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Sydney CityGrid Project

ENVIRONMENTAL ASSESSMENT FOR STAGE 2D

NOVEMBER 2010

Document Control and Approval

EnergyAustralia

Endorsed by: Craig Moody

Title: Executive Manager – Project Development and Approvals

Signed: 

Date: 2.11.10

Endorsed by: Wilma Penrose

Title: Director – Area Development - CBD and Sydney East

Signed: 

Date: 2.11.10

GHD Pty Ltd

Author: Peter Carson

Signed: 

Date: November 2010

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Certification of the environmental assessment

Submission of Environmental Assessment

Prepared under Part 3A of the Environmental Planning and Assessment Act 1979

Environmental assessment prepared by:	
Name	Peter Carson
Qualifications	BSc Hons
Address	GHD Pty Ltd Level 15, 133 Castlereagh Street Sydney NSW 2000
In respect of:	Sydney CityGrid Project - Stage 2D
Project to which Part 3A applies	
Applicant name	EnergyAustralia
Applicant address	570 George Street Sydney NSW 2000
Land to be developed	As described within the Environmental Assessment
Proposed development	Construction of Stage 2D of the CityGrid Project involving the construction of the City East Cable Tunnel, extension of the City South Cable Tunnel, refurbishment of the existing Dalley Street Zone Substation, and associated works.
Environmental assessment	An environmental assessment is attached that addresses all matters in accordance with Part 3A of the Act
Certificate	I certify that I have prepared the contents of this document and to the best of my knowledge: • It is in accordance with the requirements of Part 3A; • It contains all available information that is relevant to the enviromental assessment of the development to which it relates; and • The information contained in the document is neither false or misleading.
Signature	
Name	Peter Carson
Date	November 2010

Glossary and abbreviations

Term	Definition
AHIMS	Aboriginal Heritage Information Management System
Alluvium	Sediment deposited by flowing water, as in a riverbed, flood plain, or delta.
AS	Australian Standard
Assessment Report	The Assessment Report prepared by the Department of Planning under Part 3A of the EP&A Act, and submitted to the Minister for Planning for decision and conditions of consent.
Belmore Park Zone Substation	Belmore Park Zone Substation Project – an element of the Sydney CityGrid Project.
BS	British Standard
CBD	Central Business District
CCM	Cross City Motorway
CECT	City East Cable Tunnel
CEMP	Construction Environmental Management Plan
City East Zone Substation	City East Zone Substation – an element of the Sydney CityGrid Project
CO	Carbon monoxide
CoS	City of Sydney
CSLEP 2005	City of Sydney Local Environmental Plan 2005
CSCT	City South Cable Tunnel
CTMP	Construction Traffic Management Plan
dB(A)	Db means decibel which is a unit for measuring sound. If an "A weighting filter" is used to measure sound the sound level is given in units of dB(A).
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DIPNR	Department of Infrastructure, Planning and Natural Resources
Dykes	Dykes are geological fault zones, which vary in width from tens of centimetres to several metres, and consist of near vertical rock intrusions. Dykes generally have a significant effect on foundation bearing pressures and, particularly in tunnels, jointed margins may be a source of groundwater inflow.
EMR	Environmental Management Representative
Environmental Assessment	Generally, this term means the process of examining the environmental benefits and consequences of projects in advance of decision making. The term has a specific meaning under the Environmental Planning & Assessment Act 1979 being the form of an environmental assessment required under Part 3A of this Act.
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act (Commonwealth)	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically sustainable development. This is broadly defined as: using, conserving and enhancing the community's resources so that the ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased.
Feeder	Three individual electrical transmission cables (phases) bundled together.

Term	Definition
Hz	Hertz (one hertz is defined as one cycle per second)
INP	Industrial Noise Policy
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
kV	Kilovolts or one thousand volts. A volt is a measure of the potential difference across a conductor when a current of one ampere dissipates one watt of power.
L_{A90}	The sound level that exceeds 90% of the sampling period.
L_{Aeq}	Equivalent Continuous Sound Level: The notional sound pressure level which, if maintained constant over a given time, delivers the same amount of acoustic energy at some point as the time-varying sound pressure level would deliver at the same point and over the same period of time.
$L_{A\ (max)}$	The highest measured noise level during the period of measurement.
LEP	Local Environmental Plan
Licence conditions	Design, Reliability and Performance Licence Conditions for Distribution Network Service Providers (1 December 2007 – NSW Minister for Energy)
MCoA	Minister's Conditions of Approval
mg	milligrams
Muffler	A device to suppress noise emissions from noisy equipment or machinery.
n-2 licence conditions	Design, Reliability & Performance Licensing Conditions by the Minister for Energy for the Sydney CBD signed December 2007. N is designing the network elements for no credible contingencies; n-1 is designing for a single credible contingency (normally involving an outage of one line or one item of electrical apparatus within a substation) and n-2 is designing for two credible contingencies (normally involving outages of two lines or two items of electrical apparatus within a substation).
NES	Matters of National Environmental Significance
NO_X	Nitrogen oxides
OHS	Occupational health and safety
Paleovalley	An ancient rock valley that has been filled with sediments
PBC	Polycyclic biphenols
PM_{10}	Particles less than 10 microns in size
$PM_{2.5}$	Particles less than 2.5 microns in size
POEO	Protection of the Environment Operations Act 1997
pphm	Parts per hundred million
PPV	Peak Particle Velocity
Project	Stage 2D of the Sydney CityGrid Project
Proponent	EnergyAustralia
Preferred Project Report	A report prepared by the Proponent following consideration of all submissions if there are any proposed changes to the Project.
Reliability	An outcome based measure of the effectiveness of various network management and investment strategies in terms of their ability to provide continuous electricity supply to customers.
REP	Regional Environmental Plan
RBL	Rating Background Noise Level
RL	Relative Level
Road header	Mechanical excavating machine that has a large rotating cutting head mounted on a moveable boom. They are able to turn tight corners during tunnel construction.

Term	Definition
Sandstone	A sedimentary rock, formed by the compression and cementing of sand and other sediments over a long period of time. The majority of the Sydney Basin is underlain by sandstone.
Security	The level of back up capability able to be provided by the network. Supply security is a measure of the ability to provide back up electricity supply during stated credible contingency events.
SEPP	State Environmental Planning Policy
SEPP 55	State Environmental Planning Policy 55 – Remediation of Land
Shaft	A long, narrow, often vertical passage sunk into the earth, or a duct or conduit for the passage of air (as for ventilation or heating). Often used to access a tunnel from the ground surface.
SMF	Synthetic mineral fibres
SO_2	Sulfur dioxide
SPL	By convention, SPL has been adopted as the acronym for the Sound Pressure Levels. As power is often measured in watts, SWL has been adopted as the acronym for Sound Power Levels.
State-owned Corporation	A company or corporation specified in Schedule 1 of the State-owned Corporations Act 1989 in which the major share holder is the NSW Government.
Strata	A horizontal layer of material, especially one of several parallel layers arranged one on top of another. Sandstone is often formed of numerous layers of sediment compressed together to form the rock mass.
Stub tunnel	A short section of tunnel which links to a main tunnel
STS	A sub-transmission station generally 132kV transformed down to 11kV or 33kV transformed down to 11kV.
STSS	A sub-transmission switching station containing switchgear, generally 132kV without transformers. A STSS is generally the first stage of a bulk supply point.
Submissions Report	A report prepared by the Proponent that provides responses to the submissions received following exhibition of the Environmental Assessments.
Substation	An electrical facility which serves as a control and transfer point on an electrical transmission and distribution system. Substations route and control electrical power flow, transform voltage levels, and serve as delivery points to individual customers.
SWL	Sound Power Level
Sydney Water	Sydney Water Corporation
Sydney CityGrid Project	New and/or refurbished substations in the Sydney CBD and a tunnel network for 132kV cables.
Transformer	An item of electrical equipment that generally transforms a higher voltage to a lower voltage.
TSP	Total suspended particles
ug/m^3	Micrograms per cubic metre
VDV	Vibration Dose Value
VENM	Virgin Excavated Natural Material
Zone Substation	A zone substation at 132kV/11kV or 33kV/11kV supplying the 11kV distribution network (with transformers).

Executive Summary

Introduction

The Sydney CityGrid Project is an integrated program of works to upgrade critical electricity infrastructure in Sydney's central business district (CBD). It has been developed by EnergyAustralia to comply with recently introduced licence requirements by augmenting and replacing infrastructure which is due for retirement in the Sydney CBD and inner metropolitan area. The requirements specify that all city zone substations and transmission feeders must achieve a 'n-2' capacity which means that they must be able to supply the full electricity demand with any two transformers or feeders out of service.

The Sydney CityGrid Project is based on a holistic approach to network planning that takes into account relevant planning criteria, asset replacement requirements, network reliability standards and anticipated longer term network needs. It seeks to meet network needs in a cost effective manner and facilitate prudent longer term network investment decisions. The project is comprised of a number of discrete but interrelated components, one of which involves construction and operation of the City East Cable Tunnel (CECT), City South Cable Tunnel (CSCT) extension, and associated connection works to existing substations and local electricity networks.

The Minister for Planning granted Concept Approval for the Sydney CityGrid Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 20 September 2009.

This Environmental Assessment has been prepared as part of an application for Project Approval for Stage 2B, 2D and 2E of the Sydney CityGrid Project. It addresses the environmental assessment requirements for Stages 2B, 2D and 2E of the Sydney CityGrid Project which are detailed in Minister's Condition of Approval (MCoA) 3 of the Concept Approval. For the purposes of this report, these three stages are collectively referred to as Stage 2D.

This Environmental Assessment has been prepared by GHD Pty Ltd on behalf of EnergyAustralia.

Stage 2D of the Sydney CityGrid Project

The primary objective of Stage 2D is to construct and operate infrastructure which is a critical component to the overall Sydney CityGrid Project. Stage 2D involves the following works:

- Construction of the 3.2 km CECT between a site on the corner of Albion Street and Riley Street, Surry Hills, and the City North Zone Substation at corner of Sussex and Erskine Streets, Sydney, with connections to the proposed City East and existing Dalley Street Zone Substations;
- Extension of the existing CSCT over a length of approximately 150 m. The extension would link the existing shaft for the Surry Hills Subtransmission Substation (STS) at Wade Place, Surry Hills, and the site proposed for the Riley Street Subtransmission Switching Station (STSS) on the corner of Albion and Riley Streets, Surry Hills;
- A shaft in The Domain to connect two 33kV feeders from the CECT (Domain Shaft) to the local network;
- A shaft in Little Albion Street, Surry Hills, to connect two 33kV feeders from the CSCT extension to the local network; and
- If required, refurbishment of the existing Dalley Street Zone Substation involving replacement of equipment such as switchgear. This would require a shaft in Dalley Street to connect the CECT to the Dalley Street Zone Substation. A new building would not be constructed on the site of the Dalley Street Zone Substation as part of Stage 2D.

All works would be carried out concurrently under one construction contract.

Need for Stage 2D

Construction of the CECT, CSCT and refurbishment of the Dalley Street Zone Substation are needed as all stages of the Sydney CityGrid Project which are integrated and interdependent. Construction of the CECT would enable five feeders to run from the Riley Street STSS and the new City East Zone Substation. Two 132kV feeders would run between the new City East Zone Substation and the Dalley Street Zone Substation, two 132kV feeders would run between the new City East Zone Substation and the existing City North Zone Substation, and two 132kV feeders would run between the Dalley Street Zone Substation and the City North Zone Substation.

A new STSS is required at Riley Street, Surry Hills, to connect the eastern CBD electricity network to the 132kV supply to the Eastern Suburbs. The STSS would also provide 132kV connections to a future Bulk Supply Point to be constructed on the same site post 2020.

The CSCT extension is required to connect the Surry Hills STS in Ann Street to the future Riley Street STSS. This tunnel would also connect to existing 33kV feeders and new 132kV feeders connecting to Rose Bay Substation.

The Dalley Street Zone Substation contains plant such as switchgear that is nearing the end of its operational life and is due for retirement. This plant is to be replaced to ensure that the substation continues to be a reliable part of the CBD electricity network.

Failure to construct Stage 2D would compromise the ability to achieve the objectives of the overall Sydney CityGrid Project. This is reflected in the Concept Approval which permits:

- Construction of the CECT between Riley STSS and the City North Zone substation, with connections to the proposed City East and existing Dalley Street Zone substations;
- Extension to the CSCT from Wade Place to Riley Street, Surry Hills; and
- Refurbishment of the existing Dalley Street Zone Substation.
- Stage 2D is both needed and justified as all stages of the Sydney CityGrid Project are integrated and interdependent.

Stakeholder issues

EnergyAustralia has consulted with key stakeholders throughout development of the Sydney CityGrid Project and also during development of the design for Stage 2D. The main issues raised relating to Stage 2D include:

- Noise and vibration associated with excavation and tunnelling;
- Geotechnical issues associated with faults and fractures in the rock the tunnels would be constructed in;
- Impacts on the existing and proposed underground assets;
- Management of groundwater during excavation and tunnelling;
- Management of waste and spoil generated during construction;
- Impacts on traffic and pedestrian access;
- Impacts on archaeology and built heritage; and
- Impacts on air quality associated with dust.

A comprehensive stakeholder engagement program has commenced for the Sydney CityGrid Project and will continue throughout planning and construction phases of the discrete projects. Specific consultation activities were undertaken during preparation of this Environmental Assessment for Stage 2D to target the key stakeholders relevant to these works.

Summary of potential impacts

Noise and vibration

Construction of Stage 2D of the Sydney CityGrid Project would generate noise and vibration associated with the use of a range of plant and machinery, such as rock breakers, road header and tunnel boring machine. Each of these has the potential to impact on the amenity of the surrounding area and nearby residential, commercial and recreation land uses.

At the Riley Street construction site, within the land bound by Ann, Riley and Albion Streets, noise during site establishment and excavation of the shaft would, for short durations only, exceed noise goals calculated in accordance with the Department of Environment and Climate Change (DECC) Interim Construction Noise Guideline 2008, during normal construction hours and extended working hours on Saturdays. These exceedances are mainly associated with the use of machinery such as rock breakers and would occur for relatively short durations as site establishment would take approximately three months and excavation of the shaft would take approximately two months.

An acoustic enclosure would be installed over the tunnel shaft to enable tunnelling excavation to occur on a 24 hour basis. During tunnelling, modelling predicts a minor exceedance of the noise goal at residences fronting Ann Street. This exceedance is associated with the use of a ventilation fan and additional management measures would be implemented to reduce noise from this source to acceptable limits.

Shafts would be excavated at Dalley Street, Little Albion Street and Yurong Parkway. Modelling predicts that the noise goals would be exceeded during these works at these sites. The exceedance would be associated with the use of a piling rig which would be used for relatively short time period of time at each location - four weeks at Dalley Street, and one to two weeks at Little Albion Street and Yurong Parkway.

Vibration associated with excavation of the shafts and construction of the tunnels is predicted to comply with vibration levels for human comfort and structural damage.

Regenerated noise would be associated with the ground vibration regenerated by the operation of road headers and the tunnel boring machine (TBM) which would be transmitted to nearby buildings and may result in audible, or regenerated, noise within the buildings. Exceedances in noise goals would be expected at certain locations along Little Albion Street, Riley Street and Yurong Street. Potentially affected properties along the route would experience noise levels above the night criterion for no more than six days as the tunnel excavation passes adjacent to and under properties along the route.

A range of management measures would be detailed in a Noise and Vibration Management Plan that would be developed to minimise noise and vibration impacts. This would include a Community Information Plan to ensure that the community is informed of the progress of the project and activities that have the potential to result in noise and vibration impacts. Part of the consultation program would involve developing a protocol that has a sliding scale of response mechanisms that can be tailored to the circumstances of the affected receiver and the level and duration of impact.

Non-indigenous heritage and archaeology

The CECT and CSCT extension would generally, along the route alignment be between 10 and 55 m below the existing ground surface. As there are no archaeological sites or features located within bedrock, these elements of the project would have no impact on subsurface archaeology. Potential impacts on archaeology would be limited to areas where surface works occur, including the Riley Street construction compound, and shaft locations at Dalley Street, Little Albion Street and Yurong Parkway.

The Riley Street construction compound has already (under a previous Development Approval by others) been excavated into bedrock down to basement level and is considered to have no potential for archaeological remains.

The Dalley Street site is located in an area that was originally situated on the banks of the Tank Stream. This area has been identified as containing subsurface deposits which have potential to retain evidence of post-1830 housing as well as soil profiles connected to the Tank Stream valley. The proposed shaft at Dalley Street would be located within the road easement and this roadway appears to date to the area's subdivision. Potential archaeological remains would probably be limited to older road surfacing, services such as brick and sandstone drains, and Tank Stream soil profiles. Excavations in Dalley Street would be monitored by an archaeologist to ensure that any items of potential archaeological significance are identified and managed in accordance with the requirements of the *Heritage Act 1977*.

Items of built heritage significance are present in the vicinity of the tunnel alignments and potential impacts would be limited to vibration during construction of the tunnels. Modelling indicates that vibration levels would be below criteria for structural damage to buildings. As a result, potential impacts on items of built heritage significance are considered unlikely.

Indigenous heritage

Potential impacts on sites of indigenous heritage significance would be limited to areas that would be subject to surface ground disturbance. Construction of the CECT, CSCT extension and connections to the City East and City North zone substations involves subsurface works within bedrock. These activities would not impact on any items of significance to the Aboriginal community.

Construction at or above the ground surface would be limited to the Riley Street construction compound, Dalley Street, Little Albion Street and Yurong Parkway. Due to the extent of disturbance that has occurred at these sites, the potential for undisturbed archaeological deposits is considered to be very limited. As a result, impacts on items of significance to the Aboriginal community are considered unlikely.

Spoil and waste management

Various waste materials generated during Stage 2D would require management through reuse/recycling or disposal.

It is estimated that 50,000 m^3 in situ (125,000 tonnes) of spoil would be generated during the construction of the tunnels, 44,000 m^3 of which is produced from the excavation of the CECT. The majority of spoil generated from the CECT tunnel excavations and CSCT extension would be sandstone with a small volume of shale. This material can usually be readily reused in engineering and remediation projects. Other excavated material would be produced in smaller quantities from the shaft and stub tunnel connections and may include fill and Quaternary sediments.

As part of the CEMP, a spoil and waste management sub plan would be prepared that would identify how spoil and other waste material would be handled, stockpiled, reused and disposed in accordance the DECC's Waste Classification Guideline (2008).

Traffic and access

The main traffic generated through the construction phase would be from equipment and material deliveries including delivery of construction materials, spoil removal, delivery and removal of construction equipment and machinery and movement of construction personnel, including contractors, site labour force and specialist supervisory personnel.

It is anticipated that the main traffic impacts would occur at Riley Street as spoil from construction of the tunnels would be removed from the shaft at this site.

The volume and intensity of truck movements would vary according to the construction stage. The additional traffic movements during construction of the project would be insignificant in terms of road capacity and can be adequately accommodated and managed to maintain acceptable levels of service for the broader CBD. The delivery of materials and equipment and removal of spoil would be spread over the construction period and these vehicle movements would be scheduled to minimise impact on the local community. Oversized vehicle movements would be subject to RTA road restrictions and may occur outside standard construction hours to minimise impacts on the traffic network.

Temporary changes to traffic conditions would be required to enable vehicular access from both Riley Street and Dalley Street. This would involve removal of a small number of on-street parking spaces and establishment of work zones for construction vehicles to enable material to be loaded and unloaded. Temporary partial road closures and detours would also be required for short periods of time associated with specific activities, such as delivery of large items of plant and machinery. A comprehensive construction traffic management plan would be prepared in consultation with RTA and City of Sydney Council as part of the CEMP to ensure that appropriate traffic management controls are implemented to minimise potential impacts.

Air quality

The main potential impacts on air quality are likely to be related to dust generated during excavation, tunnelling and materials handling at the Riley Street site. The amount of dust generated would be dependent on the type of construction activity undertaken and the prevailing weather conditions. A range of management measures would be implemented to minimise the risk of dust impacts on the amenity of surrounding areas.

The construction method has been specifically developed to minimise impacts associated with generation of dust and involves installing hoarding around the Riley Street site. In addition, an acoustic enclosure would be constructed over the shaft at the Riley Street site and spoil handling activities associated with tunnelling would be undertaken within this enclosure.

Excavation of the shafts at Riley Street, Little Albion Street, Yurong Parkway and Dalley Street would generate dust at the working face and during materials handling. As the depth of the excavation would progressively increase during the course of the works, this would help protect the site from prevailing winds and reduce offsite transport of dust.

The tunnels would be constructed with a road header (CSCT extension) and a TBM (CECT). The tunnels would be fitted with a mechanical ventilation system to filter air and remove dust particles prior to the air being discharged from the tunnel. The filtration system would be designed to limit dust emissions to acceptable levels and meet the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2002* (as amended). This would ensure clean air is available to workers within the tunnel and minimise the potential for offsite impacts associated with dust.

Provided that the recommended mitigation measures are implemented, it is considered that potential dust emissions would be negligible and have localised impacts that are likely to comply with DECCW's assessment criteria.

Water quality

Potential surface water impacts would be limited to runoff that may transport sediment off-site and enter the stormwater system that ultimately discharges to Sydney Harbour. There is also the potential for vehicles associated with the project to result in sediment being deposited on adjacent roadways and for this sediment to be transported to the stormwater system. Chemical spills on the construction site may also be transported to the surface water and groundwater systems. Surface water impacts are considered to be minor and would be mitigated by implementing management measures that would be detailed in the CEMP.

Potential impacts associated with groundwater would be related to inflows to the tunnels and shafts. Surface water from rain and runoff would also accumulate in the excavations. This water would be collected, treated, and pumped to the stormwater system.

Any groundwater intercepted would be treated and discharged to the stormwater system. During the construction phase, a temporary treatment system would be located on the Riley Street site and designed such that discharged water complies with the requirement of Section 120 of the POEO Act.

The design includes fully lined tunnels to limit the volume of groundwater seepage to 300 litres/100 m/day. The results of groundwater monitoring undertaken for a number of tunnelling projects in the CBD indicate that the groundwater is likely to contain relatively high levels of manganese and iron.

Groundwater that seeps into the tunnels during the operational phase would be pumped to and treated at the existing Campbell Street water treatment plant. This system discharges water to Cockle Bay in accordance with the Operational Environmental Management Plan for the Sydney CBD 132kV Cable Project (renamed CSCT).

Draft Statement of Commitments

The Environmental Assessment provides EnergyAustralia's commitments for environmental mitigation, management and monitoring. The draft Statement of Commitments includes recommended mitigation measures to reduce and avoid identified impacts. The Statement of Commitments would be finalised following exhibition of the Environmental Assessment.

Exhibition of the Environmental Assessment

This Environmental Assessment is placed on public exhibition for a minimum period of 30 days in accordance with the requirements of the EP&A Act. During this period, written submissions on the Environmental Assessment are able to be provided to the Department of Planning. These submissions must be addressed to:

The Director

Major Infrastructure Assessment

Department of Planning

GPO Box 39

SYDNEY NSW 2001

The next steps

EnergyAustralia is seeking Project Approval from the Minister for Planning for the construction of Stage 2D of the Sydney CityGrid Project. The next steps in the process are:

- Consideration of submissions that are received by the Director-General of the Department of Planning. EnergyAustralia may then be required to prepare and submit:
  - A Submissions Report, which contains responses to issues raised in the submissions, and/or further design development.
  - A Preferred Project Report, outlining any proposed changes to the project to minimise its environmental impacts (if necessary).
  - A revised Statement of Commitments.
- Determination of the Environmental Assessment. The Director-General of the Department of Planning provides an assessment report to the Minister for Planning, who then makes a decision on the project and, if approved, can set Conditions of Approval.

Consultation with the community and stakeholders would continue throughout the construction phase of the project.

1. Introduction

The following chapter introduces the Environmental Assessment by providing an overview of the project and its objectives. It also outlines the planning approval process and the approach taken to prepare the Environmental Assessment.

1.1 Background to the project

EnergyAustralia developed the Sydney CityGrid Project as an integrated program of works to upgrade critical electricity infrastructure in Sydney's central business district (CBD). The Sydney CityGrid Project is comprised of a number of discrete but interrelated components that are described in Section 1.2.1.

Concept Approval for the Sydney CityGrid Project was granted by the Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 20 September 2009. The Concept Approval requires further environmental assessment prior to commencement of various stages of the Sydney CityGrid Project. As a result, Project Approval is now required to allow the construction and operation of the City East Cable Tunnel (CECT) and City South Cable Tunnel (CSCT) extension and the refurbishment of the existing Dalley Street Zone Substation.

The CECT and CSCT extension and the refurbishment of the existing Dalley Street Zone Substation are essential components of the overall Sydney CityGrid Project. EnergyAustralia is seeking Project Approval for these works which are, for the purposes of this report, subsequently referred to as Stage 2D of the Sydney CityGrid Project.

This Environmental Assessment has been prepared as part of an application for Project Approval for Stage 2D of the Sydney CityGrid Project. The Concept Approval includes environmental assessment requirements that must be addressed by subsequent project applications. This Environmental Assessment addresses those assessment requirements relevant to Stage 2D.

1.2 The Sydney CityGrid Project

1.2.1 Overview

During the next decade, EnergyAustralia must replace critical electrical infrastructure within the Sydney CBD that is due for retirement and to comply with new licence requirements for operation of substations and transmission feeders. The licence requirement specifies that all city zone substations and transmission feeders must achieve a 'n-2' capacity which means that they must be able to supply the full electricity demand with any two transformers or feeders out of service.

EnergyAustralia has developed an integrated strategy to meet the license requirements by constructing new infrastructure or refurbishing existing electricity infrastructure, while maintaining sufficient spare capacity to ensure an ongoing and reliable electricity supply. This strategy is referred to as the Sydney CityGrid Project.

The Sydney CityGrid Project would be implemented in the following stages:

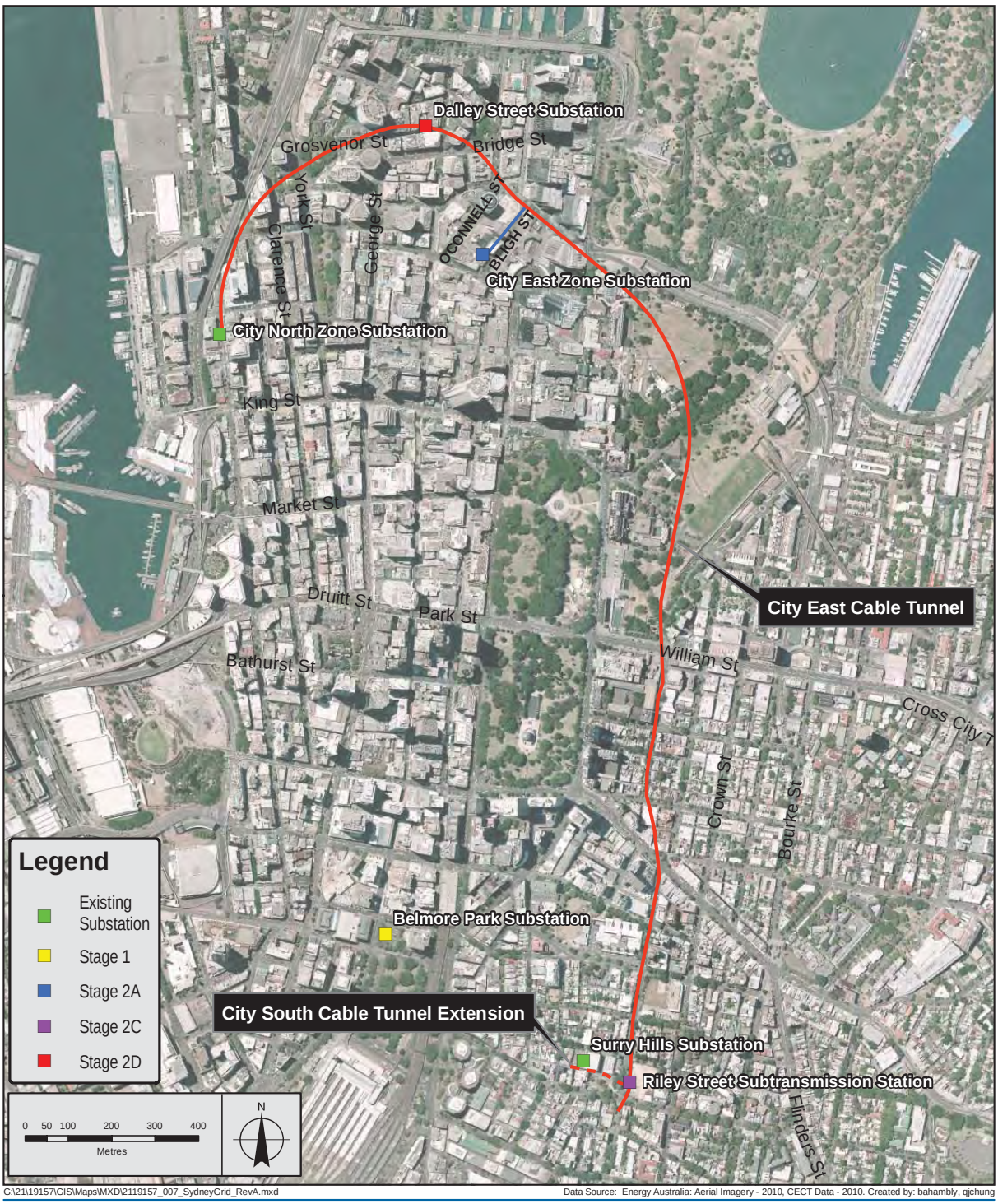
- Stage 1 – Belmore Park Substation site
  - Stage 1A – Construction and operation of the Belmore Park Zone Substation on the corner of Pitt, Campbell and Hay Streets. A stub tunnel would connect the CSCT to Belmore Park Zone Substation;
  - Stage 1B – Commercial/retail development on the site of the Belmore Park Zone Substation.
- Stage 2 – Remaining works
  - Stage 2A – Construction and operation of the City East Zone Substation at 33 Bligh Street, Sydney. This stage would be developed as two discrete components:
  - Stage 2A(i) – involves demolition of the existing building on the site (Kindersley House), and subsurface construction works;
  - Stage 2A(ii) – involves construction and operation of the City East Zone Substation and the associated commercial tower located above the substation. This involves detailed consideration of the built form of the development at the site;
  - Stage 2B – Refurbishment of existing Dalley Street Zone Substation;

- Stage 2C – Construction and operation of a sub-transmission switching station (STSS) on a site at the intersection of Riley Street and Albion Street, Surry Hills;
- Stage 2D – Construction of CECT between Riley Street STSS and City North Zone Substation with connections to the proposed City East and existing Dalley Street Zone Substations, and a potential services control room adjacent to the Riley Street STSS; and
- Stage 2E – Extension of the CSCT from Wade Place to Riley Street, Surry Hills.

An Environmental Assessment has been prepared and submitted to the Department of Planning for Stage 2A(i) works of the City East Zone Substation.

The works forming part of this Environmental Assessment include those identified as Stages 2B, 2D and 2E. For the purposes of this report, these three stages are identified as Stage 2D. The indicative location of these components is shown in Figure 1-1.

Figure 1-1 Components of the Sydney City Grid



1.2.2 Objectives of the Sydney CityGrid Project

EnergyAustralia is responsible for one of Australia's largest electricity networks which serves Sydney, the Central Coast and the Hunter region. Between 2008 and 2020, EnergyAustralia is investing about $16 billion in its network to meet increasing electricity demand and further enhance the high levels of supply and reliability. This involves maintaining and replacing existing infrastructure and building additional capacity to support new developments.

During the next decade, EnergyAustralia must augment and replace infrastructure which is due for retirement in the Sydney CBD and the inner metropolitan area in order to comply with licensing requirements. The requirements specify that all CBD substations achieve 'n-2' capacity (Design, Reliability & Performance Licensing Conditions by the Minister for Energy).

The Sydney CityGrid Project has been developed to meet the licence requirements in the Sydney CBD. It is based on a holistic approach to network planning that takes into account relevant planning criteria, asset replacement requirements, network reliability standards and anticipated longer term network needs. It seeks to meet network needs in a cost effective manner and facilitate prudent longer term network investment decisions.

Over the next 10 years, the Sydney CityGrid Project involves constructing new, or upgrading and refurbishing existing zone substations and replacing high voltage cables supplying the substations to:

- Meet 'n-2' licence conditions;
- Cater for future demand and introduce new technologies that are likely to reduce electricity 'losses' by reducing the resistance of the electricity network; and
- Ensure timely replacement of infrastructure which is due for retirement to maintain a reliable supply of electricity for the CBD.

1.2.3 Environmental Assessment of the Sydney CityGrid Project

On 11 February 2008 the Minister for Planning declared the Sydney CityGrid Project to be a project to which Part 3A of the EP&A Act applies. This declaration included:

Development by EnergyAustralia for the purposes of upgrading the electricity supply network in the Sydney Central Business District (known as the 'Sydney CityGrid Project'), located within the City of Sydney local government area, and involving:

1. *construction and operation of up to three new zone substations (including, as necessary, the demolition and/or refurbishment of existing zone substations, and the construction and use of commercial and/or retail developments on, adjacent to, or integrated with, the new zone substations);*
2. *the refurbishment and augmentation of existing zone substations;*
3. *replacement of, and upgrades to, EnergyAustralia's existing high voltage cable network;*
4. *the construction and use of tunnels for the installation and operation of high voltage cables and associated cables, and other infrastructure; and*
5. *the construction, operation and use of associated works, including ventilation and shafts and access structures, generally in the locations, or following the route, shown on the indicative map prepared by EnergyAustralia dated December 2007 and titled 'Sydney CityGrid Project.*

(NSW Government Gazette No. 21, page 1168, 22 February 2008)

On 9 April 2008, EnergyAustralia submitted to the Department of Planning a Concept Application for the Sydney CityGrid Project and a Project Application for the Belmore Park Zone Substation. The Department of Planning issued environmental assessment requirements in accordance with Section 75P(1) of the EP&A Act.

As required by Part 3A of the EP&A Act, an Environmental Assessment of the Concept Plan was prepared to address the Director-General's environmental assessment requirements. It identified potential impacts and recommended mitigation measures and included a Statement of Commitments that was developed as an integral part of the assessment process in accordance with Part 3A of the EP&A Act. Specific actions identified in the Statement of Commitments focused on issues to be assessed during preparation of subsequent Environmental Assessments as part of applications for Project Approval.

The Concept Environmental Assessment was publicly exhibited between 17 December 2008 and 16 February 2009, during which time the Department of Planning invited public submissions on the Environmental Assessment. Under Section 75(H)6 of the EP&A Act, the Director-General required that EnergyAustralia respond to issues raised in the submissions. EnergyAustralia submitted a Submissions Response and Preferred Project Report (May 2008) to the Department of Planning.

The Minister for Planning granted the following approvals under Part 3A of the EP&A Act for the Sydney CityGrid Project on 20 September 2009:

- Concept Approval for the CityGrid Project; and
- Project Approval for Stage 1 which relates to works at the Belmore Park Zone Substation site.

The Concept Approval defined that additional environmental assessment is required to obtain Project Approval for those components of the project that comprise Stage 2 of the Sydney CityGrid Project.

1.3 Purpose of this Environmental Assessment

The works which form part of this Environmental Assessment are referred to as Stage 2D and include Stage 2B, Stage 2D and Stage 2E which are defined in the Concept Approval as:

Stage 2B being the refurbishment of the existing Dalley Street Zone substation, or construction of a new building adjacent to the existing site;

Stage 2D being the City East Cable Tunnel (CECT) to be constructed between Riley Street sub-transmission switching station (STSS) and the City North Zone substation, with connections to the proposed City East and existing Dalley Street Zone substations, and potential services control room adjacent to the Riley Street STSS; and

Stage 2E being the extension to the City South Cable Tunnel from Wade Place to Riley Street, Surry Hills.

The purpose of this Environmental Assessment is to assess the environmental impacts of these three stages of the Sydney CityGrid Project, collectively referred to as Stage 2D in this report, in accordance with the requirements of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000.* Pursuant to Section 75P(1) of the EP&A Act, the environmental assessment requirements for the project are defined by Minister's Conditions of Approval (MCoA) 3.1, 3.2 and 3.3 of the Concept Approval. This Environmental Assessment addresses those assessment requirements.

1.4 Overview of Stage 2D of the Sydney CityGrid Project

Stage 2D is described in detail in Chapter 6 and involves the following works:

- Construction of the 3.2 km CECT between a site on the corner of Albion Street and Riley Street, Surry Hills, and the City North Zone Substation at northern end of the CBD, with connections to the proposed City East and existing Dalley Street Zone Substations;
- Extension of the existing CSCT over a length of approximately 150 m between the existing Surry Hills shaft at Wade Place, Surry Hills, and the site proposed for the Riley Street STSS on the corner of Albion and Riley Streets, Surry Hills;
- A shaft in The Domain to connect two 33kV feeders from the CECT (Domain Shaft) to the local network; and
- If required, refurbishment of the existing Dalley Street Zone Substation involving replacement of equipment such as switchgear. This would require a shaft in Dalley Street to connect the CECT to the Dalley Street Zone Substation. A new building would not be constructed on or adjacent to the site of the Dalley Street Zone Substation as part of Stage 2D.

The location of these works in relation to the overall Sydney CityGrid Project are show in Figure 1-1.

1.5 Objective of Stage 2D of the Sydney CityGrid Project

The objective of the Stage 2D works is to construct and operate infrastructure which is a critical component to the overall Sydney CityGrid Project. The CECT, CSCT extension, refurbishment of the existing Dalley Street Zone, and associated works, would contribute to meeting the objectives of the Sydney CityGrid Project which are detailed in Section 1.2.2.

1.6 Approvals process

Concept Approval has been obtained for the Sydney CityGrid Project and Project Approval is now required for Stage 2D. This Environmental Assessment has been prepared as part of an application for Project Approval and will be publicly exhibited for a period of at least 30 days, during which time submissions are invited to be submitted to the Director-General of the Department of Planning.

Following the conclusion of the exhibition period, the Director-General may require that EnergyAustralia respond to issues raised in submissions. If required, EnergyAustralia would respond to issues raised and may modify the project and Statement of Commitments. This response would be documented in a Submissions Report that would be submitted to the Director-General.

If significant modifications to the Project or Statement of Commitments are made at this stage, a Preferred Project Report would be prepared as part of the Submissions Report to clearly define the revised elements of the project, commitments and environmental impacts.

The Director-General would evaluate this Environmental Assessment, the Submissions Report, and any Preferred Project Report, giving consideration to submissions received during the exhibition period. The Director-General would recommend to the Minister whether to grant approval or refuse the Project Application. If the Minister grants approval this may be subject to conditions.

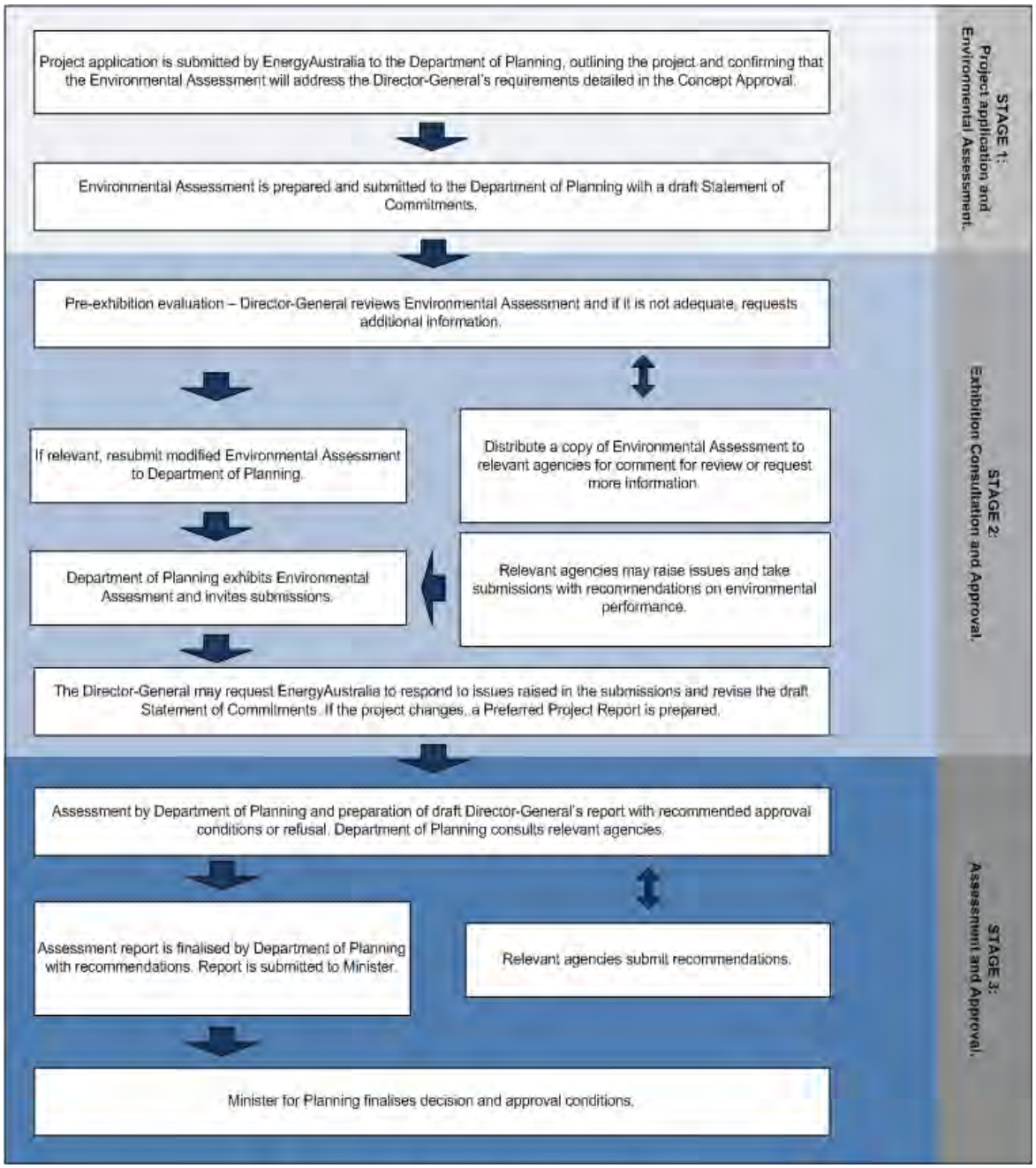
A flowchart of the main steps in the planning approval process is shown in Figure 1-2.

