Document Control and Approval

PlanCom Consulting Pty Ltd

Author:	Julian Ardas
Signed:	
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EnergyAustralia

Endorsed by:	Craig Moody
Title:	Executive Manager Project Development & Approvals
Signed:	
Date	8 December 2008

Sydney Citygrid Project

Environmental Assessment

December 2008

Prepared for

EnergyAustralia
570 Bathurst Street, Sydney NSW 2001
GPO Box 4009 Sydney NSW 2001
Telephone: (02) 131525
Facsimile: (02) 9269 2830
www.energyaustralia.com.au

By

PLANCOM CONSULTING PTY LTD
ABN: 84 937 917 994
Suite 13,12A Springfield Mall, Potts Point NSW 2011
P.O. Box 411 Potts Point NSW 2011
Telephone: (02) 9331 4336
Mobile: 0425 212 333
www.plancom.com.au

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Certification of Environmental Assessment Report

Submission of Environmental Assessment

Prepared under the Environmental Planning and Assessment Act 1979

Environmental assessment prepared by:

Name	Julian Ardas
Qualifications	BSc (Hons) Applied Economic Geography UNSW 1986, Master of Urban & Regional Planning USyd 1993.
Address	PlanCom Consulting Pty Ltd Suite 13, 12A Springfield Mall Potts Point NSW 2011
In respect of	Sydney CityGrid Project – encompassing new and/ or a refurbishment of existing substations in the Sydney CBD and a tunnel network for 132kV electricity cables (Application Number: MP08-0075)

Project to which Part 3A applies

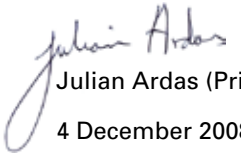
Applicant name	Craig Moody
Applicant address	EnergyAustralia Pty Ltd 570 George Street SYDNEY NSW 2000
Land to be developed	Various sites within the City of Sydney Local Government Area (refer to document)
Proposed development	Infrastructure for electricity distribution

Environmental assessment	An environmental assessment is attached

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 environmental assessment of the development to which it relates; and
- the information contained in the document is neither false nor misleading.

Signature	
Name	Julian Ardas (Principal, PlanCom Consulting Pty Ltd)
Date	4 December 2008

Abbreviations and Glossary

Term	Definition
Acoustic enclosure	An enclosure or building designed to minimise noise.
Adit	An almost horizontal entrance to a tunnel.
AHD	Australian Height Datum
Alluvium	Sediment deposited by flowing water, as in a riverbed, flood plain, or delta.
ANZECC	Australian and New Zealand Environment Conservation Council
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
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.
Belmore Park Site	The proposed site for the Belmore Park Zone Substation development.
Boreholes	Holes drilled into the earth, to enable building construction or geological testing.
BS	British Standard
Bulk Supply Point	A vital step in the transmission of electricity is decreasing the transmission line voltage using transformers. This is performed at a large substation called a Bulk Supply Point owned and operated in NSW by TransGrid.
Busbar	A system of conductors in a substation on which power is concentrated for distribution.
Capacitor	An electrical device consisting of two conducting surfaces separated by an insulator. Capacitors have the ability to store electric charge.
CBD	Central Business District
CCT	Cross City Tunnel
CECT	City East Cable Tunnel
CEMP	Construction Environmental Management Plan
Centrifugal fan	Centrifugal fans operate on the principle of “throwing” air away from the blade tips. This design is most often used for aeration applications where high airflow rates and high static pressures are required.

Term	Definition
Circuit breaker	A switch with the ability to break the flow of electric current. Often used when a circuit becomes overloaded or otherwise abnormally stressed.
City East Zone Substation	City East Zone Substation – an element of the Sydney CityGrid Project
CSCT Extension	City South Cable Tunnel Extension
CSCT stub tunnel	A section of tunnel (approximately 12 metres) to connect the existing CSCT with the new Belmore Park Zone Substation.
CTMP	Construction Traffic Management Plan
CWCT	City West Cable Tunnel
DECC	Department of Environment and Climate Change
DM&P	Demand Management and Planning
Dolerite	A dark, fine-grained igneous rock. Igneous rocks are formed from cooled molten lava.
Ductline	An encased formation of conduits combined in a group and installed or constructed in, on, over, or through the ground or watercourse which is used to interconnect support structures such as manholes and sub-surface chambers.
DWE	Department of Water and Energy
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.
Easement	A right given to a third party to use the portion of property for certain purposes.
Electric fields	Electric fields are produced by voltage and increase in strength as the voltage increases. The electric field strength is measured in units of volts per metre (V/m).
Environmental Assessment	Generally, this term means the process of examining the environmental benefits and consequences of projects in advance of decision making. The term is also has a specific meaning under Part 3A of the Environmental Planning & Assessment Act 1979 being the form of an environmental assessment conducted in regard to a Major Infrastructure Project.
EMF	Electric and magnetic fields (see electric fields and magnetic fields).

Term	Definition
EAR	Environmental Assessment Report
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
ESAA	Energy Supply Association of Australia
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.
ESR	Eastern Suburbs Railway
Feeder	Three individual electrical transmission cables (phases) bundled together.
FSR	Floor Space Ratio
GIS	Gas Insulated Switchgear
GIT	Gas Insulated Transformer, insulated by SF6 gas (see SF6).
GFA	Gross Floor Area
Hz	Hertz (one hertz is defined as one cycle per second)
INP	Industrial Noise Policy
Isopleth	(i.e. noise impact) A general term for a line, on a map or chart, along which all points have a constant or equal value of a given variable (eg. Isobars on a weather map).
Joint swarms	A number of closely sub vertical spaced joints in a rock mass
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.
Licence conditions	Design, Reliability and Performance Licence Conditions for Distribution Network Service Providers (1 December 2007 – NSW Minister for Energy)
Magnetic field	Magnetic fields result from the flow of current through cables or electrical devices and increase in strength as the current increases. Magnetic fields are measured in gauss (G) or tesla (T).
mG	milligauss
MREP	Metropolitan Rail Expansion Programme
Muffler	A device to suppress noise emissions from noisy equipment or machinery.

Term	Definition
MVA	A measure of apparent power. One MVA is equivalent to one million Volt Amperes.
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).
NHMRC	National Health and Medical Research Council
OEMP	Operational Environmental Management Plan
Paleovalley	An ancient rock valley that has been filled with sediments
Pneumatic hammer	A hammer driven by compressed air
Project	Sydney CityGrid Project
Proponent	EnergyAustralia
Proposed development	Elements of the Project
Preferred Project Report	A report prepared by the Proponent following consideration of all submissions if there are any proposed changes to the Project. The Preferred Project Report is then exhibited on the Department of Planning's website.
Prudent avoidance	Taking reasonable steps to minimise or avoid risk of exposure to magnetic fields by specific design configurations and at a modest cost.
Prudent investment	Investment which is the most economically cost-effective option to address limitations on the network to meet responsible customer and community expectations (and to meet appropriate network service standards). Investment may be asset or non-asset based.
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.

Term	Definition
Riley Street Site	The proposed site at the corner of Riley and Albion Streets where the tunnel construction site set up would be located and, in its final form, where the STSS and CECT control room/access point could be established.
RBL	Rating Background Noise Level
RL	Relative Level
Roadheader machine	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.
Rockbolts	A bar or rod, that is inserted into pre-drilled holes in rock for the purpose of securing potentially loose rock.
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.
SCADA	Supervisory Control and Data Acquisition
SEPP	State Environmental Planning Policy
Services Control Room	The control point for access and egress into the CECT – this control room would also house the ventilation and SCADA control to operate, control and record the operations of the tunnel. The services control room may also incorporate a shaft to link the facility with the CECT.
SF_6	Sulphur Hexafluoride, a colourless, odourless and non-flammable gas at standard conditions. SF_6 has good insulating properties and is used by the electrical industry as a gaseous dielectric medium for high voltage circuit breakers, switchgear and other electrical equipment.
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.
Spoil conveyor	A belt or bucket type conveyor to remove broken rock from the cutting face of a tunnel boring machine, and transport to a spoil handling facility.

Term	Definition
SREP	Sydney Regional Environmental Plan
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 substation – generally 132kV to 33kV (with transformers). A part of the electricity network confined to a given area, mainly including the ends of the sub-transmission and distribution network, electrical switchgear, control gear, and one or more transformers.
STSS	A sub-transmission switching station containing switchgear, generally 132kV without transformers. A STSS is generally the first stage of a BSP.
Submissions Report	A report prepared by the Proponent that provides responses to the submissions received following exhibition of the Environmental Assessments.
Sub-transmission network	Those parts of the electricity network (including power lines and towers, cables and substations as the case may be) that transfer electricity from the regional bulk supply points supplying areas of consumption to individual zone substations, operating at normal voltages between 132kV and 33kV inclusive, that may also fulfil a transmission role by operating parallel to and providing support to the higher voltage transmission network.
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	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.
Sydney CityGrid Project	New and/or refurbished substations in the Sydney CBD and a tunnel network for 132kV cables.

Term	Definition
TBM	Tunnel boring machine. A specialised tunnelling machine with a circular rotating cutter head; the cutter head excavates a circular profile through rock as the machine advances.
TMP	Traffic Management Plan
Transformer	An item of electrical equipment that generally transforms a higher voltage to a lower voltage.
TransGrid	A State-owned corporation responsible for the 550kV and 330kV transmission in NSW.
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 a combination of a number of discrete projects that are required to meet the expected electricity needs of the Sydney CBD and inner suburbs.

In providing network services, EnergyAustralia must comply with its obligations as an electricity distributor, including under its distribution licence conditions, which set parameters around how electricity is to be supplied. EnergyAustralia's strategy for the Sydney CBD network area is in accordance with these requirements and is based on a holistic approach to network planning, taking into account the relevant capacity planning criteria, asset replacement requirements, network reliability standards and anticipated longer term network needs. It seeks to meet the forecast network needs in a cost effective manner, while facilitating prudent longer term network investment decisions.

EnergyAustralia's major strategic development decisions for the Sydney CBD area arise from the need to replace infrastructure which is due for retirement and to meet enhanced network security requirements under EnergyAustralia's distribution licence conditions which came into effect on 1 December 2007.

On 11 February 2008 the Minister for Planning declared the EnergyAustralia Sydney CityGrid Project (Project) is a project to which Part 3A of the *Environmental Planning and Assessment Act* (EP&A Act) applies.

This Environmental Assessment Report (EAR) supports:

- a Concept Application for the Project, an application under Section 75M of the EP&A Act, for the Sydney CityGrid Project under Part 3A of the EP&A Act; and
- describes the Project, identifies its likely environmental impacts and the mitigation measures proposed to be adopted.

This summary provides an overview of the Environmental Assessment prepared to assess the potential environmental impacts of the proposed development. The Environmental Assessment has been prepared by PlanCom Consulting Pty Ltd, on behalf of the proponent, EnergyAustralia.

The proposed Project

The Project components include new and/or refurbished substations in the Sydney CBD and a tunnel network for 132kV cables, comprising:

1. Extension to the existing City South Cable Tunnel from Wade Place to Riley Street, Surry Hills (approximately 150 metres).
2. Stub tunnel connection from the existing City South Cable Tunnel (nominally 20 metres below Campbell Street) to the Belmore Park Zone Substation.
3. Belmore Park Zone Substation, encompassing commercial/retail development (at the corner of Pitt, Hay and Campbell Streets).
4. City East Cable Tunnel (approximately 3.2km) from Riley Street, Surry Hills to Erskine Street, in the northern end of the CBD, inclusive of potential ventilation shaft and services control room at an intermediate location along the alignment.
5. Shafts and/or stub tunnels up to 200 metres in length to connect the City East Cable Tunnel with the City East and Dalley Street zone substations.
6. City East Zone Substation, potentially encompassing commercial/retail development (at a site yet to be determined).
7. New Sub-transmission Switching Station (STSS) at Riley Street, Surry Hills, and potentially a tunnel services control and access to the City East Cable Tunnel (in the alternative the control and access would be located at an intermediate point along the tunnel alignment).
8. Potential refurbishment or replacement of the existing Dalley Street Zone Substation or building at a nearby site.
9. Other ancillary surface works associated with the project components noted above.

Structure of this Environmental Assessment Report

Based on requirements from the Director-General of the Department of Planning, the outcomes of the community consultation process and the results of the technical investigations, the Environmental Assessment has identified, analysed and addressed the key issues associated with the Project. This Environmental Assessment includes the following Chapters:

- **Chapters 1** and **2** provide an introduction to the Project and the Environmental Assessment, including a description of the background and the need and justification for the Project.
- **Chapter 3** provides an assessment of the alternatives considered during the development and assessment of the Project.
- **Chapter 4** provides a detailed description of the Project.
- **Chapters 5** and **6** provide an analysis of the applicable statutory planning process, and an overview of the community and stakeholder consultation activities carried out (or to be carried out) as a part of the planning approval process.
- **Chapter 7** provides an overview of the existing land use and environmental conditions within the study area.
- **Chapters 8** to **15** assess the potential impacts of the Project on the biophysical and socio-economic environments and identify mitigation measures to protect the environment.
- **Chapters 16** and **17** summarise the mitigation measures and safeguards into a draft Statement of Commitments for the project and provide a conclusion for the Environmental Assessment.

A glossary of terms is provided at the front of this EAR.

Appendices to this document also provide information relevant to the Environmental Assessment.

Stakeholder issues

EnergyAustralia has been working with key stakeholders and the community for more than a year in relation to the Project. Key issues that have been raised, which are addressed in this EAR include:

- traffic impacts during construction;
- electric and magnetic fields (EMF);
- vibration;
- settlement;
- archaeology;
- spoil and waste;
- noise;
- visual amenity;
- risks and hazards; and
- safety.

EnergyAustralia has commenced a comprehensive stakeholder engagement programme, which will continue throughout planning and construction phases of each separate project.

Summary of potential impacts and mitigation measures

This Concept Application EAR examines the following key assessment requirements as specified in the Director General's Requirements:

- project need and justification
- visual amenity impacts;
- traffic and access;
- noise and vibration impacts;
- heritage and archaeological impacts;
- spoil and waste management impacts;

- hazards and risk; and
- property (including settlement).

A general environmental risk analysis has been undertaken to examine surface and groundwater management, greenhouse gas and air quality, socio-economics, cumulative impacts and ecologically sustainable development.

The construction and operational phases of the Project were examined.

During the construction phase, visual amenity, traffic and access, noise and vibration, and spoil and waste management issues were identified as having the potential to generate significant impacts to the surrounding environment for the overall Project. Within the vicinity of Dalley Street and the proposed City East zone substations the potential exists for non-indigenous heritage to have a significant impact.

During the operational phase the potential for significant impact to the surrounding environment is limited.

Mitigation measures and safeguards have been identified to appropriately manage environmental impacts during the construction and operational phases of the Project.

A draft statement of commitments have been prepared to guide proposed future Project Applications required to deliver the Sydney CityGrid Project.

Draft Statement of Commitments

During the assessment of key issues and general environmental aspects numerous mitigation measures and safeguards were recommended.

For this concept approval EAR, the identification of investigations to be undertaken during the preparation of future project approval EARs is an important next step in the approval process.

How can I comment?

This EAR is placed on public exhibition for a minimum period of 30 days in accordance with the requirements of the EP&A Regulation. During this period, the report will be available for perusal at selected locations. The report will also be available on EnergyAustralia's website at **www.energy.com.au/citygrid** and on the Department of Planning's website at **www.planning.nsw.gov.au**. Limited copies are also available from EnergyAustralia by calling 1800 214 193.

Written submissions from organisations and the general community are invited and should be addressed to:

The Director
Major Infrastructure Assessment
Department of Planning
GPO Box 39
SYDNEY NSW 2001

What happens next?

The next steps are as follows:

- Exhibition of the EAR for the Project for a minimum of 30 days and invitation for the community and stakeholders to make submissions.
- EnergyAustralia prepares a Submissions Report and, if required, a Preferred Project Report and final statement of commitments.
- The Director-General of the Department of Planning provides an Assessment Report to the Minister for Planning, who may approve or reject carrying out the Project and determine the conditions that apply to the Project.

1 Introduction

1.1 Background

During the next decade, EnergyAustralia must replace critical infrastructure in the Sydney CBD which is due for retirement and comply with new licence requirements for operation of its substations and transmission feeders. The new licence requirements specify that all city zone substations and transmission feeders must achieve "n-2" capacity by 2014. That is, 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 rebuild or refurbish its existing electricity infrastructure, while maintaining sufficient spare capacity to ensure an ongoing and reliable electricity supply.

1.2 Purpose of this Environmental Assessment

This Environmental Assessment Report (EAR) assesses the environmental impacts of the proposed Sydney CityGrid Project in accordance with the requirements of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

EnergyAustralia consulted with the Director-General of the Department of Planning to obtain the requirements for the form and content of this Environmental Assessment. These requirements are included in **Volume 2, Appendix A**.

The following information is provided in this EAR:

- a description of the need for the Project and its objectives;
- alternatives considered in selection of the preferred option;
- a detailed description of the components of the Project, the associated works and operation;
- details of consultation with statutory authorities and the community;
- assessment and description of the key interactions of the Project with the existing environment, and assessment of the potential for the Project to result in adverse impacts on the environment;
- consideration of hazards and risks;
- detailed measures to avoid or mitigate the potential environmental impacts of the Project;
- a Statement of Commitments by EnergyAustralia relating to the construction and operation of the Project;
- the likely impacts and benefits of the proposed development; and
- justification for the Project, including consideration of the principles of ecologically sustainability development.

This EAR seeks to present the above information to the public, relevant authorities and decision-makers, in a way that assists these parties to understand the Project, its effect on the environment and the consequences of proceeding, or not proceeding with the proposed development.

This report has been prepared with consideration of existing reports, conceptual design work, specialist impact assessment studies, and consultation with the community and Project stakeholders.

1.3 Objectives of the Project

EnergyAustralia is responsible for Australia's largest electricity network serving Sydney, the Central Coast and the Hunter region. Between 2008 and 2020, EnergyAustralia is investing in the order of $16 billion in its network to meet increasing electricity demand and further enhance the high levels of supply and reliability customers have enjoyed. This investment 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 new licensing requirements. The requirements specify that all CBD substations achieve "n-2" (Design, Reliability & Performance Licensing Conditions by the Minister for Energy) by June 2014.

