



More Trains, More Services

Wolli Creek Substation and T8 Line Power Supply Upgrade

Review of Environmental Factors



November 2019

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Abbreviations

Term	Meaning
A	Amps (electrical current)
AC	Alternating Current
AEP	Annual exceedance probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AIMD	Active Implanted Medical Devices
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ARI	Average Recurrence Interval
ASA	Asset Standards Authority (refer to Definitions)
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
ASSMP	ASS management plan
BC Act	<i>Biodiversity Conservation Act 2016</i> (NSW)
Biosecurity Act	<i>Biosecurity Act 2015</i> (NSW)
CBD	Central Business District
CDEGS	Current Distribution, Electromagnetic Interference, Grounding and Soil Structure Analysis
CEMP	Construction Environmental Management Plan
CLM Act	<i>Contaminated Land Management Act 1997</i> (NSW)
CNVMP	Construction Noise and Vibration Management Plan
CNVS	<i>Construction Noise and Vibration Strategy</i> (Transport for NSW, 2019)
CPTED	Crime Prevention Through Environmental Design
DBH	Diameter at Breast Height
DBYD	Dial Before You Dig
DC	Direct Current
DEC	(former) NSW Department of Environment and Conservation

Term	Meaning
DECC	(former) NSW Department of Environment and Climate Change
DECCW	(former) NSW Department of Environment, Climate Change and Water
DoEE	Commonwealth Department of the Environment and Energy
DPIE	NSW Department of Planning, Industry and Environment
ECM	Environmental Controls Map
ECRTN	<i>Environment Criteria for Road Traffic Noise</i>
EMF	Electric and Magnetic Fields
EMS	Environmental Management System
EPA	NSW Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)</i>
EPI	Environmental Planning Instrument
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development (refer to Definitions)
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
GLVIA3	<i>Guidelines for Landscape and Visual Impact Assessment</i>
GMP	Groundwater management plan
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
HIFREQ	High Frequency (Module in CDEGS)
HV	High Voltage
ICNG	<i>Interim Construction Noise Guideline (Department of Environment and Climate Change, 2000)</i>
ICNIRP	International Commission on Non-Ionizing Radiation Protection
Infrastructure SEPP	<i>State Environmental Planning Policy (Infrastructure) 2007 (NSW)</i>
ISCA	Infrastructure Sustainability Council of Australia
kV	Kilovolts
LCZ	Landscape Character Zones
LEP	Local Environmental Plan

Term	Meaning
LGA	Local Government Area
LV	Low Voltage
LVIA	Landscape Character and Visual Impact Assessment
mG	milli gauss
MNES	Matters of National Environmental Significance
MV	Medium Voltage
NCA	Noise Catchment Area
NML	Noise Management Level
NPfi	<i>Noise Policy for Industry</i> (NSW Environment Protection Authority, 2017)
NPI	National Pollutant Inventory
NPW Act	<i>National Parks and Wildlife Act 1974</i> (NSW)
NSW	New South Wales
OEH	(former) NSW Office of the Environment and Heritage
OHW	Overhead Wiring
OOHW	Out of hours works
PMF	Probable maximum flood
PMST	Protected Matters Search Tool
PoEO Act	<i>Protection of the Environment Operations Act 1997</i> (NSW)
ppm	Parts per million
RailCorp	(former) Rail Corporation of NSW
RBL	Rating Background Level
REF	Review of Environmental Factors (this document)
RMS	(former) Roads and Maritime Services (now part of Transport for NSW)
RNP	<i>NSW Road Noise Policy</i> (Department of Environment, Climate Change and Water, 2011)
Roads Act	<i>Roads Act 1993</i> (NSW)
ROC	Rail Operations Centre
ROL	Road Occupancy Licence
SDS	Safety Data Sheet

Term	Meaning
SEPP	State Environmental Planning Policy
SHR	State Heritage Register
SoHI	Statement of Heritage Impact
TCP	Traffic Control Plan
TEC	Threatened Ecological Community
TfNSW	Transport for NSW
TfNSW (former RMS)	Transport for NSW (former Roads and Maritime Services)
TMP	Traffic Management Plan
TPZ	Tree Protection Zone
V	Volts
VDV	Vibration Dose Value
WARR Act	<i>Waste Avoidance and Resource Recovery Act 2001 (NSW)</i>
μT	Micro Tesla

Definitions

Term	Meaning
Average Recurrence Interval	The likelihood of occurrence, expressed in terms of the long-term average number of years, between flood events as large as or larger than the design flood event. For example, floods with a discharge as large as or larger than the 100-year ARI flood will occur on average once every 100-years.
Asset Standards Authority	The ASA is an independent body within TfNSW, responsible for engineering governance, assurance of design safety, and ensuring the integrity of transport and infrastructure assets. Design Authority functions formerly performed by RailCorp are now exercised by ASA.
Cess	The area either side of the railway track which is kept at a lower level in order to provide for drainage away from the rail track.
Concept design	The concept design is the preliminary design presented in this REF, which would be refined by the Construction Contractor (should the Proposal proceed) to a design suitable for construction (subject to TfNSW acceptance).
Construction Contractor	The organisation(s) engaged by TfNSW to undertake the design and construction of the Proposal.
CDEGS	Software used for the EMF Assessment.
Design and Construct Contract	A method to deliver a project in which the design and construction services are contracted by a single entity known as the Construction Contractor. The Construction Contractor completes the project by refining the concept design presented in the REF and completing the detailed design so that it is suitable for construction (subject to TfNSW acceptance). The Construction Contractor is therefore responsible for all work on the project, both design and construction.
Detailed design	Detailed design broadly refers to the process that the Construction Contractor undertakes (should the Proposal proceed) to refine the concept design to a design suitable for construction (subject to TfNSW acceptance).
Disability Standards for Accessible Public Transport	The Commonwealth <i>Disability Standards for Accessible Public Transport 2002</i> ("Transport Standards") (as amended) are a set of legally enforceable standards, authorised under the Commonwealth <i>Disability Discrimination Act 1992</i> (DDA) for the purpose of removing discrimination 'as far as possible' against people with disabilities. The Transport Standards cover premises, infrastructure and conveyances, and apply to public transport operators and premises providers.
Down (direction)	The railway direction away from Sydney (Central) in NSW. Down is also referred to as 'Country'.
Ecologically Sustainable Development	As defined by clause 7(4) Schedule 2 of the EP&A Regulation. Development that uses, conserves and enhances the resources of the community so that ecological processes on which life depends are maintained, and the total quality of life, now and in the future, can be increased.
Feasible	A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given Proposal constraints such as safety and maintenance requirements.

Term	Meaning
Feeder	A power line transferring power from a distribution substation to distribution transformers.
Fouling point	A point of a switch turnout where a car or locomotive on one track obstructs movements on the adjacent track.
Harmonic filter	A device used to filter out the electrical harmonics in a system. Harmonics are a distortion in the normal electrical frequency within the power supply. Where harmonics are not filtered out, they can result in malfunctions to the system.
Interchange	Transport interchange refers to the area/s where passengers transit between vehicles or between transport modes. It includes the pedestrian pathways and cycle facilities in and around an interchange.
Noise sensitive receiver	In addition to residential dwellings, noise sensitive receivers include, but are not limited to, hotels, entertainment venues, pre-schools and day care facilities, educational institutions (e.g. schools, TAFE colleges), health care facilities (e.g. nursing homes, hospitals), recording studios and places of worship/religious facilities (e.g. churches).
NSW Trains	From 1 July 2013, NSW Trains became the new rail provider of services for regional rail customers.
Out of hours works	Defined as works <i>outside</i> standard construction hours (i.e. outside of 7am to 6pm Monday to Friday, 8am to 1pm Saturday and no work on Sundays/public holidays).
Proponent	A person or body proposing to carry out an activity under Division 5.1 of the EP&A Act - in this instance, TfNSW.
(the) Proposal	The construction and operation of the Wollie Creek Substation and T8 Airport Line Power Supply Upgrade.
Rail possession	Possession is the term used by railway building/maintenance personnel to indicate that they have taken possession of the track (usually a section of track) for a specified period, so that no trains operate for a specified time. This is necessary to ensure the safety of workers and rail users.
Reasonable	Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.
Sensitive receivers	Land uses which are sensitive to potential noise, air and visual impacts, such as residential dwellings, schools and hospitals.
South Coast Line	The intercity element of the Sydney Trains and NSW TrainLink service connecting Sydney to the Illawarra Region.
Sydney Trains	From 1 July 2013, Sydney Trains replaced CityRail as the provider of metropolitan train services for Sydney.
T4 Eastern Suburbs and Illawarra Line	An existing commuter rail line on the Sydney Trains Network connecting Bondi Junction to Cronulla and Waterfall.
T8 Airport and South Line	An existing commuter rail line on the Sydney Trains Network connecting the Sydney CBD with the southwestern suburbs.

Term	Meaning
Transport for NSW (former Roads and Maritime Services)	Roads and Maritime Services was amalgamated into Transport for NSW on 1 July 2019.
Turnout	A short section of rail track which enables the divergence of one rail line into two rail lines, or the convergence of two rail lines into one rail line.
Up (Direction)	The railway direction being towards a major destination i.e. towards Sydney for trains in NSW. Up is also referred to as 'city'.
Vegetation Offset Guide	<p>The TfNSW guide that applies where there is vegetation clearing proposed, and where the impact of the proposed clearing is not deemed 'significant' for the purposes of section 5.5 of the EP&A Act.</p> <p>The Guide provides for planting of a minimum of eight trees for each large tree with a diameter at breast height (DBH) of more than 60 cm, four trees where the DBH is 15-60 cm, or two trees where DBH is less than 15 cm.</p>

Executive summary

Overview

Transport for NSW (TfNSW) proposes to deliver service improvements on the T4 Illawarra Line, South Coast Line and T8 Airport Line. These improvements are part of the More Trains, More Services program (the Program) that over the next ten years will transform the rail network and provide customers with more reliable turn up and go services.

As part of the Program, TfNSW proposes to upgrade the power supply of the T8 Airport Line including the construction of a new substation at Wollie Creek (the Proposal).

TfNSW is the government agency responsible for the delivery of major transport infrastructure projects in NSW and is the proponent for the Proposal.

The main features of the Proposal are:

Wollie Creek

- construction of a traction substation (proposed traction substation) at Wollie Creek Junction, located between the T8 Airport and South Line and residential apartments that front onto Lusty Street, Wollie Creek (5-13 Lusty Street)
- upgrade of the access road at the end of Lusty Street, Wollie Creek to provide access to the proposed traction substation
- demolition of the Undercliffe Substation and Wollie Creek Sectioning Hut (to be replaced by the proposed traction substation)
- installation of 33 Kilovolt (kV), 11 kV and 1500 V underground feeders to connect the proposed traction substation to the high-voltage and 1500V DC networks and the Wollie Creek portal of the Airport Line tunnel
- installation of a padmount substation
- removal of OHW structures and OHW supported by those structures

Airport Line tunnel

- installation of 33kV and 11kV feeders mounted on brackets on the sides of the tunnel
- installation of five overhead wiring (OHW) auxiliary feeders in the Airport Line tunnel and through Wollie Creek Station
- signalling upgrades in the Airport Line tunnel, including eight new signals, one relocated signal and associated modifications to trackside and relay room infrastructure

Green Square Station

- installation of an 11 kV feeder within an existing underground conduit from the Rail Operations Centre (ROC) on Wyndham Street, Alexandria to Green Square Station, including trenching works at Green Square Station

Chalmers Street Substation

- installation of 11kV and 33kV feeders between the Prince Alfred Park portal of the Airport Line tunnel and Chalmers Street Substation.

This Review of Environmental Factors (REF) has been prepared to assess the environmental impacts associated with the construction and operation of the Proposal under the provisions of Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Subject to approval, construction is expected to commence in approximately April 2020 and take approximately two and a half years to complete. A detailed description of the Proposal is provided in **Chapter 3** of this document.

Need for the Proposal

Sydney's population is growing and the city's rail network is one of the busiest in the southern hemisphere, with a record 400 million trips each year. Over the past five years there has been unprecedented customer demand on the Sydney Trains network, with rail patronage increasing by 30 percent. Even after the full commencement of Sydney Metro in 2026, the heavy rail network will continue to carry 80 percent of all rail passengers, and around 60 percent of all peak hour transport travel (TfNSW, 2017).

In parallel with the new metro train system, the Program will simplify the rail network and create turn up and go services for customers in the future. While More Trains, More Services will eventually deliver benefits to the entire network, TfNSW propose to start by targeting improvements on Sydney's busiest lines. The first lines to benefit from the Program will be the T4 Eastern Suburbs and Illawarra Line, the South Coast Line and the T8 Airport and South Line. These are some of the busiest lines on the Sydney Trains network, catering for 410,000 return trips in a typical day and representing around one third of all daily Sydney Trains daily customers.

The Proposal would address the growing demands on the network by providing customers with more services that are more reliable, increasing the overall network capacity along the T8 Airport Line. This will be undertaken by upgrading and modernising power, signalling and control systems and through the use of digital technology.

Chapter 2 of this REF further describes the need for the proposal and outlines the options considered in developing the design.

Community and stakeholder consultation

Community consultation activities for the Proposal would be undertaken during the public display period of this REF and the public invited to submit feedback to help TfNSW understand what is important to customers and the community. The REF would be displayed for a period of two weeks. Further information about these specific consultation activities is included in **Section 4.5** of this REF.

During this period a Proposal Infoline (1800 684 490) and email address (projects@transport.nsw.gov.au) would be also available for members of the public to make enquiries and provide feedback.

View the plans:

The REF can be viewed at:

- transport.nsw.gov.au/projects/mtms
- nsw.gov.au/improving-nsw/haveyoursay
- Arncliffe Library 11 Firth Street, Arncliffe
- Transport for NSW, 241 O’Riordan Street, The Gateway, Mascot

Feedback can be provided at:

- Wolli Creek Station, Brodie Spark Drive, Wolli Creek
Wednesday 4 December, 4pm – 6pm
- projects@transport.nsw.gov.au
- More Trains, More Services Program – Wolli Creek Substation and T8 Airport Line Power Supply Upgrade
Associate Director, Environmental Impact Assessment
Transport for NSW
Locked Bag 6501

In accordance with the requirements of *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP), consultation is required with local councils and/or public authorities under certain circumstances. This includes where infrastructure managed by a council or other public authority is affected by the Proposal. Initial consultation has been undertaken during the development of design options with Bayside Council and Sydney Trains. Consultation with these stakeholders would continue throughout the detailed design and construction of the Proposal.

TfNSW would review and assess all feedback received during the public display period, prior to determining whether or not to proceed with the Proposal.

Should the Proposal proceed to construction, the community would be kept informed throughout the duration of the construction period. **Figure E 1** shows the planning approval and consultation process for the Proposal.

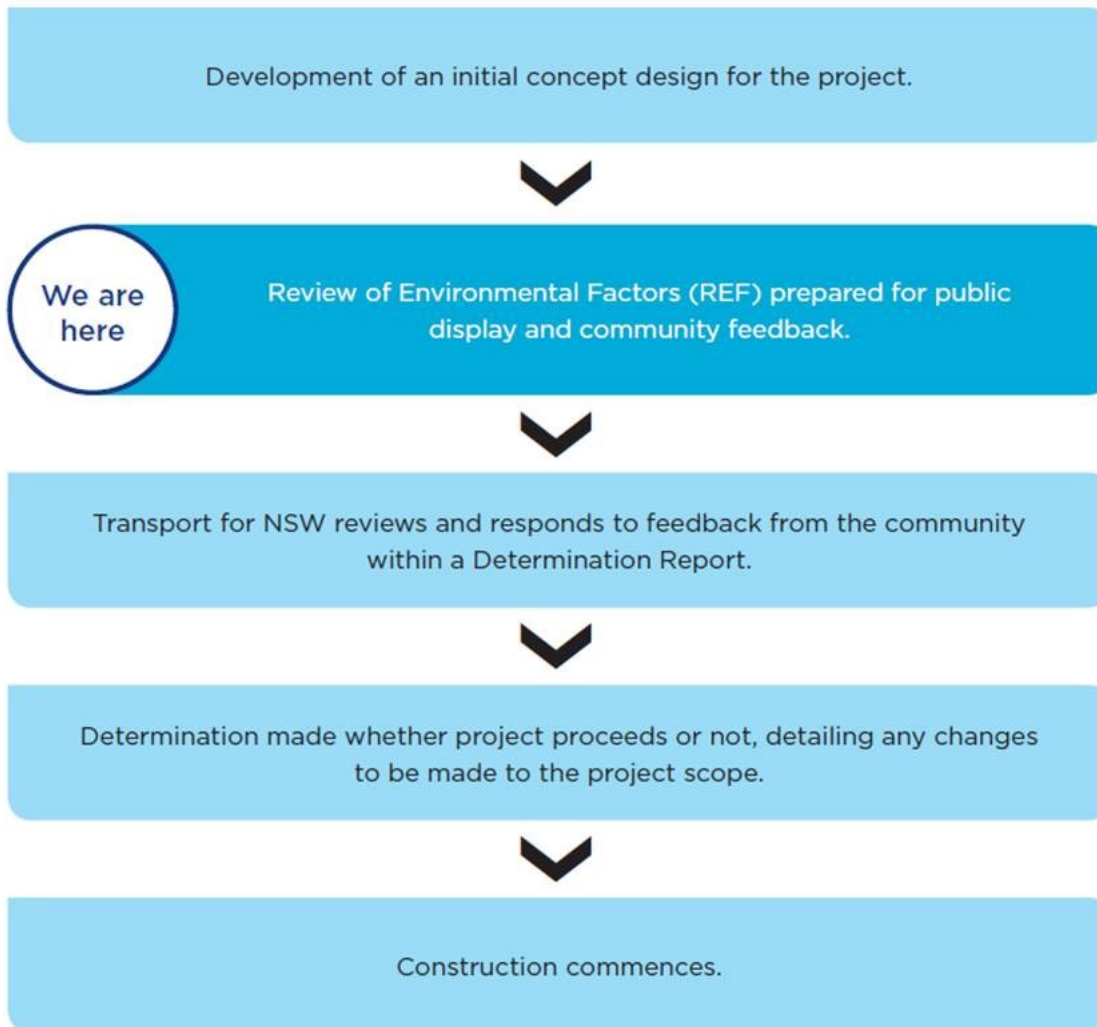


Figure E 1 Planning approval and consultation process for the Proposal

Environmental impact assessment

This REF identifies the potential environmental benefits and impacts of the Proposal and outlines the mitigation measures to reduce the identified impacts.

The following key impacts have been identified should the Proposal proceed:

- temporary changes to vehicle and pedestrian movements in and around Wolli Creek Station, Green Square Station and Chalmers Street Substation during the construction of the Proposal
- visual impacts during construction and operation
- noise and vibration impacts during construction and operation
- removal of some vegetation within and adjacent to the rail corridor.

Further information regarding these impacts is provided in **Chapter 6** of this REF.

Conclusion

This REF has been prepared having regard to sections 5.5 and 5.7 of the EP&A Act, and clause 228 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). These

require that TfNSW takes into account to the fullest extent possible, all matters affecting or likely to affect the environment as a result of the Proposal.

The impact assessment undertaken within this REF indicates that the Proposal would not result in a significant impact upon the environment, including areas of outstanding biodiversity value, threatened species, populations, ecological communities or their habitats.

Impacts associated with the key issues outlined above would be temporary during construction or of a low magnitude during operation. As such none of these impacts would be significant.

Should the Proposal proceed, any potential associated adverse impacts would be appropriately managed in accordance with the mitigation measures outlined in this REF, and the Conditions of Approval imposed in the Determination Report. This would ensure the Proposal is delivered to maximise benefit to the community and minimise any adverse impacts on the environment.

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1 Introduction

Transport for NSW (TfNSW) was established in 2011 as the lead agency for integrated delivery of public transport services across all modes of transport in NSW. TfNSW is the proponent for the Wolli Creek Substation and T8 Airport Line Power Supply Upgrade (the Proposal).

1.1 Overview of the Proposal

1.1.1 The More Trains, More Services Program

Over the next ten years the More Trains, More Services program will simplify and modernise the rail network, creating turn up and go services for many customers. Customers will experience more frequent train services, with less wait times and less crowding on a simpler, more reliable network.

While More Trains, More Services will eventually deliver benefits to the entire network, it will start by targeting improvements on Sydney's busiest lines. The first lines to benefit from the program will be the T4 Eastern Suburbs and Illawarra Line (T4 Line), the South Coast Line and the T8 Airport and South Line (T8 Line).

The More Trains, More Services program is about building a modern and up to date rail system that will play its part in making Sydney a more productive and liveable city. The NSW Government's *Future Transport Strategy 2056* (TfNSW, 2018a) identifies More Trains, More Services as a priority initiative and is a commitment to the state's transport and infrastructure needs.

More Trains, More Services is key to enabling Greater Sydney Commission's vision for the Greater Sydney Region Plan, *A Metropolis of Three Cities*, where most residents live within 30 minutes of their jobs, education and health facilities, services and great places.

More Trains, More Services is a program of staged investments that will progressively transform the rail network into a modern and reliable system using world class technology.

The program is already delivering better customer outcomes through timetable enhancements and the integration of the Sydney Metro Northwest with the existing heavy rail network. The current stage of More Trains, More Services will focus on delivering greater capacity, reliability and connectivity for customers on the T4 Line, South Coast Line and T8 Line.

These services will be enabled by upgrading and modernising signalling and control systems and using digital technology that, when combined with other infrastructure upgrades, will deliver major increases in the capacity and reliability of the network.

1.1.2 The need for the Proposal

Sydney's population is growing, and the rail network is one of the busiest in the southern hemisphere, with a record 400 million trips each year. There has been unprecedented customer demand, with rail patronage increasing by 30 percent over the last five years. Even after the full commencement of Sydney Metro in 2026, the heavy rail network will continue to carry 80 percent of all rail passengers, and around 60 percent of all peak hour transport travel.

Along with building a new metro train system, the More Trains, More Services program will simplify the rail network and create turn up and go services for customers.

While More Trains, More Services will eventually deliver benefits to the entire network, TfNSW propose to start by targeting improvements on Sydney's busiest lines. The first lines to benefit from the Program will be the T4 Line, South Coast Line and T8 Line. These are some of the busiest lines on the Sydney Trains network, catering for 410,000 return trips in a typical day, representing around one third of all daily Sydney Trains customers.

Future stages of More Trains, More Services will deliver a 30 percent increase in peak services on the T4 Line, and an 80 percent increase at stations between Green Square and Wolli Creek, meaning trains at least on average every four minutes instead of every six minutes.

As part of the Program, TfNSW propose to upgrade the power supply of the T8 Airport Line including the construction of a new substation at Wollli Creek, which would enable an increase to the number of trains per hour that can be accommodated along this line.

1.1.3 Key features of the Proposal

The key features of the Proposal are summarised as follows:

Wollli Creek

- construction of a traction substation (proposed traction substation) at Wollli Creek Junction, located between the T8 Line and residential apartments that front onto Lusty Street, Wollli Creek (5 – 13 Lusty Street)
- upgrade of the access road at the end of Lusty Street, Wollli Creek to provide access to the proposed traction substation
- demolition of the Undercliffe Substation and Wollli Creek Sectioning Hut (to be replaced by the proposed traction substation)
- installation of 33 kV, 11 kV and 1500 V underground feeders to connect the proposed traction substation to the high-voltage and 1500V DC networks and the Wollli Creek portal of the Airport Line tunnel
- installation of a padmount substation
- removal of OHW structures and OHW supported by those structures

Airport Line tunnel

- installation of 33kV and 11kV feeders mounted on brackets on the sides of the tunnel
- installation of five overhead wiring (OHW) auxiliary feeders in the Airport Line tunnel and through Wollli Creek Station
- signalling upgrades in the Airport Line tunnel, including eight new signals, one relocated signal and associated modifications to trackside and relay room infrastructure

Green Square Station

- installation of an 11 kV feeder within an existing underground conduit from the Rail Operations Centre (ROC) on Wyndham Street, Alexandria to Green Square Station including trenching works at Green Square Station

Chalmers Street Substation

- installation of 11kV and 33kV feeders between the Prince Alfred Park portal of the Airport Line tunnel and Chalmers Street Substation.

Subject to planning approval, construction is expected to commence in approximately April 2020 and take around two and half years to complete.

A detailed description of the Proposal is provided in **Chapter 3** of this document.

1.2 Location of the Proposal

The Proposal spans the T4 Line, the South Coast Line and the T8 Line from Central Station in the north, to approximately 750 metres west of Wollli Creek Station along the T8 Line, and approximately 410 metres south of Wollli Creek Station along the T4 Line and South Coast Line. Within this extent, the Proposal is separated into four distinct works locations:

- Wollli Creek
- Airport Line tunnel
- Green Square Station

- Chalmers Street Substation.

1.2.1 Wollli Creek

At Wollli Creek, the Proposal is located within the Bayside Local Government Area (LGA), and within the suburb of Wollli Creek. Wollli Creek Station is positioned centrally within the Proposal boundary at this location, being approximately 7.3 kilometres south west of Central Station.

The Proposal boundary extends from the southern side of the railway bridge over the Cooks River (140 metres north of the Wollli Creek Station T4 Platform), to approximately 750 metres west of Wollli Creek Station along the T8 Line, and approximately 410 metres south of Wollli Creek Station along the T4 Line and South Coast Line. The works at this location would be undertaken within the existing rail corridor and adjoining RailCorp owned land.

1.2.2 Airport Line tunnel

The Airport Line tunnel is approximately 10 kilometres long and has portals at Wollli Creek Station and near Central Station. Within the Airport Line tunnel, the Proposal is located in the Bayside LGA and the Sydney LGA. The Airport Line tunnel spans the suburbs of Wollli Creek, Tempe, Mascot, Alexandria, Zetland, Waterloo, Redfern and Surry Hills. All work at this location would be undertaken within the existing rail corridor.

1.2.3 Green Square Station

At Green Square Station, the Proposal is located within the Sydney LGA, within the suburb of Alexandria. The Proposal in this location incorporates part of the Green Square Station forecourt adjacent to O'Riordan Street, as well as works along Wyndham Street to the ROC located on the corner of Wyndham Street and Mandible Street. Work at this location would be undertaken within a combination of RailCorp owned land and publicly owned roads and footpaths.

1.2.4 Chalmers Street Substation

At Chalmers Street Substation, the Proposal is located within the Sydney LGA, in the suburbs of Chippendale and Surry Hills. Chalmers Street Substation is located in Prince Alfred Sidings between Prince Alfred Park and Sydney Yard, approximately 160 metres south east of Central Station Platform 23. Works at this location would occur between the Chalmers Street Substation and the Prince Alfred Park portal of the Airport Line tunnel. All work at this location would be undertaken within the existing rail corridor.





1.2.5 Proposal Area

The Proposal Area is the combination of the areas described above. The Proposal Area includes all areas where works would be undertaken, and the locations of all ancillary facilities including construction laydown and compound areas. The location of the Proposal in the context of the region is shown in **Figure 1.1**.



FIGURE 1-1: REGIONAL CONTEXT



- Legend**
-  Railway station
 -  Railway
 -  Motorway
 -  Park/Reserve

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1.3 Existing infrastructure and land uses

1.3.1 Wolli Creek

Land uses surrounding the Proposal Area at Wolli Creek consists generally of mid-rise apartment buildings and commercial retail to the south and apartment buildings, cafes, hotels and commercial retail to the east.

The nearest sensitive receivers include:

- residential dwellings (within 100 metres of the Proposal Area):
- three apartment buildings on the northern side of Lusty Street
- four apartment buildings at 97 Bonar Street
- four apartment buildings located on the southeast side of the rail corridor from the corner of Magdalene Terrace and Spark Lane to 20 Chisholm Street
- Masjid Fatima Al Zahra mosque, approximately 75 metres south west
- Al Zahra College, approximately 100 metres south west
- Tempe house, 240 metres west
- Integricare Turrella Long Day Care, approximately 275 metres south west.

Key existing rail infrastructure in this area includes:

- Wolli Creek Station
- operational rail tracks
- Wolli Creek Sectioning Hut
- Undercliffe Substation.

Access to the Proposal Area would be via the existing rail corridor entrance and access road at the eastern end of Lusty Street. The access road is partially sealed.

While the Proposal Area at Wolli Creek is located within the Bayside LGA, the applicable land zoning for this area is specified by the *Rockdale Local Environmental Plan 2011* (Rockdale LEP). The Proposal Area is located within an area zoned as 'SP2 – Infrastructure (Railway)', and 'B4 – Mixed Use'. Nearby land zones are comprised of the following:

- unzoned land
- B4 – Mixed Use
- RE2 – Private Recreation
- RE1 – Public Recreation
- IN2 – Light Industrial
- R4 – High Density Residential
- R2 – Low Density Residential.

1.3.2 Airport Line tunnel

The Airport Line tunnel is a two-way rail tunnel approximately 10 kilometres long, with portals at Wolli Creek Station and near Central Station. The key land uses within the Airport Line tunnel is the railway and underground stations including:

- International Airport Station
- Domestic Airport Station
- Mascot Station

- Green Square Station.

1.3.3 Green Square Station

Land uses surrounding the Proposal Area at Green Square Station consist of mid-rise apartment buildings, commercial uses, industrial uses, the Alexandria NSW Fire and Rescue Station and the ROC.

The nearest sensitive receivers include an apartment building located at the corner of Botany Road and Bourke Street, located approximately 80 metres east of the Proposal, Green Square Library, located approximately 90 metres east of the Proposal, and an apartment building located on the corner of Bourke Street and Ebsworth Street, approximately 130 metres north east.

The Proposal Area at Green Square Station is located entirely within the Sydney LGA. The land zoning is specified under the *Sydney Local Environmental Plan 2012* (Sydney LEP). The Sydney LEP contains the following land zones in this area:

- Deferred Matter
- B4 – Mixed Use.

Key surrounding land use zones include ‘SP2 – Infrastructure (Classified Road)’, ‘B7 – Business Park’ and ‘SP2 – Infrastructure (Educational Establishment)’.

1.3.4 Chalmers Street Substation

Land uses around the Chalmers Street Substation consist of public recreation, rail infrastructure, places of worship and commercial/retail.

The nearest sensitive receiver is the Cathedral of the Annunciation of Our Lady, Redfern, located immediately southeast of the Prince Alfred portal of the Airport Line tunnel. Residential apartment buildings are present along the eastern side of Chalmers Street and the southern side of Cleveland Street. Prince Alfred Park acts as a key barrier between the works to be undertaken and these residential receivers.

The Proposal Area around Chalmers Street Substation is located entirely within the Sydney LGA. Under the Sydney LEP, the Proposal Area at the Chalmers Street Substation section is located entirely within land zoned as ‘SP2 – Railways’.

Key surrounding land use zones include:

- SP2 – Infrastructure (Classified Road)
- B4 – Mixed Use
- RE1 – Public Recreation.

Figure 1.2, Figure 1.3, Figure 1.4 and Figure 1.5 show the location of the Proposal Area and the corresponding land use zoning.

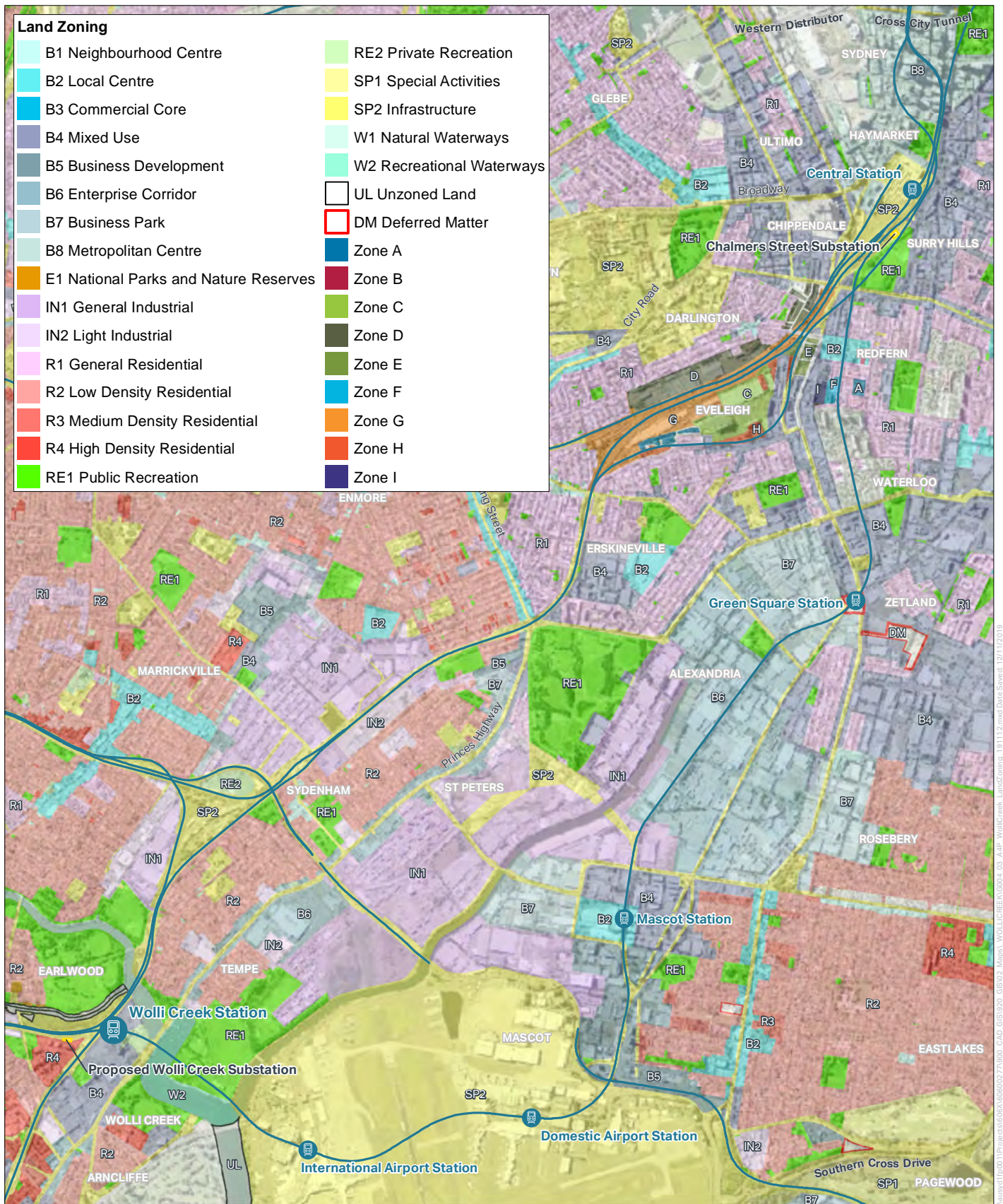




FIGURE 1-2: LAND USE ZONES AT WOLLIE CREEK SUBSTATION TO CHALMERS STREET SUBSTATION



Legend

-  Railway station
-  Railway

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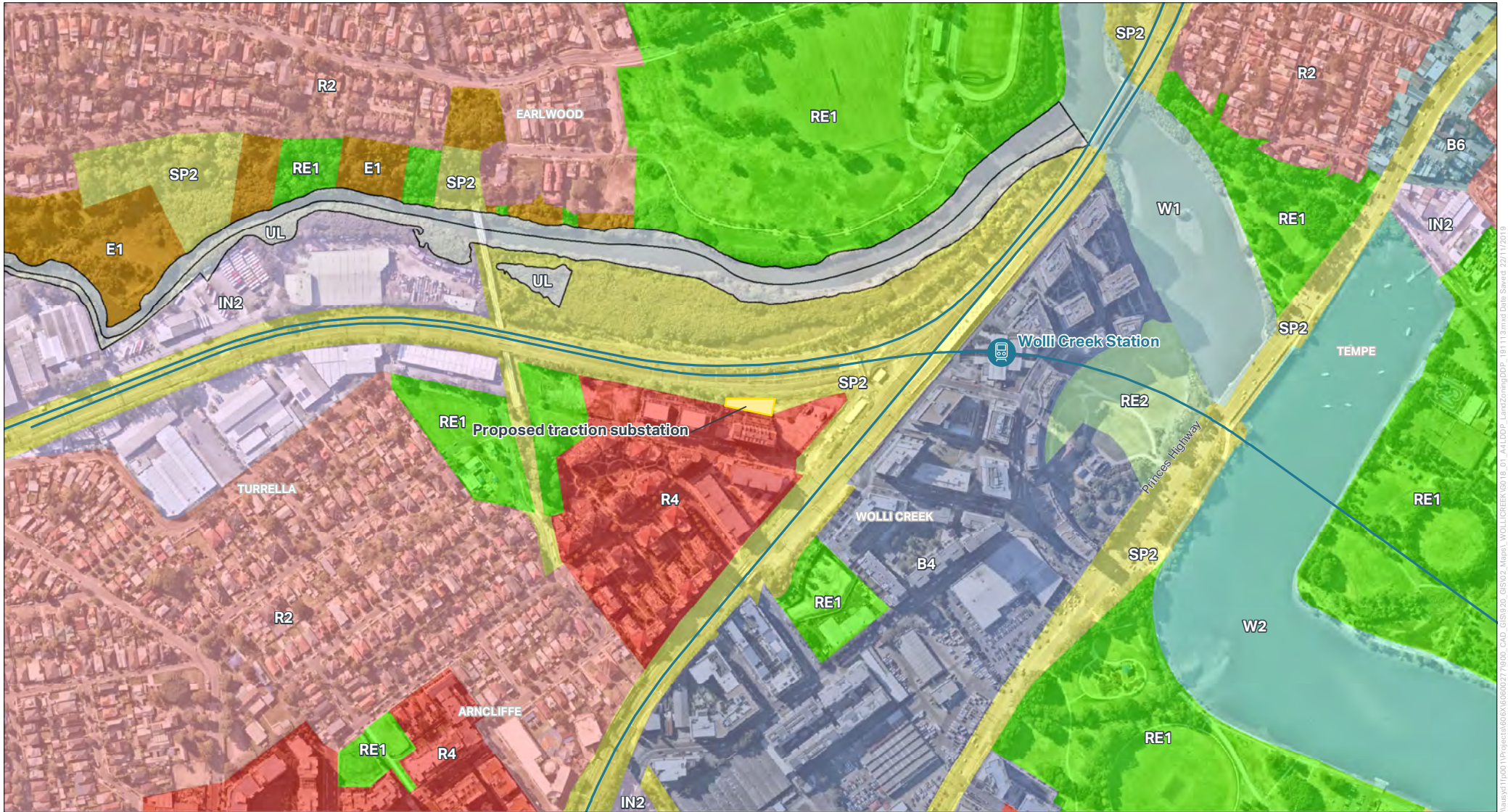
















FIGURE 1-3: LAND USE ZONES - AT WOLLRI CREEK

Legend

 Railway station
 Railway

Land Zoning

-  B4 Mixed Use
-  B6 Enterprise Corridor
-  E1 National Parks and Nature Reserves
-  IN2 Light Industrial

-  R2 Low Density Residential
-  R4 High Density Residential
-  RE1 Public Recreation
-  RE2 Private Recreation
-  SP2 Infrastructure
-  W1 Natural Waterways
-  W2 Recreational Waterways
-  UL Unzoned Land



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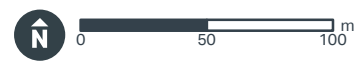
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FIGURE 1-4: LAND USE ZONES - GREEN SQUARE STATION



Legend

- Railway station
- Railway
- Land Zoning**
- B4 Mixed Use
- B7 Business Park
- R1 General Residential
- RE1 Public Recreation
- SP2 Infrastructure
- DM Deferred Matter

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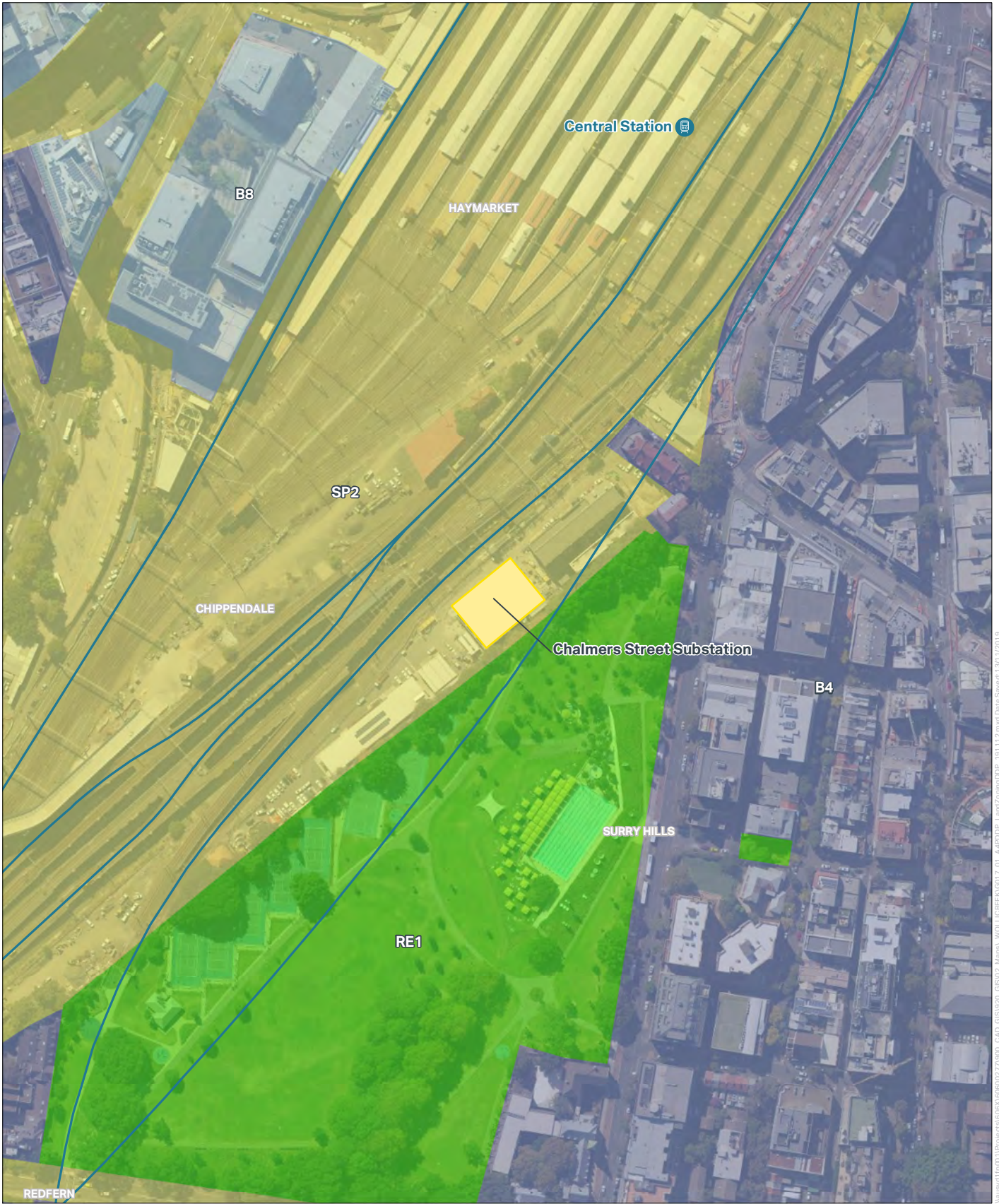


FIGURE 1-5: LAND USE ZONES - CHALMERS STREET SUBSTATION



Legend

Railway station SP2 Infrastructure

Railway

Railway

Land Zoning

- B4 Mixed Use
- B8 Metropolitan Centre
- RE1 Public Recreation

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1.4 Purpose of this Review of Environmental Factors

The purpose of this REF is to describe the Proposal, to assess the likely impacts of the Proposal having regard to the provisions of Section 5.5 of the EP&A Act, and to identify mitigation measures to avoid, reduce, mitigate or offset the likely adverse impacts. This REF has been prepared in accordance with clause 228 of the EP&A Regulation. For the purposes of this Proposal, TfNSW is the proponent and the determining authority under Division 5.1 of the EP&A Act.

This assessment has also considered the relevant provisions of other relevant environmental legislation, including the *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act) and the *Roads Act 1993* (Roads Act).

Having regard to the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), this REF considers the potential for the Proposal to have a significant impact on Matters of National Environmental Significance (MNES) or Commonwealth land. It also considers the need to make a referral to the Commonwealth Minister for the Environment should the action have the potential to result in a significant impact on MNES. Refer to **Chapter 4** for more information on statutory considerations.

2 Need for the Proposal

Chapter 2 discusses the need and objectives of the Proposal, having regard to the objectives of the Program. This chapter also provides a summary of the options that have been considered during development of the Proposal and why the preferred option has been chosen.

2.1 Strategic justification

2.1.1 Overview

The NSW Government's *Future Transport Strategy 2056* (TfNSW, 2018a) identifies the More Trains, More Services Program as a 'priority initiative for investigation' that will provide modern and reliable 'turn up and go' services to customers.

Over the next 40 years, the train network in Sydney will need to cater for 28 million trips a day and double the current metropolitan freight capacity. By 2026, it is expected that the heavy rail network will carry around 80 percent of peak hour rail travel and 60 percent of all peak hour transport travel (TfNSW, 2018a).

More Trains, More Services is key to enabling Greater Sydney Commission's vision for the Greater Sydney Region Plan, *A Metropolis of Three Cities* (Greater Sydney Commission, 2018), where most residents live within 30 minutes of their jobs, education and health facilities, services and great places.

More Trains More Services is a program of staged investments that will progressively transform the rail network into a modern and reliable mass transit system using world class technology. The program is already delivering better customer outcomes through timetable enhancements and the integration of the Sydney Metro Northwest with the existing heavy rail network. The current stage of More Trains, More Services will focus on delivering greater capacity, reliability and connectivity for customers on the T4 Line, South Coast Line and T8 Line.

These services will be enabled by upgrading and modernising signalling and control systems and using digital technology that, when combined with other infrastructure upgrades, will deliver major increases in the capacity and reliability of the network.

2.1.2 Objectives of the More Trains, More Services Program

The objectives of the More Trains, More Services Program are to:

- maintain connectivity and support efficient functioning of urban and regional centres
- meet future mass transit demand on the T4 and T8 Lines
- improve travel experience for each customer passenger group
- reduce complexity on the heavy rail network
- meet freight customer needs.

2.1.3 Customer outcomes

Customer outcomes of the More Trains, More Services Program are to:

- provide additional train and station capacity for T4 and T8 customers in line with forecast peak demand
- provide dedicated intercity services on the South Coast Line that improve the customer in-vehicle experience and provides a service consistent with other intercity lines
- improve off-peak services on the T4 and South Coast lines to align with customer requirements
- provide regular freight opportunities on the Illawarra corridor which maintains (and where possible enhances) the network capacity for freight services

- reduce network complexity on the T4 and T8 lines through simplified service routes, stopping patterns and asset utilisation
- minimise the impact on other lines that may be affected by service changes on the T4, T8 and South Coast lines.

2.1.4 Objectives of the Proposal

The specific objectives of the Wollli Creek Substation and T8 Airport Line Power Supply Upgrade are to:

- increase the operational capacity of the T8 Line for future service improvements
- improve service capacity and reliability through the provision of network infrastructure
- minimise cost and maximise benefits of project requirements
- minimise impacts to current rail operations during implementation
- ensure that safety is maintained throughout the delivery of the Proposal
- ensure that project works are delivered to TfNSW high standards of safety, quality, stakeholder engagement and environmental management.