1.7 Structure of this Environmental Assessment

The following chapters of this Environmental Assessment are structured as follows:

- **Chapter 2** provides a description of the site and its context;
- **Chapter 3** provides an outline of the statutory and strategic framework;
- **Chapter 4** provides information on stakeholder consultation undertaken as part of Stage 2D;
- **Chapter 5** provides information on the need and justification of Stage 2D;
- **Chapter 6** describes Stage 2D;
- **Chapter 7** outlines the consistency of Stage 2D with the Concept Approval and other relevant documentation;
- **Chapter 8** outlines the results of an environmental risk analysis undertaken for the Stage 2D;
- **Chapters 9–16** assess the potential environmental impacts of Stage 2D in accordance with the Director-General's requirements contained within the Concept Approval dated 20 September 2009; and
- **Chapters 17 and 18** conclude the Environmental Assessment by providing information on the management and mitigation of impacts including the draft Statement of Commitments that would be implemented to minimise and manage potential environmental impacts.

Figure 1-2 Planning approval process for Stage 2D of the Sydney CityGrid Project



2. Site location and setting

This Chapter provides a summary of the location of the project.

2.1 Sydney CBD

The objective of the Sydney CityGrid Project is to ensure that Sydney's CBD is provided with a reliable electricity supply in the long term. A reliable electricity supply is essential because Sydney, as Australia's only recognised global city, is the key link between the Australian and global economies. The Sydney CBD is a hub for commercial and financial operations and has a high concentration of business service firms, in particular those associated with the financial and stock markets. Provision of a reliable electricity supply is critical to allow the CBD to function efficiently and effectively.

Sydney's CBD is highly urbanised and the built form is characterised by high rise commercial, retail and residential developments. Land is used for a variety of purposes including residential and commercial use as well as tourist and cultural attractions, and parks and open space, including Hyde Park and the Domain and Royal Botanic Gardens.

The CBD is a popular shopping district with nine retail centres and approximately 600 speciality shops as well as Pitt Street Mall (currently undergoing refurbishment), the Queen Victoria Building, David Jones, and Myer outlets.

A range of cultural attractions are located in the CBD, including the Sydney Opera House, Harbour Bridge, Art Gallery of NSW, Australian Museum, Hyde Park Barracks, Queen Victoria Building, Sydney Town Hall and State Theatre. In addition, Sydney hosts a variety of cultural events including the Sydney Festival, Mardi Gras festival, and Chinese New Year celebrations.

Surry Hills is located immediately south east of the Sydney CBD and surrounded by inner city suburbs including Darlinghurst, Paddington, Chippendale and Redfern. Its urban character is defined by a mixture of residential, commercial and light industrial land uses. The suburb features a mix of cafes, restaurants, pubs and fashion stores, and is serviced by rail, buses and major roads. Surry Hills hosts a number of cultural and community events including monthly Surry Hills Markets and the annual Surry Hills Festival.

2.2 The CECT and CSCT extension route

A range of land uses including residential, commercial, recreational and public services exist in the vicinity of the alignment of Stage 2D. As indicated in Figure 1-1, the CECT commences at a site adjacent to the intersection of Albion and Riley Streets, Surry Hills. The southern section of the route passes through the suburbs of Surry Hills and Darlinghurst along Riley and Yurong Streets which are characterised by a mix of residential and commercial land use. The alignment then passes beneath open space that is known as The Domain, where a shaft would connect two 33kV feeders from the CECT to the local network. The tunnel would then pass beneath the northern section of the CBD which is characterised by high rise commercial development. The CECT terminates at the City North Zone Substation which is located on the corner of Sussex Street and Erskine Street.

Stage 2D also includes a 150 m long section of stub tunnel from the CECT to the existing shaft at Wade Place that is part of the Surry Hills Substation in Ann Street and connects to the CSCT. This stub tunnel is referred to as the CSCT extension and surrounding land use includes Frog Hollow Reserve, residences, and electricity infrastructure.

Surface construction works for Stage 2D would be limited to the Riley Street construction compound and shafts in Little Albion Street, Dalley Street and Yurong Parkway. These sites are described below.

2.3 Riley Street compound

The main construction compound for Stage 2D would be located on the corner of Albion and Riley Streets, Surry Hills. This is a vacant parcel of land owned by EnergyAustralia and was purchased for the purposes of constructing the Riley Street subtransmission switching station (STSS) that forms Stage 2C of the Sydney CityGrid Project. Approval for the Riley Street STSS would be obtained separately to Stage 2D.

The Riley Street site is surrounded by hoardings and is characterised by deep excavations that were commenced for a previous development at the site which did not proceed (refer to Figure 2-1 and Figure 2-2). The surrounding area is predominantly residential land use comprising 2 – 3 storey terrace housing and multi-storey apartment buildings with a number of hotels, cafes, commercial, community service and recreational facilities. These include Frog Hollow Reserve, the Albion Street Centre, Salvocare Crisis Centre, Chelsea Apartments, Gertrude Abbott Nursing Home, Sister Anne Court, Chinese Presbyterian Church, and the Womens & Girls Emergency Centre. The Surry Hills Substation is also located in this area and has frontages to Little Albion Street, Ann Street, Wade Place and Crawford Place.

Riley Street is the primary street frontage for the site, however there is a secondary frontage to Albion Street. Adjacent properties have frontages to Ann Street and Albion Street, both of which are steeply sloping. Ann Street features terraces stepping up along the slope of the street and Albion Street generally features larger (5 – 6 storey) multi-unit residential buildings to the south of the site. The commercial premises, immediately to the south-east of the site on Albion Street, are 3 – 4 storeys high, with windows overlooking the site. Buildings adjacent to the eastern side of the site include residential and commercial premises.

Figure 2-1 Photograph of the Riley Street construction compound

Figure 2-2 Photograph of land use along Riley Street

2.4 Dalley Street

The Dalley Street Substation is located on Dalley Street which is situated between Pitt Street and George Street in the northern part of the CBD (refer to Figure 1-1). Vehicular traffic along this 125 metre long street is one way in an easterly direction. The EnergyAustralia Substation is located on the corner of Dalley Street and Underwood Street.

Surrounding land uses are predominantly commercial office buildings, hotels and parking stations, including the Australian Stock Exchange, Telstra Telephone Exchange, AIG building, Exchange Square, Grosvenor Place, Brooklyn Hotel, National Australia Bank House, Macquarie Graduate School of Management, Underwood House, Sydney Harbour Marriott, Gerling House, and Endeavour House (refer to Figure 2-3).

Figure 2-3 Photograph of land use along Dalley Street

2.5 Yurong Parkway

Yurong Parkway is located on the eastern side of The Domain and links William Street with St Marys Road. Land on the eastern side of the street is used for passive recreational purposes associated with The Domain, while the western side is used for residential and community purposes, including the KU Children's Centre.

2.6 Geotechnical conditions

The CECT, CSCT extension and associated infrastructure would primarily be constructed within slightly weathered to fresh Hawkesbury Sandstone. Mudstone facies of the Hawkesbury Sandstone, including Ashfield Shale and Mittagong Formation, may be present in the upper most parts of the profile, particularly south Oxford Street. There may also be layers of closely interbedded, slightly weathered to fresh, sandstone and siltstone (laminite) within beds of slightly weathered sandstone as was encountered in the tunnels for the Cross City Motorway and Eastern Distributor (PSM, 2009).

At the Dalley Street Substation site, surface excavation works would most likely be undertaken in fill material, sediments and sandstone. The shaft would predominately be in medium to high strength sandstone.

Reclaimed land is known to be present in the Circular Quay area. The fill material is expected to be water bearing, and overlie unconsolidated alluvial sediments and sandstone bedrock. Fill also overlies parts of the Woolloomooloo Paleovalley and shallow fill occurs in parts of The Domain and Farm Cove.

Geotechnical investigations undertaken for the project by PSM (2009) indicate that the main geological features located in the vicinity of the study area that have the potential to influence construction and operational risks include:

- The Woolloomooloo Paleovalley, located near Sir John Young Crecent;
- Three dykes, known as Pittman LIV Dyke (between Dalley and Bridge Streets); Oxford Street Dyke (southern side of Oxford Street) and the Great Sydney Dyke (beneath Albion Street);
- The GPO Fault Zone, located in the vicinity of Loftus Street;
- The Woolloomooloo Fault Zone, located between Reservoir and Goulburn Streets;
- The Martin Place Joint Swarm, located near Macquarie Street; and
- Low angle bedding shears (found in the vicinity of the abovementioned features).

3. Statutory and strategic framework

This chapter summarises the approval process that applies to the project under Part 3A of the NSW EP&A Act and the permissibility under relevant environmental planning instruments.

3.1 Approval process under the NSW Environmental Planning and Assessment Act, 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the statutory framework for planning approval and environmental assessment in NSW. Implementation of the EP&A Act is the responsibility of the Minister for Planning, statutory authorities and local councils.

The EP&A Act contains three schemes that impose requirements for planning approval:

- Part 3A provides for control of projects that require approval from the Minister for Planning;
- Part 4 provides for control of 'local development' that requires development consent from the local Council; and
- Part 5 provides for control of 'activities' that do not require approval or development consent under Part 3A or Part 4.

The need or otherwise for development consent is set out in environmental planning instruments – State Environmental Planning Policies (SEPPs), Regional Environmental Plans (REPs), or Local Environmental Plans (LEPs).

3.1.1 Application of Part 3A of the EP&A Act 1979

Section 75B(1) of the EP&A Act defines projects to which Part 3A applies and states that:

This Part applies to the carrying out of development that is declared under this section to be a project to which this Part applies:

(a) by a State environmental planning policy, or

(b) by order of the Minister published in the Gazette (including by an order that amends such a policy).

The carrying out of particular or a class of development, or development for a program or plan of works or activities, may be so declared.

On 11 February 2008 the Minister for Planning declared that the Sydney CityGrid Project is a project to which Part 3A of the EP&A Act applies. This declaration includes:

Development by EnergyAustralia for the purposes of upgrading the electricity supply network in the Sydney Central Business District (known as the 'Sydney CityGrid Project'), located within the City of Sydney local government area, and involving:

- *construction and operation of up to three new zone substations (including, as necessary, the demolition and/or refurbishment of existing zone substations, and the construction and use of commercial and/or retail developments on, adjacent to, or integrated with, the new zone substations);*
- *the refurbishment and augmentation of existing zone substations;*
- *replacement of, and upgrades to, EnergyAustralia's existing high voltage cable network;*
- *the construction and use of tunnels for the installation and operation of high voltage cables and associated cables, and other infrastructure; and*
- *the construction, operation and use of associated works, including ventilation and shafts and access structures, generally in the locations, or following the route, shown on the indicative map prepared by EnergyAustralia dated December 2007 and titled 'Sydney CityGrid Project.*

(NSW Government Gazette No. 21, page 1168, 22 February 2008)

As the declaration includes 'construction and use of tunnels for the installation and operation of high voltage cables and associated cables, and other infrastructure' and the 'refurbishment and augmentation of existing zone substations', the works associated with Stage 2D are subject to approval under Part 3A of the EP&A Act.

Concept Approval of the Sydney CityGrid Project

On the 20 September 2009, the Minister for Planning granted Concept Approval for the CityGrid Project (refer to Appendix A) based on information contained in:

- 08_0075 Major Project Application;
- Sydney CityGrid Project Concept Environmental Assessment Report, prepared by PlanCom Consulting Pty Ltd and dated 8 December 2008; and
- Sydney CityGrid Project Submissions Response & Preferred Project Report, prepared by PlanCom Consulting Pty Ltd and dated May 2009.

For the purposes of the Concept Approval and any Project Approval granted under it, Minister's Condition of Approval (MCoA) 1.3 of the Concept Approval defined the various components of the Sydney CityGrid Project as:

- Stage 1 – Belmore Park Substation site
  - Stage 1A – Construction and operation of the Belmore Park Zone Substation and stub tunnel connection from City South Cable Tunnel to Belmore Park Zone Substation; and
  - Stage 1B – Commercial/ retail development on the corner of Pitt, Campbell and Hay streets, to be integrated with the works comprising Stage 1A.
- Stage 2 –The balance of the works required for the concept plan, other than those defined as Stage 1 works, and comprising:
  - Stage 2A – Construction and operation of the City East Zone Substation in the vicinity of Phillip, Bent, Bligh and O'Connell Streets;
  - Stage 2B – Refurbishment of existing Dalley Street Zone Substation or construction of a new building adjacent to the existing site;
  - Stage 2C – Construction and operation of a sub-transmission switching station (STSS) on a site at the intersection of Riley Street and Albion Street, Surry Hills;
  - Stage 2D – Construction of City East Cable Tunnel between Riley Street STSS and City North Zone Substation with connections to the proposed City East and existing Dalley Street Zone Substations, and a potential services control room adjacent to the Riley Street STSS; and
  - Stage 2E – Extension of the City South Cable Tunnel from Wade Place to Riley Street, Surry Hills.

Minister's Condition of Approval (MCoA) 2.2 requires that the construction and operation of Stage 2 of the Sydney CityGrid Project is subject to further assessment under Part 3A of the EP&A Act. In seeking approval for Stage 2 works, MCoA 2.3 allows EnergyAustralia to submit a Project Application for Stage 2 in its entirety, or submit separate applications for each sub-stage or a combination of sub-stages.

EnergyAustralia is seeking Project Approval for Stage 2B, Stage 2D and Stage 2E of the Sydney CityGrid Project in one stage referred to as Stage 2D. A Project Application for these works was submitted to the Director-General of the Department of Planning on 17 December 2009.

3.1.2 Effect of Part 3A of the EP&A Act on approvals under other legislation

Part 3A of the EP&A Act removes the need for approvals under some legislation that was previously required for activities assessed under Part 4 or Part 5 of the EP&A Act. Part 3A consolidates relevant approval requirements and environmental management provisions into a single assessment process, where the Minister's approval incorporates selected approvals and permits that would otherwise be required under other legislation.

Section 75U(1) of the EP&A Act specifies certain authorisations which are not required for an 'approved project' under Part 3A, namely:

(a) the concurrence under Part 3 of the Coastal Protection Act 1979 of the Minister administering that Part of the Act,

(b) a permit under section 201, 205 or 219 of the Fisheries Management Act 1994,

(c) an approval under Part 4, or an excavation permit under section 139, of the Heritage Act 1977,

(d) a permit under section 87 or a consent under section 90 of the National Parks and Wildlife Act 1974,

(e) an authorisation referred to in section 12 of the Native Vegetation Act 2003 (or under any Act to be repealed by that Act) to clear native vegetation,

(f) a permit under Part 3A of the Rivers and Foreshores Improvement Act 1948,

(g) a bush fire safety authority under section 100B of the Rural Fires Act 1997,

(h) a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the Water Management Act 2000.

Section 75A defines 'approved project' as 'a project to the extent that it is approved by the Minister under this Part, but does not include a project for which only approval for a concept plan has been given'. Consequently, these approvals would not be required if the Minister grants Project Approval to carry out the project under Part 3A.

Under Section 75V(1) of the EP&A Act, the following authorisations cannot be refused if necessary for the carrying out of an 'approved project' and are to be substantially consistent with an approval to carry out the project given under Part 3A:

- *An environment protection licence under Chapter 3 of the Protection of the Environment Operations Act 1997; and*
- *A consent under s138 of the Roads Act 1993.*

3.1.3 Director-General's requirements

Pursuant to Section 75P(1)(a) of the EP&A Act, the environmental assessment requirements for the Sydney CityGrid Project are specified in MCoA 3.1, 3.2 and 3.3 of the Concept Approval, dated 20 September 2009. This Environmental Assessment addresses those requirements. Table 3-1 summarises the environmental assessment requirements together with the section of this document that addresses each requirement.

Table 3-1 Summary of Director-General's requirements

Director-General requirements	Document reference
General requirements	
Demonstration that the project is consistent with the Concept Approval	Chapter 7
Detailed description and location of all project components and identification of environmental constraints	Chapter 6
Detailed project specific Statement of Commitments	Chapter 17
Outcome of consultation with RailCorp and Sydney Metro	Section 4.2
Issue-specific requirements	
A project level **noise and vibration impact assessment** for construction and operation noise prepared in accordance with the NSW Industrial Noise Policy (EPA, 2000), the interim Noise Control Guideline – Construction Site Noise (DECC 2008), the Environment Noise Management – Assessing Vibration: a Technical Guidelines (DECC, 2006) and the Environment Criteria for Road Traffic Noise (EPA 1999). The assessment shall be prepared in consultation with the DECC.	Chapter 9
A project level **non-indigenous heritage assessment** prepared in consultation with the Heritage Council of NSW.	Chapter 10
An updated **indigenous heritage assessment** informed by the views of the Metropolitan Aboriginal Land Council and any other relevant, readily contactable Aboriginal community.	Chapter 11

Director-General requirements	Document reference
An updated **air quality assessment**	Chapter 14
A **greenhouse gas potential assessment** in accordance with the methodology specified in the *National Greenhouse Accounts (NGA) Factors* (DECC, November 2008).	Not applicable to Stage 2D as this requirement relates to operation of transformers containing SF6.
Detailed information on **water quality impacts**	Chapter 15
An updated **traffic and access assessment**	Chapter 13
Design review process	
A **design review process** for the proposed Dalley Street Zone Substation	Not applicable to Stage 2D as a new Zone Substation would not be constructed at Dalley Street. Works at this location would be limited to refurbishment and subsurface works that would not alter the existing external appearance.
Consultation with **Sydney Water Corporation**	Section 4.2

3.2 Permissibility of the project under relevant environmental planning instruments

3.2.1 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to assist in the effective delivery of public infrastructure in the State by improving certainty and regulatory efficiency through a consistent planning assessment and approvals regime for public infrastructure and services across NSW. ISEPP provides clear definition of the environmental assessment and approval process for public infrastructure and services facilities.

Clause 41 – Development permitted without consent

Clause 41 of ISEPP provides that development for the purpose of an electricity transmission or distribution network may be carried out by or on behalf of an electricity supply authority or public authority without development consent on any land.

Stage 2D is therefore able to be undertaken without consent as it is for the purpose of an electricity distribution network and would be undertaken by a public authority. As discussed in Section 3.1.1, the project requires approval under Part 3A of the EP&A Act.

Clause 86 – Excavation in, above or adjacent to rail corridors

As the CBD Metro Stage 1 has been granted approval under Part 3A of the EP&A Act, it is a 'rail corridor' as defined by the ISEPP. Sydney Metro was the rail authority for this rail corridor, however the agency was formally disbanded on 30 June 2010 following deferment of the Metro Stage 1 project. The statutory functions of Sydney Metro Authority are now undertaken by Transport NSW.

Clause 86 relates to development that involves penetration of the ground to a depth of at least 2 m below the existing ground level on land:

- Within or above a rail corridor, or
- Within 25 m (measured horizontally) of a rail corridor, or
- Within 25 m (measured horizontally) of the ground directly above an underground rail corridor.

Stage 2D is not subject to Clause 86 as it would be located below the rail corridor for the CBD Metro Stage 1.

As detailed in Section 4.2, EnergyAustralia consulted extensively with the former Sydney Metro Authority during development of Stage 2D. This resulted in the depth of the CECT being substantially increased to avoid the exclusion envelope around the CBD Metro Stage 1 near Margaret Street. Stage 2D has been refined to incorporate all reasonable measures to minimise potential impacts on the safety, structural integrity, and operation of future developments within this rail corridor.

Clause 88 – Development within or adjacent to interim rail corridor

A portion of the CECT is located within an interim rail corridor as defined by ISEPP that is referred to as the 'CBD Rail Link' and includes two corridors that are commonly known as the 'Metro Pitt' and 'Metro West' alignments. The Metro Pitt alignment is generally in the vicinity of Pitt Street while the Metro West alignment is generally in the vicinity of Sussex, Kent and York Streets to the west of George Street. RailCorp is the rail authority for the CBD Rail Link.

Stage 2D is subject to Clause 88 of ISEPP as it involves development within areas marked 'Zone B' on the rail corridors map and involves penetration at least 2 m below the existing ground level.

Before determining the project application, the Department of Planning must provide written notice to the Chief Executive of RailCorp within seven days of receiving the application and take into account the likely effect of the development on:

(a) The practicability and cost of carrying out rail expansion projects on the land in the future, and

(b) Without limiting paragraph (a), the structural integrity or safety of, or ability to operate, such a project, and

(c) Without limiting paragraph (a), the land acquisition costs and the costs of construction, operation or maintenance of such a project.

As detailed in Section 4.2, EnergyAustralia has consulted extensively with RailCorp during development of designs for Stage 2D. The design has been specifically developed to incorporate reasonable measures to minimise potential impacts on both the practicality of carrying out rail expansion projects in the interim rail corridor, and the structural integrity and safety of rail expansion projects in the interim rail corridor.

3.2.2 State Environmental Planning Policy No. 55 – Remediation of Land

The aims and objectives of State Environmental Planning Policy 55 – Remediation of Land (SEPP 55) are to provide a statewide approach to remediation of contaminated land and promote remediation of contaminated land to reduce risk of harm.

SEPP 55 applies where consent is required under Part 4 of the EP&A Act for development on potentially contaminated land and/or where remediation works are proposed. SEPP 55 does not apply to the project as it is subject to approval under Part 3A of the EP&A Act, not Part 4. Never-the-less, the principles of SEPP 55 have been considered during preparation of the Environmental Assessment.

Under SEPP 55, a consent authority must not grant development consent unless:

(a) It has considered whether the land is contaminated, and

(b) If the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and

(c) If the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

The definition of remediation in Clause 4 of SEPP 55 includes 'removing, dispersing, destroying, reducing, mitigating or containing the contamination of any land'.

Results of contamination assessments undertaken as part of geotechnical investigations indicate that the majority of spoil would be classified as virgin excavated natural material (VENM). Fill materials may be classified as General Solid Waste (non-putrescible) and disposed of at landfill sites licensed by DECCW (PSM, 2009). As detailed in Section 12, any contaminated material would be managed in accordance with relevant legislation and the Department of Environment and Climate Change (DECC) Waste Classification Guidelines (2008).

3.3 Local environmental plans

Stage 2D involve works that are within areas that are covered by the following two local environmental plans:

- Sydney Local Environmental Plan 2005; and
- South Sydney Local Environmental Plan 1998.

The project is permissible without consent under the Sydney Local Environmental Plan 2005 and South Sydney Local Environmental Plan 1998.

3.4 Other relevant NSW legislation

As indicated in Section 3.1.1, Section 75U and 75V of the EP&A Act limit approvals that are required under other NSW legislation. The following section outlines additional approvals that may be required.

3.4.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) regulates noise, air, land and water pollution. Environment protection licences are granted by DECCW under the POEO Act for 'scheduled activities', 'scheduled development work' or regulating water pollution.

As Stage 2D of the project is not a 'scheduled activity' or 'scheduled development work', an environment protection licence would only be required if the project would pollute waters. Under Section 120 of the POEO Act, it is an offence to pollute waters.

As discussed in Chapter 15, there is the potential for Stage 2D to pollute waters during both the construction and operational phases due to the need to dewater the excavations, tunnels and stub tunnel. Section 122 states that it is a defence against proceedings under Part 5.3 of the POEO Act if the pollution was regulated by an environmental protection licence and the conditions of that licence were not contravened. If required, EnergyAustralia's contractors would obtain an environment protection licence.

Under Section 75V(1) of the EP&A Act, an environment protection licence under the POEO Act cannot be refused if it is required to carry out an approved project.

3.4.2 Water Act 1912

The project would involve dewatering the CECT, CSCT extension and associated shafts. A licence for this activity would be required from NSW Office of Water under Part 5 of the *Water Act 1912*.

3.4.3 Roads Act 1993

Works would be required beneath numerous streets between Surry Hills and the northern parts of the CBD including Riley Street, Bent Street (City East Zone Substation tunnel interface) and Sussex Street (City North Zone Substation tunnel interface). The alignment passes beneath streets that are a mixture of regional and local roads as classified by the RTA. Shafts would also be excavated within the carriageway of Little Albion Street, Dalley Street and Yurong Parkway.

Under Section 138 of the *Roads Act 1993*, consent of the appropriate roads authority is required to:

- *Erect a structure or carry out a work in, on or over a public road, or*
- *Dig up or disturb the surface of a public road, or*
- *Remove or interfere with a structure, work or tree on a public road, or*
- *Pump water into a public road from any land adjoining the road, or*
- *Connect a road (whether public or private) to a classified road,*

The project involves works in, on or over a public road and would disturb the surface of public roads. Clause 5 of Schedule 2 of the Roads Act 1993 relates to the application of Section 138 and states that:

Section 138 does not require a public authority, or a network operator within the meaning of the Gas Supply Act 1996, to obtain a roads authority's consent to the exercise of the public authority's or gas distributor's functions in, on or over an unclassified road other than a Crown road.

Due to the application of Clause 5 of Schedule 2 of the Roads Act 1993, EnergyAustralia would:

- Only require consent from Council under Section 138 to dig up and disturb the surface of roads for which they are the public authority, if the roads are Crown roads.
- Require consent form the RTA under Section 138 to dig up and disturb the surface of classified roads. The relevant roads authority is the RTA for classified roads and City of Sydney for non-classified roads.

As indicated in Section 3.1.2, a consent under Section 138 of the *Roads Act 1993* cannot be refused if it is necessary for carrying out an approved project and must be substantially consistent with an approval to carry out the project given under Part 3A.

Clause 5 of Schedule 2 of the Roads Act 1993 relates to the application of Section 138 and states that:

Section 138 does not require a public authority, or a network operator within the meaning of the Gas Supply Act 1996, to obtain a roads authority's consent to the exercise of the public authority's or gas distributor's functions in, on or over an unclassified road other than a Crown road.

Due to the application of Clause 5 of Schedule 2 of the Roads Act 1993, EnergyAustralia would:

- Only require consent from Council under Section 138 to dig up and disturb the surface of roads for which they are the public authority, if the roads are Crown roads.
- Require consent form the RTA under Section 138 to dig up and disturb the surface of classified roads.

3.4.4 Electricity Supply Act 1995

Part 5 of the NSW *Electricity Supply Act 1995* sets out EnergyAustralia's powers relating to acquisition of land, construction of electricity works and powers of entry. These powers allow EnergyAustralia to construct electricity works within public roads.

Under Part 5 of the *Electricity Supply Act 1995*, EnergyAustralia is required to notify the City of Sydney of the works and take into consideration any associated submission.

3.5 Commonwealth legislation

3.5.1 Environmental Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas and species, populations and communities and heritage items.

The approval of the Commonwealth Minister of Environment, Heritage, Water and the Arts is required for:

- An action which has, will have or is likely to have a significant impact on "matters of National Environmental Significance" (NES matters). NES matters include:
  - World Heritage values of a declared World Heritage property;
  - National Heritage values of a listed National Heritage place;
  - Ecological character of a declared Ramsar wetland;
  - Listed threatened species and ecological communities;
  - Listed migratory species;
  - Commonwealth marine environment; and
  - Nuclear actions.
- An action by the Commonwealth or a Commonwealth agency which has, will have or is likely to have a significant impact on the environment;
- An action on Commonwealth land which has, will have or is likely to have a significant impact on the environment; or
- An action which has, will have, or is likely to have a significant impact on the environment on Commonwealth land, no matter where it is to be carried out.

A search of the EPBC Act protected matters database was undertaken as part of the Environmental Assessment Report for the Concept Plan prepared by PlanCom Consulting Pty Ltd (December 2008). It was considered unlikely that there would be any significant impacts on the protected matters. As such, the Sydney CityGrid Project was not referred to the Commonwealth Minister for the Environment.

GHD repeated this process in February 2010. The results indicated there is unlikely to be any protected matters that would be significantly impacted by the project. As a result, Stage 2D has not been referred to the Commonwealth under the EPBC Act.

4. Stakeholder consultation

This chapter provides an overview of the community consultation and stakeholder engagement processes that have been undertaken for the project and outlines the identified issues and how these have been addressed. It also provides details on future and ongoing community consultation for the project.

4.1 Consultation approach

4.1.1 Community Information Plan

EnergyAustralia is committed to working closely with the community throughout both the planning and construction phases of the Sydney CityGrid Project and has developed a Community Information Plan to address the requirements of MCoA 4 of the Concept Approval. This plan outlines the community and stakeholder communications and consultation processes that are to be undertaken throughout all stages of the Sydney CityGrid Project. The plan is a dynamic document that would be regularly updated to ensure it addresses issues specific to particular stages of the discrete projects that sit under the overarching Sydney CityGrid Project.

The objectives of the Community Information Plan are to:

- Provide a framework that allows the community to be well informed and a process to address concerns;
- Clarify areas of responsibility between EnergyAustralia and its contractors; and
- Meet the MCoA for the Sydney CityGrid Project.

The Community Information Plan will be periodically updated during the project to ensure its relevance to particular stages of pre-construction, construction and operation.

A Community Relations Plan has been developed that specifically relates to consultation associated with Stage D. This plan is tailored towards stakeholders likely to have an interest in Stage 2D and includes consultation activities to be implemented during the planning and construction phases.

4.1.2 Consultation techniques

A range of engagement techniques would be used to inform the affected community and stakeholders and to identify issues and concerns during preparation of the Environmental Assessment. These activities include meetings with potentially affected landowners and providing community newsletters about the project and environmental assessment process.

The objectives of the community and stakeholder engagement activities are to:

- Identify interested stakeholders and appropriate methods of communication;
- Provide the community with up to date and timely information;
- Provide a direct avenue for feedback to the project team; and
- Find a balance between social and environmental needs to ensure there is equity in the way that the project is delivered.

4.2 Consultation with key stakeholders

Extensive consultation has been undertaken with statutory authorities during development of the Sydney CityGrid Project. The following section summarises issues raised during consultation related to Stage 2D and how these issues have been addressed.

4.2.1 Sydney Metro Authority and Transport NSW

As indicated in Section 6.2, the CECT would intersect the alignment of the tunnels for the CBD Metro Stage 1. Although the NSW Government has announced that the CBD Metro Stage 1 will not proceed at this time, Stage 2D has been designed to accommodate the future presence of the CBD Metro Stage 1. This minimises the potential for any interface issues between the CECT and Stage 1 of the CBD Metro Project, should it proceed in the future.

EnergyAustralia liaised closely with Sydney Metro from the outset of the CBD Metro Stage1 project until early 2010 when the NSW Government announced that the project had been deferred. A draft stakeholder deed had been prepared between EnergyAustralia and Sydney Metro.

EnergyAustralia will continue its consultation with the Transport NSW to finalise concurrence of the interface.

4.2.2 RailCorp

Consultation with RailCorp has been undertaken during development of the concept design and this involved consultation during preparation of the Concept Environmental Assessment (December 2008), as well as the Environmental Assessments for Stage 2A(i) of the Sydney East Zone Substation, and Stage 2D of the Sydney CityGrid Project. RailCorp raised a number of issues to be considered during development of the concept design to ensure that the Sydney CityGrid Project does not adversely impact on any existing or proposed assets that include the City Circle and Eastern Suburbs Rail Lines, and the proposed MetroWest and MetroPitt Rail Lines.

RailCorp was provided with the opportunity to comment on drawings that define the horizontal and vertical alignment of the Sydney CityGrid Project relative to existing and proposed rail assets.

Issues raised by RailCorp focused on the need to provide adequate separation distance between tunnels that are part of Stage 2D and RailCorp's existing and proposed infrastructure. These issues have been addressed during development of the concept design. RailCorp requested the following information be provided prior to construction in the vicinity of RailCorp infrastructure:

- An engineering assessment of the likely impact of those aspects of the CECT that interface with existing rail tunnels; and
- Based on the outcome of the engineering assessment outline above, if necessary, a dilapidation report identifying the condition of existing infrastructure prior to and after construction of the project.

RailCorp also advised that the following noise and vibration issues should be considered:

- Impacts of vibration on existing infrastructure e.g. road/rail tunnels; and
- Impacts of vibration from rail operations on the project.

EnergyAustralia would continue to consult with RailCorp to address potential issues prior to construction. This would include the opportunity to comment on relevant design information.

4.2.3 RTA and Cross City Motorway

The CECT route intersects tunnels that form the Cross City Motorway in the vicinity of William Street. Extensive consultation has been undertaken with RTA and the Cross City Motorway during development of the alignment for the CECT. The main issues raised relate to the need for adequate separation distances to be maintained between the CECT and the tunnels that form the Cross City Motorway. Issues were also raised regarding the potential for vibration during construction to impact on the tunnels.

EnergyAustralia provided the RTA and Cross City Tunnel with preliminary design drawings for review and comments were addressed during development of the concept design. The RTA and Cross City Motorway is reviewing the engineering assessment which indicates that the project would not adversely impact on the tunnels for the Cross City Motorway.

EnergyAustralia is committed to ongoing consultation with the RTA and Cross City Motorway and this would involve input to the detailed design and liaison during the construction phase.

4.2.4 Sydney Water Corporation

EnergyAustralia consulted with Sydney Water Corporation (Sydney Water) during development of the concept design for Stage 2D and a copy of correspondence received during preparation of this Environmental Assessment is provided in Appendix B. Issues raised by Sydney Water are summarised below and would be addressed during development of the detailed design. Ongoing consultation would be undertaken with Sydney Water during the design process and this would involve providing drawings identifying the location of known services and utilities relative to the excavations to be undertaken for the project.

William Street/Yurong Street

Sydney Water noted that at this location the CECT could be relatively close to several Sydney Water drainage lines of unknown depth. While Sydney Water expects the vertical clearance between the top of the tunnel and these drainage lines to be sufficient, it requested that these drainage lines should be accurately shown on the final drawings and geotechnical information provided to enable a more detailed assessment.

Little Albion Street area/CSCT extension

Sydney Water identified drainage lines in the area of the CSCT tunnel extension. While these stormwater drainage lines are unlikely to be interfered with, Sydney Water requested that these lines be accurately shown in the final drawings. Sydney Water also requested geotechnical information to enable a more detailed assessment.

Reservoir Street crossing and future Sydney Water relief sewer

Sewer works are planned along Reservoir Street, Surry Hills, that would involve a 3 m diameter relief sewer tunnel on grade. Sydney Water noted that that any change in the elevation of the sewer relief tunnel would be limited and based on the current drawings, the separation distance between the CECT and the proposed relief sewer tunnel is about 2.6 m. At this point, the CECT is on a -3% grade. Sydney Water requested that the grade of the CECT be reduced until after the tunnel had passed Reservoir Street to increase the separation distance between the two tunnels to over 6 m. As the ground conditions and support requirements at this location are currently unknown, Sydney Water advised that an increase in the separation distance between the two tunnels would be beneficial.

As indicated in Section 6.2, the vertical alignment of the CECT in the vicinity of the proposed relief sewer is determined based on the:

- Need to connect to EnergyAustralia's existing and proposed infrastructure, including the CSCT and Riley Street STSS;
- Need to maintain appropriate separation distances from existing and proposed underground infrastructure, including assets owned by Sydney Water (Busby's Bore and the Bondi Ocean Outfall Sewer), and the tunnels for the Cross City Motorway;
- Suitable geological conditions for the tunnel;
- Minimum gradients for drainage; and
- Optimal grades for operation of the TBM.

Alteration of the grade of the CECT in the vicinity of the proposed relief sewer as suggested by Sydney Water would reduce the clearance to the Bondi Ocean Outfall Sewer which is currently 5.5 m. EnergyAustralia's intention is to provide as much separation to the Bondi Ocean Outfall Sewer as possible given that the proposed relief sewer would be designed to accommodate the interface with the CECT.

EnergyAustralia would continue to consult with Sydney Water to optimise separation between its assets or confirm suitability of the currently proposed alignment.

Busby's Bore, Oxford Street

Drawing No. 208313 indicates the invert of Busby's Bore to be 24.99 m AHD. However, Sydney Water records indicate the invert level is about 31.6 m AHD.

There is uncertainty in the datum level of Busby's Bore on Sydney Water's records. The assessed level of 24.99 m AHD is conservative and has been retained on the drawings as it is closer to the alignment of the CECT compared to the level indicated on Sydney Water's records of 31.6 m AHD.

Leakage from Sydney Water assets

Sydney Water noted that the CECT crosses and runs parallel to a number of Sydney Water wastewater assets and there is the potential for leakage to occur from Sydney Water's wastewater systems into the underlying CECT.

The CECT would be a fully lined tunnel to exclude seepage to the greatest extent practicable. It is considered unlikely that seepage from Sydney Water's assets would impact on operation of the CECT.

4.2.5 Department of Environment, Climate Change and Water

DECCW was consulted during preparation of the noise and vibration assessment and confirmed that the investigation should be undertaken in accordance with DECCW guidelines that are listed in MCoA 3.1e. As indicated in Chapter 9 and Appendix F, the noise and vibration assessment has been prepared in accordance with these guidelines.

EnergyAustralia met with DECCW in July 2010 to discuss the project with a particular focus on areas where preliminary assessments indicated that the noise and vibration criteria may be exceeded. The main issues raised by DECCW were that:

- The noise and vibration assessment should identify whether construction or operation of the project is likely to comply with the relevant criteria – this is provided in Section 9.3;
- The noise and vibration assessment should identify reasonable and feasible management strategies that would be implemented to mitigate residual impacts - this is provided in Section 9.4;
- As the regenerated noise criteria is predicted to be exceeded in areas where the CECT and CSCT is relatively shallow, the Environmental Assessment should discuss factors that were considered during development of the design, such as the grade of the tunnels and constraints imposed by other existing and proposed underground infrastructure - this is provided in Section 6.2; and
- A management strategy should be developed that is fair and reasonable and includes a well developed community consultation program – this is provided in Section 9.4.1.

DECCW also requested that a figure be provided showing areas where there is a risk that regenerated noise goals would be exceeded and should identify:

- Zones where marginal exceedances are predicted;
- Zones where more substantial exceedances are predicted; and
- Land use within the zones where exceedances are predicted. This would allow more sensitive areas, such as residential zones, to be distinguished from less sensitive areas (refer to Figure 9-6).

The noise and vibration assessment in Appendix F addresses the issues raised by DECCW.

4.2.6 Heritage Branch of the Department of Planning

The Heritage Branch of the Department of Planning was consulted during development of the Concept Plan Environmental Assessment and issues raised were related to the potential for items of archaeological or heritage significance to be impacted. The Heritage Branch advised that items of non-aboriginal heritage items under or adjacent to the area affected by the project should be identified by field survey and an assessment of the impact on their heritage significance should be undertaken. This should include all heritage items along the infrastructure route such as buildings, works, relics, gardens, landscapes, views, tree or places of non-Aboriginal heritage significance. The Heritage Branch also required assessment of potential vibration impacts on items of heritage significance. These issues were addressed in the Concept Environmental Assessment (December 2008) and Submissions Report and Preferred Project Report (May 2009).

The Heritage Branch was also consulted during preparation of the Environmental Assessment for Stage 2D and this focused on a discussion of refinements to the alignment for the CECT and CSCT extension since receipt of the Concept Approval. The Heritage Branch advised that the same issues applied as those raised in relation to the Concept Environmental Assessment. In addition, it was requested that the Environmental Assessment include measures to be implemented if items of non-indigenous heritage significance are encountered during excavation of the Dalley Street shaft, and measures to manage potential impacts related to vibration. These issues are addressed in Chapter 10.

4.3 Community consultation

Community consultation undertaken during preparation of the Environmental Assessment includes distribution of letters to the community in the vicinity of the Riley Street site in October 2008 and June 2010. These provided an outline of the projects on the site and advised that an Environmental Assessment for the CECT and CSCT extension was being prepared and is expected to be publicly exhibited in late 2010. The newsletter invited the community to contact EnergyAustralia by email or a toll free telephone number to obtain further information and several contacts have been made.

The tunnel alignments were finalised in early August 2010 and a newsletter was subsequently distributed to properties along the tunnel route. The newsletter provided information on the alignment, as well as the likely construction method and program. It also outlined the range of community consultation activities that would be undertaken during the planning and construction phases of the project.

4.4 Exhibition of the Environmental Assessment

The Environmental Assessment will be public exhibited by the Department of Planning for a minimum period of 30 days in accordance with the requirements of the EP&A Act. During this time, a copy of the report will be available for viewing at selected locations and on websites maintained by the Department of Planning and EnergyAustralia.

During the exhibition period, government agencies, interested groups and organisations, and the community would be invited to make written submissions to the Department of Planning in response to the Environmental Assessment.

EnergyAustralia would also undertake community consultation during the exhibition period that is separate to the Department of Planning's formal exhibition process. This would provide the community with additional information and consultation activities would include:

- Distribution of a community newsletter outlining the Department of Planning's public exhibition process and identifying opportunities to respond;
- Letter box drops;
- Community information display;
- Further meetings with stakeholders if required;
- Website information; and
- Project information hotline.