EnergyAustralia's strategy for the Sydney CBD network area is in accordance with these requirements and is based on a holistic approach to network planning, taking 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, while facilitating prudent longer term network investment decisions.

In order to provide a reliable supply for the Sydney CBD EnergyAustralia must between 2008 and 2020, and beyond:

- carry out the construction of new, or upgrade and refurbish existing, zone substations; and
- carry out replacement of high voltage cables supplying the CBD zone substations.

1.4 Overview of the Project

Peak electricity demand in the Sydney CBD is growing at an average rate of 2.4% per annum driven primarily by new residential, hotel and office developments.

EnergyAustralia, over the next ten years, needs to construct new, or upgrade and refurbish existing, zone substations and replace high voltage cables supplying the substations in order 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.

Building works would include the construction of up to three zone substations (and, if necessary, the demolition and/or refurbishment of existing zone substations, which would most likely include integrated commercial/retail developments on or in conjunction with the zone substations within the CBD). The Project also involves the construction of up to three new tunnel sections in the Sydney CBD, and the city fringes, which would 'link' the existing tunnel networks and key zone substations servicing the city together.

1.5 The Proponent

EnergyAustralia is a statutory state-owned corporation owned by the NSW Government. Its distribution network is used to convey electricity from the transmission network operated by TransGrid to end users.

The principal objectives of EnergyAustralia as an energy distributor are prescribed by the NSW *Energy Services Corporations Act 1995*. The principal objectives are:

- to be a successful business;
- to protect the environment;
- to facilitate regional development and de-centralisation;
- to operate safe and reliable electricity distribution systems;
- to be an efficient and responsible supplier of electricity; and
- to participate in the wholesale and retail markets for electricity and other forms of energy.

EnergyAustralia is also a public authority under the EP&A Act.

1.6 The planning approval process

1.6.1 Application of Part 3A of the EP&A Act

By order dated 11 February 2008 made under Section 75B(1) of the EP&A Act, the Minister for Planning declared that the development described below is a project to which Part 3A of the EP&A Act applies:

'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 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)

1.6.2 Approvals process

Part 3A of the EP&A Act outlines the key steps required for the assessment and approval of major infrastructure projects in NSW. The Minister for Planning is the approval authority for all projects assessed under Part 3A.

EnergyAustralia was required to submit a 'Preliminary Environmental Assessment' report to accompany a major project application form. That report, outlines the Project and provides a preliminary assessment of its expected impacts.

The Director-General of the Department of Planning issued EnergyAustralia with specific requirements to be addressed as part of the Environmental Assessment Report (EAR).

This EAR is then lodged with the Department of Planning and reflects the Concept Plan Application. Future Project Applications would be submitted for individual components of the CityGrid Project. Therefore the Department's Assessment Report would reflect this Concept Plan and any further information it has received in this timeframe.

The Director-General, together with other relevant agencies and authorities, assess the adequacy of the EAR prior to its public exhibition. The public exhibition period would be at least 30 days. During this time, submissions would be invited from the public and the Director-General would consult relevant public agencies and produce a preliminary set of recommendations, including environmental and mitigation measures.

At the end of the exhibition period, these recommendations would be forwarded to EnergyAustralia, together with any public submissions received. It should be noted that only a summary of the private persons' submissions (without identification) will be forwarded to EnergyAustralia for the response. If public submissions are received, EnergyAustralia would respond to issues raised and may modify the Project and Statement of Commitments. EnergyAustralia would prepare a Submissions Report for presentation to the Director-General.

If any significant modification to the Project or Statement of Commitments was made at this stage a Preferred Project Report would be prepared clearly defining the revised proposed development, commitments and environmental impacts. That report would be publicly exhibited for a period of no less than 30 days for community information only (no submissions would be received during this period).

The Director-General would evaluate this EAR, the Submissions Report, and any Preferred Project Report, giving consideration to submissions received during the exhibition period.

The Director-General would provide an assessment report to the Minster that includes the matters set out in Section 75I(2) of the EP&A Act. These matters include the EAR, Submissions Report, Preferred Project Report, Statement of Commitments and other relevant information. The Director-General would recommend to the Minister whether to grant approval or refuse the Concept Plan under section 75O of the EP&A Act. If the Director-General is recommending the Project be approved, a set of draft conditions will be prepared.

The Minister may approve or reject the Project and will determine the conditions that apply to the carrying out of the Project. In making his decision, the Minister would consider the matters set out in Section 75J(2) of the Act. The Department would notify the Proponent of the Minister's decision and would publish the Minister's determination along with the Director-General's assessment report on the Department's website. The proposed planning approval process is shown in **Figure 1.1**.

A detailed description of the applicable legislation, regulations, and environmental planning instruments are provided in Chapter 5 – Statutory and Strategic Framework.

Figure 1.1 – Planning approval process

1.6.3 Post-approval activities

Should the Project be approved, EnergyAustralia would notify the local community via a community newsletter distributed to nearby homes and businesses and the project website(s) would be updated with the latest information.

EnergyAustralia would work closely with affected property owners about any potential impacts. Notification letters would be issued to the local community to keep them informed of upcoming activities and key milestones.

Advertisements would be placed in the Sydney Morning Herald and relevant local papers on at least a quarterly basis to keep the wider community informed of activities.

A toll free (from a fixed phone) project hotline and email address would continue to be included on all material for any issues or inquiries in relation to the Project.

1.6.4 Other approvals

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

Approval would be required under the *Crown Lands Act 1989*. Section 46 of this Act requires a licence to be obtained for the extraction of mineral substances.

EnergyAustralia's contractors may seek a licence under the *Protection of the Environment Operations Act 1997* to discharge waters during construction of the proposed development.

Roads and Traffic Authority consent must be obtained under S.138 of the *Roads Act 1993* for works in classified roads; but as a public authority, EnergyAustralia is exempt from the requirement to obtain local council consent for works in non-classified roads, which are vested in councils.

While EnergyAustralia does not intend to obtain or use supplies of sub-surface water from the excavation works required for the project, EnergyAustralia is aware that a licence may be required under Part 5 of the Water Act 1912 for excavations that are capable of obtaining supplies of sub-surface water. The Department of Water and Energy would be consulted in regards to obtaining this licence.

1.7 Structure of this Environmental Assessment Report

The EAR focuses on key assessment requirements specified by the Director-General. These are summarised in **Table 1.1** together with a reference to where they are addressed in this document (a full copy of the Director-General's Requirements are included in **Volume 2, Appendix A**).

Table 1.1 Director-General Requirements and where they are assessed in the EAR

Director-General Requirements	Where addressed in EAR
General requirements	
Executive Summary	**Executive Summary**
Detailed description of the Belmore Park Substation component of the proposal. Clear understanding on the components requiring concept approval.	**Chapter 4,** Belmore Park EAR **Chapter 4**
Assessment of environmental impacts with a focus on the key assessment requirements specified below.	**Chapters 8-15**
Consideration of relevant guidelines including the Department's draft *Network Electricity Systems and Facilities Guidelines* (2002) and ANZECC 2000 Guidelines for Fresh and Marine Water Quality and associated guidelines under the National Water Quality Management Strategy.	**Chapters 5 and 15**
Justification for undertaking the Project with consideration of the benefits and impacts of the proposal.	**Chapter 2**
A draft Statement of Commitments detailing measures for environmental mitigation, management and monitoring.	**Chapter16**
Certification by the author of the EAR that the information is neither false nor misleading.	**Certification of EAR**

Director-General Requirements	Where addressed in EAR
Key assessment requirements	
Project need & justification • Strategic assessment for the Project including justification for the need, scale, scope and location of the Project in relation to predicted electricity demand and transmission constraints, alternatives, and the strategic direction of the State and region regarding electricity supply and demand and electricity generation technologies. • Strategic planning consideration of the Project and an analysis of the suitability of the proposed tunnel route alignments regarding potential land use conflicts with existing and future land uses including other nearby projects. Identify potential impacts to existing and future road and rail infrastructure and early liaison with relevant governing agencies. • An assessment of the potential impacts of the Project to influence changes to future land use character in proximity of the site.	**Chapter 2** **Chapter 3** **Chapter 14**
Visual amenity - Assessment of visual impacts including impacts on local and regional views by substations and related infrastructure. • A design review process for the new electricity infrastructure. The outcome of the design review process for Belmore Park Substation must be provided in the EAR. The design review process should be based on the principles of the design review competition of Sydney Local Environmental Plan 2005, and include consultation with Sydney City Council. • Preliminary visual and design information for the other substations must be included, such as proposed locations, characteristics of the surrounding environment, potential visual impact and design limitations. The EAR must discuss the methodology and scope of the design review process for these Project elements.	**Chapter 8** **Chapter 8, Belmore Park EAR** **Chapter 8**
Traffic & access – Identify transport routes to and from the construction sites and impacts on affected streets and intersections. Consideration of disruption to recreational/business activities and vehicle movements/bus services, including safety impact. Restrictions on access to properties should be identified. Discuss proposed measures/arrangements for minimising impact on these activities.	**Chapter 9**
Noise & vibration – assessment of noise and vibration impacts during both construction and operations in accordance with relevant NSW Government and DECC policies.	**Chapter 10**
Heritage & archaeology – Assessment of impacts on Aboriginal cultural heritage, in accordance with *Guidelines for Aboriginal Heritage Impact and Community Consultation* to identify any Aboriginal heritage issues. Assessment of potential for the Project to impact on known items of non-Aboriginal heritage significance. Consider the likelihood of encountering archaeological material during construction and their management.	**Chapter 11**
Spoil & waste management – Estimate the likely spoil generation and type (including identification of known or potential contamination issues), disposal/recycling sites and management of all types of waste material.	**Chapter 12**
Hazards & risk – Screening of potential hazards to determine potential offsite risks, particularly at the substations and any requirement for a preliminary hazard analysis. Identify any contaminated land affected by the Project. Details of storage and management of materials, fuels and chemicals must be included. Assessment of risks to human health from electric and magnetic fields with reference to Australian Radiation Protection and Nuclear Safety Agency standards.	**Chapter 13**
Property (including settlement) – identify all existing nearby land uses and potential impacts during construction and operation. Identify control and mitigation measures.	**Chapter 14**
General environmental risk analysis – include an environmental risk analysis to identify potential environmental impacts during construction and operation, proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional environmental impacts are identified, an appropriately detailed impact assessment of this additional environmental impact must be included in the EAR.	**Chapter 15**

Director-General Requirements	Where addressed in EAR
Consultation requirements	
During the preparation of the EAR, you must undertake an appropriate and justified level of consultation with the following parties: • City of Sydney Council; • Central Sydney Planning Committee; • Sydney Harbour Foreshore Authority; • NSW Department of Environment and Climate Change; • Department of Water and Energy; • NSW Roads and Traffic Authority; • Transport Infrastructure Development Corporation; • RailCorp; • Sydney Water Corporation; • NSW Heritage Office; • NSW Fire Brigade; • TransGrid; • Royal Botanic Gardens and The Domain Trust; and • Any other relevant agencies and service providers/utilities Appropriate consultation with the local community should be undertaken. The EAR must identify issues raised by stakeholders during the consultation and how these matters have been addressed in the EAR.	**Chapter 6**

2 Project need and justification

2.1 Electricity supply in the Sydney CBD

The main electricity supply to the Sydney CBD is through five zone substations and a network of 33kV and some 132kV feeders. The zone substations range in age from three years to more than 50 years. The older zone substations must be replaced between 2012 and 2017.

Many of the high voltage feeders were installed more than 45 years ago while others were installed between 30 and 40 years ago. A recent condition assessment prepared by EnergyAustralia indicates that a number of critical feeders must be replaced by 2015. In order to find a flexible and long term solution to increasing electricity demand, and in order to minimise disruptions that can occur during extended maintenance, EnergyAustralia is proposing to construct a series of tunnels forming a circuit around the Sydney CBD (linking with the existing City South Cable Tunnel and the City West Cable Tunnel, currently being constructed).

Land required for construction of new substations within the CBD is scarce and, correspondingly, has high financial and public/planning value. To maximize the appropriate use of such land and in the interests of the proposed works being complementary to their CBD surroundings, EnergyAustralia is considering constructing the new substations such that appropriate commercial and/or retail developments can be integrated into or constructed on or adjacent to those substations. EnergyAustralia is carrying out feasibility studies giving consideration to how such commercial and/or retail developments could align with the construction and operation of the proposed new substations. Subject to those studies, mixed developments of this nature may allow for optimum public benefits for the land.

The existing City East Zone Substation, located at the northern end of Lincoln Crescent Woolloomooloo, was commissioned in the 1960s and is approaching time for retirement. A recent condition assessment of the substation recommended that the majority of the equipment should be replaced in the next five to ten years.

After the decommissioning of the existing City North Zone Substation, City East Zone Substation would be the last 33kV/11kV style CBD substation still in service. This style of substation is no longer used in the CBD. The new 132kV/11kV style substations provide a higher level of capacity. It is anticipated that the older style 33kV/11kV substations would remain in service until such time that the 11kV transfer work is complete. The 11kV work is assessed and carried out under the Electricity Supply Act 1995 (NSW), and Part 5 of the EP&A Act, and is not subject to this planning application.

EnergyAustralia has purchased land opposite Belmore Park on the corner of Pitt, Campbell and Hay Streets Sydney to construct a new 132kV to 11kV substation. This substation, to be known as Belmore Park Zone Substation, is required by 2012.

EnergyAustralia is considering options for a new City East Zone Substation and replacement or refurbishment of Dalley Street Zone Substation which is located behind Bridge Street between George and Pitt Streets.

Land has also been purchased at the corner of Riley and Albion Streets, Surry Hills. This land would be used to construct a new sub-transmission switching station to be known as Riley Street STSS and would be the main site for construction of the CSCT extension and the CECT.

2.2 Network investment criteria

Network asset investment by EnergyAustralia is generally required to:

- meet EnergyAustralia's duty of care;
- connect customers to the supply network; and
- provide a satisfactory standard of supply to customers.

The overall performance of the Sydney CBD network is driven by the reliability of individual network components and the redundancy provided by the network to enable maintenance of supply at times when critical parts of the network are out of service (due to maintenance or repair requirements).

To maintain acceptable standards of customer service it is necessary to ensure:

- infrastructure performance (reliability) is maintained at acceptable levels; and
- the network design provides adequate security (redundancy).

2.2.1 Replacement criteria

The reliability performance of equipment and infrastructure is managed through maintenance and replacement of that infrastructure. For EnergyAustralia, the decision to replace infrastructure is based on an assessment of equipment condition and consideration of the strategic replacement needs of the network.

2.2.2 Long-term refurbishment strategy

EnergyAustralia has developed a long-term strategy to replace and/or refurbish its infrastructure.

One of the key challenges in the development of the strategy is the need to ensure that security of supply is maintained to the Sydney CBD while equipment is removed from service for refurbishment or replacement.

2.2.3 'N-2' security standards

Introduction of new licence conditions

Prior to 2005, an 'n-1' security standard was applied to the distribution system assets supplying the Sydney CBD. The existing 132 kV CBD zone substations can supply full load during the outage of a single transformer (a 'n-1' level of security).

The Minister for Energy added a new draft condition to EnergyAustralia's operating licence in August 2005 to adopt 'n-2' reliability criteria for all zone substation transformers and sub-transmission feeders in the Sydney CBD. This draft condition was then made final in December 2007. This means the substation transformers and sub-transmission feeders must be able to deliver the full load requirement with two transformers or feeders offline.

This increased level of security cannot be applied to existing 132/11 kV zone substations without reducing their ratings. It would therefore be necessary to change the design and operating arrangements of the Sydney CBD supply network in order to provide additional capacity to meet the newly imposed 'n-2' security criteria.

New infrastructure

All new zone substations and sub-transmission feeders commissioned after 1 July 2007 must comply with the 'n-2' security criteria.

Existing infrastructure

The 'n-2' licence conditions apply from:

- 1 December 2007 for all newly constructed assets;
- 1 July 2014 as reasonably practical to existing assets; and
- 1 July 2019 fully compliant.

Customer interruptions are required to be less than one minute for the first interruption and less than one hour for the second outage.

Analysis has indicated that if loading of existing Sydney CBD zone substations and sub-transmission feeders is kept within their present firm rating, then the existing Sydney CBD network would comply with the one per cent risk criteria until June 2014.

The existing system would, however, be non-compliant with EnergyAustralia's licence conditions beyond 30 June 2014 when the load 'at risk factor' can no longer be considered.

Modification of the supply and operating arrangements of existing zone substations and sub-transmission feeders would be required to provide additional capacity to meet the 'n-2' licensing conditions. This can be achieved by either providing standby capacity at each zone substation, or by providing load transfer capacity and standby capacity shared between zone substations. Both these options would require a significant reduction in the capacity of existing substations.

Augmentation of the Sydney CBD supply system would therefore be required to simply maintain capacity at its current levels.

2.3 Demand projections

For zone substation capacity planning purposes, EnergyAustralia plans the Sydney CBD as a single entity with any capacity issues at individual substations being catered for by transferring load in zone substations.

After replacement of the City North Zone Substation in 2010 and the subsequent augmentation of that zone, electricity to the CBD will be supplied by five zone substations as shown in **Table 2.1**.

Table 2.1 City zone substation capacities in 2010

Zone	Type	Transformer (Tx) Details	Secure Capacity Current (Mva)	Secure Capacity 2010 (Mva)
New City North	132/11kV	5 x 50MVA	-	189 (N-2)
Existing City North	33/11kV	4 x 15MVA	46 (N-1)	-
Existing City East	33/11kV	6 x 15MVA	62 (N-2)	62 (N-2)
Dalley St	132/11kV	4 x 50MVA	177 (N-1)	177 (N-1)
City South	132/11kV	4 x 50MVA	190 (N-1)	190 (N-1)
City Central	132/11kV	4 x 50MVA	189 (N-1)	189 (N-1)
Total			**664**	**807**

The CBD must, where reasonably practical, comply with new reliability standards of n-2 by 30 June 2014. As it is not possible to provide additional transformers at existing zone substations due to space limitations, EnergyAustralia considers that it will be necessary to reduce the secure capacity of the existing zone substations to achieve the required security improvements. The extent of capacity reductions depends on the extent of remotely switched 11kV interconnection which can be called upon during contingency events. There are two possible methods to achieve the new security standards.