2.2 Design development

A need to improve the capacity of the T8 Airport Line was identified, accordingly infrastructure solutions were developed to meet future requirements.

The concept design for the proposal has been developed with consideration of the following objectives:

- power requirements for the future capacity of the network
- impacts to rail infrastructure including OHW, signalling and communications
- thermal management and fire safety systems
- maintenance of assets
- constructability of the Proposal
- applicable codes, standards and guidelines.

2.3 Alternative options considered

2.3.1 The ‘do-nothing’ option

Under a ‘do-nothing’ option, the power supply to the T8 Line would remain the same and there would be no changes to the way this line operates. This would continue to restrict the capacity of the T8 Line.

The ‘do nothing’ option was not considered a feasible alternative as it is inconsistent with NSW Government objectives. Further, it would not assist in facilitating the necessary increase in numbers of intercity services and suburban services along the T8 Line as, without the power upgrades, this line cannot accommodate additional services.

2.3.2 Assessment of identified options

Wollli Creek

Several options were explored to provide additional traction power at Wollli Creek. Initially, expanding the existing Undercliffe Substation was proposed to meet future capacity requirements. However, there were several limitations to expanding the existing substation:

- the required expansion could not be accommodated on RailCorp owned land

- surrounding properties are privately owned residential apartment buildings
- airspace above the substation has been sold therefore vertical expansion would also require acquisition
- the existing substation currently has reliability issues, with parts no longer being manufactured that would be difficult to replace or retrofit.

Three locations were then considered to construct a new substation to serve the T8 Line at Wollie Creek.

Locations were considered for the Wollie Creek Substation to the east of the T4 Line, south of the existing Wollie Creek Sectioning Hut and the proposed location. The location east of the T4 Line did not have adequate space for the substation, as well as being further from the Airport tunnel. The location south of the existing sectioning hut was not progressed due to limited space and the number of services that would need to be relocated to accommodate the substation.

Several designs were then considered for the substation in the proposed location adjacent to 5-13 Lusty Street. A low rise building was initially considered; however, this would require deep excavations that would be problematic due to shallow groundwater and the presence of Acid Sulfate Soils. These issues would require a complex construction approach, a pump-out system for the basement and waterproofing of all penetrations that are below ground level. This option was not pursued, as it would not be cost effective, have additional maintenance requirements and would potentially impact the design life of the infrastructure.

An option was then considered to have the building and all equipment at or above ground level. This resulted in an overall height of nine metres above the existing ground level. This option was considered to result in visual impacts on the adjacent residential properties that would have views of the upper three metres of the substation.

The design of the substation was therefore reconfigured to reduce the overall height of the substation, but increase the footprint of the Proposal to accommodate all of the necessary equipment. This design was considered to deliver the required capacity upgrade and have fewer impacts on the environment and adjacent receivers than other options.

Green Square Station

Two options were identified to connect the ROC to the Airport Line tunnel. The first option was to trench via Botany Road to Mandible Street, and then along Mandible Street to the ROC. The second option was to trench and where possible utilise existing conduits along Wyndham Street to the ROC. The latter option was selected as it is a more direct route and has a reduced construction footprint.

Chalmers Street Substation

Several routes were identified from the Chalmers Street Substation to the Prince Alfred Park portal. Considerations included existing services, archaeological and heritage sensitivities, underground infrastructure such as the Mortuary Tunnel and constructability.

The preferred option for this section of the Proposal would utilise existing infrastructure where possible therefore minimising the amount of excavation required, and avoiding significant heritage fabric.

2.4 Justification for the preferred options

The 'do-nothing' option was rejected as this option would not address the need to increase the number of services along the T8 Line and through the Airport Line tunnel. This would also fail to meet the objectives of both the More Trains More Services program and the Proposal, as outlined in **Section 2.1.4**.

The location adjacent to 5-13 Lusty Street at Wollie Creek was selected as the preferred option for the new substation. This option would successfully meet the required objectives increasing the capacity of the T8 Line through the Airport Line tunnel, avoid service relocations while reducing the visual impact of the Proposal.

The Wyndham Street option at Green Square was selected as it was the shortest route, and utilised existing infrastructure to reduce the construction footprint. The selected option at Chalmers Street Substation reduces impacts to heritage fabric and requires the minimal amount of excavation and avoids significant heritage fabric.

3 Description of the Proposal

Chapter 3 describes the Proposal and summarises key design parameters, construction method, and associated infrastructure and activities. The description of the Proposal is based on the concept design and is subject to detailed design.

3.1 The Proposal

As described in **Section 1.1**, the Proposal involves the upgrade of the rail traction power system near Wolli Creek Station, within the Airport Line tunnel, at Green Square Station, and through to Chalmers Street Substation near Central Station.

The Proposal would include the following key elements:

Wolli Creek

- construction of a traction substation (proposed traction substation) at Wolli Creek Junction, located between the T8 Line and residential apartments that front onto Lusty Street, Wolli Creek (5 – 13 Lusty Street)
- upgrade of the access road at the end of Lusty Street, Wolli Creek to provide access to the proposed traction substation
- demolition of the Undercliffe Substation and Wolli Creek Sectioning Hut (to be replaced by the proposed traction substation)
- installation of 33 kV, 11 kV and 1500 V underground feeders to connect the proposed traction substation to the high-voltage and 1500 V DC networks and the Wolli Creek portal of the Airport Line tunnel
- installation of a padmount substation
- removal of OHW structures and OHW supported by those structures.

Airport Line tunnel

- installation of 33kV and 11kV feeders mounted on brackets on the sides of the tunnel
- installation of five OHW auxiliary feeders in the Airport Line tunnel and through Wolli Creek Station
- signalling upgrades in the Airport Line tunnel, including eight new signals, one relocated signal and associated modifications to trackside and relay room infrastructure.

Green Square Station

- installation of an 11 kV feeder within an existing underground conduit from the ROC on Wyndham Street, Alexandria to Green Square Station including trenching works at Green Square Station.

Chalmers Street Substation

- installation of 11kV and 33kV feeders between the Prince Alfred Park portal of the Airport Line tunnel and Chalmers Street Substation.

These elements are outlined in greater detail below. **Figure 3.1**, **Figure 3.2**, **Figure 3.3** and **Figure 3.4** show the general layout of key elements for the Proposal.

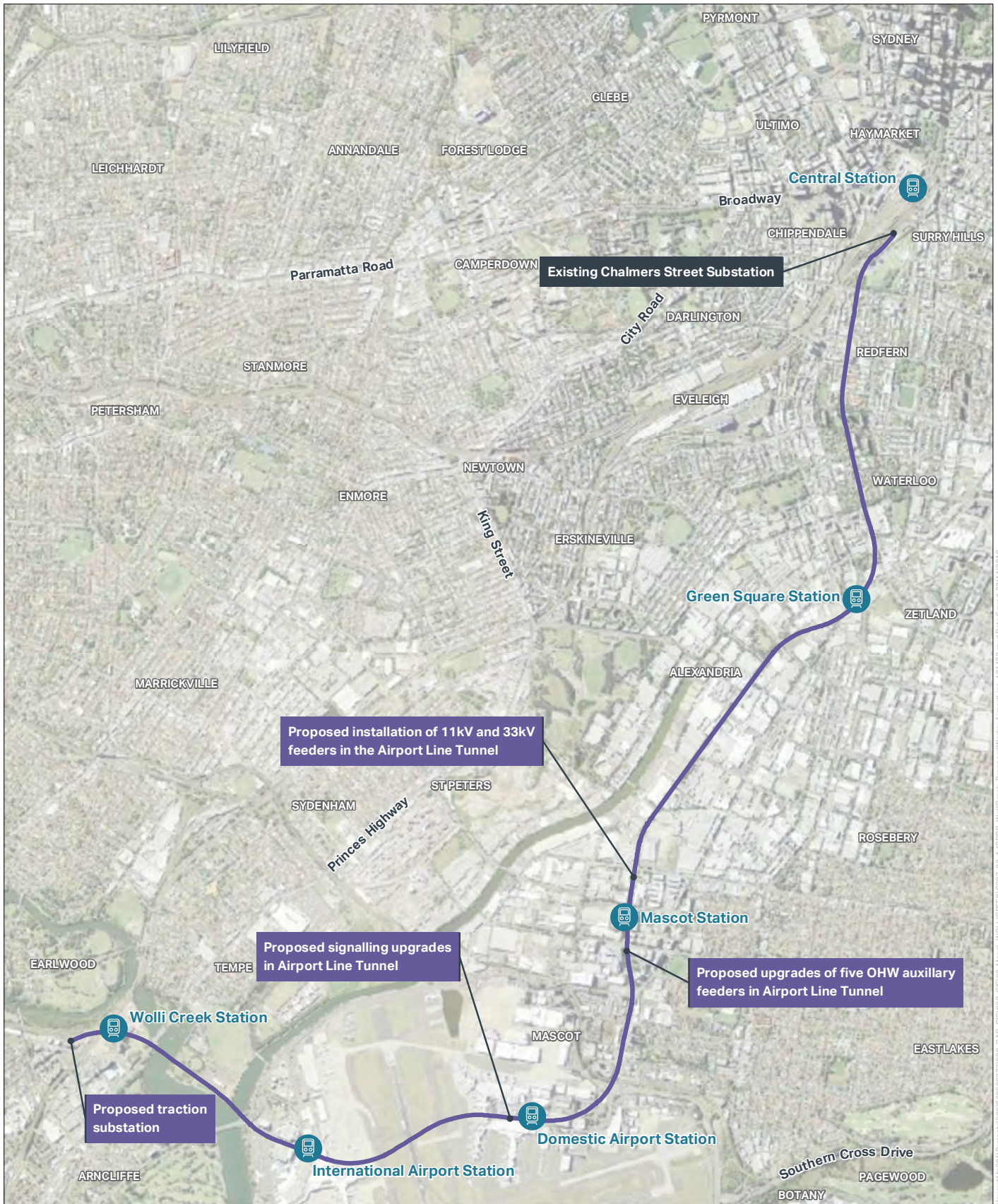


FIGURE 3-1: PROPOSED WORKS ALONG THE T8 AIRPORT LINE FROM WOLLRI CREEK STATION TO CHALMERS STREET SUBSTATION



Legend

— Main Feeder Route

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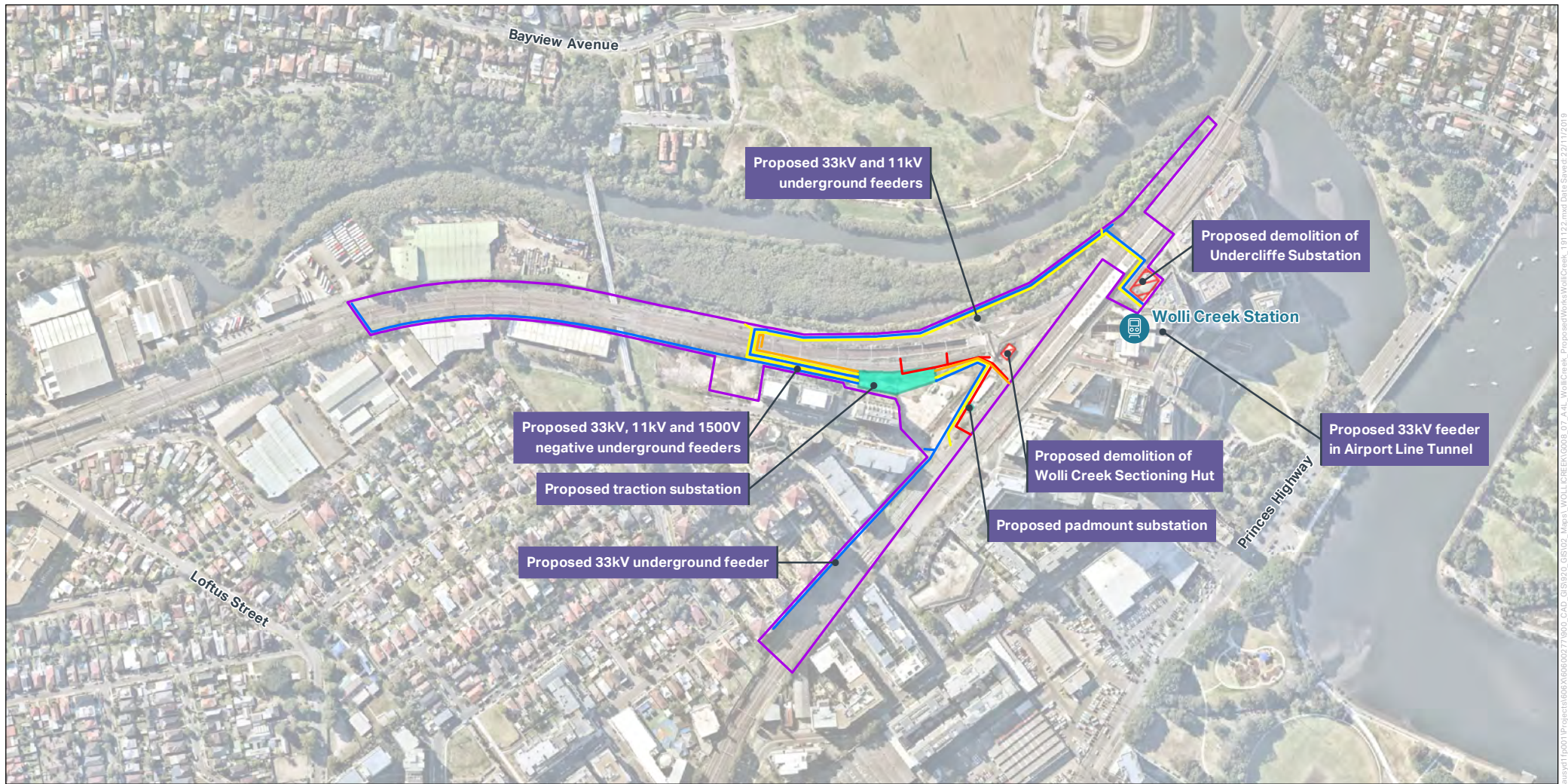










FIGURE 3-2: PROPOSED WORKS AT WOLLRI CREEK

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Legend

-  Railway station
-  Construction footprint boundary
-  Proposed substation
-  Building to be demolished
-  Proposed 33kV underground feeder
-  Proposed 11kV underground feeder
-  Proposed 1500V positive underground feeder
-  Proposed 1500V negative underground feeder

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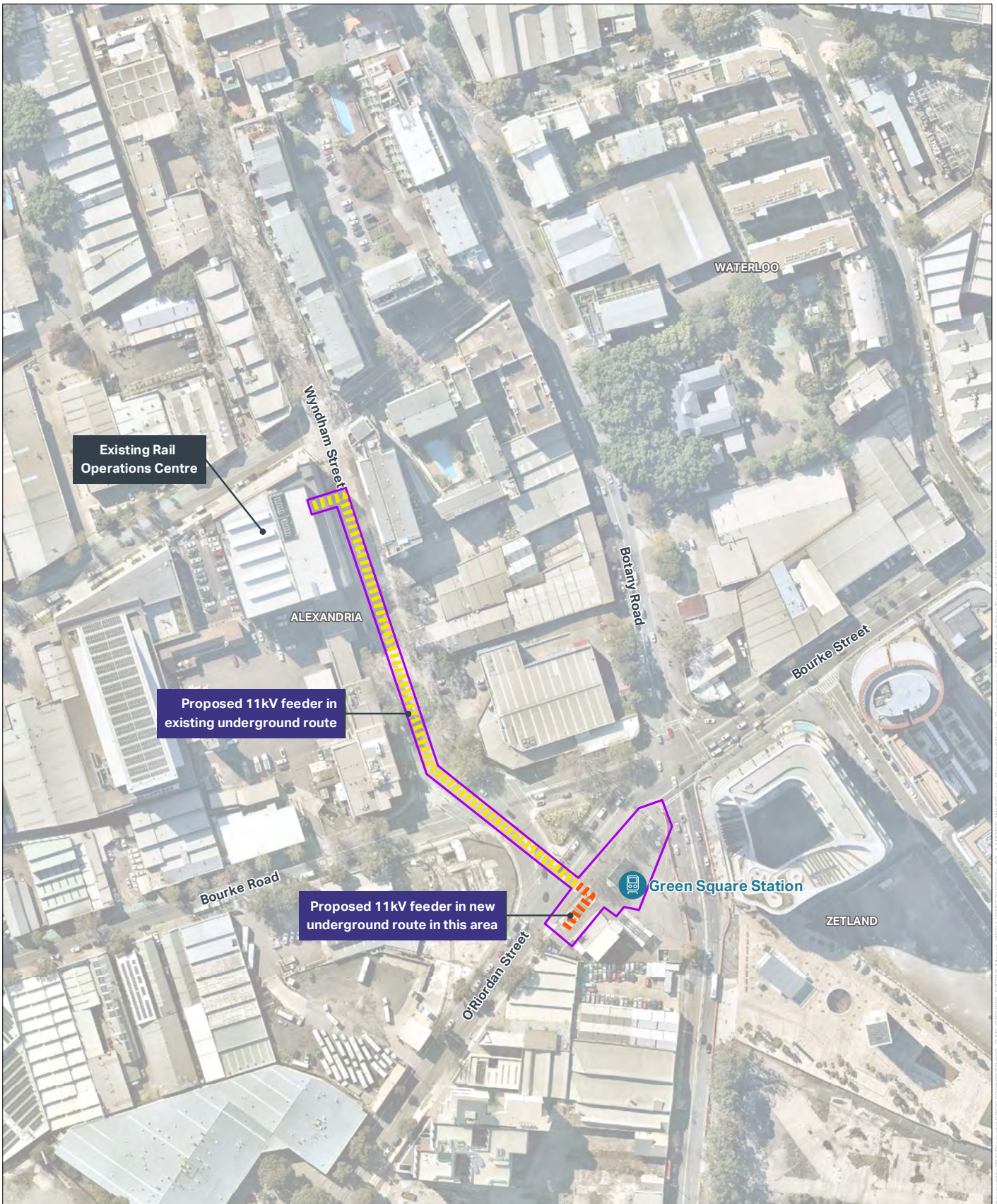


FIGURE 3-3: PROPOSED WORKS AT GREEN SQUARE



Legend

- Railway station
- Construction footprint boundary
- Proposed 11kV underground feeder (in new route)
- Proposed 11kV underground feeder (in existing conduit)

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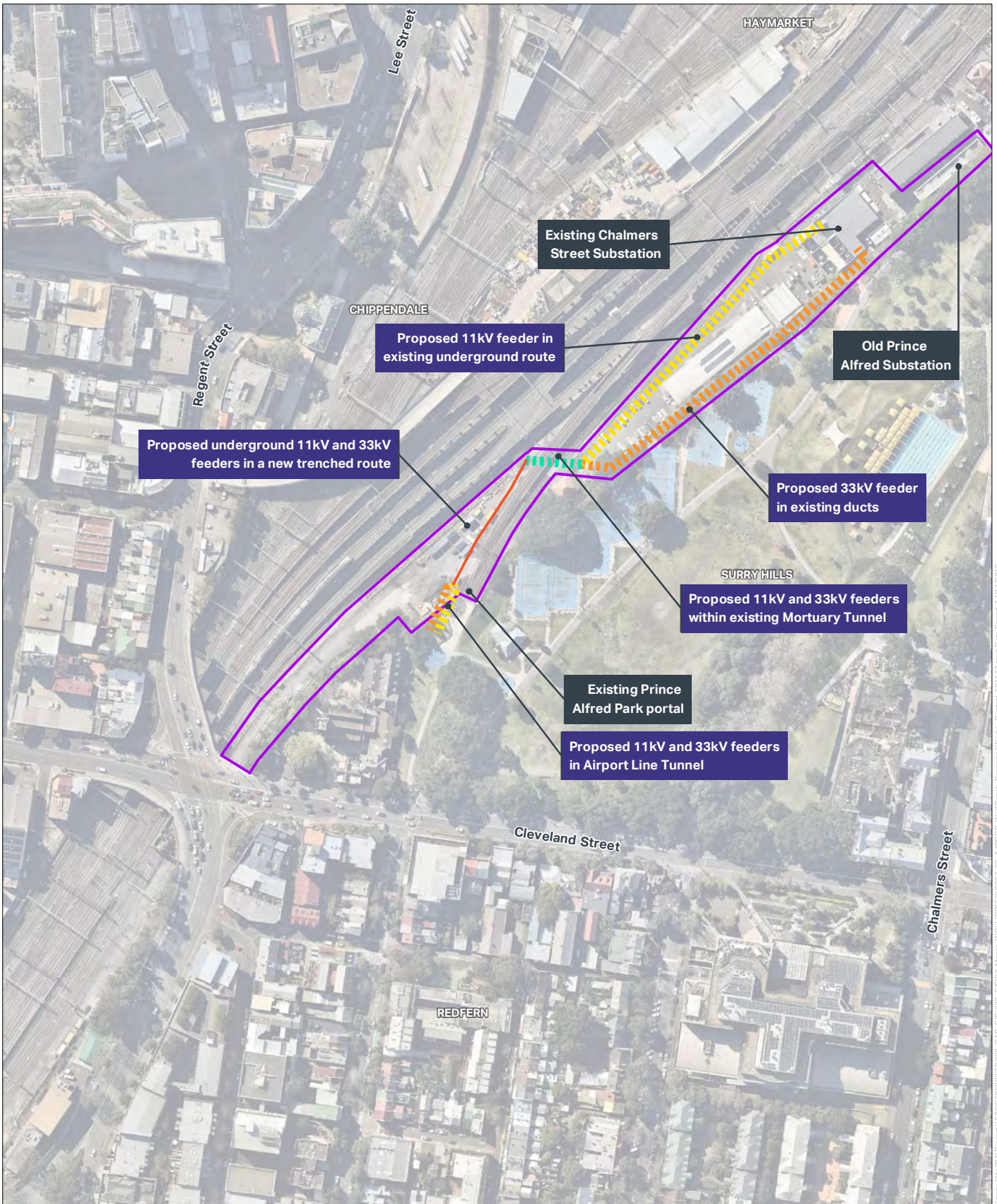


FIGURE 3-4: PROPOSED WORKS AT CHALMERS STREET SUBSTATION



Legend

- Construction footprint boundary
- Proposed 33kV underground feeder
- Proposed 11kV underground feeder
- Proposed 11kV/33kV feeders (within existing Mortuary Tunnel)
- Proposed underground 11kV/33kV feeders in new trench

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3.1.1 Scope of works

Wolli Creek

Proposed traction substation

The proposed traction substation building is to be constructed within the existing rail corridor, directly north of the boundary with the following properties:

- 5-13 Lusty Street, Wolli Creek
- 15-23 Lusty Street, Wolli Creek.

The proposed traction substation would accommodate the following equipment and facilities:

- a switchroom including high voltage and 1500 V DC switchgear
- rectifiers
- transformers
- reactors
- office space and staff amenities
- batteries
- telecommunications and control systems equipment.

The proposed traction substation building would be an asymmetrical quadrilateral shape with the following dimensions:

- outer boundary: approximately 2,000 m²
- total substation area within the boundary (inclusive of outdoor components): approximately 800 m²
- area of enclosed section: approximately 500 m².

The building would be a two-level structure comprised of a ground floor and basement. The building would have a height of approximately 6 metres above the finished ground level. The building would be set back approximately 3 metres from the retaining wall of the adjacent residential properties.

A new outdoor 33 kV harmonic filter yard is to be constructed to the west of the proposed substation building. This yard would be a rectangular shape, approximately 7 metres in width by approximately 8 metres in length and would be set back approximately 3 metres from the retaining wall of the adjacent properties. The outdoor transformer yard would be located on the eastern side of the enclosed section of the proposed traction substation.

Upgraded access road

Wolli Creek Junction is currently accessed by an access road at the eastern end of Lusty Street. This access road is proposed to be upgraded and extended to provide access to the proposed proposed traction substation. The upgraded access road would generally have a width of around 6 metres and would include a truck manoeuvring bay in the north eastern extent (over the current location of the Wolli Creek Sectioning Hut, which is to be demolished). The manoeuvring bay would provide for reversing and manoeuvring of a semi-trailer for the purposes of servicing and moving equipment into and out of the proposed traction substation.

The access road would be sealed with heavy duty pavement and lined with kerb and gutter, which would drain into the existing public stormwater system. Construction of the access road would include the establishment of a new retaining wall (approximately 1.5 metres high) along the northern side of the access road, adjacent to the existing rail line.

Padmount Substation

The proposed padmount substation is to be installed within the rail corridor near the upgraded access road.

Electrical feeders

Within the Wollie Creek section of the Proposal Area, new electrical feeder arrangements are proposed including:

- installation of an underground 33 kV feeder from Wollie Creek Substation into the Airport Line Tunnel portal
- installation of an underground 33 kV feeder from Wollie Creek Substation south to about 160 metres to the south of Guess Avenue
- installation of an underground 33 kV feeder from Wollie Creek Substation to about 500 metres to the west
- installation of underground 11 kV feeders including from Wollie Creek Substation to Wollie Creek Station Substation
- installation of underground 1500 V DC feeders around Wollie Creek Substation
- removal of OHW structures and OHW supported by those structures.

Decommissioning Undercliffe Substation and Wollie Creek Sectioning Hut

The existing Undercliffe Substation and Wollie Creek Sectioning Hut are proposed to be decommissioned and demolished, with all functions transferred to the proposed traction substation. The footprints of these buildings would be reinstated to normal ground level. The current location of the Wollie Creek Sectioning Hut is proposed to form part of the upgraded access road. The current location of the Undercliffe Substation is proposed to be left as a combination of pavement and gravel.

Materials and finishes

Materials and finishes for the Proposal have been selected primarily based on their suitability for meeting design requirements. Other important factors considered were availability, constructability, durability, low maintenance and cost effectiveness. This selection has sought to minimise visual impacts and to be aesthetically pleasing.

Each upgraded or new part of the Proposal would be constructed from a range of different materials, with a different palette for each of the architectural elements. Subject to detailed design, the Proposal would include the following:

- proposed traction substation – painted masonry with colour bond roofing, concrete footings and steel construction
- access road – concrete and asphalt.

The design will be submitted to TfNSW's Urban Design and Sustainability Review Panel at various stages for comment before being accepted by TfNSW. An Urban Design and Landscaping Plan (UDLP) would also be prepared by the Construction Contractor, prior to finalisation of detailed design for endorsement by TfNSW.

Airport Line tunnel

Works specific to the Airport Line tunnel section of the Proposal Area involve the following:

- installation of five OHW auxiliary feeders in the Airport Line Tunnel and through Wollie Creek Station with a combined length of approximately 6.5 kilometres
- signalling upgrades in the Airport Line Tunnel – eight new signals, one relocated signal and associated modifications to trackside and relay room infrastructure.

In addition to the above, feeder works for the wider Proposal Area follow the alignment of the Airport Line tunnel, from the Chalmers Street Substation section of the Proposal Area to the Wolli Creek section. Within the Airport Line tunnel, feeders are proposed to be fixed to the walls of the tunnel using brackets.

Green Square Station

Works at the Green Square Station section of the Proposal Area involve trenching works on the footpath area between O’Riordan Street and the aboveground station entrance for Green Square Station to facilitate installation of a small section of 11kV feeder. The 11kv feeder would connect to the ROC No. 1 substation via an existing conduit that is located underneath Wyndham Street.

Chalmers Street Substation

Works at the Chalmers Street Substation section of the Proposal Area involve:

- an 11 kV feeder installed in the existing underground route on the south-west side of the Chalmers Street Substation, connecting to the Mortuary Tunnel
- a 33 kV feeder installed in existing ducts on the southeast side of the Chalmers Street Substation, connecting to the Mortuary Tunnel
- the above 11 kV and 33 kV feeders would traverse through the Mortuary Tunnel on wall brackets
- a new trenched route would be established south of Mortuary Tunnel, connecting to the Prince Alfred Park portal of the Airport Line tunnel. The 11 kV and 33 kV feeders would be installed within this trenched route, prior to connecting to wall brackets in the Airport Line tunnel.

3.1.2 Engineering constraints

There are a number of constraints which have influenced the design development of the Proposal.

- existing structures: the placement and integrity of existing structures needed to be considered during the development of the design – these structures included the existing substations, the tunnel, existing track and stations within the tunnel
- Sydney Trains’ requirements: modifications for existing structures and new structures within the rail corridor must be designed and constructed with consideration of train impact loads, structural clearances to the track, and safe working provisions
- utilities: a Dial Before You Dig (DBYD) search has identified several utilities in the vicinity of the proposed works.

3.1.3 Design standards

The Proposal would be designed having regard to the following:

- National Construction Code
- relevant Australian Standards
- Asset Standards Authority standards
- Sydney Trains standards
- Infrastructure Sustainability Council of Australia (ISCA) Rating System
- Crime Prevention Through Environmental Design (CPTED) principles
- other TfNSW policies and guidelines.

3.1.4 Sustainability in design

The Proposal is targeting a rating of ‘Excellent’ using the Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability (IS) Rating Scheme (v1.2). The rating scheme provides an independent and consistent methodology for the application and evaluation of

sustainability outcomes in infrastructure projects. The sustainability outcomes address environmental, social, economic and governance aspects.

The IS Rating Scheme is grouped into six key themes:

- management and governance
- using resources
- emissions, pollution and waste
- ecology
- people and place
- innovation.

These sustainability themes are divided into 15 performance categories, against which the Proposal would be independently assessed and assigned a rating level. The Proposal would need to achieve at between 50 and 75 points out of a possible 100 to be certified as 'Excellent'.

3.2 Construction methodology

3.2.1 Work methodology

Subject to approval, construction is expected to commence in approximately April 2020 and take approximately two and a half years to complete. The construction methodology would be further developed during the detailed design of the Proposal by the nominated construction contractor and in consultation with TfNSW.

The sequence of activities required to construct the Proposal are outlined in **Table 3.1**. This staging is indicative and is based on the current concept design and may change once the detailed design methodology is finalised. The staging is also dependent on the construction contractor's preferred methodology, program and sequencing of work. Should the construction contractor's methodology contain substantive departures from that outlined within the REF, further assessment would be undertaken to consider any new or altered environmental or amenity impacts.

Table 3.1 Indicative construction staging for key activities

Stage	Activities
Site establishment	<ul style="list-style-type: none"> • establish seven site compounds. Three at Wolli Creek, one at Green Square Station and three at Chalmers Street Substation • establish temporary facilities as required (e.g. hoarding, temporary toilets etc.) • remove vegetation within the Proposal Area at Wolli Creek to facilitate the proposed substation and electrical feeder works
Install feeders	<ul style="list-style-type: none"> • install brackets in the Airport Line Tunnel for 33 kV and 11kV feeders • install 33 kV feeders from Chalmers Street Substation to Prince Alfred Park portal. • install 33 kV feeders from Prince Alfred Park portal to Wolli Creek portal • install 33 kV feeders from Wolli Creek Substation to Wolli Creek portal • install 11 kV feeders from Wolli Creek Substation to Wolli Creek Station Substation • install 11 kV feeders from Chalmers Street Substation to Prince Alfred Park portal. • install 11 kV feeders from Prince Alfred Park portal to Green Square Station • install 11kV feeders from Green Square Station to the ROC • install 33 kV, 11 kV and 1500 V feeders at Wolli Creek
Proposed traction substation at Wolli Creek	<ul style="list-style-type: none"> • construct the proposed traction substation building • fit out the the proposed traction substation building • test electrical equipment
Proposed padmount substation at Wolli Creek	<ul style="list-style-type: none"> • install the proposed padmount substation at Wolli Creek
Decommission	<ul style="list-style-type: none"> • decommission the Undercliffe Substation and Wolli Creek Sectioning Hut • demolish structures at Undercliffe Substation and Wolli Creek Sectioning Hut • reinstate sites • remove OHW feeders around Wolli Creek
Upgrade of vehicle access to new Wolli Creek Substation	<ul style="list-style-type: none"> • construct retaining wall (including required excavation and drainage work) • establish vehicle access base course • lay vehicle access seal and form kerbs and gutters
Testing and commissioning	<ul style="list-style-type: none"> • test electrical, communications and signalling components • commission new feeders
Demobilisation	<ul style="list-style-type: none"> • remove temporary site fencing • dismantle temporary site compounds/hoarding areas • remove temporary construction signage.

3.2.2 Plant and equipment

The plant and equipment likely to be used during construction includes:

- wiring trains
- generators
- hand tools
- demolition saws
- front end loaders
- agitators
- winches
- lighting towers
- light vehicles
- jackhammers
- dump trucks
- concrete pumps
- elevated working platforms

3.2.3 Working hours

The majority of works required for the Proposal would be undertaken during standard (NSW) Environment Protection Authority (EPA) construction hours, which are as follows:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm Saturdays
- no work on Sundays or public holidays.

Works would also need to occur outside standard hours and would include night works and works during rail possessions. These are scheduled closures where part of the rail network is temporarily closed, and trains are not operating. Some of these rail possessions would occur regardless of the Proposal. Extra possessions may be required to complete the works. Approximately nine rail possessions would be required across the two and a half year construction program.

Out of hours works may also be scheduled outside rail possession periods. The construction contractor would require approval from TfNSW for any out of hours work. The affected community would be notified in advance of any works, and mitigation measures would be implemented as outlined in TfNSW's *Construction Noise and Vibration Strategy* (TfNSW, 2019c) (refer to **Section 6.3** for further details).

3.2.4 Operating hours

The proposed operating hours of the proposed traction substation and associated feeders are 24 hours a day, seven days a week, including during maintenance activities.

3.2.5 Earthworks

Excavations and earthworks would generally be required for the following:

- establishing the building platform for the proposed traction substation
- trenching for feeders between the tunnel portals and the substations at either end of the Proposal
- trenching for a feeder at Green Square Station
- construction of the access road between Lusty Street and the proposed traction substation
- trenching for feeders for approximately 500 metres to the west of the proposed traction substation
- trenching for feeders for approximately 500 metres to the south of Wollli Creek Junction and underneath Guess Avenue
- reinstatement works for the demolition of Wollli Creek Sectioning Hut and Undercliffe Substation.

Excavated material would be reused onsite where possible or disposed of in accordance with relevant legislative requirements. It is estimated that the Proposal would generate approximately 6,000 cubic metres (m³) of spoil.

3.2.6 Source and quantity of materials

The source and quantity of materials would be determined during the detailed design phase of the Proposal and would consider the requirements of ISCA IS Rating Scheme version 1.2. Materials would be sourced from local suppliers where practicable. Reuse of existing and recycled materials would be undertaken where practicable.

3.2.7 Traffic access and vehicle movements

Traffic generated by construction activities would include construction worker light vehicles (including utility vans), as well as heavy vehicles for periodic delivery and removal of materials, and construction plant and equipment. Generally, construction vehicle movements would avoid local residential streets where possible and follow the most direct routes to and from the Proposal Area.

The traffic generated from the construction phase of the Proposal at Wollie Creek is not anticipated to exceed 10 light vehicles and 20 heavy vehicles per day during peak construction periods. In addition to the generation of vehicles the Proposal would also involve the operation of mobile plant and equipment including cranes.

Construction vehicle access to Wollie Creek is dependent on the location of the works being undertaken. Access to the north-west side of the rail corridor would be via an access gate located at the eastern end of Henderson Street. Access to the south-west side of the rail corridor would be via an access gate at the eastern end of Lusty Street. Access to the south-east side of the rail corridor would be via a gate located on the north-west corner of the intersection of Discovery Point Place and Spark Lane.

Construction traffic access to the Green Square Station section of the Proposal Area is directly available via O'Riordan Street and Botany Road. From those roads, construction vehicles are able to move off the road area and into the construction compound location which consists of a sealed, open area overlaying Green Square Station. The traffic generated as a part of these works is not expected to exceed five light vehicles and five heavy vehicles per day during peak construction periods.

Construction traffic access to the southern portion of the Chalmers Street Substation section of the Proposal Area would be via the existing access road off Gibbons Street, Redfern. Construction access for the northern portion of this location would be via the existing access road off Chalmers Street, between the Devonshire Street pedestrian tunnel entrance of Central Station and the Railway Institute Building. The traffic generated as a part of these works is not expected to exceed 10 light vehicles and 10 heavy vehicles per day during peak construction periods. Personnel may access the area via the western entrance to Mortuary Tunnel on the western side of the rail corridor.

Traffic and transport impacts associated with the Proposal are assessed in **Section 6.1** of this REF.

A detailed construction methodology, management plans (such as Traffic Control Plans) and a Construction Environmental Management Plan (CEMP) would be developed prior to construction. These plans would be implemented and updated throughout construction to manage potential traffic and access impacts.

3.2.8 Ancillary facilities

Seven construction compounds/laydown areas would be required to accommodate site offices, amenities, and laydown and storage area for materials. The indicative proposed areas for the construction compounds/laydown areas are outlined in **Table 3.2** and **Figure 3.5**, **Figure 3.6** and **Figure 3.7**.

Table 3.2 Proposed construction compounds/laydown areas

Number	Construction compound/laydown area	Location	Land Ownership
1	Construction compound/laydown area – Wollli Creek	Wollli Creek – 5A Lusty Street Wollli Creek	RailCorp owned land
2	Construction compound/laydown area – Wollli Creek	Adjacent to 15-23 Lusty Street, Wollli Creek	RailCorp owned land
3	Construction compound/laydown area – Wollli Creek	Adjacent to Henderson Street, Turrella	RailCorp owned land
4	Construction compound/laydown area – Green Square	Green Square Station above ground precinct	RailCorp owned land
5	Construction compound – Chalmers Street Substation north	Within the old Prince Alfred Substation. Accessed via Chalmers Street	RailCorp owned land
6	Construction compound/laydown area – Chalmers Street Substation middle	Between the old Prince Alfred Substation and Chalmers Street Substation. Accessed via Chalmers Street	RailCorp owned land
7	Construction compound/laydown area – Chalmers Street Substation south	Adjacent to the tennis courts at Prince Alfred Park, and entrance to the Airport Line Tunnel. Accessed via Gibbons Street, Redfern	RailCorp owned land

Impacts associated with utilising these areas have been considered in the environmental impact assessment including requirements for rehabilitation.

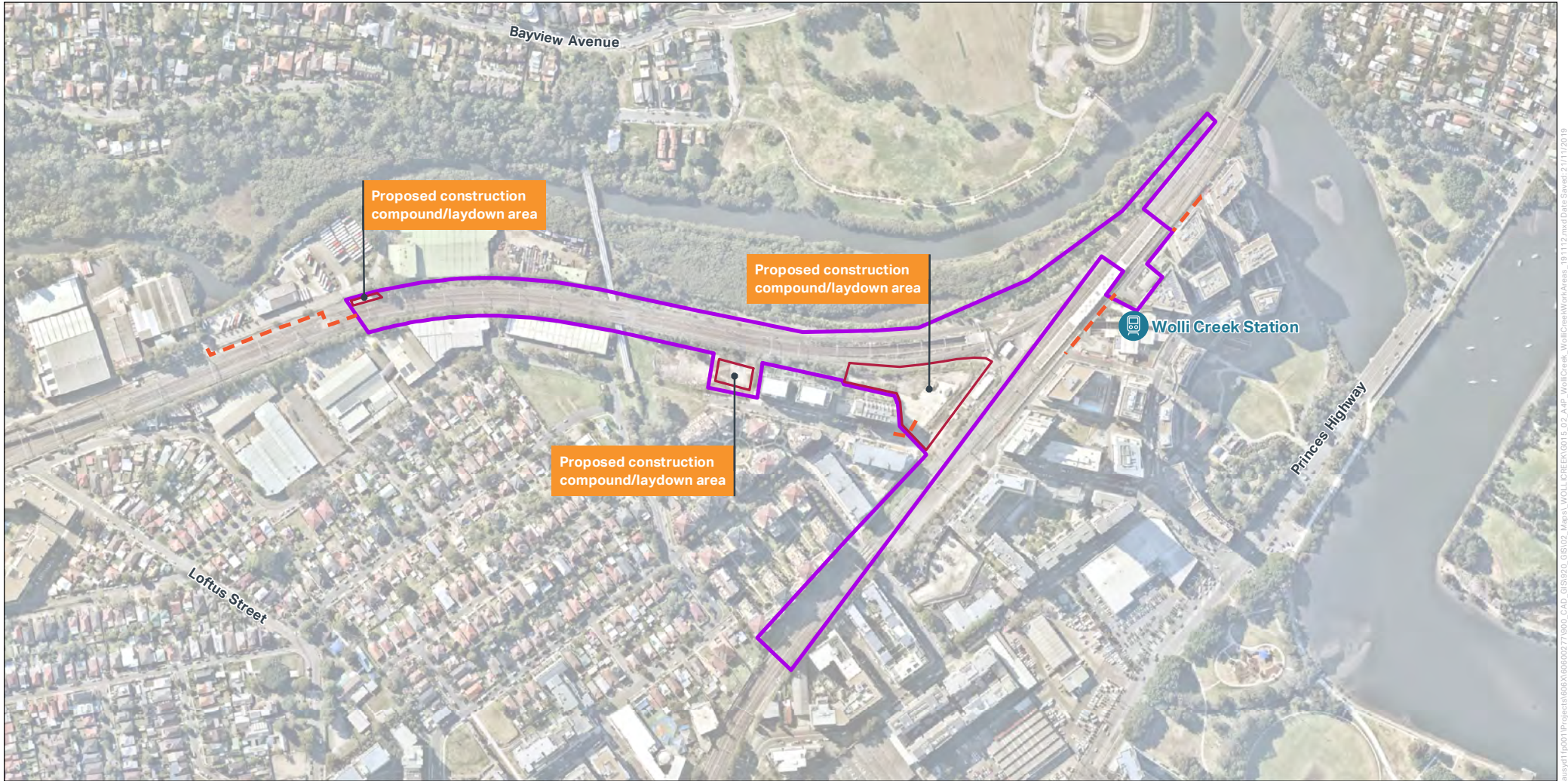






FIGURE 3-5: CONSTRUCTION COMPOUND/LAYDOWN AREAS AND ACCESS ROUTES AT WOLLI CREEK



Legend

-  Railway station
-  Construction footprint boundary
-  Proposed construction compound/laydown area
-  Proposed access route

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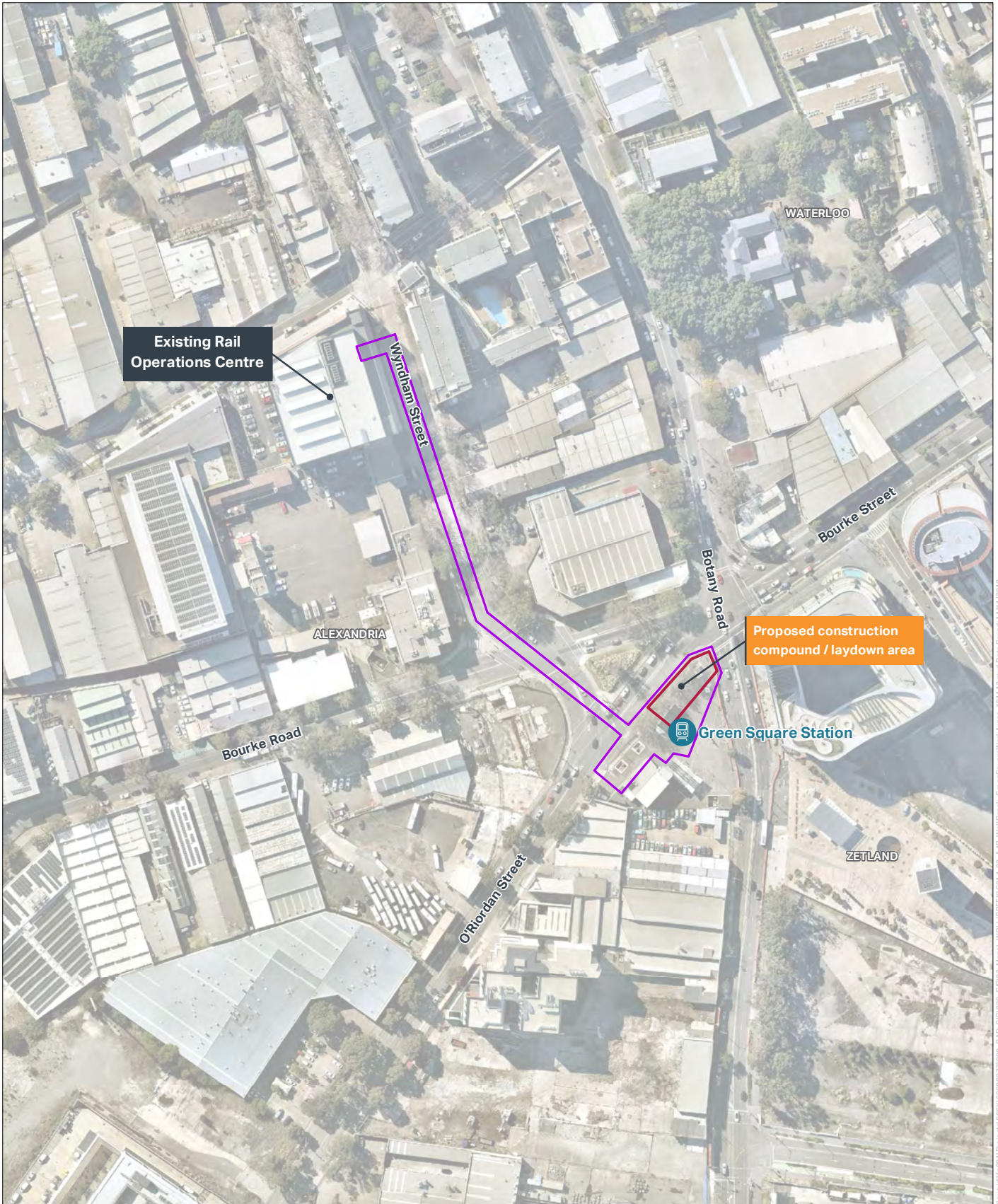





FIGURE 3-6: CONSTRUCTION COMPOUND / LAYDOWN AREA AT GREEN SQUARE



Legend

-  Railway station
-  Construction footprint boundary
-  Construction compound/laydown area

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FIGURE 3-7: CONSTRUCTION COMPOUND/LAYDOWN AREAS AT CHALMERS STREET SUBSTATION



- Legend**
- Construction footprint boundary
 - Construction compound/laydown area
 - Proposed access route

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3.2.9 Public utility adjustments

The Proposal has been designed to avoid relocation of services where feasible, however further investigation may be required. It is likely some services may require relocation, including electricity, communications and signal routes, but such relocation is unlikely to occur outside of the footprint of the works assessed in this REF. Should works be required outside of this footprint, further assessment would be undertaken. The appropriate utility providers would be consulted during the detailed design phase.

3.3 Property acquisition

TfNSW does not propose to acquire any property as part of the Proposal.

3.4 Operation management and maintenance

Upon completion of construction all electrical infrastructure, including the proposed traction substation, would be operated and maintained by Sydney Trains.