4.5 Consultation during construction Stage 2D

EnergyAustralia recognises the importance of effective communication with the community during the planning, construction and operation phases of a project. The Community Relations Plan developed for the project details activities that would be undertaken as part of community relations and consultation program during planning and construction phase. Activities to be implemented include:

- Community newsletters – these would be delivered regularly at each stage of the project to inform community surrounding the construction sites and properties along the tunnel routes of the status of the project and invite them to participate in consultation activities;
- Community information displays – these would provide an opportunity for interested stakeholders to meet the project team and ask questions. Displays would be held for works undertaken at the Riley Street site and the first event is scheduled to occur in November 2010 to coincide with the public exhibition of the Environmental Assessment;
- Key stakeholder briefings – regular briefings would be provided to key stakeholders such as Council and government agencies. Properties affected by compulsory acquisition of the stratum would be offered one-on-one meetings to answer questions they may have;
- Community Liaison Group – at the Riley Street site as this would be the main construction site for the project, a Community Liaison Group would be formed to provide information to the community in the vicinity of this site. This group would contain representatives of local businesses, residents, Council and other interested parties; and
- Project 1 800 number (1800 006 549) – a free call number would be available throughout planning and construction of the project to provide a central point of contact for any stakeholder issues;
- Web page – EnergyAustralia's website would carry a dedicated page with current information and contact details, including copies of all published consultation information;
- Media – information would be disseminated to local and metropolitan journalists to promote the project within the wider community. This may form part of communications regarding the overall Sydney CityGrid Project; and
- Project email (majorprojects@energy.com.au) – a dedicated email address would be available throughout planning and construction to enable the community to raise any inquiries or issues.

5. Project need and justification

This section outlines the need and justification for the project as well as the consequences of not proceeding. While most aspects are applicable to the whole CityGrid Project, specific reference is given to Stage 2D.

5.1 Overview of the need for the Sydney CityGrid Project

The need and justification for the Sydney CityGrid Project are described in detail in the Concept Environmental Assessment Report (PlanCom, 2008). In summary, the existing electricity supply infrastructure in the Sydney CBD requires refurbishment, replacement and augmentation to provide a secure supply of electricity to the Sydney CBD that complies with new licensing requirements. The requirements specify that all city zone substations and transmission feeders must achieve a 'n-2' capacity, which means that they must be able to supply the full electricity demand with any two transformers or feeders out of service.

EnergyAustralia developed the Sydney CityGrid Project as an integrated strategy that is the most effective means of rebuilding or refurbishing the existing infrastructure while maintaining sufficient spare capacity to ensure an ongoing and reliable electricity supply. The overall objectives of the Sydney CityGrid Project are to:

- Meet and comply with the 'n-2' licence requirements;
- Replace critical infrastructure that is scheduled for retirement;
- Meet the forecast electricity network needs and demands in a cost effective manner;
- Facilitate prudent longer term investment decisions; and
- Provide the flexibility to accommodate future network upgrades.

The potential environmental impacts of the Sydney CityGrid Project were assessed in the 2008 Concept Environmental Assessment Report and Concept Approval was subsequently granted by the Minister for Planning on 20 September 2009. Project Approval was also granted for Stage 1 of the Sydney CityGrid Project relating to construction and operation of the Belmore Park Substation development. As such, it is considered that the need for and justification of the Sydney CityGrid Project has been demonstrated.

The following section outlines the need and justification for Stage 2D within the context of the Sydney CityGrid Project.

5.2 Need and justification for Stage 2D

Stage 2D comprises a number of discrete yet interrelated components which are required to allow for the connection of five feeders from the Riley Street Subtransmission Station to the new City East Zone Substation. Two 132kV feeders would run between the new City East Zone Substation and the Dalley Street Zone Substation, two 132kV feeders would run between the new City East Zone Substation and the existing City North Zone Substation, and two 132kV feeders would run between the Dalley Street Zone Substation and the City North Zone Substation.

A new STSS is required at Riley Street, Surry Hills to provide a connection of the eastern CBD load and the 132kV supply to the Eastern Suburbs. This STSS would also provide 132kV connections for a future Bulk Supply Point to be located immediately adjacent, post 2020.

The CSCT extension is required to connect the Surry Hills Substation in Ann Street to the future Riley Street STSS. This tunnel would also enable connections to existing 33kV feeders and new 132kV feeders from the Rose Bay Substation.

The Dalley Street Zone Substation contains internal plant and equipment such as switchgear that is nearing the end of its operational life and is due for retirement. The substation would be refurbished and this would involve replacing existing plant and equipment to ensure that it continues to function effectively as part of the CBD electricity network.

Stage 2D is both needed and justified as all stages of the Sydney CityGrid Project are integrated and interdependent. Failure to construct this stage would compromise the ability to achieve the objectives of the overall project.

6. Description of the project

6.1 Overview

The CECT would be constructed between the proposed Riley Street STSS and the City North Zone Substation, with connections to the proposed City East and existing Dalley Street zone substations.

The CECT would be about 3.2 km long, approximately 4 m in external diameter, and have depths ranging from about 10 m – 55 m below ground level. The tunnel would be constructed using a tunnel boring machine and would be located beneath existing road alignments, parkland and private residential and commercial properties.

The CECT would also include:

- Equipment rooms located in the shaft at Riley Street for ventilation fans and other equipment. The shaft at Riley Street would provide emergency tunnel access. The main control room would be located at the existing Campbell Street facility;
- Shaft and stub tunnel connections between the CECT and the new City East Zone Substation and the existing Dalley Street Zone Substation;
- Tunnel to ground level connections (small shafts) in the vicinity of Little Albion Street (Surry Hills) and Yurong Parkway (Domain) to facilitate 33 kV feeders entering/leaving the tunnel at these locations; and
- Other ancillary works at various locations along the tunnel route.

The existing CSCT would be extended to connect the Surry Hills STS shaft at Wade Place, Surry Hills, and the site proposed for the Riley Street STSS. The CSCT extension would involve a 150 m long section of stub tunnel constructed by a road header generally beneath Little Albion Street. Other interface works, including shaft and surface works associated with 33 kV connections to the CECT would also be required in and around Little Albion Street.

The existing Dalley Street Zone Substation would be refurbished to allow connection of feeders from the proposed City East Zone Substation. Stage 2D does not involve construction of a new building on or adjacent to the site of the Dalley Street Zone Substation.

A separate application for Project Approval for Stage 2A(i) of the City East Zone Substation has been submitted to the Department of Planning and this included construction of the stub tunnel that connects the CECT to the proposed City East Zone Substation in Bligh Street, Sydney. Fit out, commissioning and operation of this stub tunnel connection forms part of Stage 2D.

The Riley Street STSS forms Stage 2C of the Sydney CityGrid Project and a separate application would be submitted for project approval for this infrastructure.

6.2 Description of Stage 2D

The vertical and horizontal alignments were selected following evaluation of a range of issues including geotechnical conditions, existing and proposed underground infrastructure, construction risk and cost, connection points to the existing electricity network, and potential environmental impacts. The selected alignment was adopted following an extensive option evaluation process and is considered to be an optimal balance given the constraints.

The majority of the tunnel would be at sufficient depth below the ground surface to minimise potential impacts on structures due to settlement and vibration. The depth of the tunnel along the majority of the alignment also minimises the potential for regenerated noise levels to be above guideline levels during tunnelling.

The CSCT extension is relatively shallow as it needs to connect to an existing shaft at the Surry Hills Substation. The CECT is also relatively shallow in the vicinity of Riley and Yurong streets as it passes above the tunnels for the Cross City Motorway in this location. Consideration was given to a vertical alignment that passes beneath the tunnels for the Cross City Motorway, however this was discounted as the operational requirements of the tunnel boring machine would result in a very deep shaft being required at the Riley Street construction site which would not be compatible with the alignment of the CSCT extension. Noise and vibration issues associated with these two relatively shallow sections of tunnel are assessed in Section 9.3.

The following sections outline the horizontal and vertical alignments.

6.2.1 Horizontal tunnel alignment

The horizontal alignment (route) was developed based on the need to connect the proposed Riley Street STSS and the City North Zone Substation via the proposed new City East and existing Dalley Street zone substations. This horizontal alignment also includes an extension to the existing CSCT, and would avoid all interactions with other existing or proposed underground infrastructure. This alignment would be approximately 3.2 km long and is illustrated in Figure 6-1.

The horizontal alignment:

- Commences at the site on the corner or Albion and Riley Streets, which is the proposed site for the Riley Street STSS, and proceeds in a northerly direction beneath Riley and Yurong Streets and private properties until it reaches The Domain;
- Passes under The Domain to the east of St Marys Catholic Cathedral and west of the NSW Art Gallery, and directly beneath the Mitchell Library; and
- Continues beneath Bent Street, crosses beneath private property and terminates beneath Sussex Street adjacent to the City North Zone Substation.

The alignment also includes the CSCT extension between the existing shaft for the Surry Hills Substation at Wade Place, Surry Hills, and the site proposed for the Riley Street STSS as indicated on Figure 6-1. This extension would be approximately 150 m long and generally beneath Little Albion Street.

The alignment includes shaft and stub tunnel connections between the CECT and the new City East Zone Substation and the existing Dalley Street Zone Substation.

The tunnel has been aligned to, amongst other constraints, avoid potential unstable and weathered rock that may occur due to the Woolloomooloo paleovalley located near the intersection of Riley Street and Sir John Young Crescent, and to provide as much clearance as possible to the tunnels for the Cross City Motorway.

6.2.2 Vertical tunnel alignment

The vertical alignment of the tunnel was developed to address a number of constraints due to geotechnical conditions and the presence of existing and proposed underground infrastructure. These are identified in the alignment drawings located at Appendix C and reflect that the CECT has been designed to be located:

- Beneath the interim rail corridors defined by ISEPP for the CBD Rail Link that are commonly know as the Metro Pitt and Metro West corridors;
- Beneath the rail corridor defined by ISEPP for the CBD Metro. Potential conflicts with the CBD Metro Stage 1 at Barangaroo/Wynyard were identified during consultation with Sydney Metro Authority and required that the CECT alignment be lowered in this location;
- Beneath the proposed Sydney Water relief sewer in the vicinity of Reservoir Street, Surry Hills;
- Beneath the existing Sydney Water Busby's Bore at Oxford Street;
- Beneath the existing Sydney Water Bondi Ocean Outfall Sewer at Liverpool Street;
- Above the existing four tunnels for the Cross City Motorway;
- Beneath RailCorp's existing Eastern Suburbs Railway tunnels that are beneath the Domain;
- Beneath RailCorp's existing three city circle lines;
- Beneath Telstra's existing cable tunnel; and
- The tunnel passes beneath the corridors for Railcorp's proposed MetroWest and MetroPitt tunnels.

Existing and proposed underground and basement infrastructure has been considered during development of the design.

The tunnel alignment would be about 30 m below the State Library and generally between 6 and 45 m from existing or proposed assets. The closest distance between the tunnel and a building basement is approximately 5 m at 63-73 Ann Street.

The indicative vertical alignment of Stage 2D is shown in Figure 6-2 and Figure 6-3 and indicates that the tunnel generally ranges in depth between about 10 m and 55 m below ground level. The deepest point is at the intersection of Bent and Bligh Streets where it is approximately 55 m below the ground surface.

Figure 6-1 Horizontal alignment of the CECT

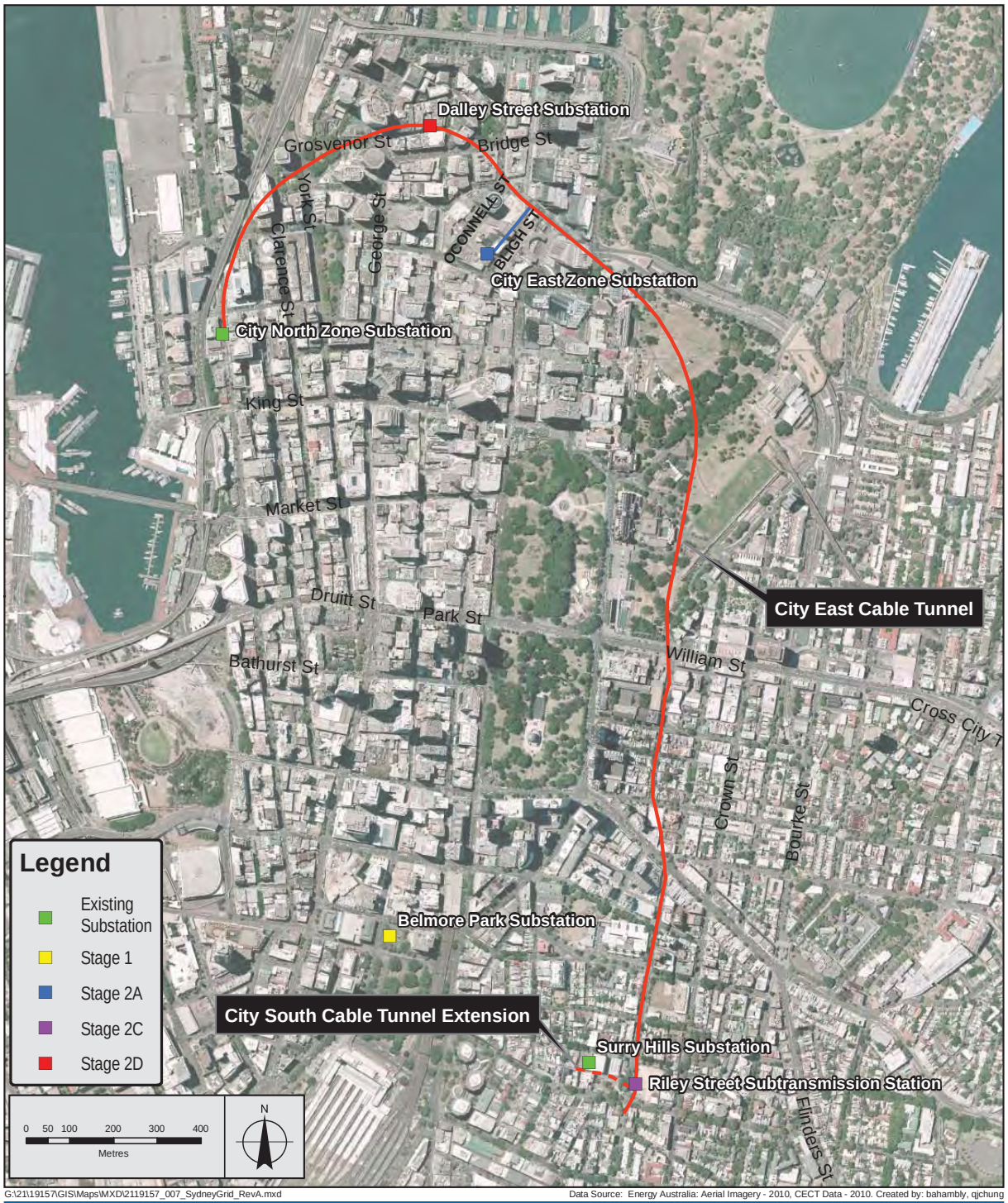
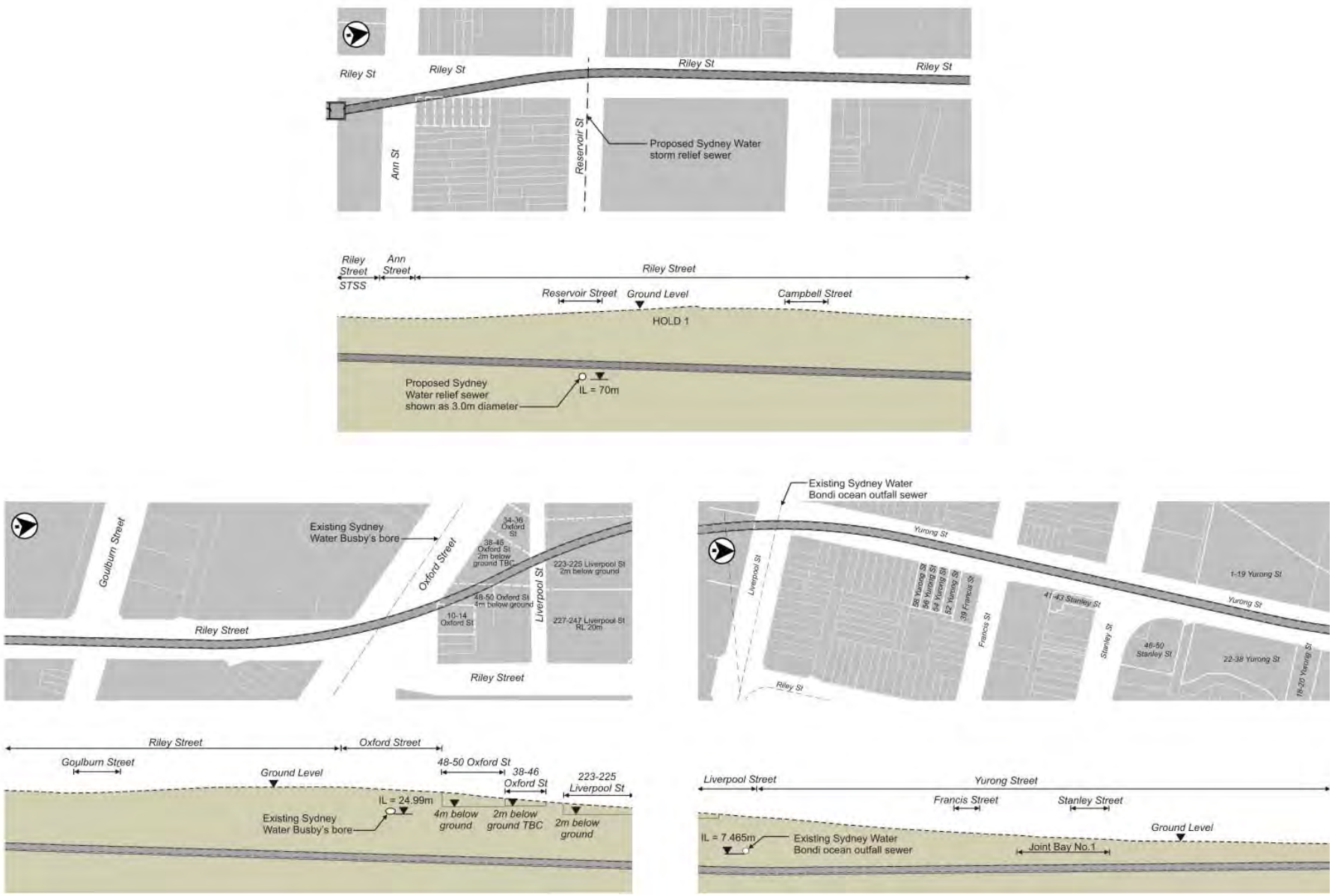
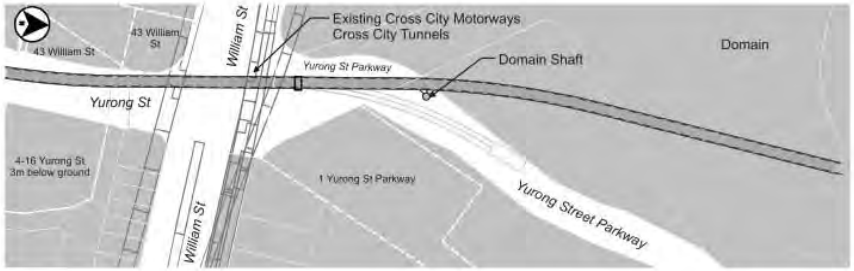
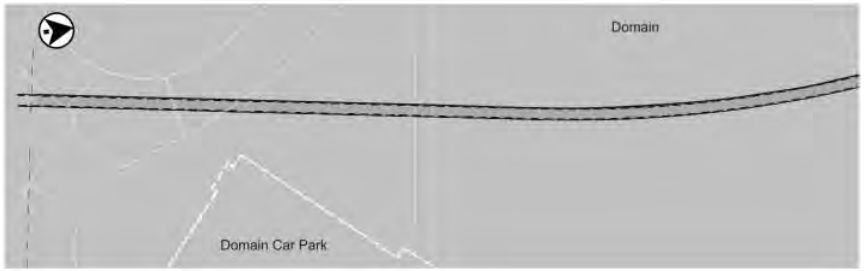
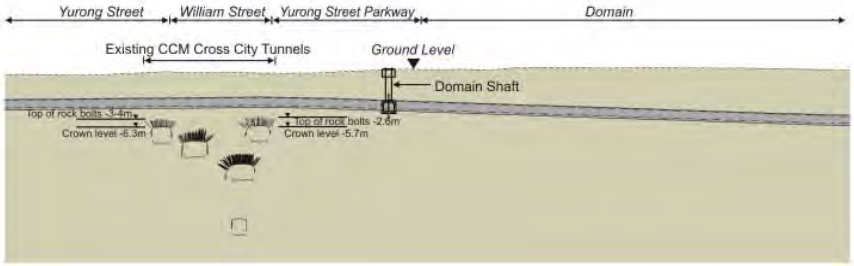


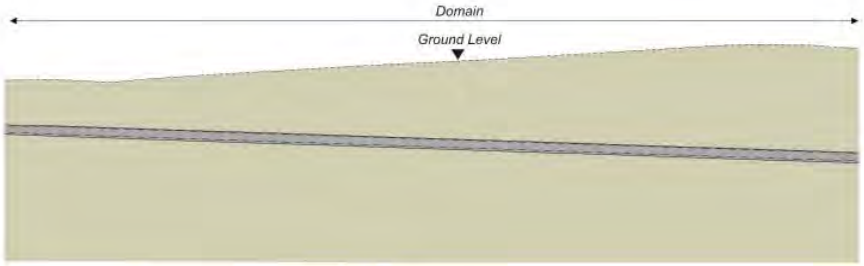
Figure 6-2 Indicative alignment of the CECT

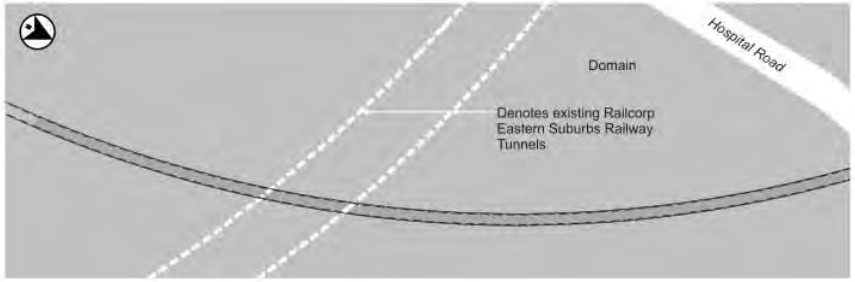


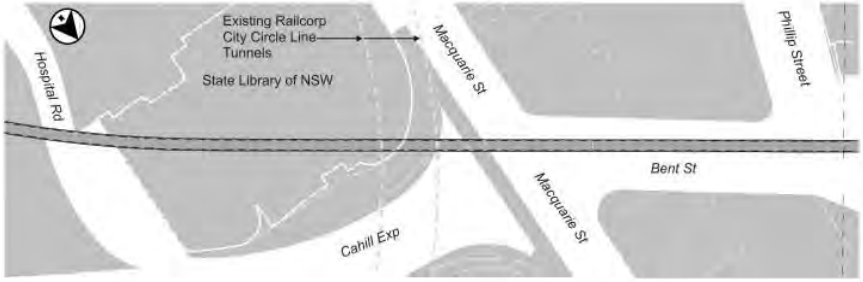

43 William St
43 William St
William St
Existing Cross City Motorways
Cross City Tunnels
Domain
Yurong St Parkway
Domain Shaft
Yurong St
4-16 Yurong St
3m below ground
1 Yurong St Parkway
William St
Yurong Street Parkway

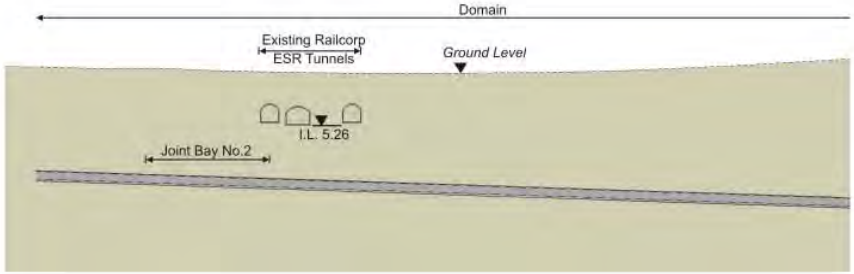

Domain
Domain Car Park

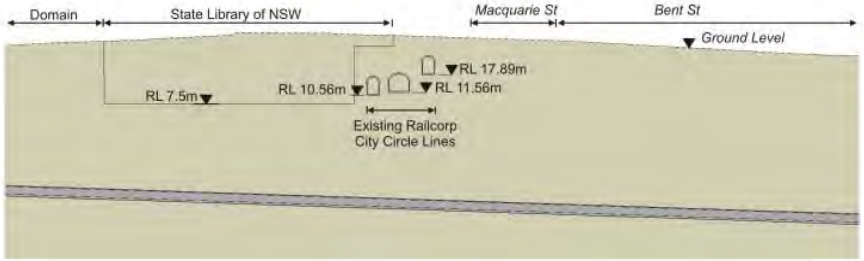

Yurong Street
William Street
Yurong Street Parkway
Domain
Existing CCM Cross City Tunnels
Ground Level
Domain Shaft
Top of rock bolts -3.4m
Crown level -6.3m
Top of rock bolts -2.8m
Crown level -5.7m


Domain
Ground Level

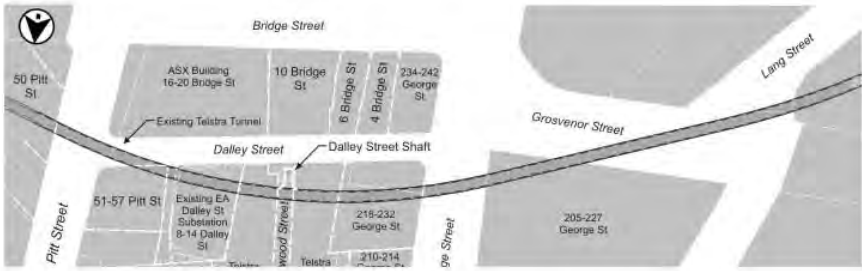

Hospital Road
Domain
Denotes existing Railcorp
Eastern Suburbs Railway
Tunnels

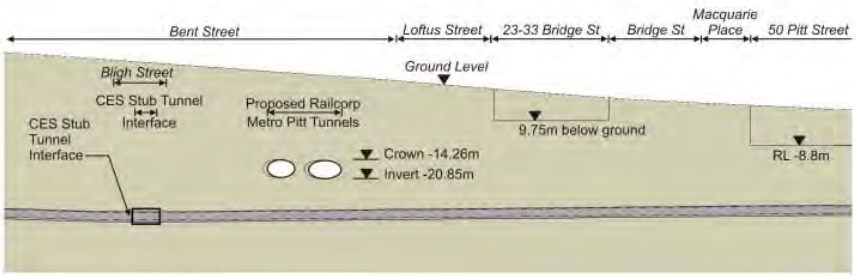

Existing Railcorp
City Circle Line
Tunnels
State Library of NSW
Macquarie St
Phillip Street
Hospital Rd
Bent St
Macquarie St
Cahill Exp

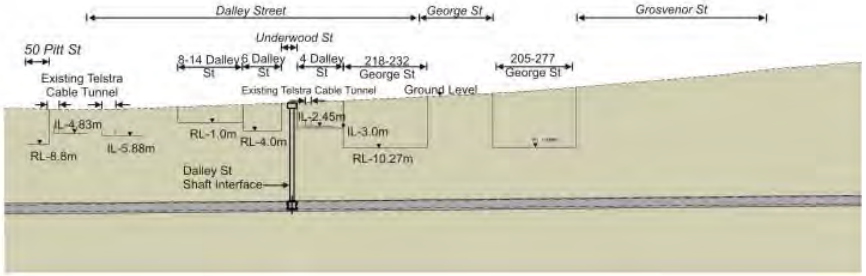

Domain
Existing Railcorp
ESR Tunnels
Ground Level
I.L. 5.26
Joint Bay No.2

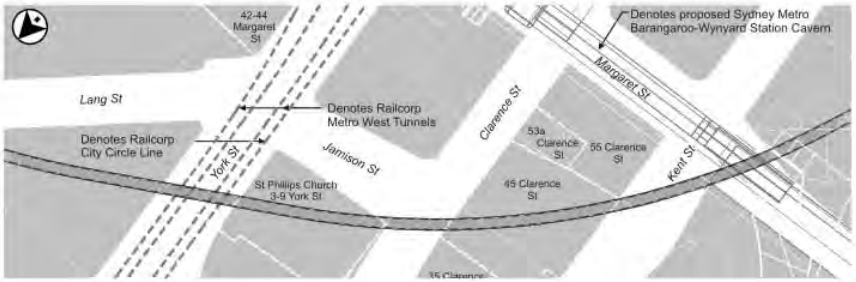

Domain
State Library of NSW
Macquarie St
Bent St
Ground Level
RL 17.89m
RL 11.56m
RL 7.5m
RL 10.56m
Existing Railcorp
City Circle Lines

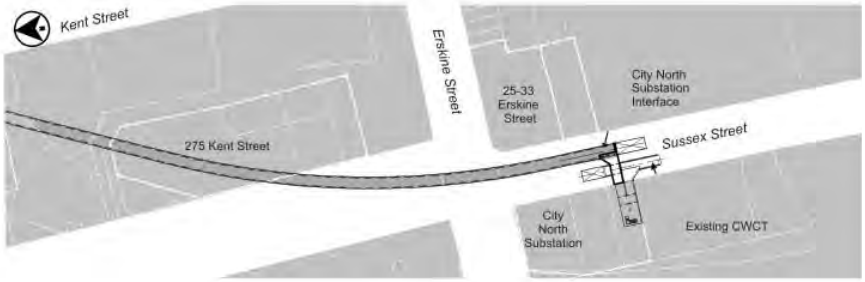

25 Bent St
21 Bent St
City East Substation Stub Tunnel
15-19 Bent St
Denotes proposed Railcrop Metro Pitt Tunnels
Bent Street
Gresham Street
Bent Street
Bent Street
23-33 Bridge St
50 Pitt St
CES Stub Tunnel Interface Sump and Pump Station
Amber Place
Loftus Street
Bridge St
Macquarie Place
27-31 Maquarie Place
26-40 Pitt St
Phillip Street
44-46 Young St
35-39 Bridge St

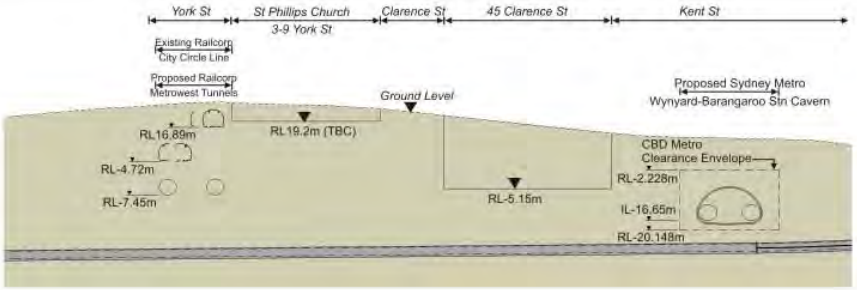

Bridge Street
50 Pitt St
ASX Building 16-20 Bridge St
10 Bridge St
6 Bridge St
4 Bridge St
234-242 George St
Lang Street
Existing Telstra Tunnel
Grosvenor Street
Dalley Street
Dalley Street Shaft
Pitt Street
51-57 Pitt St
Existing EA Dalley St Substation 8-14 Dalley St
Underwood Street
218-232 George St
205-227 George St
Telstra
210-214


Bent Street
Loftus Street
23-33 Bridge St
Bridge St
Macquarie Place
50 Pitt Street
Bligh Street
Ground Level
CES Stub Tunnel Interface
Proposed Railcorp Metro Pitt Tunnels
CES Stub Tunnel Interface
9.75m below ground
Crown -14.26m
Invert -20.85m
RL -8.8m


Dalley Street
George St
Grosvenor St
Underwood St
50 Pitt St
8-14 Dalley St
6 Dalley St
4 Dalley St
218-232 George St
205-277 George St
Existing Telstra Cable Tunnel
Existing Telstra Cable Tunnel
Ground Level
IL-4.83m
IL-5.88m
RL-8.8m
RL-1.0m
RL-4.0m
IL-2.45m
IL-3.0m
RL-10.27m
Dalley St Shaft Interface


42-44 Margaret St
Denotes proposed Sydney Metro Barangaroo-Wynyard Station Cavern
Lang St
Denotes Railcorp Metro West Tunnels
Clarence St
Margaret St
Denotes Railcorp City Circle Line
York St
Jamison St
53a Clarence St
55 Clarence St
Kent St
St Phillips Church 3-9 York St
45 Clarence St


Kent Street
Erskine Street
25-33 Erskine Street
City North Substation Interface
275 Kent Street
Sussex Street
City North Substation
Existing CWCT


York St
St Phillips Church 3-9 York St
Clarence St
45 Clarence St
Kent St
Existing Railcorp City Circle Line
Proposed Railcorp Metrowest Tunnels
Ground Level
Proposed Sydney Metro Wynyard-Barangaroo Stn Cavern
RL16.89m
RL19.2m (TBC)
RL-4.72m
RL-7.45m
RL-5.15m
CBD Metro Clearance Envelope
RL-2.228m
IL-16.65m
RL-20.148m

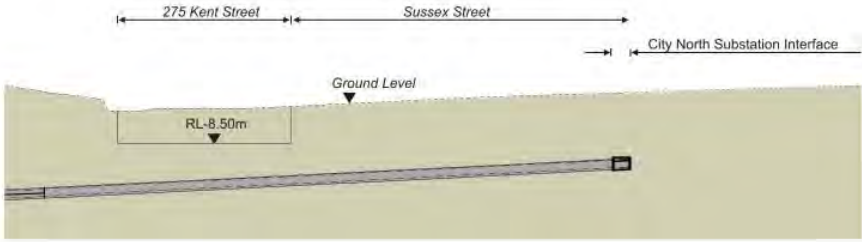
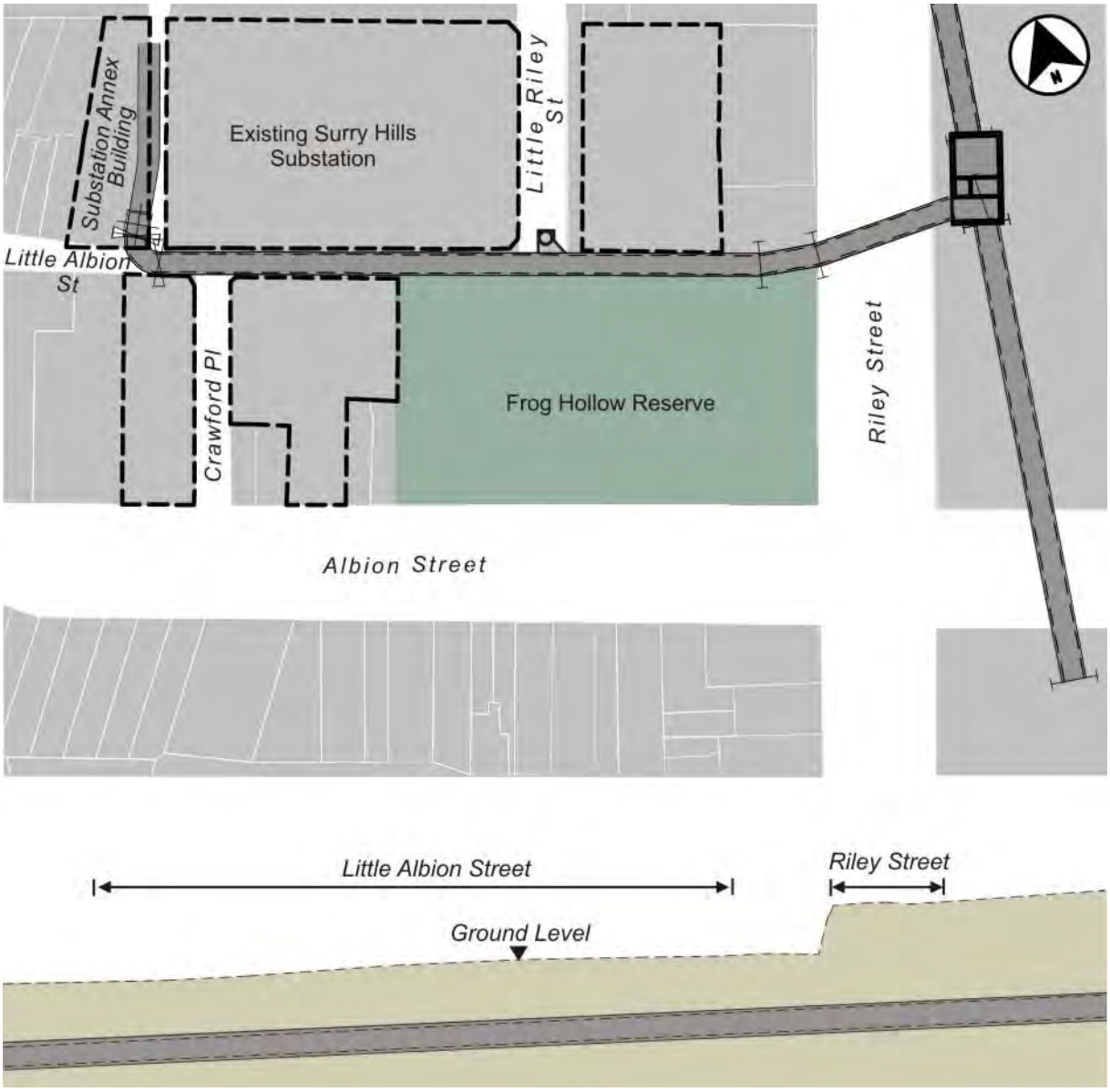

275 Kent Street
Sussex Street
City North Substation Interface
Ground Level
RL-8.50m

Figure 6-3 Indicative alignment of the CSCT extension



6.2.3 Settlement

The need to design the project to minimise impacts associated with settlement above the tunnels was considered during development of the design. The tunnels would be designed and constructed to minimise the risk of ground settlement and potential settlement induced damage to existing buildings and other aboveground and underground infrastructure. This would be achieved by:

- Geotechnical investigations and interpretation of ground conditions along the tunnel alignment that would provide input to the structural design;
- Designing the tunnel as a fully lined "tanked" tunnel to limit the amount of groundwater to 300 litres/100 m/day and to minimise the risk of drawdown of the groundwater table that would be associated with long term seepage into a "drained tunnel". Reducing the risk of drawdown of the groundwater table also minimises the risk of settlement along the alignment and associated damage to buildings;
- Selecting vertical alignments to maintain adequate clearance to existing aboveground and underground infrastructure and to provide adequate rock cover to limit tunnel induced ground surface settlement;
- Designing the tunnel lining to withstand expected permanent loads associated with the full range of ground conditions and groundwater levels (e.g. rock and water pressures); and
- Modelling tunnelling works to confirm that expected ground movements would be within acceptable limits.

6.2.4 Groundwater management

The tunnels would be fully tanked (lined) to exclude seepage of groundwater to the greatest extent practicable. No lining is completely waterproof and the tunnel design would allow for up to 300 litres/100 m/day of groundwater (including shafts and interfaces) to collect in the tunnels.

Sump and pump-out facilities would be included at the lowest points of the cable tunnels, with drainage channels throughout the tunnel length to direct seepage water to these points. For the CECT, the lowest point is located at the intersection of Bent and Bligh Streets at a depth of approximately 55m below ground level. A second sump would be located in the vicinity of Liverpool Street. Water from the sumps would be pumped along the CECT and treated at EnergyAustralia's existing water treatment plant located at the Campbell Street Substation. Groundwater seepage to the CSCT extension would also be pumped to the Campbell Street water treatment plant. A duty and stand-by pump set would be installed adjacent to each sump and a rising main would be located along the wall of the tunnels.

The water treatment plant at the Campbell Street Substation treats wastewater in accordance with the Operational Environmental Management Plan for the CBD 132kV Cable Tunnel. The objective is to treat water to comply with the Australian and New Zealand Environment and Conservation Council (2000) guidelines before discharging to Cockle Bay. The Campbell Street groundwater treatment plant has an average design capacity of 3.5 L/s and currently treats approximately 2 L/s. As groundwater from the CECT and associated connection tunnels would contribute approximately 0.1 L/s, the existing groundwater treatment plant has sufficient capacity to treat this groundwater.

6.2.5 Tunnel control and ventilation

The CECT and CSCT extension would be fitted with lighting and communications cables. The feeders would generate heat as a result of resistance to transmission of electricity through the cables.

The tunnels would be fitted with a ventilation system designed so that natural convection would be sufficient to maintain the tunnel temperature under normal cable loads and weather conditions.

Mechanical ventilation would be required to ensure sufficient fresh air and reduce temperatures to a comfortable level to allow personnel entry to the tunnel. Mechanical ventilation would also be provided to extract smoke if there is a fire in the tunnel. The ventilation system would be automatically activated and set to purge the air within the tunnel on a regular basis.

During peak power loads, when personnel access is required, or at high temperatures, the tunnel may be mechanically ventilated by the fans located at the shaft adjacent to the proposed Riley Street STSS. Air would be exhausted at City North Zone Substation with air bleeds at the City East and Dalley Street zone substation interfaces.

Materials used in the construction of the tunnel and the manufacture of cables would be fire resistant. In the unlikely event of a fire, the affected feeder(s) would be shut-down and the tunnel would be mechanically ventilated until the smoke clears. There is a very low probability of a fire occurring and an emergency response plan would be developed as part of EnergyAustralia's safety procedures.

6.2.6 Dalley Street Substation

Dalley Street Zone Substation was commissioned in 1969 and is an important asset feeding the northern end of the CBD. Its supply is fed via four oil-filled cables (feeders) running from Lane Cove. When these feeders were installed in the 1960s, they were the major supply route to the CBD and Eastern Suburbs.