1. Provide standby capacity at each existing 'n-1' substation by reducing the ratings of each existing n-1 substation by the capacity of one transformer. This provides a capacity reduction of 33% at each of the three existing 132/11kV substations within the CBD and does not utilize 11kV interconnection.
2. Restrict the capacity reductions, which would otherwise be required by 1 above, by provision of remotely switched 11kV interconnections to reduce the zone substation capacity impact. EnergyAustralia considers that at a maximum this may reduce the capacity reduction required by 16% of each of the three existing 132/11kV substations.

EnergyAustralia's current preference is to adopt method 1 above and de-rate the existing 'n-1' zones by 33%. **Table 2.2** shows the capacity in 2014 after the new 'n-2' criteria takes affect.

Table 2.2 City zone substation capacities in 2014

Zone	Type	Tx Details	Secure Capacity N- 2 (Mva)
New City North	132/11kV	5 x 50MVA	189
Existing City East	33/11kV	6 x 15MVA	62
Dalley St	132/11kV	4 x 50MVA	118
City South	132/11kV	4 x 50MVA	127
City Central	132/11kV	4 x 50MVA	126
Total			**622**

The existing City East Zone Substation has been identified for replacement in 2017 hence there will be further reductions in capacity of 62MVA in the summer of 2017/18. The new City East Zone Substation will be upgraded from 33/11kV to 132/11kV in line with EnergyAustralia's other major city zone substations.

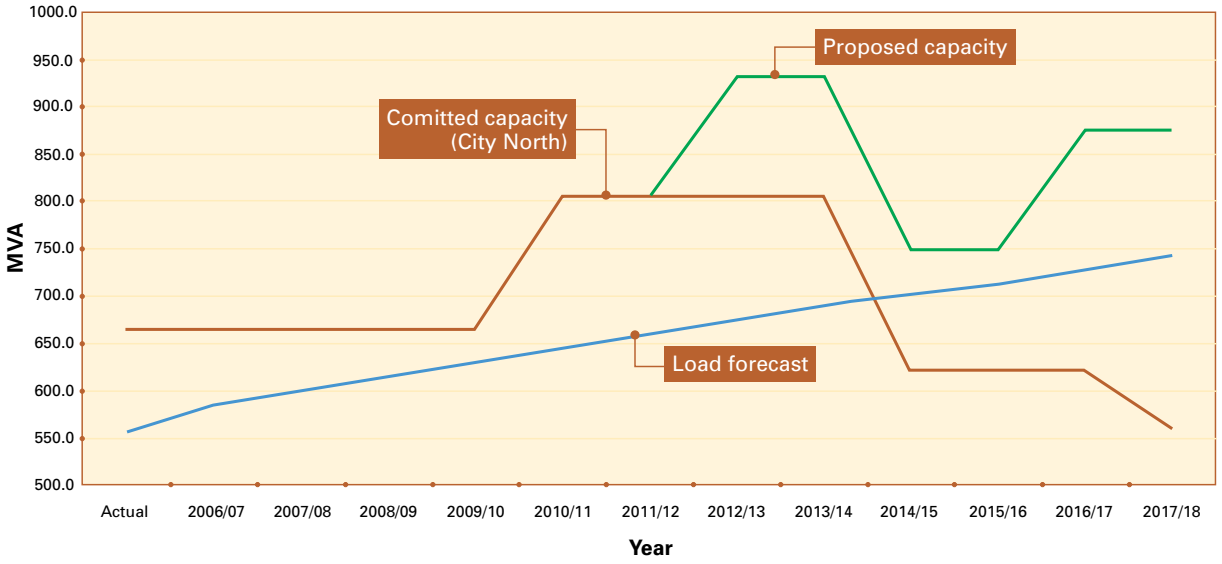
EnergyAustralia's CBD forecast (shown in **Table 2.3**) indicates that overall summer peak demand in the CBD is expected to grow by 106MVA (18%) from 2007 to 2014. This represents an annual growth rate of 2.4% or 15MVA.

Table 2.3 City load forecast (MVA) 2005/2006

Year	MVA
05/06	555
06/07	583
07/08	602
08/09	616
09/10	631
10/11	645
11/12	660
12/13	675
13/14	690
14/15	701
15/16	712
16/17	727
17/18	741

The balance of capacity and demand are shown in **Figure 2.1** below. This shows the demand will reach existing capacity around 2011/12, however, by this time the new City North Zone Substation will be commissioned and load transfers can be made to relieve the existing substations. The figure also shows that there is a shortfall in capacity of 79MVA after the new security criteria takes effect.

Figure 2.1 CBD load forecast / rating



2.4 Demand management

EnergyAustralia has undertaken an analysis of the potential for plausible reductions in demand to enable alternative, more cost effective strategies. This included a review of the technical potential for demand reductions in the CBD based on available information, particularly that arising from the Demand Management and Planning (DM&P) Project, which assessed potential demand reduction opportunities from over 250 major buildings in the Sydney CBD.

Peak demand in the CBD occurs in summer and is driven by demand from offices, hotels and high density residential development in the area. It is affected by temperature and by office, hotel and residential stock and vacancy rates.

Peak demand in the CBD has been relatively flat over the last five years, as a decline in office occupancy and hotel accommodation between the years 2000 and 2004 offset increases in residential demand. Office occupancy rates in 2004/05 returned to the 1999/2000 levels, contributing to a return to the levels of peak demand experienced in 1999/2000. The current growth in office and hotel space is expected to continue for the next few years, resulting in a growth peak in CBD demand.

An econometric forecast has also been carried out for the CBD. (It should be noted that econometric forecasts have substantially short term volatility as they depend on forecasts of economic activity which vary substantially from year to year. This makes them unsuitable as a basis of planning decisions. They do, however, provide a useful indication of long term growth.) This indicates an expected average annual growth rate of 1.6% (11MVA) up to 2020, with an upper limit of 2.2% (15MVA) per annum.

2.5 Consequences of not proceeding

EnergyAustralia would be in breach of its licensing conditions if it did not proceed with the Project as it would not be able to provide the mandatory 'n-2' security standards for the Sydney CBD.

In addition the existing electricity supply capacity to the Sydney CBD is likely to be exceeded around 2012 if the Project and other work on the Sydney CBD supply network do not proceed.

The consequences of this shortage of supply could include:

- power restrictions to residents and commercial buildings during the peak load day time periods during summer;
- restrictions on the use of air conditioning during summer in the Sydney CBD;
- potential for brownouts (a temporary reduction in voltage) and blackouts in the Sydney CBD, resulting in widespread disruption and a variety of emergency situations; and
- restrictions on commercial and residential growth in the Sydney CBD, or restrictions on office space uptake.

The consequences of a lack of network supply capacity would have extensive and wide ranging flow-on effects upon the livelihood of people reliant upon the Sydney CBD.

2.6 Conclusion

Existing electricity supply infrastructure in the Sydney CBD requires refurbishment, replacement and augmentation if the infrastructure is to continue to provide a secure supply of electricity to the increasing population of the Sydney CBD.

While demand management is an important consideration, the primary need for the Project is to allow the replacement of existing infrastructure, and to comply with the new 'n-2' security standard. The Project would achieve these objectives, whilst also providing future flexibility by allowing the system to be upgraded in the future in a cost effective way.

3 Alternatives to the proposed development

3.1 Doing nothing

EnergyAustralia has a duty of care as an asset manager of long-life assets, and it must manage its network to ensure that assets continue to operate in the manner for which they are designed. Where assets fail to perform as required, EnergyAustralia asset managers implement a strategy to address the risk of asset failure and ensure adequate network performance.

Demand growth, asset condition and operational issues influence EnergyAustralia's investment decisions. Where there is more than one driver for an investment, EnergyAustralia seeks to implement investment management strategies that address a variety of network needs to ensure that the replacement programmes, demand management initiatives and augmentation projects complement each other as much as possible.

The consequences of not proceeding with the Project would ultimately result in:

- EnergyAustralia being unable to meet n-2 licence conditions;
- demand for electricity increasing without sufficient existing supply capabilities; and
- reliability issues in the supply of electricity for the Sydney CBD.

EnergyAustralia therefore considers that this option is not acceptable.

3.2 Refurbishing existing substations

Refurbishment of existing substations is not always possible due to the risk difficulties both in operating and maintaining supply. Work in a live substation is restrictive causing the introduction of a number of safety features that could impede or slow down the efficient and effective nature of any planned works. In some instances, it can be seen to be "high risk" from both a safety and supply reliability perspective. Where possible (although not always practicable) EnergyAustralia prefers to build on greenfield sites, where there is less danger of:

- risk to life; and
- risk to supply.

EnergyAustralia considers that refurbishment does not constitute best industry practice, although in some cases where there are limited opportunities to source alternative sites (for example, in the northern CBD area) and where existing electrical infrastructure would require major relocation, refurbishment of existing substations may be the only alternative.

3.3 Using existing cables or trenching in roads

Installing feeder cables by trenching through CBD streets is not considered a practical option for the Project, given the many disadvantages, particularly in a major built up city environment, which include:

- lengthy construction time;
- spoil, dust and noise generation;
- risks to public safety;
- restricted cable rating;
- reduced potential for future expansion;
- restricted cable pulling lengths;
- more joints in the cables (introduces more risk of failure);
- restricted working hours;
- trench reinstatement and integrity;
- vehicular and pedestrian traffic disruption;
- density/congestion of other services;

- integrity of essential services;
- impacts upon businesses and turnover;
- potential compensation claims;
- political opposition;
- community disruption; and
- construction of large vaults in the city streets.

EnergyAustralia has undertaken an options assessment and feasibility study into the practicality and cost effectiveness of installing feeders in buried ductlines through the Sydney CBD between the Riley Street STSS, City East, Dalley Street and City North zone substations. The study concluded that this option is not a viable one from an economic, environmental and strategic view point.

3.4 Belmore Park Zone Substation

EnergyAustralia had been progressing the purchase of a site in the south and the east of the Sydney CBD when an opportunity arose to purchase land opposite Belmore Park. Because the existing 132kV infrastructure is located in close proximity, under Campbell Street, in the form of the City South Cable Tunnel (reducing the cost of extensive 132kV infrastructure and supply), other options were not progressed and meaningful negotiations took place to secure the site.

Investigations for development were undertaken into the following categories:

- stand alone substation;
- substation and separate commercial/retail development; and
- integrated substation and commercial/retail development.

The investigations identified eleven options for assessment and considered opportunities for maximising returns, whilst ensuring the timely delivery of a CBD style zone substation. The findings were as follows:

"The investigation which maximised usage of the residual land value by integrating the zone substation into a commercial/retail development found that the use of the permissible floor space above the substation would technically be achievable and would provide the best return on residual land value."

The integrated option was chosen as the preferred option.

A critical consideration, however, is that the zone substation must be operational by 2012 whereas the integrated commercial/retail developments could be sequenced subject to market requirements.

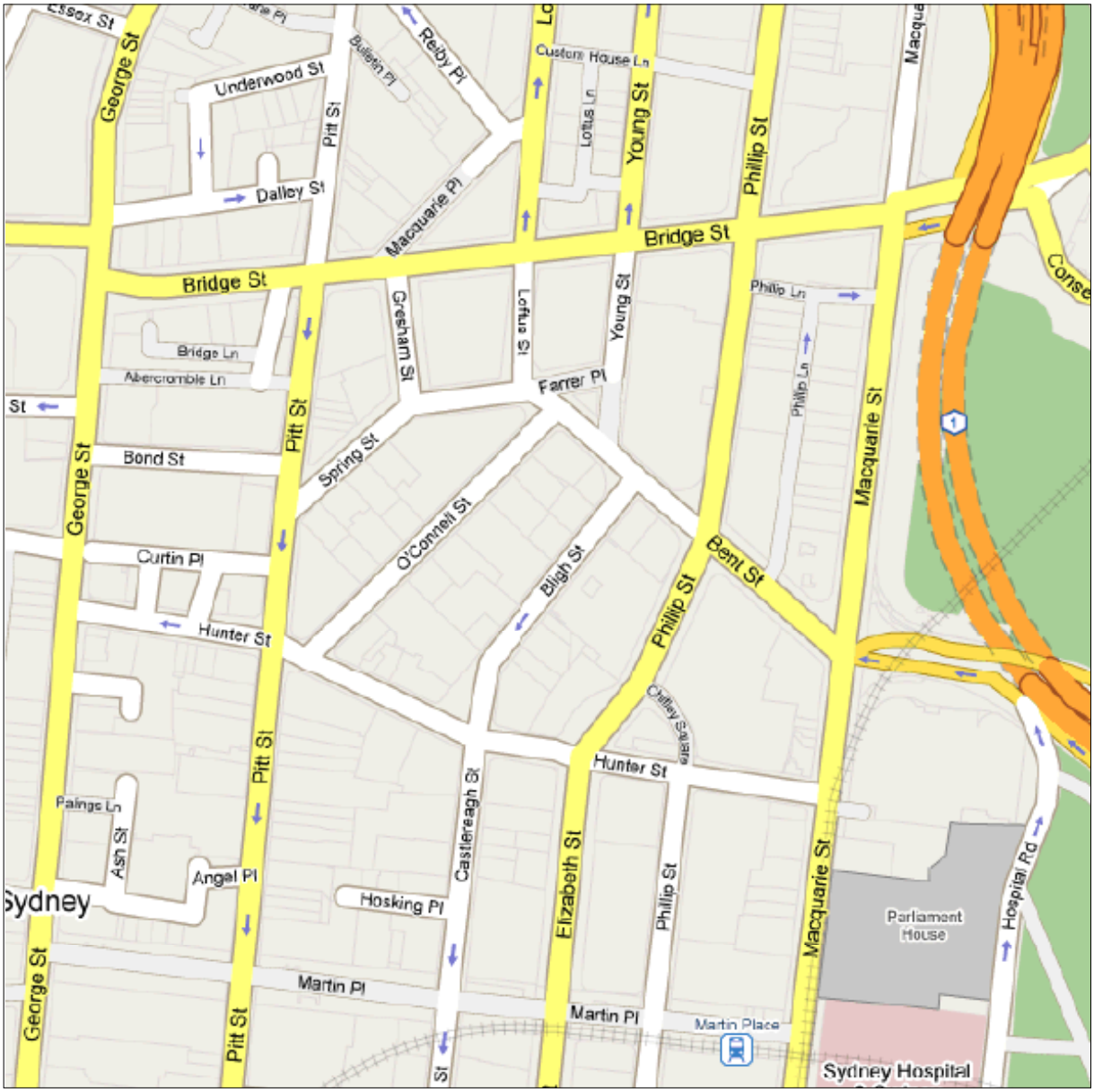
3.5 City East Zone Substation

The existing City East Substation, a 33kV/11kV type, is nearing the end of its design life and must be replaced by 2017. The existing substation must be replaced with a 132kV/11kV substation to meet the objectives of EnergyAustralia's wider integrated replacement strategy.

Given that a replacement 132kV/11kV substation must be commissioned prior to retiring the existing 33kV/11kV substation, a new City East Zone Substation must be built, preferably in the northern sector of the CBD.

At present a preferred location for the new City East Zone Substation has not been identified, however EnergyAustralia is considering a site in the vicinity of Phillip, Bent Street, Bligh and O'Connell Streets, as shown on **Figure 3.1**:

Figure 3.1 New City East Zone Substation locality plan



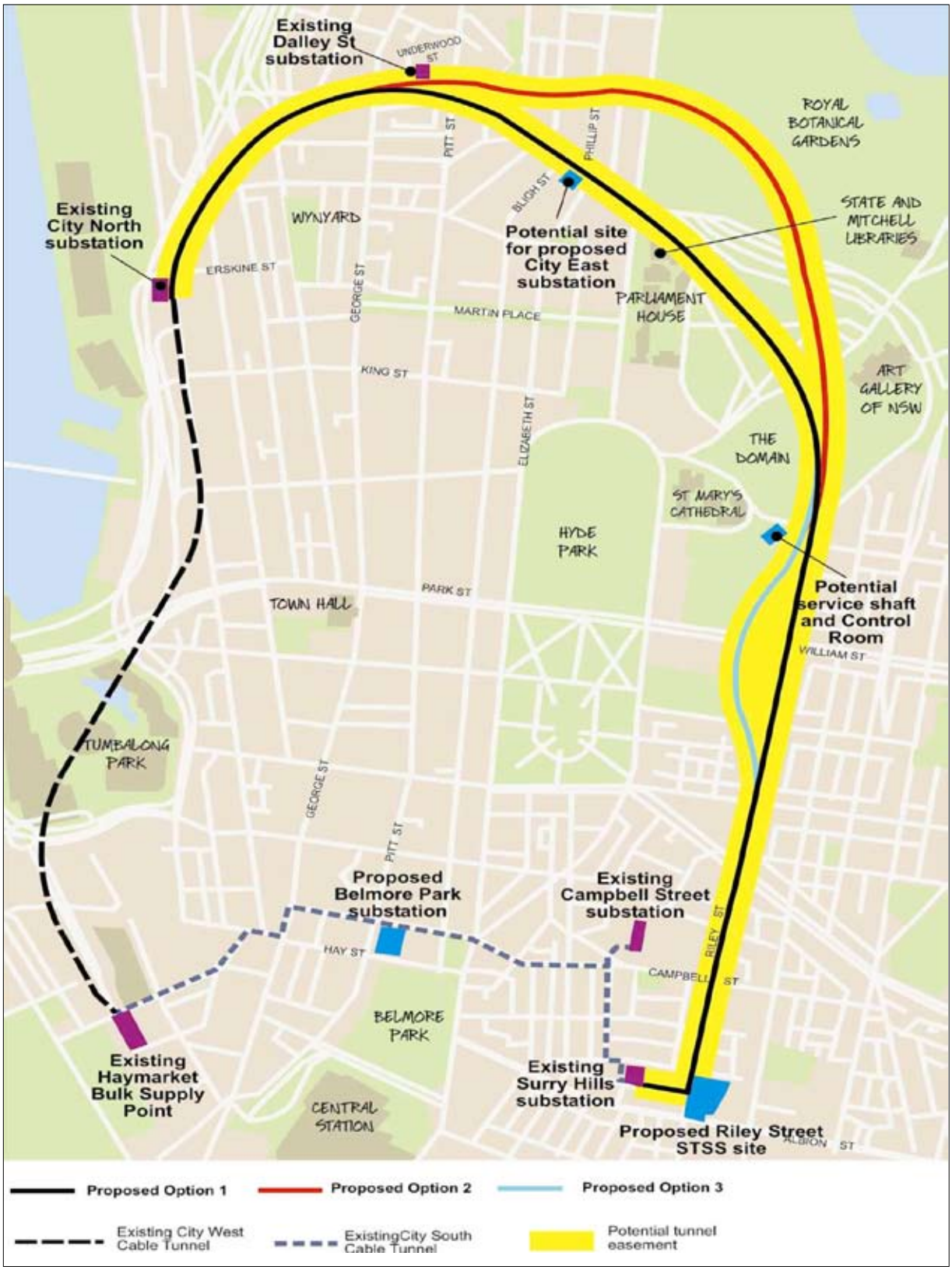
Sites under consideration are being discussed with potential developers and the final choice is subject to detailed negotiations. Given the high value of land in this part of the CBD an integrated substation/commercial development is being considered. It is expected that within an integrated development most of the substation would be accommodated in the lower and basement floors.