4 Statutory considerations

Chapter 4 provides a summary of the statutory considerations relating to the Proposal including a consideration of NSW Government polices/strategies, NSW legislation (particularly the EP&A Act), environmental planning instruments, and Commonwealth legislation.

4.1 Commonwealth legislation

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The (Commonwealth) EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places - defined in the EPBC Act as 'Matters of National Environmental Significance (MNES)'. The EPBC Act requires the assessment of whether the Proposal is likely to significantly impact on MNES or Commonwealth land. These matters are considered in full in **0**.

The application of Significant Impact Criteria for listed MNES that would be affected as a result of the Proposal was undertaken. One threatened fauna species, *Pteropus poliocephalus* (Grey-headed Flying-fox), was considered likely to utilise the subject site for foraging habitat on an occasional basis. The significant impact criteria were applied with respect to this species and concluded that a significant impact is unlikely to occur. The significant impact criteria also assessed indirect impacts likely to result from the proposed development. These are considered unlikely to significantly affect this species.

The Proposal would not significantly impact on any MNES or on Commonwealth land. Therefore, a referral to the Commonwealth Minister for the Environment is not required.

4.2 NSW legislation and regulations

4.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act establishes the system of environmental planning and assessment in NSW. This Proposal is subject to the environmental impact assessment and planning approval requirements of Division 5.1 of the EP&A Act. Division 5.1 of the EP&A Act specifies the environmental impact assessment requirements for activities undertaken by public authorities, such as TfNSW, which are permissible without development consent.

In accordance with section 5.5 of the EP&A Act, TfNSW, as the proponent and determining authority, must examine and consider to the fullest extent possible all matters affecting or likely to affect the environment by reason of the Proposal.

Clause 228 of the EP&A Regulation defines the factors which must be considered when determining if an activity assessed under Division 5.1 of the EP&A Act has a significant impact of the Proposal in accordance with clause 228 and **Appendix B** specifically responds to the factors for consideration under clause 228.

4.2.2 Other NSW legislation and regulations

provides a list of other relevant legislation applicable to the Proposal.

Table 4.1 Other legislation applicable to the Proposal

Applicable legislation	Considerations
<p><i>Biodiversity Conservation Act 2016</i> (BC Act) (NSW)</p>	<p>The Proposal Area at Wollie Creek may provide foraging habitat for the threatened species <i>Pteropus poliocephalus</i> (Grey-headed Flying-fox). A test of significance for the impact to this threatened species consistent with Section 7.3 of the BC Act concluded that the proposal is not likely to result in a significant impact.</p> <p>The Proposal Area in the Airport Line tunnel, at Green Square and at Chalmers Street Substation are located in highly modified urban areas. The Airport Line tunnel and Chalmers Street Substation sections are characterised by active rail corridors, while the Green Square section is located at a densely urban/commercial/industrial precinct in Sydney. Works at these locations are unlikely to affect threatened ecological communities or threatened flora and fauna.</p> <p>Refer Section 6.7).</p>
<p><i>Biosecurity Act 2015</i> (NSW)</p>	<p>Clause 22 requires that any person who deals with a biosecurity matter has a duty to ensure that in so far as is reasonably practicable, the potential biosecurity risk is prevented, eliminated or minimised.</p> <p>A total of eight priority weeds were identified within the Proposal Area at Wollie Creek.</p> <p>Appropriate management methods would be implemented during construction to manage priority weeds in the Bayside LGA and Sydney LGA (refer to Section 6.7).</p> <p>Under the <i>Biosecurity Regulation 2017</i>, an owner, occupier or person in charge of a premises must notify the presence of a pest or disease listed in Schedule 1 of the Regulation. Notification must be made in accordance with Part 6 of the Regulation and within one working day after the person first suspects or becomes aware of the presence.</p>
<p><i>Coastal Management Act 2016</i></p>	<p>This Act provides for the protection of the coastal environment for the benefit of both present and future generations. It divides the coastal zone into four coastal management areas (coastal wetlands and littoral rainforests area; coastal vulnerability area; coastal environment area; and coastal use area).</p> <p>The Wollie Creek section of the Proposal Area is located:</p> <ul style="list-style-type: none"> • adjacent to land mapped as ‘Coastal Wetlands’ • on land mapped as ‘Coastal Use Area’ • on land mapped as ‘Proximity Area for Coastal Wetlands’ • on land mapped as ‘Coastal Environment Area’. <p>Section 23 of the Act requires public authorities to have regard to coastal management programs when exercising their functions. The Proposal area is located in the area that would be subject to the Cooks River Catchment Coastal Management Program when it is finalised. That coastal management program is still within a “scoping stage”.</p>
<p><i>Contaminated Land Management Act 1997</i> (CLM Act) (NSW)</p>	<p>Section 60 of the CLM Act imposes a duty on landowners to notify the Department of Planning, Industry and Environment (DPIE), and potentially investigate and remediate land if contamination is above EPA guideline levels.</p> <p>Each of the four sections of the Proposal Area have not been declared under the CLM Act as being significantly contaminated (refer Section 6.8).</p>
<p><i>Crown Land Management Act 2016</i> (NSW)</p>	<p>The Proposal does not involve works on any Crown land.</p>

Applicable legislation	Considerations
<p><i>Heritage Act 1977</i> (Heritage Act) (NSW)</p>	<ul style="list-style-type: none"> • Sections 57 and 60 (approval) where items listed on the State Heritage Register are to be affected • Sections 139 and 140 (permit) where relics are likely to be exposed • Section 170 where items listed on a government agency Heritage and Conservation Register are to be affected. <p>The Chalmers Street Substation section of the Proposal Area is located within the curtilage of the <i>Sydney Terminal and Central Railway Stations Group (SHR 01255)</i>. An exemption under Section 57 is required for those works.</p>
<p><i>National Parks and Wildlife Act 1974</i> (NPW Act) (NSW)</p>	<p>Sections 86, 87 and 90 of the NPW Act require consent from DPIE for the destruction or damage of Indigenous objects. The Proposal is unlikely to disturb any Indigenous objects (refer Section 6.4).</p> <p>However, if unexpected archaeological items or items of Indigenous heritage significance are discovered during the construction of the Proposal, all works would cease and appropriate advice sought.</p>
<p><i>Protection of the Environment Operations Act 1997</i> (PoEO Act) (NSW)</p>	<p>The Proposal does not involve a ‘scheduled activity’ under Schedule 1 of the PoEO Act. Accordingly, an Environment Protection Licence (EPL) is not required for the Proposal.</p> <p>The operation of the Proposal would be regulated under the existing Sydney Trains EPL (12208).</p> <p>TfNSW must notify the EPA of any pollution incidents that occur onsite where triggered under Part 5.7 of the PoEO Act. This would be managed in the CEMP to be prepared and implemented by the Construction Contractor.</p>
<p><i>Roads Act 1993</i> (Roads Act) (NSW)</p>	<p>Section 138 of the Roads Act requires consent from the relevant road authority for the carrying out of work in, on or over a public road. However, Clause 5(1) in Schedule 2 of the Roads Act states that public authorities do not require consent for works on unclassified roads.</p> <p>The Proposal involves works in and on classified roads and also requires the temporary, partial closure of those roads. The roads are: O’Riordan Street, Wyndham Street and Bourke Road. Consent under the Roads Act and a Road Occupancy Licence would be obtained prior to the works being undertaken.</p>
<p><i>Sydney Water Act 1994</i> (NSW)</p>	<p>The Proposal would not involve discharge of wastewater to the sewer.</p>
<p><i>Waste Avoidance and Resource Recovery Act 2001</i> (WARR Act) (NSW)</p>	<p>TfNSW would carry out the Proposal having regard to the requirements of the WARR Act. A site-specific Waste Management Plan would be prepared.</p>
<p><i>Water Management Act 2000</i> (NSW) (WM Act)</p>	<p>Under section 91E (1) of the WM Act, an approval is required to carry out a controlled activity in, on or under waterfront land except where exemptions apply. In accordance with Clause 41 of the <i>Water Management (General) Regulation 2018</i> public authorities are exempt from Section 91E (1) of the WM Act in relation to all controlled activities that are carried out in, on or under waterfront land.</p> <p>Piling and excavation activities may encounter groundwater at Wollie Creek. TfNSW would liaise with DPIE for any aquifer interference licence requirements under section 91F of the WM Act.</p>

4.3 State Environmental Planning Policies

4.3.1 State Environmental Planning Policy (Infrastructure) 2007

The Infrastructure SEPP is the key environmental planning instrument which determines the permissibility of the Proposal and which part of the EP&A Act an activity or development may be assessed.

Clause 79 of the Infrastructure SEPP allows for the development of 'rail infrastructure facilities' by or on behalf of a public authority without consent on any land (i.e. assessable under Division 5.1 of the EP&A Act). Clause 78 defines 'rail infrastructure facilities' as including elements such as 'power supply (including overhead power supply) systems' and 'signalling, train control, communication and security systems'.

Consequently, development consent is not required for the Proposal which is classified as a rail infrastructure facility and the environmental impacts of the Proposal have been assessed under the provisions of Division 5.1 of the EP&A Act.

Part 2 of the Infrastructure SEPP contains provisions for public authorities to consult with local councils and other agencies prior to the commencement of certain types of development.

Section 5 of this REF discusses the consultation undertaken under the requirements of the Infrastructure SEPP.

It is noted that the Infrastructure SEPP prevails over all other environmental planning instruments except where *State Environmental Planning Policy (Major Development) 2005* or *State Environmental Planning Policy (Coastal Management) 2018* (Coastal Management SEPP) applies. The Proposal does not require consideration under the *State Environmental Planning Policy (Major Development) 2005*. The Coastal Management SEPP is considered in section 4.3.3.

4.3.2 State Environmental Planning Policy 55 – Remediation of Land

SEPP 55 provides a State-wide approach to the remediation of contaminated land for the purpose of minimising the risk of harm to the health of humans and the environment. While consent for the Proposal is not required, the provisions of SEPP 55 have still been considered in the preparation of this REF.

Section 6.8 of this REF contains an assessment of the potential contamination impacts of the Proposal. It is unlikely that any large-scale remediation (Category 1) work would be required as part of the Proposal. The proposed land use does not differ to the existing use and is, therefore, unlikely to be affected by any potential contaminants that exist within the rail corridor.

4.3.3 State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP)

The Coastal Management SEPP gives effect to the objectives of the *Coastal Management Act 2016* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone. It defines the four coastal management areas in the Act through detailed mapping and specifies assessment criteria that are tailored for each coastal management area. Councils and other consent authorities must apply these criteria when assessing proposals for development that fall within one or more of the mapped areas.

The Wollie Creek section of the Proposal Area is located:

- adjacent to land mapped as 'Coastal Wetlands'
- on land mapped as 'Proximity Area for Coastal Wetlands'
- on land mapped as 'Coastal Environment Area'
- on land mapped as 'Coastal Use Area'.

The provisions of the Infrastructure SEPP prevail over the Coastal Management SEPP except in areas identified as coastal wetlands and littoral rainforests. As the Proposal is not within an

area identified as a coastal wetland or littoral rainforest the provisions of the Coastal Management SEPP do not apply to this Proposal.

4.4 Local environmental planning instrument and development controls

The Proposal is located within the Bayside and Sydney LGAs. Prior to the amalgamation of Botany Bay Council and Rockdale Council, the Proposal Area at Wolli Creek was located within the Rockdale LGA. As a result, the LEP applicable for this section is the: the *Rockdale Local Environmental Plan 2011* (Rockdale LEP). The provisions of the Infrastructure SEPP prevail over Local Environmental Plans (LEPs), prepared by councils for an LGA. However, during the preparation of this REF, the provisions of the following LEPs were considered:

- Rockdale Local Environmental Plan 2011
- Sydney Local Environmental Plan 2012.

4.4.1 Rockdale Local Environmental Plan 2011

The *Rockdale Local Environmental Plan 2011* (Rockdale LEP) is the governing plan for the portion of the Bayside LGA around Wolli Creek. **Table 4.2** summarises the relevant aspects of the Rockdale LEP applicable to the Proposal. **Figure 1.2** shows the relevant section of the zoning map from the Rockdale LEP, with the indicative location of the Proposal.

Table 4.2 Relevant provisions of the Rockdale LEP

Provision description	Relevance to the Proposal
Clause 2.3 – Zone objectives and Land Use Tables	<p>The majority of works to be undertaken at the Wolli Creek section of the Proposal Area would be undertaken on land zoned as SP2 Infrastructure (Railway). Part of the Proposal would be undertaken on land zoned as B4 – Mixed Use.</p> <p>Other nearby land zones include:</p> <ul style="list-style-type: none"> • unzoned land • B4 – Mixed Use • RE2 – Private Recreation • RE1 – Public Recreation • IN2 – Light Industrial • R4 – High Density Residential • R2 – Low Density Residential. <p>The Proposal is consistent with the objectives of the SP2 and B4 zoned land on which it is located. The Proposal would not substantially affect the land use objectives within other nearby land zones.</p>
Clause 5.10 – Heritage Conservation	<p>Clause 5.10 of the Rockdale LEP aims to:</p> <ul style="list-style-type: none"> • conserve the environmental heritage of Rockdale • conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, setting and views • conserve archaeological sites • conserve Aboriginal objects and Aboriginal places of heritage significance. <p>The Proposal would not directly or indirectly affect any heritage items.</p>

Provision description	Relevance to the Proposal
Clause 5.12 – Infrastructure development and use of existing buildings of the Crown	<p>Clause 5.12 of the Rockdale LEP does not restrict or prohibit the carrying out of any development, by or on behalf of a public authority, which is permitted to be carried out with or without development consent.</p> <p>The Proposal would be undertaken by a public authority (TfNSW) and is permitted without development consent.</p>
Clause 6.2 – Earthworks	<p>Clause 6.2 of the Rockdale LEP aims to ensure that earthworks for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land.</p> <p>By virtue of clause 5(3) and 79 of the Infrastructure SEPP, the Proposal is permissible without development consent; however, consideration of the potential impacts and mitigation measures for earthworks for the Proposal is outlined in Section 6.8.</p>
Clause 6.6 – Flood Planning	<p>Clause 6.3 of the Rockdale LEP seeks to minimise flood risks to life and property, allow compatible development with the land’s flood hazard rating, including accounting for climate change and avoiding significant adverse impacts on flood behaviour.</p> <p>A discussion of potential impacts resulting from flooding and surface water flows is discussed in Section 6.9.</p>

4.4.2 Sydney Local Environmental Plan 2012

The *Sydney Local Environmental Plan 2012* (Sydney LEP) is the governing plan for the Sydney LGA, including Alexandria and Surry Hills where the Green Square and Chalmers Street Substation components of the Proposal are located. **Table 4.3** summarises the relevant aspects of the Sydney LEP applicable to the Proposal. **Figure 1.2** shows the relevant section of the zoning map from the Sydney LEP, with the indicative location of the Proposal.

Table 4.3 Relevant provisions of the Sydney LEP

Provision description	Relevance to the Proposal
Clause 2.3 – Zone objectives and Land Use Tables	<p><u>Green Square Station</u></p> <p>The works to be undertaken at the Green Square section of the Proposal Area would be undertaken on land zoned as:</p> <ul style="list-style-type: none"> • Deferred Matter • SP2 – Infrastructure (Classified Road) • B4 – Mixed Use • B7 – Business Park <p>A key surrounding land zone is SP2 – Infrastructure (Educational Establishment)</p> <p>The Proposal is consistent with the objectives of the land zones that it is located on. The Proposal would not substantially affect the land use objectives within other nearby land zones.</p> <p><u>Chalmers Street Substation</u></p> <p>The works to be undertaken at the Chalmers Street Substation section of the Proposal Area would be undertaken on land zoned as SP2 – Infrastructure (Railway).</p> <p>The Proposal is consistent with the objectives of the land zone that it is located on. The Proposal would not substantially affect the land use objectives within other nearby land zones.</p>

Provision description	Relevance to the Proposal
Clause 5.10 – Heritage Conservation	<p>Clause 5.10 of the Sydney LEP 2012 aims to:</p> <ul style="list-style-type: none"> • conserve the environmental heritage of Sydney • conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, setting and views • conserve archaeological sites • conserve Aboriginal objects and Aboriginal places of heritage significance. <p>The works at Chalmers Street are located within the curtilage of the Central Railway Station group (Sydney LEP I824). A discussion of impacts to heritage is included in Section 6.5.</p>
Clause 5.12 – Infrastructure development and use of existing buildings of the Crown	<p>Clause 5.12 of the Sydney LEP 2012 does not restrict or prohibit the carrying out of any development, by or on behalf of a public authority, which is permitted to be carried out with or without development consent.</p> <p>The Proposal would be undertaken by a public authority (TfNSW) and is permitted without development consent.</p>
Clause 7.15 – Flood Planning	<p>Clause 7.15 of the Sydney LEP 2012 seeks to minimise flood risks to life and property, allow compatible development with the land's flood hazard rating, including accounting for climate change and avoiding significant adverse impacts on flood behaviour.</p> <p>A discussion of potential impacts resulting from flooding and surface water flows is discussed in Section 6.9.</p>

4.5 NSW Government policies and strategies

Table 4.4 provides an overview of other NSW Government policies and strategies relevant to the Proposal.

Table 4.4 NSW Government policies and strategies applicable to the Proposal

Policy/Strategy	Commitment	Comment
<p><i>NSW: Making It Happen</i> (NSW Government, 2015)</p>	<p>In September 2015, the NSW Government announced a series of State Priorities as part of <i>NSW: Making It Happen</i> (NSW Government, 2015). The State Priorities are intended to guide the ongoing actions of the NSW Government across the State, and guide resource allocation and investment in conjunction with the NSW Budget.</p> <p><i>NSW: Making it Happen</i> focuses on 12 key 'priorities' to achieve the NSW Government's commitments. These priorities range across a number of issues including infrastructure, the environment, education, health, wellbeing and safety in addition to Government services.</p> <p>One of the 12 priorities identified as part of <i>NSW: Making It Happen</i> relates to investment in building infrastructure. The ongoing development and investment in transport infrastructure is identified as part of the wider building infrastructure priority.</p>	<p>The Proposal assists in meeting the priority by assisting in the delivery of infrastructure to support NSW population growth over the next 10 years.</p>

Policy/Strategy	Commitment	Comment
Future Transport Strategy 2056 (TfNSW, 2018a)	<p><i>Future Transport 2056</i> is an update of NSW's <i>Long Term Transport Master Plan</i>. It is a suite of strategies and plans for transport to provide an integrated vision for the state.</p> <p>The strategy places the customer at the centre of works undertaken by TfNSW. It includes issue specific and place based supporting plans that seek to integrate transport modes.</p> <p>The strategy outlines 6 state-wide outcomes</p> <ul style="list-style-type: none"> • customer focused • successful places • a strong economy • safety and performance • accessible services <p>sustainability.</p>	The More Trains, More Services program is specifically referenced in the strategy as an example of initiatives to be implemented.
Building Momentum State Infrastructure Strategy 2018-2038 (Infrastructure NSW, 2018)	<p>The <i>State Infrastructure Strategy 2018-2038</i> is a strategy to plan and fund the infrastructure that the NSW Government delivers over the next 20 years.</p> <p>Public transport is viewed as critical to productivity, expanding employment opportunities by connecting people to jobs, and reducing congestion.</p>	The Proposal invests in public transport and supports the safe and reliable growth of public transportation in NSW.
South District Plan (Greater Sydney Commission, 2018)	The <i>South District Plan</i> is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision for Greater Sydney.	<p>A key initiative in this plan to provide people in the South District of Sydney with better transport connections is the investigation into train improvements on the T4 and T8 Lines to improve capacity and reliability.</p> <p>The More Trains, More Services program specifically aims to deliver on this initiative.</p>

4.6 Ecologically sustainable development

TfNSW is committed to ensuring that its Proposals are implemented in a manner that is consistent with the principles of ecologically sustainable development (ESD). The principles of ESD are generally defined under the provisions of clause 7(4) of Schedule 2 to the EP&A Regulation as:

- the precautionary principle – If there are threats of serious or irreversible damage, a lack of full scientific uncertainty should not be used as a reason for postponing measures to prevent environmental degradation
- intergenerational equity – the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations

- conservation of biological diversity and ecological integrity – the diversity of genes, species, populations and their communities, as well as the ecosystems and habitats they belong to, should be maintained or improved to ensure their survival
- improved valuation, pricing and incentive mechanisms – environmental factors should be included in the valuation of assets and services.

The principles of ESD have been adopted by TfNSW throughout the development and assessment of the Wolli Creek Substation and T8 Airport Line Power Supply Upgrade project. **Section 3.1.4** summarises how ESD would be incorporated in the design development of the Proposal. **Section 6.13** includes an assessment of the Proposal on climate change and sustainability, and **Section 7.2** lists mitigation measures to ensure ESD principles are incorporated during the construction phase of the Proposal.

5 Community and stakeholder consultation

Chapter 5 discusses the consultation undertaken to date for the Proposal and the consultation proposed for the future. This chapter discusses the consultation strategy adopted for the Proposal and the results of consultation with relevant government agencies and stakeholders. **Figure 5.1** shows the planning approval and consultation process for the Proposal.

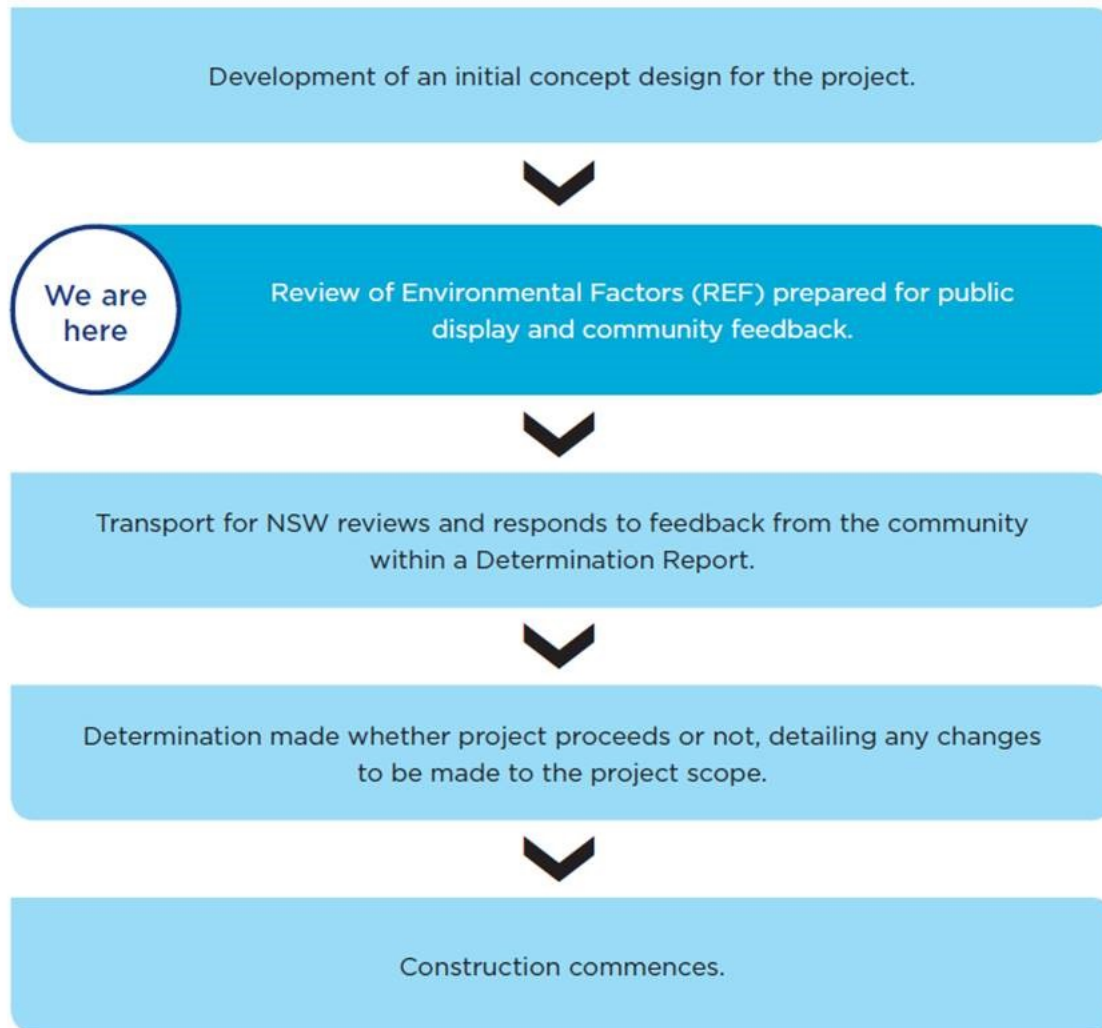


Figure 5.1 Planning approval and consultation process for the Proposal

5.1 Stakeholder consultation during concept design

Throughout the concept design phase stakeholders have been engaged proactively. Stakeholders relevant to the design phase have included TfNSW, Bayside Council, Sydney Trains, Sydney Airport Corporation Limited, Airport Link Company, Broadspectrum and utility providers including Ausgrid.

5.2 Consultation requirements under the Infrastructure SEPP

Part 2, Division 1 of the Infrastructure SEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain

types of development. Clauses 13, 14, 15, 15AA, 15A and 16 of the Infrastructure SEPP require that public authorities undertake consultation with councils and other agencies, when proposing to carry out development without consent.

Table 5.1 provides details of consultation requirements under the Infrastructure SEPP for the Proposal.

Table 5.1 Infrastructure SEPP consultation requirements

Clause	Clause particulars	Relevance to the Proposal
<p>Clause 13 Consultation with Councils – development with impacts on council related infrastructure and services</p>	<p>Consultation is required where the Proposal would result in:</p> <ul style="list-style-type: none"> • substantial impact on stormwater management services • generating traffic that would place a local road system under strain • involve connection to or impact on a council owned sewerage system • involve connection to and substantial use of council owned water supply • significantly disrupt pedestrian or vehicle movement • involve significant excavation to a road surface or footpath for which Council has responsibility. 	<p>As a result of potential impacts to traffic and pedestrian movements around Wolli Creek Station, Bayside Council would be notified of the works at the Wolli Creek section of the Proposal Area.</p> <p>Similarly, because of potential impacts to vehicle and pedestrian movements, and excavation over a public footpath, the City of Sydney Council would be notified for works occurring at the Green Square Station section of the Proposal Area.</p>
<p>Clause 14 Consultation with Councils – development with impacts on local heritage</p>	<p>Where works:</p> <ul style="list-style-type: none"> • substantially impact on local heritage item (if not also a State heritage item) • substantially impact on a heritage conservation area. 	<p>The works within the Proposal Area at the Chalmers Street Substation section are located within the footprint of the heritage item: Sydney Terminal and Central Railway Stations Group / Central Railway Station group (SHR 01255/Sydney LEP I824).</p> <p>As this item is listed as a state heritage item as well as a local heritage item, consultation is not required.</p> <p>There is no proposed impact to other local heritage/heritage conservation areas. Accordingly, consultation with Council is not required. Refer to Section 6.5.</p>
<p>Clause 15 Consultation with Councils – development with impacts on flood liable land</p>	<p>Where works:</p> <ul style="list-style-type: none"> • impact on land that is susceptible to flooding – reference would be made to <i>Floodplain Development Manual: the management of flood liable land</i>. 	<p>The Proposal is located on flood liable land at Wolli Creek, Green Square and Chalmers Street. Refer to Section 6.9.</p> <p>Bayside Council and the City of Sydney Council would be notified of the works occurring at each of those sections of the Proposal Area.</p>

Clause	Clause particulars	Relevance to the Proposal
Clause 15AA Consultation with State Emergency Service development with impacts on flood liable land	Consultation with the State Emergency Service is required where works occur on flood liable land.	The Proposal is located on land that is mapped as being affected by a probable maximum flood event at Wolli Creek, Green Square Station and Chalmers Street Substation. Accordingly, consultation with the State Emergency Service is required in regard to this aspect. Refer to Section 6.9 .
Clause 15A Consultation with councils – development with impacts on certain land within the coastal zone	Consultation is required where the Proposal would be undertaken on land that is within a coastal vulnerability area and is inconsistent with a certified coastal management program that applies to the land.	The Proposal is not located on land within a coastal vulnerability area. Consultation with Council is therefore not required.
Clause 16 Consultation with public authorities other than Councils	For <i>specified development</i> which includes consultation with DPIE for development that is undertaken adjacent to land reserved under the NPW Act, and other agencies specified by the Infrastructure SEPP where relevant.	The Proposal is not located adjacent to land reserved under the NPW Act. Accordingly, consultation with DPIE on this matter is not required.

5.3 Consultation strategy

The consultation strategy for the Proposal was developed to encourage stakeholder and community involvement and foster interaction between stakeholders, the community and the project team. The consultation strategy that was developed, having regard to the requirements of the planning process ensures that stakeholders, customers and the community are informed of the Proposal and have the opportunity to provide input.

The objectives of the consultation strategy are to:

- provide accurate and timely information about the Proposal and REF process to relevant stakeholders
- raise awareness of the various components of the Proposal and specialist environmental investigations
- keep the local community and stakeholders informed of the proposed upgrade work and encourage direct communication/identification of issues, concerns or suggestions
- engage with directly affected community near the Proposal Area and seek opportunities to minimise impacts on amenity, their properties and business operations
- provide opportunities for stakeholders and the community to express their views about the Proposal
- listen and record community and stakeholder feedback and ensure it is considered during the development of the Proposal and responded to in the Determination report
- work collaboratively with statutory regulators/authorities to facilitate the environmental approval process
- build positive relations with identified community stakeholders

- ensure a comprehensive and transparent approach
- identify and resolve issues in a timely manner.

5.4 Public display

The REF display strategy adopts a range of consultation mechanisms, including:

- public display of the REF at various locations
- distribution of a Proposal update to rail customers and local community at Wolli Creek station and residents in close proximity to proposed works at Green Square station, outlining the Proposal and inviting feedback on the REF
- advertisement of the REF public display in local newspapers with a link to the TfNSW website that includes a summary of the Proposal and information on how to provide feedback
- pop up community information session held at Wolli Creek Station
- consultation with Bayside Council, City of Sydney Council and the State Emergency Service.

Community consultation activities for the Proposal would be undertaken during the public display of this REF. The display period of the REF would be advertised in the week that the public display commences. The REF would be displayed for a period of two weeks.

The REF would be placed on public display at the following locations:

- transport.nsw.gov.au/projects/mtms
- nsw.gov.au/improving-nsw/haveyoursay
- Arncliffe Library, 11 Firth Street, Arncliffe
- TfNSW, 241 O’Riordan Street, The Gateway, Mascot.

The REF would also be available on the [TfNSW website¹](#) and [Have Your Say website²](#). Information on the Proposal would be available through the Project Infoline (1800 684 490) or by [email³](#). During this time feedback is invited. Following consideration of feedback received during the public display period, TfNSW would determine whether to proceed with the Proposal and what conditions would be imposed on the project should it be determined to proceed.

5.5 Ongoing consultation

At the conclusion of the public display period for this REF, TfNSW would acknowledge receipt of feedback from each respondent. The issues raised by the respondents would be considered by TfNSW before determining whether to proceed with the Proposal (refer **Figure E 1**).

Should TfNSW determine to proceed with the Proposal, the Determination Report would be made available on the TfNSW website and would summarise the key impacts identified in this REF, demonstrate how TfNSW considered issues raised during the public display period, and include a summary of mitigation measures proposed to minimise the impacts of the Proposal.

Should TfNSW determine to proceed with the Proposal, the Proposal team would keep the community, councils and other key stakeholders informed of the process, identify any further issues as they arise, and develop additional mitigation measures to minimise the impacts of the Proposal. The interaction with the community would be undertaken in accordance with a Community Liaison Management Plan to be developed prior to the commencement of construction.

6 Environmental impact assessment

Chapter 6 of the REF provides a detailed description of the likely environmental impacts associated with the construction and operation of the Proposal. For each likely impact, the existing environment is characterised and then an assessment is undertaken as to how the Proposal would impact on the existing environment.

This environmental impact assessment has been undertaken in accordance with clause 228 of the EP&A Regulation. A checklist of clause 228 factors and how they have been specifically addressed in this REF is included in **Appendix B**.

6.1 Traffic and transport

This section assesses and describes the impacts of the Proposal on traffic, transport and pedestrian and cyclist access surrounding the Proposal Area. The assessment is based on a desktop analysis. Detailed traffic counts and modelling were not considered necessary for any section of the Proposal Area.

6.1.1 Existing environment

Wolli Creek

Public transport

Wolli Creek Station is located on the T4 Line, South Coast Line and T8 Line, providing Wolli Creek with train services into the city as well as south to the Illawarra and beyond. Across all lines and services to and from the City, Wolli Creek is a stop for 1,588 train services each week. It also provides people with the opportunity to access and transfer between transport modes including buses and private vehicles.

A bus stop is located on the east-bound lane of Discovery Point Place. This bus stop services Route 348 – Wolli Creek to Bondi Junction on the Sydney Bus Network

Road network and traffic

The road network surrounding Wolli Creek Station consists primarily of local roads. The south-western side of the Proposal Area is bounded by Lusty Street, while Wolli Creek Station is bounded to the south by Discovery Point Place, and to the east by Brodie Spark Drive. Access to the western construction/laydown area would be via Henderson Street located on the north-western side of the Proposal Area. The closest main road is the Princes Highway, which is classified as a State and Regional road, and is also a national highway, linking Sydney and Adelaide via Melbourne.

Lusty Street is a local road with an east-west alignment. The road follows the alignment of the T8 Line and is accessible via another local road – Bonar Street. Lusty Street has one lane in each direction and contains inset, on-street parking.

Discovery Point Place is a local road with an east-west alignment. The road follows the alignment of the T8 Line and is accessible via Brodie Spark Drive. Discovery Point Place has one lane in each direction and contains a kiss and ride area/5-minute parking bay on the west-bound lane, and a bus stop on the east-bound lane.

Brodie Spark Drive is a local distributor road with a curved north-south alignment. The road has one lane in each direction, until/before (direction dependent) it reaches the intersection of Brodie Spark Drive, Magdalene Terrace and Arncliffe Street. Brodie Spark Drive divides into two lanes in each direction between that intersection and the Princes Highway.

Access

Access to the southeast side of the rail corridor for the Proposal is available via a sealed road and gate at the northern corner of Discovery Point Place and Spark Lane. Access to the northwest side of the rail corridor for the Proposal is available via an access gate at the eastern end of Henderson Street. Access to the southwest side of the rail corridor is available from an access gate at the eastern end of Lusty Street.

Parking

There are a limited number of on-street parking spaces along Lusty Street which service the high-density residential building to the west of the Proposal Area. Brodie Spark Drive contains limited inset, on-street parking nearby Wolli Creek Station, with 1-hour restrictions. There is un-timed on-street parking available on Henderson Street.

Taxi waiting areas and kiss and ride facilities

There is a designated taxi bay on the north-bound lane of Brodie Spark Drive where this road crosses above Wolli Creek Station. There is a formal kiss and ride stopping area, designated as a 5-minute parking bay on Discovery Point Place.

Bicycle and pedestrian network and facilities

There are no dedicated cycle paths near the Proposal Area at Wolli Creek, however local roads can accommodate cyclists. There are no dedicated cyclist facilities (e.g. bicycle lockers) near the Proposal Area, or at Wolli Creek Station.

Council-managed pedestrian pathways are located within the vicinity of the Proposal and can be used to access Wolli Creek Station.

Airport Line tunnel

Tunnel and access

The Airport Line tunnel is an underground railway from Central Station to Wolli Creek Station, servicing Green Square Station, Mascot Station, Domestic Airport Station and International Airport Station. The tunnel is approximately 10 kilometres in length.

Each station within the Airport Line tunnel has the same number of train services during the week and on weekends, about 800 per day. Access to the Airport Line tunnel is via the Prince Alfred Park portal near Central Station or the Wolli Creek portal.

Green Square Station

Public transport

Green Square Station is located on the T8 Line, providing services into the city as well as south to Macarthur, or to the Illawarra via Wolli Creek. There is a bus stop located on the south-bound side of Botany Road, opposite Green Square Station. Buses servicing Green Square continue to Central Station, Botany, Leichhardt, Coogee, Banksmeadow, Riverwood and Little Bay.

Road network and traffic

The local road network surrounding the Proposal Area at the Green Square Station section includes a key intersection of Bourke Street, Botany Road, O'Riordan Street and Bourke Road. This intersection encompasses the northern corner of the land where the entrance to Green Square Station is located. The Proposal Area at Green Square Station also encompasses Mandible Street and Wyndham Street.

Bourke Street, Botany Road, O'Riordan Street and Wyndham Street are classified roads, managed by TfNSW (formerly Roads and Maritime Services (RMS)), while Bourke Road and Mandible Street are local, unclassified roads managed by the City of Sydney Council.

Bourke Street is classified as a State and Regional Road and is listed as a main road. It has two lanes in each direction and is generally aligned north-south, until the intersection with Phillip Street where it bends to a northeast – southwest alignment.

Botany Road is classified as a State and Regional Road and is listed as a main road. It has two lanes in each direction and is generally aligned north-south. Botany Road provides a connection between the City and Port Botany.

O’Riordan Street is classified as a state and regional road and is listed as a main road. It contains two lanes in each direction and is generally aligned northeast – southwest. It provides a link from the intersection of Bourke Street, Botany Road and O’Riordan Street to Sydney Domestic Airport, and Qantas Drive, which links to Sydney Kingsford Smith International Airport.

Wyndham Street is classified as a regional road and is listed as a secondary road. For the majority of the road, it has two lanes in each direction, with one lane in each direction typically being used for parking after the intersection with Mandible Street. Wyndham Street has a north-south alignment.

Bourke Road is a local distributor road with a northeast – southwest alignment, providing a link from the intersection of Bourke Street, Botany Road and O’Riordan Street to Gardeners Road. Bourke Road has two lanes in each direction between Coward Street and O’Riordan Street, with no parking.

Access

Access to this section of the Proposal Area would be via O’Riordan Street and Botany Road. From those roads, construction vehicles are able to move off the road area and into the construction compound location which consists of a sealed, open area overlaying Green Square Station

Parking, taxis and kiss and ride facilities

Designated parking spaces are not available at Green Square Station. Timed and untimed street parking is available on the road network within walking distance of the station. Green Square Station does not have taxi waiting areas or kiss and ride facilities.

Bicycle network and pedestrian facilities

There are no formalised cycle paths immediately surrounding Green Square Station or the works areas on Wyndham Street, however there is a formalised bicycle lane along Bourke Road. Green Square Station currently contains 26 horizontal bicycle racks, 12 wall-mounted low spaces and 13 wall-mounted high spaces.

Pedestrian access to Green Square Station is provided from O’Riordan Street (west) and Botany Road (east). Footpaths are present on both of those roads. From the main station entrance, pedestrians can access the platforms via a lift or escalators.

Chalmers Street Substation

Public transport

The Chalmers Street Substation section of the Proposal Area is within close proximity to Central Station. Central Station is the largest and busiest railway station in New South Wales and is a major transport interchange for a number of public transport services. As works at the Chalmers Street Substation section of the Proposal are confined to the rail corridor between Chalmers Street Substation and the Airport Line tunnel, refer to the previous discussion on public transport operating in the Airport Line tunnel. Central Station accommodates 57 bus services, comprising both local and regional services. Buses operate from 14 stands around Central Station.

Road network and traffic

Key roads surrounding the Chalmers Street Substation section of the Proposal Area include Chalmers Street, Elizabeth Street, Cleveland Street, Gibbons Street and Lawson Street. The two nearest major roads to the Proposal are City Road/Princes Highway (A36) and Parramatta Road (A22).

Chalmers Street is classified as a *7000 Series Regional Road*, being a road not classified as a highway, main road, secondary road or tourist road. It is aligned north-south. From the junction with Philip Street, to the junction with Redfern Street, this road has one lane in each direction. After the junction with Redfern Street, Chalmers Street becomes a one-way only road in a northbound direction. Three lanes are provided, with a bus lane for the majority of the road, until between Rutland Street and Devonshire Street. The eastern lane is commonly used for parking, except where specifically prohibited.

Elizabeth Street is classified as a regional road and listed as a secondary road from the junction with Bourke Street, until the junction with Cleveland Street. It is aligned north-south. From Cleveland Street to King Street, Elizabeth Street is classed as a *7000 Series Regional Road*. From Bourke Street to Redfern Street, Elizabeth Street provides two lanes in each direction, though the western and eastern-most lanes are commonly occupied by parked vehicles in some sections. Elizabeth Street has four lanes in a south-bound direction from Cleveland Street to Redfern Street. There are provisions for parking on the western-most side of the road in this section of Elizabeth Street. From Cleveland Street to Devonshire Street, Elizabeth Street provides two lanes in a south-bound direction only, and a bus lane on the eastern side of the road.

Cleveland Street is classified as a State Road and is listed as a main road. It is aligned east-west. It provides a direct connection between the western and eastern sections of the city from City Road/Princes Highway (A36) to Anzac Parade. Cleveland Street has two lanes in each direction over its entire length, except at key junctions, where turning lanes are provided.

Gibbons Street is classified as a State Road and is listed as a main road. It is aligned north-south, and provides access to the Proposal Area at the Chalmers Street Substation section. It has four lanes in a north-bound direction only, with the eastern-most and western-most lanes being typically used for parking. After the junction with Lawson Street, Gibbons Street has three lanes in a north-bound direction only.

Access

The main vehicle access to the Proposal Area at the Chalmers Street Substation section is available via an access road off Gibbons Street, approximately 15 metres north of the intersection of Gibbons Street and Lawson Street, Redfern. This entrance is located approximately 750 metres from the Chalmers Street Substation, entirely within the rail corridor. Alternative access to the Proposal Area at this location is available via the existing driveway access off Chalmers Street between the Devonshire Street pedestrian tunnel entrance and the Railway Institute Building at Central Station.

Parking, taxis and kiss and ride facilities

Limited parking is available within the RailCorp land adjacent to the rail corridor after entering the Proposal Area off Gibbons Street. Parking is also available near the southern construction compound/laydown area and there is also parking near Chalmers Street Substation and Prince Alfred Substation that could be utilised. On-street parking is available on the road network within walking distance, however much of that parking is subject to time restrictions. In addition, a multi-storey carpark is located within walking distance from Central Station – Goulburn Street Carpark.

Designated taxi areas are provided at Central Station near Exits 1, 2 and 3 – 5. A formal kiss and ride area is provided near Exits 1 and 2.

Pedestrian facilities bicycle network and facilities

There are multiple formalised bicycle paths leading up to and around Central Station including separated off-road cycleways, low traffic street or bike lanes and off-road shared paths.

Pedestrian access to Central Station is provided via each of the seven exits listed above. Access to station platforms is available via escalators and lifts. Pedestrian access to the Project Area (for authorised personnel only) would also be available via driveway access off Gibbons Street, Chalmers Street and Mortuary Tunnel.

6.1.2 Potential impacts

Construction phase

a) Wollli Creek Station

Road network and traffic

The traffic generated from the construction phase of the Proposal at Wollli Creek is not anticipated to exceed 10 light vehicles and 20 heavy vehicles per day during peak construction periods. In addition to the generation of vehicles the Proposal would also involve the operation of mobile plant and equipment including cranes.

Construction vehicle routes depend on the location of works being undertaken. Generally, construction vehicle movements would avoid local residential streets where possible and follow the most direct routes to and from the Proposal Area.

Temporary interruptions to traffic flow on Brodie Spark Avenue, Arncliffe Street, Guess Avenue, Bonar Street, Lusty Street, Mount Olympus Boulevard, Spark Lane, Magdalene Terrace and Discovery Point Place may occur as a result of construction vehicles accessing and leaving the Proposal Area. Following direct routes would result in the effects of the Proposal upon localised traffic to be minor, as the number of local roads used is kept to a minimum.

Parking

Parking would be made available within the Proposal Area for all construction vehicles and mobile plant. A small number of parking spaces may be available for the private vehicles of construction contractors; however, these workers would be encouraged to utilise public transport. Where alternative modes of transport to the use of private vehicles is not feasible for construction workers, there may be slight reductions to available on-street parking spaces.

The effect of construction works upon parking around Wollli Creek Station is considered to be minor due to the temporary nature of the works, and the proximity of public transport.

Public Transport

Over an anticipated two and a half year construction period, approximately nine rail possessions would be required. Buses would replace train services during the rail possessions. The overall effect of rail possessions is considered to be negligible to minor, as services would continue to operate, via a different transport mode (buses). Furthermore, many of the rail possessions would occur regardless of the Proposal. Some additional possessions may be required however the Proposal would not have a major impact on the rail network. Regular bus services in the vicinity of the Proposal would not be affected during construction and would continue to operate as normal.

b) Airport Line tunnel

Road network and traffic

Temporary interruptions to localised traffic flow may occur as a result of construction vehicles arriving and leaving access points along the Airport Line tunnel. The number of vehicles arriving and leaving access points would be small and generally sporadic. This means that it is

unlikely for all of the predicted maximum number of vehicles to be arriving and leaving at the same time. The impact of this is therefore considered to be negligible to minor.

Parking

Parking would be made available nearby access points to the Airport Line tunnel for all construction vehicles. A small number of parking spaces may be available for the private vehicles of construction contractors; however, they would be encouraged to utilise public transport. Where alternative modes of transport to the use of private vehicles are not feasible for construction workers, there may be slight reductions to available on-street parking spaces.

The effect of construction works upon parking is considered to be minor due to the temporary nature of the works, and the proximity of public transport modes nearby works areas.

Public Transport

Over an anticipated two and a half year construction period, approximately nine rail possessions would be required. Buses would replace train services during the rail possessions. The overall effect of rail possessions is considered to be negligible to minor, as services would continue to operate, via a different transport mode (buses). Furthermore, many of the rail possessions would occur regardless of the Proposal. Some additional possessions may be required however the Proposal would not have a major impact on the rail network.

All works for this component of the Proposal would be undertaken underground, and away from the existing road network and therefore bus routes and bus stops. Regular bus services would not be affected during construction and would continue to operate as normal.

During scheduled weekend track possessions, there would be an increased number of bus services operating on the road network above the T8 Line alignment between the stops that are inaccessible as a result of the possession. Increased bus services would increase the amount of traffic on the local road network, however this is unlikely to be to an extent that would cause more than minor disruptions. This would also be offset by a reduction in the number of private vehicles accessing the station to drop off and pick up people who would otherwise take the train.

c) Green Square Station

Road network and traffic

The traffic generated from the construction phase of the Proposal at Green Square Station is not anticipated to exceed 5 light vehicles and 5 heavy vehicles per day during peak construction periods. In addition to the generation of vehicles the Proposal would also involve the operation of mobile plant and equipment including excavators for trenching.

Temporary interruptions to localised traffic flow may occur as a result of construction vehicles accessing and leaving the Proposal Area. The extent of impact that these interruptions would have upon localised traffic flow is considered to be minor as vehicles are unlikely to be arriving at and leaving the Proposal Area at the same time. This reduces the number of vehicles on the road at any one time.

There may be short term closures of lanes on O'Riordan Street, Bourke Road and Wyndham Street to facilitate excavations on the footpath area adjacent to O'Riordan Street, and the pulling of cables through existing conduits underneath O'Riordan Street, Bourke Road and Wyndham Street. With mitigation measures in place regarding working nearby the roadway, the overall effect of the cabling works at the Green Square Station section upon the road network and traffic is considered to be minor.