Two of the four feeders between Lane Cove and Dalley Street require replacement or retirement by 2012 and the remaining feeders have been prioritised for retirement by 2017. The existing zone substation would be refurbished to support new feeders emanating from the City East Zone Substation that is proposed to be located in Bligh Street. This would involve construction of a shaft beneath Dalley Street to connect the CECT to the zone substation. Internal fittings, such as switchgear, that are at or near the end of their operational life would be removed and replaced with new equipment.

With the exception of the shaft beneath Dalley Street, works associated with refurbishment would primarily be internal and would not alter the external appearance of the existing substation.

Stage 2D does not involve replacing the existing Dalley Street Zone Substation.

6.2.7 Operation of Stage 2D

As part of the overall Sydney CityGrid Project, Stage 2D would transmit electricity continuously 24 hours per day, 365 days per year except for planned maintenance outages and unexpected events. The substations, cable tunnels and feeders would be periodically inspected and continuously monitored and maintained.

The substations and cable tunnels would be made secure to prevent unauthorised access and procedures would be put in place covering the operation and access requirements including an Operational Environmental Management Plan (OEMP). This would involve periodic inspections to monitor aspects such as:

- Groundwater infiltration, pumps and rising mains;
- Lighting systems;
- Visual inspection of cables;
- Control systems;
- Brackets and cable mounts; and
- Structural features of the tunnel.

In accordance with EnergyAustralia's requirements, access to all infrastructure would be restricted to authorised personnel only.

Authorised access to the CECT would be available from:

- Riley Street tunnel shaft;
- Campbell Street Zone Substation (main access/egress);
- City East Zone Substation; and
- City North Zone Substation.

Access to the CSCT extension would be via the existing CSCT access at Campbell Street Zone Substation, with emergency access at Riley Street shaft. Protocols covering access and egress would be clearly set out in the OEMP.

6.3 Construction of Stage 2D

Construction of Stage 2D focuses on tunnelling activities for the CECT and associated tunnels to connect to existing and proposed substations. All tunnelling would emanate from the Riley Street construction compound, meaning that the tunnelling machines would be launched at this location. Spoil generated during the tunnelling activities would also be removed from the tunnel at this location.

Aside from the Riley Street construction compound, surface works would also be required in the immediate vicinity of the Dalley Street Zone Substation to construct a shaft within Dalley Street to connect the substation to the CECT. Shafts would also be constructed in Little Albion Street to connect to the CSCT extension, and in Yurong Parkway to connect to the CECT.

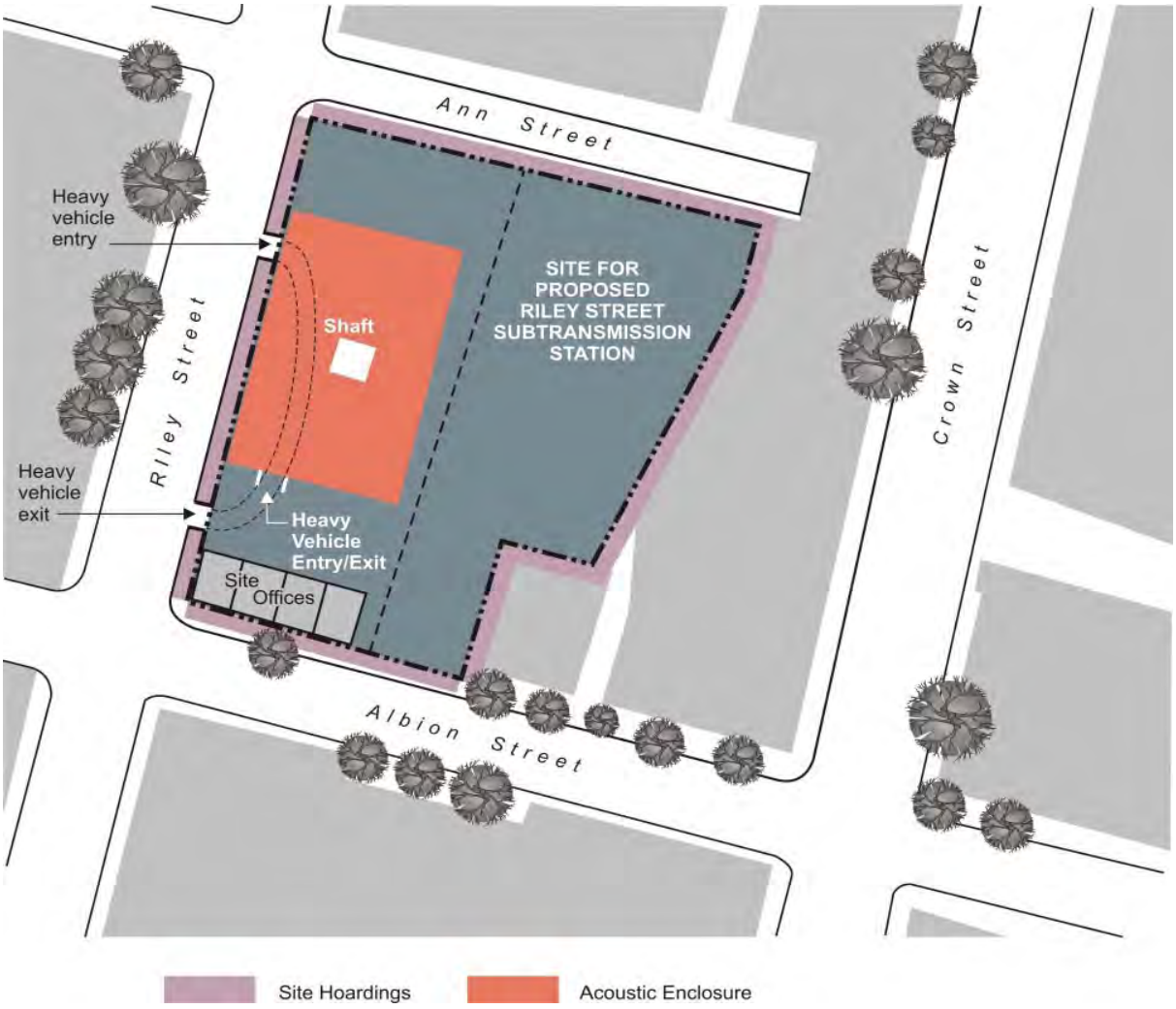
Connections to the CSCT, City North Zone Substation and proposed City East Zone Substation would involve subsurface works.

The following sections outline an indicative construction method for Stage 2D that would be refined by the contractor during detailed project planning.

6.3.1 Site establishment at the Riley Street compound

An indicative layout of the Riley Street construction compound is provided in Figure 6-4 which shows the location of the facilities likely to be required to construct Stage 2D. The following section provides an overview of the main components of the construction compound.

Figure 6-4 Indicative layout of Riley Street construction compound



Hoardings

Hoardings or other protective structures would be installed along the site boundaries to provide a safe working environment for construction workers, as well as those in the surrounding area. All hoardings would be erected in accordance with the City of Sydney Guidelines for Temporary Protective Structures.

Site amenities

Site amenities to be provided within the site would include first aid rooms, induction rooms, lunch sheds, change rooms and amenities. The location of the site amenities would be selected with due consideration to factors such as clearances required to load/unload trucks.

Temporary service and utility connections would be provided for use during construction. This would include electricity, water, sewer, and communications. Consultation would be undertaken with relevant service and utility operators to determine whether any existing services need to be relocated to facilitate construction.

Construction facilities

Site establishment would involve installing a number of facilities that are essential to tunnelling activities, including:

- An acoustic enclosure and gantry crane over the tunnel shaft. This is required to manage noise emissions to enable tunnelling activities to occur 24 hours per day;
- A temporary groundwater treatment plant with a capacity of 8 – 15 L/s (depending on the water quality and sediment loading). Groundwater, once treated to comply with ANZECC guidelines, would be discharged to stormwater;

- A temporary storage area for pre-cast concrete segments that would line the CECT;
- Temporary tunnel ventilation equipment;
- Temporary site amenities; and
- Plant to prepare grout that would be pumped to fill the gap between the concrete lining and the rock near the tunnel face.

Dilapidation surveys

Dilapidation surveys of buildings and structures surrounding the site would be completed prior to the commencement and upon completion of construction. The surveys would provide the basis for stakeholders to assess the extent of any damage that may be attributed to the project.

Site access

It is anticipated that the main site access would be off Riley Street, just south of the intersection with Ann Street. Egress would be to Riley Street, north of the intersection with Albion Street. Pedestrian and traffic control measures would be implemented to ensure access and safety is maintained for all road and footpath users.

A work zone for construction vehicles would be established for Riley Street frontage and would utilise the existing parking/traffic lane on the eastern side of the street.

Measures to be implemented to manage impacts associated with changes to traffic and pedestrian conditions would be discussed with the City of Sydney during preparation of the traffic management plan that would be prepared as part of the CEMP.

6.3.2 Tunnel construction process

Interaction with other utilities

As indicated in Section 4.2.4 of the Concept Environmental Assessment, a preliminary survey of the existing underground infrastructure and building basement foundations in the vicinity of the proposed tunnel alignment was undertaken. EnergyAustralia recognise the need to consider potential interfaces of the tunnel alignment with existing and proposed services and utilities including the CBD Metro, RailCorp tunnels and corridors, Sydney Water services and the Cross City Motorway. During refinement of the alignment as part of Stage 2D, EnergyAustralia has undertaken additional surveys of these services and identified appropriate separation distances in consultation with relevant stakeholders.

A detailed survey of existing services and utilities would be carried out prior to construction to accurately locate all existing services in the vicinity of the tunnel and shaft excavations. Decisions on relocation would consider the requirements of affected utility companies.

Dilapidation surveys

Dilapidation surveys of buildings and structures in the zone of influence around the tunnels would be completed prior to commencement of tunnelling in that location. The surveys would provide the basis for stakeholders to assess the extent of any damage that may be attributed to the project.

Shaft excavation

The CECT and CSCT extension would commence from a shaft extending from the Riley Street compound to a depth of about RL18 which is approximately 20 m below the existing level of Riley Street (refer to Figure 6 3). This shaft would provide access for construction of the CECT and CSCT extension.

Construction of the shaft would generally involve:

- Excavation of the shaft using a rock breaker;
- Excavation of the tunnel cavern using a road header;
- Installation of mesh and rock bolts; and
- Installation of shotcrete on the walls.

To enable 24 hour operation of the tunnelling activities, an acoustic enclosure would be constructed over the shaft. The enclosure would be fitted with a gantry crane and associated facilities to remove spoil from the shaft and stockpile it prior to offsite disposal.

A range of ancillary plant and equipment would be used, including mobile cranes, ventilation fan, loader, haulage trucks, hand held pneumatic drills for the shaft, shotcrete equipment, and trucks delivering other plant and equipment.

It is likely that excavation of the shaft would commence prior to completion of the acoustic enclosure. Construction of the shaft would be limited to standard construction hours defined in Section 6.3.7 until the acoustic enclosure is complete.

Construction of the CSCT extension using a road header

The CSCT extension would be constructed prior to the CECT. This is required to allow connection two new 132kV feeders in Albion Street to Belmore Park and Campbell Street Zone Substations via the CSCT extension. These feeders are required to be operational by late 2012 and would operate during construction of the CECT. The feeders would connect to the new Rose Bay Station which is scheduled to be completed in mid-2012. The Rose Bay project involves installing approximately 8.6 km of underground cables between Surry Hills and Rose Bay to supply the new Rose Bay substation with electricity.

The CSCT extension would be about 150 m long and would be constructed using a road header which is a mechanical excavating machine with a large rotating cutting head mounted to a moveable boom. The cutting head is moved over the tunnel face to create the desired tunnel profile. The walls and roof exposed by the road header excavation are inspected at regular intervals to assess their condition and determine whether any additional rock support is required.

Figure 6-5 shows the excavated and lined tunnel cross-section which is approximately 4 m wide by 4 m high.

The detailed design would ensure that the CSCT extension is designed and constructed to minimise the risk of ground settlement and potential settlement induced damage to existing buildings and other above ground and underground infrastructure.

Spoil produced from this excavation would be removed from the tunnel via the shaft at the Riley Street site. The final disposal location for spoil would be determined by the contractor. Further details on this spoil disposal process are outlined in the Chapter 12.

Temporary rock bolts or rock anchors would be progressively installed as the tunnel advances to stabilise the tunnel crown and walls. A cast in situ reinforced concrete lining with a water resistant membrane would be constructed upon completion of the excavation.

A concrete slab would be cast in the floor of the tunnel with drains either side of the slab to collect and channel any groundwater that seeps into the tunnel.

As with excavation of the shaft, a range of ancillary plant and equipment would be used, including mobile cranes, ventilation fan, loader, haulage trucks, hand held pneumatic drills for the shaft, trucks delivering other plant and equipment, workshop tools such as grinders and hammers for the road header, shotcreting equipment.

Following completion of the CSCT extension, it would be partitioned from the CECT to allow feeder installation and operation.

Construction of the CECT using a tunnel boring machine

The CECT would be constructed using a tunnel boring machine (TBM) launched from the construction compound at Riley Street. The TBM would travel northwards towards the City North Zone Substation. The TBM is a specialised cylindrical machine with a circular rotating cutter head that uses discs to excavate a circular profile through rock as the machine advances. The excavated material would be conveyed from the cutter head back to the Riley Street shaft via rail bogeys prior to being lifted to the surface and removed from the site.

As indicated in Figure 6-6, a circular tunnel cross-section of approximately 4 m in external diameter would be excavated by the TBM. Pre-cast concrete segments would be progressively installed at the tail end of the machine (approximately 8 – 10 m from the tunnel face) to provide a structural support and water resistant tunnel lining. The space between the concrete segment lining and the rock face would be grouted.

The TBM would be driven to the City North Zone Substation adjacent to the recently completed City West Cable Tunnel beneath the corner of Sussex Street and Erskine Street and all recoverable components would be removed. As a result, an exit shaft is not required to remove the machine from the tunnel. This is a common practice when using TBMs when extraction is not possible or economically viable.

A small cavern would be constructed using hand held methods to connect the CECT to the City North Zone Substation.

As with excavation of the CSCT extension, a range of ancillary plant and equipment would be used to construct the CECT, including mobile cranes, ventilation fans, loaders, haulage trucks, hand held pneumatic drills for the shaft, trucks delivering other plant and equipment, workshop tools such as grinders and hammers for the TBM, shotcreting equipment.

Construction groundwater management

Groundwater that seeps into the tunnels and shafts during the construction phase would be collected, treated and pumped to the stormwater system. The treatment system would be designed such that discharged water complies with the requirements of Section 120 of the POEO Act.

Tunnel ventilation and dust control

To minimise dust impacts, the tunnel would be fitted with a mechanical ventilation system to filter the air and remove dust particles prior to the air being discharged from the tunnel. The filtration system would be designed to limit dust emissions to acceptable levels and meet the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2002* (as amended). This would ensure clean air is available to workers within the tunnel and minimise the potential for offsite impacts associated with dust.

6.3.3 Refurbishment of the Dalley Street Zone Substation

The existing Dalley Street Zone Substation would be refurbished and this would involve replacing internal plant and equipment such as switchgear that is near the end of its operational life. These works would be internal and would not alter the external appearance of the substation.

Refurbishment of the substation would require truck movements to deliver new components and remove those that are redundant.

6.3.4 Ancillary works

A range of ancillary works would be undertaken as part of Stage 2D to ensure it is able to function effectively as part of the Sydney CityGrid Project. This includes, but is not limited to, construction of shafts at the following locations to connect to the CECT or CSCT extension:

- Within Dalley Street to connect the CECT to the Dalley Street Zone Substation;
- Within Yurong Parkway to connect to the CECT and facilitate 33 kV feeders entering/leaving the tunnel; and
- Within Little Albion Street to connect to the CSCT extension to facilitate 33kV feeders entering/leaving the tunnel.

The shaft locations are shown in Figure 6-2 and would be constructed using an auger boring machine (piling rig) that would operate during standard working hours for a period of about one to two weeks at Little Albion Street and Yurong Parkway, and four weeks at Dalley Street.

Compounds would be present at the shaft locations at Little Albion Street and Yurong Parkway for about one to two months and about six months at Dalley Street. The compounds would provide access to subsurface works associated with construction of the shafts, including installation of lining, fit out, and construction of a stub connection to the CECT in the case of the Dalley Street shaft. The compounds would be surrounded by hoardings and works would be limited to standard construction hours.

Existing feeders that enter the Surry Hills STS and the Annex Building from Little Albion Street would be cut, jointed and redirected to the Riley Street STSS via the CSCT extension. These interface works would require the following works in Little Albion Street:

- Excavation and construction of joint bays within Little Albion Street;
- A bored shaft within Little Albion Street to facilitate connection to the CSCT extension; and
- Cable installation and jointing in Little Albion Street and Wade Place.

6.3.5 Spoil volumes, handling and removal

Spoil is material removed from ground excavation and would be generated during excavation of the shafts and tunnels. The total expected spoil generated from the project would be approximately 50,000 m^3 (in situ).

Based on the inferred subsurface profile from the PSM geotechnical and environmental investigations (May 2008), it is likely that the majority of spoil generated from the project would be virgin excavated natural material (VENM) comprising Class IV, III and II sandstone. VENM is clean, natural material that is uncontaminated with other waste materials or manufactured chemicals. Fill would also be excavated that would not be VENM and would require disposal to an appropriately classified and licensed landfill, though it may be able to be reused at the landfill for remediation or general operational purposes.

6.3.6 Fit-out of the CECT, CSCT extension and associated connection tunnels

Fit-out would commence in parallel but lagging behind excavation. This would include:

- Installation of steel cable support posts and arms on either side of the tunnel;
- Installation of access platforms and stairs;
- Electrical, communication and lighting services required for operation of the tunnel; and
- Installation of the supervisory control and data acquisition system (SCADA), to operate and record operations of the tunnel.

These elements are shown in Figure 6-5 and Figure 6-6.

The CSCT extension would be constructed, fitted-out and commissioned prior to completion of the CECT. This is required to enable connection of the CSCT extension to the Rose Bay feeders so that they are operational during construction of the CECT. The connection between Surry Hills and Rose Bay is required to be complete by mid-2012 to provide electricity to the new Rose Bay Substation.

Figure 6-5 Indicative cross section of the CSCT extension

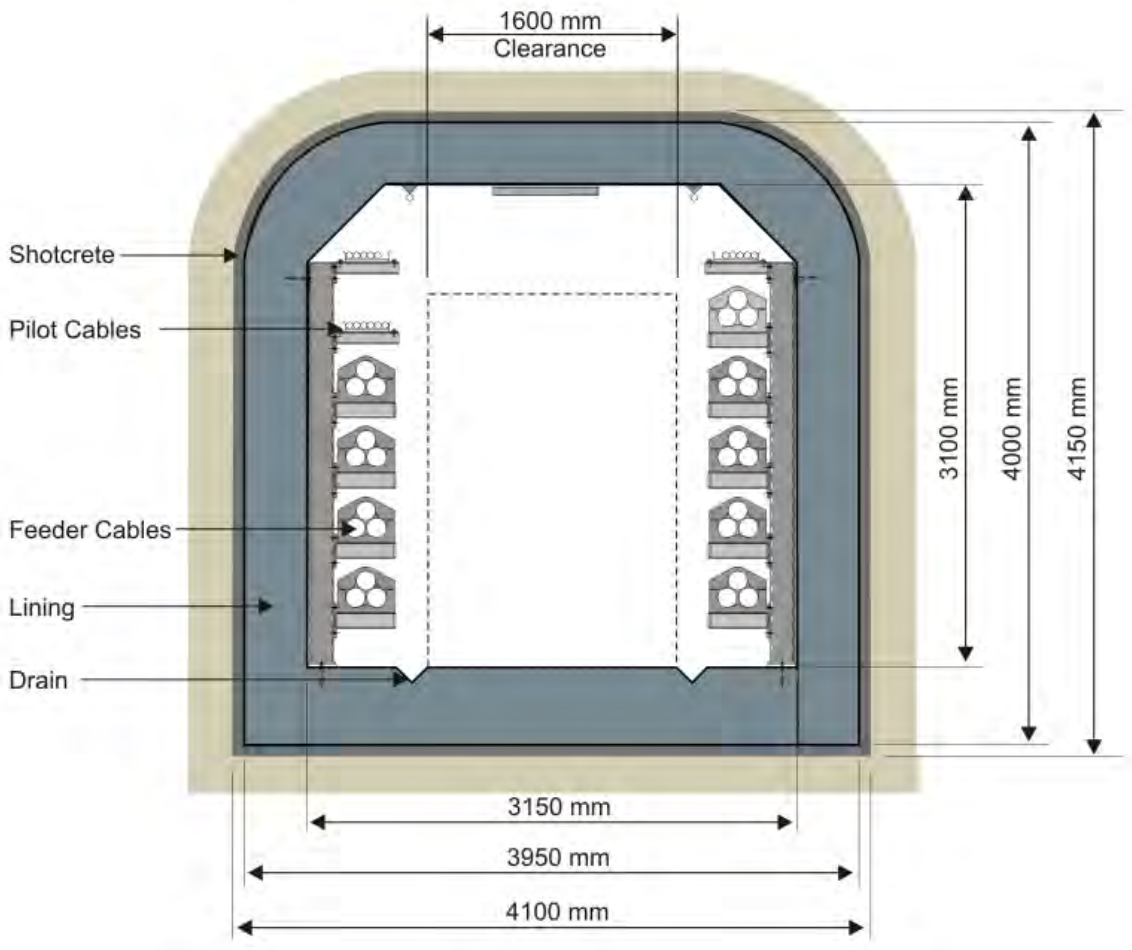
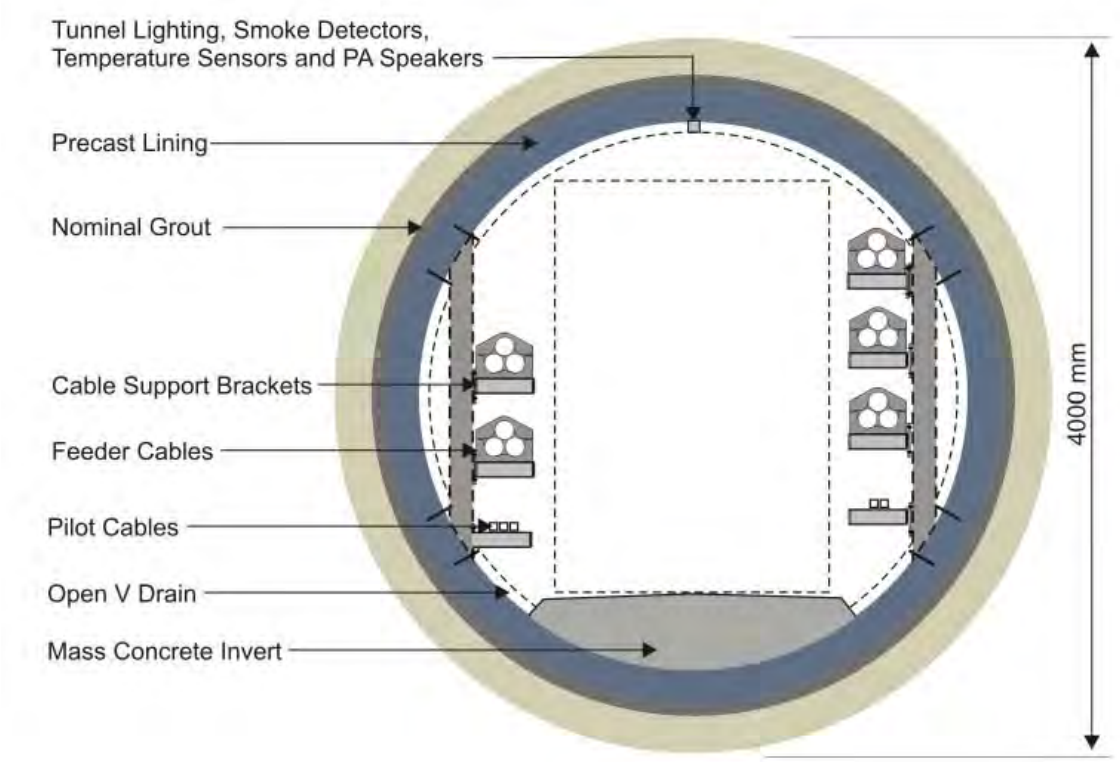


Figure 6-6 Indicative cross section of the CECT



Cable installation

Once fit-out is complete the tunnel would be ready for cable installation. The 33kV and 132 kV electricity transmission cables would be specially manufactured composite (cross linked polyethylene) cables, comprising a copper conducting core surrounded by numerous layers of insulation, communications and protective layers. The cables would not contain oil.

The cables would be fabricated off-site in lengths of approximately 1 km and transported to the site on drums. The drums are likely to require transport using an oversize vehicle that would be subject to RTA restrictions.

Cable installation would likely occur from the Riley Street compound and would generally use a purpose built cable-pulling tractor to pull the cable along a specially constructed set of rollers and guides. The cables would be loaded onto the cable arms and fastened into the trefoil arrangement (three cables tied together).

Pilot cables would also be installed during this process. Pilot cables are used to compare the voltage and currents at either end of a main transmission cable and are part of a control and protection system that allows power transmission faults such as breaks, leakage currents, or loss of transmission efficiency, to be detected instantaneously. Each feeder typically has a main and a back-up pilot cable that are separated to increase the security of the fault detection system. A fibre optic pilot cable would be installed as part of the control and protection system.

Cable joints and ancillary equipment

The 132kV cables are generally only available in lengths of approximately 1 km which means they would need to be jointed. Once the cables are installed and in position, separate lengths of cable would be jointed within the tunnels. This process would be repeated for each of the three cables in the trefoil bundles for each feeder.

Commissioning the cables

Once each individual cable is installed and clamped into position, jointing and termination of each feeder would commence. On completion of these tasks a 10 kV direct current serving test on the outer protective fire rated sheath would be carried out. The feeder would then be placed on 'no load' volts for at least 24 hours before being placed into full service.

6.3.7 Construction hours

It is anticipated that underground tunnelling and works within the acoustic enclosure would be undertaken continuously over a 24 hour period. These working hours are required to ensure EnergyAustralia meets its commitment to the NSW Government to expedite delivery of the project to secure the electricity supply to Sydney's CBD and inner metropolitan areas. To maximise efficiencies during operation of the tunnel boring machine, underground tunnelling works would be carried out 24 hours per day.

Construction works outside the tunnel would generally be undertaken during the following hours:

- Monday to Friday 7 am to 7 pm;
- Saturdays 7 am to 5 pm; and
- No work on Sundays or Public Holidays.

Surface works, such as loading spoil into trucks, would be limited to the standard construction hours.

Noise intensive activities above ground such as rock breaking would be undertaken during the following hours:

- Monday to Saturday 7 am to 12 pm;
- Monday to Friday 2 pm to 5 pm; and
- At no time on Sundays or public holidays.

Ancillary activities that may occur outside the standard construction hours include, but may not be limited to, oversize truck movements and deliveries of certain plant and equipment on an occasional basis. Works may also be undertaken outside these hours in the event of a direction from police or other relevant authority for safety reasons, or emergency work to avoid the loss of lives, property and/or to prevent environmental harm.

6.4 Timeframe

Construction is scheduled to commence in February 2011 and be completed around June 2014. Installation of the feeders in the CECT would follow construction and would be completed by December 2015. The main stages within this period are:

- Stage 1 Site establishment – about three months;
- Stage 2 - Excavation of shaft at Riley Street – about two months from May – June 2011;
- Stage 3 - Construction of CSCT extension – June 2011 – May 2012
  - Excavation – about three months;
  - Lining and fit-out – about nine months;
- Stage 4 - Installation of feeders in CSCT extension by February 2013;
- Stage 5 - Construction of CECT – September 2011 – June 2014;
  - Excavation of tunnel – about 18 months;
  - Excavation of Dalley Street shaft - about six months (concurrent with excavation of tunnel);
  - Construction of interfaces with the City East Zone Substation, Dalley Street Zone Substation and City North Zone Substation;
  - Mechanical and electrical fit-out of the tunnel – about three months;
  - Commissioning of the tunnel - about two months;
  - Installation of feeders – about 12 months;
- Stage 6 – Operation. December 2015

This construction program would be refined by the contractor during project planning.

7. Consistency assessment

7.1 Overview

MCoA 3.1a of the Concept Approval requires a demonstration that the project is consistent with the requirements of the Concept Approval and generally consistent with the scope and intent of the concept outlined in the documents listed in Condition 1.1 of the Approval. The following sections demonstrate how Stage 2D of the Sydney CityGrid Project is consistent with MCoA 3.1a.

7.2 Consistency with the Concept Approval

On 20 September 2009, the Minister for Planning approved the Concept Plan for the Sydney CityGrid Project subject to compliance with a number of conditions. The following sections demonstrate how the project is consistent with relevant MCoA. There are a number of MCoA that are not relevant to Stage 2D of the Sydney CityGrid Project, including MCoA 4-6 inclusive which relate to actions that must be completed prior to commencement of construction.

7.2.1 MCoA 1.3 – Staging/scheduling of Concept Plan Components

MCoA 1.3 defines the various components of the Concept Plan and MCoA 1.3b(ii), (iv) and (v) include:

- 'Stage 2B being refurbishment of the existing Dalley Street Zone substation in the vicinity of Phillip, Bent, Bligh and O'Connell Street';
- 'Stage 2D being the City East Cable Tunnel (CECT) to be constructed between Riley Street sub-transmission switching station (STSS) and the City North Zone substation, with connections to the proposed City East and existing Dalley Street Zone substations, and a potential services control room adjacent to the Riley Street STSS'; and
- 'Stage 2E being extension of the City South Cable Tunnel from Wade Place to Riley Street, Surry Hills'.

As outlined in Section 1.1, Stages 2B, 2D and 2E are collectively referred to as Stage 2D for the purposes of this Environmental Assessment. Stage 2D is consistent with MCoA 1.3b(ii), (iv) and (v) as it involves works for the construction of the CECT, extension of the CSCT and refurbishment of the existing Dalley Street Zone Substation.

7.2.2 MCoA 2.2 – Stage 2 Development

MCoA 2.2 requires that construction and operation of Stage 2 (including Stages 2A, 2B, 2C, 2D and 2E) are subject to further assessment under Part 3A of the EP&A Act.

As discussed in Section 1.1, EnergyAustralia is seeking approval for Stage 2B, 2D and 2E of the Sydney CityGrid Project as one stage, referred to as Stage 2D. Stage 2D is consistent with MCoA 2.2 because approval for would be sought under Part 3A of the EP&A Act.

7.2.3 MCoA 2.3 – Stage 2 Development

MCoA 2.3 allows EnergyAustralia to submit an application for Stage 2 in its entirety or to submit separate applications for each sub-stage (stages 2A, 2B, 2C, 2D and 2E) or any combination of these stages.

The Stage 2D works are consistent with MCoA 2.3 as approval has been sought for sub-stages 2B, 2D and 2E as part of a single project application.

7.2.4 MCoA 3.1 – Project Applications and Specific Requirements

Pursuant to Section 75P(1)(a) of the EP&A Act, MCoA 3.1 provides the environmental assessment requirements for project applications for Stage 2, of any sub-stage of Stage 2, or any combination of sub-stages submitted as a single project. These requirements are detailed in Table 3-1 which also includes a cross reference to the section of this Environmental Assessment in which they are addressed. As such, the Environmental Assessment is consistent with MCoA 3.1.

7.2.5 MCoA 3.2 – Project Applications and Specific Requirements

Pursuant to Section 75P(1)(a) of the EP&A Act, MCoA 3.2 provides environmental assessment requirements for any project application for Stage 2A and/or 2B that are additional to those detailed in MCoA 3.1. MCoA 3.2 requires that a design review process for the proposed City East Zone Substation or Dalley Street Zone Substation be undertaken during preparation of the Environmental Assessment. The outcome of this design review process would form part of the Environmental Assessment. The design review process would be based on the principles of the design review competition of the Sydney Local Environmental Plan 2005 and include consultation with Council.

The design review process was not applied to Stage 2D because works at the Dalley Street Zone Substation would be either below or at the surface of the ground, or within the existing substation building. As such, the external building form would not be substantially altered.

7.2.6 MCoA 3.3 – Project Applications and Specific Requirements

Pursuant to Section 75P(1)(a) of the EP&A Act, MCoA 3.3 provides environmental assessment requirements for any project application including Stage 2D that are additional to those detailed in MCoA 3.1. MCoA 3.3 requires that EnergyAustralia consult with Sydney Water when confirming the preferred route for the CECT to ensure its major sewer assets, stormwater and associated infrastructure (existing or planned) are not located within the selected route. This consultation with Sydney Water must continue during the detailed design and construction stage to avoid impacts.

As discussed in Section 4.2, EnergyAustralia has consulted with Sydney Water during development of Stage 2D. This consultation would continue during the detailed design and construction phases to ensure that Stage 2D does not impact on Sydney Water's major sewer assets, stormwater and associated infrastructure (existing or planned). The project is therefore consistent with MCoA 3.3.

7.3 General consistency with the documents specified in the Concept Approval

The project is required to be generally consistent with documents listed in MCoA 1.1, including:

- 08_0075 Major Project Application;
- Sydney CityGrid Project Concept Environmental Assessment Report, prepared by PlanCom Consulting Pty Ltd and dated 8 December 2008;
- Sydney CityGrid Project Submissions Response & Preferred Project Report, prepared by PlanCom Consulting Pty Ltd and dated May 2009.

Consistency with these documents is discussed below.

7.3.1 08_0075 Major Project Application

Tunnel options and alignment

Section 2.4.5 of the Major Project Application outlined three alignment options for the CECT and CSCT extension which included:

- Option 1 – Riley Street alignment;
- Option 2 –Yurong Street alignment; and
- Option 3 – Bridge Street alignment.

Section 2.5.2 of the Major Project Application contained information relating to the tunnel alignment. It noted that the proposed CECT would be constructed between the Riley Street STSS and City North Zone Substation, with connections to the proposed new City East and Dalley Street substations, and potentially for a new services shaft and control room facility along the tunnel alignment, if required. Section 2.5.2 also outlined that the proposed Riley Street STSS site would be used as the primary construction site for both the CECT and CSCT extension. The application also detailed that the CECT would be constructed using a tunnel boring machine, whereas the CSCT extension would be constructed using a roadheader.

Stage 2D is consistent with the alignment and construction methods described in the Major Project Application as the tunnel would run along the general Yurong Street alignment referred to as Option 2. It would connect the Riley Street STSS and City North Zone Substation with connections to the proposed City East and existing Dalley Street zone substations.

Dalley Street Zone Substation refurbishment

Section 2.5.5 of the Major Project Application states that the Dalley Street Zone Substation must be refurbished or replaced to support new feeders emanating from new City East Zone Substation. Stage 2D is consistent with this as it would involve refurbishment of Dalley Street Zone Substation.

Stage 2D does not involve replacing the substation on or adjacent to the site of the existing Dalley Street Zone Substation.

7.3.2 Sydney CityGrid Project Concept Environmental Assessment Report, prepared by PlanCom Consulting Pty Ltd and dated 8 December 2008

CSCT extension

Section 4.2.1 of the Concept Environmental Assessment outlines the proposed CSCT extension which would be constructed between the existing Surry Hills Substation shaft at Wade Place and the Riley Street site, generally beneath the alignment of Little Albion Street.

Stage 2D of the Sydney CityGrid Project is consistent with the description of the CSCT extension provided in the Concept Environmental Assessment. As detailed in Section 6.2.1, the CSCT extension would connect the existing Surry Hills shaft at Wade Place to the Riley Street site.

The Concept Environmental Assessment also outlines that the CSCT extension would be excavated using a roadheader machine and the Riley Street site would be used as the primary construction site for the works associated with the CSCT.

Stage 2D is consistent with the alignment and construction method for the CSCT extension that are described in the Concept Environmental Assessment.

CECT options and alignment

Section 4.2.4 of the Concept Environmental Assessment details the tunnel alignment options for the CECT which would be constructed between the proposed Riley Street STSS and the City North Zone Substation, with connections to the proposed new City East and existing Dalley Street zone substations, and a services control room adjacent to the Riley Street STSS. The tunnel would also include:

- A stub tunnel connection between the CECT and the new City East Zone Substation and the existing Dalley Street Zone Substation; and
- Extension to the existing CSCT to form a link between the Riley Street STSS and Belmore Park Zone Substation.

The Concept Environmental Assessment outlined three route tunnel options for the CECT and CSCT extension including:

- Option 1 – Riley Street alignment;
- Option 2 –Yurong Street alignment; and
- Option 3 – Bridge Street alignment.

The CECT and CSCT extension for Stage 2D is described in Section 6.2 and consistent with the Concept Environmental Assessment as the tunnel boring machine constructing the tunnel would run along the general Yurong Street alignment that is referred to as Option 2.

Tunnel dimensions

Section 4.2.4 of the Concept Environmental Assessment outlines the tunnel dimensions including:

- CECT – approximately 3.2 km in length and 4 m outside diameter;
- CSCT – approximately 3.5 m wide and 4.5 m high, with an overall length of approximately 150m and
- Potentially three stub tunnel connections up to 200 m in length and with cross-sectional dimensions 4m wide x 4 m high.

Stage 2D is generally consistent with these dimensions as indicated in Section 6.2.

7.3.3 Sydney CityGrid Project Submissions Response & Preferred Project Report, prepared by PlanCom Consulting Pty Ltd and dated May 2009

Section 4.1 of the Submissions Response & Preferred Project Report states that:

Apart from design changes to the Belmore Park Zone Substation and amendments to the proposed staging of the commercial development aspect of that project, there are no other proposed changes to the Sydney CityGrid Project, as detailed in the Project EAR submitted on 17 December 2008.

The Submissions Response & Preferred Project Report did not amend the aspects of the Sydney CityGrid Project described in the Concept Environmental Assessment that are relevant to Stage 2D. As Section 7.3.2 indicates that the project is consistent with the Concept Environmental Assessment, it is therefore consistent with the Submissions Response & Preferred Project Report.

Section 4.1 of the Submissions Report outlines that since the submission of the Concept Environmental Assessment in December 2008, *EnergyAustralia has determined a preferred tunnel alignment for the CECT, which is generally in accordance with the Option 3 alignment.* Stage 2D is within the alignment corridor outlined in the Submissions Report.

8. Environmental risk assessment

8.1 Purpose of the environmental risk analysis

An environmental risk analysis was undertaken to identify key issues for Stage 2D and ensure they are addressed in this Environmental Assessment. This was based on the same process that was implemented during development of the Concept Environmental Assessment for the Sydney CityGrid Project. The risk analysis involved reviewing the likely construction and operation methods to identify:

- Potential risks and/or issues;
- Potential impacts and consequences associated with the risk and/or issues; and
- Indicative management measures that could be implemented to mitigate potential impacts.

The environmental risk analysis was limited to those elements of the Sydney CityGrid Project relevant to Stage 2D.

8.2 Results of the environmental risk analysis

A summary of results from the environmental risk analysis is presented in Appendix E. Risks have been separated into 'key' risks to the project and 'other' environmental risks.

The key potential risks and therefore environmental impacts to be addressed in the Environmental Assessment were identified based on the:

- Characteristics and sensitivity of the receiving environment;
- Potential impacts likely to occur, including their duration, intensity and degree to which they can be mitigated; and
- Level of uncertainty regarding the anticipated residual impacts.

The key issues are those that are considered to have medium or high adverse environmental impacts, if not effectively mitigated. These issues require investigation to ensure a high degree of certainty that potential risks can be effectively managed. Key issues are assessed in Chapters 9 - 16.

Other environmental risks are those that are considered to have low risks associated with adverse impacts and would be managed by implementing the Statement of Commitments (Chapter 17).

Based on the results of the environmental risk analysis, the following issues were identified as key issues that require consideration in this Environmental Assessment:

- Noise and vibration associated excavation and tunnelling. This includes the potential for associated offsite impacts on the amenity of the surrounding area and structural integrity of buildings;
- Geotechnical issues associated with faults and fractures. These issues primarily relate to impacts on the structural integrity of the tunnels and safety of workers during construction and are addressed in the design report;
- Impacts on existing and proposed underground assets. There is a need for the design to ensure that Stage 2D does not constrain:
  - RailCorp's Metro Pitt and Metro West corridors;
  - RailCorp's existing three city circle lines;
  - RailCorp's existing Eastern Suburbs Railway tunnels beneath the Domain;
  - Sydney Water's existing Busby's Bore beneath Oxford Street;
  - Sydney Water's Bondi ocean outfall sewer beneath Liverpool Street;
  - Sydney Water's proposed relief sewer beneath Reservoir Street, Surry Hills;
  - Existing tunnels for the Cross City Motorway; and
  - Telstra's existing cable tunnel.

- Management of groundwater during excavation and tunnelling works;
- Management of waste and spoil generated during excavation, tunnelling and general construction works;
- Traffic impacts, particularly those associated with delivery of plant and materials, and transport of spoil and waste;
- Air quality impacts associated with dust generated during tunnelling and excavation; and
- Potential impacts on subsurface archaeology particularly at the Dalley Street substation site where the potential for deposits associated with 19th century housing as well as soil profiles connected to the Tank Stream valley has been identified.

9. Noise and vibration

This chapter provides a summary of the noise and vibration impact assessment prepared by Wilkinson Murray Pty Limited. The complete report is provided in Appendix F.

9.1 Existing environment

9.1.1 Ambient noise levels and surrounding receivers

Long-term ambient noise levels were monitored at three residences surrounding the Riley Street site that are representative of the nearest sensitive receivers. The locations are presented in Table 9-1.

Table 9-1 Long term noise monitoring locations

Monitoring site	Address	Relevant noises noted during site visits
A	92 Ann Street	Local traffic and general city noise
B	279 Riley Street	Local traffic and general city noise
C	137 Albion Street	Local traffic and general city noise

Noise monitoring was conducted between Tuesday 27 April and Monday 3 May, 2010.