4 Description of the Project

4.1 Introduction

A plan showing the locations and elements of the Sydney CityGrid Project is shown in **Figure 4.1** below.

Figure 4.1 Sydney CityGrid Project location plan



4.2 Proposed Project design components

4.2.1 City South Cable Tunnel (CSCT) Extension

It is proposed that the CSCT Extension be constructed between the existing Surry Hills shaft at Wade Place and the Riley Street Site, generally beneath the alignment of Little Albion Street. Other interface works in and around Little Albion Street would also be required.

The Riley Street Site would be used as the primary construction site for the CSCT Extension.

It is anticipated that the CSCT Extension would be excavated using a roadheader machine.

4.2.2 Stub tunnel from the existing City South Cable Tunnel

A small tunnel connection is required from the existing CSCT infrastructure to interface with the proposed Belmore Park Zone Substation. It is anticipated that this Belmore Park stub tunnel connection would be constructed at the time of the bulk excavation for the zone substation works.

4.2.3 Belmore Park Zone Substation development

A zone substation integrated with a commercial/retail development is proposed on the corner of Pitt, Campbell and Hay Streets Sydney with the critical element being the completion of the substation by 2012.

One of the primary objectives for this integrated development is for it to be designed to allow for continuous operation and maintenance of the zone substation unimpeded by other activities that may be occurring within the remainder of the development.

The proposed zone substation development layout allows the residual space above and adjacent to the substation to be used for commercial/retail development. The Gas-insulated transformers are proposed for this substation. These will be configured in a single row along the eastern site boundary, with an additional floor utilised at the top level of the substation to accommodate radiators for cooling the transformers. Use of the air space above the substation is proposed for commercial development.

In order to minimise the required basement depths for the zone substation and in order to optimise the retail areas at street level, the zone substation basement would extend beyond the commercial/retail footprint at ground level on the west side of the substation.

Depending upon projected market demand for the commercial/retail development, the construction of this component may need to be sequenced. If required, short term land use options would be developed for the surplus site area. For example, an interim land use option for the residual land could be to operate a commercial carpark at ground level, similar to the site's current use or provide temporary landscaping until the construction of the remaining development commences.

It is proposed to integrate the substation with an 'A' grade 5+ Star Green Star building, which in itself has the potential to enhance the aesthetics of the area generally. EnergyAustralia considered the possibility of achieving a 6 star Green Star rating for the commercial development, however it was advised that typical rents in this area of the CBD would not be sufficient to justify the additional capital costs required to meet this rating and to place this restriction on the development, particularly in the present economic climate, would be an overly onerous burden.

Further details for the Belmore Park Zone Substation development can be found in the separate EAR seeking project approval under Part 3A of the EP&A Act, which is issued concurrently with this concept approval EAR.

4.2.4 City East Cable Tunnel

Tunnel route options

The preferred option for installing and connecting 132kV feeders between the various substation components of the Project is via the construction of a new cable tunnel, known as the City East Cable Tunnel (CECT). The CECT would form the major backbone for installing 132kV feeders between the various substations.

The CECT would be constructed between the proposed Riley Street Sub-transmission switching station (STSS) and 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 smaller stub tunnel sections to facilitate these substation connections, including:

- stub tunnel connections between the CECT and the new City East Zone Substation and the existing Dalley Street Zone Substation; and
- extension to the existing City South Cable Tunnel (CSCT) to form a link between the Riley Street STSS and Belmore Park Zone Substation.

A preliminary geotechnical study and options assessment of potential tunnel route alignments shown on **Figure 4.1** for the CECT and CSCT Extension resulted in the development of three alignment options described generally as follows:

- option 1 – Riley Street Alignment;
- option 2 – Bridge Street Alignment; and
- option 3 – Yurong Street Alignment.

Further feasibility analysis of these options is currently being undertaken to determine likely constraints, and to assess risks and operational requirements associated with each alignment option.

A number of constraints have been taken into account to-date in assessing the preliminary horizontal and vertical tunnel alignments. Constraints primarily arise from the locations and depths of existing and proposed road and rail tunnels, including the practicalities and limitations associated with modern tunnelling and cable installation techniques.

Preliminary investigations indicate that geological conditions give rise to constraints on vertical and horizontal alignments in the following two areas:

- Sydney Cove and Tank Stream fill and alluvial deposits in the area of the Dalley Street Zone Substation; and
- alluvium within the Woolloomooloo Palleovalley in the vicinity of Yurong Street and Sir John Young Crescent.

The proposed tunnel routes considered to-date are approximately 3.2 kilometres in length and range in depth from approximately 10 to 70 metres below existing ground level. In general, the tunnels would be located beneath existing road alignments, parkland, and private residential and commercial properties. EnergyAustralia would acquire an underground stratum easement for the tunnels, including a distance of approximately three to four metres around the tunnels to protect them from future development.

The following guidelines were adopted in developing the preliminary alignments:

- to locate the tunnels beneath existing road easements as much as is practicable;
- to connect the tunnel/s to the existing Surry Hills Sub-transmission Substation (STS), Dalley Street and City North zones substations, and to the proposed zone substations at new City East and Belmore Park including the proposed STSS at the Riley Street Site;
- a minimum separation to other underground structures of three metres where the tunnels are to be excavated in slightly weathered and fresh sandstone and laminate (for example, the Cross City Tunnel and the proposed Metro West Rail link);
- to provide a minimum plan radius of 300 metres for changes in the TBM tunnel alignment; and
- to limit the maximum tunnel grade to 3% to facilitate efficient TBM excavation and spoil removal.

Notwithstanding the guidelines, the proposed tunnel alignments do pass beneath or adjacent to several existing properties and infrastructure. EnergyAustralia has undertaken a preliminary survey of existing underground infrastructure and building basements/foundations and the preliminary tunnel alignments developed to date have been selected with these issues in mind. The impacts upon specific building foundations and existing utilities' infrastructure would require further assessment during the detailed design phase of the Project, and on a case-by-case basis.

The preferred option for the CECT is the Yurong Street Alignment (option 3). This alignment passes above the Cross City Tunnel alignment and is considered the preferred alignment by Cross City Motorway and the Roads and Traffic Authority (RTA).

The alignment options considered for the CECT are shown in **Figure 4.1**. A number of vertical alignments have been considered for each of these plan options. **Figures 4.2** and **4.3** show the preferred vertical alignment.

Tunnel construction

The Riley Street Site would be used as the primary construction site for the CECT.

It is anticipated that the CECT would be constructed using a TBM.

The internal components of the tunnel would include:

- cable support posts and arms on either side of the tunnel;
- electrical, communication and limited lighting services required for the operation of the tunnel;
- a Supervisory Control and Data Acquisition system (SCADA) to operate and record the operations of the tunnel;
- drainage and ventilation equipment; and
- some form of vehicular transport within the tunnel.

The vertical alignment shown in **Figures 4.2** and **4.3** includes an indication of the relationship of the proposed tunnel alignment with respect to various other existing and proposed below ground infrastructure. The CECT alignment has been designed to have a clear separation from other infrastructure of a minimum of 3m or nominally one tunnel diameter. During the detailed design stage, particular attention will be paid to sections of tunnel at or close to the minimum separation to determine the interaction effects. The design will be adjusted as necessary to ensure any potential adverse effects are mitigated. During construction, monitoring of nearby structures will be carried out as agreed with the relevant stakeholder.

Tunnel dimensions

Feasibility designs undertaken by EnergyAustralia to date indicate that the tunnel components of the Project would have the following dimensions:

- CECT – approximately 3.2 km in length and 4 metres outside diameter;
- CSCT extension – approximately 3.3 metres wide and 4.5 metres high, with an overall length of approximately 150 metres; and
- potentially three stub tunnel connections up to 200 metres in length and with cross-sectional dimensions 4 metres wide x 4 metres high.

Indicative cross-sections for the CECT and CSCT extension are shown in **Figure 4.4** and **Figure 4.5**:

4.2.5 Services shaft and control room

A services shaft and control room is required to house the major tunnel control services, particularly the tunnel ventilation system, and is presently being considered at two possible locations.

The preferred location is to integrate the CECT services shaft and control room within or adjacent to the Riley Street STSS building.

Alternatively, the Services shaft and control room may be required at an intermediate location along the tunnel alignment. This option would most likely require the construction of a shaft connection between the control room and the tunnel. To date, EnergyAustralia has identified a potential alternative location for this facility in the vicinity of Cook and Phillip Park, adjacent to St Mary's Road and Yurong Parkway, however, the ultimate location would be determined during the detailed design phase of the Project.

4.2.6 City East Zone Substation

A new City East Zone Substation is also required to be constructed which may include an integrated commercial/retail development. The specific site is still to be confirmed. A detailed Environmental Assessment in support of a separate project approval would be submitted to the Department of Planning at a later date.

The CECT would be designed to allow for the connection of five 132kV feeders at new City East Zone Substation, emanating from the Riley Street STSS. Similarly, the City East connection must also allow for the installation of the four 132kV feeders that would run between the new City East Zone Substation and Dalley Street Zone Substation.

City East Zone Substation would need to be commissioned by 2017.

4.2.7 Sub-transmission Switching Station

A new STSS is required at Riley Street, Surry Hills by 2015. The STSS would be established to provide a connection of the eastern CBD load and the 132kV supply to the Eastern Suburbs. Also to provide 132kV connections for a future Bulk Supply Point to be located immediately adjacent, post 2020.