Parking

Limited parking would be available within the construction footprint near the trenching works for vehicles and plant/equipment associated with works only. These vehicles would be positioned in a way that would limit the disturbance they have to pedestrians walking along the

footpath area. Local on-street parking may be utilised by construction workers for their private vehicles, however the use of public transport would be encouraged where their vehicle is not required for construction. The impact of the Proposal upon parking near the Green Square Station section is considered to be negligible.

Public Transport

Works at Green Square Station would not result in an impact to ordinary train services. The minor affect that construction vehicles may have upon localised traffic conditions may affect the flow of buses through the area, however it is considered that this affect would be minor.

d) Chalmers Street Substation

Road network and traffic

The traffic generated during these works is not expected to exceed 10 light vehicles and 10 heavy vehicles per day during peak construction periods. Temporary interruptions to traffic flow may occur on Gibbons Street and Chalmers Street as construction vehicles enter and exit the Proposal Area.

As with the other sections of the Proposal, it is anticipated that construction vehicles would not be arriving at and leaving the Proposal Area at the same time. This reduces the amount of vehicles introduced into the road network at any one time. The impact of the Proposal at the Chalmers Street Substation on the road network and traffic is considered to be negligible to minor.

Parking

Parking for construction vehicles and plant used for construction would be made available within the construction footprint inside the Proposal Area at the Chalmers Street Substation section. There may be provisions for the parking of the private vehicles driven by construction workers, however they would be encouraged to take public transport to and from the Proposal Area. The impact upon parking as a result of the Proposal at the Chalmers Street Substation section is considered to be negligible to minor.

Public transport

Over an anticipated two and a half year construction period, approximately nine rail possessions would be required. Buses would replace train services during the rail possessions. The overall effect of rail possessions is considered to be negligible to minor, as services would continue to operate, via a different transport mode (buses). Furthermore, many of the rail possessions would occur regardless of the Proposal. Some additional possessions may be required however the Proposal would not have a major impact on the rail network. Regular bus services in the vicinity of the Proposal at this section would not be affected during construction and would continue to operate as normal.

Operational phase

a) All sections of the Proposal Area

Vehicular access to the Proposal Area would continue via the access routes outline previously for operational maintenance purposes. Parking would be available within the Wolli Creek and Chalmers Street Substation precincts. The operation of the Proposal would have a negligible impact as access for maintenance would be infrequent and require only a small number of vehicles.

6.1.3 Mitigation measures

The following mitigation measures would be implemented:

- a construction Traffic Management Plan (TMP) would be prepared by the construction contractor in consultation with TfNSW and provided to Bayside Council, City of Sydney Council and TfNSW. The construction TMP would be the primary tool to manage

potential traffic and pedestrian impacts associated with construction. At a minimum, the construction TMP would include:

- ensuring adequate signage at construction work sites
 - consideration of safety and accessibility for pedestrians and cyclists
 - ensuring adequate sight lines to allow for safe entry and exit from the site
 - managing impacts and changes to on and off street parking, and parking locations for construction workers
 - routes to be used by heavy construction related vehicles to minimise impacts on sensitive land uses and businesses
 - measures to manage traffic flows around the area affected by the Proposal, including as required regulatory and direction signposting, line marking and variable message signs and all other traffic control devices necessary for the implementation of the TMP
- consultation with the relevant road authorities would be undertaken during preparation of the construction TMP. The performance of all project traffic arrangements would be monitored during construction
 - communication would be provided to the community, local residents and businesses to inform them of changes to parking, pedestrian access and/or traffic conditions including vehicle movements and anticipated effects on the local road network relating to site works
 - access for emergency vehicles would be maintained in accordance with relevant requirements. Emergency services would be advised of all planned changes to traffic arrangements prior to applying the changes.

Refer to **Table 7.1** for a list of proposed mitigation measures. All mitigation measures are to be incorporated into the CEMP.

6.2 Urban design, landscape and visual amenity

6.2.1 Methodology

Wolli Creek

A Landscape Character and Visual Impact Assessment (LVIA) was undertaken by AECOM for the Proposal (AECOM, 2019a). The assessment included desktop analysis, site inspection, visual envelope mapping, creation of photomontages and detailed impact assessment. The findings of the assessment are summarised in this section.

There is no accepted National published guidance on LVIA specific to Australia. Therefore, the industry typically refers to guidance from elsewhere for producing LVIA. The method for this assessment has been developed with reference to Guidelines for Landscape and Visual Impact Assessment (GLVIA3), Third Edition (2013), developed by the Landscape Institute and Institute for Environmental Management (UK). GLVIA3 is widely recognised as comprising an example of 'best practice' in this field. In accordance with this guideline, an impact grading matrix was used to assess both landscape and visual impacts. The sensitivity and magnitude of the impact was determined to produce a combined impact rating of negligible, low, moderate-low, moderate, high-moderate and high (refer to **Table 6.1**).

Table 6.1 Landscape character and visual impact grading matrix

	Magnitude				
		High Change	Moderate Change	Low Change	Negligible change
Sensitivity	High	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Airport Line tunnel, Green Square Station and Chalmers Street Substation

Works associated with the Proposal at these sections of the Proposal Area only consist of minor construction works (installation of feeder cables). As a result, the assessment of urban design, landscape and visual amenity impacts for these sections during the construction and operation phase is limited to a desktop assessment only.

6.2.2 Existing environment

a) Wolli Creek

Landscape character

Landscape Character Zones (LCZ) have been identified within the broader setting of the site. The LCZs that fall within the Proposal Area are listed and described below.

- **LCZ 1 - Rail corridor**

Within the study area, this LCZ is predominantly zoned ‘SP2 Infrastructure (Railway)’. LCZ 1 is dominated by the linear, functional rail corridor that includes tracks, trains, utilities, overhead electrical wiring and associated rail infrastructure. Stations are interspersed along the corridor, including Wolli Creek.

The rail corridor in this area is intermittently screened from the surrounding landscape, with residential fencing, fringing vegetation and existing landforms all assisting in visually screening the corridor in different locations. The rail corridor is generally utilitarian in character, with only minimal vegetation management and maintenance regimes. The corridor is generally flat, with batters and elevated areas following undulations in the surrounding landscape. The corridor is typically fenced at its boundaries with a combination of residential paling/sheet metal fencing and Sydney Trains’ chainwire fencing.

- **LCZ 2 - Road corridor**

Excluded from assessment as it falls outside of the study area and its character is not affected by the Proposal.

- **LCZ 3 – Public open space**

Within the study area, public open space is located along the Wolli Creek corridor. This LCZ is characterised by extensive open turf areas with mature trees and shrub planting along boundaries and near pathways. Mature trees are typical along the public open space edges, providing partial or full screening from surrounding areas and roads.

- **LCZ 4 – Town centre**

The town centre is situated near the Wollli Creek Station entrance and is typically characteristic of a transport-centric residential development. Surrounded by mixed use mid-rise residential buildings on all sides, shops, cafes and restaurants line a central pedestrian mall which connects the station entrance to its surrounds.

- **LCZ 5 – Low-rise residential**

Low density residential neighbourhoods are positioned further away from the town centres, and typically comprise one and two storey detached houses with mature landscaped front and back gardens.

- **LCZ 6 – Mid-rise residential**

LCZ 6 comprises the area to the south of the rail corridor, adjacent to the Proposed Wollli Creek Substation. The majority of this LCZ is zoned R4 High Density Residential, with some of the buildings falling within B4 Mixed Use. Built form typically comprises tall relatively modern buildings, with the facades typically in keeping with a three-tone colour scheme with patterned material accents at ground level.

- **LCZ 7 - Creek corridor**

Wollli Creek, a tributary to the Cooks River, runs adjacent to the northern boundary of the LGA. The creek corridor is heavily vegetated, with only a few gaps within the mangrove forest adjacent to Waterworth Park that allow views to the water. The corridor has several vegetation communities, the most predominant of which is the Estuarine Mangrove Forest, which creates a visual barrier to the creek from its surrounds.

- **LCZ 8 - Industrial**

LCZ 8 comprises large utilitarian buildings that line the rail corridor, are used for industrial purposes and are generally not publicly accessible. The built form within this LCZ varies. The large lots that characterise this LCZ generally contain little to no vegetation but are bordered by mature vegetation - either due to the neighbouring Wollli Creek or the vegetation within the nature strip to provide screening to the nearby residences.

Visual receivers

Visual receivers are individuals and/or groups of people whose views may be affected by the Proposal. The area from which the Proposal can be seen is relatively small, broadly comprising:

- views from Wollli Creek Station platform
- views from nearby mid-rise residential apartments
- views from the rail corridor, seen by commuters and rail workers.

Visibility of the Proposal is substantially limited by:

- the tall built form immediately adjacent to the Proposal
- the dense mangroves along Wollli Creek which obstruct views from across the creek corridor and from Waterworth Park
- the limited amount of publicly accessible land near to the Proposal.

Visual effects of the Proposal are assessed for the following key visual receivers:

- local residents within nearby mid-rise residential buildings
- workers within the rail corridor
- rail commuters.

b) Airport Line tunnel

The Airport Line tunnel section of the Proposal Area is located entirely within the T8 Line Airport Line tunnel. The Airport Line tunnel does not have any permanent visual receivers. Temporary visual receivers are restricted to customers at stations along the T8 Line.

c) Green Square Station

This part of the Proposal Area is located in a heavily urbanised environment, south of the Sydney CBD, but within the City of Sydney LGA.

Land uses surrounding Green Square Station consist generally of mid-rise apartment buildings, commercial uses, industrial uses, the Alexandria NSW Fire and Rescue Station and the ROC. Nearby permanent visual receivers are listed in **Table 6.2**.

Table 6.2 Nearby permanent visual receivers

Visual receivers	Approximate distance from Proposal
Residential	<ul style="list-style-type: none">79 metres east (305 Botany Road, Zetland [Infinity Tower])
Non-residential	<ul style="list-style-type: none">18 metres south (6 – 12 O’Riordan Street, Alexandria)20 metres southeast (320 – 322 Botany Road, Alexandria)70 metres north (284 Wyndham Street, Alexandria)96 m northwest (Fire and Rescue NSW, Alexandria Fire Station)

Other visual receivers include pedestrians and motorists travelling along O’Riordan Street, Botany Road, Bourke Road and Wyndham Street, as well as those accessing the station.

d) Chalmers Street Substation

This part of the Proposal Area is located within a heavily urbanised environment in the southern part of the Sydney CBD.

The land uses surrounding this location consist of an operational rail corridor immediately to the northwest and a large park (Prince Alfred Park) immediately to the southeast. Nearby permanent visual receivers would be restricted to the north-western side of the rail corridor. Views of the Proposal from the south-eastern side of the rail corridor (i.e. residential apartments along Chalmers Street) are generally obscured by trees within Prince Alfred Park and trees planted along the rail corridor boundary. In addition, the works at this location would be carried out on land that is situated at a lower level than Prince Alfred Park. Potential nearby permanent visual receivers are listed in **Table 6.3**.

Table 6.3 Nearby permanent visual receivers

Visual receivers	Approximate distance from Proposal
Residential	<ul style="list-style-type: none">187 metres west (52 Regent Street, Chippendale)227 metres northwest (71 – 75 Regent Street, Chippendale)
Non-residential	<ul style="list-style-type: none">208 metres northwest (26 – 30 Lee Street, Haymarket)

Other visual receivers include customers travelling on trains to and away from Central Station, and users of Prince Alfred Park, especially the tennis courts and basketball courts.

6.2.3 Potential impacts

Construction phase

a) Wolli Creek

In addition to visual impact associated with construction activity, three temporary site compounds/laydown areas would be required to accommodate a site office, amenities, laydown and storage area for materials. These would all be located on RailCorp owned land.

Visible construction elements would be expected to typically include a range of site sheds, hoardings, plant and equipment as detailed in **Section 3**.

These visual impacts would be visually contained within rail corridor, which within the Proposal Area is screened by the dense mangroves along the riparian corridor of Wolli Creek. Views from south of the rail corridor would be limited from publicly accessible locations by mid-rise apartment blocks that line the corridor. Receivers within these apartments would see clear views of these activities (refer to **Figure 6.1**).

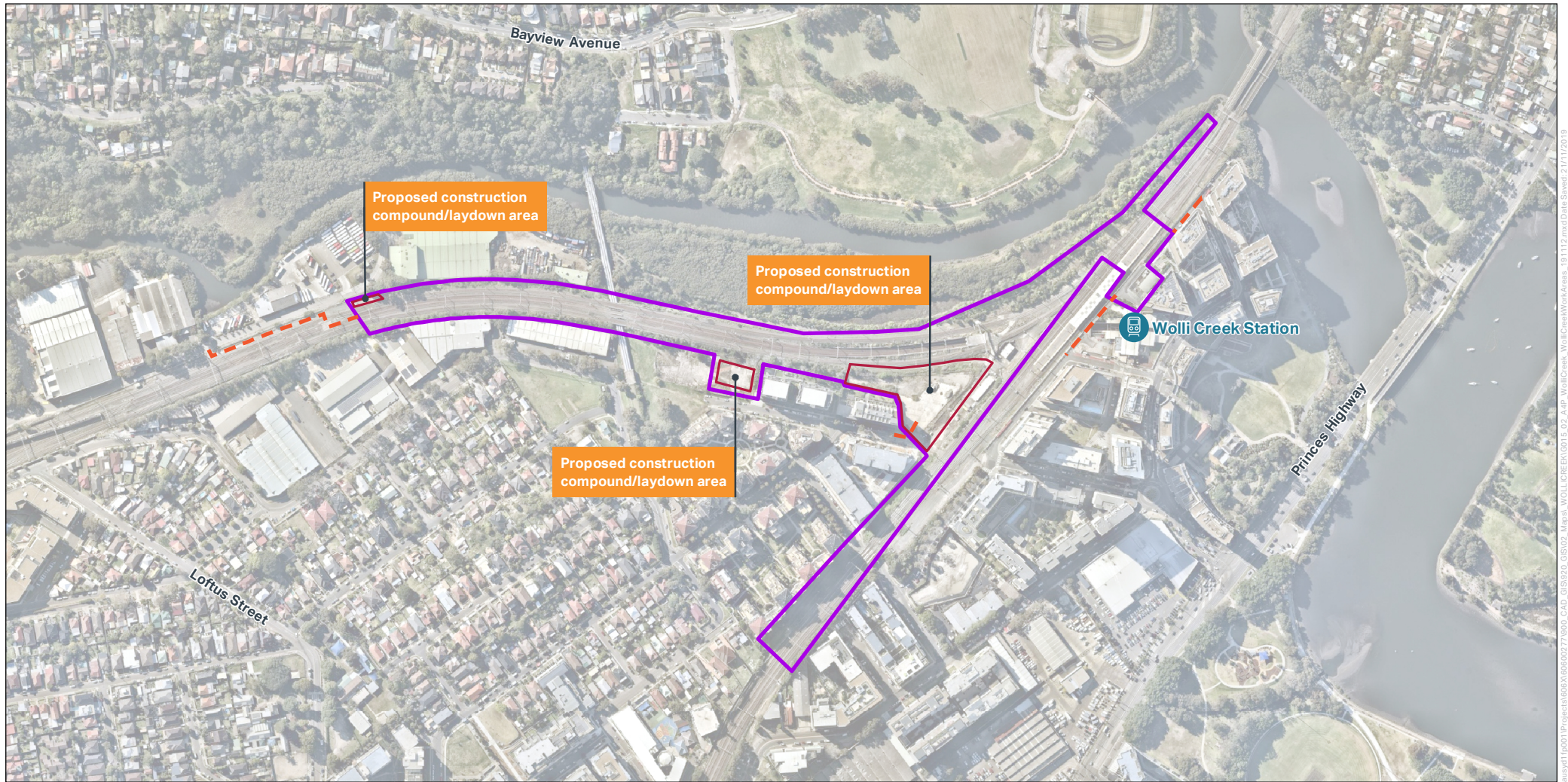






FIGURE 6-1: CONSTRUCTION COMPOUND/LAYDOWN AREAS AND ACCESS ROUTES AT WOLLI CREEK

AECOM



Legend

-  Railway station
-  Construction footprint boundary
-  Proposed construction compound/laydown area
-  Proposed access route

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Visible changes due to construction would be seen within the context of the working rail corridor. Although elements within the views would differ from existing, these changes would be seen within an area of low scenic value, whose character is greatly influenced by the utilitarian, function-driven design of the corridor. Furthermore, these changes would be temporary, seen over a period of about two and a half years until completion of the Proposal.

b) Airport Line tunnel

There would be no impacts to urban design, landscape or visual amenity as a result of the construction phase of the Proposal within the Airport Line tunnel.

c) Green Square Station

In addition to the construction activity seen due to the trenching works, a temporary site compound/laydown area would be required to accommodate the laydown and storage of materials. The temporary site compound/laydown area would all be located at Green Square, at Street level.

Visible construction elements would be expected to typically include a range plant and equipment as detailed in **Section 3**.

These visual impacts would be visually contained within the works and compound/laydown area. The works would be visible from all receivers located north of the Green Square Station entry.

Visible changes due to construction would be seen within the context of the busy and heavily urbanised surrounding environment. Although elements within the views would differ from existing, these changes would be seen within an area of low scenic value, whose character is greatly influenced by human uses. Furthermore, these changes would be temporary.

d) Chalmers Street Substation

In addition to the construction activity seen due to the trenching works, three temporary site compounds/laydown areas would be required to accommodate a site office, amenities, laydown and storage area for materials. The temporary site compounds/laydown areas would all be located on RailCorp owned land.

Visible construction elements would be expected to typically include a range plant and equipment as detailed in **Section 3**.

These visual impacts would be visually contained within rail corridor, which is screened by mature trees along the south-eastern boundary between the rail corridor and Prince Alfred Park. The works would be visible from some publicly accessible locations in Prince Alfred Park and potentially from some mid-rise buildings on the northwestern side of the rail corridor.

Visible changes due to construction would be seen within the context of the working rail corridor. Although elements within the views would differ from existing, these changes would be seen within an area of low scenic value, whose character is greatly influenced by the function-driven design of the rail corridor. Furthermore, these changes would be temporary.

Operational phase

a) Wollli Creek

An assessment of landscape character impacts at operation arising from the Proposal has been undertaken for each LCZ within the study area (LCZ 2 is not within the study area) to determine the effects of the change on the character of the landscape within which the Proposal is set, and the significance of those effects.

LCZ 1 – Rail Corridor

The potential effects of change on LCZ 1 are described in **Table 6.4**.

Table 6.4 Rail corridor landscape character impact assessment

LCZ 1 - Rail corridor
Refer to Section 6.2.2 for a description of LCZ 1.
<p>Anticipated change</p> <p>The Proposal lies completely within LCZ 1, which is dominated by existing rail infrastructure. The anticipated operational change would consist of the Proposed Wollie Creek Substation, and the associated demolition of the Wollie Creek Sectioning Hut and Undercliffe Substation, installation of feeder cables and power and signalling upgrades.</p>
<p>Sensitivity</p> <p>The susceptibility of LCZ 1 to change due to the Proposal is influenced by:</p> <ul style="list-style-type: none"> • the landscape is utilitarian in character, with function being the primary driver of overall design and visual context • the LCZ's lack of heritage value, and low visual amenity and ecological values • the LCZ's land use zoning. The corridor is predominantly zoned 'SP2 Infrastructure (Railways)', with a small portion near the Proposal zoned 'R4 High Density Residential'. <p>Based on the above, the sensitivity of LCZ 1 to the anticipated change is considered to be <i>Low</i>.</p>
<p>Magnitude of change</p> <p>Relative to the overall size of the LCZ 1, the proposed change (substation construction and associated demolition) is small. The geographical extent of the area over which the effects of the Proposal may have an influence is at the level of the immediate setting of the site.</p> <p>The duration of the Proposal would be long-term (50-60 years), with low potential for reversibility.</p> <p>Given the above, the magnitude of change for LCZ 1 is considered to be <i>Low</i>.</p>
<p>Significance of landscape character effect</p> <p>Using the landscape and visual impact assessment matrix, the impact of the Proposal on LCZ 1 is considered to be <i>Low (neutral)</i>, therefore the Proposal would not result in a significant change to the overall character of the LCZ.</p>

LCZ 3 – Public open space

The potential effects of change on LCZ 3 are described in **Table 6.5**.

Table 6.5 Public open space landscape character impact assessment

LCZ 3 - Public open space
Refer to Section 6.2.2 for a description of LCZ 3.
<p>Anticipated Change</p> <p>No changes would occur within this LCZ.</p> <p>As no changes lie within or adjacent to this LCZ, the sensitivity and magnitude to the Proposal is considered to be <i>Negligible</i>.</p>
<p>Significance of landscape character effect</p> <p>Using the landscape and visual impact assessment matrix, the impact of the Proposal on LCZ 3 at operation is considered to be <i>Negligible</i>. The Proposal would not result in a significant change to the overall character of this LCZ.</p>

LCZ 4 – Town centre

The potential effects of change on LCZ 4 are described in **Table 6.6**.

Table 6.6 Town centre landscape character impact assessment

LCZ 4 - Town centre
Refer to Section 6.2.2 for a description of LCZ 4
Anticipated change The closest part of LCZ 4 is located approximately 50 metres east of the Proposal and is separated by existing rail infrastructure. No changes occur within this LCZ. As no changes lie within or adjacent to this LCZ, the sensitivity and magnitude to the Proposal is considered to be <i>Negligible</i> .
Significance of landscape character effect Using the landscape and visual impact assessment matrix, the impact of the Proposal on LCZ 4 at operation is considered to be <i>Negligible</i> . The Proposal would not result in a significant change to the overall character of the LCZ.

LCZ 5 – Low rise residential

The potential effects of change on LCZ 5 are described in **Table 6.7**.

Table 6.7 Low rise residential landscape character impact assessment

LCZ 5 - Low rise residential
Refer to Section 6.2.2 for description of LCZ 5
Anticipated change No changes occur within this LCZ, therefore the sensitivity and magnitude to the Proposal is considered to be <i>Negligible</i> .
Significance of landscape character effect Using the landscape and visual impact assessment matrix, the impact of the Proposal on LCZ 5 at operation is considered to be <i>Negligible</i> . The Proposal would not result in a significant change to the overall character of the LCZ.

LCZ 6 – Mid-rise residential

The potential effects of change on LCZ 6 are described in **Table 6.8**.

Table 6.8 Mid-rise residential landscape character impact assessment

LCZ 6 – Mid-rise residential
Refer to Section 6.2.2 for description of LCZ 6
Anticipated change While the Proposal does not lie within this LCZ, it is positioned immediately adjacent to LCZ 6.

LCZ 6 – Mid-rise residential

Sensitivity to change

The *susceptibility* of LCZ 6 to change due to the Proposal is influenced by:

- the landscape is residential, with high density apartment living as the primary driver of overall design
- the scale of the residential buildings and the density of living in the zone has resulted in this LCZ comprising a landmark within its surroundings, with built form visible from the surrounding landscape
- the LCZ is predominantly zoned R4 High Density Residential. The existing character conforms to this zoning.

The LCZ has a moderate level of landscape value as the LCZ does not have heritage value but has a high quality of design of streetscapes and built form.

Given the above, the sensitivity of LCZ 6 to the anticipated change is considered to be *Moderate*.

Magnitude of change

The Proposal would be of comparable scale and character to that of existing infrastructure within the LCZ within which it lies (LCZ 1). However, the scale of the Proposal would be small in comparison to the scale of built form within LCZ 6.

The geographical extent of the area over which the effects of the Proposal may have an influence is at the level of the immediate setting of the site and outside of LCZ 6, although immediately adjacent.

The duration of the Proposal would be long-term (50-60 years), with low potential for reversibility.

Given the above, the magnitude of change on the character of LCZ 6 is considered to be *Negligible*.

Significance of landscape character effect

Using the landscape and visual impact assessment matrix, the impact of the Proposal on LCZ 6 at operation is considered to be *Negligible*. The Proposal would not result in a significant change to the overall character of the LCZ.

LCZ 7 – Creek corridor

The potential effects of change on LCZ 7 are described in **Table 6.9**.

Table 6.9 Creek corridor landscape character impact assessment

LCZ 7 - Creek corridor

Refer to **Section 6.2.2** for description of LCZ 7

Anticipated change

No changes occur within this LCZ, therefore, the sensitivity and magnitude to the Proposal is considered to be *Negligible*.

Significance of landscape character effect

Using the landscape and visual impact assessment matrix, the impact of the Proposal on LCZ 7 is considered to be *Negligible*. The Proposal would not result in a significant change to the overall character of the LCZ.

LCZ 8 – Industrial

The potential effects of change on LCZ 8 are described in **Table 6.10**.

Table 6.10 Industrial corridor landscape character impact assessment

LCZ 8 - Industrial corridor
Refer to Section 6.2.2 for description of LCZ 8
Anticipated change No changes occur within this LCZ, therefore, the sensitivity and magnitude to the Proposal is considered to be <i>Negligible</i> .
Significance of landscape character effect Using the landscape and visual impact assessment matrix, the impact of the Proposal on LCZ 8 is considered to be <i>Negligible</i> . The Proposal would not result in a significant change to the overall character of the LCZ.

An assessment of visual impacts at operation arising from the Proposal has been undertaken to assess potential operational visual impacts as a result of the Proposal, three (viewpoints) were selected. These viewpoints are shown on **Figure 6.2**.

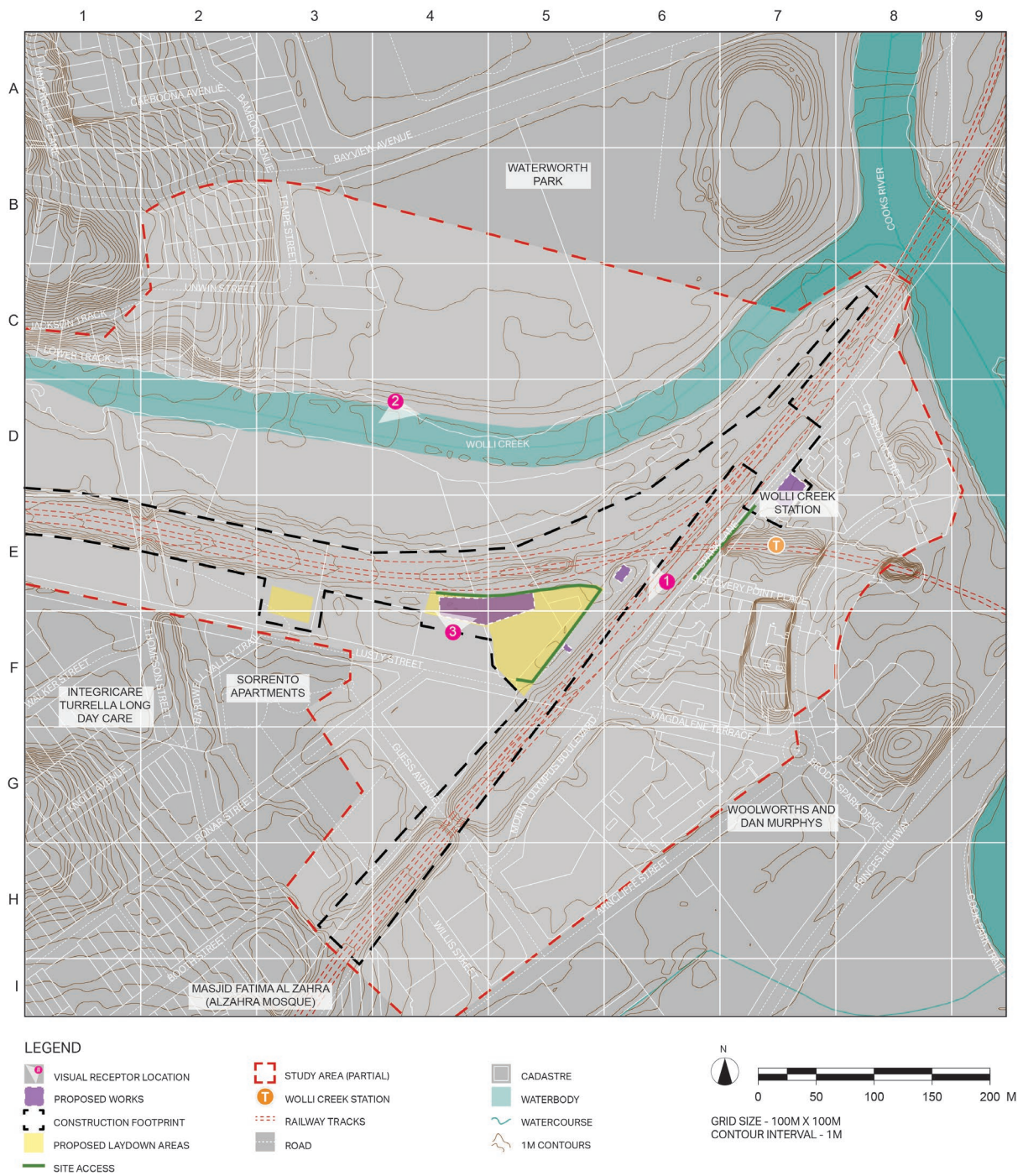


Figure 6.2 Plan of visual receptor locations (source: AECOM)

The rationale for selecting the viewpoints is as follows:

- Viewpoint 1 - Wollie Creek Station platform, the higher elevation of this viewpoint acts as a representative viewpoint for commuters travelling to and from Wollie Creek Station, as well as a representative viewpoint for workers within the rail corridor
- Viewpoint 2 - Waterworth Park from the gap in vegetation on the northern edge of the Cooks River gives a representative view of what park users and nearby local residents might see through the dense vegetation
- Viewpoint 3 – apartments at 5-13 Lusty Street which act as a proxy for all residents from mid to high rise buildings with views of the Proposal.

Viewpoint 1 – Wollie Creek Station platform

This viewpoint is representative for all commuters using Wollie Creek Station, with the view taken from the platform with the greatest visibility of the Proposal. The visual receivers for this location include the commuters and rail workers within the rail corridor. **Table 6.11** summarises visual impacts seen by these receptors.

Table 6.11 Viewpoint 1 - Wollie Creek Station platform visual impact assessment

Viewpoint 1
<p>Existing view</p> <p>This viewpoint is located at the station platform (refer to Figure 6.2). Key elements of the existing view comprise:</p> <ul style="list-style-type: none"> • the rail corridor and the track junction in the foreground and the to the right of frame • remnant vegetation fringing the rail corridor • the mid-rise residential buildings along Lusty Street and associated with Sorrento Apartments to the left of frame • overhead gantries and wiring within the rail corridor in the background to the left and centre of frame • mature, dense vegetation along Wollie Creek to the right and centre of frame.
<p>Anticipated change to view</p> <p>The key changes to the view would comprise:</p> <ul style="list-style-type: none"> • the addition of the proposed traction substation, demolition of the Wollie Creek Sectioning Hut and vegetation removal within the rail corridor • an upgraded access road.
<p>Sensitivity to change</p> <p>The changes to the view would be seen by:</p> <ul style="list-style-type: none"> • rail commuters travelling to and from the station • workers and train drivers working within the rail corridor. <p>Rail commuters are expected to pay low levels of attention and only spend a short period of time at the visual receptor location as this stop would be only one of a wider journey and would give their surrounding a cursory view rather than an in-depth gaze. Workers, train drivers and train guards within the rail corridor are also expected to have low amount of attention given to their surroundings as it is expected that they would be concentrating on their work. The train drivers would additionally only be within the close proximity of the visual receptor location for a short period of time.</p> <p>The value attached to the view seen from Viewpoint 1 is influenced by:</p> <ul style="list-style-type: none"> • the view is dominated by rail infrastructure, which is utilitarian in character and designed for function over aesthetics • the Wollie Creek Wetlands and Valley can be seen within the existing view, but are seen beyond the rail corridor and are therefore partially obstructed by rail infrastructure • the view is not picturesque, nor seen from a location where leisure is the primary activity. <p>Due to the above, the sensitivity of receptors at this viewpoint to the anticipated change arising from the Proposal is considered to be <i>Low</i>.</p>

Viewpoint 1

Magnitude of change

The changes due to the proposal are small in scale considering the greater view. These comprise the addition of one element (the proposed traction substation) and the removal of another (the Wolli Creek Sectioning Hut). Both changes would be seen in the middle ground of the view, with the scale of the mid-rise apartment blocks behind the proposed substation dwarfing the proposed substation.

Furthermore:

- the proposed traction substation would comprise an additional piece of rail infrastructure which would be in keeping with the character of infrastructure within the working rail corridor
- the proposed traction substation would be visually absorbed within the view due to the backdrop of built form outside the rail corridor
- the proposed traction substation and access road would comprise of concrete and sheet metal roofing which is consistent with the existing materiality of the rail corridor and neighbouring residential buildings.

The geographic extent of the visual effect from Viewpoint 1 is limited to within the rail corridor and makes up a minor part of the overall view from this location.

The operational life of the Proposal would be long-term (50-60 years), with low potential for reversibility.

Due to the above, the magnitude of visual effects arising from the Proposal is considered to be *Low*.

Significance of visual effect

The significance of the visual effects arising from the Proposal on Viewpoint 1 would be *Low (neutral)*. The high quality of the design of the Wolli Creek Substation and the fact that the changes would comprise the addition and the removal of built form would result in a neutral change to the view seen from this location.

Viewpoint 2 – Waterworth Park

This visual receptor location represents the views seen by park users and the residents from the low rise residences nearby. **Table 6.12** summarises visual impacts seen by these receptors.

Table 6.12 Viewpoint 2 – Waterworth Park visual impact assessment

Viewpoint 2

Existing view

This view is taken from the northern bank of Wolli Creek in Waterworth Park where there is a gap in vegetation. Key elements of the existing view comprise:

- Wolli Creek waterway, including dense mangrove vegetation fringing the creek within the riparian corridor
- the mid-rise residential buildings adjacent to Wolli Creek Station.

Anticipated change to view

Due to the dense vegetation along and within the Wolli Creek riparian corridor which obstruct views to the rail corridor, the Proposal is not visible from this location.

Significance of visual effect

The Proposal is not visible from this visual receptor location, therefore there would be no significant effect on views from this location, arising from the Proposal.

Viewpoint 3 – apartments at 5-13 Lusty Street

This visual receptor location represents the views seen by residents from the mid-rise residential buildings adjacent to the Proposal and the rail corridor. **Table 6.13** summarises visual impacts seen by these receptors.

Table 6.13 Viewpoint 3 – apartments at 5-13 Lusty Street visual impact assessment

Viewpoint 3
<p>Existing view</p> <p>This view is taken from the level 1 courtyard at 5 - 13 Lusty Street, Wollli Creek. Key elements of the existing view comprise:</p> <ul style="list-style-type: none"> • the landscaped courtyard surrounded by hedging and solid fencing with the top of vegetation located within the rail corridor poking above the fencing in the foreground • mid to high-rise residential buildings to the north-east of the aboveground Wollli Creek Station platform in the background to the right of frame • from upper apartments, more distant views to the landscape would be seen, including the rail corridor itself, the riparian corridor, and parklands and residential buildings beyond.
<p>Anticipated change to view</p> <p>The substation has been specifically designed so as to not protrude above the 6.5 metre height of the existing fence along the rail corridor boundary of the level 1 courtyard and would therefore not be visible looking out from the courtyard. A small amount of taller vegetation in the rail corridor which is currently seen above the fencing and hedges around the courtyard would be removed, with this change seen from the courtyard.</p> <p>From upper apartments, the roof of the substation would be visible in the foreground, partially screening views to the existing rail corridor in the mid-ground. The extent of the roof that is visible would vary with the height of the apartment.</p>
<p>Sensitivity to change</p> <p>The receptors at this location comprise the residents of the mid-rise residential building at 5-13 Lusty Street.</p> <p>The sensitivity of the receptors would relate to the height of the receptor within the building, the existing quality of their view and the degree to which the proposed substation might be visible.</p> <p>From lower apartments the proposed substation would be partially obscured by the hedge along the perimeter of the level 1 courtyard area. Whilst the amount of the substation visible would increase with height, these higher receptors would also be subject to more expansive and panoramic views which would reduce the percentage of the view occupied by the substation, as well as providing greater interest in the mid to long distance, hence reducing the visual emphasis on the substation building.</p> <p>Whilst residents are typically a sensitive receptor group, views of the substation would be mitigated by the above factors, as well as the presence of the balcony, which would obstruct views for most people from within their apartment. In addition to this, residents are expected to be intermittently focused on the views below them, with their attention primarily focused on activities inside their apartment or far-field vistas.</p> <p>The value attached to views from this location would also be influenced by the fact that these views would be seen from their place of residence, with Wollli Creek (which is subject to a heritage listing) seen within the view.</p> <p>Based on the above factors, the sensitivity of the visual receptor at this location to the anticipated change in the view arising from the Proposal is considered to be <i>Moderate</i>.</p>
<p>Magnitude of change</p> <ul style="list-style-type: none"> • From the level 1 courtyard area of the apartments at 5-13 Lusty Street the built form of the Proposal would not be visible. A small number of existing narrow trees protruding above the fence and hedging would be removed during the construction phase • The operation of the substation would be long-term (50-60 years), with a low potential for reversibility • There would be no change to night-time views of the Proposal Area. <p>It is noted that the roof of the proposed substation would be visible, to varying degrees, as an additional element within the view from upper apartments depending on the specific location of the apartment within the building and the balcony arrangement. In addition to this, the proposed substation roof would potentially screen the views from some apartments to the existing rail corridor, including views of 'hard'</p>

Viewpoint 3

elements such as passing trains, electrical infrastructure, ballast and tracks. The view to the horizon would not be affected, nor the view to the creek corridor and the vegetation and parklands beyond.

Based on the above factors, the magnitude of impact of visual effects arising from the Proposal is considered to be *Low*.

Significance of visual effect

The Proposed substation would not be visible from the level 1 courtyard area. The removal of some taller vegetation currently seen above the existing fence and hedge would not result in a significant change to the existing view.

From upper apartments, the proposed substation roof would be seen to varying extents depending on the height and location of the apartment within the building and the balcony arrangement. While this would be a new element within the view, the proposed substation roof would not interrupt sight lines to the more picturesque elements of the view such as the creek corridor and parkland beyond, nor would it affect the view to the horizon. Views to the operational rail corridor (e.g. trains, tracks, overhead wiring etc.) would be partially screened from some of these upper apartments.

Based on the above factors, the significance of the visual effects arising from the Proposal on Viewpoint 3 would be *Moderate to Low (adverse)*.

An example photomontage outlining the view for residents in the upper apartments of 5-13 Lusty Street has been included to illustrate the degree of change to the view.

b) Airport Line tunnel, Green Square Station and Chalmers Street Substation

As the electrical feeders would be located underground, there would be no impact to urban design, landscape and visual amenity as a result of the operation of the Proposal.

6.2.4 Mitigation measures

The following mitigation measures would apply to the Proposal:

Design development

The following general mitigation measures are recommended to minimise visual impact of the Proposal:

- limit disturbance of vegetation to the minimum amount necessary to construct the Proposal
- offer a landscaping solution (e.g. tall hedge planting) within the private courtyard of the mid-rise residential apartments at 5-13 Lusty Street to reduce the visual impact of the proposed substation from upper apartments
- select a roof colour for the proposed substation to be visually recessive and in keeping with the surrounding vegetation. An olive green to dark grey selection would help the roof visually recede within the view seen from upper apartments in neighbouring buildings.

The following opportunities would increase the visual amenity of the Proposal as seen from surrounding locations:

- develop a landscape plan for the site of the demolished Undercliffe Substation, and the proposed traction substation. Cues for landscape design could be taken from nearby Wollie Creek riparian corridor. This would potentially partially screen views of the Proposal from the existing Wollie Creek platforms, decreasing the landscape visual impact
- consider a landscape restoration response to the edges of the rail corridor, particularly where it lies adjacent to the Wollie Creek riparian corridor
- consider measures to limit or deter graffiti on proposed structures.

Construction

The following mitigation measures are recommended to minimise visual impacts as a result of construction:

- establish Tree Protection Zones (TPZs) around trees to be retained. Tree protection would be undertaken in keeping with AS 4970-2009 Protection of Trees on Development Sites and would include exclusion fencing of TPZs
- provide well-presented and maintained construction hoarding and site fencing with shade cloth (or similar material) (where necessary) to minimise visual impacts on key view points during construction. Hoardings and site fencing would be removed following construction completion
- provide cut-off or directed lighting to be used with and outside of the construction site, with lighting location and direction considered to ensure glare and light spill is minimised
- construction personnel to keep the construction areas clean and tidy including refuse placed in appropriate receptacles
- measures taken to ensure no tracking of dirt and mud into public roads and other public spaces
- implement the landscape restoration plan as described in Section 8.1 of the LVIA.

Operation

The following mitigation measures are recommended to minimise visual impacts during operation:

- ongoing maintenance and repair of constructed elements.
- ongoing maintenance of vegetation, both surrounding and within the Proposal.
- removal of graffiti in accordance with Sydney Trains maintenance requirements.

All mitigation measures are to be incorporated into the CEMP. For a full list of additional mitigation measures, refer to **Section 7.2** and the Landscape Character and Visual Impact Assessment in **Appendix C**.

6.3 Noise and vibration

6.3.1 Methodology

A Noise and Vibration Impact Assessment **Appendix D** (AECOM, 2019b) was completed for the proposal and included the following scope:

- establish the noise management levels (NMLs) and vibration limits that would apply to the Proposal
- predict environmental noise and vibration levels at nearby residential and other sensitive receivers due to the construction and operation of the Proposal
- predict noise levels from additional off-site construction and operational traffic generated by the Proposal
- recommend mitigation measures, where necessary, to reduce and manage noise and vibration impacts from the Proposal to comply with established NMLs and vibration limits.

The findings of this assessment are summarised below.

In assessing the construction noise and vibration impacts of works at Green Square Station and Chalmers Street Substation, a simple construction noise and vibration assessment using the TfNSW Construction Noise Impact Estimator Tool was undertaken as the works would not exceed six weeks duration at either location.

An assessment of noise and vibration impacts as a result of works within the Airport Line tunnel has not been undertaken, as the Proposal within the Airport Line tunnel would not result in noise or vibration impacts, due to it being located underground and the works being low-intensity.

6.3.2 Existing environment

a) Wollli Creek

The Proposal is located predominately within the rail corridor in the area around Wollli Creek Station. The proposed Wollli Creek Substation would be located approximately 250 metres west of Wollli Creek Station, directly north of the property boundary with 5 - 13 Lusty Street, Wollli Creek. The Proposal is located about nine kilometres south west of the Sydney CBD, within the Bayside LGA.

The proposed Wollli Creek Substation is bounded by the T8 Airport Line to the north, with the waterway of Wollli Creek further north. The northern bank of the creek is parkland.

The area to the south of the Proposal is predominantly residential urban, with high density residential receivers surrounding the proposed Wollli Creek Substation and Wollli Creek Station, and low-density residential receivers to the north west.

The acoustic environment is considered to be dominated by typical urban noise, with road, rail and air traffic noise.

Receivers

Residential receivers potentially affected by the construction and operation of the Proposal have been identified within the Proposal Area and are presented in **Figure 6.3**. Receivers predominantly comprise multi-storey residential properties located within the suburb of Wollli Creek. The assessment of construction noise impacts has been undertaken for all residential receivers.

Unlike the assessment of noise impacts to receivers during construction, five residential receivers were chosen to provide a comprehensive assessment of noise impacts during the operational phase of the Proposal (**Table 6.14**). The residential properties located closest to the Proposal were selected as the potentially most affected receivers.

It is noted that there are other residential and non-residential sensitive receivers which could potentially be affected by the Proposal in the vicinity. However as noted above, noise impacts have been assessed at representative most-affected receivers.

Table 6.14 Representative residential receiver addresses

Receiver ID	Receiver address
R1	5-13 Lusty Street, Wollli Creek
R2	15-23 Lusty Street, Wollli Creek
R3	7 Mount Olympus Boulevard, Wollli Creek
R4	9 Brodie Spark Drive, Wollli Creek
R5	12 Unwin Street, Wollli Creek



Figure 6.3 Proposal overview

Unattended noise monitoring

The unattended noise measurements define the long-term noise environment throughout the Proposal Area and are used to define the construction and operational noise criteria.

Unattended noise monitoring was carried out from 5 July 2019 to 17 July 2019 at one location considered to be representative of the noise sensitive receivers within the Proposal Area. The noise monitoring location is shown graphically in **Figure 6.3** below and described in **Table 6.15**.

Table 6.15 Noise monitoring details

Address	Model	Serial number
5A Lusty Street, Wolli Creek	Rion NL-52	553967

A summary of the measured L_{A90} background noise levels and existing L_{Aeq} ambient noise levels is presented in **Table 6.16**.

Table 6.16 Existing background and ambient noise levels, dB(A)

Address	Rating background level, L_{A90} dB(A)			Ambient noise levels, L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
5A Lusty Street, Wolli Creek	43	43	38	58	58	54

Note: In accordance with the Noise Policy for Industry, time of day is defined as follows:

Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.

Evening – the period from 6 pm to 10 pm.

Night – the remaining periods.

Attended noise monitoring

Attended noise measurements are carried out to determine what noise sources contribute to the local noise environment. Attended noise monitoring was conducted on 17 July 2019. The measurement was completed over a 15-minute period. Weather conditions were clear on the day of monitoring, with no wind. The monitoring results from the attended measurements are presented in **Table 6.17**.

Table 6.17 Attended noise monitoring details

Address	Date	Time	Description	L_{Amax} , 15min dB(A)	L_{A10} , 15min dB(A)	L_{Aeq} , 15min dB(A)	L_{A90} , 15min dB(A)
5A Lusty Street, Wolli Creek	17/7/2019	13:27	Noise environment dominated by construction in the vicinity of the site and aircraft and train activity. Train horns at Wolli Creek Station 85 dB(A) L_{Amax} .	85	58	55	46

b) Green Square Station and Chalmers Street Substation

These areas are predominantly urban with most residential receivers located within close proximity to dense transportation, commerce and industry. At the Green Square Station section of the Proposal Area, the closest residential receiver is located at the corner of Botany Road and Bourke Street, approximately 80 metres from the trenching works.

At the Chalmers Street Substation section of the Proposal Area, the closest residential noise receivers are located along Cleveland Street, approximately 135 metres from the works. The roads in the area surrounding both of these sections are predominantly arterial or sub-arterial roads, with high traffic flows. The main source of noise around the Green Square Station section of the Proposal Area is likely to be generated from traffic movements and industrial noise. The main source of noise around the Chalmers Street Substation section of the Proposal Area is likely to be generated from train movements within the rail corridor.

6.3.3 Noise criteria

a) Wolli Creek

The EPA's *Interim Construction Noise Guideline* (ICNG) (Department of Environment and Climate Change (DECC), 2009) is the principal guideline for the assessment and management of construction noise in NSW. A quantitative assessment, based on likely construction scenarios, has been carried out for these works.

The ICNG recommends standard hours of construction as:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays and public holidays: no works.