Table 9-2 summarises the noise results, for daytime, evening and night time periods as defined in the DECCW's Construction Noise Guildelines (CNG). Noise monitoring results for Saturday (7.00am-8.00am and 1.00pm-5.00pm) are included as EnergyAustralia propose to operate during these periods that are outside standard construction hours defined by the CNG. The summary values are:

- L_{Aeq} (period) – the equivalent continuous LAeq noise level measured over the assessment period; and
- RBL – Rating Background Level is a measure of typical background noise levels which is used in determining noise criteria.

Table 9-2 Summary of measured noise levels

Noise logging site	RBL (dBA)				$L_{Aeq,period}$ (dBA)			
	Daytime 7am-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 7am-5pm	Daytime 7am-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 7am-5pm
A	50	50	46	48	62	55	51	58
B	51	49	44	50	65	64	61	66
C	55	54	47	56	68	68	63	67

Long-term noise monitoring was not conducted at the Dalley Street and Yurong Parkway sites. However, an indicative daytime RBL noise level of 60dBA has been established for assessment purposes based on experience of noise in similar areas of the city.

9.2 Performance criteria

The following sections detail the applicable site specific construction noise and vibration criteria based on the guidelines from DECCW, being:

- *Interim Construction Noise Guideline; and*
- *Assessing Vibration: A Technical Guideline.*

9.2.1 Construction noise criteria

DECCW's CNG (July 2009) provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the $L_{Aeq,15min}$ noise level should not exceed the background noise by more than 10dBA. This is for the following standard hours defined by the CNG: Monday to Friday 7.00am to 6.00pm, and Saturday 8.00am to 1.00pm. Outside the standard hours, the criterion would be background plus 5dBA. A more complete description of the guidelines and how they should be applied is provided in Table 9 3.

Table 9-3 Construction noise goals at residences using quantitative assessment

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

Source: CNG, 2009

In addition, the following construction noise management levels $L_{Aeq,15\ min}$ are recommended for other receivers and areas.

- Active recreation areas (such as parks) external $L_{Aeq,15\ min}$ 65dBA
- Industrial premises external $L_{Aeq,15\ min}$ 75dBA
- Offices, retail outlets external $L_{Aeq,15\ min}$ 70dBA

Based on the background noise levels and goals in the CNG, Table 9-4 presents the construction noise goals for the project.

Table 9-4 Site specific construction noise management levels

Location	Construction noise management level, L_{Aeq} - dBA				Maximum construction noise level, L_{Aeq} - dBA
	Day	Evening	Night	Saturday (extended)	
Ann Street/Crown Street	60	55	51	53	75
Riley street	61	54	49	55	75
Albion Street/Little Street Albion Street, Yurong Parkway	65	59	52	61	75
Commercial Properties Dalley Street & Yurong Street	70				75

9.2.2 Construction vibration criteria

Human comfort criteria

Criteria for assessment of the effects of vibration on human comfort are set out in British Standard 6472-1992. Methods and criteria in that Standard are used to set "preferred" and "maximum" vibration levels in the document *"Assessing Vibration: A Technical Guideline"* (2006) produced by the NSW DECCW.

Acceptable values of human exposure to continuous vibration, such as that associated with tunnelling, are dependent on the time of day and the activity taking place in the occupied space (e.g. workshop, office, residence or a vibration-critical area). Guidance on preferred values for continuous vibration is set out in Table 9-5.

Table 9-5 Criteria for exposure to continuous vibration

Place	Time	Peak velocity (mm/s)	
		Preferred	Maximum
Critical working areas (e.g. hospital operating theatres precision laboratories)	Day or night-time	0.14	0.28
Residences	Daytime	0.28	0.56
	Night-time	0.20	0.40
Offices	Day or night-time	0.56	1.1
Workshops	Day or night-time	1.1	2.2

In the case of intermittent vibration, which is caused by plant such as rock breakers, the criteria are expressed as a Vibration Dose Value (VDV) which is presented in Table 9-6.

Table 9-6 Acceptable vibration dose values for intermittent vibration (m/s$^{1.75}$)

Calculation of VDV requires knowledge of the number of events in the relevant time period.

Location	Daytime		Night-time	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Structural damage criteria

In terms of the most recent relevant vibration damage objectives, Australian Standard AS 2187: Part 2-2006 "Explosives - Storage and Use - Part 2: Use of Explosives" recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they "are applicable to Australian conditions".

The British Standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The recommended limits (guide values) from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 9-7.

Table 9-7 Transient vibration guide values – minimal risk of cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	N/A
Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

The standard states that the guide values relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

The British Standard states that *"some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity".* In addition, a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

Guidelines for structural damage to heritage buildings due to vibration is also derived from the German Standard DIN 4150 -3 "Structural Vibration Part 3 – Effects of Vibration on Structures (refer to Table 9-8).

Table 9-8 DIN 4150 recommended PPV vibration level for heritage buildings

Guideline values for velocity - mm/s		
1 to 10 Hz	10 to 15 Hz	40 to 50 Hz
3	3 to 8	8 to 10

Ground-borne noise

Ground-borne noise refers to noise produced by vibration of floor slabs and other building elements, which radiates noise into the interior of a building. The CNG states that:

Ground-borne noise is noise generated by vibration transmitted through the ground into a structure. Ground-borne noise caused, for example by underground works such as tunnelling, can be more noticeable than airborne noise. The following ground-borne noise levels for residences indicate when management actions should be implemented. These levels recognise the temporary nature of construction and are only applicable when ground-borne noise levels are higher than airborne noise levels. The ground-borne noise levels are for evening and night time periods only, as the objectives are to protect the amenity and sleep of people when they are at home.

- *Evening (6.00pm to 10.00pm) Internal: $L_{Aeq\ (15\ min)}$ 40dBA*
- *Night time (10.00pm to 7.00am) Internal: $L_{Aeq\ (15\ min)}$) 35dBA*

The internal noise levels are to be assessed at the centre of the most-affected habitable room.

Traffic noise criteria

The DECCW's Environmental Criteria for Road Traffic Noise (ECRTN) presents the NSW Government's guidelines for road traffic noise criteria. It provides road traffic noise criteria for proposed roads or residential land use developments as well as criteria for other sensitive land uses.

Table 9-9 presents the relevant noise criteria for this project, extracted from the ECRTN.

Table 9-9 Traffic noise criteria extracted from the NSW ECRTN

	Criteria		
Type of development	**Day time 7am-10pm**	**Night time 10pm-7am**	**Where criteria are already exceeded**
Land use development with the potential to create additional traffic on existing freeways and arterial roads	$L_{Aeq(15hour)}$ 60dBA	$L_{Aeq(9hour)}$ 55dBA	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria via judicious design and construction o the development. Locations, internal layouts, building materials and construction should be chosen so as to minimise noise impacts. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2dB
Land use development with the potential to create additional traffic on collector road	$L_{Aeq(1hour)}$ 60dBA	$L_{Aeq(1hour)}$ 55dBA	
Land use development with the potential to create additional traffic on local roads	$L_{Aeq(1hour)}$ 55dBA	$L_{Aeq(1hour)}$ 50dBA	

The existing traffic noise in the study area already exceeds the "base" noise criteria in Table 9-9. As any increase in traffic volumes associated with this project would be temporary in nature, the noise goal adopted for this project is a 2dBA increase above existing levels.

9.3 Impact assessment

9.3.1 Noise source levels

Riley Street excavation and tunnelling

Potential noise and vibration impacts at the Riley Street site were assessed based on three stages of construction. Equipment used during these three stages are summarised in Table 9-10 to Table 9-12.

Riley Street site establishment

The main noise producing construction equipment likely to operate during site establishment is presented in Table 9-10.

Table 9-10 Riley Street site establishment

Equipment likely to operate simultaneously	Assumed operation in any 15 minute period
Front end loader (1 location)	10 minutes
Mobile crane (2 locations)	10 minutes
Power tools (2 locations)	5 minutes
Dump truck (2 locations)	5 minutes

Riley Street shaft excavation

The main noise producing construction equipment likely to operate during excavation of the Riley Street shaft is presented in Table 9-11.

Table 9-11 Riley Street shaft excavation

Equipment likely to operate simultaneously	Assumed operation in any 15 minute period
2 x rock breaker (2 locations)	10 minutes
Crane (1 location)	10 minutes
Compressor (1 location)	15 minutes
Dump truck (2 locations)	5 minutes

Tunnelling from the Riley Street compound

The main noise producing construction equipment likely to operate during tunnelling from the Riley Street site is presented in Table 9-12.

Table 9-12 Tunnelling from the Riley Street site

Equipment likely to operate simultaneously	Assumed operation in any 15 minute period
Gantry crane (1 location)	5 minutes
Front end loader (1 location)	5 minutes
Exhaust fan and dust collector (1 location)	15 minutes
Conveyor (1 location)	15 minutes
Dump truck (1 location)	5 minutes

Dalley Street, Yurong Parkway and Little Albion Street works

As a worst case scenario, noise associated with construction activities at the Dalley Street, Yurong Parkway and Little Albion Street sites were considered to be equivalent to those associated with excavation of the Riley Street shaft (refer to Table 9-11).

Sound levels from equipment

Typical sound power levels (SWL) and sound pressure levels (SPL) from equipment likely to be used during construction are summarised in Table 9-13.

The piling rig to be used to construct the shafts at Dalley Street, Little Albion Street and Yurong Parkway would be an auger type similar to a Soilmec R930 piling rig (refer to Figure 9-1).

Airborne noise from a road header or TBM is not acoustically significant as noise associated with this equipment is contained by the tunnel walls. It is the ancillary equipment, including the exhaust fan and dust collector, which generate airborne noise associated with this construction activity.

Table 9-13 Typical construction plant sound levels - dBA

Plant	SWL, dBA	Sound pressure level at 7 m
Excavator	107	82
Dump trucks	112	87
Rock breaker	122	97
Concrete pump	112	87
Saws	116	91
Saw cutter	115	90
Small excavators	90	65
Concrete trucks	109	84
Small generators	95	71
Front-end low-loader	112	87
Compressor	100	75
Bobcat	103	78
Hand tools	90	65
Jackhammer	105	80
Piling rig	112	87
Excavator with header	112	87
Bogie (dump) truck	112	87
Crane	110	85
Power tools	115	90
Concrete trucks	109	84
Small generators	95	70
Ventilation fan* and dust collector	105	80

Note: *assumes a silencer on the fan

Figure 9-1 Piling rig

9.3.2 Construction noise assessment

Airborne noise at commercial and residential receivers surrounding the work sites have been assessed and the results are summarised in Table 9-14 (Riley Street site), Table 9-15 (Dalley Street), Table 9-16 (Yurong Parkway) and Table 9-17 (Little Albion Street). These tables compare modelled noise levels against the noise goals that are outlined in Section 9.2.

Riley Street compound

During establishment of the Riley Street compound, the noise goals are predicted to be exceeded by up to 11dBA on weekdays and up to 18dBA on Saturdays. These works would occur for a relatively short period of time (about three months).

During excavation of the shaft at the Riley Street compound during normal construction hours, noise levels are predicted to exceed the goal by up to 14dBA. During extended Saturday hours, the predicted exceedance is up to 21dBA. Use of large rock breakers is the main factor contributing to these predicted exceedances and lower levels of impact are predicted when the large rock breakers are not operating. These works would occur for a relatively short period of time (about two months).

An acoustic enclosure would be installed over the Riley Street shaft to allow tunnelling works to occur 24 hours per day over an overall period of about three years. A small exceedance is predicted at the most-affected location in Ann Street during the night period and this is due to the ventilation fan. Additional mitigation of this noise source would be required to achieve the noise goals.

Exceedances during works at the Riley Street compound are predicted to be higher at properties facing Crown Street as these are elevated over the site. Due to the elevated location of these receivers, installation of noise barriers at the perimeter of the site is likely to provide minimal noise attenuation and the most effective options to mitigate impacts are considered to be source control measures such as those outlined in Section 9.4.

Dalley Street, Yurong Street and Little Albion Street

At the Dalley, Yurong and Little Albion Streets sites, exceedances of noise objectives are predicted at surrounding receivers and in the nearby parks. This is due to the close proximity of the sites to buildings.

At Dalley Street, the largest exceedances are predicted at the adjacent Telstra Exchange Buildings which are not generally occupied. In the case of the commercial buildings, an exceedance of up to 15dBA is predicted at the rear facade of 10 Bridge Street. Installing barriers around the site would not be effective at upper levels of the surrounding buildings due the high rise nature of the area although the use of hoarding barriers will be of acoustic benefit to pedestrians passing the site. The relatively short period of drilling (four weeks) is the main factor mitigating the noise impact at this site.

At the Yurong Street site, the noise goals are predicted to exceed the noise goals by up to 10dBA at the nearest receivers, while at the Little Albion Street site the noise goals are predicted to be exceeded by up to 20 dBA. These noise levels would primarily be associated with operation of the piling rig which would operate for one to two weeks at each location. As many of the surrounding receivers are elevated, minimal noise attenuation would be achieved by installing barriers around the sites and the most effective mitigation measures would be associated with source controls.

Mitigation measures to minimise noise impacts are outlined in Section 9.4.

Table 9-14 Predicted noise levels at receivers around Riley Street construction site

	Predicted	Day			Evening			Night			Saturday (Extended)		
	Noise dBA	**Criteria dBA**	**Exceedance dBA**	**Compliance**	**Criteria dBA**	**Exceedance dBA**	**Compliance**	**Criteria dBA**	**Exceedance dBA**	**Compliance**	**Criteria dBA**	**Exceedance dBA**	**Compliance**
Site establishment													
Ann Street	67	60	7	No	55	-	N/A	51	-	N/A	53	14	No
Riley Street	65	61	4	No	54	-	N/A	49	-	N/A	55	10	No
Albion Street	67	65	2	No - Marginal	59	-	N/A	52	-	N/A	61	7	No
Crown Street	71	60	11	No	55	-	N/A	51	-	N/A	53	18	No
Excavation													
Ann Street	71	60	11	No	55	-	N/A	51	-	N/A	53	18	No
Riley Street	67	61	8	No	54	-	N/A	49	-	N/A	55	2	No - Marginal
Albion Street	75	65	10	No	59	-	N/A	52	-	N/A	61	14	No
Crown Street	74	60	14	No	55	-	N/A	51	-	N/A	53	21	No
Tunneling													
Ann Street	64 / 55*	60	4	No	55	0	Yes	51	4	No	53	11	No
Riley Street	64 / 37*	61	3	No - Marginal	54	0	Yes	49	0	Yes	55	9	No
Albion Street	65 / 51*	65	0	Yes	59	0	Yes	52	0	Yes	61	4	No
Crown Street	59 / 39*	60	0	Yes	55	0	Yes	51	0	Yes	53	6	No

Table 9-15 Predicted noise levels at receivers around Dalley Street construction site

Location	Predicted	Day			Evening			Night			Saturday (Extended)		
	Noise dBA	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
Excavation													
10 Bridge Street	85	70	15	No	-	-	-	-	-	-	70	15	No
16-20 Bridge Street	78	70	8	No	-	-	-	-	-	-	70	8	No
Telstra Exchange	95	75	20	No	-	-	-	-	-	-	75	20	No

Table 9-16 Predicted noise levels at receivers around Yurong Street construction site

Location	Predicted	Day			Evening			Night			Saturday (Extended)		
	Noise dBA	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
Excavation													
Yurong Street	80	70	10	No	-	-	-	-	-	-	70	10	No
Domain Park	78	70	8	No	-	-	-	-	-	-	70	8	No

Table 9-17 Predicted noise levels at receivers around Little Albion Street construction site

Location	Predicted	Day			Evening			Night			Saturday (Extended)		
	Noise dBA	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
Excavation													
102-104 Albion Street	76	65	11	No	-	-	-	-	-	-	61	15	No
115 Albion Street	69	65	4	No	-	-	-	-	-	-	61	8	No
Sony Building	88	75	20	No	-	-	-	-	-	-	75	20	No
Park	78	65	13	No							65	13	No

9.3.3 Construction vibration assessment

Vibration would be generated by a range of construction activities. Plant and machinery likely to generate comparatively high vibration levels include rock breakers (Figure 9-2) to excavate the Riley Street shaft, and road headers (Figure 9-3) and TBMs to excavate the tunnels.

Vibration during excavation of the Riley Street shaft

Table 9-18 sets out the typical Peak Particle Velocity (PPV) ground vibration levels at various distances from rock breakers operating in hard sandstone.

Table 9-18 Rock breaker PPV vibration levels (mm/s) versus distance

Operation	PPV vibration level (mm/s) at given distance					
	5 m	10 m	20 m	30 m	40 m	50 m
Heavy rock breaker (eg 1500 kg)	4.5	1.3	0.4	0.2	0.15	0.02
Medium rock breaker (eg 600 kg)	0.2	0.06	0.02	0.01	-	-

Excavation of the Riley Street shaft would be conducted using rock breakers. The nearest sensitive receivers are residences on the western side of Riley Street, approximately 40 m from the shaft location. Based on the values in Table 9-18, PPV vibration levels from heavy (1500kg) and medium sized (600kg) rock breakers would be in the order 0.15mm/s and below 0.01mm/s respectively at a distance of 40 m.

At a PPV level of 0.15mm/sec, the Vibration Dose Value from a rock breaker operating eight hours per day is less than 0.1mm/s$^{1.75}$ compared with the preferred daytime value for residences of 0.2 mm/s$^{1.75}$ (refer to Table 9-6). Based on this, vibration levels from rock breakers are considered to have an acceptable impact on human comfort.

As indicated in Table 9-7, vibration criteria for structural damage in commercial and residential buildings are much higher than human comfort criteria. Therefore, compliance with the human comfort criteria indicates that compliance with the structural damage criteria would also be achieved.

Figure 9-2 Hydraulic rock breaker

Tunnelling vibration

Maximum PPV vibration levels at a distance of 10 m are predicted to be in the order of 0.3 mm/s at residences due to tunnelling by road header or TBM. These levels of vibration lie between the preferred and maximum night time PPV levels of 0.2 mm/s and 0.4 mm/s for continuous vibration (refer to Table 9-5). As tunnelling would proceed at a rate of about 10 m/day, these impacts would be transitory and individual locations would experience vibration for a relatively short period of time. As such, this level of vibration is considered acceptable.

As the majority of the CECT and CSCT extension would be in excess of 10 m from buildings, vibration levels at these locations would comfortably comply with the human comfort criteria.

A small number of residences on Little Albion Street are located 5-6 m from the CSCT extension that would be excavated using a road header. At this distance vibration levels in the order of 0.42 mm/s are predicted. This vibration level is slightly above the maximum recommended night vibration level. Some of these residences have basements and vibration levels would be reduced by at higher levels.

Structural damage vibration criteria are much higher than human comfort criteria, and these would be satisfied at residences and other surface structures, including heritage listed buildings in the vicinity of the alignment.

Underground services and infrastructure that is in the vicinity of the tunnel route includes:

- Busby's Bore at a distance of about 20 m from the CECT tunnel;
- Bondi ocean outfall sewer tunnel at a distance of 5.5 m from the CECT tunnel;
- The Cross City Tunnel at a distance of 5.7 m from the tunnel and 2.6 m from associated rock bolts; and
- Rail tunnel at a distance of 20 m for the Eastern Suburbs Rail and 32 m for the City Circle tunnels.

Based on previous vibration measurements of TBM's in Sydney, a maximum PPV vibration level of less than 1 mm/s can be expected at distances of 2.6 m. This vibration level is well below criterion levels for damage to structures. Based on this, adverse vibration impacts on existing underground structures in the vicinity of the route are considered to be unlikely.

In the case of rail tunnels, the vibration levels generated by trains in the tunnel would be much higher than the vibration associated with tunnel boring operations.

Figure 9-3 Road header

9.3.4 Regenerated noise assessment

Ground vibration generated during operation of road headers and the TBM would be transmitted to nearby buildings, and may result in audible (regenerated) noise within the buildings. As tunnelling would occur in the evening and night time periods, this noise has been assessed against the DECCW criteria.

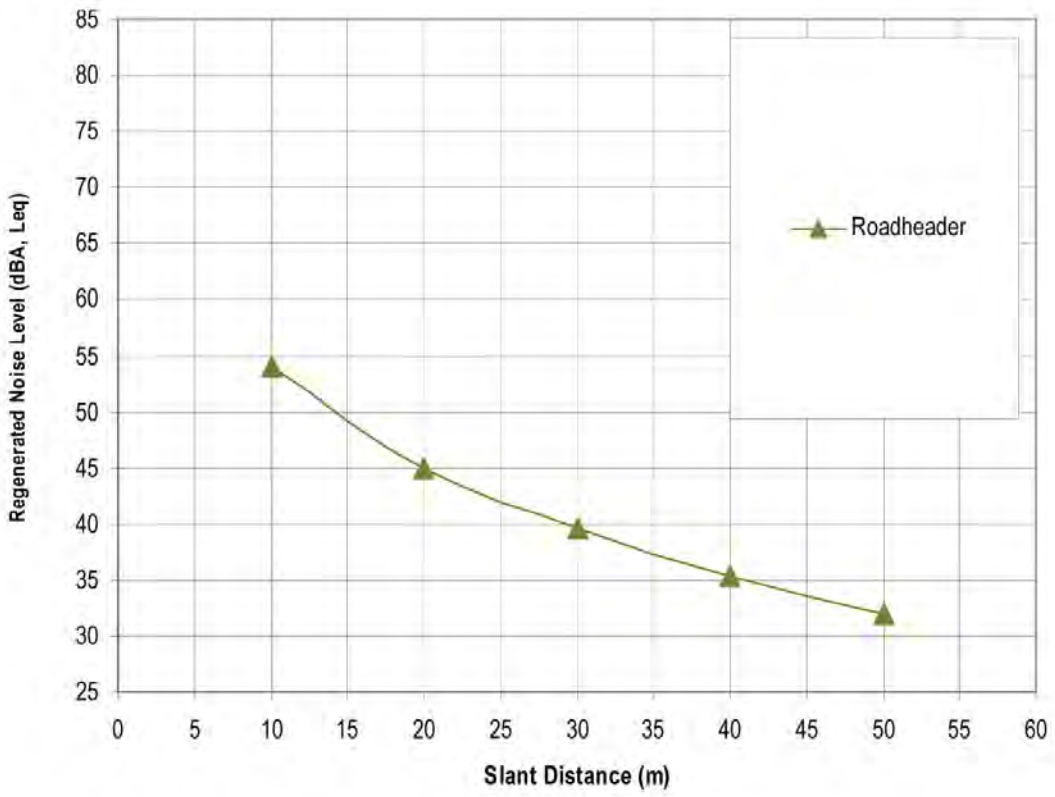
Road header tunnelling

The CSCT extension would be excavated by a road header similar to that illustrated in Figure 9-3. Road headers remove rock using a "grinding" action that provides close control over the excavated profile of the tunnel crown and upper walls.

This type of machine can safely perform detailed excavations quite close to sensitive structures such as historic buildings and generates relatively low levels of vibration (and regenerated noise). Experience has shown that they can be used on a 24 hour basis in tunnels near residences with minimal disturbance to the occupants.

Ground-borne noise levels were measured from a road header similar to that likely to be used for the project. The results of the measurements are shown in Figure 9-4 and were used to predict noise in basements of buildings near the alignment of the CSCT extension.

Figure 9-4 Predicted regenerated noise from road header



The minimum distance from the crown of the CSCT extension to the basement of commercial properties and residences is in the order of 10 m, however there are a small number of buildings with basements that are located 5-6 m from the tunnel.

As discussed in Chapter 6, the CSCT extension is relatively shallow due to the need to connect to the existing shaft at the Surry Hills substation and the optimal grades at which road headers can operate. At distances of 10 m, a regenerated noise level in the order of up to 53 dBA can be expected inside ground level properties, while at distances of about 6 m, regenerated noise levels would be about 60 dBA. These levels exceed the evening and night time regenerated noise criteria of 40 and 35 dBA respectively.

At a depth of 10 m, the area of affectation is predicted to extend up to 35 m either side of the tunnel, beyond which compliance with the 35 dBA criterion is achieved. As tunnelling would progress at a rate of approximately 10 m per day, under a worst case scenario, residences directly above the tunnel route may be affected by regenerated noise in excess of the night-time criterion for up to 6 days.

A mixture of commercial and residential land uses are present along the section of Little Albion Street that is predicted to be affected by regenerated noise exceeding night-time goals. The management measures in Section 9.4 would be implemented to minimise potential impacts on affected receivers.

Operation of the tunnel boring machine

A review of the cross section of the CECT tunnel indicates the tunnel depth varies between approximately 10 - 55 m below the ground surface. Wilkinson Murray has measured ground-borne noise levels from an 8 m diameter TBM. As the vibration energy transmitted to the rock face is proportional on a log scale to the area of the cutting face, the ground-borne noise levels from the 4 m diameter TBM to be used on for the CECT are predicted to be 6 dB less than those of the 8 m diameter TBM. The results of the measurements are shown in Figure 9-5.

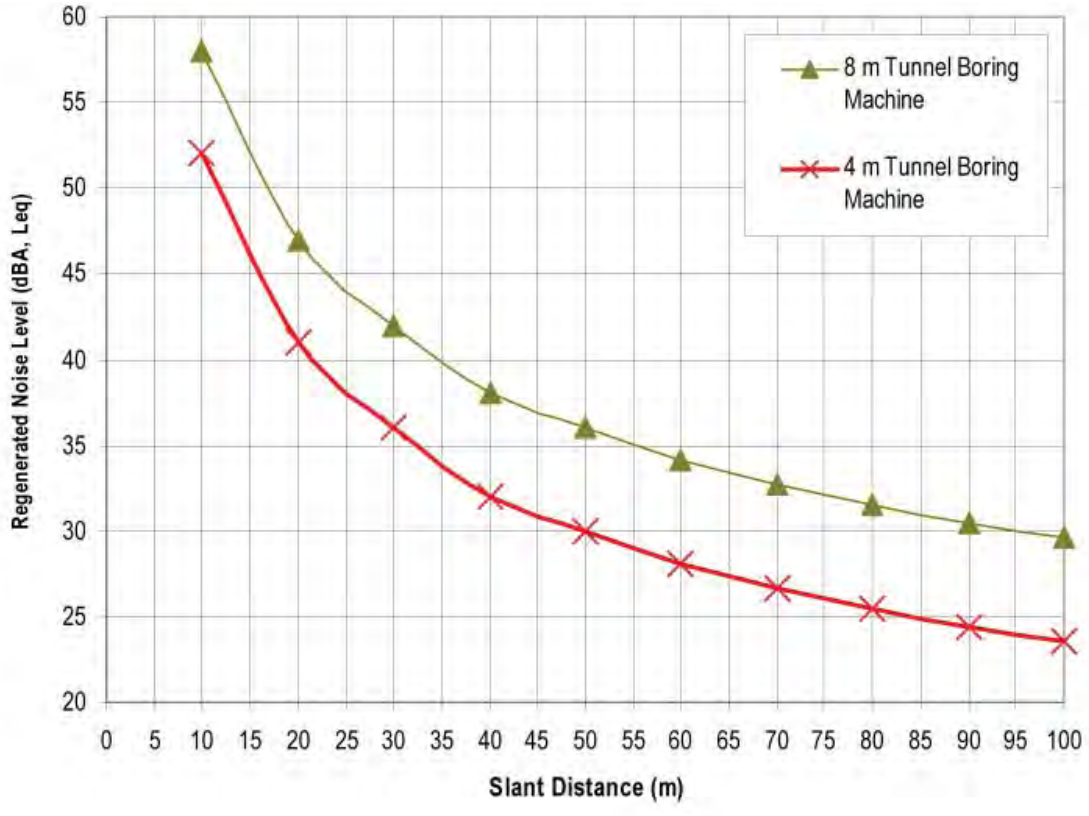
The minimum distance from the CECT to the basements of commercial/retail and properties is in the order of 6 m near the intersection of Yurong Street and William Street. Based on this separation distance, the regenerated noise level due to vibration from the TBM is predicted to be up to 60 dBA in these locations. However, this minimum distance applies only in a relatively short section of Riley Street and Yurong Street. As discussed in Chapter 6, the tunnel is shallower in this location due to the need to pass over the tunnels for the Cross City Motorway. Along the remainder of the alignment, the CECT would be at greater depths (generally over 20 m) and regenerated noise levels would be in the range 35 – 45 dBA (Figure 7-5).

At a depth of 10 m, the area of affectation extends up to 33 m either side of the tunnel, beyond which compliance with the 35dBA criterion is achieved. As tunnelling would progress at a rate of approximately 10 m per day, potentially-affected properties along the CECT route would be affected by noise levels above the 35 dBA night criterion for no more than 6 days.

The management measures outlined in Section 9.4 would be implemented to minimise potential impacts, and would involve a targeted community consultation program and implementation of a sliding scale of mitigation measures.

Figure 9-6 depicts the land use in the immediate vicinity of Stage 2D and areas that are predicted to be affected by regenerated noise that is above the night time goal of 35dBA.

Figure 9-5 Predicted ground-borne noise from TBM



9.3.5 Construction traffic

The construction of Stage 2D of the Sydney CityGrid Project would generate additional traffic movements. The majority of heavy vehicle movements would be from spoil haulage from the Riley Street site. In addition, transport of equipment to the site would occur during all stages, particularly during shaft excavation and tunnelling.

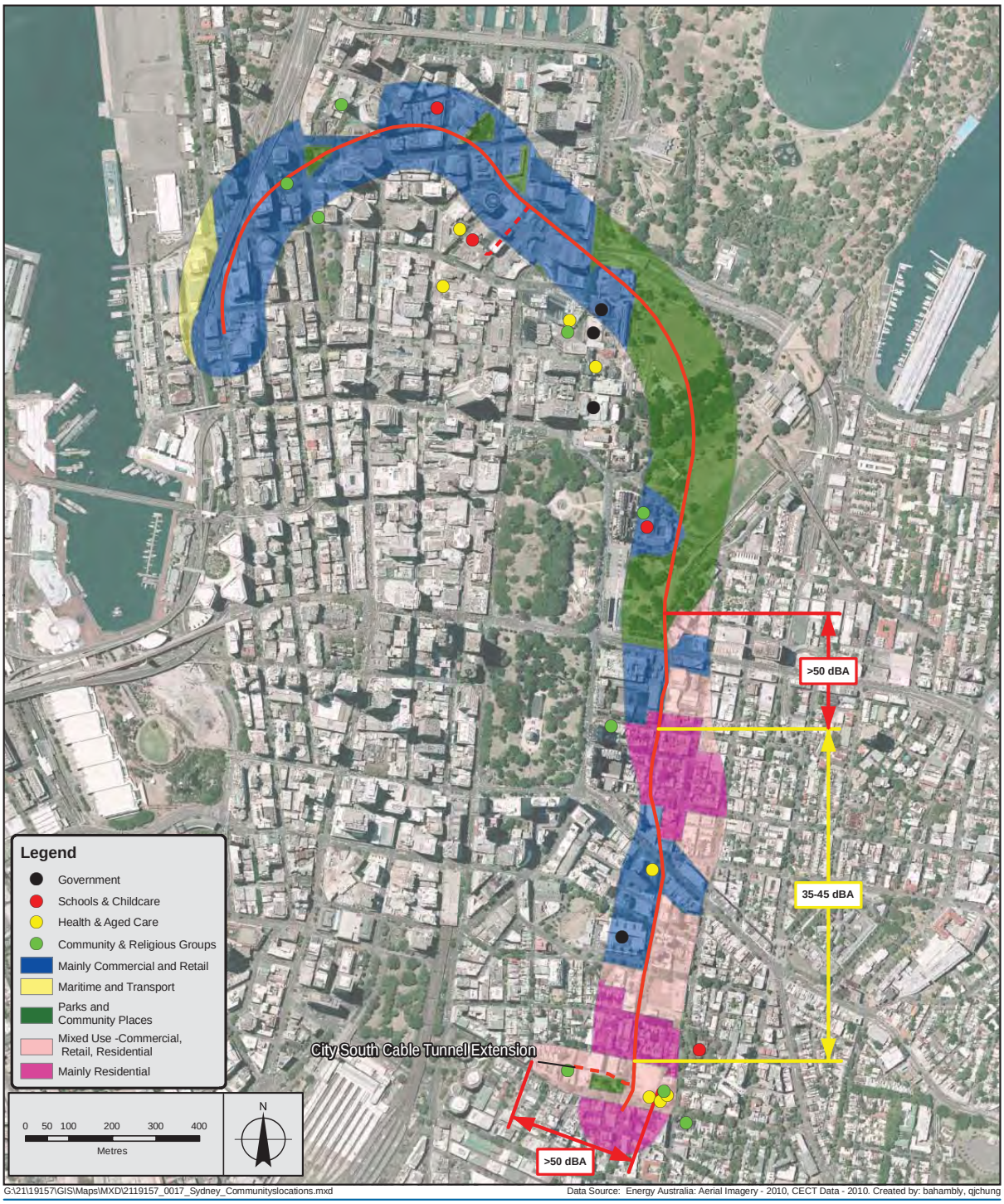
Heavy vehicle traffic would mainly be generated by activities associated with the removal of spoil from tunnelling activities and other general construction waste for the various stages. The number of heavy vehicles is related to the volume of spoil generated from the project which would be about 50,000 m^3 (in situ) or 125,000 tonnes.

It is estimated that approximately 12 light vehicle movements per hour and 8 heavy vehicle movements per hour would occur during the peak hour for the Riley Street construction compound. For the Dalley Street site it is estimated that there would be 6 light vehicle movements per hour and 4 heavy vehicle movements per hour during the peak hour.

The additional construction traffic represents a minor increase of approximately 2-3% on the existing peak hour traffic on Riley Street (500 vehicles per hour) and Albion Street (1,100 vehicles per hour). This increase is expected to have an insignificant impact on noise from the road sections and intersections in the areas surrounding the site.

Based on the existing traffic volumes and the estimated vehicle movements during the construction phase, it is estimated that construction traffic would increase road traffic noise levels by less than 0.2 dBA. This is well below the goal of a 2 dBA increase above existing traffic noise level that applies to the project.

Figure 9-6 Route aerial showing tunnelling zone of potential regenerated noise affectation



9.4 Mitigation measures

Without mitigation, noise levels from some construction activities have been predicted to exceed the noise management levels at surrounding receivers. The following noise control measures would be implemented to ensure that noise is reduced where feasible and practicable.

9.4.1 Community liaison and general approaches to mitigation

An effective community relations program would be implemented to keep the community informed of progress of the project and to advise potentially affected groups of any anticipated changes in noise and vibration emissions prior to critical stages of the works. This would involve providing information to explain management measures that would be implemented, along with complaint procedures, and response mechanisms. This program would be included in the Community Information Plan developed by EnergyAustralia for Stage 2D.

Part of the consultation program would involve developing a protocol that has a sliding scale of response mechanisms that can be tailored to the circumstances of the affected receiver depending on the level and duration of impact. These response mechanisms may include options such as:

- Monitoring;
- Investigating opportunities to alter work methods, such as reducing the tunnelling rate; and
- Possible temporary relocation of highly affected residents.

Close liaison would be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints, should they occur.

9.4.2 Noise and vibration management plan

A Noise and Vibration Management Plan would be included in the Construction Environmental Management Plan for the project. This plan would detail the mitigation, monitoring and community liaison measures. The plan would be updated to incorporate any additional measures that emerge as the project design evolves and work methodologies become better defined.

Areas that would be addressed in the plan include:

- Noise and vibration monitoring;
- Temporary relocation measures;
- Response to complaints;
- Responsibilities;
- Monitoring of noise emissions from plant items;
- Reporting and record keeping;
- Non-compliance and corrective action; and
- Community consultation and complaint handling.

Specific actions to be included in the plan would relate to:

- Plant noise audit – noise emission levels from all critical items of mobile plant and equipment would be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service. To this end, testing would be undertaken by the contractor;
- Operator instruction – operators would be trained to be aware of potential noise issues and to increase their use of techniques to minimise noise emission;
- Equipment selection – all fixed plant at the work sites would be appropriately selected, and where necessary, fitted with silencers, acoustic enclosures and other noise attenuation measures to ensure that the total noise emission from each work site complies with DECCW guidelines, where feasible and practicable;

- Site noise planning – where practical, the layout and positioning of noise-producing plant and activities on each work site would be optimised to minimise noise emission levels;
- During detailed construction planning, consideration would be given to options that could be implemented to reduce regenerated noise levels, such as reducing the cutting rate of the tunnelling machines;
- Use rocksaws and rippers in preference to rock breakers where feasible;
- Install a noise barrier with minimum 17 mm thick structural plywood around construction sites with street frontages. (The Riley Street site would be surrounded by hoardings erected in accordance with the City of Sydney Guidelines);
- Where feasible, use lighter rock breakers;
- Noise intensive activities such as rock breaking would be undertaken during the following hours: Monday to Saturday 7.00am to 12.00pm and Monday to Friday 2.00pm to 5.00pm providing a respite period between 12.00pm and 2.00pm;
- Initial trial noise monitoring would be conducted within residences when tunnelling commences to confirm predicted regenerated noise levels; and
- Based on trial noise tests, the extent of impact along tunnelling route would be established. This would be used to determine requirements for temporary accommodation for residents that may be affected.

10. Non-indigenous heritage

A Non-Indigenous archaeological assessment was undertaken by Casey & Lowe as part of the Concept Environmental Assessment Report prepared by PlanCom Consulting (2008). Casey & Lowe (2010) reviewed the 2008 report in the context of the additional information now available regarding the works associated with Stage 2D and this chapter summarises the findings of the 2008 and 2010 assessments.

This chapter also outlines non-indigenous heritage items located in the immediate vicinity of the tunnel alignments.

10.1 Existing environment

10.1.1 Archaeology

The historical development of areas that would be impacted by the project were researched by Casey & Lowe (2008, 2010) to determine the nature of potential archaeological remains that may be impacted. This involved reviewing relevant plans and other sources to develop an understanding of the land-use history of each area. When coupled with an assessment of archaeological potential, this enables predictions to be made of the kind of archaeological remains that might be present and their level of heritage significance.

The historical review focused on locations that would be impacted by surface works associated with the project. These are the Riley Street site, and shafts at Dalley Street, Little Albion Street and Yurong Parkway.

A series of plans identified varying degrees of development at the sites between 1788 and 1836. The exception is the Cook & Phillip Park/The Domain site located southeast of St Mary's Cathedral which shows no significant development.

The Phillip/Bligh/Hunter/Bent Street block was well established by 1822, however, the block in the area of Dalley/George/Bridge/Pitt/Underwood Streets did not appear in a form recognisable today until the middle of the 19th century.

The following section provides an historical overview of these sites and their archaeological potential.

Riley Street construction compound

The site was vacant throughout much of the nineteenth century. On the 1886 survey it is described as 'Burdekin's Paddock'.

In 1902 the site was occupied by F. Lassetter and Co., machine yard and workshops and in 1913 by Newlands Bros "Metallic Bedstead and Wire Mattress Manufacturers", and by Anderson Bros., "manufacturers of babies' carriages and invalids' chairs". The most recent building on the site was listed on the South Sydney LEP 1998 as a heritage item. This Former Industrial Sugar Mills Pty Ltd building was a two-storey inter-war warehouse that has since been demolished, leaving a basement level excavation.

Assessment of archaeological potential

The site is considered to have no archaeological potential as substantial excavation into sandstone bedrock has already occurred following demolition of the previous building.

Dalley Street

Dalley Street is located in an area that was originally situated on the banks of the Tank Stream and the general area was built upon once the stream was enclosed and no longer flooded the adjacent area. A plan thought to be from 1837 shows the area as primarily being part of the Female Orphan House Grounds but does not show any buildings, fences or other development. This reflects the earlier 1807 plan which shows the extent of the land grant. Another plan thought to be from 1836 indicates the Stores of Edye Manning being south of Queen Street (Casey & Lowe, 2008).

The reference to Queen Street refers to an area in the vicinity of the current locations of Dalley and Underwood Streets. There are a number of variations around the location of this street and some plans suggest it was what is now known as Dalley Street. However a Queen's Place and a Queen's Court are shown to exist close to Underwood Street.

An 1854 plan shows significant but unidentified development on the site. The 1894 Metropolitan Detail Plan for the area shows commercial buildings such as the tourist bureau and banks along Bridge Street. George Street appears to have further commercial buildings of a smaller variety. Several hotels are located on these frontages. Several small buildings are located in the area bounded by Queen's Place (approximate location of the current Dalley Street), Pitt and Underwood Streets. Numerous small buildings and sheds are located north of Underwood Street. The Tank Stream runs through the eastern edge of the site adjacent to Pitt Street (Casey & Lowe, 2008).

The Commercial Sydney 1844-48 plan shows a variety of adjoining commercial properties on George and Bridge Streets. The area west of the Tank Stream is undeveloped.

An image dated c.1875 shows what appears to be a small stone residence with timber outhouse on the street frontage believed to be located in Queen's Place. If correct, this is located within the subject block.

A 1910 plan and the Fire Underwriters Insurance Plan (1919-1940) show a variety of commercial premises on the street frontages including printers, cafes, shops, showrooms, department style stores, offices, warehouses and flats. Within the centre of the area around Underwood Street, there is a lesser retail focus, and more of a trade focus with coppersmiths, bulk storage and packing rooms. A Sydney Council substation is located on the northern side of Dalley Street. Queens Court appears to be demolished in 1922 as part of post plague resumptions.

A 1922 image shows a series of small to medium buildings set around stone paving with drain at Queen's Court. The Nock and Kirby building behind suggests that this image is likely to be located in the subject block as a Knock and Kirby building was identified on several plans for the area (Casey & Lowe, 2008).

By 1949 there appears to have been an amalgamation of sites with larger sites now evident such as Latec House, General House, carparking and the telephone exchange.