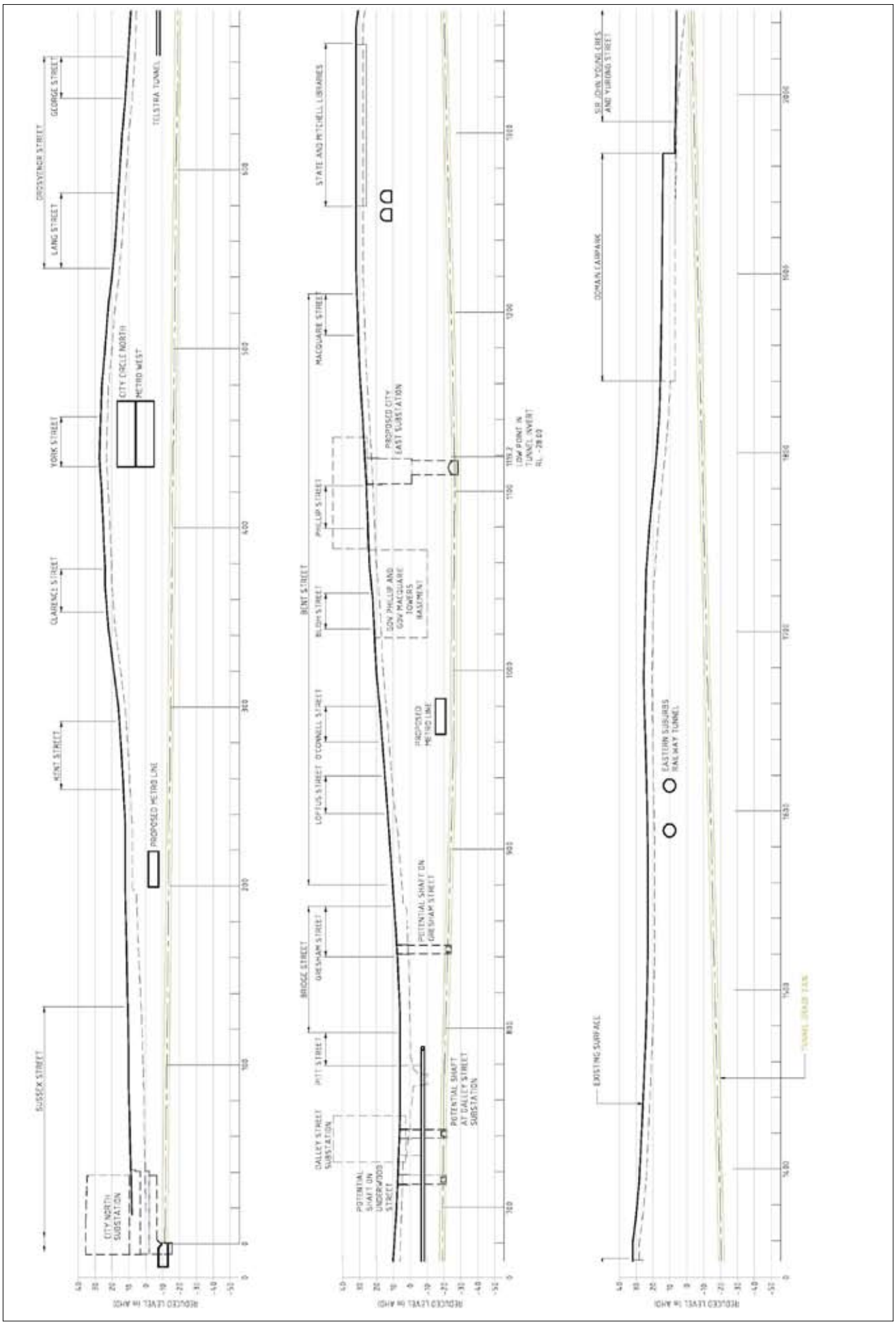


Figure 4.2 CECT preferred vertical alignment part 1

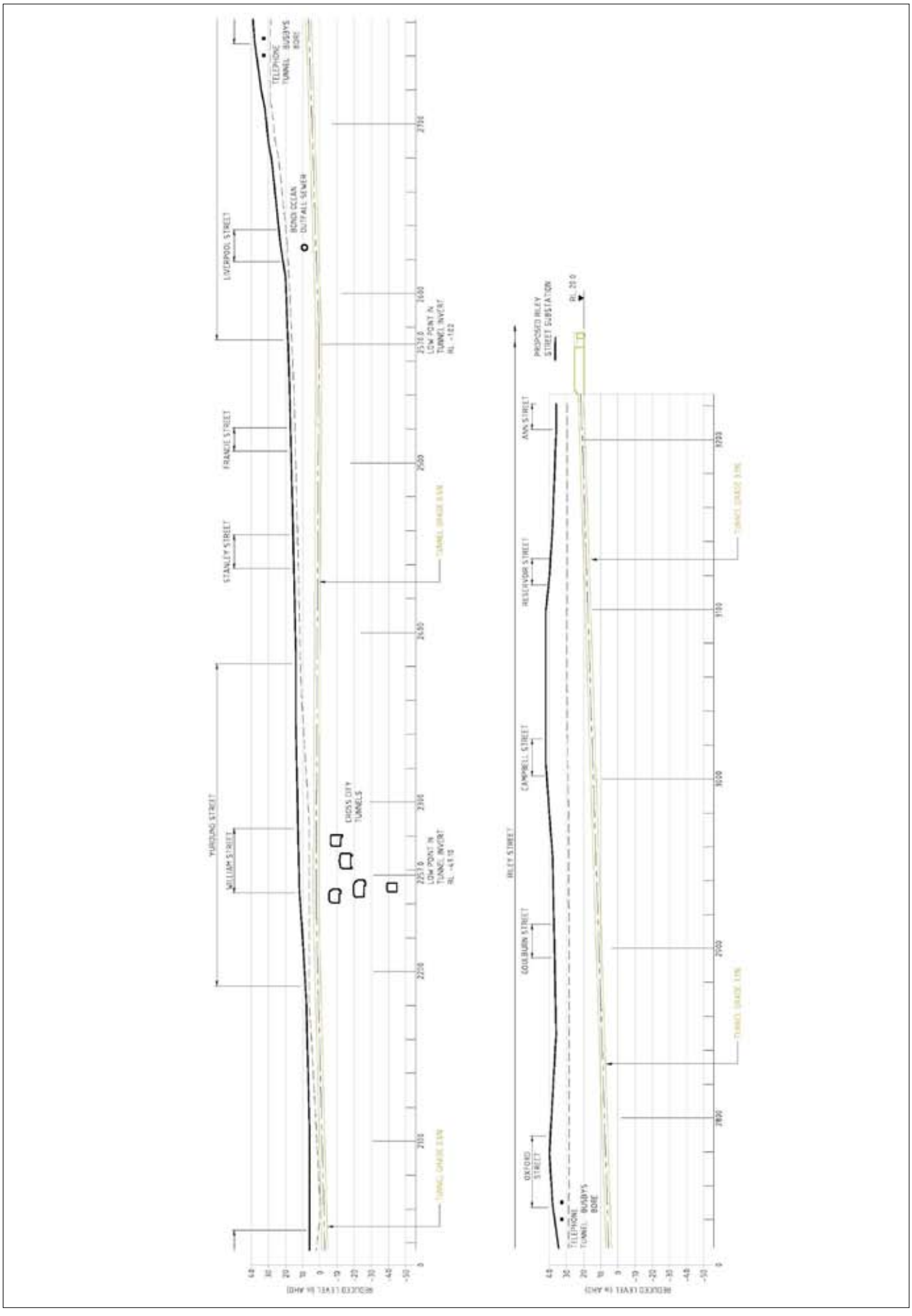


Figure 4.3 CECT preferred vertical alignment part 2

Figure 4.4 Typical section – City East Cable Tunnel

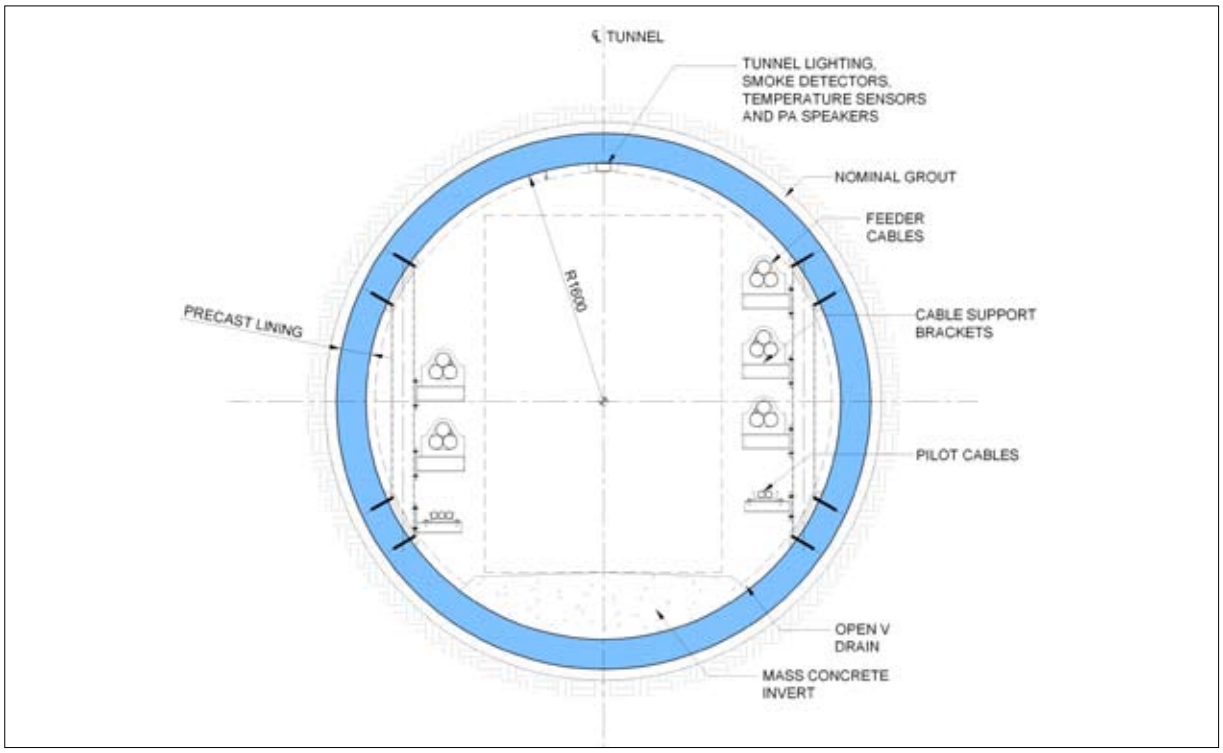
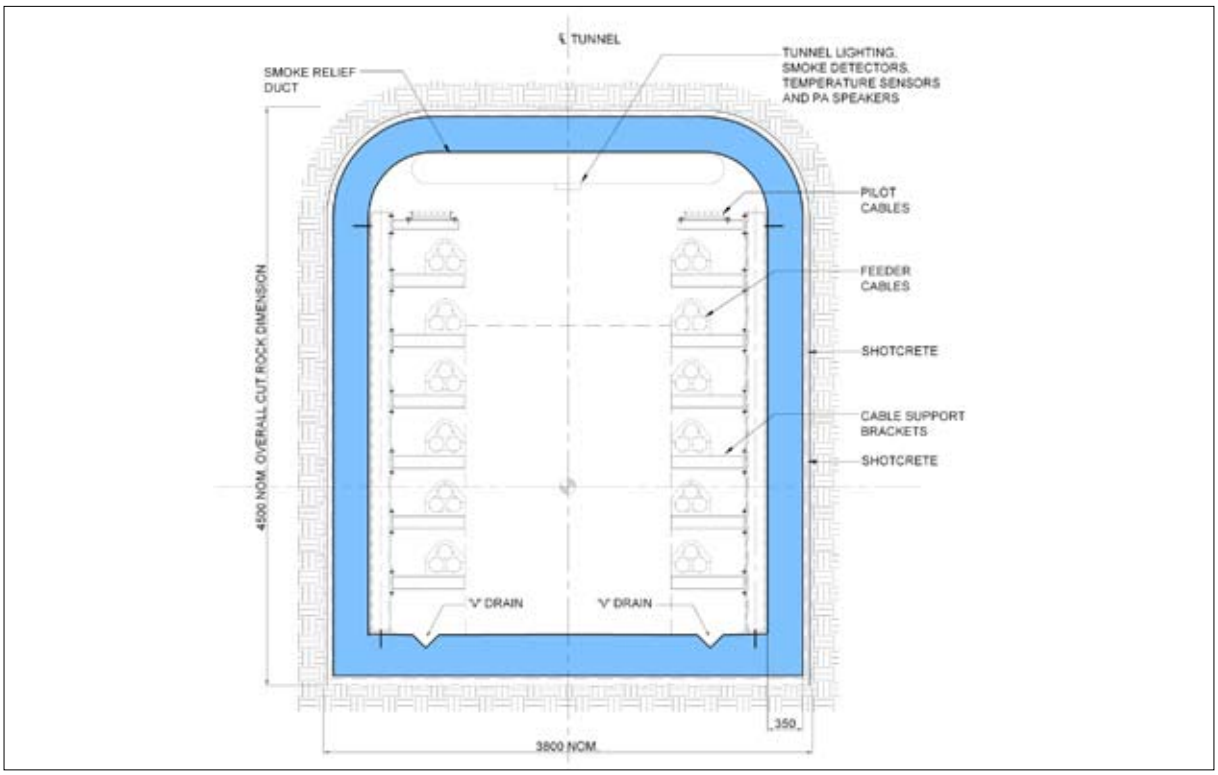


Figure 4.5 Typical section – City South Cable Tunnel Extension



It is envisaged that most, if not all, of the tunnelling works would need to be complete at the Riley Street Site, prior to commencing construction of the STSS. However, options are being considered for sequencing both the tunnelling and the STSS works at the site concurrently.

Partial excavation of the land has already been carried out following the demolition of the previous building on that site. There is also a hoarding installed around the perimeter, however, further bulk excavation would be necessary to prepare the site to the required reduced levels (RL) for the subsequent design of the STSS and the tunnel chamber prior to construction of the CSCT Extension and the CECT.

4.2.8 Dalley Street Zone Substation

Dalley Street Zone Substation was commissioned in 1969 and is an important asset feeding the northern end of the CBD. Presently, 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. The remaining feeders have been prioritised for retirement by 2017. Therefore, refurbishment or replacement of the existing zone substation must be achieved to support new feeders emanating from new City East Zone Substation.

In order to establish the connection between the CECT and the Dalley Street Zone Substation, it is envisaged that a shaft would be constructed in close proximity to the substation, and connected to CECT via a short stub tunnel. Localised surface works (for example, trenching and excavation) in and around Dalley Street would also be required to connect the shaft to the substation and to facilitate installation of feeder cables.

4.3 Potential interfaces

4.3.1 Cross City Tunnel

The Cross City Tunnel (CCT) comprises two main east to west tunnels and a number of on and off ramp tunnels in the vicinity of Riley/Crown/Yurong Streets, and a ventilation tunnel that lies below all of those features.

It is not considered viable to thread the CECT between the CCT at Riley Street hence as one option the CECT would have to pass below the CCT (ventilation tunnel), a depth of about 65 metres below William Street.

Based on preliminary investigations and to avoid these excessive depths, it is considered feasible to align the CECT above the CCT.

The preferred option is the Yurong Street alignment (**Option 3, Figure 4.1**) which passes above the CCT alignment and intersects it at approximately 90°. Discussions with Cross City Motorway and the RTA also favoured this option, which passes within about 6 metres above the CCT crown.

4.3.2 Proposed North West Metro

The preliminary information obtained on the proposed North West Metro rail tunnel alignment indicates that these tunnels may have an invert at about RL-21 metres at Bent/O'Connell Streets and about RL-16 metres in the vicinity of Wynyard Station/Kent Street. The CECT is approximately 5 metres below the North West Metro at this intersection.

EnergyAustralia has held preliminary discussions with the Transport and Infrastructure Development Corporation (TIDC) in regard to these alignments, and further assessment would be required during detailed design to ascertain the extent of potential interfaces and/or clashes.

4.3.3 MetroWest and MetroPitt

Preliminary information regarding the proposed MetroWest tunnels indicates that they could be at about RL–5 metres where they pass beneath York and Grosvenor Streets. Furthermore, it should be noted that the Metropolitan Rail Expansion Programme (MREP) is considering a wide variety of routes and the final alignment has not been confirmed at this time. The CECT crown at this location is approximately 10 metres below these rail corridors.

4.3.4 City Circle Rail Line

Near the intersection of Grosvenor and York Streets the inverts of the rail tunnels are at about RL+5.8 metres whereas below the State Library the inverts of the tunnels are at about RL+11 metres. The CECT is well below these rail lines, in the order of 20 to 30 metres.

4.3.5 Eastern Suburbs Rail Line

In the vicinity of Art Gallery Road, where the proposed CECT alignments cross the Eastern Suburbs Rail Line, the inverts of the rail tunnels are between about RL+6.6 metres and RL+8.7 metres, some 15-20 metres above the proposed CECT alignment.

4.3.6 Dalley Street Telstra Cable Tunnel

The tunnel invert is at about RL-8.5 metres along Dalley Street, and nominally 14.5 metres below the corner of Pitt and Dalley Streets. The CECT is approximately 10 metres below the Telstra tunnel.

4.3.7 Tank Stream

The Tank Stream at Dalley Street is located above the level of the Telstra Cable tunnel.

4.3.8 Sydney Water Assets

Major underground water assets potentially affected by the CECT include the Bondi Ocean Outfall Sewer (BOOS) and Busby's Bore. The preliminary CECT alignments developed to date consider the location of these assets and EnergyAustralia has held talks with Sydney Water regarding potential interface issues. The impact of the CECT on these assets would be assessed further during detailed design, however, it is anticipated that the CECT will pass more than 3 metres below these assets.

4.3.9 EnergyAustralia interfaces

Little Albion Street interface

Existing feeders that enter the Surry Hills STS and the Annex Building from Little Albion Street would ultimately be cut, jointed and extended to the Riley Street STSS through the CSCT Extension.

Interface works in and around Little Albion Street would be required to reconfigure the existing 132kV supplies to the Surry Hills STS and Riley Street STSS. Existing 132kV cables buried in Little Albion Street would need to be cut, jointed and re-routed into the CSCT Extension. To achieve this, the following works are envisaged in Little Albion Street:

- • excavation and construction of joint bays within Little Albion Street;
- • potential construction of small bored shafts within Little Albion Street to facilitate connection to the CSCT Extension;
- • potential shoring works to protect adjacent structures; and
- • cable installation and jointing in Little Albion Street and Wade Place.

City East Zone Substation interface

Planning and feasibility studies in regard to the construction of a new City East Zone Substation are underway and an area in the northern CBD, in the general vicinity of Bent Street is considered to be a favourable location.

The CECT would be designed to allow for the connection of five 132kV feeders at new City East Zone Substation, emanating from Riley Street STSS. Similarly, the City East Zone Substation connection must also allow for the installation of four 132kV feeders that would run between the new City East and Dalley Street zone substations. The following three potential options have been identified to achieve those requirements:

- • a shaft, and associated headworks within, or nearby to the substation building, and connection to the tunnel either directly or by stub tunnel between the main CECT alignment and the shaft;
- • construction of a cable vault near to the substation building and then connection to the CECT alignment via directional drilling or micro-tunnelling; and
- • direct connection between the CECT alignment and the substation basement via directional drilling or micro-tunnelling.

Dalley Street Zone Substation interface

The Dalley Street Zone Substation is situated on Dalley Street, between George and Pitt Streets. The CECT is to be designed to allow for the connection of four 132kV feeders at Dalley Street, emanating from the new City East Zone Substation. Similarly, the Dalley Street connection must also allow for the installation of the four 132kV feeders that would run between the Dalley Street and City North zone substations. To achieve these requirements the same three options as described for City East Zone Substation interface are proposed.

City North Zone Substation interface

The City North Zone Substation is located at the corner of Sussex and Erskine Streets and is currently under construction. The substation has a basement specifically constructed to allow a direct connection between the City West Cable Tunnel (currently under construction) and the substation. There is provision to allow a future connection to the CECT. This interface will be constructed at tunnel level immediately adjacent and to the north of the CWCT connection.

4.4 Construction of the proposed development

4.4.1 Timeframe

Nominal key target dates have been developed for the Project and are shown in **Figure 4.6.**

4.4.2 Substation construction

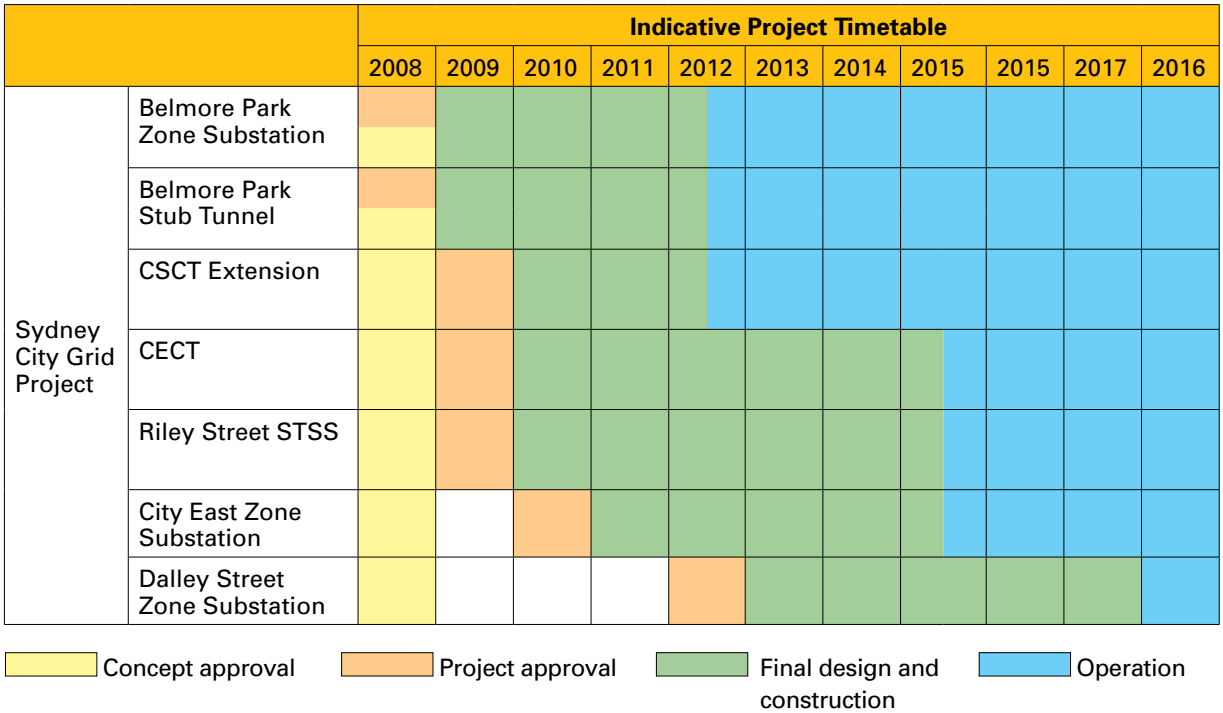
Details of construction sequencing for Belmore Park Zone Substation are provided below:

- site establishment activities – such as the erection of site sheds and the establishment of temporary power;
- site preparation activities – such as the erection of hoardings,
- services disconnections and diversions and site survey;
- bulk excavation works;
- construction of the zone substation; and
- construction of the commercial component.

Depending upon projected market requirements for the commercial/retail development, the construction of this component may need to be sequenced. If required, short term land use options would be developed for the surplus site area. For example, an interim land use option for the residual land could be to operate a commercial carpark at ground level, similar to the site's current use or provide temporary landscaping for public amenity until the construction of the remaining development is commenced.

At this stage, construction sequencing for the City East Zone Substation and the Dalley Street Zone Substation has not been finalised and would be dealt with in the future project approval EARs.

Figure 4.6 Nominal key target dates



4.4.3 CECT & CSCT Extension

EnergyAustralia has purchased land on the corner of Riley and Albion Streets, Surry Hills, which is proposed for use as the primary construction site for the CECT and CSCT Extension works, and preferably for use as the Services Control Room for these tunnels.

The major CECT alignment would be constructed using a tunnel boring machine (TBM) launched from the Riley Street Site, which would be the main tunnel construction site. The TBM launch chamber and CSCT Extension between the Riley Street Site and Surry Hills STS would be constructed using a roadheader machine.

For the CECT alignment, precast concrete segments would be installed behind the machine as it progresses, in order to form the permanent lining for the tunnel. Subject to design requirements, it is envisaged that the CSCT Extension would be constructed with a cast in-situ reinforced concrete lining and waterproof membrane.

All of the spoil from the tunnel excavation would be removed via the TBM launch cavern and construction compound to be established at the Riley Street Site.

Similarly, all construction materials required for the construction of the tunnels would be delivered via the Riley Street Site.

It is anticipated that underground construction works would be carried out 24 hours per day, seven days per week, including some downtime for maintenance on the tunnel boring machine. Construction works outside of the tunnel, and above ground, would typically be carried out during the following hours:

- 7 a.m. to 5 p.m. Monday to Friday
- 8 a.m. to 12 p.m. Saturdays
- No work on Sundays or Public Holidays.

Oversize trucks and certain equipment and material deliveries (tunnel boring machine and roadheader machine) may need to be made outside of standard construction hours from time to time.

