangerous goods handled on the MPE Stage 2 site, a Dangerous Goods Management Plan would be developed for the operation of the Proposal. Site personnel and contractors would be informed of the management of dangerous goods and their identification and separation requirements as part of a site induction, in accordance with the relevant Australian standards and NSW WorkCover guidelines.

Methods of release

The proposed operational activities to be undertaken on the MPE Stage 2 site were reviewed with reference to similar container operations to identify potential hazards which may arise. Consideration was also given to the location of activities involving dangerous goods. These were identified to be:

- Transportation on-site via container trucks and machinery
- Unloading of materials and storage within warehouses.

Potential on-site methods of release are shown in Table 14-6. The management measures, standards and guidelines that would advise facility design and operating procedures to mitigate risks and hazards associated with the Proposal are also noted.

[1] : Note there is not a screening threshold for Class 3 dangerous goods

Table 14-6 Hazard scenarios, consequence and mitigation measures associated with the Proposal

Activity/Equipment	Cause/Comment	Effect	Consequence Range	Management standards and guidelines
Stacking containers within storage areas	• Unstable/unbalanced container load. • Impact with containers/plant. • Lower containers misaligned. •	• Falling or uncontrolled objects (potentially leading to other effects such as fire/spills/explosion)	• Death. • Serious injury. • Loss of operating time. • Increase cost. • Property damage •	• *AS 2550.1 Cranes hoists and winches* • *Work Cover NSW Bridge and Gantry Crane Drivers: A guide for power crane operators (1997).* • *Draft Code of Practice for Industrial Lift Trucks (WorkSafe Australia, 2012).* • *Work Cover NSW Dogging Guide (2003).* • *Work Cover NSW Rigging Guide (1995).*
Mobile plant and LV movements	Mechanical or electrical faults Interaction with other mobile plant and pedestrians Poor road conditions	• Spills • Fire/explosion. • Vehicle/pedestrian collision.	• Work Cover fines • Death. • Serious injury. • Loss of operating time. • Increase cost.	• *Work Cover NSW Traffic Management in Warehousing (2009).* • Clear signage and road markings • An OEMP will be prepared including traffic management procedures and operations onsite. • Operators licenced and hold current verification of competencies • Operational procedures for machinery to be outlined in the OEMP

Activity/Equipment	Cause/Comment	Effect	Consequence Range	Management standards and guidelines
Gas leaks (LNG)	Weld/cylinder failure, equipment failure, impact, corrosion, drive-away during loading or refuelling, other operational error, malicious damage or sabotage	• Explosion • Fire	• Death • Serious injury • Loss of operating time • Property damage • Increase cost	• Use pipe of robust design, emergency isolation valves, and pressure relief system. • Design the LNG storage to AS 3961-2005. • Secure site from unauthorised access. • Significant separation distances to residences and other assets.
Leak of LNG during transportation	Truck accident	Gas cloud flash or jet fire if source of ignition or static electricity present Explosion	• Death • Serious injury • Property damage	• Transport according to ADG Code, relevant standards and regulations. • Ensure that the contractor delivering the gas is trained, competent and certified by relevant authorities.
Loss of containment of flammable/combustible or corrosive liquids	Mobile plant impact, operational error or equipment failure	• Fire • Explosion • Pollution	• Contamination of land • Death • Serious injury • Loss of operating time • Environmental fines	• Storage in accordance with AS 1940, secondary containment for all storages, located away from drainage paths.

Activity/Equipment	Cause/Comment	Effect	Consequence Range	Management standards and guidelines
Inappropriate waste disposal	Lack of understanding and training and/or use of unlicensed contractors or waste disposal facilities	• Pollution	• Contamination of land • Contamination of watercourses or groundwater • Injury • Environmental fines	• Implementation of an operational waste management plan • No hazardous or regulated wastes will be disposed of on-site. • All off-site disposal shall be via approved waste transport operators and to appropriately licenced waste facilities

14.5 Mitigation Measures

14.5.1 Construction

- Hazards associated with operation of the Proposal would be identified through a Hazard and Operability Study (HAZOP), which would be undertaken as part of the detailed design.
- The following measures would be included in the CEMP (or equivalent) to minimise hazards and risks:
  - Construction works, including the storage, handling and use of hazardous construction materials would be undertaken in accordance with the provisions of the *Work Health and Safety Act 2011* and *Work Health and Safety Regulation 2011*.
  - All demolition activities would be undertaken in accordance with *Australian Standard AS2601-1991 – Demolition of Structures*
  - Safe operational access and egress for emergency service personnel and workers will be provided at all times, and specified in the CEMP.
  - Regular maintenance and inspection of all environmental and safety protection controls would be undertaken.
- An Asbestos Management Plan would be prepared for the Proposal in accordance with the *Code of Practice: How to Manage and Control of Asbestos in the Workplace* (WorkCover NSW, 2011). The plan would include, but not be limited to:
  - Identification of potential (suspected or confirmed) asbestos areas
  - an outline of how asbestos risks would be controlled
  - the identification of each person with responsibilities and details of their responsibilities under this plan
  - Reference the asbestos register and risk assessment, which would also be prepared prior to construction being undertaken.
- All asbestos removal works, including the demolition of the eight structures identified as containing asbestos (refer to Table 14-3) will be undertaken in accordance with the Environmental Management Plan (GHD, 2016) and the following:
  - The Code of Practice for the Safe Removal of Asbestos (NOHSC, 2005)
  - Code of Practice: How to Safely Remove Asbestos (WorkCover NSW, 2011)[2]

  Asbestos removal would be carried out by an appropriately licensed asbestos removalist. The licencing requirements for asbestos removal are specified in the *Code of Practice How to Safely Remove Asbestos* (WorkCover NSW, 2011).

[2] Excavation or disturbance of those areas of the Proposal site where potential for asbestos to be present within the soil is discussed and mitigated in Chapter 13 (Soils, Geology and Contamination).

14.5.2 Operation

- Dangerous goods entering or leaving the Stage 2 site must be notified in advance in accordance with the International Maritime Organisation (IMO) and regulations pertaining to the International Convention for the Safety of Life at Sea (SOLAS).
- Handling of dangerous goods including unpacking from containers and storage within warehouses on the Stage 2 site would be undertaken in accordance with the *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover NSW, 2005).
- Staff involved in the transport and handling of dangerous goods within the Proposal site would receive training regarding the contents of the dangerous goods provisions and their roles and responsibilities. All training would be recorded and maintained in accordance with the appropriate competent authority (SafeWork NSW).
- Design, installation and maintenance of gas reticulation infrastructure would be undertaken in accordance with *Australian Standard AS 2944-1 (2007): Plastic pipes and fittings for gas reticulation – Polyamide pipes* and *Australian Standard AS 2944-2 (2007): plastic pipes and fittings for gas reticulation – Polyamide fittings*.
- Storage of flammable/combustible liquids within the Proposal site would be carried out in accordance with A*ustralian Standard AS 1940: The Storage and Handling of Flammable and Combustible Liquids*. Secondary containment measures would be implemented in a location away from waterways and drainage paths/infrastructure.
- An Operational Hazard and Risk Management Plan would be developed for the Proposal site and be implemented as part of the OEMP for the Proposal. This plan would be reviewed regularly and updated should goods entering the site change. As a minimum, the plan would adopt the requirements of the Code of Practice for Storage and Handling of Dangerous Goods (WorkCover NSW, 2005).
- Appropriate testing, alarm systems and work, health and safety (WHS) precautions would be implemented for the safety of personnel and infrastructure.
- No hazardous or regulated wastes would be disposed of on site.

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