For residential receivers, the ICNG recommends the following NMLs during standard construction hours: the applicable Rating Background Level (RBL) + 10 dB(A). Where NMLs are predicted to be exceeded the ICNG recommends feasible and reasonable measures to be implemented to minimise adverse impacts. Where construction noise levels reach 75 dB(A) at residences (during standard construction hours), residential receivers can be considered as 'highly noise affected' and the proponent may be required to consider restricting hours of very noisy works to provide respite periods.

Outside of recommended standard hours the ICNG recommends the following NMLs for residential receivers: the applicable RBL + 5 dB(A).

The ICNG recommends separate NMLs for non-residential sensitive receivers, which applies when the applicable receiver is in use.

The construction NMLs developed for the Proposal for residential, non-residential sensitive receivers and commercial and industrial receivers are listed in **Table 6.18**, **Table 6.19** and **Table 6.20** respectively.

Table 6.18 Construction NMLs – residential receivers

Period	RBL L_{A90} , dB(A)	Standard hours noise management levels, $L_{Aeq,15min}$, dB(A)	Out of hours noise management levels, $L_{Aeq,15min}$, dB(A)
Day	43	53	48
Evening	43	-	48
Night	38	-	43

Table 6.19 Construction NMLs – non-residential receivers

Land use	Noise management level, $L_{Aeq}(15 \text{ min})$
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended “maximum” internal levels in AS2107 for specific uses.

Table 6.20 Construction NMLs – commercial and industrial land uses

Land use	Noise management level, $L_{Aeq}(15 \text{ min})$
Industrial premises	External noise level 75 dB(A)
Offices, retail outlets	External noise level 70 dB(A)

Sleep disturbance criteria

The ICNG requires a sleep disturbance assessment to be undertaken where construction works are planned to extend over more than two consecutive nights. The ICNG makes reference to the EPA’s NSW *Environment Criteria for Road Traffic Noise* (ECRTN), now superseded by the NSW *Road Noise Policy* (RNP), for the assessment of sleep disturbance.

The guidance provided in the RNP for assessing the potential for sleep disturbance recommends that to minimise the risk of sleep disturbance during the night-time period (10pm to 7am), the $L_{A1}(1 \text{ min})$ noise level outside a bedroom window should not exceed the $L_{A90}(15 \text{ min})$ background noise level by more than 15 dB(A).

The EPA considers it appropriate to use this metric as a screening criterion to assess the likelihood of sleep disturbance. If this screening criterion is found to be exceeded then a more detailed analysis must be undertaken that should include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

Sleep disturbance noise goals have been established for residential receivers based on the RNP. Based on the Policy, the sleep disturbance criteria for the Noise Catchment Area are a screening level of 53 dB(A) $L_{A1}(1 \text{ minute})$ and an awakening reaction level of 65 dB(A) $L_{A1}(1 \text{ minute})$.

Construction traffic noise criteria

To assess noise impacts from construction traffic, an initial screening test has been undertaken by evaluating whether existing road traffic noise levels would increase by more than 2 dB(A). Where the predicted noise increase is 2 dB(A) or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2 dB(A), and the predicted road traffic noise level exceeds the road category specific criterion then noise mitigation should be considered for those receivers affected.

Construction vibration criteria

Vibration assessment criteria relate to human comfort (tactile vibration) and structural or building damage.

Structural damage to buildings

No Australian Standards exist for the assessment of building damage caused by vibration at present. The German standard (DIN 4150) provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are presented in **Table 6.21**. DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage.

Table 6.21 DIN 4150: Structural damage safe limits for building vibration

Group	Type of structure	At foundation - Less than 10 Hz	At foundation - 10 Hz to 50 Hz	At foundation - 50 Hz to 100 Hz ¹	Vibration at the horizontal plane of the highest floor for all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order/heritage listed)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

- Note 1: At frequencies above 100 Hz, the values given in this column may be used as minimum values.

Human comfort

The assessment of intermittent vibration outlined in the NSW EPA guideline *Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation (DEC), 2006) is based on Vibration Dose Values (VDVs). The VDV accumulates the vibration energy received over the daytime and night-time periods.

Maximum and preferred VDV for intermittent vibration arising from construction activities are listed in **Table 6.22**. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

Table 6.22 Preferred and maximum vibration dose values for intermittent vibration (m/s^{1.75})

Location	Daytime ¹ Preferred	Daytime Max	Night time Preferred	Night time Max
Critical areas (examples include hospital operating theatres and precision laboratories where sensitive operations are occurring)	0.1	0.2	0.1	0.2
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions, commercial premises and places of worship	0.4	0.8	0.4	0.8
Workshops or factory environments	0.8	1.6	0.8	1.6

Note 1: Day is defined as 7:00 am to 10:00 pm. Night is defined as 10:00 pm to 7:00 am.

Operational noise criteria

Intrusive noise levels

The *Noise Policy for Industry* (EPA, 2017) (NPfl) states that the intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (L_{Aeq} level), measured over a 15 minute period, does not exceed the RBL measured by more than 5 dB(A). The RBL is the background noise level to be used for assessment purposes and is determined by the methods given in Fact Sheet B of the NPfl.

The intrusiveness noise levels applicable to the Proposal are presented in **Table 6.23**.

Table 6.23 Intrusiveness noise levels

Period	RBL L_{A90} , dB(A)	Intrusiveness noise level (RBL + 5), dB(A)
Day	43	48
Evening	43	48
Night	38	43

Notes: In accordance with the NPfl, time of day is defined as follows:

Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.

Evening – the period from 6 pm to 10 pm.

Night – the remaining periods.

Protecting noise amenity

To limit continuing increases in noise levels, the maximum ambient noise level resulting from all industrial noise sources in an area should not normally exceed the acceptable levels specified in Table 2.2 of the NPfl. As per the definitions of receiver types in Table 2.3 of the NPfl, residential receivers likely to be affected by noise from the operation of the facility are classed as being urban.

The project amenity noise level is equal to the recommended amenity level minus 5 dB(A). In addition, the project amenity $L_{Aeq(15min)}$ level is converted to an $L_{Aeq(15min)}$ period by adding 3 dB(A). Therefore, the relevant project noise amenity level for each applicable type of receiver is shown below in **Table 6.24**.

Table 6.24 Recommended L_{Aeq} noise levels from industrial noise sources

Type of receiver	Indicative noise amenity area	Period	Recommended amenity noise level, $L_{Aeq(15min)}$	Project amenity noise level, $L_{Aeq,15min}$
Residential	Urban	Day	60	58
		Evening	50	48
		Night	45	43
School classroom	All	Noisiest 1-hour period when in use	45 ¹	43
Place of worship	All	When in use	50 ¹	48
School playground	All	When in use	55	53
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50	48
Commercial premises	All	When in use	65	63

Note 1: External noise levels are based on a 10 dB(A) reduction from outside to inside through an open window.

Project noise level trigger levels

The project noise trigger level is the lower of the intrusiveness and the amenity noise levels. Provided in **Table 6.25** are the established project noise trigger levels for the assessment locations within the Proposal Area. The table presents the project noise trigger levels for the day, evening and night-time periods.

Table 6.25 Operational noise criteria

Type of receiver	Assessment Period	Intrusive noise levels, $L_{Aeq,15min}$	Amenity noise levels, $L_{Aeq,15min}$	Project noise trigger levels, $L_{Aeq,15min}$
Residential urban	Day	48	58	48
	Evening	48	48	48
	Night	43	43	43
School classroom - internal	Noisiest 1-hour period when in use	-	43	43
School playground	When in use	-	53	53
Area specifically reserved for passive recreation (e.g. national park)	When in use	-	48	48
Place of worship - internal	When in use	-	48	48
Commercial premises	When in use	-	63	63

Tonality

The NPfl requires a penalty for noise characteristics such as tonality, impulsiveness, intermittency, irregularity or low frequency content. Specifically, the penalty is “to be applied to the noise from the source predicted at the receiver”.

The NPfl provides additional guidance and criteria for assessing noise emission from sources defined as ‘tonal’ or ‘low-frequency’. Of significance to substation noise is that penalties of up to 5 dB(A) may be applied where the subject noise emission is tonal or has significant low frequency content at the receiver.

A tonal penalty is applied when the level of a one-third octave band exceeds the level of each adjacent band by:

- 5 dB(A) or more if the centre frequency of the band containing the tone is between 500 Hz and 10,000 Hz
- 8 dB(A) or more if the centre frequency of the band containing the tone is between 160 Hz and 400 Hz
- 15 dB(A) or more if the centre frequency of the band containing the tone is between 25 Hz and 125 Hz

A low frequency noise penalty is applied when the difference between the C and A weighted noise levels is 15 dB or more and:

- where any of the one-third octave noise levels in **Table 6.26** are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period
- where any of the one-third octave noise levels in **Table 6.26** are exceeded by more than 5 dB and cannot be mitigated, a 5 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2 dB(A) positive adjustment applies for the daytime period.

Table 6.26 One-third octave low-frequency noise thresholds

Hz/dB (Z)	One-third octave $L_{Zeq(15\ min)}$ threshold level												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Frequency (Hz)													
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The maximum adjustment is 10 dB(A) where the noise contains two or more modifying factors (excluding the duration correction).

Maximum noise level assessment

The NPfl requires the potential for sleep disturbance to be assessed by considering maximum noise level events during the night-time period.

Where the subject development/premises night-time noise levels at a residential location exceed the following screening levels a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in **Table 6.27**.

Table 6.27 Night-time sleep disturbance screening levels

Type of receiver	Measured night-time RBL, $L_{A90,15min}$, dB(A)	Sleep disturbance screening levels	
		$L_{Aeq,15min}$	L_{AFmax}
Residential	38	43	53

b) Green Square Station and Chalmers Street Substation

The background noise levels for the Green Square Station and Chalmers Street Substation sections of the Proposal Area were estimated using Appendix B of the CNVS. The resulting noise management levels (NMLs) from this classification are shown below in **Table 6.28**.

Table 6.28 Construction noise management levels, residential receivers

Period	Estimated background noise level, dB(A)	Noise Management level, dB(A)
Standard hours - Day	55	65
Out of hours – Day	55	60
Out of hours - Evening	50	55
Out of hours - Night	45	50
Residential “highly affected level” (HAL)	N/A	75

6.3.4 Potential impacts

Construction phase

a) Wollli Creek

Predicted construction noise levels

In order to assess noise impacts from the site during construction, a noise model was created to represent a conservative worst case scenario. Construction noise was modelled in SoundPLAN Version 8.0, with the model being based on ground topography, ground absorption and reflection, receivers and from the use of plant and equipment listed in **Section 3.2.2**.

A summary of the number of receivers where construction noise levels are predicted to exceed NMLs during the loudest construction stages are presented for standard hours construction activities in **Table 6.29** and for out-of-hours construction activities in **Table 6.30**.

The results presented in **Table 6.29** show that there is a very limited number of exceedances of the relevant NMLs during the daytime. During standard construction hours, there are up to six receivers where noise levels are anticipated to exceed the NMLs by more than 10 dB(A), and two receivers are expected to be considered highly noise affected (>75 dB(A)).

The results presented in **Table 6.30** show that during the night-time, noise levels at a large number of receivers are predicted to exceed the NMLs. Noise levels at up to 131 receivers are predicted to exceed the NMLs in the worst-case decommissioning scenario. This is due to the high noise levels associated with this activity, in addition to the low NMLs applicable during the night-time.

It is important to consider that this assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to each sensitive receiver location. The assessed scenario does not represent the ongoing day to day noise impact at noise sensitive receivers for an extended period of time.

Particularly noisy activities, such as piling, are likely to persist for only a portion of the overall construction period.

Table 6.29 Predicted construction noise impacts for residential receivers – Daytime

Construction scenario	NML (dB(A))	Number of receivers where noise levels >10 dB(A) above NML	Number of highly noise affected receivers where noise levels ≥75 dB(A)
Proposed Wollli Creek Substation	53	2	1
Decommissioning of Wollli Creek Sectioning Hut and Undercliffe Substation	53	1	1
Upgrade of vehicle access to new Wollli Creek Substation	53	0	0

Table 6.30 Predicted construction noise impacts for residential receivers – Night-time

Construction scenario	NML (dB(A))	Number of receivers where noise levels may exceed the NML			
		NML exceedance <5 dB(A)	NML exceedance 5-14 dB(A)	NML exceedance 15-25 dB(A)	NML exceedance >25 dB(A)
Proposed Wolli Creek Substation	43	70	22	3	2
Decommissioning of Wolli Creek Sectioning Hut and Undercliffe Substation	43	95	32	3	1
Upgrade of vehicle access to new Wolli Creek Substation	43	9	6	0	0

Sleep disturbance assessment

Sleep disturbance is assessed using an $L_{A1(1min)}$ parameter, which is considered to be the maximum noise level excluding extraneous noise events. A sleep disturbance assessment has been undertaken for the proposed night works with the construction information available to date. The noise modelling results are provided in **Table 6.31** below with predicted noise levels compared with the sleep awakening reaction criterion.

A number of exceedances of the sleep disturbance screening criteria have been predicted due to the potential night-time construction works associated with the Proposal. Noise associated with construction works are anticipated to exceed the awakening reaction criteria for a small number of receivers, with noise levels at up to five receivers exceeding the awakening reaction criterion. These exceedances are attributed to the proximity of the construction site to residences located along Lusty Street.

Table 6.31 Predicted $L_{A1(1min)}$ sleep disturbance impacts at residential receivers

Construction scenario	Sleep disturbance criteria, dB(A)	Sleep disturbance awakening reaction $L_{A1(1min)}$ criteria, dB(A)	Maximum $L_{A1(1min)}$ noise level, dB(A)	Number of receivers where noise levels exceed	
				Sleep disturbance criteria	Awakening reaction criteria
Proposed Wolli Creek Substation	53	65	99	216	24
Decommissioning of Wolli Creek Sectioning Hut and Undercliffe Substation	53	65	100	32	4
Upgrade of vehicle access to Proposed Wolli Creek	53	65	72	18	2

Construction scenario	Sleep disturbance	Sleep disturbance	Maximum LA1(1min)	Number of receivers where noise levels exceed
Substation				

Construction traffic assessment

For the construction traffic noise assessment indicative construction vehicle movements have been used in the absence of detailed vehicle movements.

Traffic counts for the existing AM peak (8am – 9am) and PM peak (5pm – 6pm) traffic flows have been sourced from a survey in a previous assessment completed for Rockdale City Council titled ‘*Wolli Creek and Bonar Street – Traffic Study*’ dated August 2013. These values have been converted to daytime (15 hour) and night-time (9 hour) traffic volumes. This conversion assumed the peak hour traffic flow is 11 percent of the daily 24-hour traffic volume, and 88 percent of the daily 24-hour traffic volume occurs during the 15 hour day (7am to 10pm) period whilst the remaining 12 percent of vehicles travel during the 9 hour night-time (10pm to 7am) period. These volumes are presented in **Table 6.32** below. The survey was conducted in 2012 and traffic flows have been increased based on an annual growth rate of 0.05 percent as stated in the traffic study report. It has also been assumed that current traffic consists of 3 percent heavy vehicles during the daytime and night-time.

The following construction traffic movements were conservatively used:

- 70 light vehicle movements during the daytime and night-time periods
- 30 heavy vehicle movements during the daytime and night-time periods.

It is not likely that the number of vehicles would exceed 10 light vehicles and 20 heavy vehicles per day or night during peak construction periods, however a more conservative criteria was used to account for unexpected occurrences of increased vehicles numbers.

Table 6.32 Existing traffic flows and additional traffic flows due to construction traffic

Road	Period	Existing traffic flow		Additional traffic flow		Relative noise increase, dB(A)
		Light	Heavy	Light	Heavy	
Bonar Street and Guess Avenue	Daytime	4,046	121	70	30	0.3
	Night-time	552	17	70	30	1.9

The results indicate that the predicted noise increases are expected to be lower than the 2 dB(A) screening criteria presented in the RNP. As a result, no further consideration of construction traffic is required at this stage.

Construction vibration assessment

Vibration intensive work has the potential to occur as part of the construction work. Work may include the use of jackhammers and piling activities.

Typical minimum distances for the construction equipment that may be part of this Proposal are provided in **Table 6.33**. Minimum working distances have been developed to meet the recommended levels of vibration in British Standard 6472-1992 and DIN 4150 and are based upon the safe working distances presented in TfNSW’s CNVS and AECOM’s library of vibration data.

Minimum working distances should be adhered to when operating vibration intensive equipment near buildings in order to minimise the risk of discomfort to occupants and structural damage.

Table 6.33 Recommended minimum working distances for vibration intensive equipment

Equipment	Rating/description	Minimum working distance (metres)	
		Cosmetic damage ¹	Human response
Jackhammer	Hand held	1 metres (nominal)	Avoid contact with structure
Piling rig - hammer	12t down force	15 metres	50 metres

Note 1: More stringent conditions may apply to heritage or other sensitive structures.

The minimum working distances presented in **Table 6.33** assume individual items of plant would be operating independently. Concurrent operation of vibration intensive equipment should be avoided, however if it is necessary to operate multiple items of equipment concurrently close to the safe working distance then vibration monitoring is recommended.

The minimum working distances for cosmetic damage are generally considered to be conservative and working within them would not necessarily result in damage. However, factors such as work practices and intervening ground conditions can affect vibration levels. As vibration intensive activities are anticipated to occur within these minimum working distances, vibration monitoring is recommended and should be carried out at the beginning of the work in order to refine the safe working distances for site specific conditions.

b) Green Square Station

In order to assess noise impacts from the site during construction, the worst case construction scenario has been assessed through TfNSW's Construction Noise Impact Estimator Tool. It is important to consider that this assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to the nearest sensitive receiver location. The assessed scenario does not represent the ongoing day to day noise impact at noise sensitive receivers for an extended period of time. It has also assumed that all equipment would be operating simultaneously, which is unlikely to occur and hence a conservative assumption.

The Construction Noise Impact Estimator Tool estimates that the predicted noise level at the nearest sensitive receiver would be approximately 70 dB(A). In relation to the estimated background noise level for works carried out during the day, evening and night, this would be an exceedance of 15 dB(A), 20 dB(A) and 25 dB(A) respectively. In addition, the Construction Noise Impact Estimator Tool estimates that the predicted noise level would exceed the daytime NML (65 dB(A)) for all receivers within 150 metres of the works.

The works would occur over a limited duration, and are likely to be less intensive than the conservative estimates used for this assessment. With the implementation of the mitigation measures in **Section 6.3.5** the overall construction noise impact at Green Square Station would not be significant.

c) Chalmers Street Substation

In order to assess noise impacts from the site during construction, the worst case construction scenario has been assessed through TfNSW's Construction Noise Impact Estimator Tool. It is important to consider that this assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to the nearest sensitive receiver location. The assessed scenario does not represent the ongoing day to day noise impact at noise sensitive receivers for an extended period of time. It has also assumed that all equipment would be operating simultaneously, which is unlikely to occur and hence a conservative assumption.

The Construction Noise Impact Estimator Tool estimates that the predicted noise level at the nearest sensitive receiver would be approximately 66 dB(A). In relation to the estimated background noise level for works carried out during the day, evening and night, this would be

an exceedance of 11 dB(A), 16 dB(A) and 21 dB(A) respectively. In addition, the Construction Noise Impact Estimator Tool estimates that the predicted noise level would exceed the NML (65 dB(A)) for all receivers within 150 metres of the works.

The works would occur over a limited duration, and are likely to be less intensive than the conservative estimates used for this assessment. With the implementation of the mitigation measures in **Section 6.3.5** the overall construction noise impact at Chalmers Street Substation would not be significant.

Operational phase

a) Wollli Creek

Operational noise emissions associated with the operation of the Proposal were assessed in accordance with the NPfl. Noise levels were predicted at nearby receiver locations based on typical operational noise sources from similar substation facilities. The typical scenarios were modelled to assess the potential for noise emissions to affect nearby sensitive receiver locations and achieve the required project noise trigger levels presented in **Table 6.25**. The predicted noise levels are presented below for 'reasonable' worst case night-time operations.

Noise modelling methodology

Both standard and noise-enhancing meteorological conditions were considered in accordance with the NPfl, with the following parameters:

Night-time

- standard meteorological conditions – Pasquill stability class D with wind speed up to 0.5 m/s at 10 metres
- noise-enhancing meteorological conditions – Pasquill stability class D with wind speed up to 3 m/s at 10 metres, and/or stability category F with winds up to 2 m/s at 10 metres.

The modelling includes:

- ground topography
- buildings and structures
- all identified noise producing items within the project site modelled as point or line sources where appropriate
- all sources are modelled to assume a 'reasonable' worst case 15-minute period scenario
- ground absorption.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the equipment and other noise sources.

All predicted noise levels are free field and at the most-affected point within a residential property boundary within 30 metres of the nearest facade.

Noise sources modelled

The operational equipment are generally categorised as steady-state or quasi steady-state noise sources which typically produce continuous and consistent noise levels. The operation of the substation equipment is expected to be consistent throughout the daytime, evening and at night.

To undertake the operational noise assessment in accordance with the NPfl, the future operations were considered for the night-time periods. This scenario has been assumed to represent 'reasonable' worst case operational conditions.

The major noise sources that have been considered for the operation of the new substation are detailed in **Table 6.34**.

Table 6.34 Substation equipment reference noise levels

Source	Sound power level (SWL), dB(A)
5.35 MVA Rectifier Transformer	68 L _{Aeq} ¹
DC Rectifier	<58 L _{Aeq} ²
Reactor	71 L _{Aeq} ²
9 MVA Transformer	71 L _{Aeq} ¹

Notes:

- 1 Sound Power Level (SWL) calculated in accordance with reduced maximum noise levels provided in AS60076.10.1:2009 considering the transformer capacity.
- 2 SWL based on equipment on similar substations projects.

Given that the L_{A1} sleep disturbance criterion is 10 dB less stringent than the project noise trigger level, compliance with the project noise trigger level will result in compliance with the sleep disturbance criteria. Therefore, no further consideration has been given to the sleep disturbance assessment.

Noise modelling results

A summary of the predicted operational noise impacts associated with the operation of the Proposal is presented for the night-time in **Table 6.35**.

Table 6.35 Summary of predicted noise levels for night time operations

Receiver location	Project noise trigger level, dB(A)	Predicted L _{Aeq} noise level, dB(A)	
		Standard meteorological conditions	Noise-enhancing meteorological conditions
R1 - 5-13 Lusty Street, Wollli Creek	43	48	48
R2 - 15-20 Lusty Street, Wollli Creek	43	37	37
R3 - 7 Mount Olympus Boulevard, Wollli Creek	43	36	36
R4 - 9 Brodie Spark Drive, Wollli Creek	43	25	25
R5 - 12 Unwin Street, Wollli Creek	43	12	15

The maximum adjustment for annoying characteristics is 10 dB where the noise contains two or more modifying factors (excluding the duration correction). Based on spectral noise levels for typical transformers, the proposed substation may be tonal and low frequency and therefore attracts a 10 dB adjustment.

Considering tonality and low frequency adjustments, it can be seen in **Table 6.35** that the noise levels are predicted to exceed the project noise trigger level for the residential receivers at 5-13 Lusty Street, Wollli Creek. A number of mitigation options are available to address the predicted noise exceedances from the operation of the new substation, which are described below in **Section 6.3.5**.

It is likely that the noise emissions from the Project will comply for all non-residential receivers at greater distances.

b) Green Square Station and Chalmers Street Substation

The operational phase of the Proposal at these locations would not result in additional noise impacts.

6.3.5 Mitigation measures

Detailed design phase

- it is recommended that the noise emissions of the substation be reviewed once the final equipment selections have been made during detailed design
- the tonal characteristics of the proposed equipment should be considered at the detailed design stage.
- the noise generating equipment and the equipment sound power levels should be confirmed at the detailed design stage.

Construction phase

- a Construction Noise and Vibration Management Plan (CNVMP) should be developed for the Proposal and implemented prior to commencement of construction activities. The CNVMP should include all feasible and reasonable safeguards to manage the noise emissions from the site and any complaints which may occur due to construction noise. The CNVMP should include, as a minimum, the following:
 - identification of nearby residences and other sensitive land uses
 - description of approved hours of work
 - description and identification of all construction activities, including work areas, equipment and duration
 - description of what work practices (generic and specific) would be applied to minimise noise and vibration
 - a complaints handling process
 - noise and vibration monitoring procedures, including for heritage structures
 - overview of community consultation required for identified high impact works.
 - construction works should be planned and carried out during standard construction hours wherever possible. The standard mitigation measures contained within the *Construction Noise and Vibration Strategy* (TfNSW, 2019) will be considered as mitigation measures as part of the CNVMP
- wherever practical, piling activities shall be completed using non-percussive piles. If impact (i.e. percussive) piles are proposed to be used, approval from TfNSW should be obtained prior to commencement of impact piling activities
- all residents and sensitive receivers affected by noise levels from the Proposal which are expected to exceed the NML should be consulted prior to the commencement of the particular activity, with the highest consideration given to those that are predicted to be most affected as a result of the works. The information provided to the receivers would include:
 - programmed times and locations of construction work
 - the hours of proposed works
 - construction noise and vibration impact predictions
 - construction noise and vibration mitigation measures being implemented on site.

- community consultation regarding construction noise and vibration would be detailed in a Community Liaison Management Plan for the construction of the Proposal and would include a 24 hour hotline and complaints management process
- TfNSW's CNVS provides practical guidance on how to minimise, to the fullest extent practicable, the impacts on the community from airborne noise, ground-borne noise and vibration generated during the construction of TfNSW projects. This is managed through the application of all feasible and reasonable mitigation measures. Where exceedances are still expected to occur after standard mitigation measures have been applied, the CNVS recommends the implementation of additional mitigation measures. These mitigation measures are specified within the CNVS and presented in **Table 6.36** and **Table 6.37**.

Table 6.36 How to implement additional airborne noise management levels

Construction hours	Receiver perception	dB(A) above RBL	dB(A) above NML	Additional management measures
Standard hours Monday-Friday (7am-6pm) Saturday (8am-1pm)	Noticeable	5 to 10	0	-
	Clearly audible	> 10 to 20	< 10	-
	Moderately intrusive	> 20 to 30	> 10 to 20	PN, V
	Highly intrusive	> 30	> 20	PN, V
	75 dB(A) or greater	N/A	N/A	PN, V, SN
OOHW Period 1 Monday-Friday (6pm-10pm) Saturday (7am-8am, 1pm-10pm) Sunday/PH (8am-6pm)	Noticeable	5 to 10	< 5	-
	Clearly audible	> 10 to 20	5 to 15	PN
	Moderately intrusive	> 20 to 30	> 15 to 25	PN, V, SN, RO
	Highly intrusive	> 30	> 25	PN, V, SN, RO, RP#, DR#
OOHW Period 2 Monday-Saturday (12am-7am, 10pm-12am) Sunday/PH (12am-8am, 6pm-12am)	Noticeable	5 to 10	< 5	PN
	Clearly audible	> 10 to 20	5 to 15	PN, V
	Moderately intrusive	> 20 to 30	> 15 to 25	PN, V, SN, RP, DR
	Highly intrusive	> 30	> 25	PN, V, SN, AA, RP, DR

Notes: PN = Project notification
V = Verification monitoring
RP = Respite period
AA = Alternative accommodation

SN = Specific notification, individual briefings, or phone call
DR = Duration respite
RO = Respite specific respite order

* SWLs used for the purpose of estimating noise impact shall be increased by 5 dB(A) where works will include: power saws for the cutting of timber, masonry & steel; grinding of metal, concrete or masonry; rock/line drilling; bitumen milling & profiling; jack hammering, rock hammering & rock breaking; or impact piling as a correction factor for noise with special audible characteristics.

Respite periods and duration reduction are not applicable when works are carried out during OOHW Period 1 Day only (i.e. Saturday 6am-7am & 1pm-6pm, Sundays / Public Holidays 8am-6am).

Table 6.37 How to implement additional vibration management measures

Construction hours	Receiver perception	Above VML	Additional management measures
Standard hours Monday-Friday (7am-6pm)	Human disturbance	Above human disturbance management level	PN, V, RO
	Building damage	Above cosmetic damage management level	V, AC
Saturday (8am-1pm)	Building damage	Above cosmetic damage management level	V, AC
OOHW Period 1 Monday-Friday (6pm-10pm)	Human disturbance	Above human disturbance management level	PN, V, SN, RO, RP, DR
	Building damage	Above cosmetic damage management level	V, AC
	Saturday (7am-8am, 1pm-10pm)	Building damage	Above cosmetic damage management level
Sunday/PH (8am-6pm)	Building damage	Above cosmetic damage management level	V, AC
OOHW Period 2 Monday-Saturday (12am-7am, 10pm-12am)	Human disturbance	Above human disturbance management level	PN, V, SN, RO, AA, RP, DR
	Building damage	Above cosmetic damage management level	V, AC
	Sunday/PH (12am-8am, 6pm-12am)	Building damage	Above cosmetic damage management level

Notes: PN = Project notification
V = Verification monitoring
RP = Respite period
AA = Alternative accommodation

SN = Specific notification, individual briefings, or phone call
DR = Duration respite
RO = Project specific respite order
AC = Alternative construction methodology

Operational phase

As discussed above, the final equipment selections have not been made and equipment noise levels were determined using Australian Standard AS60076.10.1:2009 Power transformers Determination of sound levels - Application guide and noise levels used on similar developments. Given that the predicted noise level exceeds the project noise trigger levels in **Table 6.25** by 5 dB at 5-13 Lusty Street, Wollie Creek, the final equipment selections of the reactor and transformers should be selected with a sound power level 5 dB lower than the noise levels present in **Table 6.34**.

Alternatively, the transformers and reactors should be selected with units that do not attract either the low frequency or tonality penalties specified in the NPfl.

Given that the predicted noise level exceeds the project noise trigger levels at 5-13 Lusty Street, Wollie Creek presented in **Table 6.25** by 5 dB:

- the project noise trigger levels could be achieved by providing barriers that break line of sight to the affected receivers at 5-13 Lusty Street. The barriers would be most effective if located as near as possible to the noise generating equipment
- the transformers and reactors could be enclosed by an acoustic enclosure which provides 5 dB reduction. The enclosure would need to break line of sight to the receivers at 5-13 Lusty Street, Wollie Creek. An enclosure may consist of acoustically sealed walls, roof and architectural louvres (facing away from 5-13 Lusty Street, Wollie Creek) and absorptive treatment to the internal walls.

6.4 Indigenous heritage

6.4.1 Methodology

A due diligence assessment was undertaken for the Proposal in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010). An Aboriginal Heritage Information Management System (AHIMS) basic search was undertaken for the Wollie Creek, Green Square Station and Chalmers Street Substation sections of the Proposal Area. Where those searches identified Indigenous heritage items, an extensive search was undertaken for the area covered by the Proposal at those sections.

6.4.2 Existing environment

The nature and distribution of Aboriginal archaeological materials are closely connected to the environments in which they occur. Environmental variables such as topography, geology, hydrology and the composition of local floral and faunal communities will have played an important role in influencing how Aboriginal people moved within and utilised their respective Country.

Amongst other things, these variables will have affected the availability of suitable campsites, drinking water, economic plant and animal resources and raw materials to produce stone and organic implements. Consideration of those variables is provided for each section of the Proposal Area. In addition, certain landscape features, such as nearby waterways, sand dune systems, ridge tops, ridge lines, headlands, cliff faces and rock caves/shelters, can indicate the likely presence of Indigenous objects.

Wollie Creek

The Proposal Area at Wollie Creek and the surrounding area includes landscape features and terrain considered to be indicative of the potential presence of Aboriginal objects including:

- watercourses (Wollie Creek and Cooks River)
- geology – the presence of Hawkesbury Sandstone to the south and west of the Proposal Area at Wollie Creek. Sandstone outcrops and overhangs were often utilised by Indigenous peoples, resulting in the presence of grinding grooves, engraving, art and rock shelter sites.

In addition, a review of the existing environment at the Wollie Creek section of the Proposal Area was undertaken. Key observations to be drawn from this review are as follows:

- prior to European occupation, the permanency of potable water sources is likely to have played an important role influencing the nature and duration of Indigenous activity in this area. Proximity to the Cooks River suggests this location would have been well resourced and therefore has the potential to have been utilised
- original native vegetation has been cleared from the Proposal Area due to the rail developments at this location. As old growth trees with the potential for cultural modification have been removed during the past clearance activities it is unlikely that scarred or carved trees will be present within the Proposal Area
- the Proposal Area has been subject to a range of historic and recent land use impacts. As the current Proposal Area consists of heavily modified terrain, it is unlikely that sites and deposits will be extant.

Local Archaeological Context

The Aboriginal Heritage Information Management System (AHIMS) database, administered by DPIE, contains records of all Aboriginal objects reported to the Chief Executive of the Environment, Energy and Science Group of the DPIE in accordance with Section 89A of the NPW Act. It also contains information about Aboriginal places, which have been declared by

the Minister to have special significance with respect to Aboriginal culture. Previously recorded Aboriginal objects and declared Aboriginal places are known as 'Aboriginal sites'.

A search of the AHIMS database on 22 October 2019 centred on the Proposal Area was carried out. The search was undertaken using the AHIMS basic search tool, which identified four (one duplicate) registered Aboriginal sites recorded within the search area. As a result of that search, a further search using the AHIMS extensive search tool was undertaken. That search clarified the details of those registered Aboriginal sites identifying them as follows:

- 45-6-2737: Artefact; Potential Archaeological Deposit (PAD) - located approximately 180 metres southeast from the nearest part of the Proposal Area
- 45-6-2198/45-6-2538: Shell; Artefact within a midden - located approximately 93 metres north east from the nearest part of the Proposal Area, on the opposite side of the Cooks River
- 45-6-2547: Artefact within an open camp site - located approximately 273 metres north west from the nearest part of the Proposal Area on the opposite side of Wolli Creek
- 45-6-0615 (closed site): Shell; artefact; art (pigment or engraved) within a midden/shelter with art - located approximately 600 metres north west from the nearest part of the Proposal Area on the opposite side of Wolli Creek.

The locations of those sites were verified based on data on the site cards for those sites.

Airport Line tunnel

The Proposal Area within the Airport Line tunnel exists within a heavily modified and excavated tunnel. The tunnelling and construction activities undertaken to establish the tunnel suggest that the existence of items of Aboriginal heritage within the tunnel would be unlikely.

A search of the AHIMS database is not considered to be necessary for the Proposal within the Airport Line Tunnel as a result of the heavily disturbed nature of the tunnel, and that excavations within the tunnel would not occur.

Green Square Station

The Proposal Area at Green Square Station does not contain landscape features that would be indicative of Indigenous objects. The Proposal near Green Square Station is therefore not considered to be located within a high-risk landscape for Aboriginal heritage potential. The extensive landscape modification and high level of disturbance that has occurred due to the urbanisation of the area, including the provision of underground infrastructure such as the Airport Line tunnel suggests that the presence of culturally sensitive buried items is unlikely within the boundaries of the Proposal.

Notwithstanding, a search of the AHIMS database on 22 October 2019 centred on the Proposal Area was carried out. The search was undertaken using the AHIMS basic search tool, which identified no registered Aboriginal sites within the search area.

Chalmers Street Substation

The Proposal Area at Chalmers Street Substation is a heavily modified urban landscape, within an active rail corridor and within close proximity to the entrance of the Airport Line tunnel. Landscape features indicative of the occurrence of Indigenous objects are not present in this location. The Proposal Area near Chalmers Street Substation is therefore not considered to be within a high-risk landscape for Indigenous heritage potential. Although it is not located within a high-risk landscape, the presence of Indigenous objects cannot be completely excluded.

A search of the AHIMS database on 22 October 2019 centred on the Proposal Area was carried out. The search was undertaken using the AHIMS basic search tool, which identified one registered Aboriginal site recorded within the search area. As a result of that search, a

further search using the AHIMS extensive search tool was undertaken. That search clarified the details of the registered Aboriginal site identifying it as follows:

- 45-6-3654: Artefact - located approximately 125 metres north west from the nearest part of the Proposal Area.

The locations of this site was verified based on data on the site cards for this site

6.4.3 Potential impacts

Construction phase

a) Wollie Creek Station

During the construction phase of the Proposal at Wollie Creek, shallow excavation and minor ground disturbance activities would be undertaken. These include:

- trenching for cabling works
- excavation for the construction of the proposed access road and retaining wall
- excavation for the proposed substation.

The works occurring at the Wollie Creek section of the Proposal Area are located at moderate distances from each of the registered Aboriginal sites listed in **Section 6.4.1**. Further, tangible barriers such as Brodie Sparks Drive, Cooks River and Wollie Creek exist between work areas and the relevant registered Aboriginal heritage sites. Accordingly, it is unlikely that the works at this location would affect any of these registered sites.

In addition, as the Proposal Area is located within a highly modified area within an active rail corridor, the potential for encountering and subsequently affecting unidentified items of Indigenous heritage is considered to be low. Notwithstanding, the management measures listed in **Section 6.4.4** would be implemented should previously unidentified Indigenous objects be found during construction.

b) Airport Line tunnel

Excavation would not be required in the Airport Line Tunnel therefore the works would not result in an impact to items of Indigenous heritage.

c) Green Square Station

During the construction phase of the Proposal at Green Square Station, shallow excavation and minor ground disturbance activities such as trenching would be undertaken.

No registered Aboriginal heritage sites were identified in the vicinity of Green Square Station. The works at this location would therefore not have an impact upon registered Aboriginal Heritage sites.

As the Proposal Area is located within a highly modified urban area, the potential for encountering and subsequently affecting unidentified items of Indigenous heritage is considered to be low. Notwithstanding, the management measures listed in **Section 6.4.4** would be implemented should unidentified Indigenous objects be found during construction.

d) Chalmers Street Substation

During the construction phase of the Proposal at Chalmers Street Substation, shallow excavation and minor ground disturbance activities such as trenching would be undertaken.

The works occurring at this location are being undertaken at a moderate distance from the registered Aboriginal heritage site listed in **Section 6.4.1**. Tangible barriers between the registered Aboriginal heritage site and the works exist in the form of railway tracks, bridges, buildings and an unsealed vehicle access route. Accordingly, it is unlikely that the works at the Chalmers Street Substation section of the Proposal Area would affect that registered site.

In addition, as the Proposal Area is located within a highly modified area of an active rail corridor, the potential for encountering and subsequently affecting unidentified items of Indigenous heritage is considered to be low. Despite this, Aboriginal heritage item No. 45-6-3654 was identified within the rail corridor at a depth of approximately 1.5 metres below ground level within the undisturbed sand sheet layer. Although works would not be undertaken at a depth of 1.5 metres, if the undisturbed sand sheet is encountered, there is a chance that previously unidentified items of Aboriginal heritage would be identified. Should this occur, the management measures listed in **Section 6.4.4** would be implemented.

Operational phase

a) All sections of the Proposal Area

The operation of the Proposal would not result in any ongoing impacts to Aboriginal heritage.

6.4.4 Mitigation measures

The following mitigation measures would be implemented:

- all construction staff would undergo an induction in the recognition of Indigenous cultural heritage material. This training would include information such as the importance of Indigenous cultural heritage material and places to the Indigenous community, as well as the legal implications of removal, disturbance and damage to any Indigenous cultural heritage material and sites
- if unforeseen Indigenous heritage objects are uncovered during construction, the procedures contained in TfNSW's Unexpected Heritage Finds Guideline (TfNSW, 2019b) would be followed, and works within the vicinity of the find would cease immediately. The Contractor would immediately notify the TfNSW Project Manager and TfNSW Environment and Planning Manager so they can assist in co-ordinating the next steps which are likely to involve consultation with an Aboriginal heritage consultant, DPIE and the Local Aboriginal Land Council
- if human remains are found, work would cease, the site secured and the NSW Police and DPIE notified. Where required, further archaeological investigations and an Aboriginal Heritage Impact Permit would be obtained prior to works recommencing at the location.

Refer to **Table 7.1** for a list of proposed mitigation measures. All mitigation measures are to be incorporated into the CEMP.

6.5 Non-Indigenous heritage

6.5.1 Methodology

The historic heritage assessment has been undertaken in accordance with the NSW Heritage Division *Assessing Heritage Significance* (NSW Heritage Office, 2001) and *Statements of Heritage Impact* (NSW Heritage Office & Department of Urban Affairs & Planning, 2002) and includes:

- desktop searches of relevant heritage registers
- review of Proposal drawings and concept design reports
- review of the following key documents:
 - heritage register listings
 - historic plans from the Sydney Trains Plans Room
 - previous reports and other relevant documentation provided by TfNSW

- background research into the historical development of the Proposal Area using historic plans, historical photographs, newspapers and other primary and secondary historical sources as relevant
- a site inspection on 5 June 2019 of the Wolli Creek section of the Proposal Area, undertaken by AECOM principal archaeologist and heritage specialist Dr Darran Jordan. The purpose of the survey was to assess heritage items, existing character and past land uses in relation to the proposed works. The Green Square and Chalmers Street sections of the Proposal Area were subject to desktop assessment only.

A Statement of Heritage Impact (SoHI) was prepared by AECOM in October 2019 (AECOM, 2019c). The purpose of this assessment is to identify non-Aboriginal sites or heritage items which may be potentially affected by the proposed works and provide advice regarding the management of identified heritage issues. The findings of the report have been considered in this assessment.

The SoHI is included in **Appendix E**.

6.5.2 Existing environment

Database searches

A desktop search of historic heritage registers was undertaken on 22 October 2019 to assess the extent of known historical heritage items in proximity to the Proposal. This included a search of the:

- World Heritage List
- National Heritage List
- Commonwealth Heritage List
- National Trust of Australia
- Register of the National Estate (non-statutory archive)
- NSW State Heritage Register (SHR)
- Section 170 Heritage and Conservation Register
- Rockdale Local Environmental Plan 2011
- Sydney Local Environmental Plan 2012.

The searches and their results are shown in **Table 6.38**, **Table 6.39** and **Table 6.40**. The nearby heritage items are shown on **Figure 6.4**, **Figure 6.5** and **Figure 6.6**.

The significance assessments for the heritage items to determine if it were to be of State significance is in Appendix A of the SoHI.