4.4.4 Riley Street Site

The site for the proposed Riley Street STSS is on a vacant block of land at the corner of Riley and Albion Streets. With an overall area of approximately 5200m^2, the site is ideally located for the construction of the substation, and for use as the main construction site for tunnelling works associated with the CECT and CSCT Extension.

The Riley Street Site would be utilised as a construction site for the installation of 132kV cables within both tunnels and depending on design outcomes, may ultimately be utilised to house the Services Control Room.

The site has three street frontages, being bounded by Albion, Riley and Ann Streets with the Riley Street frontage situated approximately 150 metres from the existing Surry Hills STS.

It is proposed that the CSCT Extension between the Riley Street Site and the Surry Hills STS, be constructed generally beneath Little Albion Street.

As noted previously, it is envisaged that the Riley Street Site would be used as the primary construction site for both tunnel alignments noted above, with the CECT constructed using a TBM, and the CSCT Extension constructed using a roadheader machine.

The following general construction sequence is envisaged at this location:

- bulk excavation for the Riley Street Site;
- site setup and mobilisation;
- construction of the tunnelling launch chamber beneath Riley Street;
- construction of the CSCT Extension between the Riley Street Site and the existing Surry Hills shaft at the corner of Wade Place;
- construction of the CECT between the Riley Street Site and the City North Zone Substation;
- construction of Services Control Room at the Riley Street Site (to be confirmed following detailed design);
- finalisation of tunnel construction works;
- construction of the STSS; and
- cable installation and commissioning.

In addition the following would be constructed at this location:

- access for construction personnel and equipment;
- temporary ventilation facilities required for construction purposes;
- facilities required for the removal of spoil from the tunnel and the delivery of precast concrete lining segments, and other construction equipment and materials to the tunnel;
- underground spoil handling and storage facility; and
- any other infrastructure required to service construction techniques and sequencing.

To ensure that noise levels are kept within regulatory limits, the requirements for noise walls or temporary noise reducing structures (acoustic shed) to be built around the construction site would be considered during the design of this site.

It should be noted that at some time in the future the remainder of the Riley Street site may be developed to accommodate a future Bulk Supply Point (BSP). However, this would be subject to a separate planning application by TransGrid.

EnergyAustralia may complete the shell of the BSP as part of the STSS design and construction works, which would minimise the disruption to the community. However, fit out of TransGrid's electrical equipment and associated cables would be carried out post 2020 under separate planning approval.

Once the works are complete on the site, EA would review options for the residual land. These may include commercial and/or community use. This would be dependent upon further detailed design consideration, layout options and commercial considerations. Further details would become available in the assessment and design of this component of the Project and would be detailed in the future project approval EAR.

TBM launch chamber

In order to construct the CECT and CSCT Extension from the Riley Street Site, it is envisaged that a launch chamber / construction adit be excavated beneath Riley Street itself, to allow roadheader excavation to proceed to the west along Little Albion Street, with TBM excavation proceeding north along Riley Street.

Ideally, the launch chamber would be constructed to a depth similar to that of the lowest substation basement, which would facilitate future cable installation activities and ultimately provide for at-grade connections between the substation and tunnel alignments. Indicatively, basement levels of the substation would extend to approximately 20 metres below existing ground level.

Post-construction access

In regard to the operational access to the CECT, EnergyAustralia's preferred option is that the Riley Street Site be designed to accommodate the Services Control Room including permanent access and ventilation requirements for the tunnels. Whilst the tunnels are to be designed as an accessible structure, the requirement for access to the tunnels would be infrequent, possibly once every six months.

Notwithstanding the requirements for access generally, the substation would be secured from both tunnel alignments by means of a lockable fire rated door at the entry to the STSS cable basement.

4.4.5 Tunnel fitout

Tunnel fit-out would commence directly after the roadheader machine and the TBM are removed from the respective tunnels. Once the tunnels are fully lined and the floor slab constructed, fit-out of the cable support structures would commence, including:

- installation of steel cable support posts and arms on either side of the tunnel;
- installation of access platforms and stairs;
- electrical, communication and limited lighting services required for operation of the tunnel;
- installation of the SCADA system, to operate and record operations of the tunnel; and
- installation of the feeders.

4.4.6 Cable installation

Once fit-out is complete, the tunnel would be ready for cable installation. The cables would be fabricated off-site in approximately one-kilometre lengths, and transported to site. Once the cables are installed and in position, separate lengths of cable would be jointed within the tunnels.

4.4.7 Construction workforce

Approximately 290 full time equivalent construction jobs would be generated during the construction phase.

4.5 Commissioning of the 132kV feeders

Once each individual cable is installed and clamped into position, termination of each feeder would commence. On completion of this task 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 24 hours before being placed into full service.

4.6 Operation of the Project components

The substations and cables 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.

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).

4.6.1 Operational workforce

Approximately 18 full time equivalent jobs would be generated.

4.7 Capital investment value

The capital cost of the Project is estimated to be approximately $800 million. This is broken down as follows:

- Belmore Park Zone Station $125 million
- CSCT Extension & CECT $200 million
- City East Zone Substation $170 million
- Dalley Street Zone Substation refurbishment or replacement $170 million
- Riley Street STSS and site works $100 million
- Ancillary construction works $45 million

Ancillary construction works include connections and extension of existing duct lines to interface with each of the above components, construction of cable vaults, duct lines and trenching, as well as reinstatement of road surfaces, licences and approvals.

Note that these are strategic budget estimates, and costs would be further refined once assessment and detailed design is carried out.

5 Statutory and strategic framework

5.1 NSW planning approval process

On 11 February 2008 the Minister for planning declared the Project to be a project to which Part 3A of the EP&A Act applies. Refer also to Section 1.6 of this EAR.

5.1.1 Part 3A of the EP&A Act 1979

Part 3A of the EP&A Act commenced on 1 August 2005 and consolidates the assessment and approval regime for all major projects that need the approval of the Minister for Planning. Previously these were dealt with under Parts 4 and 5 of the Act. Part 3A applies to State Government infrastructure projects, developments previously classed as State significant, and other projects, plans or programmes as declared by the Minister. It provides a separate streamlined and integrated development assessment and approvals regime for major infrastructure and other projects of significance to the State of NSW. Clause 75B states:

'(1) General

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

- by a State environmental planning policy; or
- by order of the Minister published in the Gazette.'

5.1.2 Environmental planning instruments

Clause 41 of the State Environmental Planning Policy (Infrastructure) 2007 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.

There are no State Environmental Planning Policies (SEPPs) that substantially govern the carrying out of the Project, and accordingly, no SEPPs have been considered in this application.

No aspect of the Project is therefore prohibited.

5.2 Commonwealth legislation

A search of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 protected matters (National Environmental Significance) database shows that a number of sites listed on the Register of the National Estate are close to the proposed Project corridor.

The Project is unlikely to result in any significant impact on the protected matters and, as such, the Proponent has decided not to refer the Project to the Commonwealth Minister for the Environment pursuant to the Environment Protection and Biodiversity Conservation Act 1999.

5.3 Other planning guidelines

This EAR, and planning activities for the Project generally, have been undertaken with due consideration to the following guidelines, which are referenced throughout this document:

- ANZECC 2000 – Guidelines for Fresh and Marine Water Quality; and
- PlanningNSW – Network Electricity Systems and Facilities, draft EIA Guidelines (July 2002).

6 Stakeholder consultation

6.1 Introduction

Part 3A requires the Director General of the Department of Planning to consult with relevant stakeholders in the preparation of the EAR for the Project. Depending on the nature of further assessments required for the various elements of the Project (be it Part 3A or another Part of the EP&A Act), EnergyAustralia would carry out further environmental assessment and community consultation, which may allow, or require, further input prior to the carrying out of aspects of the Project.

6.2 Consultation approach

EnergyAustralia is committed to working closely with the community throughout both the planning and construction phases of the Project. Consultation with the community and other key stakeholders has been underway for more than a year and is ongoing. **Table 6.1** below identifies stakeholders who have already been consulted as part of the planning and environmental assessment process.

Table 6.1 Identified stakeholders

Participants	
Local and State Government	• Department of Planning • City of Sydney • Department of Environment and Climate Change • Roads and Traffic Authority (RTA) • Transport Infrastructure Development Corporation; • Ministry of Transport • NSW Heritage Office • RailCorp • NSW Fire Brigade; • State Transit Authority • Department of Water and Energy • Sydney Water Corporation • TransGrid • Royal Botanic Gardens and The Domain Trust
Other stakeholders and community groups	• Neighbours impacted through construction and new land use • Businesses impacted through construction and new land use • NSW National Trust • Australian Stock Exchange • Telstra • Cross City Tunnel • Local community and resident groups • Local Aboriginal Land Councils • Environment groups • Special interest groups • Other potential organisations and utilities • State Library of NSW
General community	• Interested members of the broader community who may wish to make comments through any public exhibition process required. • Schools • Day Care Facilities

6.2.1 Approach to stakeholder consultation

EnergyAustralia aims to involve the local community at the planning stage of its infrastructure projects to balance local issues against the wider community's increasing electricity needs and its promise to deliver safe and reliable electricity for customers. In developing projects, EnergyAustralia places a high value on engaging local communities to achieve an outcome that assesses social, environmental, technical and economic needs.

EnergyAustralia is committed to working closely with the community throughout the planning and construction phases of this Project. Consultation with the key stakeholders has taken place as detailed in **Section 6.3** below.

Futhermore, it is intended that for each future project approval EAR, additional and ongoing consultation would be required covering community information sessions and government agency discussions.

A Planning Focus Meeting was held on 28 April 2008. The following government agencies attended:

- RailCorp;
- EnergyAustralia;
- Ministry of Transport;
- Transport Infrastructure Development Corporation;
- Department of Water and Energy;
- City of Sydney Council;
- Department of Planning;
- Department of Environment and Climate Change;
- Roads and Traffic Authority; and
- Heritage Branch (Department of Planning).

A copy of the minutes of the Planning Focus Meeting (PFM) are included in **Volume 2, Appendix A.**

The issues raised by these government agencies at or subsequent to the PFM informed the preparation of the Director General's Requirements and the Environmental Assessment.

6.2.2 Outline of consultation activities

Table 6.2 provides a summary of the consultation activities undertaken by EnergyAustralia.

6.3 Key issues raised

6.2.1 Government agencies

The Director General's Requirements (see **Volume 2, Appendix A**) identified the need to consult with a number of government agencies during the preparation of the Environmental Assessment. A summary of the issues raised, along with responses or where the issue has been addressed in this EAR is provided in **Table 6.3**.

Table 6.2 Summary of consultation activities

Stakeholder	Mechanism						
	Personal Meeting	News-letter	Group Meeting	Correspondence	Ad in Local Paper	Ad in Regional Paper	Website
Neighbours to Belmore Park and Riley Street sites							
Department of Water and Energy							
Royal Botanic Gardens and The Domain Trust							
Cross City Motorways							
RailCorp							
Community and environmental groups							

Stakeholder	Mechanism						
	Personal Meeting	News-letter	Group Meeting	Correspondence	Ad in Local Paper	Ad in Regional Paper	Website
TransGrid							
NSW Fire Brigade							
Broader community							
NSW Department of Environment and Climate Change							
Department of Planning							
NSW Heritage Office							
Sydney Harbour Foreshore Authority							
NSW Roads and Traffic Authority (RTA)							
Transport Infrastructure Development Corporation							
Sydney Water Corporation							

Table 6.3 Summary of government agencies' issues and responses

Government Authority	Issues Raised	Response or Where addressed in EAR
City of Sydney Council & Central Sydney Planning Committee	• Contamination on Riley Street Site - previous owner did not address the dewatering issues especially during heavy rainfalls – water logging has become an issue for mosquitoes in times of hot weather. • Complaints have been received from residents regarding the condition of the hoarding at the Riley Street Site (from a safety perspective). • Complaints have been received from residents regarding the display of posters on hoarding around the Riley Street Site. • Residents are continually raising questions about the use of the Riley Street Site. • To satisfy the requirements of Part 5 Division 2 of the Sydney LEP, it is necessary for the development to go through a competitive process, generally in the form of a design competition. In particular this should apply to the design of Belmore Park, City East and Dalley Street zone substations. • Belmore Park Zone Substation should comply with the sun access plane particulars contained in schedule 2 of the Sydney LEP 2005. • It is recommended that consideration is given to encouraging active uses at ground floor level of Belmore Park Zone Substation through the mid-block connection.	• The following comments have been noted and further dialogue and investigations would occur during design development and a future EAR seeking project approval. • A design review process has been specified in the Director General's Requirements. • Chapters 5 and 8 • Chapter 5 and 8
Sydney Harbour Foreshore Authority (SHFA)	• The Project is not within SHFA's land - no issues raised.	• A copy of the EAR would be forwarded to SHFA when exhibited.

Government Authority	Issues Raised	Response or Where addressed in EAR
NSW Department of Environment & Climate Change	• A comprehensive assessment of the predicted noise and vibration impacts during both construction and operational phases in accordance with the relevant NSW Government and DECC policies should be undertaken.	• Chapter 10
	• An assessment of all feasible and reasonable noise and vibration mitigation measures should be undertaken.	• Chapter 10
	• A complaints monitoring and handling system for the construction phase of the project should be outlined.	• Chapter 16
	• Reference must be made to relevant Water Quality Objectives including identification of environmental values and human uses to be protected or achieved for those waterways.	• Section 15.1
	• Erosion and sediment controls during construction and runoff from storage of spoil must be addressed.	• Section 15.1
	• Any problems that may result from flooding within the tunnel including the need for alarms on pumping systems must be considered.	• Chapter 4
	• A system for managing contaminated water generated from any automated fire control system must be addressed.	• Section 13.3
	• A system for managing groundwater issues (for example potential iron oxides from seepage) must be considered.	• Section 15.1
	• Assess, quantify and report on waste and resource management options for the project in the context of: a) avoidance of unnecessary resource consumption; and b) resource recovery (reuse, reprocessing, recycling and energy recovery); and c) disposal.	• Chapter 12
	• Identify and report on proposed measures to assess, classify and manage waste and virgin excavated natural material.	• Chapter 12
	• Assess, quantify and report on how the project would satisfy the requirements of the NSW Waste Reduction and Purchasing Policy.	• Chapter 12
	• Assess and report on proposed measures to manage excavation spoil to ensure: a) Contaminated spoil is treated and disposed of, using best practices. b) Noise and dust emissions are minimised. c) Uncontaminated spoil is re-used rather than landfilled.	• Chapter 16 • Section 7.5

Government Authority	Issues Raised	Response or Where addressed in EAR
NSW Department of Environment & Climate Change	• Include a preliminary site contamination investigation including all areas where the project associated construction works are to be undertaken. • Discuss the need for further work to fully assess site contamination and remediate any identified contamination of the site. • An assessment of all potential air emissions including dust must be carried out. This assessment must include an outline of proposed mitigation and management measures. • Storage of all materials, fuels and chemicals, including management of runoff, containment and disposal must be considered.	• Section 7.5 • Section 7.5 • Section 15.2.2 • Section 13.3
Department of Water & Energy	• The EAR should consider demand management. • In-principle support for the CityGrid Project concept application.	• Section 2.4 • Noted
NSW Roads & Traffic Authority/ Cross City Motorway	• CCM is currently updating the easement profile for CCT. • CCM prefers that the CECT alignment be constructed outside the CCM easements. • RTA does not favour tunnel alignments within the CCT easement with the main priority is to avoid conflict with the rock bolt support. • RTA/CCM generally prefer a CECT alignment that passes above tunnels of the CCT. • RTA/CCM advised of in principle agreement with progressing with the development of a stakeholder agreement using the existing City West Cable Tunnel stakeholder deed as a template. • Potential for encroachment on existing tunnel easements, in particular, possible conflicts with rock anchors or rockbolt supports. There must be grade separations between the proposed CityGrid tunnel and existing rail tunnels and other below ground infrastructure.	• The following comments have been noted and further dialogue would occur.
Transport Infrastructure Development Corporation	• Discussed likely interfaces with existing and proposed underground assets. • Exchanged information for these assets. • Set the framework for future liaison and agreements between the parties. • Obtained design information on proposed Northwest Metro and ANZAC Lines.	• The following comments have been noted and further dialogue would occur.

Government Authority	Issues Raised	Response or Where addressed in EAR
RailCorp	• Discussed likely interfaces with existing and proposed underground assets. • Exchanged information for these assets. • Set the framework for future liaison and agreements between the parties. • Obtained design information on: City Circle and Eastern Suburbs Rail Lines; and proposed MetroWest and MetroPitt Rail Lines. • Accurate survey information must be provided, clearly defining horizontal and vertical relativity between existing rail infrastructure and easements, and the proposed tunnel design criteria.	• The following comments have been noted and further dialogue would occur.
	• An electrolysis report may be required for those areas of the proposed works within sixty (60) metres of the existing electrified rail network (or other distance as agreed with RailCorp). • A services search should be carried out to identify the presence of any rail services in the areas under consideration. • The following locations may be impacted by the project and must be considered: - Wynyard – station and tunnels. - City Circle at Royal Botanic Gardens - tunnels near Conservatorium of Music. - City Circle at Eastern Distributor - tunnels near Macquarie St, both live and disused. - Eastern Suburbs Railway - tunnels near Art Gallery of NSW. - Eastern Suburbs Railway - tunnels near Belmore Park (which will also impact on the existing Metro Light Rail corridor in Hay Street. • Where proposed works are to be located within twenty five (25) metres of existing rail infrastructure, Geotechnical and Structural Reports must be submitted for review.	• The following comments have been noted and further dialogue would occur.
	• Construction methodologies, risk assessments, Safe Work Method Statements and any monitoring regimes applicable to rail infrastructure will be required to be submitted for review.	• Chapter 14
	• Prevention of contaminants entering into the rail corridor. Including possible stormwater ingress must be taken into account.	• Chapters 14 and 16
	• A dilapidation report identifying the condition of existing infrastructure prior to and after any works.	• Chapters 14 and 16
	• Impacts of vibration on existing infrastructure e.g. road/ rail tunnels - vibration monitoring may be required depending on the construction techniques used and relative proximity. • Acoustic/vibration treatment may need to be assessed for any impact from rail operations on the proposed CityGrid tunnel.	