Assessment of archaeological potential

Dalley Street is in the vicinity of the original location of mudflats at the mouth of the Tank Stream. It appears to be immediately adjacent to the tanks that were cut from bedrock to store water and which gave the Tank Stream its name. This implies that exposed bedrock was present in the immediate area and that the mudflats were further north. Dalley Street is considered to be within the original Tank Stream valley and the soil profiles in the area should reflect the pre-1788 as well as the early historical environment. The archaeology and history of the Tank Stream valley is an important resource.

Post-1788 land use includes being part of the grounds of the Female Orphan School, a group of small houses off Queen's Court, and a small street running off Queens Place (Dalley Street). Some of these houses are located under the site of the existing substation.

Potential archaeological remains in the vicinity of this site have been identified as older road surfacing, services such as brick and sandstone drains, and Tank Stream soil profiles.

Little Albion Street and Yurong Parkway

The shaft locations in Little Albion Street and Yurong Parkway have been substantially disturbed by construction of the roadways and associated services and utilities. These locations are considered unlikely to have archaeological potential.

10.1.2 Built heritage

The following registers were searched to identify heritage listings in the immediate vicinity of the project:

- The Commonwealth Heritage List, the National Heritage List and the Register of the National Estate;
- The State Heritage Register;
- Section 170 Heritage and Conservation Registers – for culturally significant items or places managed or owned by government agencies
- The heritage schedules of the Sydney LEP 2005 and South Sydney LEP 1998; and
- The *Central Sydney Archaeological Zoning Plan 1992*, which identifies areas within Central Sydney with archaeological potential in the form of below surface cultural remains.

The identified heritage items are summarised in Table 10-1. Maps identifying the location of heritage items listed in the schedules of the Sydney LEP 2005 and South Sydney LEP 1998 are located in Appendix D.

Table 10-1 Identified heritage items within the study area

Name	Address	Register
Former Children's Court	66-78 Albion Street, Surry Hills	LGOV
St Francis de Sales Group	80-96 Albion Street, Surry Hills	LGOV
O'Hears Stairs	Albion Street, Surry Hills	LGOV
Crown Street Reservoir	224a Riley Street, Surry Hills	SGOV, LGOV
Terrace houses	238-250 Riley Street, Surry Hills	LGOV
Former Industrial Sugar Mills Pty Ltd	252-284 Riley Street, Surry Hills (the site)	LGOV
Former Reservoir Hotel	263-265 Riley Street, Surry Hills	LGOV
Three storey Victorian Italianate style terrace house	267 Riley Street, Surry Hills	LGOV
Victorian building	165 Riley Street, Darlinghurst	LGOV
Brighton Hotel	75-77 Oxford Street, Darlinghurst	LGOV
SILF Company Building	10-20 Oxford Square, Darlinghurst	LGOV
Burton Building	52-54 Oxford Street, Darlinghurst	LGOV
Burton Family Home (former)	20 Burton Street Darlinghurst	LGOV
Sandstone Victorian terrace house	22 Burton Street, Darlinghurst	LGOV
Victorian Free Classical style commercial building	165 Riley Street, Darlinghurst	LGOV
Victorian terrace house group	5-11 Norman Street, Darlinghurst	LGOV
Victorian terrace house group	13-17 Norman Street, Darlinghurst	LGOV
Pearson's Florist	48-50 Oxford Street, Darlinghurst	LGOV
Exchange Hotel	34-36 Oxford Street, Darlinghurst	LGOV
Corner shop and residence (former)	176 Liverpool Street, Darlinghurst	LGOV
Victorian terrace house	178 Liverpool Street, Darlinghurst	LGOV

Name	Address	Register
Victorian terrace houses	180-182 Liverpool Street, Darlinghurst	LGOV
Victorian terrace house	184 Liverpool Street, Darlinghurst	LGOV
Victorian terrace house group	164-170 Liverpool Street, Darlinghurst	LGOV
Federation building (former Hillside Private Hospital)	172-174 Liverpool Street, Darlinghurst	LGOV
Victorian Georgian style terrace house	57 Yurong Street, Darlinghurst	LGOV
Victorian Georgian style terrace house	54-56 Yurong Street, Darlinghurst	LGOV
Sandstone mid-Victorian terrace house	58 Yurong Street, Darlinghurst	LGOV
Sandstone Victorian Georgian style terrace house group	60-72 Yurong Street, Darlinghurst	LGOV
Victorian former corner shop, residence and attached terrace house	33-35 Francis Street, Darlinghurst	LGOV
Corner shop and residence (former)	38 Francis Street, Darlinghurst	LGOV
Victorian Georgian style terrace house group	27-31 Francis Street, Darlinghurst	LGOV
St. Vincent de Paul	50 Francis Street, Darlinghurst	LGOV
Victorian Georgian style corner shop, residence and attached terrace house group	31-39 Yurong Street, Darlinghurst	LGOV
Victorian terrace house group	31-39 Stanley Street, Darlinghurst	LGOV
Victorian terrace house group	45-65 Stanley Street, Darlinghurst	LGOV
The Park Hotel	18-20 Yurong Street, Darlinghurst	LGOV
Hotel William	47-49 William Street Darlinghurst	LGOV
Peejays Building	52-58 William Street, Woolloomooloo	LGOV
Art Gallery of NSW	3B Art Gallery Road	LGOV, AAP
Public Library of NSW	1 Shakespeare Place	NSW HA, SGOV, LGOV

Name	Address	Register
Wentworth Hotel	61 Phillip Street (6 Bligh Street)	LGOV
Department of Lands building	23-33 Bridge Street	NSW HA, SGOV, LGOV, AAP-DSF
Department of Education building	35-39 Bridge Street	NSW HA, LGOV, AAP-DSF
Cliveden	4 Bridge Street	LGOV, AAP-PD
Northumberland Insurance	6 Bridge Street	LGOV, AAP-PD
St Phillips Church of England	3 York Street	LGOV, AAP-PD
Scots Church	2 York Street	LGOV, AAP
Retail and residential terrace	42-50 Erskine Street	LGOV, AAP
Retail and residential terrace	52-54 Erskine Street	LGOV, AAP
Retail and residential terrace	62-66A Erskine Street	LGOV
Watch house terraces and shops	66-80 Erskine Street	NSW HA, LGOV, AAP
Former watch house	82 Erskine Street	NSW HA, LGOV, AAP
Bristol Arms Hotel	81 Sussex Street	NSW HA, LGOV, AAP-PD
Tank stream tunnel and tanks	King Street to Circular Quay	NSW HA, LGOV, AAP
Crown Street Pumping Station WP0001	Lot 1 DP 229343 Riley Street, Surry Hills	SGOV
Busby's Bore	Centennial Park to College Street, Surry Hills	NSW HA, SGOV, LGOV, AAP
Albion Street Heritage Streetscape (HS1)	Albion Street, Surry Hills	LGOV
Oxford Street Heritage Streetscape	Oxford Street, Darlinghurst-Paddington	LGOV
East Sydney and Darlinghurst Heritage Conservation Area	Darlinghurst, Surry Hills	LGOV
Foveaux Street Conservation Area	Surry Hills	LGOV
Reservoir Street and Fosterville Heritage Conservation Area	Surry Hills	LGOV

NSW HA = item listed under the NSW Heritage Act including listing on the State Heritage Register, an Interim Heritage Order or protected under section 136 of the NSW Heritage Act.
LGOV = items listed by Local Councils and Shires.
SGOV = items listed by State Government agencies.
AAP = Area of archaeological potential under The Central Sydney Archaeological Zoning Plan.
AAP – DSF = Area of archaeological potential – deeper sub-surface features only under The Central Sydney Archaeological Zoning Plan.
AAP – PD = Area of archaeological potential – partially disturbed under The Central Sydney Archaeological Zoning Plan.

10.2 Impact assessment

The following section discusses potential construction impacts on archaeology and heritage. The project would not result in any operational impacts on archaeology or heritage.

10.2.1 Archaeology

The CECT and CSCT extension would be in bedrock that is generally between 10 and 55 m below the existing ground surface. As there are no archaeological sites or features located within bedrock, these elements of the project would not impact on subsurface archaeology.

Potential impacts on items of archaeological significance would be limited to locations where surface works would be performed, such as the Riley Street construction site and shaft locations at Dalley Street, Little Albion Street, and Yurong Parkway. The archaeological potential of these sites is discussed below.

Riley Street

Although the South Sydney LEP 1998 indicates that a two storey inter-war warehouse of local environmental significance is located at the site, this structure was demolished and the site excavated down to basement level as part of preliminary works associated with a previous development at the site. The development has not been completed and the basement excavation remains exposed.

As the Riley Street site has been excavated down to basement level, the site is considered to have no potential for archaeological remains.

Dalley Street shaft

A shaft would be excavated within Dalley Street to link the CECT with the adjacent Dalley Street Zone Substation. Subsurface deposits in Dalley and Underwood Streets generally have the potential to retain evidence of post-1830 housing as well as soil profiles connected to the Tank Stream valley. The shaft in Dalley Street would be located within road easement and this roadway appears to date to the area's subdivision. Potential archaeological remains would probably be limited to older road surfacing, services such as brick and sandstone drains, and Tank Stream soil profiles (Casey & Lowe, 2008, 2010).

Potential impacts would be managed by implementing the mitigation measures.

Little Albion Street and Yurong Parkway shafts

Small shafts would be excavated in Little Albion Street and Yurong Parkway to connect feeders to the local electricity networks.

Deposits associated with brickfields are known to occur in the Surry Hills area. The shaft location in Little Albion Street is located outside the main area of brickmaking activity, which would have been more likely on more level ground with easier access to water. As such, impacts on subsurface archaeology are considered unlikely.

A small shaft would be excavated in Yurong Street to connect 33kV feeders to the CECT. Historical research did not identify any substantial buildings or land use in this area. The site appears to have been used as open space (currently a road) and has not contained structures or buildings that are likely to have left archaeological features or deposits (Casey & Lowe, 2008).

10.2.2 Built heritage

Potential impacts on built heritage items in the vicinity of the tunnel routes that are identified in Section 10.1.2 would be limited to those associated with settlement and vibration. As discussed in Section 6.2.2, the tunnels would be constructed between 10 and 55 m below the ground surface and have been designed as fully tanked tunnels to minimise the potential for settlement to impact on structures in the vicinity of the alignment.

Long term visual impacts associated with Stage 2D would be limited to those associated with the control room (approximately 15m long, 8m wide and 6m high) located within the Riley Street construction compound as the remainder of the project is below the ground surface. The Riley Street construction compound is located directly opposite two heritage items, as indicated in Appendix D. The Riley Street compound would be surrounded by hoardings that would screen views from heritage listed structures.

Although the control room would be completed in advance of the Riley Street STSS, the hoardings surrounding the Riley Street compound would only be removed following completion of the STSS. The control room would be a relatively small structure and when viewed from the surrounding area, including heritage listed structures, it would present as a component of the Riley Street STSS. Visual impacts associated with the STSS would be assessed as part of Stage 2C of the Sydney CityGrid Project.

Potential visual impacts on the heritage significance of items in the vicinity of the Riley Street site due to the presence of the control room are considered to be negligible as it would be screened by hoardings during construction and would be integrated into the STSS.

There is the potential for heritage listed items to be impacted by vibration during construction. As indicated in Section 9, British Standard *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2* notes that a building of historical value should not be assumed to be more sensitive unless it is structurally unsound. As vibration modelling indicates that the project is likely to comply with vibration criteria for structural damage, vibration impacts on heritage listed buildings are considered unlikely.

10.3 Mitigation measures

Potential impacts on archaeology and built heritage would be mitigated by implementing the following measures:

- Archaeology –
  - Construction of the Dalley Street shaft would be carried out with archaeological input as the site has the potential to contain archaeological remains associated with the history and development of Sydney, including the Tank Stream. The site should be inspected by an archaeologist once the existing road surface has been removed and prior to excavation commencing. The initial bulk excavation should be monitored so that any buried features can be recognised. Should it be determined that construction of the shaft would impact on any remaining archaeological remains, including the Tank Stream, EnergyAustralia would investigate alternative locations for the Dalley Street shaft, giving consideration to existing services and utilities located within the vicinity of the area;
  - Any items of archaeological significance or interest would be recorded by the archaeologist and managed in consultation with the Heritage Branch of the Department of Planning. Any evidence of substantial archaeological remains would be investigated and recorded and soil samples taken for analysis;
- Built heritage
  - Potential indirect impacts on items of built heritage due to vibration impacts would be managed in accordance with the mitigation measures detailed in Section 9.4; and
  - Dilapidation surveys would be conducted on buildings in the immediate vicinity of the alignment and this would identify any heritage listed buildings that are structurally unsound. If heritage listed buildings are found to be structurally unsound, consideration would be given to the need to adopt alternative vibration criteria.

11. Indigenous heritage

11.1 Existing environment

An Aboriginal Cultural Heritage Assessment was undertaken by Navin Officer Heritage Consultants as part of the Concept Environmental Assessment (EnergyAustralia 2008). This involved a search of the Aboriginal Heritage Information Management System (AHIMS) that is maintained by DECCW which identified 16 known Aboriginal sites in the vicinity of the Sydney CityGrid Project. Navin Officer concluded that these results demonstrate that remnants of Aboriginal archaeological material may survive in limited contexts in the now highly modified environment of the CBD. However, the likelihood that Aboriginal site remnants survive in an undisturbed context is remote. None of the known sites are located in the vicinity of areas where surface works would be required for Stage 2D.

Given the high degree of landform modification within the intensely urbanised area of Sydney's CBD, the remaining Aboriginal archaeological resource is likely to consist of isolated remnants that are hard to predict at a local level. Areas with the greatest potential for subsurface archaeological deposits were predicted to be:

- The pre-European foreshore zone, up to 200 m from the former shoreline, especially where the former land surface was lower than the current (artificially elevated) one;
- Formerly lower lying areas which have been subsequently filled to provide an elevated building or road platform; and
- Where excavation for building foundations or below-ground levels has not removed the pre-European soil profile.

Deposits underlying road carriageways and their adjacent pavements are likely to be highly disturbed due to the construction of the road foundation, former road surfaces and grades, and the intrusion of below ground service trenches for sewer and water pipelines and telecommunication cables. High-rise structures and buildings with basements are also unlikely to overlie sediments with archaeological potential due to the high level of disturbance and soil extraction required during construction.

Navin Officer assessed all ground surface and subsurface disturbance areas associated with the Sydney CityGrid Project, including Stage 2D, as having low to negligible potential for Aboriginal archaeological remains.

11.2 Impact assessment

Potential impacts on Aboriginal sites would be limited to areas that would be subject to disturbance of the ground surface. Construction of the CECT, CECT extension, and connections to the Surry Hills and City North Substations involves subsurface works within bedrock. As such, these activities would not impact on any items of significance to the Aboriginal community.

Construction at or above the ground surface would be limited to the Riley Street construction compound, the shaft associated with the Dalley Street Substation, and the shafts in Little Albion Street and Yurong Parkway. The site for the Riley Street construction compound has been substantially modified as part of preliminary works for a previous development that involved excavation into the sandstone bedrock to depths of up to 3 m.

The shaft to connect to the Dalley Street Zone Substation would be located within the roadway. The shafts in Little Albion Street and Yurong Parkway would be located within the roadway. As stated in Section 11.1, it is likely that any items of significance to the Aboriginal community in these locations would have been disturbed during construction of the road and installation of below ground services such as water, sewer, communications and electricity.

Due to the extent of disturbance that has occurred at the sites where surface works would be undertaken for the project, the potential for direct impact to surviving archaeological deposits is considered to be very limited and impacts on items of significance to the Aboriginal community are considered unlikely.

11.3 Mitigation measures

The following mitigation measure would be included in the CEMP to manage potential impacts on items of Aboriginal heritage significance:

- If unexpected Aboriginal object(s) are encountered during construction, all work likely to affect the object(s) would cease immediately and the DECCW would be informed in accordance with the *National Parks and Wildlife Act 1974*. The Metropolitan Local Aboriginal Land Council would also be notified. Works would not recommence until written authorisation from DECCW is received.

12. Spoil and waste management

12.1 Impact assessment

Spoil and waste would be generated during the all stages of construction:

- Site establishment;
- Construction of the CECT, CSCT extension, and associated shafts; and
- Refurbishment of the Dalley Street Zone Substation.

12.1.1 Site establishment

During initial site establishment (installation of site hoardings, temporary service and utility connections, grout plant, water treatment plant and site amenities) and set up of the acoustic enclosure and gantry crane over shaft, the following types of waste are expected to be generated:

- General waste from site personnel (e.g. lunch wrappers, cans, paper and office waste);
- Small volumes of spoil during excavation of footings and removal of existing spoil;
- Packaging from delivery of parts and construction materials; and
- Surplus general construction materials.

12.1.2 Tunnel construction

The main waste generated during construction of the tunnels would be spoil and approximately 50,000 m^3 in situ or 125,000 tonnes is expected to be produced. Table 12-1 summarises the estimated quantities of spoil associated with each construction activity/source. The majority of spoil would be generated during bulk excavation (tunnelling) of the CECT and CSCT extension, with smaller quantities expected to be generated from associated shaft and stub tunnel connections. Spoil from tunnelling would be removed from the shaft at the Riley Street construction compound prior to being transported offsite using trucks.

Table 12-1 Estimated spoil generation

Construction activity/source	Expected spoil generation m^3 (insitu)
CECT	44,000
CECT extension	3000
Riley Street shaft	2600
Little Albion Street shaft	55
Yurong Street shaft	55
Dalley Street shaft	200
Rose Bay feeder shaft (within Riley Street site)	100
TOTAL	**50,000m^3**

Except for the shafts in Little Albion, Yurong and Dalley Streets, all spoil would be removed via the shaft at Riley Street using a gantry crane.

Geotechnical and hydrogeological investigations (PSM January 2009) of the tunnel alignment indicates that the CECT and CSCT extension tunnels would be located within Hawkesbury Sandstone. The expected geology of the CECT tunnel alignment would be predominantly slightly weathered and fresh Hawkesbury Sandstone (Class I and II) with some intermittent portions of mudstone (including laminate/shale). As a result, the majority of spoil generated from the CECT tunnel excavations would be sandstone with some shale material. Sandstone spoil can usually be readily reused in engineering and remediation projects.

It is expected that the geology that would be encountered during excavation activities for the CSCT extension would also comprise slightly weathered and fresh Hawkesbury Sandstone (Class I and II) and cross bedded highly to slightly weathered Hawkesbury Sandstone (Class III) (PSM May 2010). Spoil generated from the CSCT extension also is likely to be mostly sandstone that may be suitable for reuse or recycling.

The relatively smaller quantities of excavated material from shaft and stub tunnel connections may also include fill and Quaternary Sediments (such sandy clays, inorganic and organic clays and sand layers).

Other types of waste would be associated with:

- Establishment of the main construction shaft at Riley Street for spoil removal and material delivery;
- Shaft and stub tunnel connections to the existing Dalley Street Zone Substation;
- Shafts to facilitate 33 kV and 132 kV feeders at Little Albion Street (Surry Hills) and Yurong Street Parkway (The Domain);
- Ancillary surface works at various locations along the tunnel route; and
- Fit out and commissioning of the CECT and associated tunnel connections.

These activities would produce a range of waste, including:

- General waste from site personnel (e.g. lunch wrappers, cans, paper and office waste);
- Packaging from delivery of parts and construction materials; and
- Surplus construction material such as concrete from the tunnel lining, cable off cuts, shotcrete, and tunnel fit out and finishing wastes.

12.1.3 Potential for contamination

A preliminary waste classification assessment (Report PSM1055.TR) found that existing fill materials that may be encountered during excavation of the shafts would be classified as 'General Solid Waste (non-putrescible)' and therefore require disposal at a landfill licensed to accept this (i.e. Class II landfill) (PSM January 2009).

PSM (January 2009) also states that in the vicinity of the Dalley Street Substation, the shaft to provide access to the CECT is expected to extend through reclaimed filling placed in Sydney Cove. This fill was not classified as part of the geotechnical investigations.

Geotechnical investigations for the project did not indicate the presence of acid sulphate soils. As the majority of the project would be excavated in bedrock, it is unlikely that acid sulphate soils would be encountered during construction.

12.1.4 Management approach

All wastes generated by the project, including spoil, would be managed in accordance with the DECC (April 2008) *Waste Classification Guidelines* and the principles of the waste management hierarchy as set out in the NSW Waste Avoidance and Resource Recovery Strategy 2007 (refer to Figure 12-1. Specific management strategies for spoil and other general waste are discussed in the following sections.

Figure 12-1 The waste hierarchy

Spoil management

The overarching approach to spoil management is based on the principles of the waste hierarchy and includes the objectives to maximise reuse and recycling of spoil generated and manage contaminated spoil appropriately to avoid impacts to the environment.

The majority of spoil would be classified as virgin excavated natural material (VENM). There are limited opportunities to reuse excavated spoil material as part of the project, however there are good opportunities for beneficial reuse off-site. For example, spoil can be reused as engineering fill or other construction materials. Spoil can also be beneficially reused for land reclamation or remediation works or for operational purposes at landfills. The least preferred option for off-site management is disposal at landfill. Other disposal options such as dumping at sea are unlikely to be acceptable and therefore were not considered. The spoil management options are summarised in the following spoil management hierarchy.

Figure 12-2 Spoil management hierarchy

A spoil and waste management sub-plan prepared as part of the Construction Environmental Management Plan would identify how spoil and other waste material would be handled, stockpiled, reused and disposed. It would address the principles of the waste hierarchy and relevant health and safety as well as environmental legislation.

Spoil reuse and disposal options

When considering spoil reuse and disposal, the volume of material and timing of spoil generating activities are key to determining feasible options. Small quantities can be utilised on a large number of construction projects or accepted at disposal sites (such as landfills or mining voids), but larger quantities often require special arrangements to be negotiated. The possibility of such arrangements also depends on the timing of other major construction projects requiring fill coinciding with the period when spoil is being generated.

VENM can be accepted and re-used on other construction sites with minimum effort and cost. There are a number of applications for shale and sandstones found in the Sydney region. The technique used to extract the material or the degree of processing largely determines the likely reuse application. Hawkesbury Sandstone can be used to produce coarse concrete sand or as select earth fill material. Other potential applications are as a lower level pavement material or low grade road base. Some shale types can be used as fill for building sub-base road pavements, others are suited to crushing, grinding and processing to produce clay for vitrified products such as tile, pipes and bricks.

VENM can also be used in beneficial land management. For example, shale materials can be suitable as cover for contaminated land reclamation projects. The opportunities for reuse of spoil materials in beneficial land management can sometimes be limited, as appropriate land management projects may not be underway in the vicinity of the VENM generating activities.

At some 'VENM only' sites in Sydney such as extractive industry voids (quarries), VENM can be accepted free of the Section 88 Waste and Environment Levy, so disposal costs are low. While there are a number of extractive industry voids in the Sydney region, not all are potential VENM filling sites and only a few are currently operating as VENM only receival sites. Table 12-2 lists some potential VENM only sites and spoil reuse and recycling sites.

Table 12-2 Potential VENM only and spoil reuse/recycling sites

Name	Location	Materials accepted	Capacity
Eastern Creek / Dial-a-Dump	Eastern Creek	Sandstone and shale	Recently approved 1.6 million tonnes/year
Rocla Sand Quarry	Calga	Sandstone	400,000 m^3, 1500 tonnes/day
Penrith Lakes Development	Penrith	Sandstone	1 million m^3/year for 8-10 years
CSR Schofields Quarry	Schofields	Sandstone and shale	1 million m^3, 500 tonnes/day clay for brick production, requiring 10 per cent sandstone and 50 per cent shale
CSR Cecil Park	Cecil Park	Sandstone and shale	1,000 tonnes/day clay brick production, 10 per cent sandstone and 50 per cent shale
Austral Plant 3	Horsley Park	Shale of appropriate quality	1.5 million m^3, active brickworks
Holt Land Rehabilitiation	Kurnell	Sandstone and shale	VENM only receival site for land rehabilitation of former sand mining areas Capacity not known
Boral Prospect Recycling Plant	Prospect	Sandstone	60,000-70,000 tonnes/year
Badgery's Creek Brick Plant	Badgerys Creek	High quality and particular types of shale	Capacity not specified
Hornsby Quarry	Hornsby	VENM	3-5 million m^3 capacity, but limited filling and not approved.

In August 2009, Hornsby Council resolved to progress actions to fill the Hornsby Quarry pit with VENM, but noted that filling would be limited to that necessary for safety, other operational reasons or where financially viable. Approval to fill Hornsby Quarry has not been obtained.

There are also large clay mining voids in the Horsley Park area that could potentially be filled with VENM, however planning and approval for such sites is not in place at present.

VENM and spoil classified as non-putrescible waste (i.e. their characteristics do not allow them to be classified as VENM) can be disposed of at Class 2 (non-putrescible) licensed landfills, however doing so would incur the Section 88 Waste and Environment Levy. Disposal of clean spoil material at landfills is not a preferred management option, but can occasionally be necessary to maintain construction progress.

Landfilling of the former Pioneer quarry at Archold Road, Eastern Creek was recently approved by the NSW Department of Planning as part of an overall project for a materials processing centre and landfill. This site has a capacity of 11 to 15 million m^3 and is expected to be able to accept between 400,000 and 700,000 tonnes per year of non-putrescible waste.

Other non-putrescible landfills within Sydney are shown in Table 12-3.

Table 12-3 Non-putrescible landfills in Sydney

Name	Licensed to	Location
Penrith Waste (Penrith Waste Services)	Penrith Waste Services Pty Ltd	842 Mulgoa Road, Mulgoa 2745
Elizabeth Drive (SITA)	SITA Australia Pty Ltd	1725 Elizabeth Drive, Kemps Creek 2178
Schofields (Hlebar & Draga)	Hlebar, Draga	North Street, Schofields 2762
Kemps Creek (Kari & Ghossayn)	Kari & Ghossayn Pty Ltd	Clifton Avenue, Kemps Creek 2171
Kimbriki (Warringah Council)	Warringah Council	Kimbriki Road, Terry Hills 2084
Kurnell (Breen Holdings)	Breen Holdings Pty Ltd	Captain Cook Drive, Kurnell 2231
Alexandria (Dial-a-Dump)	Alexandria Landfill Pty Ltd	10 Albert Street, St Peters 2044
Brandown	Brandown Pty Ltd	Lot 9 Elizabeth Drive, Kemps Creek 2178
Blacktown (Blacktown Council)	Blacktown Waste Services Pty Ltd	Richmond Road, Marsden Park 2765
Horsley Park (Veolia)	Veolia Environmental Services (Australia) Pty Ltd	Wallgrove Road, Horsley Park 2164
Erskine Park (Enviroguard)	Enviroguard Pty Ltd	Quarry Road off Mamre Road, Erskine Park 2759

The Enviroguard landfill at Erskine Park is scheduled to close within the next couple of years.

VENM can also be accepted at landfill sites without incurring the s88 Levy, provided it is used for operational purposes such as daily cover. Landfills are restricted to the amount of VENM they are able to claim a rebate on the s88 Waste and Environment Levy – 20 percent of the total quantity of waste received and landfilled at the site. Often, sufficient material is delivered to these landfills by small operators (such as landscapers and builders), and so there may be limited opportunities to accommodate material from the project.

Typical landfill sites that receive VENM for use as daily cover or onsite engineering works include the WSN landfills at Belrose, Eastern Creek and Lucas Heights, the Glenfield Waste Depot and Enviroguard, Brandown and Penrith Waste landfills as listed above.

'Contaminated' spoil management

Spoil that is contaminated could be disposed of at the SITA landfill at Kemps Creek or at Penrith Waste at Mulgoa. Both these sites are licensed to receive contaminated soils. The SITA landfill is also licensed to receive 'Special Waste' and 'Restricted Waste', which requires special landfilling techniques.

Minimal contaminated spoil material is expected to be generated by the project.

Management of other waste types

Redundant plant and machinery from the Dalley Street Substation, such as switchgear, would be removed and recycled where practicable. When recycled, the plant and machinery would generally be disassembled and stripped of metals before disposal.

Waste concrete from tunnel lining not used during construction and shotcreting may be suitable for crushing and reuse if significant quantities are generated. If this is the case, the waste concrete would be transferred off site to a construction and demolition recycler. Otherwise, it would be collected and disposed of to an appropriately licensed landfill.

Cable off cuts produced during tunnel fit out would contain useful and valuable metals (the conductor) and would be suitable for recycling. Any off cuts would be collected and recycled.

Any other surplus recyclable construction material such as steel off cuts or scrap would be recycled. Timber and plywood (from formwork) would be reused or recycled where possible, for example for firewood/wood chips. Other construction materials that are non-recyclable would be disposed of at an appropriately licensed landfill in accordance with NSW legislative requirements.

Recycling and general waste bins would be provided at site offices and amenities. Recyclable materials such as glass, aluminium, plastic and paper would then be taken off site for recycling.

12.2 Mitigation measures

As part of the Construction Environmental Management Plan, a spoil and waste management sub plan would be prepared that would identify how spoil and other waste material would be handled, stockpiled, reused and disposed. It would address the principles of the waste hierarchy and relevant health and safety as well as environmental legislation and would include measures such as:

- All waste would also be managed in accordance with NSW DECCW *Waste Classification Guidelines* (2008);
- Arrangements to reduce the volume of materials being brought onto site such as packaging. In addition, construction materials would be ordered in the correct quantities to minimise waste;
- Sites for disposal of surplus spoil would be selected according to the rate of development activity and the volumes of material generated elsewhere;
- Procedures for the management and disposal of any contaminated material found during excavations; and
- Ongoing training for construction personnel to ensure correct sorting of waste and recyclable materials and promote the principles of the waste hierarchy. Waste minimisation and management would be included in tool box sessions and site management planning.

13. Traffic and access

13.1 Existing environment

13.1.1 Existing road network

The CECT commences at a site adjacent to the intersection of Albion and Riley Streets. The route passes through the suburbs of Surry Hills and Darlinghurst along Riley Street, Surry Hills, then passes beneath open space known as The Domain, then beneath the northern section of the CBD before terminating at the City North Zone Substation located on the corner of Sussex Street and Erskine Street. As most of the tunnelling works would be below ground, and surface construction works would be limited to the Riley Street construction compound and shafts within Dalley, Little Albion and Yurong Parkway.

Dalley Street

Dalley Street is a narrow one-way (eastbound) single carriageway road with on-street parking on the northern side. It intersects with George Street on its western end and Pitt Street on its eastern end. Dalley Street is priority controlled at Pitt Street intersection and has a posted speed limit of 50 km/h. The adjacent section of Pitt Street is one way in a southbound direction.

Dalley Street conveys low levels of traffic and vehicle movements are associated with access to underground car parks for adjacent commercial buildings such as the Australian Stock Exchange. It also provides access to the Dalley Street Zone Substation and Telstra Exchange.

Figure 13-1 shows Dalley Street with an adjacent parking lane on the north side. Limited parking is available between driveways that provide access to buildings and is time limited to ¼ P.

Figure 13-1 Dalley Street, looking east

The intersection of Dalley Street with George Street at the west end is in very close proximity to the signalised intersection of George Street with Grosvenor Street and Bridge Street (south of Dalley Street). Vehicles on the southbound lane of George Street would tend to block the access to Dalley Street. There is a no right turn restriction on traffic turning from George Street into Dalley Street. Figure 13-2 shows the road network surrounding the Dalley Street Zone Substation.

Figure 13-2 Road network surrounding Dalley Street zone substation

G:\21\19157\GIS\Maps\MXD\2119157_014_Dalley_Street_Subtransmission.mxd

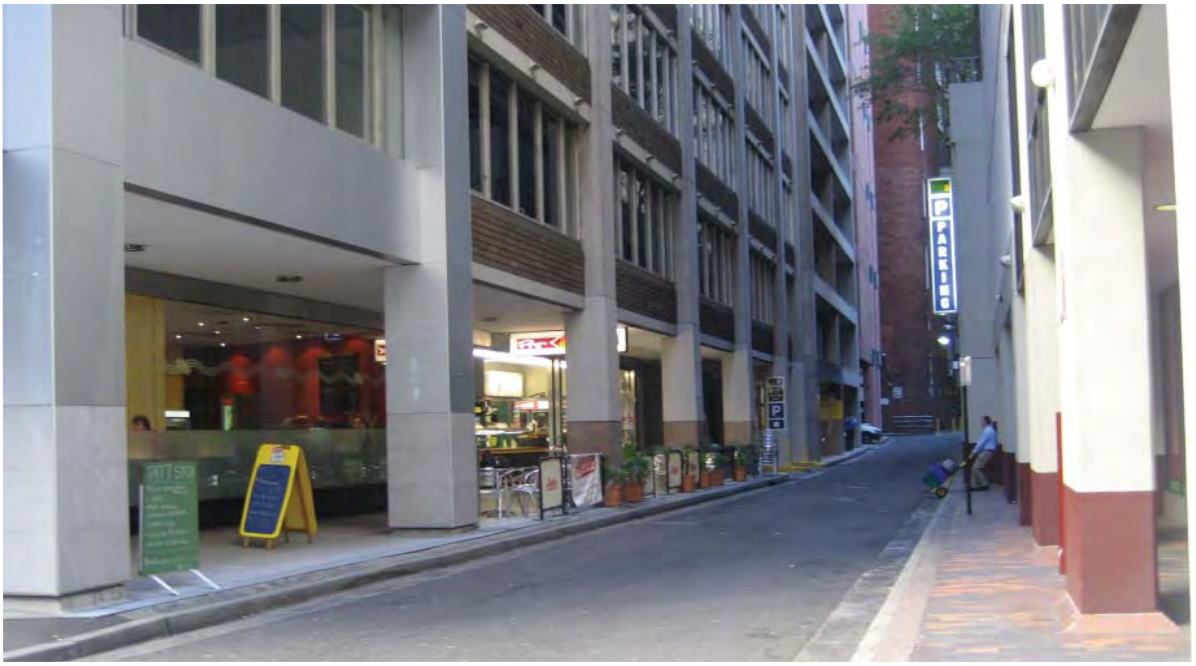
Data Source: Energy Australia: Aerial Imagery - 2010, CECT Data - 2010. Created by: qjchung

Underwood Street

Underwood Street is a narrow one-way road from Pitt Street to Dalley Street via a left-turn alignment and exits just west of the Dalley Street Zone Substation. The road currently provides access to the underground parking for the adjacent buildings and can potentially provide access for construction traffic from Pitt Street to Dalley Street.

Figure 13-3 shows a view of Underwood Street taken from the intersection with Pitt Street.

Figure 13-3 Underwood Street looking west from Pitt Street



Riley Street

Riley Street is a two-way road with generally one lane per direction, a designated cycle lane and adjacent parking on both sides (see Figure 13-4).

The posted speed limit is 40 km/h. Riley Street intersects with Albion Street at a signal-controlled intersection. The main construction compound for Stage 2D would be located on the corner of Albion and Riley Streets. Riley Street is the primary street frontage for the site, however there is a secondary frontage to Albion Street.

Figure 13-4 Riley Street, looking south from the project site

Figure 13-5 Riley Street construction site viewed from the southwest corner of the intersection of Albion Street and Riley Street

Riley Street currently carries approximately 6,000 vehicles per day with an estimated peak hour volume of 550 vehicles per hour. It connects to Oxford Street on its northern end and Devonshire Street on its southern end, as shown in Figure 13-6.

Albion Street

Albion Street is a one-way (eastbound) road with generally two central lanes, a bus lane on the north side and adjacent parking lane on the south side. The posted speed limit is 50 km/h. Albion Street connects to Elizabeth Street at the western end and Flinders Street on the eastern end. Intersections at both ends are signal-controlled, as are the intersections of Albion Street with Riley, Crown and Bourke Streets.

Albion Street currently carries approximately 10,000 – 11,000 vehicles per day with a peak hour volume of around 960 vehicles/hour in the AM peak and 1100 in the PM peak.

Little Albion Street

Little Albion Street is located to the south of the Surry Hills Substation. It is a one-way street with a single travel lane and 1 hour parking on the southern side. The western part of Little Albion Street is predominantly residential land use, while the eastern end includes land uses such as Frog Hollow Reserve, a church, commercial property, and EnergyAustralia's Surry Hills Substation and Annex.

Little Albion Street is accessed via Ann Street, Wade Place and Little Riley Street.

Yurong Parkway

Yurong Parkway has one lane in each direction and links William Street in the south with St Marys Road in the north. On-street parking is limited to six spaces adjacent to the KU Phillip Park Children's Centre. Yurong Parkway coveys very low volumes of traffic and provides access to the Children's Centre as well as residential properties to the east, while the Domain is located to the west.

Yurong Parkway is accessed via a left turn from William Stre

Figure 13-6 Road network surrounding Riley Street construction site

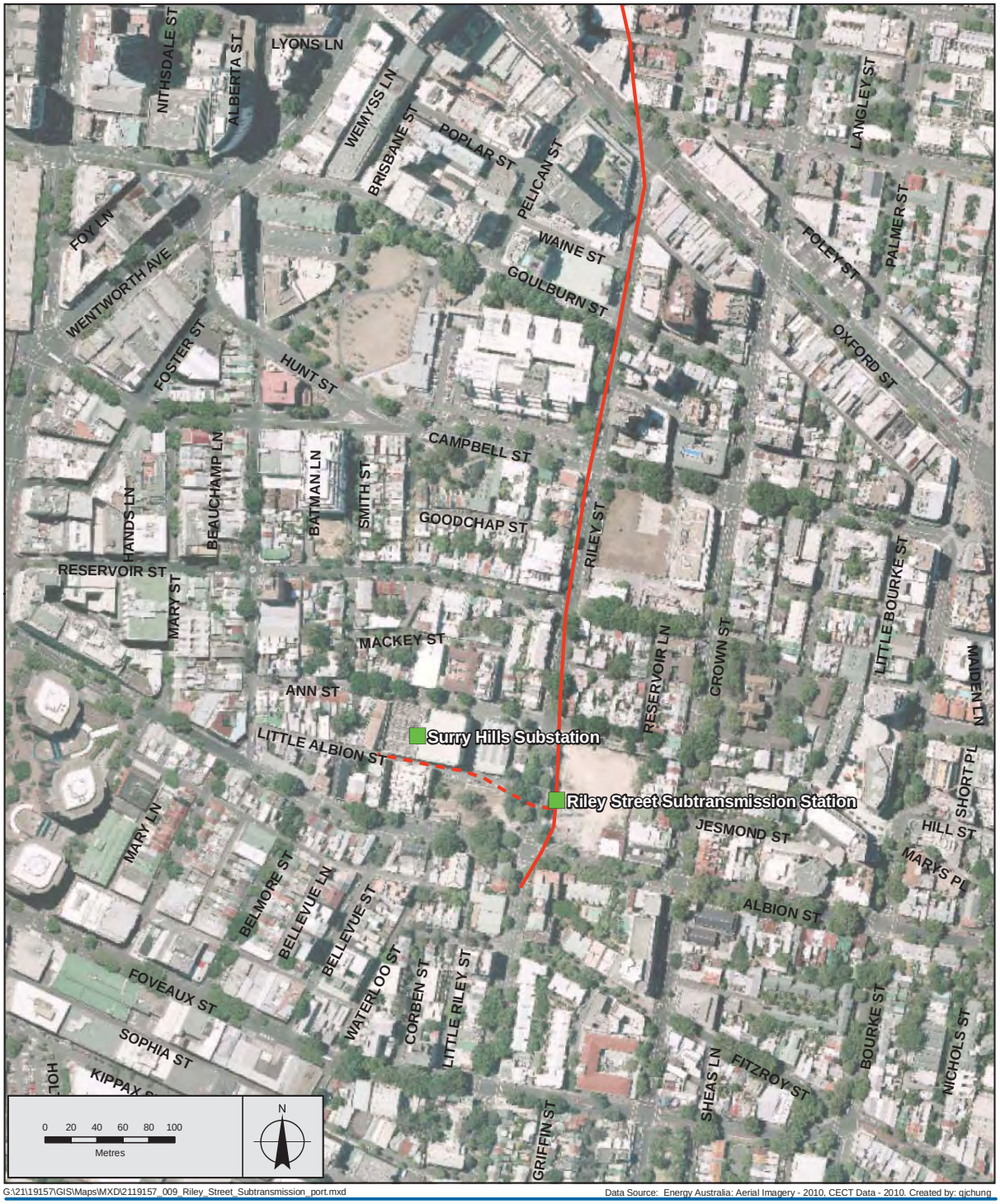


Figure 13-7 Albion Street looking east from the intersection with Riley Street

13.1.2 Site accessibility

Vehicle access to the Riley Street site would be provided from Riley Street.

Access to Little Albion Street is via Commonwealth Street, Ann Street, and Little Riley Street, while egress is to Commonwealth Street.

Access to Yurong Parkway is via left turn from William Street, while egress is to William Street, St Marys Street or Sir John Young Crescent.

Access to Dalley Street is via a left turn in from George Street, or a right turn into Underwood Street from Pitt Street. Egress is via right turn into Pitt Street.

13.1.3 Bus routes

Public transport in the vicinity of the Riley Street site is restricted to bus routes along Albion Street which is an important west-east bus corridor through the Sydney CBD.

There are no bus routes or bus stops along Riley Street.

The Albion Street corridor is a major bus route for outbound buses from Central Station. Bus routes using this corridor include routes 339, 374, 376, and 391. The bus routes pass through Eddy Avenue, cross Elizabeth Street, then to Albion Street before heading to the east via Flinders Street and segregated bus lanes along Anzac Parade.

For the northern section of the CBD where the Dalley Street substation zone compound is located, the major north-south bus corridors from Circular Quay include George Street and Pitt Street. There are no bus stops in the immediate vicinity of Dalley Street.

There are no bus routes along Little Albion Street or Yurong Parkway.

Figure 13-8 shows these bus routes in the vicinity of the Riley Street compound site and Dalley Street Substation.