Table 6.38 Summary of listed heritage items intersecting or within 100 m of the Wollie Creek Substation Proposal Area

Heritage list	Item	Distance to Proposal (metres)	Level of significance
World Heritage List	Nil		n/a
National Heritage List	Nil		n/a
Commonwealth Heritage List	Nil		n/a
National Trust of Australia	Nil		n/a
Register of the National Estate (non-statutory)	Nil		n/a
State Heritage Register	Western Outfall Main Sewer / Wollie Creek Aqueduct / Southern and Western Suburbs Ocean Outfall Sewer (SWSOOS) – Western Main Carrier and aqueduct (SHR 01647)	Within Proposal Area	State
	Tempe House and St Magdalenes Chapel (SHR 00725)	20	State
Section 170 Heritage and Conservation Register	Nil		n/a
Rockdale LEP 2011	Western Outfall Main Sewer / Wollie Creek Aqueduct / SWSOOS – Western Main Carrier and aqueduct (I35, I36 and I238)	Within Proposal Area	State
	Tempe House and St Magdalenes Chapel (I236)	20	State
	Wollie Creek Wetlands (I232)	0	Local
	Wollie Creek Valley (I237)	10	Local

Table 6.39 Summary of listed heritage items intersecting or within 100 m of the Green Square Proposal Area

Heritage list	Item	Distance to Proposal (metres)	Level of significance
World Heritage List	Nil		n/a
National Heritage List	Nil		n/a
Commonwealth Heritage List	Nil		n/a
National Trust of Australia	Nil		n/a
Register of the National Estate (non-statutory)	Nil		n/a
State Heritage Register	Nil		n/a
Section 170 Heritage and Conservation Register	Nil		n/a
Sydney LEP 2012	Waterloo Public School group (I2071)	10	Local

Table 6.40 Summary of listed heritage items intersecting or within 100 m of the Chalmers Street Substation, near Central Station Proposal Area

Heritage list	Item	Distance to Proposal (metres)	Level of significance
World Heritage List	Nil		n/a
National Heritage List	Nil		n/a
Commonwealth Heritage List	Nil		n/a
National Trust of Australia	Nil		n/a
Register of the National Estate (non-statutory)	The Block (RNE ID 101630)	100	Local
	Darlington Heritage Conservation Area (ID 1785)	70	Local
Section 170 Heritage and Conservation Register	Sydney Terminal and Central Railway Stations Group (4801296)	With Proposal Area	State
	Mortuary Railway Station and site (4803219)	With Proposal Area	State
State Heritage Register	Sydney Terminal and Central Railway Stations Group / Central Railway Station group (SHR 01255)	Within Proposal Area	State

Heritage list	Item	Distance to Proposal (metres)	Level of significance
	Mortuary Railway Station and site (SHR 00157)	100	State
	Cathedral of the Annunciation of Our Lady (SHR 01881)	15	State
	Railway Institute Building (SHR 01257)	20	State
Sydney LEP 2012	Sydney Terminal and Central Railway Stations Group / Central Railway Station group (I824)	Within Proposal Area	State
	Mortuary Railway Station and site (I194)	100	State
	Redfern Aboriginal Children's Services and Archives (SHR 01951)	100	State
	Greek Orthodox Church Group (I1476)	15	Local
	Former "Railways Institute" building including fence and interior (I1472)	20	State
	Prince Alfred Park (I1406)	10	Local
	Former Co-masonic Temple Including Interior (I195)	95	Local
	Former Mercantile Bank Chambers (I199)	50	Local
	Cottage 137-139 Regent Street Chippendale (I198)	80	Local
	Chippendale Conservation Area (C9)	40	Local
	Redfern Estate Conservation Area (C56)	10	Local
	Darlington Heritage Conservation Area (C11)	160 (this item on the RNE is due to a different curtilage)	Local

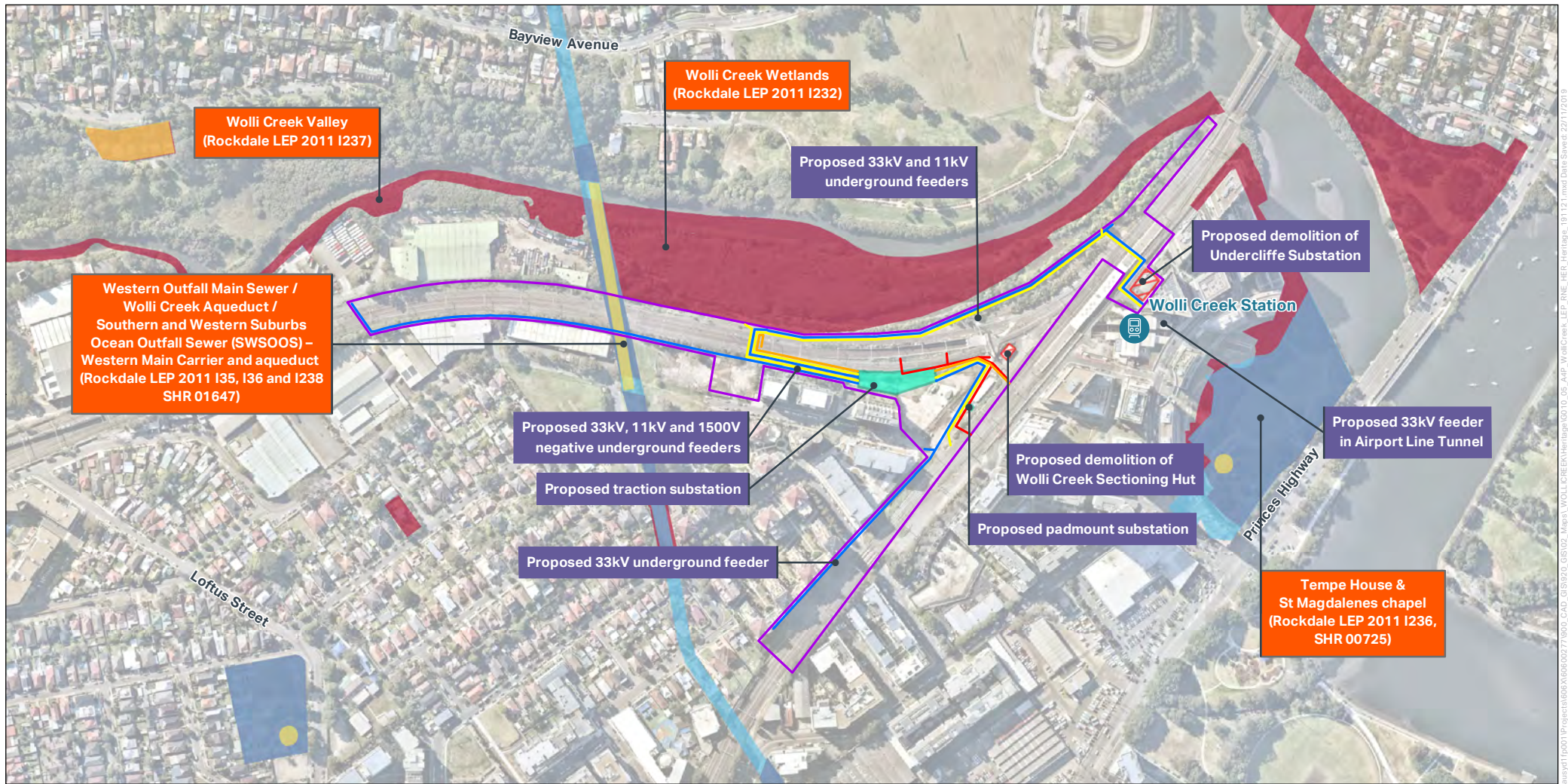













FIGURE 6-4: PROPOSED WORKS AND NON-INDIGENOUS HERITAGE ITEMS AT WOLLI CREEK

AECOM



Legend

-  Railway station
-  Construction footprint boundary
-  Proposed substitution
-  Building to be demolished
-  RNE Heritage Items
-  NSW State Heritage Register Items
-  LEP Heritage Items
-  Proposed 33kV underground feeder
-  Proposed 11kV underground feeder
-  Proposed 1500V positive underground
-  Proposed 1500V negative underground

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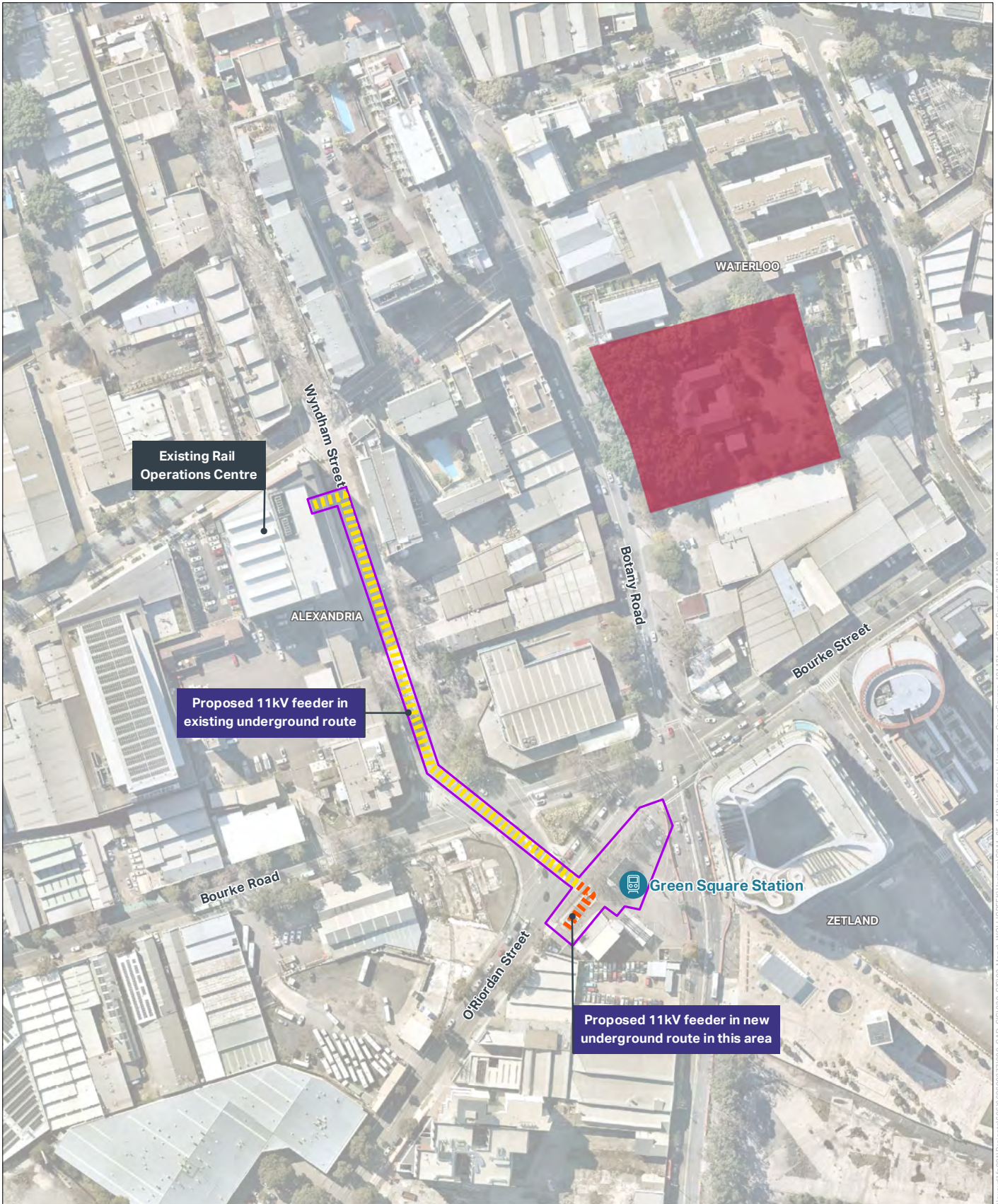


FIGURE 6-5: PROPOSED WORKS AND NON-INDIGENOUS HERITAGE ITEMS LOCATED AT GREEN SQUARE



Legend

- Railway station
- Construction footprint boundary
- LEP Heritage Item
- Proposed 11kV underground feeder (in new route)
- Proposed 11kV underground feeder (in existing conduit)

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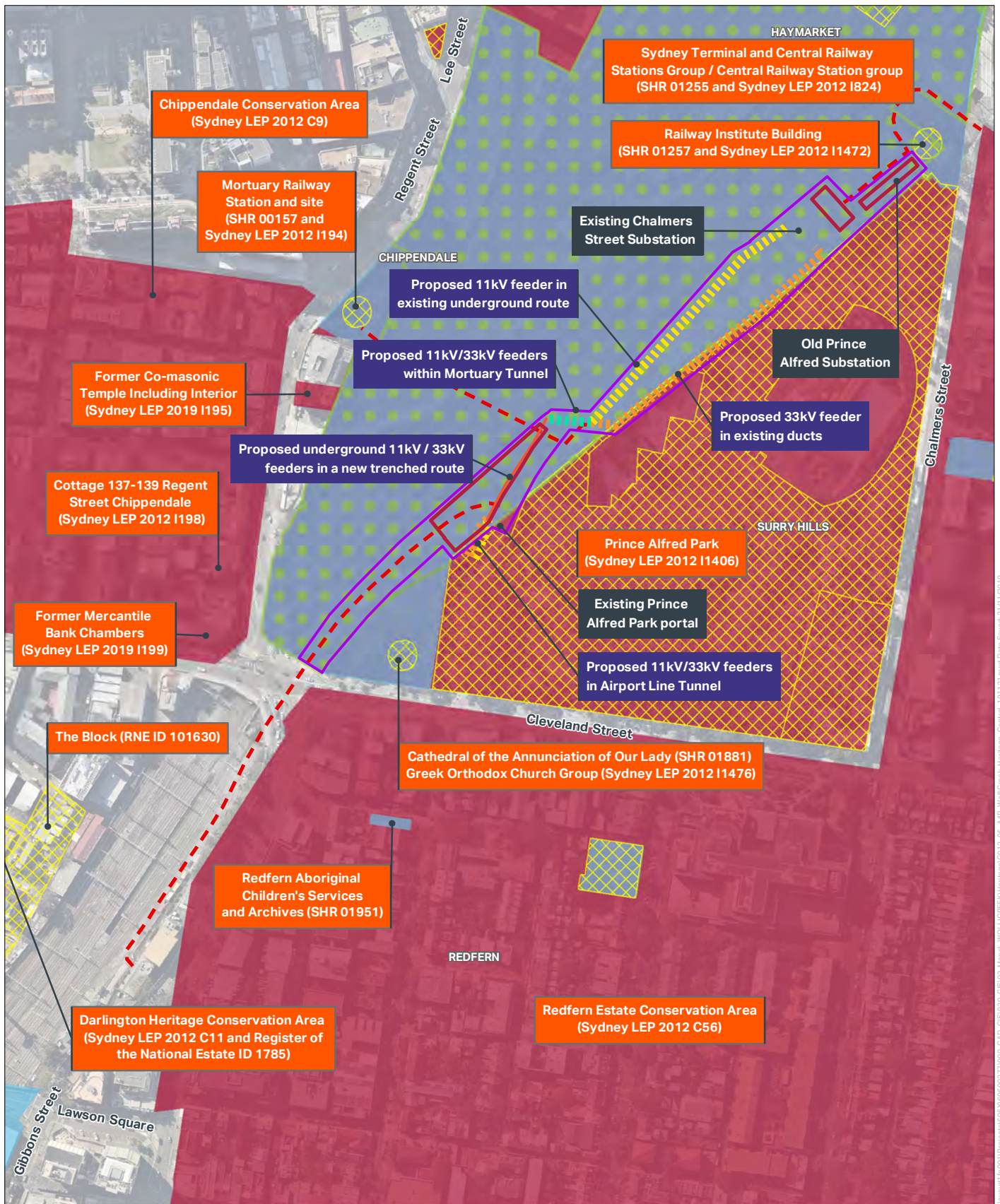


FIGURE 6-6: PROPOSED WORKS AND NON-INDIGENOUS HERITAGE ITEMS AT CHALMERS STREET SUBSTATION

Legend

- Construction footprint boundary
- Construction compound/laydown area
- RNE Heritage Items
- NSW State Heritage Register Items
- LEP Heritage Items
- Railcorp s170 Heritage and Conservation Register
- Proposed access route
- Proposed 33kV underground
- Proposed 11kV underground
- Proposed 11kV/33kV (within Mortuary Tunnel)
- Proposed underground 11kV/33kV in new trench



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Site inspection

A site inspection was undertaken of the Wolli Creek Substation Proposal Area by AECOM archaeologist Dr Darran Jordan on 5 June 2019. The purpose of the inspection was to identify the potential for direct or indirect impacts to historic heritage items. The listed items were verified as outside the bounds of the Proposal Area and unlikely to be affected either directly or indirectly by the proposed works.

No further heritage items were identified and no areas of subsurface archaeological potential likely to be affected by the proposed works were identified. The Wolli Creek Sectioning Hut proposed for demolition was not identified as having any specific heritage values.

No inspections were undertaken for Green Square or Chalmers Street, which were assessed by desktop research only.

6.5.3 Potential impacts

Construction phase

Direct impacts

Direct impacts would occur within the curtilage of the State significant item and s170 Heritage and Conservation Register Sydney Terminal and Central Railway Stations Group / Central Railway Station group (SHR 01255, SHI 4801296 and Sydney LEP 2012 I824). A review of historical plans and imagery for the Chalmers Street Substation area showed sheds in the vicinity at the turn of the 20th century. Direct impacts would not occur to any known and identified heritage items or fabric associated with the heritage listing.

The assessment has identified that there is not likely to be any historical archaeological remains associated with any of the former sheds constructed in this area, as they were likely to be lightweight structures. There are not expected to be any relics in situ in these areas associated with these structures.

The proposed works may pass over the location of the Prince Alfred Sewer. This sewer is presumed to be at a depth greater than 1.5 metres. If crossed, the works may cross through the cut associated with the construction of the sewer. If so, this would not have any direct impact to the sewer itself. The cut and associated fill is not likely to have any associated relic material present. These works are unlikely to impact upon the heritage values of the listed item. No other direct impacts would occur to heritage items or values as a result of the proposed works.

Indirect impacts

There may be temporary visual changes to the landscape during works. The following heritage listed items have the potential for temporary indirect impacts:

- Wolli Creek Wetlands (Rockdale LEP 2011 I232)
- Wolli Creek Valley (Rockdale LEP 2011 I237)
- Waterloo Public School group (Sydney LEP 2012 I2071)
- Sydney Terminal and Central Railway Stations Group / Central Railway Station group (SHR 01255, SHI 4801296 and Sydney LEP 2012 I824)
- Prince Alfred Park (Sydney LEP 2012 I1406).

However, impacts to these items either consist of temporary elements (i.e. the presence of work equipment which would be removed following works) or reversible impacts (i.e. trenches that would be in-filled following works). None of these have been assessed as having a likelihood of long-term visual impacts to identified heritage items. It is possible that accidental impacts could occur during works or unexpected finds could be encountered, but the risk for these can be mitigated by control measures and management planning. As such, no indirect

impacts have been identified in relation to the identified heritage items or values as a result of the proposed works.

Operational phase

The Proposal contains subsurface infrastructure within heritage curtilages and therefore would not impact the visual elements of the identified heritage items. The works are in keeping with past uses of the area, which contains existing subsurface infrastructure including 11 kV underground cables as well as existing galvanised steel troughing (GST). It is considered unlikely that the Proposal would adversely affect these heritage items during operation.

6.5.4 Mitigation measures

The following mitigation measures would apply to the Proposal:

- a heritage induction should be provided to all on-site staff and contractors involved in the Proposal. The induction should clearly describe the heritage items located in the surrounding vicinity and their curtilages to ensure that they are avoided from all impacts, including accidental impacts, during works
- the Construction Environmental Management Plan (CEMP) is to include details on protection measures (such as temporary fencing) and stop work procedures in accordance with TfNSW's *Unexpected Heritage Finds Guideline* (TfNSW, 2019b) to manage activities in the unlikely event that unexpected archaeological relics or deposits are encountered during works
- approval is required for the proposed works within the curtilage of the State significant item Sydney Terminal and Central Railway Stations Group / Central Railway Station group (SHR 01255 and Sydney LEP 2012 I824). An exemption under Section 57 of the Heritage Act utilising Exemptions 2 and 20 of the Rail Specific Exemptions is the appropriate approval pathway for the proposed works (i.e. excavation adjacent to the rail corridor for the purposes of cable laying, fixings, penetrations and cabling to be installed in existing ducts and tunnels as well as temporary compound works including the movement, laydown and storing of tools, material and equipment during works).

6.6 Socio-economic

6.6.1 Existing environment

Wolli Creek

The Proposal Area at Wolli Creek is located within the Bayside LGA, within the suburb of Wolli Creek. The Proposal Area in this location is approximately 10 kilometres from the Sydney CBD, on RailCorp owned land, and zoned as 'SP2 Infrastructure (Railway)' and 'B4 – Mixed Use'.

Wolli Creek is an established urban environment. The suburb is bordered by the waterway of Wolli Creek to the north and Georges River to the east. The Wolli Creek Wetland and Wolli Creek Valley are located to the north of the Proposal Area. The suburb has parklands and a large commercial/industrial area on the eastern side of the rail line between Wolli Creek Station and Arncliffe Station.

The surrounding land uses generally comprise of high-density residential/mixed use developments, commercial uses and some industrial uses.

The nearest sensitive receivers at the Wolli Creek section of the Proposal Area include:

- residential dwellings (within 100 metres of the Proposal Area):
- three apartment buildings on the northern side of Lusty Street
- four apartment buildings at the rear of the apartment complex at 97 Bonar Street

- four apartment buildings located on the southeast side of the rail corridor from the corner of Magdalene Terrace and Spark Lane to 20 Chisholm Street
- Masjid Fatima Al Zahra mosque, approximately 75 metres south west
- Al Zahra College, approximately 100 metres south west
- Tempe house 240 metres west
- Integricare Turrella Long Day Care, approximately 275 metres south west.

A review of the Australian Bureau of Statistics 2016 census data (ABS) was undertaken for Wollli Creek. Wollli Creek has a population of 6,394 people with a median age of 29 years. Over half of the population (62 percent) over the age of 15 are employed full time (ABS, 2017).

Airport Line tunnel

Stations within the Airport Line tunnel accommodate 149 train services each day during weekdays, 136 train services each Saturday and 121 daily services on Sundays and public holidays. Amongst others, these train services accommodate domestic residents travelling between work and home, and both international and domestic tourists. Among those, more than 9 million customers use the Airport Line Tunnel to travel to or from Sydney Airport (Domestic and International) (Airport Link, 2019), equating to around 24,658 per day, just for the airport stations.

Green Square Station

The Proposal Area near Green Square Station is located within the City of Sydney LGA, within the suburb of Alexandria. The Proposal Area in this location is located approximately 8 kilometres from the Sydney CBD, on land zoned as 'Deferred Matter' and 'B4 – Mixed Use'.

The nearest sensitive receivers include an apartment building located at the corner of Botany Road and Bourke Street, located approximately 80 metres east of the Proposal, Green Square Library, located approximately 90 metres east of the Proposal, and an apartment building located on the corner of Bourke Street and Ebsworth Street, approximately 130 metres north east. There is a mixed used development currently under construction and nearing completion on the corner of Botany Road and Bourke Street, known as 'Infinity' by Crown Group. It is unknown whether this development would be occupied for residential purposes at the time of construction works for the Proposal.

A review of the ABS 2016 Census data was undertaken for Alexandria. Alexandria has a population of 8,262 with a median age of 33 years. About three quarters of the population (75.4 percent) over the age of 15 are employed full time (ABS, 2017).

Chalmers Street Substation

The Proposal Area near the Chalmers Street Substation is located within the City of Sydney LGA, predominantly in the suburb of Chippendale, with parts of the Proposal Area at this location in Surry Hills and Redfern, adjacent to the Sydney CBD. The Proposal Area at the Chalmers Street Substation section is located entirely within land zoned as 'SP2 – Railways'.

The nearest sensitive receiver is the Cathedral of the Annunciation of Our Lady, Redfern, located adjacent to the Proposal Area at the Chalmers Street Substation section. There are residential apartment buildings located within 200 metres of this section of the Proposal Area, along the eastern side of Chalmers Street and the southern side of Cleveland Street. Prince Alfred Park acts as a key barrier between the works to be undertaken and those receivers.

A review of the ABS 2016 Census data was undertaken for the Redfern – Chippendale statistical area (RCSA). The RCSA has a population of 22,501 with a median age of 31 years. Over half of the population (63.9 percent) over the age of 15 are employed full time (ABS, 2017).

6.6.2 Potential impacts

Construction phase

a) All sections of the Proposal Area

No property acquisition would be required as a result of the Proposal.

Construction of the Proposal has the potential to temporarily affect customers, pedestrians, residents, motorists and other receivers as a result of:

- temporary disruptions to local traffic movements near each section of the Proposal Area
- noise and traffic impacts associated with truck movements delivering materials and equipment and transporting waste, particularly at Wolli Creek, Green Square Station and Chalmers Street Substation
- construction noise, vibration, dust and visual impacts, particularly at Wolli Creek, Green Square Station and Chalmers Street Substation.

Access to the stations on the T8 Line would be maintained during construction. The exception is when construction works occur during a track possession. The track possessions would occur regardless of the Proposal being undertaken.

Beyond the traffic, noise, vibration, visual amenity, electric and magnetic fields (EMF) and cumulative impacts described in this REF, the construction phase of the Proposal is unlikely to result in further social or economic impacts.

Operational phase

a) Wolli Creek

Noise

As outlined in **Section 6.3**, operational noise levels are predicted to exceed the project noise trigger level for the residential receivers at 5-13 Lusty Street, Wolli Creek. It is likely that the noise emission from the Project will comply for all non-residential receivers at greater distances. However, appropriate mitigation measures would be applied to minimise noise and vibration impacts.

Traffic

As outlined in **Section 6.1**, operational traffic associated with the Proposal would be negligible. As such there is not expected to be any social or economic impacts associated with traffic.

Visual amenity

The impact of changes associated with the visual environment is considered to be low to moderate, as outlined in **Section 6.2**. The Proposal would result in the addition of one built element within the existing rail corridor. This element (the proposed substation) would be in keeping with the utilitarian character of the working rail corridor, although the high quality of architecture of the substation would include visually recessive materials and colours. These would assist in the substation being visually recessive when viewed from some locations. Consequently, the potential socio-economic impact from visual amenity changes during operation are considered to be low.

As the operation of the substation is largely consistent with existing activities currently undertaken on site, the Proposal is not anticipated to result in any additional socio-economic impacts to the surrounding community or businesses.

Electric and Magnetic Fields

As outlined in **Section 6.12**, operational EMF impacts associated with the Proposal at Wollie Creek would not have a significant impact as the predicted magnetic field in all locations are confirmed to be below the Reference Levels applied to the general public and staff.

b) Airport Line tunnel, Green Square Station, Chalmers Street Substation

The operation of the Proposal would provide positive socio-economic benefits to the wider Bayside and Sydney LGA, including:

- improved services including capacity, reliability and connectivity on the T8 Airport Line
- reduced crowding on train services by supporting the increase of the overall network capacity along the T8 Airport Line.

Noise

As outlined in **Section 6.3**, there would be no operational noise impacts to the local community.

Traffic

As outlined in **Section 6.1** Operational traffic associated with the Proposal would be negligible. As such there is not expected to be any social or economic impacts associated with traffic.

Visual amenity

There would be no visual amenity impacts to the local community during operation for the proposed works. In the rail tunnel, the feeder cables are proposed to be fixed to the walls of the tunnel. The feeder cables are proposed to be underground outside and within the rail corridor.

Electric and Magnetic Fields

As outlined in **Section 6.12**, operational EMF impacts associated with the Proposal along the T8 Airport Line feeder would not have a significant impact as the predicted magnetic fields in all locations are confirmed to be below the Reference Levels applied to the general public and staff.

6.6.3 Mitigation measures

Mitigation of potential socio-economic impacts can be considered in line with mitigation of noise impacts, visual amenity impacts, EMF impacts and traffic impacts outlined in Sections **6.3**, **6.2**, **6.12** and **6.1** respectively.

In addition, the following mitigation measures are proposed:

- a Community Liaison Management Plan (refer to **Section 5**) would identify all potential stakeholders and the best practice methods for consultation with these groups
- sustainability criteria would be established to encourage construction personnel to purchase goods and services locally helping to ensure the local community benefits from the construction of the Proposal
- feedback through the submissions process would be encouraged and opportunities and channels for the community and stakeholders to have input into the project would be provided.
- contact details for a 24-hour construction response line, Project Infoline and email address would be provided for ongoing stakeholder contact throughout the construction phase
- the community would be kept informed of construction progress, activities and impacts in accordance with the Community Liaison Management Plan to be developed prior to construction

- mitigation measures would be implemented in respect of potential impacts on amenity (e.g. noise, dust and visual) as listed in **Section 7.2**.

Refer to **Table 7.1** for a list of proposed mitigation measures. All mitigation measures are to be incorporated into the CEMP.

6.7 Biodiversity

6.7.1 Methodology

Wolli Creek

Eco Logical Australia Pty Ltd (ELA) was engaged to provide a Flora and Fauna Assessment (FFA) Report for the Proposal at the Wolli Creek section of the Proposal Area. The assessment area contains existing rail infrastructure, cleared land and patches of remnant native vegetation. The study area is immediately adjacent to the waterway of Wolli Creek (refer to **Figure 6.7**). The full FFA is attached as **Appendix F**.

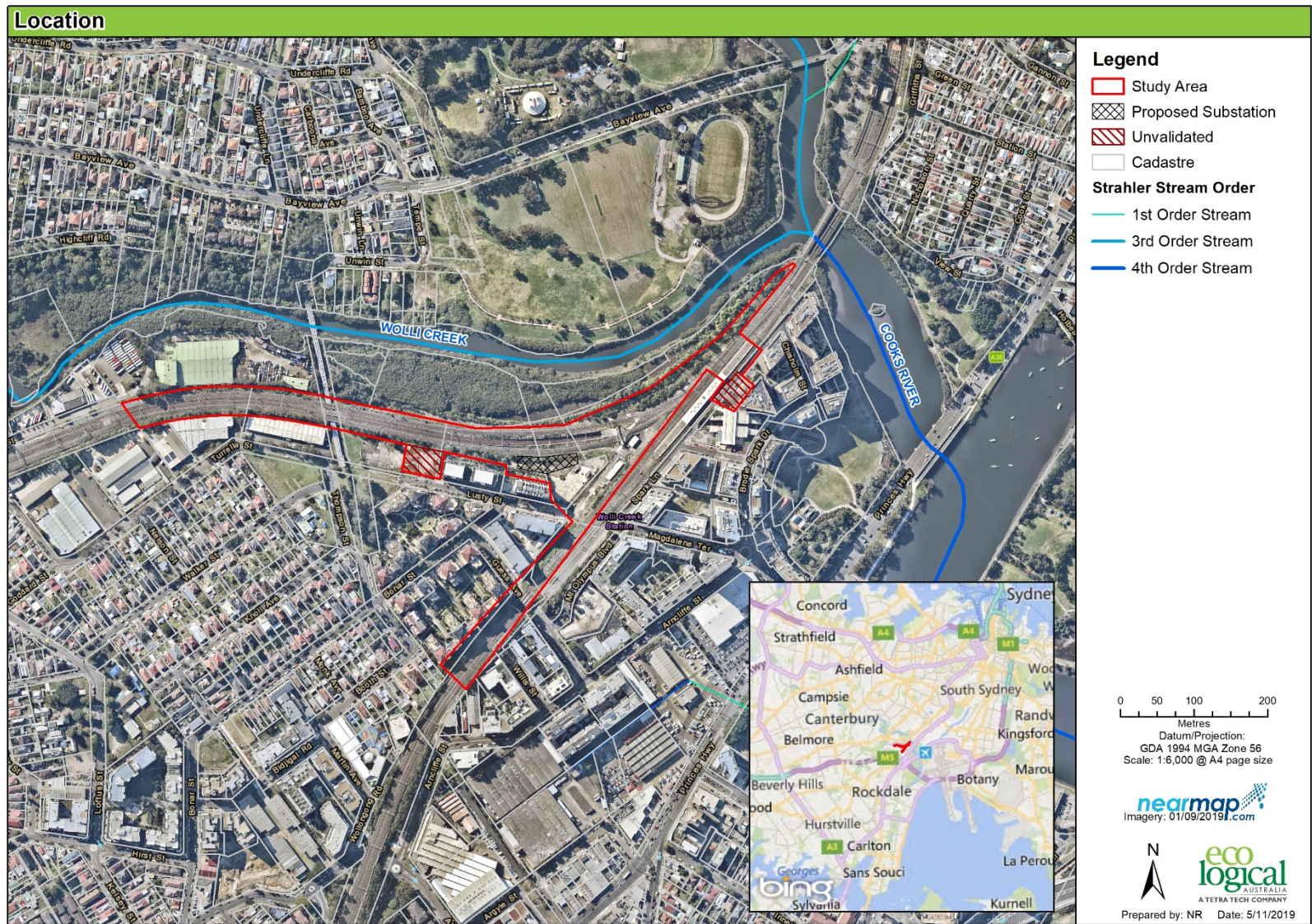


Figure 6.7 Location of the Proposal Area

Prior to field surveys being undertaken a desktop literature and database review was undertaken to inform the FFA. This included review of the following information and data sources:

- BioNet / Atlas of NSW Wildlife (OEH, 2019a)
- EPBC Act Protected Matters Search Tool (DotEE, 2019)
- NSW Threatened Species Profiles (OEH, 2019b)
- Native Vegetation Maps of the Sydney Metropolitan Area v3.0 (OE,H 2016)
- Rockdale LEP
- 1:25,000 hydroline data.

Aerial photography of the Proposal Area and surrounds were also used to investigate the extent of native vegetation cover and landscape features in the Proposal Area.

Field survey

A field survey was conducted on 30 May 2019 and 27 September 2019 by an ELA ecologist. Field survey covered a majority of the footprint, however the two areas mapped as 'un-validated' were not assessed (refer to **Figure 6.7**). Weather conditions during the survey were clear and sunny with temperatures ranging from 8.3°C to 17°C and 14.4°C and 27.7°C, respectively (BOM, 2019).

The subject site was traversed on foot by the ecologist. The survey focused on, and included, the following:

- validation of existing vegetation mapping, determining type, condition and extent
- threatened flora and fauna habitat assessment
- habitat-bearing tree search
- opportunistic fauna sightings
- assessment of vegetation present against ISCA criteria
- assessment of vegetation present against the *Vegetation Offsetting Guide 9TP-SD-087* (TfNSW 2016).

Where vegetation was mapped in un-validated portions of the Proposal Area, assumptions were made about the vegetation likely to be present.

The results of the surveys and database reviews are discussed in **Section 6.7.2** below.

Airport Line tunnel, Green Square Station and Chalmers Street Substation

As these sections of the Proposal Area are located in urban environments, and no vegetation is required to be removed, the assessment of biodiversity for these sites was restricted to a desktop assessment.

6.7.2 Existing environment

Wolli Creek

a) Literature and database review

The literature and database review returned 22 threatened flora, 48 threatened fauna (including migratory species) and three threatened ecological communities either known or considered likely to occur within a 10 km radius of the Proposal Area. The threatened species *Pteropus poliocephalus* (Grey-headed Flying-fox) (vulnerable under the BC Act and the EPBC Act) has been previously recorded immediately adjacent to the Proposal Area. The Grey-

headed Flying-fox was considered likely to utilise the study area for foraging on an occasional basis given the proximity of the Turrella camp 500 m west of the study area.

There are no threatened fauna species previously recorded within the Proposal Area. One threatened flora species; *Tetratheca juncea* (Black-eyed Susan) (vulnerable under the BC Act and the EPBC Act) was previously recorded within the Proposal Area. This record is from 1886 (OEH, 2019a).

Vegetation mapping

Two vegetation communities were previously mapped within the Proposal Area (OEH, 2016):

- Estuarine Mangrove Forest
- Weeds and Exotics.

b) Field survey

Vegetation validation

Field survey confirmed the presence of three vegetation communities in the Proposal Area and one additional feature:

- Coastal Sandstone Foreshores Forest (0.47 hectares)
- planted native and exotic (0.57 hectares)
- exotic cover (0.35 hectares)
- hardstand surfaces (4.66 hectares).

No threatened ecological communities were identified in the Proposal Area during survey (refer to **Figure 6.8**).



Figure 6.8 Validated vegetation communities (ELA, 2019)

Coastal Sandstone Foreshores Forest

Coastal Sandstone Foreshores Forest is found on sheltered sandstone slopes along the foreshores of Sydney's major waterways and coastal escarpments. It is an open forest with a moist shrub layer and a ground cover of ferns, rushes and grasses. The flora of this community has a maritime influence given its exposure to prevailing sea breezes.

The canopy can be dominated by pure stands of Smooth-barked Apple (*Angophora costata*), though more regularly this is found in combination with other tree species. Localised patches of Bangalay (*Eucalyptus botryoides*) and coast banksia (*Banksia integrifolia*) occur closest to the coast, whereas Sydney Peppermint (*Eucalyptus piperita*) and Blackbutt (*Eucalyptus pilularis*) prefer more protected locations and in the case of the latter some minor shale enrichment in the soil.

A prominent layer of hardy mesic small trees and shrubs is present. These include Sweet Pittosporum (*Pittosporum undulatum*), Cheese Tree (*Glochidion ferdinandi*) and Blueberry Ash (*Elaeocarpus reticulatus*). This forest is restricted to sandstone soils derived from either Hawkesbury or Narrabeen geology. The distribution is coastal and requires a combination of low elevation (between two and 45 metres above sea level) and mean annual rainfall that exceeds 1,100 millimetres per annum. Samples are situated up to 10 kilometres from the coastline, but still in proximity to major waterways.

Field survey confirmed the presence of Coastal Sandstone Foreshores Forest in two conditions: moderate condition and regrowth.

Where the community was in moderate condition the canopy was absent. The midstorey was diverse and contained *Banksia integrifolia* (Coast Banksia), *Allocasuarina littoralis* (Black She-oak), *Indigofera australis* (Australian Indigo), *Melaleuca ericifolia*, *Melaleuca linearifolia*, *Melaleuca nodosa*, *Pittosporum undulatum* (Native Daphne) and *Banksia serrata* (Old Man Banksia). The groundcover was dominated by exotic species including *Asparagus aethiopicus* (Ground Asparagus), *Conyza bonariensis* (Flaxleaf Fleabane), *Ageratina adenophora* (Crofton Weed) and *Chloris gayana* (Plump Windmill Grass). Where native species were present, they were scattered in occurrence and included *Imperata cylindrica* (Blady Grass), *Dianella revoluta* and *Lomandra longifolia* (Spiny-headed Mat-rush) (**Figure 6.9**).

Where the community existed as regrowth, the patches did not contain a canopy and contained limited midstorey species with an exotic groundcover. Midstorey species present were limited to *Pittosporum undulatum*, *Melaleuca linearifolia* and *Melaleuca styphelioides*. The groundcover was dominated by *Cenchrus clandestinus* (Kikuyu) and *Chloris gayana* (**Figure 6.10**).



Figure 6.9 Coastal Sandstone Foreshores Forest in moderate condition in the Proposal Area



Figure 6.10 Coastal Sandstone Foreshores Forest as regrowth in the Proposal Area

Planted native and exotic cover

Planted Native and Exotic cover occurred along the edges of the rail corridor closest to the existing platforms at Wollie Creek. The species present included *Callistemon citrinus* (Crimson Bottlebrush), *Casuarina glauca* (Swamp Oak), *Populus nigra* (Lombardy Poplar), *Acacia longifolia*, *Acacia mearnsii* (Black Wattle) and *Phoenix canariensis* (Canary Island Date Palm). The groundcover was dominated by *Cenchrus clandestinus* (Kikuyu) and *Bidens pilosa* (Beggar's Ticks) (**Figure 6.11**).

Exotic cover

The exotic cover in the Proposal Area consisted of exotic groundcover species. Areas mapped as exotic cover were dominated by *Cenchrus clandestinus*, *Cynodon dactylon* (Couch), *Andropogon virginicus* (Whisky Grass) and *Chloris gayana* (Figure 6.12).

Hardstand surfaces

Hardstand surfaces were mapped as all areas of existing rail infrastructure and concrete within the Proposal Area (Figure 6.13).



Figure 6.11 Planted native and exotic cover in the Proposal Area



Figure 6.12 Exotic cover in the Proposal Area



Figure 6.13 Hardstand surfaces in the Proposal Area

Airport Line tunnel

The existing ecological environment within the Airport Line tunnel does not contain any threatened flora or ecological communities. Given that the tunnel is an active rail tunnel, the likelihood of the presence of threatened fauna such as microbats is relatively low, though without field confirmation, cannot be completely excluded. The main presence of fauna within the Airport Line tunnel is likely to consist of invasive rodent species.

Green Square Station

Vegetation communities

A BioNet Atlas search was undertaken on 5 November 2019 over a 10 kilometre x 10 kilometre area centred on the Proposal Area at Green Square Station. The search identified 26 threatened ecological communities (TECs) listed under the BC Act and/or the EPBC Act.

A search of the Protected Matters Search Tool (PMST) was undertaken on 5 November 2019 for the Proposal Area at this location and a one kilometre buffer around the search area. The search is provided in **0**. The search identified five TECs listed under the EPBC Act.

The Proposal at this location is within an area that has been highly modified by human activity. The surrounding area is characterised by high density urban development (especially commercial, industrial and high-density residential uses). The vegetation at and surrounding the Proposal Area at this location consists predominantly of planted street trees.

Threatened flora and fauna

The above BioNet Atlas search for threatened species listed under the BC Act and EPBC Act identified 66 threatened flora and fauna species.

The PMST search identified 23 threatened fauna species and 11 threatened flora species listed under the EPBC Act.

Fauna habitat

The Proposal Area contains minimal desirable fauna habitat as it is located within a densely urbanised area.

Chalmers Street Substation

Vegetation communities

A BioNet Atlas search was undertaken on 5 November 2019 over a 10 kilometre x 10 kilometre area centred on the Proposal Area at Chalmers Street Substation. The search identified 27 TECs listed under the BC Act and/or the EPBC Act.

A search of the PMST was undertaken on 5 November 2019 for the Proposal Area at this location and a one kilometre buffer around the search area. The search is provided in **0**. The search identified 5 TECs listed under the EPBC Act.

The Proposal at this location is within an area that has been highly modified by human activity. The surrounding area is characterised by an operational rail corridor to the northwest and a parkland setting to the southeast. Vegetation consists of a small number of planted and naturally regenerated trees and shrubs. The majority of the vegetation is located along the southeast boundary of the rail corridor, between the corridor and Prince Alfred Park.

Threatened flora and fauna

The above BioNet Atlas search for threatened species listed under the BC Act and EPBC Act identified 68 threatened flora and fauna species.

The PMST search identified 32 threatened fauna species and 11 threatened flora species listed under the EPBC Act.

Fauna habitat

The Proposal Area contains minimal desirable fauna habitat as it is located within an operational rail corridor. There are fragmented patches of foraging and shelter area for fauna in the vegetated fringes of the Proposal Area, however these are not anticipated to be affected by the Proposal.

6.7.3 Potential impacts

Construction phase

a) Wolli Creek

Direct impacts

The proposal will result in the removal of Coastal Sandstone Foreshores Forest and foraging habitat for the Grey-headed Flying-fox (**Table 6.41**). The application of Significant Impact Criteria for listed MNES that would be affected as a result of the Proposal was undertaken. One threatened fauna species, *Pteropus poliocephalus* (Grey-headed Flying-fox), was considered likely to utilise the subject site for foraging habitat on an occasional basis. The significant impact criteria were applied with respect to this species and concluded that a significant impact is unlikely to occur. The significant impact criteria also assessed indirect impacts likely to result from the proposed development. These are considered unlikely to significantly affect this species. The Proposal would not impact on any other MNES or on Commonwealth land. Therefore, a referral to the Commonwealth Minister for the Environment is not required.

A test of significance under the BC Act for Grey-headed Flying-fox concluded that the proposal is unlikely to constitute a significant impact therefore a Biodiversity Development Assessment Report (BDAR) or a Species Impact Statement (SIS) are not required.

Although one threatened flora species; *Tetradlea juncea* (Black-eyed Susan) was previously recorded within the Proposal Area, the species was not identified during the field validation. Further this record is from 1886 (OEH, 2019a). The likelihood of this species being impacted is extremely low. No TECs, or threatened flora or populations would be affected as part of the works.

Offsets for impacts to native vegetation will be required under the TfNSW Vegetation Offsetting Guide. The vegetation within the study area was split into two categories, based on vegetation formation and structure. Offsets for Coastal Sandstone Foreshores Forest in moderate condition and regrowth (0.47 hectares) were calculated individually, and offsets for planted native and exotic cover (0.57 hectares) was calculated. Offset ratios of 2.20 and 2.60 respectively, were determined.

Offsets under the ISCA tool were calculated and achieved a score of -0.116 and a score of 0 was achieved.

Table 6.41 Values that will be affected in the Proposal Area

Value	Affected (ha)
Coastal Sandstone Foreshores Forest Moderate	0.34
Coastal Sandstone Foreshores Forest Regeneration	0.13
Planted Native and Exotic cover	0.57
Exotic cover	0.35
TOTAL	1.39
Foraging habitat for the potentially affected species (Grey-headed Flying-fox)	1.04

Indirect impacts

Indirect impacts associated with the proposal include:

- temporary increases in noise during construction
- increased movement of dust, soil and plant material during construction
- temporary increase in light pollution.

b) Airport Line tunnel, Green Square Station and Chalmers Street Substation

The Proposal at the remaining locations would not require the clearing of existing vegetation.

There is the potential for construction to introduce weeds, carried on vehicles or clothing. The risk of new weed introductions in this location would be minor given the highly urbanised nature of the area. During construction, noise, dust, light and sedimentation impacts may occur upon fauna species. Such impacts would be expected to be minimal given the highly urbanised nature of the surrounding environments and with the implementation of mitigation measures detailed in this REF.

Measures outlined in **Section 7.2** would be implemented to minimise indirect impacts on biodiversity.

Operational phase

a) Wolli Creek

Indirect impacts

Indirect impacts associated with the operation of the Proposal would include:

- permanent increase in noise resulting from the operation of the Wolli Creek Substation
- the expected light pollution is unlikely to increase beyond the current operational levels of the rail corridor.

b) Airport Line tunnel, Green Square Station and Chalmers Street Substation

There is no potential for further operational impacts to biodiversity as a result of the Proposal at these sections of the Proposal Area.

6.7.4 Mitigation measures

A number of safeguards would be implemented to minimise potential impacts on biodiversity including:

- works within the corridor should be consistent with the following guidelines:
- Vegetation Management (Protection and Removal) Guidelines (TfNSW, 2019c)
- Weed Management and Disposal Guideline (TfNSW, 2019d)
- offsets should be secured consistent with the Transport for NSW (TfNSW) 2016. *Vegetation Offsetting Guide 9TP-SD-087*
- potential offset requirements or retention of some native vegetation present should be considered in relation to the ISCA tool metrics
- develop a Construction Environmental Management Plan (CEMP) with relevant mitigation measures to minimise potential impacts to biodiversity values within the Proposal Area and outside of the Proposal Area. The CEMP should include:
- Sediment and Erosion Control Plan
- the establishment of clearly defined areas, such as the works area and any 'no-go' areas within/adjacent to work site boundaries that are not to be in any way disturbed or

damaged by the works, particularly adjacent to vegetation to be retained and Wolli Creek

- construction fencing prior to and during construction to ensure that construction related impacts are contained within the construction areas
- sediment fencing should be placed 2 metres either side of the construction footprint (where possible)
- surface runoff should be diverted away from areas of soil disturbance and away from Wolli Creek
- prevent tracking of soils / sediments from work site to roadways, footpaths and drainage lines as a result of work vehicle / machinery movement
- vehicle and machinery movement will be confined to designated tracks and work areas
- any concrete washout would be established and maintained in accordance with *Concrete Washout Guideline* (TfNSW, 2019e)
- the site-specific CEMP must include instructions for dealing with orphaned or injured native animals and include the contact details for the NSW Wildlife Information, Rescue and Education Service Inc. (WIRES).
- drainage should be controlled in the impact areas consistent with the *Protection of the Environment Operations Act 1997* requirements to avoid impacts on downstream habitats, and ecological communities
- ensure fertilisers, turf, mulch, weeds and imported soils are not unintentionally introduced into bushland areas adjacent to the rail corridor (i.e. through natural drainage pathways or general proximity)
- temporary tree protection measures (such as machinery exclusion zones from tree roots and tree trunk protection) must be in place for any retained trees and to protect adjacent native vegetation during all construction works. High visibility orange bunting must be placed at a one metre distance from the trunk of the tree with “no-go” signage attached
- no chemicals or rubbish must be allowed to escape the construction area
- all chemicals must be correctly stored within bunding
- works must be stopped if any previously undiscovered threatened species or communities are discovered during works. An assessment of the impact and any required approvals must be obtained
- equipment, heavy machinery and materials must be situated in designated lay-down areas in portions of cleared land where they are least likely to cause erosion or damage vegetation
- work vehicle access must be restricted to designated work areas and existing formed access tracks/roadways
- weed removal must be undertaken using mechanical and manual means, and if herbicides are required user must follow the prescriptions on the label. Herbicide use should be restricted within proximity to the creek.

Refer to **Section 7.2** for a full list of proposed mitigation measures.

6.8 Contamination, landform, geology and soils

6.8.1 Existing environment

Wolli Creek

Landform, geology and soils

Reference to the 1:100,000 Geological Map of Sydney identified that the underlying geology of the Proposal Area at Wolli Creek is Cainozoic Holocene formations comprising of silty to peaty to quartz sand, silt and clay, with ferruginous and humic cementation in places and common shell layers.

The elevation of the Proposal Area varies between two to four metres Australian Height Datum (AHD).

The soil landscape at Wolli Creek is located within the boundaries of the Birrong landscape (eSPADE, 2019). The Birrong landscape comprises level to gently undulating alluvial floodplains with local relief <5 metres and slope gradients <3 percent.

Soils within the Birrong soil landscape consist of deep (>250 cm) yellow podzolic soils and yellow solodic soils on older alluvial terraces; deep (>250 cm) solodic soils and yellow solomertz on the current floodplain. Limitations of the Birrong soil landscape include localised flooding, high soil erosion hazard, saline subsoil, seasonal waterlogging and very low soil fertility.

Above the recorded soil and geological landscape, the rail corridor is likely to consist of human-imported fill material and ballast as a result of the ongoing construction and maintenance of the rail corridor.

Acid sulfate soils

Acid sulfate soil (ASS) risk maps have been obtained from the Rockdale LEP. Based on the ASS map, the Proposal Area is located on land mapped as containing Class 3 ASS.

Contamination

A search of the NSW EPA Contaminated Land Register on 29 October 2019 identified one site approximately 200 metres west of the Proposal Area which has been declared as a significantly contaminated site under the CLM Act. The site is located at 61 Turella Street, Turella.

The AS 4482.1-2005 – *Guide to the investigation and sampling of sites with potentially contaminated soil – Non-volatile and semi-volatile compounds* lists the chemicals used by specific industries. The Standard lists the following chemicals that are commonly associated with railway yards and the electrical industry and may be present at the Proposal Area:

- polychlorinated biphenyls
- solvents
- hydrocarbons
- arsenic
- phenolics
- heavy metals
- nitrates and ammonia.

Given the historical and current use of the Proposal Area as a rail corridor, there is potential for contaminants to be present within underlying soils. Historic activities associated with rail corridors that have the potential to result in contamination include the introduction of fill,

materials including ash, the use of asbestos containing materials, fuel or oil spills and accidental leaks or spills from maintenance and operational activities.

Airport Line tunnel

The Airport Line tunnel is located underground within the existing bedrock. Excavation and general ground penetration would not be undertaken within the Airport Line tunnel, so a complete understanding of the existing environment in terms of contamination, landform and soils is not required. However, a review of publicly available geological information was undertaken.

The Airport Line tunnel is likely to be located within the underlying bedrock, which is likely to consist of Hawkesbury Sandstone of the Wianamatta Group. This is based on a review of the geological cross-section supplied on the 1:100,000 Geological Map of Sydney.

Green Square Station

Landform, geology and soils

Reference to the 1:100,000 Geological Map of Sydney identified that the underlying geology of the Proposal Area at Green Square Station is underlain by Cainozoic Holocene formations comprising of medium to fine-grained “marine” sand with podzols.