Government Authority	Issues Raised	Response or Where addressed in EAR
Sydney Water Corporation	• The CityGrid project is subject to the Section 73 process for the tunnel sections and the aboveground urban building development. • Issues that will be need to be considered involve the safe clearance to major assets such as Bondi main sewer and the prevention of induced voltages in our metal mains and access covers, etc.	• The following comments have been noted and further dialogue would occur.
NSW Heritage Office	• All known heritage items under or adjacent to the route of the tunnel and substation sites should be identified and their significance assessed. Statements of Heritage Impact will need to be prepared for all heritage items that are identified on LEPs and the State Heritage Inventory which are within the area affected by the proposal.	• Chapter 11
	• Non-Aboriginal heritage items within the area affected by the proposal should be identified by field survey. This should include any buildings, works, relics (including relics underwater), gardens, landscapes, views, trees or places of non-Aboriginal heritage significance. A statement of significance and an assessment of the impact of the proposal on the heritage significance of these items should be undertaken. This assessment should be undertaken in accordance with the guidelines in the NSW Heritage Manual. The field survey and assessment should be undertaken by a qualified practitioner/ consultant with historic sites experience.	• Chapter 11
	• Any policies/measures to conserve heritage significance or to mitigate against potential impacts must be identified in the Statements of Heritage Impact, baring in mind the different statutory requirements for various types of heritage items (especially the distinction between works and relics).	• Chapter 11
	• Impacts on places, items or Aboriginal objects of significance to Aboriginal people must be considered. Where it is likely that the project will impact on Aboriginal heritage, adequate community consultation should take place regarding the assessment of significance, likely impacts and management/ mitigation measures.	• Chapter 11
	• Aboriginal heritage issues should be identified through a preliminary assessment in accordance with DECC's Guidelines.	• Chapter 11
NSW Fire Brigade	• Further information requested as the CECT progresses into design stage.	• The comments are noted and further dialogue would occur
TransGrid	• TransGrid supports the Project through its joint planning process with EnergyAustralia.	• Noted

Government Authority	Issues Raised	Response or Where addressed in EAR
Royal Botanic Gardens & The Domain Trust	• What will happen to the old City East Zone Substation once the new City East Zone Substation is commissioned?	• Advised that old City East Zone Substation at Lincoln Crescent would be decommissioned over time but may be used for other purposes within the electricity network.
	• A copy of the final EAR was requested.	• A copy would be provided.
	• There are plans to enlarge The Domain car park. The Trust would advise the car park operators of the Project.	• Estimated that The Domain car park would be able to get three additional car park levels before impacting the CECT. The tunnel is approximately 16 metres below the car park hence there would be minimal vibration
	• The fig tree roots often went very deep. The Botanic Gardens Trust can supply locations and valuations on the fig trees for risk analysis and insurance.	• EA would provide a copy of the CECT alignment and proposed borehole locations.
	• What volumes of water will be within the tunnel?	• Using a TBM to bore the tunnel and lining the tunnel would minimise water ingress
	• Regular events occur at The Domain after September. December to March is a "no go" period and that the turf would need to be protected from heavy vehicles.	• EA would need to get a licence agreement to access site
	• A schedule of events and an electronic plan of the Botanic Gardens and The Domain would be provided to EnergyAustralia.	• Noted
	• Heritage impacts to the Botanic Gardens would be done internally by the Botanic Gardens Trust.	• Noted

6.3.2 Community

EnergyAustralia has begun consultation with the local community in relation to the Belmore Park Zone Substation and Riley Street Site.

Activities undertaken to date include:

- distributing a community newsletter around the Belmore Park Site;
- holding two community information displays in relation to Belmore Park Site;
- advertising in the Sydney Morning Herald and Australian Chinese Daily in relation to Belmore Park Site;
- Establishing project information on EnergyAustralia's website;
- answering phone calls and emails about the Belmore Park and Riley Street sites; and
- distributing a notification letter regarding geotechnical work around the Belmore Park Site.

6.4 Environmental Assessment Exhibition and Making a Submission

This EAR 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, a copy of the report will be available for perusal at selected locations. The report will also be available on EnergyAustralia's website at **www.energy.com.au/citygrid** and on the Department of Planning's website at **www.planning.nsw.gov.au**. Limited copies are also available from EnergyAustralia by calling 1800 214 193.

Written submissions from organisations and the general community are invited and should be addressed to:

The Director
Major Infrastructure Assessment
Department of Planning
GPO Box 39
SYDNEY NSW 2001

Submissions may contain comments on any aspect of the proposed development or the Environmental Assessment.

As a guide, submissions should include:

- the nature of the respondent's interest in the Project;
- the respondent's opinions on the Project;
- any suggested alternatives or improvements to the Project;
- additional measures that are considered necessary to protect the environment;
- factual errors or omissions in the EAR;
- any additional information that should be considered; and
- any other issues of relevance to the Project, the EAR, or the approval process.

All information provided by respondents in their submissions would be collected for the sole purpose of assisting in the assessment of the Project. The information may be used by the relevant staff and consultants of the Department of Planning, and EnergyAustralia during the environmental assessment process, and may be disclosed to appropriate government authorities as required by 75H(5) of the EP&A Act.

Where the respondent indicates that their submission should remain confidential, EnergyAustralia would attempt to ensure that it remains so; however, there may be legislative or legal requirements for its release (for example, under the NSW Freedom of Information Act 1989).

Each respondent will have free access at all times to their submission and may make a correction to their submission in writing to the above address.

EnergyAustralia would collate the submissions at the end of the exhibition period and examine and analyse the issues raised. EnergyAustralia would prepare a Submissions Report to address the issued raised in submissions, identify any new information on the proposed development, and any proposed modifications.

In order to ensure that the issues raised in the submissions can be analysed and considered properly, it is advised that submissions:

- include details of the respondent's name, address, and the date;
- list separate points to make the separate issues clear;
- refer each point to the relevant section of the EAR; and
- are as legible as possible.

6.5 Next steps

The next stage of consultation with stakeholders would build on the activities undertaken so far and the proposed actions in the consultation plan for the Project.

The next steps are as follows:

- Exhibition of the concept approval EAR for the Project for a minimum of 30 days and invitation for the community and stakeholders to make submissions.
- EnergyAustralia prepares a Submissions Report and, if required, a Preferred Project Report and final statement of commitments.
- The Director-General of the Department of Planning provides an Assessment Report to the Minister for Planning who then determines the Project and, if approved, sets conditions for further assessment and/or further approvals required.

7 Existing environment

7.1 Introduction

This section summarises the existing environment within the study area surrounding the Sydney CityGrid Project components.

7.2 Landuse

A variety of land uses including residential, commercial, recreational and public services exist within the vicinity of the properties that may be potentially impacted by the proposed Project. The key locations where surface works may impact upon surrounding property include Pitt, Campbell and Hay Streets for Belmore Park Zone Substation; Riley Street Site; potentially in the vicinity of Sir John Young Crescent/St Mary's Road (Services Control Room); Dalley Street (refurbishment or replacement of existing zone substation); Wade Place and Little Albion Street (ancillary surface works) and a future site in the vicinity of the northern Sydney CBD (City East Zone Substation).

Table 7.1 describes the land uses surrounding the proposed surface works locations and construction sites.

Table 7.1 – Land use near surface works locations/construction sites

Belmore Park Site	
Situated on the corner of Pitt, Campbell and Hay Streets, Surry Hills Proposed new 132kV to 11kV zone substation to be constructed by 2012. The surrounding locality is characterised by a mixture of entertainment, office, retail, commercial, parking stations, hotels and residential land uses including Belmore Park, Pitt Street bus terminal, Central Square, Chamberlain Hotel, Central Station, Capitol Theatre, Roden Cutler House, Regis Towers, Campbell Towers and Pitt Tower. The Belmore Park Site is currently used as a privately operated open-air commercial car park accommodating approximately 100 vehicles. It is open 24 hours, seven days per week and allows vehicles to enter and exit via the site's single two-way driveway off Hay Street.	
Plate 7.1 View from Campbell Street	**Plate 7.2 View from Pitt Street**
	

Existing Surry Hills STS & Annex

Situated in Ann Street, Surry Hills – adjacent to Wade Place.

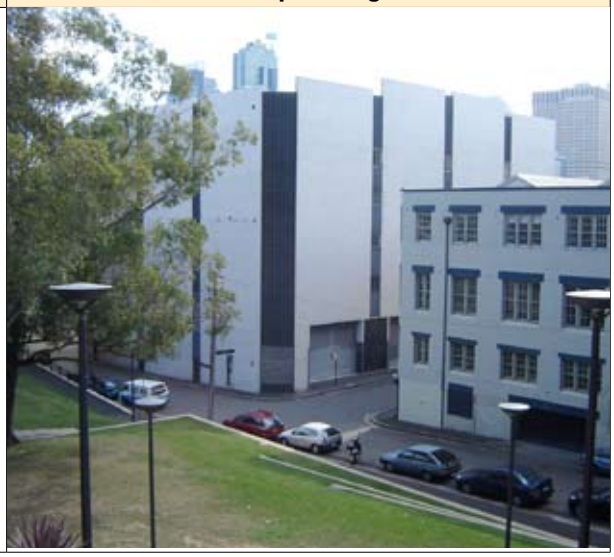
The surrounding locality is predominantly characterised by residential land use interspersed with some commercial activities. St Francis de Sales Catholic Church, Frog Hollow Reserve, William Booth House, Key College, local shops and cafes are situated to the south along Albion Street.

This site is approximately 150 metres from the Riley Street Site.

The substation and annex infrastructure would remain as part of the 132kV/33kV sub-transmission network, which provides supply to the CBD and inner suburbs.

Plate 7.3 Existing Surry Hills Substation & Annex

Plate 7.4 Existing Surry Hills Substation & Annex (view from top of Frog Hollow Reserve)



Riley Street Site

Situated on the corner Riley and Albion Streets, Surry Hills.

Proposed site for tunnel construction and new substation.

The surrounding locality is predominantly characterised by residential land use comprising terrace housing and multi-storey apartment buildings with a number of hotels, cafes, commercial and recreational activities. 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.

This site is close to Wade Place Annex and Surry Hills STS.

Plate 7.5 View from Riley Street

Plate 7.6 View of Riley Street Site

Services Control Room

Potentially situated close to Cook and Phillip Park, Yurong Parkway, Sydney (if not included in the Riley Street Site)

As noted previously, this option is dependant upon detailed design review of the ventilation services for the tunnel.

The surrounding locality includes recreational land uses to the north, west and south. St Mary's Cathedral College is situated further west along St Mary's Road and the entrance to the The Domain Carpark is situated to the north of the site. Activities to the east include residential land uses, a child care centre, youth centre, Council depot, Park Lane Towers (apartments), Crown Garden apartments, cafes and restaurants, and hotels.

Plate 7.7 View from St Mary's Road

Proposed City East Zone Substation

Situated in the vicinity of Phillip, Bent, Bligh and O'Connell Streets, Sydney.

Potential site for a new City East Zone Substation.

Surrounding land uses are predominantly commercial office towers with active street frontages, retail activities, hotels, restaurants and cafes including Sheraton Wentworth Hotel, Chifley Tower/Square, Macquarie Apartments, ABN Amro/Aurora Place, Noble House, and Governor Macquarie Tower.

Plate 7.8 Locality aerial – proposed City East Zone Substation

Plate 7.9 Phillip Street

Plate 7.10 Bligh Street

Plate 7.11 Hunter Street

Refurbishment or replacement of Dalley Street Zone Substation

Situated on Dalley Street, between George and Pitt Streets, Sydney.

Surrounding land uses for the Dalley Street site are predominantly commercial office buildings, hotels and parking stations with the major activities being 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.

Plate 7.12 Dalley St Zone Substation view from Pitt Street

7.3 Socio-economics

Sydney CBD has an integral role within metropolitan Sydney, Sydney's global arc, the State and, most importantly, as being Australia's only recognised global city. Over the past two decades, Sydney CBD has undergone constant growth, which in turn has seen its population, tourism and its role in the international economy excel.

As a global city, Sydney CBD has Australia's highest population density reaching 8,400 persons per km^2 in 2005. This is expected to grow well into the future with population projections from 2001-2031 showing steady increases (89 percent from 2001 to 2031). The city is working towards an additional 48,000 dwellings (around 87,000 people) and 95,000 jobs (from 370,000 to 465,000) from 2006 to 2030.

Tourism is another key element of Sydney's global status. In 2006, metropolitan Sydney received around 2.6 million international visitors (half of the national total), with around 75 percent of these visitors destined for Sydney CBD. The city also accommodates a diverse population, including a constant inflow and outflow of professionals and other skilled people and receives two-thirds of international business visitors.

Sustainable Sydney 2030 City of Sydney Strategic Plan prepared by SGS Economics and Planning in 2008 supports Sydney as a globally competitive and innovative city. Sydney CBD is the primary link between the global and Australian economies. The city generates $70 billion of economic activity (value-added), or nearly nine percent of the total Australian economy. With 30 percent of national employment in financial and business services (accounting, legal, financial, communications and advertising), nearly half of Australia and New Zealand's top 500 companies and more than 60 percent of Asia Pacific's regional headquarters established by multinational companies. Complimenting the high concentration of key businesses and multinationals is the highly skilled and globally mobile workforce based in Sydney.

The proposed Project is located in the Sydney Central Business District (CBD), and is necessary to provide a secure supply of electricity to support economic activities that allow the city to remain globally competitive.

The proposed Project considers a number of stakeholder groups including local residents, visiting tourists, local businesses and global corporations.

EnergyAustralia has an important role in supporting Sydney with supplying adequate and efficient energy supplies. A number of projects have been proposed over the next ten years involving the construction of new or upgrading and refurbishing existing zone substations and replacing aged high voltage cables supplying the substations. The proposed Project is part of this 10 year plan.

7.4 Visual amenity

The proposed Project is in the Sydney Central Business District (CBD) area, which includes state and locally listed heritage buildings and residential, commercial and recreational uses. There are also a number of existing and future infrastructure corridors within the Project study area. A brief summary of the key visual features surrounding each Project element is provided below.

Belmore Park Zone Substation

The surrounding area for the Belmore Park Site is a mixture of retail, commercial, entertainment and residential land uses. The site is at the south eastern edge of the CBD, in close proximity to Central Railway Station. The elevated railway lines to the east of the site form an implied edge to the city and a boundary to the Surry Hills precinct. Belmore Park to the south of the site is a formal urban green park.

The eastern half of the street block fronting Castlereagh Street, was developed in 1972 and contains a 23 storey commercial tower ("Central Square").

The Belmore Park Site is currently used as a privately operated open-air commercial car park accommodating approximately 100 vehicles. It is open 24 hours, seven days per week and allows vehicles to enter and exit via the site's single two way driveway off Hay Street. **Plate 7.13** is a photographic image of the Belmore Park Site.

Plate 7.13 The Belmore Park Site viewed from Regis Tower, looking south

Riley Street Site

The surrounding Surry Hills area is dominated by 2-3 storey terrace housing with a mixture of commercial uses in larger buildings such as former warehouse developments. Frog Hollow Reserve is located opposite the site.

Riley Street is the primary street frontage for the site. In the immediate vicinity of the site, the built form is generally 2-3 storey terraces with 4-6m wide frontages. Ann Street is steeply sloping with terraces stepping up along the slope of the street.

Albion Street is steeply sloping with larger multi-unit residential buildings to the south of the site. The multi residential building is 5-6 storeys high with a garage and blank façade at ground level. 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 at the rear of the site (eastern side) include residential and commercial premises. The commercial and multi residential buildings present mostly blank façade to the site at lower levels.

City East Zone Substation

The Sydney CBD location is a mixture of retail and commercial land uses. The potential site would be at the eastern area of the CBD. (Note that the location of the site would be determined following discussions with developers, however, as stated previously the area in the vicinity of Phillip, Bent, Bligh and O'Connell Streets is preferred.)

Surry Hills STS

The area surrounding the existing Surry Hills STS comprises residential terraces along Little Albion Street and a mixture of medium density dwellings, commercial and church uses fronting Albion Street. Frog Hollow Reserve is located to the east. The terrain rises sharply to the east and south of the site. Although the substation building is visible from numerous surrounding locations, views toward the Annex building are obscured by the substation building and surrounding buildings along Albion Street.

Dalley Street Zone Substation

Dalley Street is a small laneway scale street with mainly utilitarian 'back of house' uses. The site is at the northern area of the CBD.

Services Control Room (alternative location)

Cook and Philip Park and The Domain form part of a 'green belt' along the eastern edge of the CBD extending from Hyde Park to the Royal Botanic Gardens. The parklands are highly valued and sensitive to locations of any new structures.

The parklands frontage along St Mary's Rd, Yurong Parkway and Sir John Young Crescent has a varied edge condition including large retaining walls and The Domain car park building. The retaining walls create low areas, which are less visible from within the park.

The buildings facing Yurong Parkway and Sir John Young Crescent running alongside the park edge are highly varied including residential, commercial and hotel uses.

7.5 Geology, topography and soils

The geological map of the Belmore Park Site indicates that the site is underlain predominantly by filling on previous swampy alluvial areas. Previous studies further indicate the upper four to five metres is filling, clays and sandy clays, below this medium to high strength sandstone.

Spoil from bulk excavation works at the Riley Street and City East Zone Substation sites would consist mostly of medium to high strength sandstone, however some shale materials and fill may be encountered in the upper layers of the excavation.

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

The cable tunnels would be primarily constructed within Hawkesbury Sandstone, although Ashfield Shale and beds of Mittagong Formation may be expected in the upper most parts of the profile, particularly to the south of 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 CCT and Eastern Distributor tunnels.

Reclaimed land is known to be present in the Circular Quay area. The fill material is expected to be water bearing and overlying 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.

Major geological features that may impact upon tunnelling include:

- the GPO and Woolloomooloo Fault Zones;
- Pittman LIV Dyke (between Dalley and Bridge Streets); Oxford Street Dyke (southern side of Oxford Street) and the Great Sydney Dyke (beneath Albion Street);
- Martin Place joint swarm; and
- low angle bedding shears (found in the vicinity of all three abovementioned features).