Figure 13-8 Bus routes in the vicinity of Riley Street and Dalley Street compounds

Source: http://www.sydneybuses.info/uploads/File/pdfs/terminus_maps/Cityguidemap.pdf

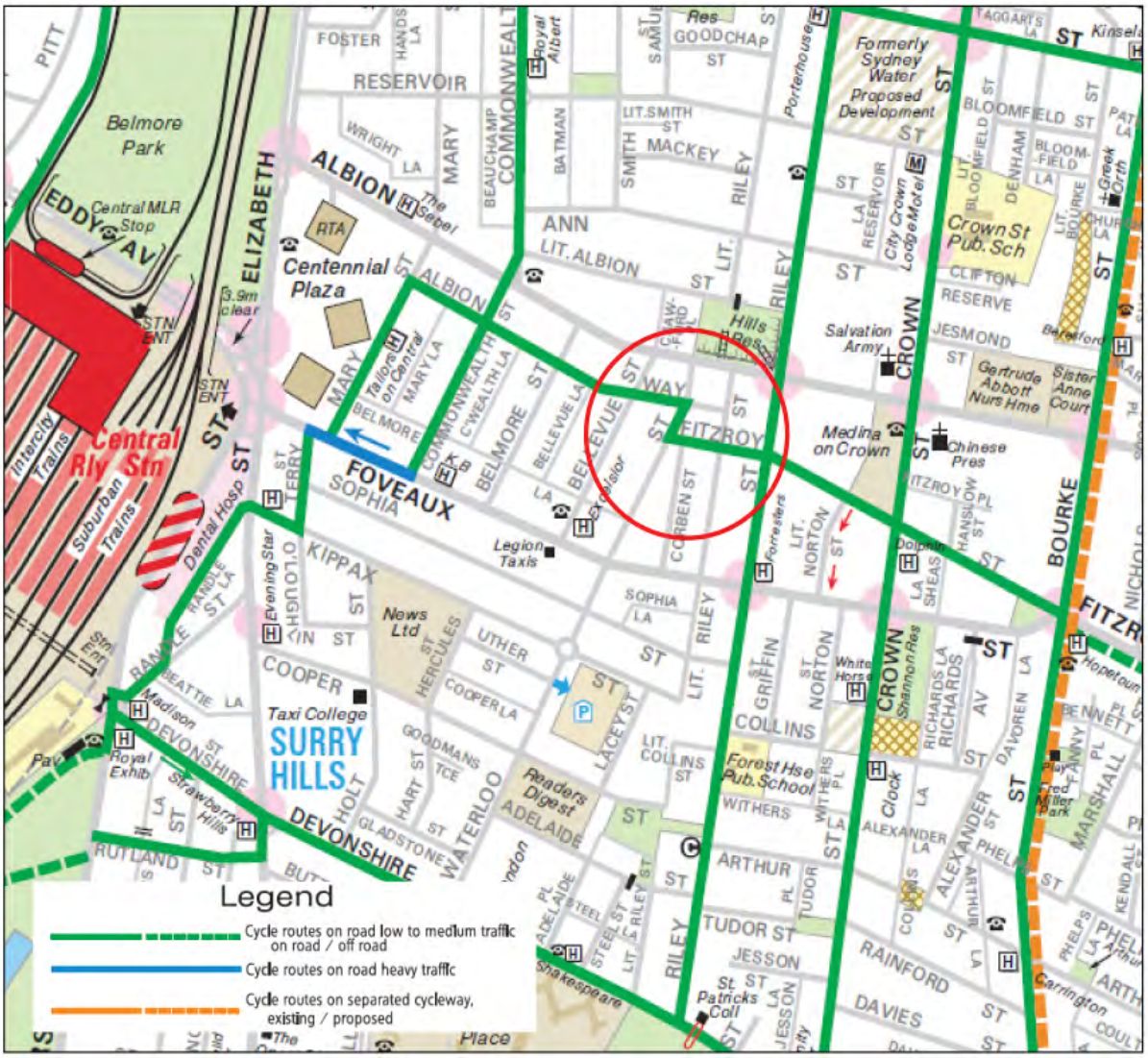
13.1.4 CityRail stations

The Riley Street site is located about 450 m east of Central Railway Station, while the Dalley Street site is about 350 m south of Circular Quay Railway Station, and about 500 m north of Wynyard Station.

13.1.5 Bicycle network

Riley Street is a designated on-road cycle route in the City of Sydney Council's bicycle network and links the on-road routes along Devonshire Street towards Campbell Street. Other designated on-road cycle routes in the vicinity of the site include Crown Street and Fitzroy Street. Designated bicycle routes in the vicinity of the Riley Street compound are shown in Figure 13-9.

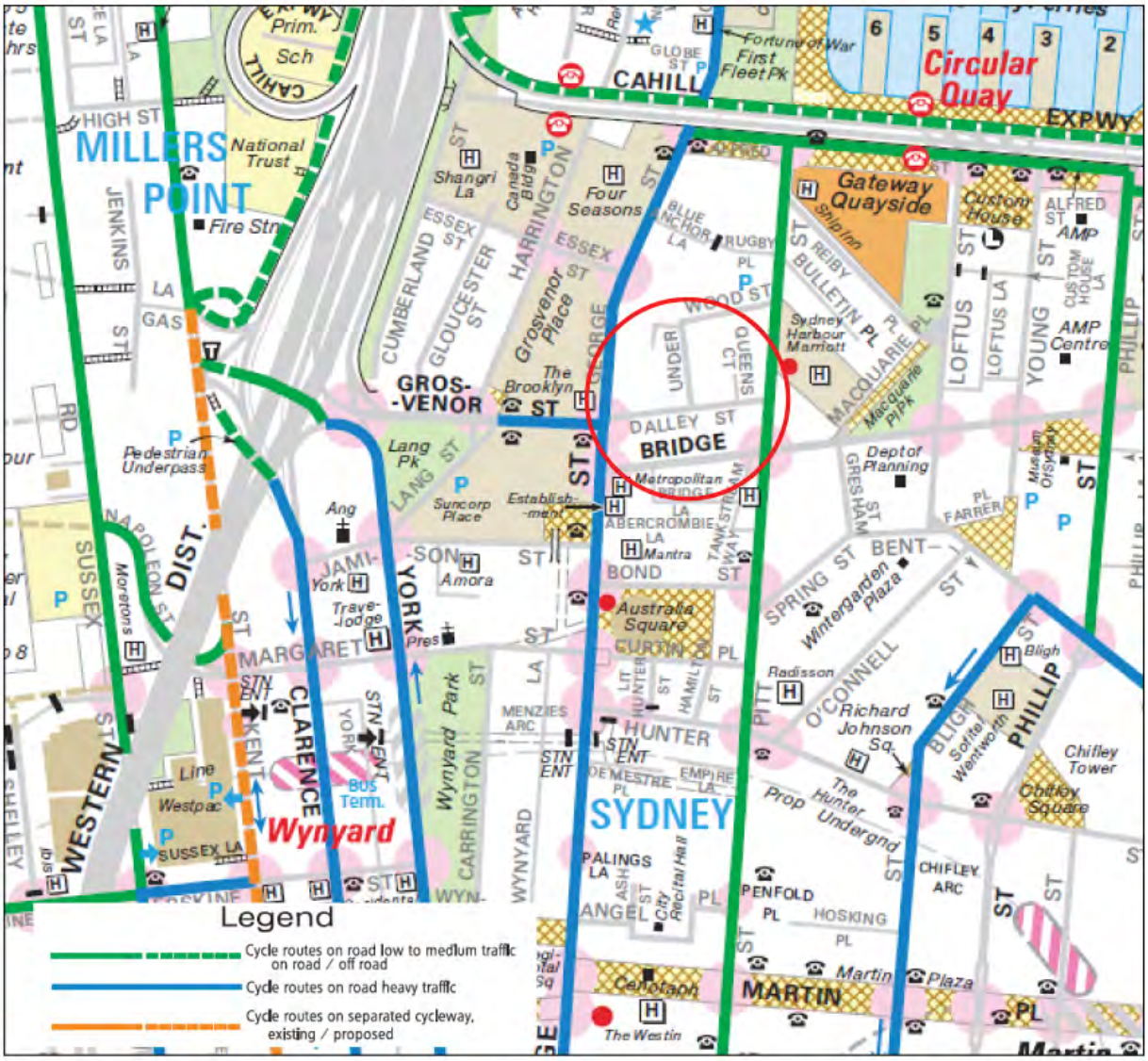
Figure 13-9 Designated bicycle routes in the vicinity of the Riley Street construction compound



Source:http://www.cityofsydney.nsw.gov.au/AboutSydney/documents/ParkingAndTransport/Cycling/CoSCycleMap.pdf

Designated bicycle routes in the vicinity of the Dalley Street compound are shown in Figure 13-10 and include George Street and Pitt Street. These routes link the on-road routes along Alfred Street to the north and King Street to the south.

Figure 13-10 Designated bicycle routes in the vicinity of Dalley Street



Source:http://www.cityofsydney.nsw.gov.au/AboutSydney/documents/ParkingAndTransport/Cycling/CoSCycleMap.pdf

13.2 Impact assessment

13.2.1 Overview

Construction staging and operation

As discussed in Section 6.4, construction activities are identified in five stages and anticipated to occur over a period of 39 months. Construction hours for the project would vary depending on the works and it is anticipated that tunnelling works would be undertaken continuously over a 24 hours period as detailed in Section 6.3.7.

Traffic volumes generated by the construction employees and by materials delivery would vary depending on the construction phasing.

Construction access

Riley Street construction compound and Dalley Street are the only locations where substantial surface works would be undertaken as part of Stage 2D that have the potential to directly impact on the traffic network. Construction of the shafts in Little Albion Street and Yurong Parkway would also involve works within carriageways that would impact on traffic movement for short periods of time.

Connections to the Surry Hills Substation, City North Zone Substation and proposed City East Zone Substation would involve subsurface works.

Traffic generation

The main traffic generated through the construction phase would be from equipment and material deliveries, such as:

- Delivery of construction materials;
- Spoil removal;
- Delivery and removal of construction equipment and machinery; and,
- Movement of construction personnel, including contractors, site labour force and specialist supervisory personnel.

Light vehicle traffic

Light vehicle traffic movements would generally be associated with staff and visitors accessing the site. Staff would comprise project management, various trades, and general construction staff. Over the full construction period, the peak construction workforce is estimated to be approximately 100 staff. It is assumed that the traffic generation would be influenced by the availability of on-site parking spaces. The Riley Street compound would contain limited on-site parking. It is estimated that approximately 5 to 10 on-site parking spaces would be provided to accommodate construction staff, works vehicles and visitor parking with the site area. Moreover, long-term on-street parking in the vicinity of the site is limited while demand is high. Hence, construction staff may be discouraged from utilising on-street parking to minimise impacts on existing usage.

Considering the proximity of the site to various public transport services, staff would be encouraged to use public transport to reduce vehicle traffic generation to the site. It is estimated that approximately 10 daily car movements (or 20 trips per day) would be generated. Assuming all light vehicles arrive during the peak hour, this translates to 10 vehicles per hour (inbound in the AM and outbound in the PM).

Heavy vehicle traffic

Heavy vehicle traffic would mainly be generated by activities associated with the removal of spoil from tunnelling activities and other general construction waste for the various stages. The number of heavy vehicles has been estimated based on the volume of spoil which is expected to be approximately 50,000 m^3 (in situ) or 125,000 tonnes.

Table 13-1 shows the expected number of truck movements at each location associated with each construction activity/source or stage as identified in Section 6.4. The majority of spoil would be generated during excavation of the tunnels.

Table 13-1 Indicative number of truck movements associated with spoil generation

Construction activity/source	Riley Street	Dalley Street
Stage 1 - Site establishment	4 truck movements per day	
Stage 2 – excavation of the Riley Street shaft	12 -16 truck movements per day	
Stage 3 and 5 – construction of the CECT and CSCT extension	20 -24 truck movements per day	4 truck movements per day

Table 13-2 Indicative additional number of vehicle movements (combination of light vehicles and trucks) associated with delivery of construction materials

Construction activity/source	Riley Street Construction Compound	Dalley Street Construction Compound
Stage 1 - site establishment	16-24 vehicle movements per day (combination of light vehicles and trucks)	
Stage 2 – excavation of the Riley Street shaft	16-24 vehicle movements per day (combination of light vehicles and trucks)	
Stage 3 and 5 – construction of the CECT and CSCT extension	16-24 vehicle movements per day (combination of light vehicles and trucks) 12-16 semi trailer movements to delivering segments per day	8-12 vehicle movements per day (combination of light vehicles and trucks)

Stage 4 involves installation of cable within the CSCT extension and would require a small number of vehicle movements that would be limited to heavy vehicles delivering cable drums and light vehicles used by the workforce. On average, it is anticipated that approximately eight daily vehicle movements during Stage 4, inclusive of both heavy and light vehicles.

Stage 5 includes installation of cables in the CECT and would involve similar numbers of vehicle movements to those in Stage 4.

In addition, equipment that would need to be brought to the site would entail heavy vehicle movements. At the Riley Street site, equipment could include:

- Piling rig;
- Excavator with rock breaker attachment;
- Mobile cranes;
- Ventilation fan;
- Loader;
- Haulage trucks;
- Road header (Mitsui S200);
- Rock bolting equipment (electric hydraulic underground drill rig – Sandvik DS310 or similar,
- Hand held pneumatic drills for the shaft);
- Workshop tools such as grinders and hammers for the tunnel boring machine; and
- Concrete trucks, pumps, and associated equipment.

The Dalley Street site would require the following equipment requiring heavy vehicle movements:

- Excavator;
- Mobile cranes;
- Ventilation fan;
- Loader;
- Haulage trucks, including those to remove redundant plant and equipment, such as switchgear;
- Piling rig (100t class piling rig Soilmec R930 or similar);
- Rock bolting equipment (handheld pneumatic drills); and
- Workshop tools (grinders and hammers).

The majority of heavy vehicle movements associated with the transport of equipment to the site would occur during the initial stage involving site preparation works and intermittently in between stages. Approximately 1-2 deliveries per day are estimated.

Oversize vehicle movements

In some instances, plant and equipment required for the project would be delivered using oversized vehicles and these traffic movements would be subject to relevant RTA road restrictions. Special arrangements would be made to ensure minimal disruption to traffic and that the appropriate signs and warning devices are displayed to maintain road safety. This may involve undertaking selected traffic movements outside standard construction hours to minimise impacts on the traffic network.

Estimated total vehicle movements

In summary, it is estimated that approximately 12 light vehicle movements per hour and 8 heavy vehicle movements per hour would occur during the peak hour for the Riley Street construction compound. For the Dalley Street site, there are estimated to be 6 light vehicle movements per hour and 4 heavy vehicle movements per hour occur during the peak hour.

Design construction vehicles

Ideally, the largest vehicle practicable would be used to minimise the number of truck movements. Given the constraints of the CBD access routes, safety and site constraints, it is likely that the standard vehicle used to remove spoil would be a single unit tipper truck able to carry 5 m^3. The RTA usually advises to avoid the use of truck and dog vehicles within the CBD. However, it is noted that there is a requirement for the use of semi-trailers to deliver large items of plant and machinery, as well as pre-cast tunnel segments, to the Riley Street compound. A semi trailer would have a capacity of about 12 m^3.

Indicative heavy vehicle routes

Designated access routes for heavy vehicles used for construction and spoil management would be along the arterial road network where practicable. Details of all routes used for access and haulage during construction would be developed in consultation with the City of Sydney and detailed in site specific traffic management plans that would be prepared as part of the Construction Environmental Management Plan (CEMP). Haulage routes to and from the site and the major road network would generally utilize designated heavy vehicles routes where possible.

Riley Street construction compound

The potential truck routes for the Riley Street site are outlined below and identified on Figure 13-11. Potential departure routes from the site include:

- To the South: Albion Street – Flinders Street – Eastern Distributor – Southern Cross Drive;
- To the East: Albion Street – Flinders Street – Anzac Parade;
- To/from the West: Riley Street – Oxford Street – Liverpool Street – Western Distributor; and
- To the North: Oxford Street – Liverpool Street – Western Distributor – Cahill Expressway.

Potential arrival routes to the site include:

- From the South: Southern Cross Drive – Eastern Distributor – Foveaux Street – Riley Street;
- From the East: Anzac Parade / Moore Park Road – Foveaux Street – Riley Street;
- From the West: Western Distributor – Harris Street - Goulburn Street – Riley Street; and
- From the north: Cahill Expressway – Crown Street – Oxford Street – Riley Street.

Figure 13-11 Indicative heavy vehicle routes for the Riley Street construction compound

Dalley Street

The potential truck routes for the Dalley Street site are outlined below and identified in Figure 13-12.

Potential departure routes from the site include:

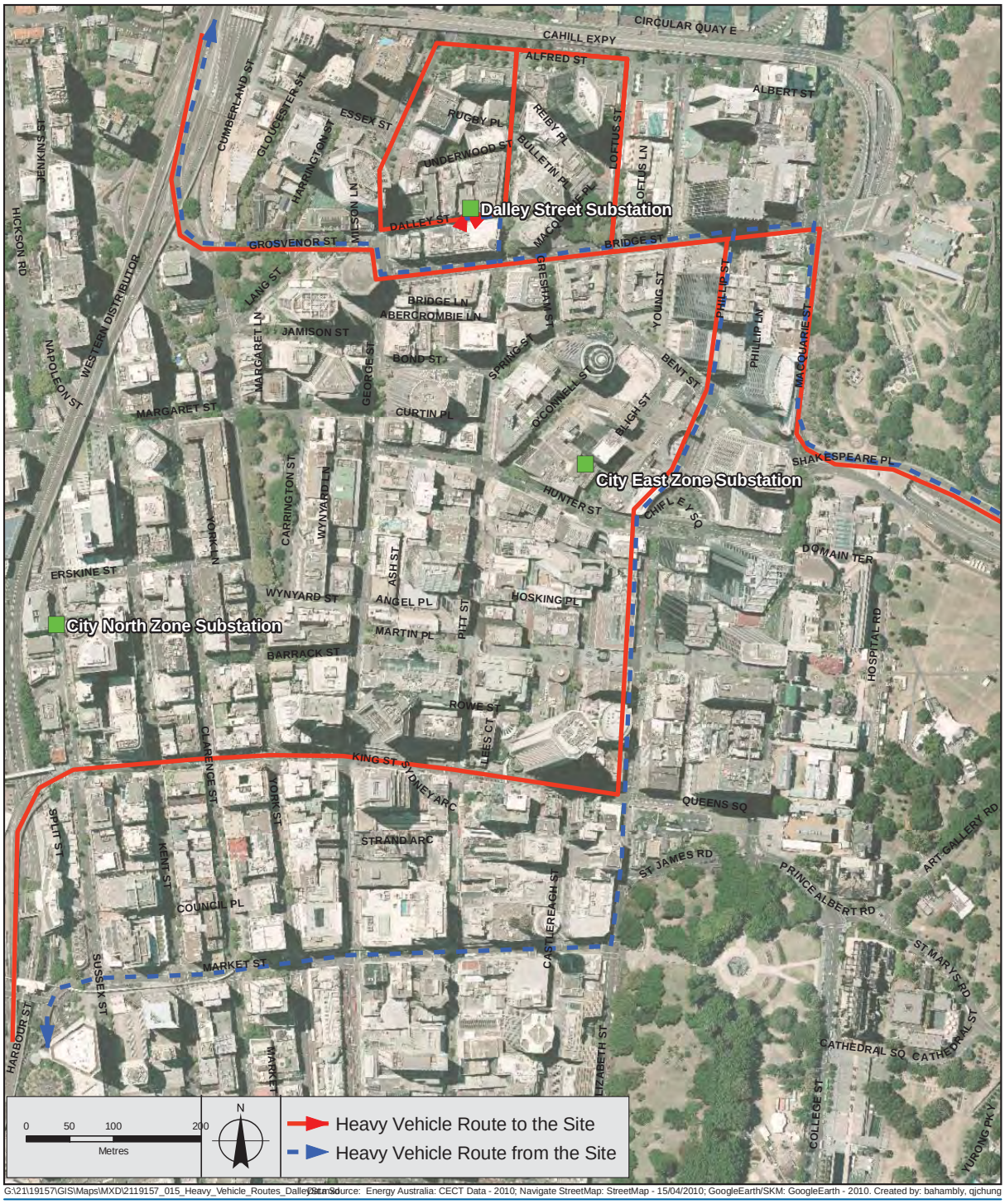
- To the South: Pitt Street – Bridge Street – Macquarie Street– Eastern Distributor;
- To the East: Pitt Street – Bridge Street – Macquarie Street – Eastern Distributor;
- To the West: Pitt Street – Bridge Street– Phillip Street – Elizabeth Street – Market Street – Western Distributor; and
- To the North: Pitt Street – Bridge Street – Grosvenor Street – Western Distributor – Cahill Expressway.

Potential arrival routes would be used under the current traffic arrangements and include:

- From the South: Southern Cross Drive – Eastern Distributor – Macquarie Street –Bridge Street - Loftus Street – Alfred Street — George Street – Dalley Street;
- From the East: Southern Cross Drive – Eastern Distributor – Macquarie Street – Bridge Street – Loftus Street – Alfred Street – George Street – Dalley Street;
- From the West: Western Distributor – King Street – Elizabeth Street – Bridge Street – Loftus Street – Alfred Street – George Street/ Pitt Street – Dalley Street; and
- From the north: Western Distributor – Grosvenor Street (or Cahill Expressway)– Bridge Street – Loftus Street – Alfred Street – Pitt Street – Dalley Street.

To minimise traffic that would need to use the intersections of Bridge Street with Albert Street and Bridge Street with Dalley Street, an alternate temporary route would be via Pitt Street (from Alfred Street) but this would require modification of the one-way control on Dalley Street and the temporary removal of on-street parking on Dalley Street.

Figure 13-12 Indicative heavy vehicle routes for the Dalley Street Substation



13.2.2 Distribution of traffic

For the purpose of this assessment, the following distribution is assumed:

- 20% - West via Western Distributor;
- 60% - South, and East via the Eastern Distributor; and
- 20% - North via the Cahill Expressway.

13.2.3 Impact assessment

Riley Street construction compound

The primary site for the construction activities for Stage 2D would be the Riley Street construction compound. All tunnelling would emanate from Riley Street and spoil generated during the tunnelling activities would be removed from the tunnels at this location.

Site access arrangements

As indicated in Figure 6-4, the main access and egress to the compound would be off Riley Street, just south of the intersection with Albion Street, and would be designed to accommodate the range of heavy vehicles required to access the site throughout the construction period. Pedestrian and traffic control devices would be implemented to ensure access and safety is maintained for all road and footpath users.

A work zone for construction vehicles would be established for the Riley Street frontage and would utilise the existing parking/traffic lane on the eastern side of the street.

Access to the construction site would require controlled and managed vehicle access to ensure that road safety is maintained at all times. The maximum estimated vehicle movements per day would comprise of 20 light vehicle movements (10 in and 10 out) for staff and visitors, 24 heavy vehicle movements (12 in and 12 out) for spoil disposal and 24 combined light and heavy vehicles (12 in and 12 out) for general deliveries plus an additional 16 semi-trailers per day (eight in and eight out) for deliveries of pre-cast segments of the tunnel during Stage 5 of the construction period. It is estimated that the likely peak hourly generation would be a maximum of eight heavy vehicle movements and 12 light vehicle movements, as shown in Table 13-3.

Table 13-3 Inbound and outbound traffic at key intersections adjacent to the Riley Street construction compound

	AM Peak		PM Peak	
	Inbound	Outbound	Inbound	Outbound
Light vehicle	10	2	2	10
Heavy vehicles for deliveries	2	2	2	2
Heavy vehicles for spoil disposal*	2	2	2	2
Total vehicles	14	6	6	14

**This assumes the stage works are not concurrent activities*

The average daily traffic volumes through the various road sections in the adjacent roads range from 6,000 vehicles per day (Riley Street) and 9,600 – 11,000 vehicles per day (Albion Street). The peak hour volumes are estimated to range from 500 - 1,100 vehicles per hour.

It is generally noted that the existing road network currently operates close to capacity during the midday business peak hour and the morning and afternoon peak hours. Previous assessments of the traffic conditions in the CBD have noted little spare capacity and congestion during peak periods.

In comparison, the additional traffic brought about by the construction represents a minor increase in existing traffic. The likely generation of the Stage 2D constitutes approximately 0.02-0.03% of the existing peak hour traffic on Riley Street (500 vehicles per hour) and Albion Street (1,100 vehicles per hour). This increase is expected to have an insignificant impact on the road sections and intersections in the surrounding areas of the site. Noting that the existing conditions are already close to capacity, it is unlikely that Stage 2D would result in a substantial additional adverse traffic impact.

Impact of partial and/or temporary road closures

Partial and/or temporary road closures along Riley Street or Albion Street may be required during some stages of construction to enable heavy vehicle manoeuvres and to accommodate construction procedures. Such closures would impact on the existing travel routes. Detour routes would be identified and appropriate advance notices, and warning signs would be provided to notify motorists of changes to the traffic conditions. An activity specific traffic management plan would be prepared to ensure appropriate measures are implemented.

Impact on parking

It is anticipated that temporary possession of kerbside parking may be necessary to provide suitable access to the construction site. Due to restricted space within the worksites, there may be requirements for some on road parking/waiting/unloading by construction traffic. Where this does not interfere with traffic lanes, such as where there is existing on-street parking, provision may be made for a dedicated construction zone. The contractor is expected to minimise the extent and number of these zones.

Impact on bus stops and bus routes

It is unlikely that the temporary changes to traffic conditions associated with the project would directly impact on operation of the nearest bus routes and bus stops which are located along Albion Street. Where necessary, consultation with the bus service provider and City of Sydney Council at an early stage would assist in identifying appropriate measures to minimise potential disruptions or temporary changes to the bus service.

Impact on pedestrians and cyclists

The Albion Street/Riley Street area is a potentially high pedestrian activity zone owing to its proximity to Central CBD and the nearby residential land use. There is the potential for short term delays to pedestrian access along Riley Street/Albion Street during vehicle access and/or egress to the Riley Street construction site. Hoardings would include overhead protection to ensure that pedestrian safety along the footpaths is maintained.

A pedestrian management plan would be developed as part of the Construction Environmental Management Plan (CEMP) to minimise potential impacts on pedestrian and cyclists movements. This would detail specific measures to be implemented to minimise impacts on pedestrian safety during activities such as vehicle access and egress to the construction sites. Riley Street is a designated on-road cycling route. Suitable detours would need to be investigated in detail and mitigation measures implemented to manage pedestrian and cycle movements near and around the construction site if changing to the existing arrangements are required.

Dalley Street

Surface works would be required in the immediate vicinity of the Dalley Street Zone Substation where a shaft would be excavated within Dalley Street to connect the substation to the CECT.

Dalley Street is one-way eastbound and exits to Pitt Street where traffic flow is one-way southbound. Access to Dalley Street would be via George Street on the western end of Dalley Street. Dalley Street could also be accessed via Underwood Street. Vehicles would exit Dalley Street via the intersection with Pitt Street.

Site access arrangements

Access to the construction site would require controlled and managed vehicle access to ensure that road safety is maintained at all times. The maximum estimated vehicle movements per day at the Dalley Street site would comprise of 10 light vehicle movements (five in and five out) for staff and visitors and four heavy vehicle movements (two in and two out) for spoil disposal and 12 combined light and heavy vehicles (six in and six out) for general deliveries during Stage 5. It is further estimated that the likely peak hourly generation would be a maximum of four heavy vehicle movements and six light vehicle movements, as shown in Table 13-4.

Table 13-4 Inbound and outbound traffic at key intersections adjacent to the Dalley Street construction compound

	AM Peak		PM Peak	
	Inbound	Outbound	Inbound	Outbound
Light vehicle	5	1	1	5
Heavy vehicles for deliveries	1	1	1	1
Heavy vehicles for spoil disposal*	1	1	1	1
Total vehicles	7	3	3	7

**This assumes the stage works are not concurrent activities*

It is generally noted that the existing road network currently operates close to capacity during the midday business peak hour and the morning and afternoon peak hours. Previous assessments of the traffic conditions in the CBD have noted little spare capacity and congestion during peak periods.

In comparison, the additional traffic brought about by the construction represents a minor increase in existing traffic. The likely traffic generated by Stage 2D constitutes less than 0.01% of the existing peak hour traffic on Pitt Street/George Street. This increase is expected to have an insignificant impact on the road sections and intersections surrounding the site. Noting that the existing conditions are already close to capacity, it is unlikely that Stage 2D would result in a substantial additional adverse traffic impact.

Impact of partial and/or temporary road closures

The shaft at Dalley Street would be constructed within the roadway and partial and/or temporary road closures would be required during some stages of construction to enable heavy vehicle manoeuvres and to accommodate construction procedures. Such closures would impact on the existing travel routes. Detour routes would be identified and appropriate advance notices, and warning signs would be provided to notify motorists of changes to the traffic conditions. An activity specific traffic management plan would be prepared to ensure appropriate measures are implemented.

Impact on access routes

Dalley Street is currently only able to be accessed from George Street, which is a very busy intersection, or Underwood Street, which is a narrow street. Right hand turns from Pitt Street into Dalley Street are not permitted under the existing traffic control provisions.

The Pitt Street intersection may be also used as an alternative access to Dalley Street to minimise the use of George Street. This arrangement would require temporary conversion to two-way traffic of Dalley Street and the temporary removal of kerbside parking at the eastern end of Dalley Street.

Impact on parking and access to underground car parks

It is anticipated that temporary possession of kerbside parking may be necessary to provide suitable access to the construction site. Due to restricted space within the worksite, there may be requirements for some on road parking/waiting/unloading by construction traffic. Where this does not interfere with traffic lanes, such as where there is current parking, provision may be made for a dedicated construction zone. The contractor is expected to minimise the extent and number of these zones.

It is estimated that around five kerbside parking spaces may be utilised for construction vehicles in front of the construction site. Access to the underground car parks would be maintained and by implementing traffic management measures access is provided. This may also require the temporary removal of kerbside parking along Dalley Street.

In addition, to ensure the safety of the vehicles to and from the carparks, installation of additional traffic mirrors may be required to provide a better view of vehicle movements along Dalley Street.

Impact on bus stops and bus routes

It is unlikely that the temporary changes to traffic conditions associated with the project would directly impact on operation of the nearest bus routes and bus stops which are located along George Street and Pitt Street. If necessary, consultation with State Transit Authority at an early stage would assist in identifying appropriate measures to minimise potential disruptions or temporary changes to the bus service.

Impact on pedestrians and cyclists

The northern portion of the Sydney CBD is a high pedestrian activity zone, and there is the potential for short term delays to pedestrian access along George Street/Pitt Street during vehicle access and/or egress to the Dalley Street construction site. Hoardings would include overhead protection to ensure that pedestrian safety along the footpaths is maintained.

A pedestrian management plan would be developed as part of the Construction Environmental Management Plan (CEMP) to minimise potential impacts on pedestrian and cyclists movements. This would detail specific measures to be implemented to minimise impacts on pedestrian safety during activities such as vehicle access and egress to the construction sites. George Street and Pitt Street are also designated on-road cycling routes. Suitable detours would need to be investigated in detail and mitigation measures implemented to manage pedestrian and cycle movements near and around the construction site.

Little Albion Street and Yurong Parkway

Construction of the shafts in Little Albion Street and Yurong Parkway would take one to two months and would require a partial closure of these streets. In the case of Little Albion Street, traffic controls would be implemented to ensure road safety is maintained and vehicles can continue to circulate via Ann Street, Crawford Place and Little Albion Street (which is a one-way street).

At Yurong Parkway, two way traffic flow would be provided under traffic controls that would be implemented to ensure road safety is maintained.

Given the small number of vehicles that utilise Little Albion Street and Yurong Parkway, these impacts are considered to be minor and able to be managed by implementing appropriate traffic control measures and consulting with the local community.

13.3 Mitigation measures

Traffic management issues would be addressed with the preparation of a Traffic Management Plan as part of the CEMP. An event specific Traffic Management Plan would also be prepared if there are any special events in the CBD that would potentially be impacted by traffic movements associated with the project. The timing and duration of these events would be clearly noted and construction delivery processes would be rearranged to cater to the affected days.

A number of mitigation measures would be implemented to ensure that transport and traffic impacts arising from the project are minimised. These measures would be incorporated into a Traffic Management Plan for the project and be developed in consultation with RTA and City of Sydney Council.

A community information and awareness program would be initiated prior to construction commencing and during the construction period to ensure that the local business establishments in the area are fully aware of the construction activities. This would involve providing information on construction traffic movements associated with the project.

The awareness program shall identify communication protocols for community feedback on issues relating to construction vehicle driver behaviour and construction related matters.

Additional measures that would be part of the Traffic Management Plan include:

- In consultation with RTA and Council, develop Traffic Control Plans for each site. This would include general signposting in the immediate vicinity of the construction sites with appropriate heavy vehicle and construction warning signs;
- Consultation with businesses adjacent to Dalley Street, particularly those with underground car parks, to ensure that the plan includes management measures to maintain access to these car parks throughout construction;
- Consultation with landholders in the vicinity of the shafts in Little Albion Street and Yurong Parkway to ensure that traffic control measures provide an appropriate level of access;
- Development of a suitable vehicle detour route, if required during specific construction activities;
- Installation of specific signs at entrances to the construction site to warn road users of entering and exiting construction traffic;
- Distribution of day warning notices to advise local road users of scheduled construction activities, road closures, detours, etc.;
- Installation of appropriate traffic control and warning signs for areas identified where potential safety risk issues exist;
- Preparation of a pedestrian management plan;
- Management of the transportation of construction materials to maximise vehicle loads and minimise vehicle movements; and
- Inducting truck and vehicle operators on the requirements of the Traffic Management Plan.

14. Air quality

14.1 Existing environment

14.1.1 Air quality

Air quality in the CBD is considered to be typical of a highly developed residential and commercial area and the main emissions that affect quality are related to traffic along major arterial roads, dust, and smoke from bushfires elsewhere in the region on occasion. Pollutants that are potentially harmful to humans include carbon monoxide, ozone, nitrous oxides, sulphur dioxide, and total suspended particles (TSP) (including PM_{10} – particles less than 10 microns in size). In Sydney, the largest source of oxides of nitrogen (NO_X) emissions is on-road vehicles, which contribute over 71% of total NO_X emissions. Road traffic is the main source of pollutants in the study area.

The DECCW operates a network of air quality monitoring stations and the two closest to the CBD are located at Randwick and Rozelle. Monitoring results from these two locations between the year 2000 – 2008 are summarised in Table 14-1 and indicate that air quality generally complied with DECCW's air quality goals. The one hour average ozone goal of 10 parts per hundred million (pphm) was exceeded during three of the years at Randwick and in one year at Rozelle. The PM_{10} 24 hour average goal of 50 micrograms per cubic metre (ug/m^3) was exceeded in three years at Rozelle and one year at Randwick.

Table 14-1 Summary of air quality data for the Randwick and Rozelle monitoring stations

	Sulphur dioxide (pphm)		Nitrous oxides (pphm)		Ozone (pphm)		PM_{10} (ug/m^3)		Carbon dioxide (ppm)	
	Randwick	Rozelle	Randwick	Rozelle	Randwick	Rozelle	Randwick	Rozelle	Randwick	Rozelle
DECCW goal	20 (Maximum 1 hour average)		12 (Maximum 1 hour average)		10 (Maximum 1 hour average)		50 (24 hour average)		9 (Maximum 8 hour average)	
2000	2.7	NA	6.6	7.0	8.7	8.0	NA	NA	NA	4.5
2001	3.6	NA	6.5	6.6	11.4	11.5	NA	NA	NA	3.2
2002	2.4	NA	5.4	8.6	13.9	10.0	NA	NA	NA	2.8
2003	3.5	NA	5.5	5.2	7.9	8.3	NA	NA	NA	2.2
2004	2.4	NA	5.7	6.4	11.0	9.4	NA	54.1	NA	2.2
2005	2.5	NA	6.3	5.2	9.6	8.1	NA	46.8	NA	2.1
2006	4.3	NA	6.0	5.7	8.3	9.3	NA	50.3	NA	2.0
2007	3.6	NA	4.5	5.0	9.0	8.8	71.2	54.4	NA	1.8
2008	2.9	NA	4.1	4.0	6.1	5.6	36.3	43.1	NA	1.3

Source: DECCW data from air quality index for Randwick and Rozelle

14.2 Impact assessment

14.2.1 Construction

Potential impacts on air quality during Stage 2D are related to dust in general and PM_{10} in particular. These impacts would be limited to the immediate vicinity of the Riley Street construction compound and Dalley Street Zone Substation. DECCW's assessment criteria are a maximum annual increase in deposited dust of 2g/m^2 per month above background levels. The maximum total dust deposited from any source during a 24 hour period should not exceed 4 g/m^2 over a 12 month period. The PM_{10} 24 hour limit is 50 ug/m^3.

Dust at the Riley Street construction compound

Dust would be generated during a range of activities associated with excavation, tunnelling and materials handling and has the potential to impact on the amenity of surrounding receivers that include residential and commercial land uses.

Environmental effects of airborne particulate matter (dust) are generally related to the particle size range of the dust. Health effects are associated with fine particles less than 10 micrometres in equivalent aerodynamic

diameter, whereas coarser particles (10 - 100 micrometres) are associated with effects on amenity such as visible dust plumes or deposition on surfaces. As a dust plume is transported downwind from a source, the coarser particulates progressively drop-out of the air column to deposit on surfaces (land, buildings, cars etc) downwind of the source, while the finer particulate fractions are retained in the air column longer by turbulent mixing. Wind erosion or dust lift-off can become significant under strong winds (greater than 5 m/s).

The amount of dust generated would be dependent on the type of construction activity undertaken and the prevailing weather conditions. There is a risk that dust may impact on the amenity of the surrounding areas if appropriate controls are not implemented.

Excavation of the CECT would use a tunnel boring machine. A cooling fluid that is mainly water would be used to reduce the amount of dust generated. Excavation of the CSCT tunnel extension would use a road header that would generate dust at the working face and during handling and transport of spoil material.

To minimise dust impacts associated with the tunnel boring machine, road header, and handling and transport of spoil, the tunnels would be fitted with mechanical ventilation systems to filter the air and remove dust particles prior to the air being discharged from the tunnels. The filtration system would be designed to limit dust emissions to acceptable levels and meet the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2002* (as amended). This would ensure clean air is available to workers within the tunnel and minimise the potential for offsite impacts associated with dust. The outlet for the ventilation system at the Riley Street construction compound would be oriented to ensure that discharges do not impact on sensitive receivers.

The Riley Street construction compound would feature an acoustic enclosure extending over the shaft used to access the tunnels. As tunnelling proceeds, spoil would be removed from the shaft using a gantry crane and either loaded directly into trucks or temporarily stockpiled within the enclosure. While the primary purpose of the acoustic enclosure is to minimise noise impacts due to spoil management and operation of plant and machinery associated with the tunnelling equipment, it would also contain dust generated when spoil is removed from the shaft and loaded into trucks. The enclosure would be fitted with a ventilation system to ensure that air quality meets occupational health and safety requirements for the construction workforce.

Trucks transporting spoil would be covered to minimise dust generated during transport to the disposal site.

Dust from general construction activities associated with use of the site is likely to be negligible as the majority of the site would be sealed surfaces and hoardings would be installed around the perimeter of the site.

Provided that the recommended mitigation measures are implemented, it is considered that potential dust emissions would be negligible and have localised impacts that are likely to comply with DECCW's assessment criteria. These impacts are unlikely to affect the amenity of the surrounding receivers which include residences and commercial land uses.

Dust at the shaft locations

Dust would be generated during construction of the shafts and general construction activities in Dalley Street, Little Albion Street and Yurong Parkway. Impacts at these locations are considered to be minor and short term given that:

- A small surface area would be disturbed (about 25 m^2);
- Spoil volumes would be small. Material would be removed from site and transported to the disposal location on a regular basis; and
- There are few sensitive ground level receivers in the immediate vicinity of the shaft locations. While there are surrounding commercial and recreational land uses, management measures would be implemented to mitigate impacts. It is unlikely that dust would materially impact on the amenity of the surrounding land uses.

Combustible emissions

Operation of construction plant, equipment and vehicles would generate combustible emissions that contain substances such as oxides of nitrogen (NO_X), fine particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO) and sulfur dioxide (SO_2). At the peak of construction activity for the project a tunnel boring machine, delivery vehicles, spoil trucks, semi-trailers (for deliveries of pre-cast concrete tunnel segments), grout machine, gantry crane, front-end loader, excavator, dump truck and general tools and equipment may be operating simultaneously. In comparison to emissions from similar sources in the CBD, emissions are considered to be insignificant and would be readily dispersed by the prevailing winds.

14.2.2 Operation

The CECT and CSCT extension would be fitted with ventilation systems to manage air quality impacts during operations. Operation of the cables would increase air temperatures within the tunnels above ambient conditions and the purpose of the ventilation system is to regulate the temperature within the tunnel if necessary. Aside from elevated temperature, the air would be clean and unlikely to contain contaminants that are likely to impact on air quality.

The final form of the ventilation system would be determined during detailed design, however it is likely to be mechanically ventilated and controlled from the tunnel control room, located at EnergyAustralia's Campbell Street Substation. Ventilation fans would be located at the Riley Street shaft. Air would be delivered into the tunnel via the air intake grills which would be located within the Riley Street shaft. Air would be exhausted at the City North Zone Substation.

There is an existing ventilation shaft at the City North Substation located approximately 20 m above street level. The exhaust shaft has been integrated into the design of the City North Substation building and was designed to accommodate the requirements of the CECT.

The mechanical ventilation system would be operated when personnel access is required or when high temperatures are recorded. It would also be operated periodically to purge air from the tunnels, and test and maintain the ventilation equipment.