The elevation of the Proposal Area varies between 11 to 16 metres AHD.

The soil landscape at Green Square Station is located within the boundaries of the Tuggerah landscape (eSPADE, 2019). The Tuggerah landscape comprises gently undulating to rolling coastal dunefields, with slope gradients of generally 1-10 percent, but occasionally up to 35 percent.

Soils within the Tuggerah soil landscape consist of deep (>200 cm) podzols on dunes and porzols/humus podzol intergrades on swales. Limitations of the Tuggerah soil landscape include extreme wind erosion hazard, non-cohesive, highly permeable soil, very low soil fertility, localised flooding and permanently high watertables.

Above the recorded soil and geological layers, the material is likely to consist of human-imported fill material, asphalt, road base and concrete as a result of the extensive urbanisation of the area.

Acid sulfate soils

ASS risk maps have been obtained from the Sydney LEP. Based on the ASS map, the Proposal Area is located on land mapped as not containing ASS and on land mapped as containing Class 3 ASS. The area containing Class 3 ASS is the portion of the Proposal located on Wyndham Street. The area requiring trenching works i.e. above Green Square Station is not mapped as containing ASS.

Contamination

A search of the NSW EPA Contaminated Land Register on 29 October 2019 did not identify any sites near the Proposal Area that are currently regulated under the CLM Act. This search also identified that the Proposal Area at Green Square Station has not been declared as significantly contaminated and is not regulated under the CLM Act.

The AS 4482.1-2005 – *Guide to the investigation and sampling of sites with potentially contaminated soil – Non-volatile and semi-volatile compounds* lists the chemicals used by specific industries. The Standard lists the following chemicals that are commonly associated with the electrical industry and may be present at the Proposal Area:

- polychlorinated biphenyls
- solvents
- heavy metals.

Given the urbanised nature of the Proposal Area in this location, and surrounding industrial uses, there is potential for contaminants to be present within the soils underlying the Proposal Area. Historic activities associated with the development and ongoing use of the area for urban, industrial and road transport purpose that have the potential to result in contamination include the introduction of fill, materials such as ash, fuel or oil spills, chemical spills and other leaks or spills from the development and operations in the area.

Chalmers Street Substation

Landform, geology and soils

Reference to the 1:100,000 Geological Map of Sydney identified that the underlying geology of the Proposal Area at Chalmers Street Substation is underlain by Ashfield Shale of the Wianamatta Group, consisting of black to dark-grey shale and laminite.

The elevation of the Proposal Area at this location varies from about 23 metres to 24 metres AHD, meaning that overall it is relatively flat.

The soil landscape at Chalmers Street Substation is located within the boundaries of the Blacktown landscape (eSPADE, 2019). The Blacktown landscape comprises gentle rises on Wianamatta Group shales and Hawkesbury shale, with slopes <5 percent. The Blacktown landscape features broad rounded crests and ridges with gently inclined slopes.

Soils within the Blacktown soil landscape consist of shallow to moderately deep (<100 cm) red and brown podzolic soils on crests, upper slopes and well drained areas; deep (150 – 300 cm) yellow podzolic soils and soloths on lower slopes and in areas of poor drainage. Limitations of the Blacktown soil landscape include moderately reactive highly plastic subsoil, low soil fertility, poor soil drainage.

Above the recorded soil and geological landscape, the rail corridor is likely to consist of human-imported fill material, ballast and concrete as a result of the ongoing construction and maintenance of the rail corridor and access roads within the corridor.

Acid sulfate soils

ASS risk maps have been obtained from the Sydney LEP. Based on the ASS map, the Proposal Area is located on land mapped as containing Class 5 ASS.

Contamination

A search of the NSW EPA Contaminated Land Register on 29 October 2019 identified one site approximately 200 metres west of the Proposal Area which has been issued with a Preliminary Investigation Order under the CLM Act but has not yet been declared as a significantly contaminated site. The Proposal Area at this section has not been declared as significantly contaminated and is not regulated under the CLM Act.

The AS 4482.1-2005 – *Guide to the investigation and sampling of sites with potentially contaminated soil – Non-volatile and semi-volatile compounds* lists the chemicals used by specific industries. The Standard lists the following chemicals that are commonly associated with railway yards and the electrical industry and may be present at the Proposal Area:

- polychlorinated biphenyls
- solvents
- hydrocarbons
- arsenic
- phenolics
- heavy metals
- nitrates and ammonia.

Given the historical and current use of the Proposal Area as a rail corridor, there is potential for contaminants to be present within the soils underlying the Proposal Area. Historic activities associated with rail corridors that have the potential to result in contamination include the introduction of fill, materials including ash, the use of asbestos containing materials, fuel or oil spills and accidental leaks or spills from maintenance and operational activities.

6.8.2 Potential impacts

Construction phase

a) Wollli Creek

Soil disturbance, erosion and sedimentation

The Proposal at Wollli Creek would involve excavation and other earthworks associated with the proposed access road, proposed traction substation and cabling works. If not adequately managed, these works could result in the following risks:

- erosion of exposed soil and stockpiled materials
- dust generation from excavation and vehicle movements over exposed soil
- increase in sediment loads entering the stormwater system and/or local runoff.

The chance of those risks occurring is increased during high wind, rainfall events and on work situated on or adjacent to downward sloping surfaces. Those risks have implications upon other environmental factors including biodiversity, water quality and air quality. Where sediment loads in local waterways such as Wollli Creek or the Cooks River are increased as a result of erosion of materials, it would alter the existing water quality conditions, which may result in negative impacts upon aquatic flora and fauna.

Inadequately covered or watered-down stockpiles may result in increased dust in the local area during high wind events. Increased dust in the area surrounding the works may have nuisance impacts upon surrounding receivers.

With no mitigation measures in place, and in inclement weather conditions involving rain and/or high-velocity wind, the impact of those risks is considered to be a temporary, moderate negative impact. However, through the implementation of the mitigation measures listed in **Section 6.8.3**, despite weather conditions, the risks associated with soil disturbance, erosion and sedimentation at the Proposal Area at Wollli Creek is considered to be low.

Acid Sulfate Soils

The Proposal Area at Wollli Creek has been mapped as containing Class 3 ASS, meaning that the presence of ASS is likely at depths of one metre below ground level. The presence of ASS within the Proposal Area has not been confirmed through field testing, however given the mapping of ASS, there is a potential for its exposure, should excavations exceed one metre below ground level.

The exposure of ASS to the atmosphere through excavation activities can result in the oxidisation of the sulfide minerals within those soils (typically iron sulfide). This oxidisation of sulfides results in the production of sulfuric acid. The acidic conditions that result can cause the mobilisation of other contaminants within that soil including heavy metals and metalloids, which may leach into surrounding soils.

Works that would exceed one-metre depth at Wollli Creek include piling works for the traction substation foundations. An ASS management plan (ASSMP) should be prepared regardless of the construction methodology chosen to support the structure. If required, the ASSMP would outline disposal requirements for any encountered ASS.

Through the implementation of an ASSMP as detailed in **Section 6.8.3**, the potential impact of ASS as a result of construction works at the Wollli Creek section of the Proposal Area is considered to be low to moderate.

Contamination

Excavation also has the potential to expose contaminants such as those identified in **Section 6.8.1**, which if not appropriately managed, can present a health risk concern to construction workers and the community. The exposure of contaminants could also pose an environmental risk if they were to enter nearby waterways directly or via stormwater infrastructure.

Potential contamination impacts may also arise from the use of fuels, lubricants and chemicals for construction plant and equipment for the Proposal. Fuels, lubricants and chemicals have the potential to be spilled during construction and transfer offsite to adjacent properties or may contaminate the stormwater system.

The risk of impacts from contamination (if any) on human health and the receiving environment from construction activities would be reduced and managed through the mitigation measures identified in **Section 6.8.3**. Further, the extent of potential contamination is unlikely to be significant enough to preclude the Proposal from going ahead as there would be no change to the existing land use post-development. Overall the impact resulting from contamination at the Wollli Creek section of the Proposal Area is considered to be low.

b) Airport Line tunnel

Soil disturbance, erosion and sedimentation

Construction of the Proposal within the Airport Line tunnel would not result in any soil disturbance, erosion or sedimentation.

Acid Sulfate Soils

Construction of the Proposal within the Airport Line tunnel would not involve excavation of soil generally, and would therefore not impact upon ASS.

Contamination

Potential contamination impacts may also arise from the use of fuels, lubricants and chemicals for construction plant and equipment for the Proposal. Fuels, lubricants and chemicals have the potential to be spilled during construction resulting in impacts to human health. With the implementation of the mitigation measures identified in **Section 6.8.3**, the impact of this is considered to be low.

c) Green Square Station

Soil disturbance, erosion and sedimentation

The Proposal at Green Square Station would involve minor trenching works. If not adequately managed, these works could result in the following risks:

- erosion of exposed soil and stockpiled materials
- dust generation from excavation
- increase in sediment loads entering the stormwater system and/or local runoff.

The chance of those risks occurring is increased during high wind and rainfall events. Those risks have implications upon other environmental factors including biodiversity, water quality and air quality. Where sediment loads in local waterways are increased as a result sediment-laden water entering the stormwater system, if not filtered via that system, it has the potential to alter the existing water quality conditions, which may result in negative impacts upon aquatic flora and fauna.

Exposed soils during works may result in increased dust in the local area during high wind events. Increased dust in the area surrounding the works may have nuisance impacts upon surrounding receivers.

With no mitigation measures in place, and in inclement weather conditions involving rain and/or high-velocity wind, the impact of those risks is considered to be a temporary, moderate negative impact. However, through the implementation of the mitigation measures listed in **Section 6.8.3**, despite weather conditions, the risks associated with soil disturbance, erosion and sedimentation at the Proposal Area at Green Square Station is considered to be low.

Acid Sulfate Soils

The section of the Proposal Area at Green Square Station requiring soil disturbance (trenching) is being undertaken within an area not mapped as containing ASS. Accordingly, impacts associated with ASS at the Green Square Station section of the Proposal Area are anticipated to be nil to negligible.

Contamination

Excavation also has the potential to expose contaminants such as those identified in **Section 6.8.1**, which if not appropriately managed, can present a health risk concern to construction workers and the community. The exposure of contaminants could also pose an environmental risk if they were to enter nearby waterways via stormwater infrastructure.

Potential contamination impacts may also arise from the use of fuels, lubricants and chemicals for construction plant and equipment for the Proposal. Fuels, lubricants and chemicals have the potential to be spilled during construction and transfer offsite to adjacent properties or may contaminate the stormwater system.

The risk of impacts from contamination (if any) on human health and the receiving environment from construction activities would be reduced and managed through the mitigation measures identified in **Section 6.8.3**. Further, the extent of potential contamination is unlikely to be significant enough to preclude the Proposal from going ahead as there would be no change to the existing land use post-development. Overall the impact resulting from contamination at the Green Square Station section of the Proposal Area is considered to be low.

d) Chalmers Street Substation

Soil disturbance, erosion and sedimentation

The Proposal at Chalmers Street Substation would involve shallow excavation and other earthworks associated with cabling works. If not adequately managed, these works could result in the following risks:

- erosion of exposed soil and stockpiled materials
- dust generation from excavation
- increase in sediment loads entering the stormwater system and/or local runoff

The chance of those risks occurring is increased during high wind and rainfall events. Those risks have implications upon other environmental factors including biodiversity, water quality and air quality. Where sediment loads in local waterways are increased as a result of sediment-laden water entering the stormwater system, if not filtered via that system, it has the potential to alter the existing water quality conditions, which may result in negative impacts upon aquatic flora and fauna.

Exposed soils during works may result in increased dust in the local area during high wind events. Increased dust in the area surrounding the works may have nuisance impacts upon surrounding receivers.

With no mitigation measures in place, and in inclement weather conditions involving rain and/or high-velocity wind, the impact of those risks is considered to be a temporary, moderate negative impact. However, through the implementation of the mitigation measures listed in **Section 6.8.3**, despite weather conditions, the risks associated with soil disturbance, erosion

and sedimentation at the Proposal Area at Chalmers Street Substation is considered to be low.

Acid Sulfate Soils

The Proposal Area at Chalmers Street Substation has been mapped as containing Class 5 ASS, meaning that the presence of ASS is unlikely, however, it is located within 500 metres of land mapped as Class 1 – 4 ASS. The presence of ASS within the Proposal Area has not been confirmed through field testing, notwithstanding, given the classification of Class 5 ASS, the potential for exposure is low.

Despite the classification, should ASS be uncovered during excavation activities at the Proposal Area, the potential impact would be managed through the implementation of the ASSMP as detailed in **Section 6.8.3**. Overall it is considered that the potential impact of ASS as a result of construction works at the Chalmers Street Substation section of the Proposal Area is considered to be negligible.

Contamination

Excavation also has the potential to expose contaminants such as those identified in **Section 6.8.1**, which if not appropriately managed, can present a health risk concern to construction workers and the community. The exposure of contaminants could also pose an environmental risk if they were to enter nearby waterways via stormwater infrastructure.

Potential contamination impacts may also arise from the use of fuels, lubricants and chemicals for construction plant and equipment for the Proposal. Fuels, lubricants and chemicals have the potential to be spilled during construction and transfer offsite to adjacent properties or may contaminate the stormwater system.

The risk of impacts from contamination (if any) on human health and the receiving environment from construction activities would be reduced and managed through the mitigation measures identified in **Section 6.8.3**. Further, the extent of potential contamination is unlikely to be significant enough to preclude the Proposal from going ahead as there would be no change to the existing land use post-development. Overall the impact resulting from contamination at the Chalmers Street Substation section of the Proposal Area is considered to be low.

Operational phase

a) All sections of the Proposal Area

During the operational phase of the Proposal, general maintenance is likely to be required to ensure the continued, efficient operation of services. During maintenance, there is potential for contamination to occur as a result of accidental fuel, oil or chemical spills. The potential impact as a result of this would be mitigated through the implementation of mitigation measures identified in **Section 6.8.3**.

6.8.3 Mitigation measures

The following mitigation measures would apply to the Proposal:

- prior to commencement of works, a site-specific Erosion and Sediment Control Plan would be prepared in accordance with the 'Blue Book' *Managing Urban Stormwater: Soils and Construction Guidelines* (Landcom, 2004) and updated throughout construction so it remains relevant to the activities. The Erosion and Sediment Control Plan measures would be implemented prior to commencement of works and maintained throughout construction
- erosion and sediment control measures would be established prior to any site establishment activities and would be maintained and regularly inspected (particularly following rainfall events) to ensure their ongoing functionality. These measures would be maintained and left in place until the works are complete and areas are stabilised

- vehicles and machinery would be properly maintained and routinely inspected to minimise the risk of fuel/oil leaks. Construction plant, vehicles and equipment would also be refuelled offsite, or in a designated refuelling area
- all fuels, chemicals and hazardous liquids would be stored within an impervious bunded area in accordance with Australian Standards, EPA Guidelines and TfNSW's *Chemical Storage and Spill Response Guidelines* (TfNSW, 2018c)
- prior to or during construction, further assessment and testing would be carried out to further characterise and target materials to be disturbed/excavated
- an appropriate Unexpected Finds Protocol, considering asbestos containing materials and other potential contaminants, would be included in the CEMP. Procedures for handling asbestos containing materials, including licensed contractor involvement as required, record keeping, site personnel awareness and waste disposal to be undertaken in accordance with SafeWork NSW requirements
- all spoil to be removed from site would be tested to confirm the presence of any contamination. Any contaminated spoil would be disposed of at an appropriately licensed facility
- all spoil and waste must be classified in accordance with the *Waste Classification Guidelines Part 1: Classifying waste* (EPA, 2014) prior to disposal
- hydrocarbons and chemicals such as fuels, lubricants and oils would be stored on-site in dedicated facilities such as secure sheds, containers, storage tanks and proprietary hazardous substance cupboards, and in accordance with the applicable Safety Data Sheet (SDS)
- in the event of a pollution incident, works would cease in the immediate vicinity and the Contractor would immediately notify the TfNSW Project Manager and TfNSW Environment and Planning Manager. The EPA would be notified by TfNSW if required, in accordance with Part 5.7 of the PoEO Act
- spill kits appropriate to products used on site must be readily available
- spills of fuel, oil, chemicals or the like would be cleaned immediately, and the site environmental manager would be notified of the location of the incident, extent of the incident and type of material spilled
- any concrete washout would be established and maintained in accordance with TfNSW's *Concrete Washout Guideline* (TfNSW, 2019e) with details included in the CEMP and location marked on the Environmental Controls Map (ECM)
- an ASSMP is to be prepared. The ASSMP needs to detail the management requirements for ASS within the Proposal Area. This would be determined in consultation with the construction contractor. At Wollie Creek, all natural soils one metre below ground level and any filling below the water table, should be assumed to be ASS, unless high density ex situ assessment indicates specific horizons are not ASS.

Refer to **Section 7.2** for a full list of proposed mitigation measures.

6.9 Hydrology and water quality

6.9.1 Existing environment

Wolli Creek

Surface water

The Proposal Area at Wolli Creek is located within the Cooks River catchment. The Cooks River and its tributary, Wolli Creek are located within about 10 metres from the nearest part of the Proposal at this location.

The Cooks River catchment has been classified as *waterways affected by urban development*, meaning that the waterways within that catchment are frequently substantially modified and generally carry poor quality stormwater (NSW Department of Environment, Climate Change and Water, 2006). In line with that categorisation, the most recent ecological health card (2016-2017) prepared for the Cooks River Catchment (Cooks River Alliance, 2018) provides a snapshot of water quality conditions within the catchment and assigns grades from A+ to F- with A+ being excellent and F- being poor. The health card contains the following observations relevant to the Proposal Area at Wolli Creek:

Overall

- the ecological health of the Cooks River catchment was poor
- conditions within the creek systems are affected by excessive nutrient concentrations, lack of complex aquatic habitats and frequent, high-velocity stormwater flows
- water quality at freshwater sites was degraded
- riparian vegetation and creek channel condition was degraded.

Wolli Creek Rating: E

- water quality was frequently non-compliant with regional guidelines
- contained elevated nutrients, low dissolved oxygen, lack of diversity in macroinvertebrate and benthic diatom communities and a degraded creek channel.

Lower Cooks River Estuary Rating: D

- frequent non-compliance to guideline values for turbidity and chlorophyll
- occurrences of sediment laden, nutrient enriched urban stormwater entering the estuary resulted in elevated turbidity and excessive algal growth.

Groundwater

A study of WaterNSW's real-time water data mapping was undertaken on 31 October 2019 in order to understand the potential groundwater depths of the Proposal Area at Wolli Creek. Using the Greater Sydney Region Map, the three closest bores that discovered groundwater are as follows:

- GW111344: located within the Proposal Area, with the standing water level of the groundwater identified at 1.55 metres below the surface
- GW111345: located within the Proposal Area, with the standing water level of the groundwater identified at 1.24 metres below the surface
- GW111346: located within the Proposal Area, with the standing water level of the groundwater identified at 1.25 metres below the surface.

The exact depth of groundwater over the entire Proposal Area is unknown, however, around the location of the proposed traction substation, groundwater is located from 1.24 metres to 1.55 metres below the surface.

Flooding

A review of a flood study prepared for Sydney Water by MWH+PB (2009) for the Cooks River, and a flood study prepared for Bayside Council by WMA Water (2019) identified that the entire Proposal Area at Wolli Creek is located within an area that would be inundated by a probable maximum flood (PMF) event.

Both studies show that a section of the Proposal Area at Wolli Creek near the railway bridge over the Cooks River and near the location of the proposed substation would also be inundated by a one percent annual exceedance probability (AEP) flood event. In addition to those findings, the 2009 flood study undertook modelling for the one percent AEP flood event, with climate change as a consideration. That modelling identified that a one percent AEP flood event would inundate a greater proportion of the Proposal Area at Wolli Creek, including the location of the proposed substation, compared to existing levels.

As well as the flood study undertaken, other important considerations in relation to flooding relate to the topography of the Proposal Area. The Proposal Area at Wolli Creek is not located on an overland flow path, however it is located in a local sag point, which in this case is an area slightly lower than the surrounding areas. Where the surface has poor solubility or drainage, stormwater runoff is likely to pool in this area.

Airport Line tunnel

Consideration of the existing hydrological and water quality environment for the Airport Line tunnel is not considered necessary due to the tunnel being located underground. Further, penetrative works would not be carried out within the tunnel, restricting the potential of penetrating an undiscovered aquifer.

Green Square Station

Surface water

The Proposal Area at Green Square Station is located within the Cooks River catchment. Sheas Creek which flows into the Alexandra Canal, is located approximately 210 metres west of the Proposal Area where ground-penetration works would be undertaken as part of the Proposal. The most northern point of the Alexandra Canal is located approximately 1.1 kilometres from the Proposal Area.

The Cooks River catchment has been classified as *waterways affected by urban development*, meaning that the waterways within that catchment are frequently substantially modified and generally carry poor quality stormwater (NSW Department of Environment, Climate Change and Water 2006). In line with that categorisation, the most recent ecological health card (2016-2017) prepared for the Cooks River Catchment (Cooks River Alliance, 2018) provides a snapshot of water quality conditions within the catchment and assigns grades from A+ to F- with A+ being excellent and F- being poor. The health card contains the following observations relevant to the Proposal Area at Green Square Station:

Alexandra Canal Rating: D

- frequent non-compliance to guideline values for turbidity and chlorophyll
- occurrences of sediment laden, nutrient enriched urban stormwater entering the estuary resulted in elevated turbidity and excessive algal growth.

Groundwater

A study of WaterNSW's real-time water data mapping was undertaken on 31 October 2019 in order to understand the potential groundwater depths of the Proposal Area at Green Square Station. Using the Greater Sydney Region Map, the two closest bores that discovered groundwater are as follows:

- GW017684: located approximately 147 metres west of the Proposal Area, identified an initial water bearing zone of 2.4 metres to 6.3 metres below the surface. The standing water level was not recorded
- GW017342: located approximately 63 metres west of the Proposal Area, identified an initial water bearing zone of 7.31 metres to 13.2 metres below the surface. The standing water level was not recorded.

The exact depth of groundwater at the Green Square Station section of the Proposal Area is currently unknown.

Flooding

A review of two flood studies that incorporated the Proposal Area at Green Square Station (Webb, McKeown & Associates, 2008; Cardno, 2014), identified that the Proposal Area at Green Square Station is located within an area that is flood affected. Both reports indicate that the Proposal Area in this location would be inundated by flood waters during both a PMF event and a one percent AEP flood event.

Chalmers Street Substation

Surface water

The Proposal Area at Chalmers Street Substation is located within the Sydney Harbour catchment area. At its closest point the nearest part of the Harbour is located approximately 1.48 kilometres north west of the Proposal Area. The Sydney Harbour catchment has been classified as *waterways affected by urban development*, meaning that the waterways within that catchment are frequently substantially modified and generally carry poor quality stormwater (NSW Department of Environment, Climate Change and Water, 2006). This is supported by the *Sydney Harbour Water Quality Improvement Plan* (Local Land Services, 2015) which identifies that thousands of tons of toxic pollutants enter the Harbour each year, through the stormwater system and sewage overflows. It goes on to state that stormwater pollution is now the major threat to the ecological integrity of Sydney Harbour.

Groundwater

A study of WaterNSW's real-time water data mapping was undertaken on 31 October 2019 in order to understand the potential groundwater depths of the Proposal Area at Chalmers Street Substation. Using the Greater Sydney Region Map, the three closest bores that discovered groundwater are as follows:

- GW109502: located approximately 515 metres northwest of the Proposal Area, identified that the standing water level was 2.18 metres below the surface
- GW109503: located approximately 512 metres northwest of the Proposal Area, identified that the standing water level was 2.24 metres below the surface.

The exact depth of groundwater at the Chalmers Street Substation section of the Proposal Area is currently unknown.

Flooding

A review of a flood study prepared for City of Sydney Council by WMA Water (2015) for the Blackwattle Bay Catchment, identified that part of the Proposal Area at Chalmers Street Substation is located within an area that would be inundated by PMF and one percent AEP flood event. More specifically, the area affected is nearby the entrance to the Airport Line tunnel, where the elevation of the land lowers.

6.9.2 Potential impacts

Construction phase

a) Wollli Creek

Surface water

The Proposal involves minor, shallow excavation for the cabling works, and deep excavation which, dependent on the method chosen, is likely to displace and generate loose sediment at the surface level.

During rain events, this material may be transported via overland stormwater flow (where sag points are not located, and where the depth of stormwater flow exceeds the depth of the sag point), into nearby underground stormwater drains. Further to this, given the proximity of the Proposal Area to Wollli Creek and the Cooks River, there is also the potential that the loose sediment may flow directly into those waterways.

During construction, fuels, lubricants, oils and other chemicals may be used. The use of fuels, lubricants, oils and other chemicals during the construction phase of the Proposal, especially through the refuelling and maintenance of plant and equipment has the potential to affect local water quality. These chemicals may enter the existing underground stormwater system through stormwater drains within the Proposal Area, and nearby stormwater drains located on the road areas surrounding the Proposal Area. During rain events, if unprotected, these chemicals would drain directly to the Cooks River or Wollli Creek.

Each of the above issues have the potential to affect local water quality, especially within Wollli Creek and the Cooks River. Implementing the control measures proposed in **Section 6.9.3** would reduce the likelihood of those issues occurring, and thus it is anticipated that any potential impact upon surface water as a result of the Proposal would be negligible to minor.

Groundwater

Cabling works at the Wollli Creek section of the Proposal Area would not require excavation or ground penetration to a depth that would reach groundwater, which is likely to be between 1.24 metres to 1.55 metres below the surface. Groundwater is expected to be encountered during piling works for the foundations of the proposed substation.

A groundwater management plan (GMP) would be prepared and implemented to manage impacts to groundwater during construction. The GMP would include management measures for groundwater dewatering. With the GMP in place, and the limited amount of groundwater that would be displaced, the overall impact to groundwater at the Wollli Creek section of the Proposal Area would be a minor negative impact.

Flooding

Within the Proposal Area at Wollli Creek, flood mapping indicates that the depth of flood waters would exceed 0.25 metres during a one percent AEP flood event. During a PMF flood event, flood waters range from 1 metre to >2 metres in depth. Should such flood events occur during the construction phase, it is likely that exposed sediment from those excavations, as well as any piled sediment, would be eroded with the flood waters.

As the one percent AEP flood event and PMF flood event are extremely rare flood events, the risk of this occurring is low. Further, given the limited amount of material that would be exposed and available to be eroded by flood waters, the extent of the affect these materials would have is anticipated to be low in the context of a major flood event. Overall, flood impacts associated with the construction phase of the Proposal at Wollli Creek are negligible.

b) Airport Line tunnel

Surface water

Works within the Airport Line tunnel would not affect surface water.

Groundwater

Works within the Airport Line tunnel would not affect groundwater.

Flooding

Works within the Airport Line tunnel would not affect the behaviour of floodwater flows, or the storage capacity for floodwaters within the floodplain.

c) Green Square Station

Surface water

The Proposal involves minor, shallow excavation for the cabling works. Cabling works are likely to result in the temporary exposure of loose soil/spoil/sediment of unknown composition and origin to elemental conditions such as rain and wind.

During rain events, this material may be transported via overland stormwater flow into nearby underground stormwater drains that discharge into local waterways.

During construction, fuels, lubricants, oils and other chemicals may be used. The use of fuels, lubricants, oils and other chemicals during the construction phase of the Proposal, especially through the refuelling and maintenance of plant and equipment has the potential to impact upon local water quality. These chemicals may enter the existing underground stormwater system through stormwater drains within the Proposal Area, and nearby stormwater drains located on the road areas surrounding the Proposal Area.

Each of the above issues have the potential to affect local water quality. Implementing the control measures proposed in **Section 6.9.3** would reduce the likelihood of those issues occurring, and thus it is anticipated that any potential impact upon surface water as a result of the Proposal would be negligible to minor.

Groundwater

The nearest borehole to the Proposal Area indicated that the water bearing zone began from >2 metres below the surface. The shallow excavations required as part of this section of the Proposal would not reach those depths and is unlikely to contact groundwater. Accordingly, affects upon groundwater during construction at Green Square Station are negligible.

Flooding

Within the Proposal Area where ground excavation works would be undertaken, flood mapping indicates that the depth of flood waters would range from <0.2 metres to 0.21 – 0.5 metres during a one percent AEP flood event. During a PMF flood event, flood mapping indicates that the depth of flood waters would range from 0.21 – 0.5 metres to 0.51 – 1 metre. Should such flood events occur during the construction phase, it is likely that exposed soil/spoil/sediment from those excavations, would be eroded with the flood waters.

As the one percent AEP flood event and PMF flood event are extremely rare flood events, the risk of this occurring is low. Further, given the limited amount of material that would be exposed and available to be eroded by flood waters, the extent of the affect these materials would have is anticipated to be low. Overall, flood impacts associated with the construction phase of the Proposal at Green Square Station are negligible.

d) Chalmers Street Substation

Surface water

The Proposal involves minor, shallow excavation for the cabling works. Cabling works are likely to result in the temporary exposure of loose soil/spoil/sediment of unknown composition and origin to elemental conditions such as rain and wind.

During rain events, this material may be transported via overland stormwater flow into nearby underground stormwater drains that discharge into local waterways. In addition, during days

with strong winds, loose material may be transported through aeolian processes and be deposited into or around entrance points to stormwater channels.

During construction, fuels, lubricants, oils and other chemicals may be used. The use of fuels, lubricants, oils and other chemicals during the construction phase of the Proposal, especially through the refuelling and maintenance of plant and equipment has the potential to impact upon local water quality. These chemicals may enter the existing underground stormwater system through stormwater drains within the Proposal Area, and nearby stormwater drains located on the road areas surrounding the Proposal Area.

Each of the above issues have the potential to affect local water quality. Implementing the control measures proposed in **Section 6.9.3** would reduce the likelihood of those issues occurring, and thus it is anticipated that any potential impact upon surface water as a result of the Proposal would be negligible to minor.

Groundwater

The nearest borehole to the Proposal Area indicated that the water bearing zone began from greater than two metres below the surface. The shallow excavations required as part of this section of the Proposal would not reach those depths and is unlikely to contact groundwater. Accordingly, affects upon groundwater during construction at Chalmers Street Substation are negligible.

Flooding

Within the Proposal Area where ground excavation works would be undertaken, flood mapping indicates that the depth of flood waters would range from 0.1 – 0.25 metres during a one percent AEP flood event. During a PMF flood event, flood mapping indicates that the depth of flood waters would range from 0.1 – 0.25 metres to 0.25 – 0.5 metres. Should such flood events occur during the construction phase, it is likely that exposed sediment from those excavations, would be eroded with the flood waters.

As the one percent AEP flood event and PMF flood event are extremely rare flood events, the risk of this occurring is low. Further, given the limited amount of material that would be exposed and available to be eroded by flood waters, the extent of the affect these materials would have is anticipated to be low. Overall, flood impacts associated with the construction phase of the Proposal at Chalmers Street Substation are negligible.

Operational phase

a) Wollli Creek

Surface water

A slight increase to the impervious surface area within the Proposal Area at Wollli Creek would occur as a result of the formalising of the access road to the proposed substation from Lusty Street. Increasing impervious surface area reduces the ability for the site to naturally drain rainwater and surface runoff through the existing soil network and increases the potential for additional surface runoff and the flow speed of that surface runoff. Those increases raise the chance of urban pollutants/sediments entering the underground stormwater drainage network, consequently flowing into the drainage outflows at Wollli Creek and the Cooks River. However, the extent of the impact is anticipated to be negligible to minor, as the relative overall increase in impervious surface, and thus surface runoff, is minor.

Groundwater

The operation of the Proposal at the Wollli Creek section of the Proposal Area would have no ongoing additional impacts to groundwater.

Flooding

As the Proposal is still in the concept design phase, an assessment of the potential flood impact from the Proposal at Wollli Creek was undertaken via a desktop assessment. It is

recommended that a detailed flood impact assessment is undertaken during the detailed design phase of this Proposal, to determine the exact extent of the operational flood impact of the Proposal at Wollie Creek.

The Proposal at Wollie Creek would introduce the proposed substation into the floodplain. The proposed substation adds an additional area of approximately 500 m² that flood waters would not be able to freely flow through and would consequently be diverted. During a one percent AEP flood event, flood waters are modelled to reach 0.25 metres in height at the location of the proposed substation. This would mean that approximately 128.75 m³ (or 128,750 litres) of flood water would be affected and would need to divert into other locations within the floodplain.

The removal of the Wollie Creek Sectioning Hut and the Undercliffe Substation removes 107 m² and 494 m² (respectively) of barriers to floodwaters within the floodplain. With the assumption that floodwaters would reach the same height at the Wollie Creek Sectioning Hut and the Undercliffe Substation, during a one percent AEP flood event, this results in a gain in the storage capacity for floodwaters of 26.75 m³ (26,750 litres) and 123.5 m³ (123,500 litres) respectively. In total, this is an increase of 150.25 m³ (150,250 litres).

Assuming the flood waters would reach the now vacant sections of land at the previous locations of the Wollie Creek Sectioning Hut and the Undercliffe Substation, there would be a gain in the storage capacity of floodwaters within the floodplain. The gain in storage capacity is approximately 21.5 m³ (21,500 litres).

Notwithstanding, if floodwaters do not reach the vacant areas created by the removal of those buildings, the loss of storage capacity would be approximately 128.75 m³ (or 128,750 litres) as a result of the introduction of the proposed substation. Within the context of the size of the floodplain and the depth of floodwaters in this section of the floodplain, it is considered that the effect of the diversion of those waters would not be significant. The extent of impact and confirmation of it not being significant should be undertaken through a detailed flood impact assessment during the detailed design phase of the Proposal.

b) Airport Line tunnel, Green Square Station and Chalmers Street Substation

The operation of the Proposal within the Airport Line tunnel, Green Square Station and Chalmers Street Substation sections of the Proposal Area would not result in additional operational impacts to surface water, groundwater or flooding.

6.9.3 Mitigation measures

The following hydrology and water quality mitigation measures are to be considered during detailed design:

- a hydrological assessment would be undertaken during the detailed design phase to determine final drainage arrangements and flooding risks
- consultation would be undertaken with Bayside Council regarding any additional discharge in stormwater from the station into the Council's existing drainage system
- all fuels, chemicals and hazardous liquids would be stored away from drainage lines, within an impervious bunded area in accordance with Australian Standards, EPA Guidelines and TfNSW's *Chemical Storage and Spill Response Guidelines* (TfNSW, 2018c)
- water quality and hazardous materials procedures (including spill management procedures, use of spill kits and procedures for refuelling and maintaining construction vehicles/equipment) would be implemented in accordance with relevant EPA guidelines and the TfNSW *Chemical Storage and Spill Response Guidelines* (TfNSW, 2018c) during the construction phase. All staff would be made aware of the location of the spill kits and be trained in how to use the kits in the case of a spill

- in the event of a pollution incident, works would cease in the immediate vicinity and the Contractor would immediately notify the TfNSW Project Manager and TfNSW Environment and Planning Manager. The EPA would be notified by TfNSW if required, in accordance with Part 5.7 of the POEO Act
- the existing drainage systems would remain operational throughout the construction phase
- dewatering activities, if required, would be undertaken in accordance with the Blue Book and TfNSW's *Water Discharge and Reuse Guideline* (2019f)
- should groundwater be encountered during excavation works, groundwater would be managed in accordance with the requirements of the *Waste Classification Guidelines* (EPA, 2014) and TfNSW's *Water Discharge and Reuse Guideline* (TfNSW, 2019f).

Refer to **Section 7.2** for a full list of mitigation measures.

6.10 Air quality

6.10.1 Existing environment

All sections of the Proposal Area

Based on a review of the existing land uses surrounding the Proposal, the existing air quality is considered to be characteristic of a typical suburban environment in Sydney. There are several sources that may be contributing to the air quality in the Proposal Area as discussed below.

The OEH monitor air quality across NSW. Ground-level ozone (a key component of photochemical smog which appears as white haze in summer) remains an issue for Sydney and concentrations generally continue to exceed national air quality standards on a number of days each year.

A search of the National Pollutant Inventory (NPI) database was undertaken on 1 November 2019. Searches were conducted within an extent of 1 kilometre at sections of the Proposal Area where earthworks are proposed – Wolli Creek, Green Square Station and Chalmers Street Substation.

The database search for Wolli Creek did not identify any facilities whose emissions meet the NPI reporting requirements.

The database search within 1 kilometre of the Proposal Area at Green Square Station returned three facilities that meet the NPI reporting requirements:

- Australian Refined Alloys Pty Ltd at Alexandria located approximately 970 metres west of the Proposal Area
- Spotless Facility Services, Rosebery located approximately 580 metres southeast of the Proposal Area
- Monroe Springs Alexandria, Alexandria located approximately 920 metres southwest of the Proposal Area.

The database search for Chalmers Street Substation did not identify any facilities whose emissions meet the NPI reporting requirements.

A number of non-industrial sources in the Proposal Area have the potential to influence the local air quality to varying degrees. These include:

- vehicle exhaust from the surrounding road network, with particular focus on vehicles on the Princes Highway
- domestic solid fuel burning

- railways (diesel freight).

Potentially affected receivers within the vicinity of the Proposal Area include local residents, businesses, community centres and educational facilities surrounding the site.

6.10.2 Potential impacts

Construction phase

All sections of the Proposal Area

Temporary air quality impacts that have the potential to occur during construction include minor increases in dust and emissions of carbon monoxide, sulphur dioxide, particulate matter, nitrous oxides, volatile organic compounds and other substances associated with excavation and the combustion of diesel fuel and petrol from construction plant and equipment.

Anticipated sources of dust and dust-generating activities include:

- demolition of existing infrastructure
- trenching works
- stockpiling activities
- loading and transfer of material from trucks
- other general construction activities.

The air quality impact associated with the above activities would be localised and generally contained within the Wollie Creek Junction, Green Square Station and at Chalmers Street Substation. These impacts would be small scale, involving small numbers of machinery, vehicles and equipment. They would also be intermittent and temporary, being restricted to construction hours. Appropriate measures would be established to manage dust emissions from construction and demolition works. On this basis the overall significance of air quality impacts associated with the construction of the Proposal is expected to be minor.

Operational phase

All sections of the Proposal Area

Overall impacts to air quality during the operation of the Proposal would be negligible as the Proposal would not result in any changes in land use. Also, as the Proposal would improve the customer experience, the Project may contribute to a mode shift to public transport from private vehicles and a reduction in emissions in the long-term. The works would increase electrical activity in the area (refer to the impacts of EMF in **Section 6.12**). However, there would be no emissions released from the new substation and thus no anticipated impacts to air quality are anticipated.

6.10.3 Mitigation measures

The following mitigation measures would apply to the Proposal:

- air quality management and monitoring for the Proposal would be undertaken in accordance with TfNSW's *Air Quality Management Guideline* (TfNSW, 2019a)
- methods for management of emissions would be incorporated into project inductions, training and pre-start/toolbox talks
- plant and machinery would be regularly checked and maintained in a proper and efficient condition. Plant and machinery would be switched off when not in use, and not left idling
- vehicle and machinery movements during construction would be restricted to designated areas and sealed/compacted surfaces where practicable

- to minimise the generation of dust from construction activities, the following measures would be implemented:
- apply water (or alternate measures) to exposed surfaces (e.g. unpaved roads, stockpiles, hardstand areas and other exposed surfaces)
- cover stockpiles when not in use
- appropriately cover loads on trucks transporting material to and from the construction site and securely fix tailgates of road transport trucks prior to loading and immediately after unloading
- prevent mud and dirt being tracked onto sealed road surfaces.

Refer to **Section 7.2** for a list of proposed mitigation measures. All mitigation measures are to be incorporated into the CEMP.

6.11 Waste

6.11.1 Potential impacts

All sections of the Proposal Area

Construction of the Proposal would result in the generation of the following waste materials:

- excavated spoil
- asphalt and concrete
- surplus building materials and building waste (metal, timber, plastics, etc.)
- electrical wiring and conduit waste
- hazardous waste (chemicals)
- green waste (including weeds)
- packaging waste
- oil and lubricants
- general waste, including food scraps generated by construction workers.

Efforts to minimise the volume of surplus materials have been undertaken during planning and design of construction activities.

The Proposal would not result in changes to operational waste management arrangements.

Mitigation measures to address waste generated during construction of the Proposal are found in Section **6.11.2** and **Table 7.1**. All measures would be incorporated into the CEMP.

6.11.2 Mitigation measures

The following mitigation measures would apply to the Proposal:

The CEMP (or separate Waste Management Plan, if necessary) must address waste management and would at a minimum:

- identify all potential waste streams associated with the works and outline methods of disposal of waste that cannot be reused or recycled at appropriately licensed facilities
- detail other onsite management practices such as keeping areas free of rubbish
- specify controls and containment procedures for hazardous waste and asbestos waste
- outline the reporting regime for collating construction waste data
- an appropriate Unexpected Finds Protocol, considering asbestos containing materials and other potential contaminants, would be included in the CEMP. Procedures for

handling asbestos containing materials, including licensed contractor involvement as required, record keeping, site personnel awareness and waste disposal to be undertaken in accordance with SafeWork NSW requirements

- all spoil to be removed from site would be tested to confirm the presence of any contamination. Any contaminated spoil would be disposed of at an appropriately licensed facility
- any concrete washout would be established and maintained in accordance with TfNSW's *Concrete Washout Guideline* (TfNSW, 2019e) with details included in the CEMP and location marked on the ECM
- all spoil and waste must be classified in accordance with the *Waste Classification Guidelines Part 1: Classifying waste* (EPA, 2014) prior to disposal.

Refer to **Table 7.1** for a list of proposed mitigation measures. All mitigation measures are to be incorporated into the CEMP.

6.12 Electric and magnetic fields (EMF)

6.12.1 Methodology

An EMF assessment report was prepared (AECOM, 2019d) to assess the impact of the proposed Wollie Creek Substation and the T8 Airport Line Power Supply Upgrade.

The EMF assessment is included as **Appendix I**.

Health Legislation and Guidelines

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) has adopted International Commission on Non-Ionizing Radiation Protection's (ICNIRP) 2010 *Guidelines for limiting exposure to time-varying electric and magnetic fields (1Hz to 100 kHz)*, which it regards as international best practice, for application in Australia. The recommended ICNIRP (2010) magnetic field Reference Levels are provided in **Table 6.42**.

Table 6.42 50Hz Magnetic field reference levels¹

Publication	Reference Levels ²	
	General Public ³	Occupational ⁴
ICNIRP (2010)	200µT (2,000mG)	1,000µT (10,000mG)

Notes:

- At 50Hz the most sensitive known impact is to the retinal tissue in the form of magneto-phosphenes.
- The International System of Units (SI) for magnetic field strength is Tesla (T) and another commonly used unit is Gauss (G), where 1µT = 10mG.
- The general public is defined as individuals of all ages and of differing health statuses, which may include particularly vulnerable groups or individuals, and who may have no knowledge of or control over their exposure to EMF. Note that a foetus is defined as a member of the general public, regardless of exposure scenario, and is subject to the general public restrictions (ICNIRP 2010).
- Occupationally-exposed individuals are defined as healthy adults who are exposed under controlled conditions associated with their occupational duties. They are trained to be aware of potential EMF risks and to employ appropriate harm-mitigation measures, and who have the capacity for such awareness and harm-mitigation response it is not sufficient for a person to merely be a worker (ICNIRP 2010).

The possibility of adverse health effects due to the EMF associated with electrical equipment has been comprehensively studied over several decades worldwide. To date the scientific evidence does not establish that exposure to EMF found around the home, office or near power lines causes health effects.

Personal medical devices

For persons wearing Active Implanted Medical Devices (AIMDs), which include pacemakers and implantable defibrillators, the most relevant standard is considered to be European Standard *EN 50527-1 (2016) Procedure for the assessment of the exposure to electromagnetic fields of workers bearing active implanted medical devices*. Clause 4.1.2 of this standard states that:

“AIMDs are expected to function as described in their product standards as long as the General Public Reference levels of Council Recommendation 1999/519/EC (except for static magnetic fields) are not exceeded... and where no specific warnings have been issued to the AIMD-Employee.”

In regard to AIMD manufacturers, what this means in practice is that the devices need to be designed with an immunity up to the general public reference levels. Based on the date of the referred European Council recommendation, this means that older AIMDs are considered to be immune up to 100µT (1,000mG).

For persons wearing a hearing aid or cochlear implant there is the standard risk of 50Hz magnetic field noise occurring, which would not damage the devices or the ear. Where the device has a loop system receiver, operating the device in this mode would also function correctly as the magnetic field strength of the induction loop transmissions are to be designed with a high enough signal-to-noise ratio over background magnetic fields (as per EN 60118-4). Whilst modern AIMDs are expected to be designed with consideration of the current published Reference Levels, due to differences between manufacturers and countries of origin, we recommend any persons concerned consult with their physician.

6.12.2 Existing environment

EMF are found wherever electricity is present, including home and office appliances, substations and electrical cables. All electrical equipment creates electrical and magnetic fields. The electric field is associated with the voltage of the equipment and the magnetic field is associated with the current.

In combination, these fields cause energy to be transferred along electric wires. With both electric and magnetic fields, the strength of the field is strongest when close to its source and diminishes rapidly with distance from the source. ARPANSA provide a summary of typical magnetic field levels that may be encountered in daily life, including what would be experienced at each section of the Proposal Area. The levels are shown in **Table 6.43**.

Table 6.43 Typical magnetic field levels encountered

Location	Source	Typical range	
		µT	mG
Home ¹	Television	0.02 – 0.2	0.2 – 2
	Pedestal Fan	0.02 – 0.2	0.2 – 2
	Refrigerator	0.2 – 0.5	2 – 5
	Kettle	0.2 – 1	2 – 10
	Toaster	0.2 – 1	2 – 10
	Hairdryer	1 – 7	10 – 70
	Electric Stove	0.2 – 3	2 – 30
	Electric Blanket	0.5 – 3	5 – 30
Public Streets / Neighbourhood	Directly under LV/Medium Voltage (MV) Distribution Line	0.2 – 3	2 – 30

Location	Source	Typical range	
		μT	mG
	10 m away from LV/MV Distribution Line	0.05 – 0.1	0.5 – 10
	Directly under HV Transmission Line	1 – 20	10 – 200
	At the edge of HV Transmission Line Easement	0.2 – 5	2 – 50
	Above underground cables (voltage not defined)	0.5 – 20	5 – 200

Note 1: The range of typical magnetic field levels associated with common household/office appliances are at normal user distances.

6.12.3 Potential impacts

Construction phase

During construction, the proposed Wolli Creek Substation and feeders would not be energised (i.e. would not be operational) and would therefore not generate a magnetic field.

Operational phase

Wolli Creek Substation

The magnetic field contributions of the new Wolli Creek Substation have been modelled in the HIFREQ module of the CDEGS software package. The purpose of these calculations provides an understanding of the magnetic field contribution likely to be associated with the proposed substation.

In all cases, the field contributions have been calculated at a height of 1m above ground in accordance with international practice. The total field level at any point will be the vector sum of the field contributions of the various underground and above ground sources modelled within the substation. The modelled magnetic field within and around the substation is displayed in **Figure 6.14**.