The ventilation system would be designed to have the capacity to efficiently remove smoke from the tunnel in the unlikely event of a fire.

14.3 Mitigation measures

14.3.1 Construction

A construction air quality management plan would be prepared as part of the CEMP and would include the following measures to manage potential impacts on air quality:

- During tunnel construction, all air would be ventilated through a filter unit such that discharged air meets the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2002* (as amended). A similar ventilation system would also be used to manage dust within the acoustic enclosure. The ventilation systems would be designed such that exhausts do not discharge directly to sensitive receivers;
- Vehicles and construction plant/equipment would also be maintained in good condition and regularly serviced so that vehicular emissions remain within air quality standards set by the DECCW;
- Exposed surface areas would be managed via dust mitigation measures;
- Wheels of all site plant and vehicles would be cleaned so that material with potential to generate dust is not spread on surrounding roads;
- Sealed roads around construction sites would be swept to remove deposited material with the potential to generate dust, if necessary;
- If required, water would be used to suppress dust generated during site establishment, such as the erection of barriers, screens and other ancillary structures;
- Water may be used to suppress dust emissions during dry windy periods (as required);
- The height from which dust generating material is dropped would be minimised;
- Loaded trucks carrying spoil would be covered at all times;
- Cutting/grinding of materials on site would be kept to a minimum, but if necessary equipment and techniques to minimise dust would be used;
- Earthworks would be kept damp, as required, especially during dry weather;
- Spoil stockpiles would be damped as necessary;
- Potentially dusty materials would be handled as little as possible;

- Construction plant and vehicles would be well maintained and regularly serviced. Visible smoke from plant would be avoided. Defective plant would not be used;
- Engines would be switched off when vehicles are not in use and refuelling areas would be away from areas of public access; and
- Where practicable and feasible, loading and unloading would take place within the site.

14.3.2 Operation

As the tunnel would be ventilated, adverse operational air quality impacts are unlikely and additional management measures are not considered to be required.

15. Water quality

15.1 Existing environment

15.1.1 Surface water

Water quality in Sydney Harbour

There are no surface water courses within the study area and runoff is directed to the existing stormwater system. The Dalley Street site is located within the Bennelong drain catchment which has an area of approximately 72 hectares and is bounded by Clarence Street to the west, Bathurst Street to the south, Macquarie Street to the east, and Sydney Harbour to the north. Sydney's CBD stormwater drainage system consists of a series of drains aligned in a north-south direction. Stormwater runoff generally flows in a northerly direction until it reaches Alfred Street at Circular Quay. At Alfred Street, the drainage system branches into three outlets, two of which discharge to Circular Quay and the third and largest discharges at Bennelong Point.

The drainage characteristics of these catchment areas have been heavily modified by urban development and there are no natural drainage lines remaining. Water quality in Sydney Harbour is typical of an urbanised catchment. It is likely that a number of port and non-port related activities including accidental spills and polluted stormwater run-off from land combine to affect water quality. This includes sediment in runoff from construction and maintenance activities and litter and other contaminants such as oil from the catchment.

Water quality within Sydney Harbour is heavily influenced by runoff following large rain events. Runoff from urban areas is generally contaminated with sediment, nutrients, hydrocarbons, heavy metals, pathogens, and other toxic, and occasionally persistent chemicals (DEC, 2006). This contamination originates from roads, sewer overflows, spills, industrial activities, building sites and other sources. Water quality is comparatively better during drier periods with reduced volumes of runoff.

Cockle Bay

Cockle Bay is one of a number of small bays that together form Sydney Harbour. It is located immediately west of the CBD and is commonly referred to as Darling Harbour.

The Riley Street site lies within a stormwater catchment that discharges to Sydney Harbour via Cockle Bay. Cockle Bay has a catchment of about 3,200 ha and includes parts of the CBD, surrounding high density residential and commercial areas, wharves, and recreational areas.

Water quality within Cockle Bay is frequently poor, particularly following rainfall, as a result of the combined influences of runoff from a highly developed catchment, sewage contamination, recreational and commercial water traffic and relatively low rate of tidal flushing (SKM 2005). A summary of water quality in Cockle Bay is provided in Table 15-2.

15.1.2 Groundwater

Groundwater levels

Piezometers were installed in four boreholes drilled as part of the geotechnical investigations for the project by PSM (2009). The results are summarised in Table 15-1 and indicate that the depth of the groundwater table varies along the alignment.

Table 15-1 Summary of groundwater levels

Borehole	Location	Water level
CECT 1	Near the intersection of Grosvenor and Gloucester Streets	-5.66mRL
CECT 3	Gresham Street	-0.24 mRL
CECT 7	Near Sir John Young Crescent	6.06 mRL*
CECT 10	Riley Street construction compound	25.40 mRL

** Result indicates water is located at the top of rock. PSM consider the result likely to be influenced by water in the overlying soils rather than within the rock itself. This is probably a result of a poor seal in the rock/soil zone, or that geological features are influencing water levels in the upper part of the rock profile.*

Shallow, perched groundwater tables may be present in the fill and alluvial deposits in and around the vicinity of paleovalleys of Sydney Cove, Farm Cove and Woolloomooloo Bay. A deeper groundwater table exists in the Hawkesbury Sandstone.

The existence of separate groundwater systems within alluvial deposits and bedrock has been confirmed by groundwater monitoring during construction of other tunnels in the CBD, including the City South Cable Tunnel (PSM, 2009).

Groundwater chemistry

Groundwater monitoring has been undertaken for a number of tunnelling projects in the CBD, including EnergyAustralia's City West Cable Tunnel and City South Cable Tunnel. Groundwater chemistry was tested as part of geotechnical investigations for the CECT and the results indicate that it is similar to that recorded during construction of the Cross City Tunnel, City South Cable Tunnel, City West Cable Tunnel, and the City North Zone Substation (PSM, 2009).

Groundwater is considered to be of relatively good quality, however it contains elevated concentrations of iron and manganese. Poor groundwater quality was encountered in the Haymarket area during construction of the City South Cable Tunnel and toward the southern end of the City West Cable Tunnel alignment. This water was associated with flows from the Great Sydney Dyke and the sandstone surrounding it and required installation of a water treatment plant (WTP) at the site of the Campbell Street Substation. It has also resulted in seepage through the shotcrete lining in the City South Cable Tunnel that has raised issues in regard to long term durability of the shotcrete and some fixtures in the tunnel (PSM, 2009).

Groundwater from the City South Cable Tunnel is treated at the Campbell Street WTP and groundwater from the City West Cable Tunnel is pumped to and treated at the Campbell Street WTP. Water from the treatment plant is then discharged to the stormwater system and ultimately enters Cockle Bay.

Water quality objectives were developed for the Campbell Street WTP by SKM (2005) in accordance with guidelines prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ). The water quality objectives were developed to be consistent with the 'high level of protection' trigger values. These were selected because although Cockle Bay is highly disturbed and receives significant pollutant loads from stormwater, sewer, hardstand and roadway runoff, it is an important tourist venue, and is connected to Sydney Harbour (SKM 2005).

Table 15-2 summarises the characteristics of the raw and treated groundwater at the Campbell Street WTP and compares it to the water quality objectives. The monitoring is undertaken in accordance with the Operational Environmental Management Plan for the City South Cable Tunnel.

The water quality goals in Table 15-2 are ideal performance parameters against which operation of the plant is evaluated over the long term. There are times when the concentration of parameters of the treated water is higher or lower than the goals. This variability is a function of changes in raw water chemistry, as well as events such as malfunction of the WTP. To account for this variability, the Operational Environmental Management Plan also includes:

- Chronic water quality criteria – this criteria has been developed to provide operational staff with guidance on what pollutant concentrations may have an impact on Cockle Bay. If the long term average discharge levels from the WTP are below these chronic levels, the impact is considered to be negligible. If the long term chronic levels are exceeded, management responses may include additional sampling, review of pollutant sources, and investigation of potential modifications to the WTP; and
- Acute water quality criteria – exceedance of the acute water quality criteria is considered to be a potential pollution event that is required to be reported to DECCW in accordance with EnergyAustralia's incident investigation and reporting procedures. This may also trigger management responses such as visual inspections of the discharge point at Cockle Bay, additional sampling, review of potential pollutant sources, and potential modification to the operation of the WTP.

Table 15-2 reflects that the average treated water quality meets the water quality goal for the majority of parameters. These results are long term averages that are influenced by a small number of spikes when there are elevated concentrations of water quality parameters. As a result, average water quality for total suspended solids, turbidity, total iron, total manganese, arsenic, chromium, zinc, and mercury exceed the water quality goal but are below the chronic water quality criteria defined in the Operational Environmental Management Plan and are therefore considered to have negligible impact. Copper is the only average water quality parameter that exceeds the chronic water quality criteria, however it does not exceed the acute criteria.

Table 15-2 Summary of groundwater quality monitoring at Campbell Street WTP

Parameter	Unit	Water quality goal [1]	Chronic water quality criteria [1]	Acute water quality criteria [1]	Average raw water quality [2]	Average treated water quality [2]	Cockle Bay water quality [3]
Total suspended solids (TSS)	mg/L	10	29	71	62	17	4
Turbidity	NTU	10	40	82	989	12	0.5
Dissolved Oxygen	mg/L	8-11	8-11	<6	8	9	-
Oil and grease	mg/L	10 (no visible)	10	40	6	6	-
pH	pH	7.0 – 8.5	7.0 – 8.5	<6.0 and >9.0	6	8	8
Soluble Iron (Fe)	µg/L	300	1250	49817	18953	85	3
Total Iron (Fe)	µg/L	2000	8150	49817	118741	2224	57.7
Soluble Manganese (Mn)	µg/L	1250	5150	66639	3608	1183	6.4
Total Manganese (Mn)	µg/L	1250	5150	66639	3977	1397	8.7
Aluminium (Al)	µg/L	41.3	41.3	240	140	22	41.3
Arsenic (As)	µg/L	4.5	13.5	1603	8	6	1.7
Cadmium (Cd)	µg/L	5.5	22.5	121	2	1	0.1
Chromium (Cr)	µg/L	4.4	17.5	4799	7	5	0.25
Copper (Cu)	µg/L	8	8	73	11	11	3.3
Lead (Pb)	µg/L	4.4	10.5	3567	5	3	2.4
Nickel (Ni)	µg/L	70	290	1443	63	23	0.9
Zinc (Zn)	µg/L	25	123	450	729	73	12
Mercury (Hg)	µg/L	0.4	1.5	45	10	1	0.05

1 – SKM, 2005

2 – Sampling, September 2006 – October 2010

3 – Source, KBR,2007

15.2 Impact assessment

15.2.1 Surface water

Potential surface water impacts would be limited to the Riley Street construction compound and small shafts located at Dalley Street, Little Albion Street, and Yurong Parkway as these are the only locations where works would disturb the ground surface. The main potential impact at these locations would be associated with runoff transporting sediment off-site and entering the stormwater system that ultimately discharges to Sydney Harbour via Cockle Bay and Bennelong Point. There is also the potential for vehicles associated with the project to transfer sediment onto adjacent roadways and for this sediment to enter the stormwater system. Chemical spills on the construction sites may be transported to the surface water and groundwater systems.

Surface water impacts are considered to be minor as the area of surface disturbance would be very small, with the Riley Street construction compound having an area of about 2,000 m^2 and the three shaft sites each having an area of about 25 m^2. Given the small surface areas, it is unlikely that substantial volumes of sediment would be transported off-site. Potential impacts at both sites would be mitigated by implementing the recommended management measures which focus on installing controls at the downslope site boundaries and nearby inlets to the stormwater system. This would minimise the potential for sediment or spills to be transported off-site and enter the stormwater system.

15.2.2 Groundwater

Groundwater drawdown and seepage

Groundwater would flow into excavations below the water table, including those for the CECT, CSCT extension, and associated shafts. The majority of the tunnels would be constructed in slightly weathered to fresh Hawkesbury Sandstone and the water table within this strata is generally separate from and below the water table in overlying alluvium. The shaft at the Riley Street construction compound is likely to encounter groundwater at 25.4 mRL (existing ground surface is 33.5 mRL). The shaft in Dalley Street is likely to encounter groundwater at -7 mRL (existing ground surface 7 mRL).

The permeability of rock strata along the alignment is controlled by joints, faults and bedding planes. Permeability measurements undertaken as part of the geotechnical investigations varied from 0.02 Lugeon (about 2 x 10^{-9} m/s) up to 50 Lugeon. The large range indicates that, as the tunnel advances, particular features that would generate most of the groundwater inflow, including:

- Open bedding planes, and
- A number of near vertical zones of faulting or closely spaced joints known as the Woolloomooloo Fault Zone, GPO Fault Zone, and Martin Place Joint Swarm. These zones typically contain subparallel, isolated faults and/or joints and the rock mass either side of the features can also contain some more closely spaced jointing near vertical zones of faulting (PSM, 2009).

These features are more conducive to groundwater movement and are likely to be associated with higher groundwater flow rates. The tendency for higher inflow rates to be associated with specific features was confirmed during construction of other tunnels in the CBD, in particular the City South Cable Tunnel which encountered higher inflow rates and poor quality associated with the Great Sydney Dyke. Although Stage 2D would not intersect the Great Sydney Dyke, it is likely that groundwater of similar quality to that encountered in the City South Cable Tunnel may be encountered between the dyke and works undertaken in the Surry Hills area (PSM, 2009).

Based on the results of monitoring during tunnelling works in similar geotechnical conditions within the CBD, it is estimated that the average seepage of groundwater into those sections of the tunnels not affected by faults, joints or bedding planes would be less than 1 L/s.

The tunnels and associated shafts constructed as part of Stage 2D would be fully lined to exclude groundwater seepage as far as practicable and once complete would not affect groundwater levels. The tunnels would be designed to limit groundwater inflows to less than 300 L/100m/day. Any groundwater intercepted would be collected and treated to an acceptable level prior to discharge to the stormwater system. A licence to extract the groundwater would be obtained from the NSW Office of Water.

Settlement of buildings due to groundwater drawdown typically only occurs if the water table is within the soil horizon and the buildings are founded within this soil horizon prior to the water table being drawn down. As the tunnels would be fully lined, it is unlikely that the small volumes of groundwater that may flow into the tunnel during operation of the project would result in surface settlement impacts, such as damage to building foundations.

Groundwater treatment

Sampling indicates that groundwater quality is expected to be similar to inflows to the City South Cable Tunnel and City West Cable Tunnel that are currently collected and treated at the Campbell Street WTP. As a result, treatment of groundwater is unlikely to be more onerous than that which is presently encountered and treated. Groundwater from these tunnels is currently being treated to long term average levels that are below limits detailed in the Operational Environmental Monitoring Plan that are considered likely to impact on Cockle Bay.

A temporary system would be installed at the Riley Street site to treat groundwater generated during construction. This system would have a capacity of 8 – 15 L/s (depending on the water quality and sediment loading) and would treat water to comply with ANZECC guidelines, after which it would be discharged to stormwater. As water quality would comply with criteria developed in accordance with the ANZECC guidelines, potential impacts on water quality in the receiving environment are considered to be minor.

A permanent drainage system would be installed during fit-out of the tunnel and, once it has been commissioned, the temporary system would be decommissioned. The permanent drainage system would accommodate all components of the CECT, CSCT extension, and associated stub tunnel connections to substations.

The Campbell Street Substation WTP is designed to treat 3.5 L/s under normal conditions and it currently treats about 2 litres per second. The tunnels have been designed as fully tanked tunnels to minimise ingress of groundwater. The CECT design inflow criteria is 300 litres per 100 m of tunnel per 24 hours. This translates into 0.1 L/s that would need to be treated. Based on this, the inflow treated at the Campbell Street Substation would increase from approximately 2 L/s to 2.1 L/s, well within the design capacity of the treatment plant.

As this WTP is considered to be operating effectively and has substantial spare capacity, during operations it is proposed to pump groundwater Stage 2D to the existing Campbell Street WTP. Treatment would focus on removal of iron and manganese which are generally in relatively high concentrations in groundwater in the Sydney CBD.

Water from the treatment plant would continue to be discharged to stormwater mains that ultimately enter Cockle Bay. The treatment system is likely to continue to comply with the requirement of Section 120 of the POEO Act.

Based on the above, given the small increase in the volume of groundwater to be treated due to operation of Stage 2D, potential impacts associated with groundwater treated at the Campbell Street WTP and discharged to Cockle Bay are considered to be minor.

The performance of the Campbell Street WTP and its potential impact on the ecosystem of Cockle Bay would continue to be monitored in accordance with the requirements of the Operational Environmental Management Plan. The monitoring requirements of this strategy are summarised in Section 15.3.

15.3 Mitigation measures

A Water Quality Management Sub-Plan would be prepared as part of the CEMP for the project. The sub-plan would be prepared in accordance with 'Managing Urban Stormwater: Soils and Construction' (Volume 1, 4th Edition, the 'Blue Book', Landcom, 2004) and would detail specific measures to be implemented to manage soil, surface and groundwater impacts during construction including:

- Establishment of sediment control devices around construction sites to manage stormwater entering and leaving the sites. Control devices would also be installed on inlets to the stormwater system downstream of the sites;
- Daily check of machinery to ensure there are no oil, fuel or other liquids leaking;
- Development of contingency plans to deal with spills which might occur during construction;
- On-site storage of chemicals or fuels in accordance with relevant Australian Standards and Material Safety Data sheets. Spill kits would be provided on site and bunded areas would contain 110% of the liquid material as required by DECC's Environmental Protection Manual *Technical Bulletin Bunding and Spill Management*;
- Final cleanup after the works are complete would include removal of any erosion control devices, removal of any sediment in drainage lines which has been trapped by erosion control devices, and restoration of disturbed areas.

Consultation with Sydney Water and/or the City of Sydney would be undertaken to determine whether there are any capacity limitations within the stormwater system associated with the increase in the volume of water discharged from the Campbell Street WTP.

Treated water from the Campbell Street WTP would be monitored in accordance with the Operational Environmental Management Plan for the Sydney CBD 132kV Cable Project which requires:

- Regular sampling and analysis of discharge water;
  - Samples of discharge water would be collected at least once a week for the first month of operation, and analysed for each of the analytes set out in Table 15-2. Turbidity and pH would be continuously monitored through permanent probes contained within the WTP;
  - Weekly analysis of samples for all analytes set out in Table 15-2 would continue for the first month of operation, or until the quality of the water is consistent, and it is determined that the WTP is operating effectively;
- Once it is confirmed that the WTP is operating efficiently, sampling frequency would be reduced to once a month, and samples would be tested only for total and soluble iron, and total and soluble manganese. Turbidity and pH would continue to be monitored through the permanent probes. pH monitors that water treatment chemicals have been correctly dosed, while turbidity monitors the effectiveness of chemical dosing. If any analytes were detected at concentrations exceeding the water quality goals during the first month of sampling, or if concentrations of a particular analyte were inconsistent during the first month of sampling, the monthly samples should also be tested for these analytes;
- Once every 3 months, samples would be tested for all analytes listed in Table 15-2 to ensure that no significant changes in water quality have taken place; and
- Samples would be sent to NATA accredited laboratories for analysis.

To ensure that the groundwater sampling plan provides accurate and representative information regarding the quality of discharge water, the following quality control measures would be applied:

- Samples would be collected in clean bottles/jars, which have been prepared and supplied by the NATA accredited laboratory that would conduct the analysis.
- Records of each sampling event would be kept, and would include information such as date, time, person who conducted the sampling event, and observations regarding the sample such as colour, clarity, etc.
- Samples would be placed into a chilled esky immediately after being collected, and be delivered to the laboratory for analysis as soon as practicable. This would ensure that the chemical composition of the sample is not altered between being collected and being tested.
- Operational staff would review results of analysis as soon as they are available. Any abnormal results would be checked with the laboratory. The Environmental Services Unit (ESU) would be notified in cases where the water quality results exceed the nominated discharge criteria.
- The ESU would immediately discuss any significant changes to water quality with the WTP operator, so that action can be taken to rectify any problems with the WTP operation. The DECCW would be informed of changes to water quality that represent a significant risk of harm to the receiving environment.
- Once every six months, an extra (duplicate) sample would be collected and sent to a different NATA accredited laboratory for analysis of iron and manganese. The aim of this is to check the performance of the laboratory at which samples are regularly analysed. If analyte concentrations are found to be significantly different between the two laboratories, investigations into the cause of the discrepancy would take place.
- The pH and turbidity probes would be routinely inspected, cleaned and calibrated by the WTP operator, in accordance with the manufacturers instructions.

16. Electric and magnetic fields

This section provides a summary of the electric and magnetic field considerations for the project. More detailed information is contained in the Concept Environmental Assessment.

16.1 Introduction to EMF

Electric and magnetic fields (EMF) are part of the natural environment and are present in the earth's core and the atmosphere. EMF is also produced wherever electricity or electrical equipment is in use. Power lines, electrical wiring, household appliances and electrical equipment all produce EMF. EMF is sometimes incorrectly referred to as electromagnetic radiation.

The electric field is proportional to the voltage which can be considered as the pressure with which electricity is pushed through the wires. The magnetic field is proportional to the current; that is, to the amount of electricity flowing through the wires. Both electric and magnetic fields are also dependent on the source geometry (i.e. conductor heights, cable depths, phase separations and so on).

All electric and magnetic fields decrease rapidly with increasing distance from the source. Generally, the smaller the object or closer the conductors producing the field, the more rapidly the field will decrease as you move away from the source.

16.2 EMF and health

The issue of EMF and health effects has been extensively reviewed over the past 30 years by Australian and international inquiries and expert panels established to try to determine whether or not human exposure to EMF is related to adverse health effects. Consistently, no basis has been found for the scientific community to conclude that EMF causes cancer or any other disease. While the balance of evidence is against there being a risk, the possibility cannot be ruled out.

The relevant Australian regulatory authority, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) concludes that "On balance, the scientific evidence does not indicate that exposure to 50 Hz EMFs found around the home, the office or near power lines is a hazard to human health" (Australian Radiation Protection and Nuclear Safety Agency 2003).

There are currently no Australian standards regulating exposure to these fields. EnergyAustralia have followed interim guidelines for exposure to these fields developed by the National Health and Medical Research Council (NHMRC).

Under these guidelines, the recommended magnetic field exposure limit for members of the public (24 hour exposure) is 0.1 millitesla (1,000 mG (milliGauss)) and for occupational exposure (whole working day) is 0.5 millitesla (5,000 mG). These guidelines are aimed at preventing immediate health effects resulting from exposure to these fields.

EnergyAustralia operates its powerlines, substations, and other electrical infrastructure well within these interim guidelines.

The NHMRC guidelines have been officially rescinded ahead of the release of an Australian Standard. In December 2006 ARPANSA released a draft new standard for EMF exposure in Australia, which includes similar public exposure limits to the NHMRC guidelines. Following public comment, the new Australian Standard is expected to be finalised and implemented in late 2010.

16.3 EnergyAustralia's position on EMF

EnergyAustralia's policy involves:

- Providing balanced and accurate information to our employees and customers, including electric and magnetic field measurements and advice;
- Taking reasonable steps to limit field exposures from new facilities by locating and operating our electrical installations prudently within the latest Australian health guidelines;
- Closely monitoring engineering and scientific research, overseas policy development and major reviews of scientific, medical and engineering research regarding electric and magnetic fields and health; and
- Cooperating fully with any bodies established by governments in Australia to investigate and report about power frequency electric and magnetic fields.

EnergyAustralia designs its infrastructure according to the principle of prudent avoidance, which means taking reasonable steps to limit field exposures from new facilities by locating and operating the equipment prudently within Australian health guidelines.

Independent studies would be carried out on the EMF impact for each element of the Project.

16.4 Impact assessment

EnergyAustralia would take a number of steps to minimise EMF around the elements of Stage 2D. These measures would be technically reasonable and within the context of prudent avoidance - "doing whatever can be done at modest cost and without undue inconvenience to avoid the possible risk (to health)" (Gibbs, 1991).

The cables would be located in a concrete lined tunnel at a depth of 10 to 55 metres below ground level. The EMF from these cables would not be discernible from typical background levels.

- Incorporating a number of mitigation measures into the design, including:
  - Restricting access to substation sites to limit exposure of the general public to higher fields within the substation;
  - Where possible, equipment which produces the highest magnetic fields such as cables, busbars, transformers and switchgear, have been positioned furthest away from adjoining property boundaries;
  - Where possible, items which produce the lowest magnetic fields such as control rooms, equipment rooms, amenities, stairs, walkways, air vents/ducts and pilot isolation rooms, have been positioned closest to the adjoining property;
  - 11kV and 132kV loads would be balanced with minimum zero sequence current;
  - Where possible, cables would be positioned in trefoil arrangement to reduce phase separation distances. Trefoil has the lowest fields compared to other configurations;
  - Where possible, cable trays would be positioned away from adjacent adjoining property boundaries;
  - Incoming and outgoing connections would be installed underground using the most compact construction technically practicable; and
  - Use of 132kV GIS (gas insulated switchgear) instead of conventional air-insulated equipment.

17. Statement of commitments

17.1 Introduction

This Environmental Assessment has identified a range of measures to avoid, manage, mitigate offset and/or monitor the environmental impacts of the project. These measures are detailed in Chapters 9 – 16 and would be implemented during pre-construction, construction and operation.

This chapter provides EnergyAustralia's draft Statement of Commitments. This may be revised to respond to issues raised in submissions received by the Department of Planning during exhibition of the Environmental Assessment, or to address potential impacts associated with any changes to the project made following exhibition of the Environmental Assessment. Following approval of the project, the final Statement of Commitments would guide the subsequent phases of the project to reduce environmental impacts. Organisations involved in the design and construction phases would be required to undertake the works in accordance with these commitments.

17.2 Environmental management framework

The environmental management framework during construction of the project would be based on development and implementation of a CEMP by the contractor. This plan would be prepared in accordance with the *Guideline for the Preparation of Environmental Management Plans* (DIPNR, 2004). It would address the compliance obligations set out in the Minister's Conditions of Approval and Statement of Commitments and would be implemented by the contractor and any subcontractors undertaking construction activities.

Implementation of the CEMP would ensure that construction of Stage 2D complies with relevant environmental legislation; conditions of applicable licences, approvals and permits; and the Environmental Management Systems Guidelines (NSW Government 1998). The CEMP would be endorsed by the appointed project Environmental Management Representative (EMR) prior to approval by the Director-General of the Department of Planning.

The CEMP would include:

- Emergency contact information for key personnel;
- An overview of the project and its objectives;
- Relevant legislative requirements that apply to the project;
- Project scope;
- An outline of the existing environment and conditions;
- Project environmental impacts;
- Licences and permits obtained to meet statutory requirements;
- Roles and responsibilities for all personnel, including responsibilities for planning, approving, implementing, maintaining, assessing and monitoring environmental controls; and
- Implementation requirements and environmental procedures. This would detail the actions to be implemented to address the compliance obligations set out in the Minister's Conditions of Approval and Statement of Commitments, including any requirements for monitoring and/or auditing.

The CEMP would include a number of sub-plans that would detail measures to be implemented to manage specific issues, including but not limited to:

- Noise and vibration;
- Traffic and access;
- Spoil and waste management;
- Surface and groundwater management;
- Air quality; and
- Consultation and community engagement.

Compliance with the CEMP would be monitored by implementing a Compliance Tracking Program prepared in accordance with MCoA 5 of the Concept Approval.

17.3 Amendments to the statement of commitments prepared for the Concept Plan

As required by MCoA 3.1c of the Concept Approval, this section provides the project specific commitments for environmental mitigation, management and monitoring. The commitments listed in this section are consistent with the Statement of Commitments prepared for the Sydney CityGrid Concept which are detailed in the Submissions Response and Preferred Project Report (May 2009). The commitments from the Submissions Response and Preferred Project Report have been updated to reflect only those commitments that are relevant to Stage 2D.

The commitments that are not relevant to this stage of the project or have been superseded have been deleted, and the remaining commitments have been retained or amended. New commitments developed as an outcome of this Environmental Assessment have been added. These changes are summarised in Appendix I.

The draft Statement of Commitments are additional to EnergyAustralia's obligations under the Concept Approval.

Table 17-1 Draft Statement of Commitments

Key Issue	Commitment
Noise and vibration	Construction would generally be carried out during the following hours: • Monday to Friday 7 am to 7 pm • Saturdays 7 am to 5 pm • No work on Sundays or Public Holidays Noise intensive activities such as rock breaking would be undertaken during the following hours: • Monday to Saturday 7 am to 12 pm • Monday to Friday 2 pm to 5 pm • At no time on Sundays or Public Holidays Subsurface works associated with construction of the tunnels and works within the acoustic enclosure at the Riley Street site would occur 24 hours per day. Other activities that may occur outside the standard construction hours include, but may not be limited to, oversize truck movements and deliveries of certain plant and equipment on an occasional basis. Works may also be undertaken outside these hours in the event of a direction from police or other relevant authority for safety reasons, or emergency work to avoid the loss of lives, property and/or to prevent environmental harm.
	A noise and vibration management sub-plan would be prepared as part of the CEMP and would: • Identify potentially affected receivers, activities to be carried out, ancillary facilities, and associated sources of construction noise; • Quantify the background noise level for the sensitive receivers nearest to the surface construction compounds; • Identity the construction noise, ground-borne noise and vibration objectives; • Provide an assessment of potential levels during construction against the noise and vibration goals and identify locations where these goals are predicted to be exceeded; • Identify reasonable and feasible mitigation measures to reduce noise and vibration levels where the objectives would be exceeded. This may include options such as reducing the cutting rate of tunnelling machines to reduce potential impacts associated with regenerated noise; • Describe noise and vibration management methods and procedures that would be implemented, including measures to monitor compliance with the objectives; and • Detail procedures for consulting with the community regarding potential noise and vibration impacts that have the potential to affect their amenity. This would include a protocol for managing complaints in accordance with MCoA 4.3 of the Concept Approval (refer to the Community Information Plan).
	The following general management measures would be included in the noise and vibration management sub-plan: • Where feasible and practicable, only dampened and/or smaller rock breakers would be used; • Where reasonable and feasible, plant and equipment such as excavators, cranes and trucks would be fitted with silencers, low noise mufflers (residential standard), and reversing alarms on vehicles would be replaced with silent measures; • Where possible, plant would be located and orientated to direct noise away from sensitive receivers; • Where possible, deliveries would be carried out within standard construction hours; • Plant and equipment would be selected to minimise noise emission, in-so-far-as possible whilst maintaining efficiency of function. All plant and equipment would be maintained in good order;

Key Issue	Commitment
	• Mobile plant and trucks operating on site for a significant portion of the project would have reversing alarm noise emissions minimised in-so-far-as possible, recognising the need to maintain occupational safety; and • Solid hoardings and/or site sheds would be erected on work site boundaries to function as noise barriers.
	A dilapidation survey would be undertaken of surrounding buildings, services and structures prior to commencement of construction. This would include inspecting surrounding heritage listed buildings to determine whether they are structurally sound, and if so, whether the vibration criteria for residential buildings should be applied to the heritage listed buildings. A post construction dilapidation survey would also be undertaken. Any damage attributable to the project would be repaired at EnergyAustralia's expense.
Non-indigenous heritage	Construction of the Dalley Street shaft would be carried out with archaeological input as the site has the potential to contain archaeological remains associated with the history and development of Sydney. The site would be inspected by an archaeologist once the existing road surface has been removed and prior to bulk excavation commencing. The initial bulk excavation would be monitored so that any buried features can be recognised. Any items of archaeological significance or interest would be recorded by the archaeologist and managed in consultation with the Heritage Branch of the Department of Planning. Any evidence of substantial archaeological remains would be investigated and recorded and soil samples taken for analysis. If any unexpected historical relic(s) are encountered during the course of construction, all work likely to affect the relic(s) would cease immediately and the Heritage Branch of the Department of Planning would be notified in accordance with the *Heritage Act 1977.*
Indigenous heritage	If any unexpected Aboriginal object(s) are encountered during the course of construction, all work likely to affect the object(s) would cease immediately and the DECCW would be informed in accordance with Section 91 of the *National Parks and Wildlife Act 1974.* Consultation would also occur with the Metropolitan Local Aboriginal Land Council regarding an appropriate course of action.
Air quality	A construction air quality management plan would be prepared as part of the CEMP and would include the following measures to manage potential impacts on air quality: • During tunnel construction, all air would be ventilated through a filter unit such that discharged air meets the requirements of the Protection of the *Environment Operations (Clean Air) Regulation 2002* (as amended); • Exposed surface areas would be managed via dust mitigation measures; • Wheels of all site plant and vehicles would be cleaned so that material with potential to generate dust is not spread on surrounding roads; • Sealed roads around construction sites would be swept if necessary to remove deposited material with potential to generate dust; • Water may be used to suppress dust emissions from activities such as earthworks, stockpiles etc (as required); • The height from which dust generating material is dropped would be minimised; • Loaded trucks carrying spoil would be covered at all times; • Cutting/grinding of materials on site would be kept to a minimum, but if necessary equipment and techniques to minimise dust would be used;

Key Issue	Commitment
Air quality	• Potentially dusty materials would be handled as little as possible; • Construction plant and vehicles would be well maintained and regularly serviced. Visible smoke from plant would be avoided. Defective plant would not be used; • Engines would be switched off when vehicles are not in use and refuelling areas would be away from areas of public access; and • Where practicable and feasible, loading and unloading would take place within the site.
	The air quality management plan would also: • Establish a protocol to handle dust complaints that includes recording, reporting and appropriate actions for excepted types of complaints; • Include a reactive management program detailing how and when operations are to be modified to minimise the potential for dust emissions, should emissions exceed the relevant criteria; and • Address the monitoring, management and control of air pollutants including gaseous substances generated during construction.
Soil and water	A Water Quality Management Sub-Plan would be prepared as part of the CEMP for the project. The sub-plan would be prepared in accordance with 'Managing Urban Stormwater: Soils and Construction' (Volume 1, 4th Edition, the 'Blue Book', Landcom, 2004) and would detail specific measures to be implemented to manage soil, surface and groundwater impacts during construction. It would identify opportunities for on-site reuse of groundwater and surface water, and include a program for monitoring the effectiveness of the sediment control system. Groundwater and surface water discharges during construction and operation would be managed to comply with the requirements of Section 120 of the POEO Act. Treated water from the Campbell Street WTP would be monitored in accordance with the Operational Environmental Management Plan for the Sydney CBD 132kV Cable Project during operation of the project. Consultation with Sydney Water Corporation and/or the City of Sydney would be undertaken to determine whether there are any capacity limitations within the stormwater system that would influence the location of the connection for the water discharged from the treatment system.
Traffic and access	A construction traffic management plan would be prepared in consultation with RTA and City of Sydney Council as part of the CEMP and would include the following measures to manage potential impacts on the traffic and transport network: • General signposting of streets in the immediate vicinity of the construction sites with appropriate heavy vehicle and construction warning signs; • If temporary road closures are required, traffic control measures specified in "AS1742.3: 2002 Traffic Control Devices for Works on Roads" and the RTA's "Traffic Control at Work Sites" would be detailed in a traffic control plan and subsequently implemented; • Development of a suitable vehicle detour route, if required, during specific construction activities; • Installation of specific warning signs and safety devices at entrances to the Riley Street construction site to warn road users of entering and exiting construction traffic; • Preparation of a pedestrian management plan that details measures to be implemented to minimise impacts on pedestrian movement and maintain pedestrian safety. Specific consideration would be given to activities undertaken in the vicinity of work sites in Riley Street, Little Albion Street, Yurong Parkway and Dalley Street;

Key Issue	Commitment
	• In addition to relevant Australian Standards and RTA guidelines, all traffic management would also conform to Workcover NSW "Code of Practice for Working Near Traffic and Mobile Plant"; • Barriers approved by the RTA and/or City of Sydney Council would be provided between the construction sites and trafficable areas. Pedestrian and cycle diversions would be required during the works; • Management of the transportation of construction materials to maximise vehicle loads to therefore minimise vehicle movements; • Inducting truck and vehicle operators on the requirements of the traffic management plan; and • An event specific traffic management plan would also be prepared if there are any special events in the CBD that would potentially be impacted by traffic movements associated with the project. The time and duration of these events would be clearly noted and construction delivery processes would be rearranged to cater to the affected days. Prior to the commencement of construction, dilapidation reports would be prepared for sections of Riley Street, Albion Street, Little Albion Street, Dalley Street, Underwood Street, Crawford Place and Yurong Parkway in the immediate vicinity of the sites that are likely to be used by construction traffic. Any road/ footpath damage attributed to the project, aside from that resulting from normal wear and tear, would be repaired to the pre-existing standard at EnergyAustralia's cost.
Storage of dangerous goods	All dangerous goods (as defined by the Australian Dangerous Goods Code) and combustible liquids, would be stored and handled strictly in accordance with: • All relevant Australian Standards; • A minimum bund volume requirement of 110% of the volume of the largest single stored volume within the bund; and • The DECC's *Environment Protection Manual Technical Bulletin Bunding and Spill Management.*
Spoil and waste management	A spoil and waste management sub-plan would be prepared as part of the CEMP and would identify how spoil and other waste material would be handled, reused and disposed. It would address the principles of the waste hierarchy and relevant health and safety as well as environmental legislation and would include measures such as: • All waste would be managed in accordance with DECC's Waste Classification Guideline (2008); • Arrangements to reduce the volume of materials being brought onto site such as packaging. In addition, required construction materials would be ordered in the correct quantities to minimise waste; • Reuse or recycling of demolition and excavation materials would be undertaken wherever practicable. Stockpile areas would be allocated for construction and demolition waste to allow separate stockpiling of recyclable and non-recyclable materials. In addition, colour coded and clearly marked containers for different recyclable materials would be provided; • Records would be kept of all waste volumes and destinations; • Sites for disposal of surplus spoil would be selected according to the rate of development activity and the volumes of material generated elsewhere; • Ongoing training would be provided for construction personnel to ensure correct sorting of waste and recyclable materials and promote the principles of the waste hierarchy. Waste minimisation and management would be included in tool box sessions and site management planning; and • Any synthetic mineral fibres would be bagged or wrapped in plastic and handled per Worksafe Australia's *Synthetic Mineral Fibres – National Standard and National Code of Practice.*

Key Issue	Commitment
Urban design	The contractor would implement reasonable and feasible measures to refine the construction method to minimise the number of street trees to be removed. Any trees removed would be replaced with advanced stock and the species would be selected in consultation with the City of Sydney Council.
Detailed design investigations	Detailed design of the tunnels and associated infrastructure would be undertaken based on the results of additional geotechnical investigations to minimise potential impacts associated with ground settlement and stability. RailCorp, RTA, Cross City Motorway, Sydney Water, and Transport NSW would continue to be consulted during development of the detailed designs to ensure that potential impacts associated with existing and proposed underground infrastructure are mitigated to an acceptable level. This would include consideration of the location and impact of associated items such as rock bolts and rock anchors. Stakeholder agreements would be developed between EnergyAustralia and Railcorp, RTA, Cross City Motorway and Transport NSW prior to construction in the vicinity of the stakeholders assets.
Hazards and risks	EnergyAustralia would identify the services potentially affected by construction activities to determine requirements for diversion, protection and/or support. EnergyAustralia's contractors would prepare and implement construction safety sub plans to manage hazardous incidents and public safety during the construction of the project.
Consultation	A Community Information Plan would be prepared in accordance with the requirements of MCoA 4.3 of the Concept Approval. This would set out the community communications and consultation processes to be undertaken during Stage 2D and would include specific consultation regarding issues such as: • Noise and vibration –This would include identifying receivers that are likely to experience noise or vibration that exceeds relevant goals and outlining methods that would be implemented to ensure these receivers are consulted regarding the timing and duration of works, including reasonable and feasible mitigation measures that will be implemented. A sliding scale of responses that may be implemented depending on the impact at individual locations would be developed; and • Traffic and access - A community information and awareness program would be initiated prior to construction commencing and during the construction period to ensure that those in the surrounding area are fully aware of the construction activities with particular regard to construction traffic accessing the sites. The awareness program would identify communication protocols for community feedback on issues relating to construction vehicle driver behaviour and construction related matters.
Cumulative impacts	As construction of the Riley Street STSS (Stage 2C) would occur concurrently with construction activities at the Riley Street compound, cumulative impacts are likely to occur during the overlapping phases of construction. These cumulative impacts would be assessed during preparation of the Environmental Assessment for Stage 2C.

18. Conclusion

This Environmental Assessment has been prepared in accordance with the requirements of Part 3A of the EP&A Act and addresses the Director-General's requirements provided in MCoA 3 of the Concept Approval.

The existing electricity supply infrastructure in the Sydney CBD requires refurbishment, replacement and augmentation to provide a secure supply of electricity to the Sydney CBD that complies with the 'n-2' licence conditions. EnergyAustralia developed the Sydney CityGrid Project as an integrated strategy that is the most effective means of rebuilding or refurbishing the existing infrastructure while maintaining sufficient space and capacity to ensure an ongoing and reliable electricity supply.

Stage 2D is both needed and justified as all stages of the Sydney CityGrid Project are integrated and interdependent. Failure to construct Stage 2D would compromise the ability to achieve the objectives of the overall project.

Key environmental issues have been progressively evaluated and assessed during development of the design and preparation of the Environmental Assessment. This has involved extensive consultation with government agencies and stakeholders that would have a role in constructing and operating the project. The outcomes of consultation have also informed development of the draft Statement of Commitments that would be implemented to manage potential adverse impacts and enhance benefits during the construction and operational phases. The draft Statement of Commitments would reduce the duration, extent and severity of potential impacts.

While the project has the potential to result in some residual adverse construction impacts, these need to be balanced against the substantial positive impacts that would result from operation of the overall Sydney CityGrid Project. The benefits of the project substantially outweigh adverse impacts.

It is concluded that Stage 2D of the Sydney CityGrid Project is unlikely to result in significant environmental impacts provided the draft Statement of Commitments are implemented.

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