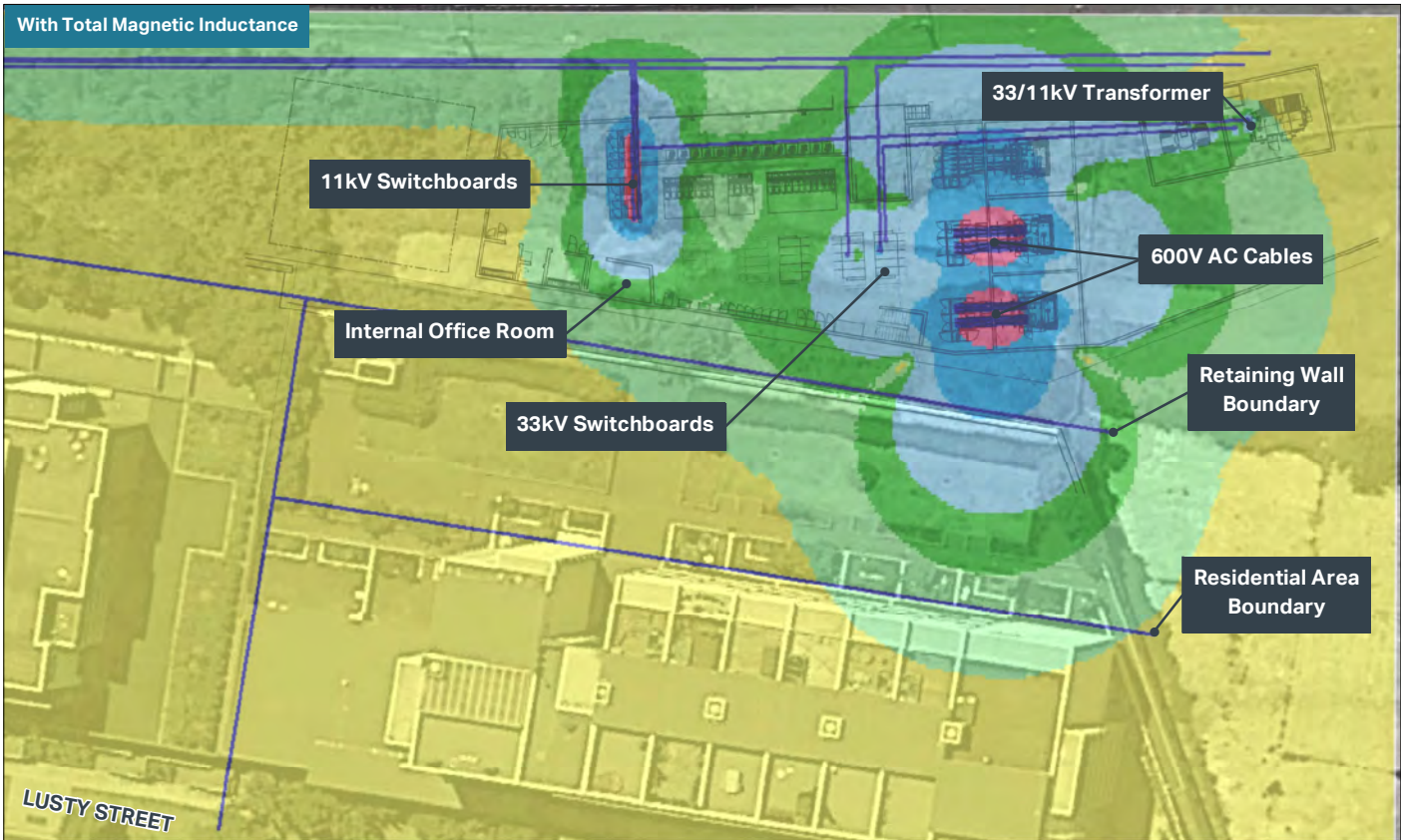
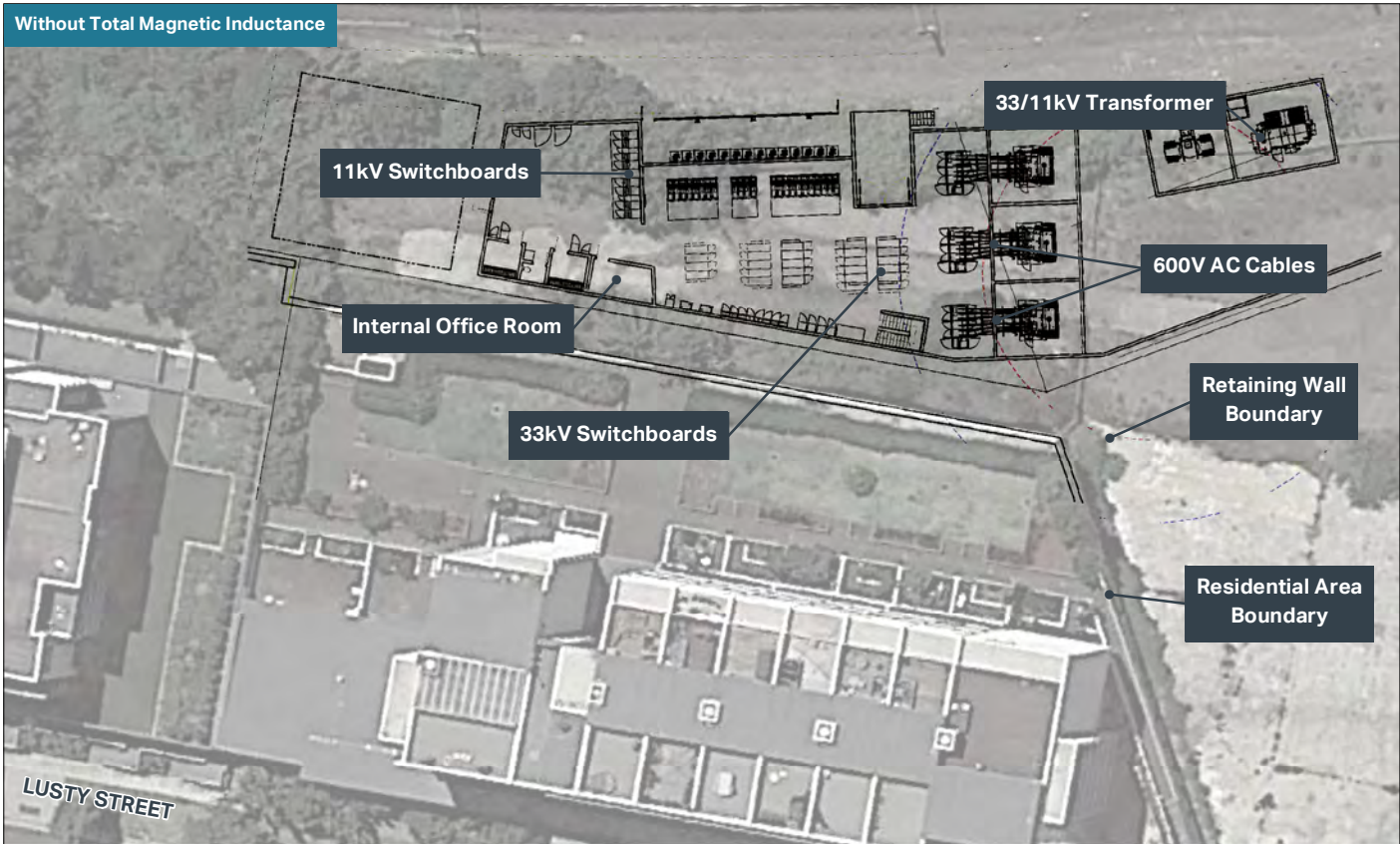


FIGURE 6-14: PROPOSED TRACTION SUBSTATION AT WOLLI CREEK - MAGNETIC FIELD RESULTS (AT SUBSTATION/RAIL LEVEL)



Legend

Total Magnetic Inductance (mG)	Color	Value
< 2000	Red	< 2000
< 1000	Pink	< 1000
< 500	Light Blue	< 500
< 50	Light Green	< 50
< 5	Green	< 5
< 2	Yellow	< 2

Maximum Value: 1720
Minimum Value: 0.05

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The following observations are made with regard to magnetic fields at this location:

- magnetic field levels in the areas of the 33 kV switchgear may reach approximately 1,000 mG which is below the occupational guideline reference level of 10,000 mG but it is potentially an issue for a person with an AIMD
- magnetic field levels near the 600 V Alternating Current (AC) cables are approximately up to 1,000 mG which is below the occupational guideline reference level of 10,000 mG but it is potentially an issue for a person with an AIMD
- the highest magnetic field contribution is at the 11 kV switchboard with magnetic field levels approximately up to 2000 mG. These levels are below the occupational guideline reference level of 10,000 mG but it is potentially an issue for a person with an AIMD
- magnetic field levels at the public boundary adjacent to the retaining walls are approximately up to 50 mG which is below the general public guideline reference level of 2,000 mG. The levels are reduced to negligible value (less than 2 mG) at 10 metres away from the public boundary.

T8 Airport Line feeder upgrade

In the rail tunnel, the feeder cables are proposed to be fixed to the walls of the tunnel using brackets. The feeder cables are proposed to be underground outside and within the rail corridor.

At Chalmers Street Substation, the predicted magnetic fields of the proposed underground feeders has a maximum up to 40 mG directly above the feeders which is below the occupational guideline reference level of 10,000 mG. The magnetic levels are reduced to 2 mG at 4 metres away from the centreline of the feeders.

The predicted magnetic fields of the proposed feeders at the Northern Portal Tunnel Section is predicted to be at a level of 32 mG inside the train carriage which is below the general public guideline reference level of 2,000 mG.

The calculated magnetic fields of the proposed feeders at the Mascot Station Tunnel Section is predicted to be at a level of 22 mG inside the train carriage which is below the general public guideline reference level of 2,000 mG.

At Green Square the predicted magnetic field levels has a maximum level of 4mG above the feeder and the levels are reduced to 2 mG at 3 metres away which are below the general public guideline reference level of 2,000 mG.

The predicted magnetic field in all locations are confirmed to be below the Reference Levels applied to the general public and staff. However, persons with AIMDS should consult with their physicians prior to working inside the substation.

6.12.4 Mitigation measures

The following mitigation measures would apply to the Proposal:

- the project will operate within the limits set in the International Commission on Non-Ionizing Radiation Protection (ICNIRP) *Guidelines for limiting exposure to EMF* (ICNIRP, 2010)
- within six months of operations commencing, magnetic field levels will be measured at select locations around the proposed substation to verify that levels are below the ICNIRP reference levels
- the design has located the proposed Wolli Creek Substation in an area within the rail corridor, where general public access is unlikely
- the substation design proposed using three-core cables for 11kV and three 1 core cables for 33kV feeders. It is recommended to use all three-core cables (or trefoil for any single core cables that cannot be avoided) to maximise the cancellation of

magnetic fields openly share to public and staff the EMF predictions and comparison to the applicable standards and guidelines for the proposed facilities

- ensure staff awareness of the EMF predictions and field sources within the substation, and comparison to the applicable standards and guidelines, and required safety protocols
- staff with AIMDS should consult with their physician if working in high EMF exposure areas
- the feeder design has incorporated using three-core cables for 33 kV and 11 kV feeders to maximise magnetic field cancellations
- inside the tunnels, it is recommended to lay the cables as close to the tunnel wall as possible to increase the separation between the cables to the public inside the train
- the cables under the road are recommended to be installed at a minimum depth of 900 mm.

Refer to **Section 7.2** for a full list of proposed mitigation measures.

6.13 Climate change and sustainability

6.13.1 Greenhouse gas emissions

An increase in greenhouse gas emissions, primarily carbon dioxide, would be expected during construction of the Proposal due to exhaust emissions from construction machinery and vehicles transporting materials and personnel to and from site.

The detailed design process would undertake an AS 14064-2 (Greenhouse Gases – Proposal level) compliant carbon footprinting exercise in accordance with TfNSW's *Greenhouse Gas Inventory Guide for Construction Proposals* (TfNSW, 2013a). The carbon footprint would be used to inform decision making in design and construction.

Due to the small scale of the Proposal and the short term temporary nature of the individual construction works, it is considered that greenhouse gas emissions resulting from the construction of the Proposal would be minimal. Furthermore, greenhouse gas emissions generated during construction would be kept to a minimum through the implementation of the standard mitigation measures detailed in **Table 7.1**.

6.13.2 Climate change

The dynamic nature of our climate system indicates a need to focus attention on how to adapt to the changes in climate and understand the limitation of adaptation. The effects of climate on the Sydney region can be assessed in terms of weather changes, storm intensity, flooding and increased risk of fire.

Climate change could lead to an increase in the intensity of rainfall events, whereby the rainfall expected to occur in a 100-year average recurrence interval flood event would occur more frequently. The Proposal is located on flood liable land and near a major water body. Therefore, there is the potential that it would be expected to be affected by potential rainfall events amplified by climate change.

Climate change could lead to an increase in frequency and severity in bushfires. The Proposal is not situated on land mapped as bush fire prone, but would be designed with appropriate fire protection measures.

The detailed design process would undertake an AS 14064-2 (Greenhouse Gases - project level) compliant carbon footprinting exercise in accordance with TfNSW's *Carbon Estimate and Reporting Tool Manual* (TfNSW, 2017). The carbon footprint would be used to inform decision making in design and construction'.

6.13.3 Sustainability

The design of the Proposal would be based on the principles of sustainability, including the incorporation of the *NSW Sustainable Design Guidelines – Version 4.0* (TfNSW, 2017) and the TfNSW *Environmental Management System* (EMS). These guidelines require a number of mandatory and discretionary initiatives to be applied. Refer to **Section 3.1.4** for more information regarding the application of these guidelines.

Sustainability is a key priority for More Trains More Services . TfNSW is committed to delivering sustainable transport for NSW. More Trains More Services will contribute to the achievement of a sustainable transport system through:

- minimising impacts to the environment through design, construction and maintenance
- reinforcing inherent sustainability benefits
- driving sustainability through recognised rating tools
- maximising energy efficiency, renewables and greenhouse gas reduction
- advocating for sustainable communities
- reporting on progress and achievements.

The construction contractor will (in conjunction with TfNSW) play a role in endeavouring to achieve an Infrastructure Sustainability Council of Australia (ISCA) rating of “Excellent” (in accordance with Version 1.2 of ISCA Guidelines) for the delivery, operation and maintenance phases of More Trains More Services.

6.14 Cumulative impacts

In accordance with clause 82 of the EP&A Regulation, any cumulative environmental effects of the Proposal associated with other existing and likely future activities must be taken into account in determining the potential impacts of the proposal on the environment.

Cumulative impacts occur when two or more projects are carried out concurrently and in close proximity to one another. The impacts may be caused by both construction and operational activities and can result in a greater impact to the surrounding area than would be expected if each project was undertaken in isolation. Multiple projects undertaken at a similar time/similar location may also lead to construction fatigue, particularly around noise, traffic and air quality impacts, if not appropriately managed.

6.14.1 Existing environment

Wolli Creek

A search of the Department of Planning, Industry and Environment’s Major Projects Register, Development and Planning Register, and Bayside Council Development Application Register was undertaken on 14 November 2019. These searches identified the following proposed nearby developments:

- Major Projects
- West Connex – The New M5 is located about 1 kilometre east of the Wolli Creek section of the Proposal Area. The Arncliffe construction site is located within the Kogarah Golf Club and has resulted in an increase in noise, dust, visual and traffic impacts in the area
- Sydney Gateway Project – this project involves the Sydney Gateway road project (upgrades of major roads and terminal links around Sydney Airport) and Port Botany Rail Duplication (to duplicate a three-kilometre section of the Port Botany freight rail line) to provide new direct high capacity road connections linking the Sydney motorway

network with Sydney Airport. Located about 1.1 kilometres southeast of the Wolli Creek Junction

- M6 Extension Stage 1 – located approximately 2 kilometres south of the Wolli Creek section of the Proposal Area. This project would involve both underground and aboveground works. The aboveground works would generate noise, dust and traffic affects.
- Bayside Council
- Around Wolli Creek Station, there are multiple, ongoing high-density residential developments. Some of those developments have reached completion and are now occupied by people. The extent of occupation is unknown. In addition, some of those developments are still within the construction phase.

Airport Line tunnel

Other projects would not generate negative cumulative impacts in combination with works in the Airport Line tunnel component of the Proposal.

Green Square Station

- Major Projects
- Green Square Integrated Community Facility and School – this project is still in the “request for SEARs” stage, meaning that a potential environmental impact statement for that project has not been submitted to DPIE for consideration. It is unknown whether the works would coincide with works at Green Square Station. If approved, this project would be located approximately 400 metres from Green Square Station
- Sydney Metro – Waterloo Station. This project is located approximately 1 kilometre from the Proposal at the Green Square Station section. This project is currently within the construction phase until approximately 2024. It is likely that the aboveground construction works associated with this project and the impacts associated with those works including traffic, noise and air quality would coincide with the minor works at Green Square Station
- Sydney Metro – Waterloo Over Station Development. This project is located approximately 1 kilometre from the Proposal at the Green Square Station section. This project is currently in the planning assessment phase. Should that project be approved, construction is anticipated to occur between 2021 – 2024.
- More Trains More Services
- As part of the More Trains More Services program, a new substation is being proposed to be constructed near Mascot Station. If approved, these works would be located approximately 2.5 kilometres from the works at Green Square Station.
- City of Sydney Council
- Similar to Wolli Creek, the area surrounding Green Square Station, especially on the eastern side of Botany Road features several ongoing high-density residential developments and communal developments as part of the Green Square Town Centre Development. This development features construction at:
 - 301-303 Botany Road, Zetland
 - 324 Botany Road Alexandria
 - 501 Botany Road Zetland
 - 509 Botany Road Zetland
 - 511-515 Botany Road Zetland

- 97-115 Portman Street Zetland
- 811 Elizabeth Street Zetland
- 312-318 Botany Road Alexandria
- 318A Botany Road Alexandria
- 320-322 Botany Road Alexandria
- 3 Joynton Avenue, Zetland
- 6-12 O’Riordan Street
- 2A Bourke Road.

Each of the developments being carried out on those properties are within 500 metres of the Proposal at the Green Square Station section of the Proposal Area.

Chalmers Street Substation

- Major Projects
- Sydney Metro – Central Station. This project is located within the Central Station precinct within 300 metres of the Proposal at the Chalmers Street Substation section. This project is currently under construction, and will continue to be under construction during the construction phase of the Proposal at this location.
- Central Park, Chippendale. This ongoing project is located within 500 metres of the Proposal at this section of the Proposal Area. While most of the construction work for this project is now complete, there are still ongoing construction works that are likely to contribute to the overall cumulative amenity impacts in this region.
- City of Sydney Council
- Generally, development within 500 metres of the Proposal Area at the Chalmers Street Substation section of the Proposal Area that is not a major project consists of internal fit out works to existing buildings. These types of works would inevitably create additional amenity impacts including through increased noise and traffic volume, however not to the extent of a major construction project.

6.14.2 Potential impacts

Construction phase

a) Wolli Creek

Should the Proposal coincide with the major projects identified above, the potential for cumulative impacts is considered to be limited. This is due to their substantial separation from the Proposal, as well as the low likelihood that residual impacts from either would contribute to any environmental or amenity factors exceeding suitable thresholds.

Construction of the Proposal would be coordinated with any other NSW government agencies, such as TfNSW (formerly RMS) or Sydney Trains, so as to minimise cumulative construction impacts such as traffic and noise.

In relation to the surrounding high-density residential developments, those developments are likely to result in increased traffic movements from light and heavy construction vehicles during the construction phases of those projects. In addition, those projects are also likely to contribute to other amenity affects in the area surrounding the Proposal, especially through the generation of noise during construction works

During the operational phase of those projects, of which some have reached, the increased number of residents in those buildings is likely to generate greater pedestrian and vehicular

traffic around this section of the Proposal Area. Combined with the traffic generation from the construction phase of this component of the Proposal, there would be a slight increase in overall traffic. The effect of this is not considered to be significant.

b) Airport Line tunnel

Other projects would not generate negative cumulative impacts in combination with works in the Airport Line tunnel component of the Proposal.

c) Green Square Station

The Proposal at the Green Square Station section of the Proposal Area would coincide with the abovementioned major project works at the Green Square Town Centre development, should the Proposal be approved. As the works at this section of the Proposal Area are minor, especially in comparison to surrounding works involving the construction of high-density residential and mix-used buildings, the contribution to cumulative impacts from the Proposal would be negligible.

Overall, with all projects coinciding, there would be increased noise, traffic, visual and air quality amenity impacts. Those impacts would be mitigated in line with the mitigation measures presented in this document, and the mitigation measures/conditions of approval applicable to the surrounding development projects.

d) Chalmers Street Substation

The Chalmers Street Substation component of the Proposal is not likely to be a key contributor to cumulative amenity impacts in the area surrounding the works. In addition to the major projects occurring nearby the Proposal, and other projects including internal fit out works, there is likely to be an overall increase in construction traffic, noise, visual amenity and air quality impacts. Those impacts would be mitigated through the mitigation measures proposed throughout this document, and the mitigation measures/conditions of approval applicable to the surrounding developments.

Operation

a) Wolli Creek

The operational phase at the Wolli Creek section of the Proposal would not result in negative cumulative impacts with other projects.

b) Airport Line tunnel

The operational phase of the Airport Line tunnel section of the Proposal would not result in negative cumulative impacts with other projects.

c) Green Square Station

The operational phase of the Green Square Station section of the Proposal would not result in negative cumulative impacts with other projects.

d) Chalmers Street Substation

The operation phase of the Chalmers Street Substation section of the Proposal would not result in negative cumulative impacts with other projects.

6.14.3 Mitigation measures

The potential cumulative impacts associated with the Proposal would be further considered as the design develops and as further information regarding the location and timing of potential developments is released. Environmental management measures would be developed and implemented as appropriate.

7 Environmental management

This chapter of the REF identifies how the environmental impacts of the Proposal would be managed through environmental management plans and mitigation measures. **Section 7.2** lists the proposed mitigation measures for the Proposal to minimise the impacts of the Proposal identified in **Chapter 6**.

7.1 Environmental management plans

A CEMP for the construction phase of the Proposal would be prepared in accordance with the requirements of TfNSW's EMS. The CEMP would provide a centralised mechanism through which all potential environmental impacts relevant to the Proposal would be managed, and outline a framework of procedures and controls for managing environmental impacts during construction.

The CEMP would incorporate as a minimum all environmental mitigation measures identified below in **Section 7.2**, any conditions from licences or approvals required by legislation, and a process for demonstrating compliance with such mitigation measures and conditions.

7.2 Mitigation measures

Mitigation measures for the Proposal are listed below in **Table 7.1**. These proposed measures would minimise the potential adverse impacts of the Proposal identified in **Chapter 6** should the Proposal proceed.

Table 7.1 Proposed mitigation measures

No.	Mitigation measure
	General
1.	A Construction Environmental Management Plan (CEMP) would be prepared by the Contractor in accordance with the relevant requirements of <i>Guideline for Preparation of Environmental Management Plans</i> , Department of Infrastructure, Planning and Natural Resources, 2004) for approval by TfNSW, prior to the commencement of construction and following any revisions made throughout construction.
2.	A Proposal risk assessment including environmental aspects and impacts would be undertaken by the Contractor prior to the commencement of construction and documented as part of the CEMP.
3.	An Environmental Controls Map (ECM) would be developed by the Contractor in accordance with TfNSW's <i>Guide to Environmental Controls Map</i> (TfNSW, 2018b) for approval by TfNSW, prior to the commencement of construction and following any revisions made throughout construction.
4.	Prior to the commencement of construction, all contractors would be inducted on the key Proposal environmental risks, procedures, mitigation measures and conditions of approval.
5.	Site inspections to monitor environmental compliance and performance would be undertaken during construction at appropriate intervals.
6.	Service relocation would be undertaken in consultation with the relevant authority. Contractors would mark existing services on the ECM to avoid direct impacts during construction.

No.	Mitigation measure
7.	Any modifications to the Proposal, if approved, would be subject to further assessment and approval by TfNSW. This assessment would need to demonstrate that any environmental impacts resulting from the modifications have been minimised.
Traffic and site access	
8.	<p>A construction TMP would be prepared by the construction contractor in consultation with TfNSW and provided to Bayside Council, City of Sydney Council and TfNSW. The construction TMP would be the primary tool to manage potential traffic and pedestrian impacts associated with construction. At a minimum, the construction TMP would include:</p> <ul style="list-style-type: none"> • ensuring adequate signage at construction work sites • consideration of safety and accessibility for pedestrians and cyclists • ensuring adequate sight lines to allow for safe entry and exit from the site • managing impacts and changes to on and off street parking, and parking locations for construction workers • routes to be used by heavy construction-related vehicles to minimise impacts on sensitive land uses and businesses • measures to manage traffic flows around the area affected by the Proposal, including as required regulatory and direction signposting, line marking and variable message signs and all other traffic control devices necessary for the implementation of the TMP.
9.	Consultation with the relevant road authorities would be undertaken during preparation of the construction TMP. The performance of all project traffic arrangements would be monitored during construction.
10.	Communication would be provided to the community, local residents and businesses to inform them of changes to parking, pedestrian access and/or traffic conditions including vehicle movements and anticipated effects on the local road network relating to site works.
11.	Access for emergency vehicles would be maintained in accordance with relevant requirements. Emergency services would be advised of all planned changes to traffic arrangements prior to applying the changes.
Urban design, landscape and visual amenity	
12.	Establish tree protection zones (TPZs) around trees to be retained. Tree protection would be undertaken in keeping with AS 4970-2009 Protection of Trees on Development Sites and would include exclusion fencing of TPZs.
13.	Provide well-presented and maintained construction hoarding and site fencing with shade cloth (or similar material) (where necessary) to minimise visual impacts on key view points during construction. Hoardings and site fencing would be removed following construction completion.
14.	Provide cut-off or directed lighting to be used with and outside of the construction site, with lighting location and direction considered to ensure glare and light spill is minimised.
15.	Construction personnel to keep the construction areas clean and tidy including refuse placed in appropriate receptacles.
16.	Measures taken to ensure no tracking of dirt and mud into public roads and other public spaces.

No.	Mitigation measure
17.	<p>To minimise visual impacts to the Proposal during operational activities, the following measures would be implemented:</p> <ul style="list-style-type: none"> • ongoing maintenance and repair of constructed elements • ongoing maintenance of vegetation, both surrounding and within the Proposal • removal of graffiti in accordance with Sydney Trains maintenance requirements.
Noise and vibration	
18.	It is recommended that the noise emissions of the substation be reviewed once the final equipment selections have been made during detailed design
19.	The tonal characteristics of the proposed equipment should be considered at the detailed design stage.
20.	The noise generating equipment and the equipment sound power levels should be confirmed at the detailed design stage.
21.	<p>Prior to commencement of works, a Construction Noise and Vibration Management Plan (CNVMP) would be prepared and implemented in accordance with the requirements of the <i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change, 2009), <i>Construction Noise and Vibration Strategy</i> (TfNSW, 2019g) and the Noise and Vibration Impact Assessment for the Proposal (AECOM, 2019b). The CNVMP would take into consideration measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where practicable.</p>
22.	<p>The CNVMP should include, as a minimum, the following:</p> <ul style="list-style-type: none"> • identification of nearby residences and other sensitive land uses • description of approved hours of work • description and identification of all construction activities, including work areas, equipment and duration • description of what work practices (generic and specific) would be applied to minimise noise and vibration • a complaints handling process • noise and vibration monitoring procedures, including for heritage structures • overview of community consultation required for identified high impact works.
23.	<p>Construction works should be planned and carried out during standard construction hours wherever possible. The standard mitigation measures contained within the <i>Construction Noise and Vibration Strategy</i> (CNVS) (TfNSW, 2019g) will be considered as mitigation measures as part of the CNVMP.</p>
24.	<p>Wherever practical, piling activities shall be completed using non-percussive piles. If impact (i.e. percussive) piles are proposed to be used, approval from TfNSW should be obtained prior to commencement of impact piling activities.</p>

No.	Mitigation measure												
25.	<p>All residents and sensitive receivers impacted by noise levels from the Proposal which are expected to exceed the NML should be consulted prior to the commencement of the particular activity, with the highest consideration given to those that are predicted to be most affected as a result of the works.</p> <p>The information provided to the receivers would include:</p> <ul style="list-style-type: none"> programmed times and locations of construction work the hours of proposed works construction noise and vibration impact predictions construction noise and vibration mitigation measures being implemented on site. 												
26.	<p>Community consultation regarding construction noise and vibration would be detailed in a Community Liaison Management Plan for the construction of the Proposal and would include a 24 hour hotline and complaints management process.</p>												
27.	<p>TfNSW's CNVS provides practical guidance on how to minimise, to the fullest extent practicable, the impacts on the community from airborne noise, ground-borne noise and vibration generated during the construction of TfNSW projects. This is managed through the application of all feasible and reasonable mitigation measures. Where exceedances are still expected to occur after standard mitigation measures have been applied, the CNVS recommends the implementation of additional mitigation measures. These mitigation measures are specified within the CNVS.</p> <p>The provision of additional mitigation is based on the predicted exceedances above RBLs and when the exceedances occur.</p>												
28.	<p>The final equipment selections of the reactor and transformers should be selected with a sound power level 5 dB lower than the noise levels presented the table below. Alternatively, the transformers and reactors should be selected with units that do not attract either the low frequency or tonality penalties specified in the Npfl.</p> <table border="1" data-bbox="300 1200 1297 1541"> <thead> <tr> <th colspan="2" data-bbox="300 1200 1297 1256">Substation equipment reference noise levels</th> </tr> <tr> <th data-bbox="300 1256 794 1312">Source</th> <th data-bbox="794 1256 1297 1312">Sound power level (SWL), dB(A)</th> </tr> </thead> <tbody> <tr> <td data-bbox="300 1312 794 1368">5.35 MVA Rectifier Transformer</td> <td data-bbox="794 1312 1297 1368">68 L_{Aeq}¹</td> </tr> <tr> <td data-bbox="300 1368 794 1424">DC Rectifier</td> <td data-bbox="794 1368 1297 1424"><58 L_{Aeq}²</td> </tr> <tr> <td data-bbox="300 1424 794 1480">Reactor</td> <td data-bbox="794 1424 1297 1480">71 L_{Aeq}²</td> </tr> <tr> <td data-bbox="300 1480 794 1536">9 MVA Transformer</td> <td data-bbox="794 1480 1297 1536">71 L_{Aeq}¹</td> </tr> </tbody> </table> <p><i>Notes:</i></p> <ol style="list-style-type: none"> Sound Power Level (SWL) calculated in accordance with reduced maximum noise levels provided in AS60076.10.1:2009 considering the transformer capacity. SWL based on equipment on similar substations projects. 	Substation equipment reference noise levels		Source	Sound power level (SWL), dB(A)	5.35 MVA Rectifier Transformer	68 L _{Aeq} ¹	DC Rectifier	<58 L _{Aeq} ²	Reactor	71 L _{Aeq} ²	9 MVA Transformer	71 L _{Aeq} ¹
Substation equipment reference noise levels													
Source	Sound power level (SWL), dB(A)												
5.35 MVA Rectifier Transformer	68 L _{Aeq} ¹												
DC Rectifier	<58 L _{Aeq} ²												
Reactor	71 L _{Aeq} ²												
9 MVA Transformer	71 L _{Aeq} ¹												
29.	<p>Given that the predicted noise level exceeds the project noise trigger levels at 5-13 Lusty Street, Wollie Creek by 5 dB:</p> <ul style="list-style-type: none"> the project noise trigger levels could be achieved by providing barriers that break line of sight to the affected receivers at 5-13 Lusty Street. The barriers would be most effective if located as near as possible to the noise generating equipment the transformers and reactors could be enclosed by an acoustic enclosure which provides 5dB reduction. The enclosure would need to break line of sight to the receivers at 5-13 Lusty Street, Wollie Creek. An enclosure may consist of acoustically sealed walls, roof and architectural louvres (facing away from 5-13 Lusty Street, Wollie Creek) and absorptive treatment to the internal walls. 												

No.	Mitigation measure
	Indigenous heritage
30.	All construction staff would undergo an induction in the recognition of Indigenous cultural heritage material. This training would include information such as the importance of Indigenous cultural heritage material and places to the Indigenous community, as well as the legal implications of removal, disturbance and damage to any Indigenous cultural heritage material and sites.
31.	If unforeseen Indigenous objects are uncovered during construction, the procedures contained in TfNSW's <i>Unexpected Heritage Finds Guideline</i> (TfNSW, 2019b) would be followed, and works within the vicinity of the find would cease immediately. The Contractor would immediately notify the TfNSW Proposal Manager and TfNSW Environment and Planning Manager so they can assist in co-ordinating next steps which are likely to involve consultation with an Aboriginal heritage consultant, DPIE and the Local Aboriginal Land Council.
32.	If human remains are found, work would cease, the site secured and the NSW Police and DPIE notified. Where required, further archaeological investigations and an Aboriginal Heritage Impact Permit would be obtained prior to works recommencing at the location.
	Non-Indigenous heritage
33.	A heritage induction would be provided to workers prior to construction, informing them of the location of known heritage items and guidelines to follow if unanticipated heritage items or deposits are located during construction.
34.	The Construction Environmental Management Plan (CEMP) is to include details on protection measures (such as temporary fencing) and stop work procedures in accordance with Transport for NSW's (TfNSW's) <i>Unexpected Heritage Finds</i> (TfNSW, 2019b) to manage activities in the unlikely event that unexpected archaeological relics or deposits are encountered during works.
35.	Approval is required for the proposed works within the curtilage of the State significant item Sydney Terminal and Central Railway Stations Group (SHR 01255). An exemption under Section 57 of the Heritage Act utilising Exemptions 2 and 20 of the Rail Specific Exemptions is the appropriate approval pathway for the proposed works (i.e. excavation adjacent to the rail corridor for the purposes of cable laying/fixings, penetrations and cabling to be installed in existing ducts and tunnels as well as temporary compound works including the movement, laydown and storing of tools, material and equipment during works).
	Socio-economic
36.	A Community Liaison Management Plan would identify all potential stakeholders and the best practice methods for consultation with these groups.
37.	Sustainability criteria would be established to encourage construction personnel to purchase goods and services locally helping to ensure the local community benefits from the construction of the Proposal.
38.	Feedback through the submissions process would be encouraged and opportunities and channels for the community and stakeholders to have input into the project would be provided.
39.	Contact details for a 24-hour construction response line, Project Infoline and email address would be provided for ongoing stakeholder contact throughout the construction phase.

No.	Mitigation measure
40.	The community would be kept informed of construction progress, activities and impacts in accordance with the Community Liaison Management Plan to be developed prior to construction.
41.	Mitigation measures would be implemented in respect of potential impacts on amenity (e.g. noise, dust and visual).
Biodiversity	
42.	<p>Works within the corridor should be consistent with the following guidelines:</p> <ul style="list-style-type: none"> • TfNSW <i>Vegetation Management (Protection and Removal) Guidelines</i> (TfNSW, 2019c) • TfNSW <i>Weed Management and Disposal Guideline</i> (TfNSW, 2019d) • Offsets should be secured consistent with the <i>Vegetation Offsetting Guide 9TP-SD-087</i> (TfNSW 2016) • potential offset requirements or retention of some native vegetation present should be considered in relation to the ISCA tool metrics.
43.	<p>The CEMP should include:</p> <ul style="list-style-type: none"> • the establishment of clearly defined areas, such as the works area and any ‘no-go’ areas within/adjacent to work site boundaries that are not to be in any way disturbed or damaged by the works, particularly adjacent to vegetation to be retained and Wolli Creek • construction fencing prior to and during construction to ensure that construction related impacts are contained within the construction areas • sediment fencing should be placed 2 metres either side of the construction footprint (where possible) • surface runoff should be diverted away from areas of soil disturbance and away from Wolli Creek • prevent tracking of soils / sediments from work site to roadways, footpaths and drainage lines as a result of work vehicle / machinery movement • vehicle and machinery movement will be confined to designated tracks and work areas • any concrete washout would be established and maintained in accordance with TfNSW’s <i>Concrete Washout Guideline</i> (TfNSW, 2019e) • the site-specific CEMP must include instructions for dealing with orphaned or injured native animals and include the contact details for the NSW Wildlife Information, Rescue and Education Service Inc. (WIRES).
44.	Drainage should be controlled in the impact areas consistent with the <i>Protection of the Environment Operations Act 1997</i> requirements to avoid impacts on downstream habitats, and ecological communities.
45.	Ensure fertilisers, turf, mulch, weeds and imported soils are not unintentionally introduced into bushland areas adjacent to the rail corridor (i.e. through natural drainage pathways or general proximity).
46.	Temporary tree protection measures (such as machinery exclusion zones from tree roots and tree trunk protection) must be in place for any retained trees and to protect adjacent native vegetation during all construction works. High visibility orange bunting must be placed at a one metre distance from the trunk of the tree with “no-go” signage attached.
47.	Works must be stopped if any previously undiscovered threatened species or communities are discovered during works. An assessment of the impact and any required approvals must be obtained.

No.	Mitigation measure
48.	Equipment, heavy machinery and materials must be situated in designated lay-down areas in portions of cleared land where they are least likely to cause erosion or damage vegetation.
49.	Work vehicle access must be restricted to designated work areas and existing formed access tracks/roadways.
50.	Weed removal must be undertaken using mechanical and manual means, and if herbicides are required user must follow the prescriptions on the label. Herbicide use should be restricted within proximity to the creek.
Contamination, landform, geology and soils	
51.	Prior to commencement of works, a site-specific Erosion and Sediment Control Plan would be prepared in accordance with the 'Blue Book' <i>Managing Urban Stormwater: Soils and Construction Guidelines</i> (Landcom, 2004) and updated throughout construction so it remains relevant to the activities. The Erosion and Sediment Control Plan measures would be implemented prior to commencement of works and maintained throughout construction.
52.	Erosion and sediment control measures would be established prior to any clearing, grubbing and site establishment activities and would be maintained and regularly inspected (particularly following rainfall events) to ensure their ongoing functionality. Erosion and sediment control measures would be maintained and left in place until the works are complete and areas are stabilised.
53.	Vehicles and machinery would be properly maintained and routinely inspected to minimise the risk of fuel/oil leaks. Construction plant, vehicles and equipment would also be refuelled offsite, or in a designated refuelling area.
54.	All fuels, chemicals and hazardous liquids would be stored away from drainage lines, within an impervious bunded area in accordance with Australian Standards, EPA Guidelines and TfNSW's <i>Chemical Storage and Spill Response Guidelines</i> (TfNSW, 2018c).
55.	An appropriate Unexpected Finds Protocol, considering asbestos containing materials and other potential contaminants, would be included in the CEMP. Procedures for handling asbestos containing materials, including licensed contractor involvement as required, record keeping, site personnel awareness and waste disposal to be undertaken in accordance with SafeWork NSW requirements.
56.	All spoil to be removed from site would be tested to confirm the presence of any contamination. Any contaminated spoil would be disposed of at an appropriately licensed facility.
57.	All spoil and waste must be classified in accordance with the <i>Waste Classification Guidelines Part 1: Classifying waste</i> (EPA, 2014) prior to disposal.
58.	Hydrocarbons and chemicals such as fuels, lubricants and oils would be stored on-site in dedicated facilities such as secure sheds, containers, storage tanks and proprietary hazardous substance cupboards, and in accordance with the applicable Safety Data Sheet (SDS).
59.	In the event of a pollution incident, works would cease in the immediate vicinity and the Contractor would immediately notify the TfNSW Project Manager and TfNSW Environment and Planning Manager. The EPA would be notified by TfNSW if required, in accordance with Part 5.7 of the PoEO Act.
60.	Spill kits appropriate to products used on site must be readily available.

No.	Mitigation measure
61.	Spills of fuel, oil, chemicals or the like would be cleaned immediately, and the site environmental manager would be notified of the location of the incident, extent of the incident and type of material spilled.
62.	Any concrete washout would be established and maintained in accordance with TfNSW's <i>Concrete Washout Guideline</i> (TfNSW, 2019e) with details included in the CEMP and location marked on the Environmental Controls Map (ECM).
63.	An ASSMP is to be prepared. The ASSMP would detail the management requirements for ASS within the Proposal Area. At Wolli Creek, all natural soils one metre below ground level and any filling below the water table, would be assumed to be ASS, unless high density ex situ assessment indicates specific horizons are not ASS.
Hydrology and water quality	
64.	A hydrological assessment would be undertaken during the detailed design phase to determine final drainage arrangements and flooding risks.
65.	Consultation would be undertaken with Bayside Council regarding any additional discharge in stormwater from the station into the Council's existing drainage system.
66.	All fuels, chemicals and hazardous liquids would be stored away from drainage lines, within an impervious bunded area in accordance with Australian Standards, EPA Guidelines and TfNSW's <i>Chemical Storage and Spill Response Guidelines</i> (TfNSW, 2018c).
67.	Water quality and hazardous materials procedures (including spill management procedures, use of spill kits and procedures for refuelling and maintaining construction vehicles/equipment) would be implemented in accordance with relevant EPA guidelines and the TfNSW <i>Chemical Storage and Spill Response Guidelines</i> (TfNSW, 2018c) during the construction phase. All staff would be made aware of the location of the spill kits and be trained in how to use the kits in the case of a spill.
68.	In the event of a pollution incident, works would cease in the immediate vicinity and the Contractor would immediately notify the TfNSW Project Manager and TfNSW Environment and Planning Manager. The EPA would be notified by TfNSW if required, in accordance with Part 5.7 of the POEO Act.
69.	The existing drainage systems would remain operational throughout the construction phase.
70.	Dewatering activities, if required, would be undertaken in accordance with the Blue Book and TfNSW's <i>Water Discharge and Reuse Guideline</i> (2019f).
71.	Should groundwater be encountered during excavation works, groundwater would be managed in accordance with the requirements of the <i>Waste Classification Guidelines</i> (EPA, 2014) and TfNSW's <i>Water Discharge and Reuse Guideline</i> (TfNSW, 2019f).
Air quality	
72.	Air quality management and monitoring for the Proposal would be undertaken in accordance with TfNSW's <i>Air Quality Management Guideline</i> (TfNSW, 2019a).
73.	Methods for management of emissions would be incorporated into Proposal inductions, training and pre-start/toolbox talks.
74.	Plant and machinery would be regularly checked and maintained in a proper and efficient condition. Plant and machinery would be switched off when not in use, and not left idling.

No.	Mitigation measure
75.	Vehicle and machinery movements during construction would be restricted to designated areas and sealed/compacted surfaces where practicable.
76.	<p>To minimise the generation of dust from construction activities, the following measures would be implemented:</p> <ul style="list-style-type: none"> • apply water (or alternate measures) to exposed surfaces (e.g. unpaved roads, stockpiles, hardstand areas and other exposed surfaces) • cover stockpiles when not in use • appropriately cover loads on trucks transporting material to and from the construction site and securely fix tailgates of road transport trucks prior to loading and immediately after unloading • prevent mud and dirt being tracked onto sealed road surfaces.
Waste and contamination	
77.	<p>The CEMP (or separate Waste Management Plan, if necessary) must address waste management and would at a minimum:</p> <ul style="list-style-type: none"> • identify all potential waste streams associated with the works and outline methods of disposal of waste that cannot be reused or recycled at appropriately licensed facilities • detail other onsite management practices such as keeping areas free of rubbish • specify controls and containment procedures for hazardous waste and asbestos waste • outline the reporting regime for collating construction waste data • an appropriate Unexpected Finds Protocol, considering asbestos containing materials and other potential contaminants, would be included in the CEMP. Procedures for handling asbestos containing materials, including licensed contractor involvement as required, record keeping, site personnel awareness and waste disposal to be undertaken in accordance with SafeWork NSW requirements • all spoil to be removed from site would be tested to confirm the presence of any contamination. Any contaminated spoil would be disposed of at an appropriately licensed facility • any concrete washout would be established and maintained in accordance with TfNSW's <i>Concrete Washout Guideline</i> (TfNSW, 2019e) with details included in the CEMP and location marked on the ECM • all spoil and waste must be classified in accordance with the <i>Waste Classification Guidelines Part 1: Classifying waste</i> (EPA, 2014) prior to disposal.
Electric and magnetic fields (EMF)	
78.	The project would operate within the limits set in the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for limiting exposure to EMF (ICNIRP, 2010).
79.	Within six months of operations commencing, magnetic field levels would be measured at select locations along the transmission cable route to verify that levels are below the ICNIRP reference levels.
80.	The design has located the proposed Wolli Creek Substation in an area within the rail corridor, where general public access is unlikely.
81.	The substation design proposed using 3 core cables for 11kV and three 1 core cables for 33kV feeders. It is recommended to use all 3 core cables (or trefoil for any single core cables that cannot be avoided) to maximise the cancellation of magnetic fields.

No.	Mitigation measure
82.	Openly share to public and staff the EMF predictions and comparison to the applicable standards and guidelines for the proposed facilities.
83.	Ensure staff awareness of the EMF predictions and field sources within the substation, and comparison to the applicable standards and guidelines, and required safety protocols.
84.	Staff with medical implants should consult with their physician if working in high EMF exposure areas.
85.	The feeder design has incorporated using 3 core cables for 33kV and 11kV feeders to maximise magnetic field cancellations.
86.	Inside the tunnels, it is recommended to lay the cables as close to the tunnel wall as possible to increase the separation between the cables to the public inside the train.
87.	The cables under the road are recommended to be installed at a minimum depth of 900mm.
Climate change and sustainability	
88.	The project would aim to achieve an 'Excellent' rating through the ISCA rating scheme (v1.2).
89.	The detailed design process would undertake an AS 14064-2 (Greenhouse Gases - project level) compliant carbon footprinting exercise in accordance with TfNSW's <i>Carbon Estimate and Reporting Tool Manual</i> (TfNSW, 2017). The carbon footprint would be used to inform decision making in design and construction'.
Cumulative impacts	
90.	The potential cumulative impacts associated with the Proposal would be further considered as the design develops and as further information regarding the location and timing of potential developments is released. Environmental management measures would be developed in the CEMP and implemented as appropriate.

8 Conclusion

This REF has been prepared in accordance with the provisions of section 5.5 of the EP&A Act, taking into account to the fullest extent possible, all matters affecting or likely to affect the environment as a result of the Proposal.

The likely key impacts of the Proposal are as follows:

- temporary changes to vehicle and pedestrian movements in and around Wolli Creek Station, Green Square Station and Chalmers Street Substation during the construction of the Proposal
- visual impacts during construction and operation
- noise and vibration impacts during construction and operation
- removal of some vegetation within and adjacent to the rail corridor.

This REF has considered and assessed these impacts in accordance with clause 228 of the EP&A Regulation and the requirements of the EPBC Act (refer to **Chapter 6, Appendix A and Appendix B**). Based on the assessment contained in this REF, it is considered that the Proposal is not likely to have a significant impact upon the environment or any threatened species, populations or communities. Accordingly, an EIS is not required, nor is the approval of the Minister for Planning.

The Proposal would also take into account the principles of ESD (refer to **Section 4.6**). These would be considered during the detailed design, construction and operational phases of the Proposal. This would ensure the Proposal is delivered to maximum benefit to the community, is cost effective and minimises any adverse impacts on the environment.

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