A stage 2 contamination assessment for the Belmore Park Site was conducted by Douglas Partners Pty Ltd in August 2008. On the basis of the investigation, the potential for contamination associated with the soil and groundwater at the site was low. The site was considered suitable for the proposed development (given that most of the filling is to be removed for the basement excavation) and provided that groundwater is sampled from Bore 103 during the construction stage and verifies the second round of groundwater results for total petroleum hydrocarbons (TPH) and monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylene (BTEX)) as being detected below the adopted screening criteria.

7.6 Surface and groundwater

The Project is within the catchment area of Sydney Harbour.

The catchment area is highly urbanised with the exception of parklands such as Belmore Park, Frog Hollow Reserve, The Domain and Royal Botanical Gardens.

Surface water is managed by drainage systems which direct water into Sydney Harbour.

Shallow, perched groundwater tables, controlled by sea levels, may be expected 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.

7.7 Traffic and transportation

Traffic and transport movements within and around the Sydney CBD and East Sydney area occur using a variety of transportation modes including private vehicles, public bus services, light rail and heavy rail services, pedestrian and cyclist movements. These movements are critical for the transportation of people, goods and services and play an integral role in the prosperity and vitality of the CBD.

The following sections describe the existing conditions of the road network, on-street parking, public transport, and pedestrian and cyclist facilities surrounding the proposed Project work sites.

Belmore Park Zone Substation

The Belmore Park Site is located between Campbell and Hay Streets, east of Pitt Street. The site is surrounded by established southern CBD development including the Capitol Theatre and commercial land uses on the western side of Pitt Street, commercial land uses to the north and east, and Belmore Park and Central Station to the south. At present, the proposed development site is used as a commercial car park with approximately 100 parking spaces. It has left-in/left-out access to and from Hay Street.

The proposed development site is located adjacent to local streets with direct access to the major road network. This would allow removal of spoil and delivery of construction materials almost exclusively on arterial roads, which are suitable for such purposes.

At present traffic movements from the site are limited to the 100 space commercial car park at ground level on the site.

Access from the local road network is available via Hay Street and Campbell Street east to Elizabeth Street and Campbell Street west to George Street. Hay Street and Campbell Street have underpasses beneath the CityRail network lines travelling north from Central Station with a vehicle height restriction of 3.8 metres for the Campbell Street underpass. Access to the major road network is as follows:

- east and west via Hay Street and Elizabeth Street south to Cleveland Street, and south from Cleveland Street onto South Dowling Street and Southern Cross Drive; and
- north via Hay Street, Elizabeth Street, Wentworth Avenue, College Street, Prince Albert Road and Macquarie Street to access Cahill Expressway.

Riley Street Site

The Riley Street Site is located on the north-east corner of Riley and Albion Streets and is adjacent to local streets with direct access to the major road network. This would allow removal of spoil and delivery of construction materials almost exclusively on arterial roads, which are suitable for such purposes.

Access from the local road network is available via Albion Street east to Flinders Street and west from Elizabeth Street, and Riley Street south to Foveaux Street or east along Albion Street. From there, access to the major road network is as follows:

- south via Albion Street, Flinders Street and South Dowling Street to Southern Cross Drive, or east from South Dowling Street to Moore Park Road or Anzac Parade;
- north via Riley Street, Foveaux Street, Elizabeth Street, Wentworth Avenue, College Street, Prince Albert Road and Macquarie Street to access Cahill Expressway; and
- west via Riley Street, Foveaux Street, Elizabeth Street and Cleveland Street.

To the west of the site, Riley Street is a two-way, single carriageway road with two travel lanes and adjacent parking lanes. Riley Street has a 40 km/h speed restriction and intersects with Albion and Foveaux Streets at signal-controlled intersections. There is a 3-tonne weight restriction along Riley Street, south of Albion Street.

To the south of the site, Albion Street is a one-way (eastbound), single carriageway road with two central travel lanes and adjacent parking lanes. On its northern side, there is a marked bus-lane in operation during designated periods. Albion Street has a local 50 km/h speed restriction and intersects with Riley, Elizabeth and Flinders Streets at signal-controlled intersections.

City East Zone Substation

The precise location of the City East Zone Substation site has not yet been determined. Planning and feasibility studies in regard to the construction of the new substation are underway and an area within the northern CBD precinct in the general vicinity of Phillip, Bent, Bligh and O'Connell Streets is considered to be a favourable location.

Bent Street provides direct access to the Eastern Distributor while Phillip Street, together with Bridge Street, provides direct access from Cahill Expressway, both of which are part of the major road network. This would allow removal of spoil and delivery of construction materials almost exclusively on arterial roads, which are suitable for such purposes.

Access through the CBD road network to travel west is available by travelling south via Phillip Street and Elizabeth Street. This connects with King and Market Streets, which are one-way eastbound and westbound respectively, to connect with the Western Distributor.

To the north of the site, Bent Street is a two-way, single carriageway road with two to four travel lanes dependant on adjacent on-street parking restrictions. Bent Street has a 50 km/h speed restriction and intersects with Phillip Street at a signal-controlled intersection.

To the east of the site, Phillip Street is also a two-way, single carriageway road with two to four travel lanes dependant on adjacent on-street parking restrictions. Phillip Street has a local 50 km/h speed restriction.

Surry Hills STS

The existing Surry Hills STS site is located on Ann Street, north of Little Albion Street and adjacent to Wade Place.

Wade Place is effectively a pedestrian thoroughfare, restricted to non-vehicular traffic. It connects Ann Street to the north with Little Albion Street to the south.

To the south of the site, Little Albion Street is a narrow one-way (eastbound), single carriageway road with enough width for a single travel lane and adjacent parking lane. It becomes two-way north of Crawford Place. Little Albion Street connects Commonwealth Street to the west with Frog Hollow Reserve and Little Riley Street to the east. Little Albion Street has a local 50 km/h speed restriction and intersects with Crawford Place (midway near Wade Place) and Commonwealth Street at priority-controlled intersections.

Ann Street is a relatively narrow two-way street with limited linemarking. It has barely enough width for two opposing travel lanes and adjacent kerbside parking. Ann Street connects Commonwealth Street to the west with Riley Street and beyond to Reservoir Lane in the east. Ann Street has a local 50 km/h speed restriction and intersects with Riley Street and Commonwealth Street at priority-controlled intersections.

Construction access points would most likely be via the Riley Street Site, although it is possible that access to Little Albion Street would be required to facilitate road works for cable transition works from the street level to the CSCT Extension.

Dalley Street Zone Substation

The Dalley Street Zone Substation site is located on the northern side of Dalley Street, at Underwood Street.

To the south of the site, Dalley Street is a narrow one-way (eastbound) street with enough width for a single travel lane and adjacent parking lane. Dalley Street connects George Street to the west with Pitt Street to the east. It has a local 50 km/h speed restriction and intersects with Underwood Street (midway adjacent to the proposed work-site), George Street and Pitt Street at priority-controlled intersections.

Underwood Street is a narrow one-way lane travelling from Pitt Street to Dalley Street via a right-angle alignment at approximately its mid-point. Underwood Street has a local 50 km/h speed restriction and intersects with Dalley Street and Pitt Street at priority-controlled intersections.

Construction access points have yet to be resolved, although it is likely these would be required to be via Dalley Street or Underwood Street to enable suitable access.

Services Control Room

An alternative location for the Services Control Room has been identified on the southern side of St Mary's Road near Yurong Parkway.

St Mary's Road is a two-way, single carriageway road with two central travel lanes and adjacent parking lanes. It connects Prince Albert Road - College Street to the west with Yurong Parkway - Sir John Young Crescent to the east. St Mary's Road has a 40km/h speed restriction and intersects with Yurong Parkway - Sir John Young Crescent at a signal-controlled intersection and with Prince Albert Road at a priority-controlled intersection, which then continues to the College Street signalised intersection.

7.8 Noise

It is considered that the existing local noise environments are consistent with the land use and zoning for the CBD and surrounds. The noise environment for the area is dominated by road traffic noise.

Heggies Pty Ltd undertook a detailed site inspection on 29 May 2008 and identified the potentially most affected noise and vibration-sensitive receivers in the vicinity of the surface works. A summary of their findings are provided below. Further details are contained in **Volume 2, Appendix D**.

The nearest noise and vibration-sensitive receivers to the surface works in the vicinity of the Surry Hills STS are identified in **Table 7.2**.

Table 7.2 Receivers near Surry Hills STS

Receiver type	Receiver address
Residential	22 Little Albion Street
	20 Little Albion Street
	18Little Albion Street
	16 Little Albion Street
	14 Little Albion Street
	2 Little Albion Street
	84 Albion Street
	92 Albion Street - Strata Units
	108 Albion Street
	102 Albion Street - Strata Units
Religious	80 Albion Street - St Francis de Sales Church
Commercial	66 Albion Street
	303 Riley Street - Drop-in Centre
Mixed-Use	63 Ann Street
Passive Recreation Area	'Frog Hollow' Reserve

Note: This table is not exhaustive; it gives an indication of the most potentially affected receivers near to the proposed works, as identified during a site inspection. Other nearby receivers in Little Albion Street, Ann Street, Riley Street and other nearby streets should also be considered 'potentially affected' by airborne noise, regenerated noise and vibration due to the proposed works.

The nearest noise and vibration-sensitive receivers to the proposed Belmore Park Zone Substation are identified in **Table 7.3**.

Table 7.3 Receivers near Belmore Park Zone Substation

Receiver type	Receiver address
Residential	420 Pitt Street/36 Campbell Street - Strata Units
	414 Pitt Street - Strata Units
Hotel/Tavern	428 Pitt Street - Chamberlain Hotel
	431 Pitt Street
Commercial	323 Castlereagh Street
	441 Pitt Street

Note: This table is not exhaustive; it gives an indication of the most potentially affected receivers near to the proposed works, as identified during a site inspection. Other nearby receivers in Campbell Street, Pitt Street and other nearby streets should also be considered 'potentially affected' by airborne noise, regenerated noise and vibration due to the proposed works.

The nearest noise and vibration-sensitive receivers to the proposed Riley Street Site including the tunnel launch chamber are identified in **Table 7.4**.

Table 7.4 Receivers near Riley Street Site

Receiver type	Receiver address
Residential	76 - 90 Ann Street - single residential dwellings
	92- 94 Ann Street - single residential dwellings
	315 Crown Street
	317 Crown Street
	319 Crown Street - units
	321- 327 Crown Street - single residential dwellings
	329 Crown Street - strata units
	265 - 293 Riley Street
	295 - 301 Riley Street
	300 Riley Street/127 Albion Street - strata units
	319 - 327 Riley Street - single residential dwellings
Mixed-Use	72 - 74 Ann Street
	226- 248 Riley Street
	337-349 Crown Street - Salvation Army and Albion Street Centre
	150 - 154 Albion Street - Albion Street Centre
	303 Riley Street - Drop-in Centre
	351 Crown Street
	117 Albion Street - Buddhist Church
Passive Recreation Area	'Frog Hollow' Reserve

Note: This table is not exhaustive; it gives an indication of the most potentially affected receivers near to the proposed works, as identified during a site inspection. Other nearby receivers in Crown Street, Albion Street, Riley Street, Ann Street, Mackey Street, Reservoir Lane and other nearby streets should also be considered 'potentially affected' by airborne noise, regenerated noise and vibration due to the proposed works

Land uses surrounding the Dalley Street Zone Substation site are predominantly commercial office buildings, hotels and parking stations with the major buildings being:

- 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.

Prominent land uses in the vicinity of City East Zone Substation include:

- Sheraton Wentworth Hotel;
- Chifley Tower/Square;
- Macquarie Apartments;
- ABN Amro/Aurora Place;
- Noble House and
- Governor Macquarie Tower.

7.9 Non Aboriginal heritage and Aboriginal archaeology

7.9.1 Non Aboriginal heritage

Based on a review of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Report for the Sydney LGA there are many properties listed on the Register of the National Estate within the Sydney LGA.

The subject sites are not listed on any heritage instrument but do appear on the Archaeological Zoning Plan for Central Sydney (1992) as follows:

- Belmore Park Site (430-450 Pitt Street) – Area of Archaeological Potential (AAP);
- Alternative Services Control Room (Cook and Phillip Park) – Area of Archaeological Potential (AAP);
- City East Zone Substation (for example, 59 Phillip Street) – Area of Archaeological Potential – Deeper Sub-Surface Features (AAP-DSF); and
- Dalley Street Zone Substation (8-16 Dalley Street) – Area of Archaeological Potential – Deeper Sub-Surface Features (AAP-DSF).

7.9.2 Aboriginal archaeology

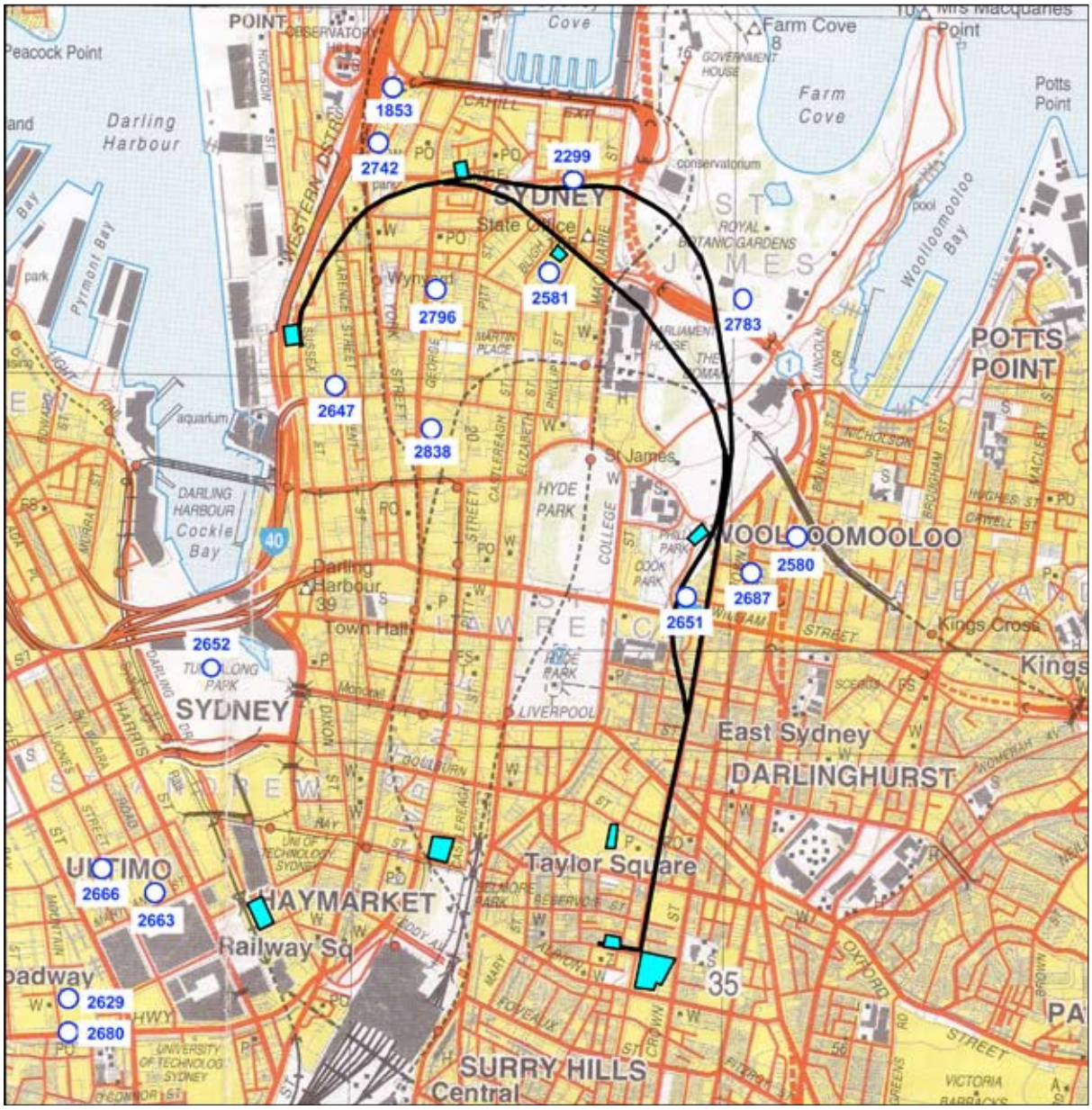
The following Aboriginal archaeological information was extracted from the Aboriginal Cultural Heritage Assessment by Navin Officer Heritage Consultants (June 2008). A full copy is provided in **Volume 2, Appendix E**.

There are 16 reported Aboriginal sites in the vicinity of the anticipated areas of development impact. **Table 7.5** describes these sites and **Figure 7.1** shows their locations in relation to the proposed Sydney CityGrid Project.

Table 7.5 Summary of previously identified Aboriginal sites in the vicinity of the proposed Sydney CityGrid Project

Site ID	Site name	Grid reference (AGD)	Site type
1853	Lilyvale	334056.6251791	Midden
2299	First Government House	334576.6251541	Burial/s, Historic Place
2580	Junction Lane	335176.6250601	Open camp site
2581	Angel Place	334506.6251291	Open camp site
2629	Broadway 1	333165.6249291	Artefact
2647	KENS Site 1	333856.6250976	Artefact
2651	William St PAD	334905.6250411	PAD
2652	Ultimo PAD1	334556.6250191	PAD
2663	Mountain Street Ultimo	333406.6249591	Artefact/PAD
2666	Wattle Street PAD1	333256.6249450	PAD
2680	Broadway Picture Theatre PAD1	333256.6249191	PAD
2687	Crown Street PAD1	335056.6250491	PAD
2742	171-193 Gloucester Street PAD	334032.6251652	PAD
2783	PAD Central Royal Botanic Gardens	335006.6251221	PAD
2796	320-328 George Street PAD	334205.6251241	PAD
2838	420 George Street PAD	334186.6250861	PAD

Figure 7.1: Locations of previously recorded Aboriginal sites (numbered) and proposed Sydney CityGrid infrastructure (black line)



7.10 Air quality

The following information was extracted from the Air Quality Assessment prepared by Pacific Air and Environment Pty Limited (June 2008). A full copy of the report can be found in **Volume 2**, **Appendix F**.

The NSW DECC operates a comprehensive state-wide air quality monitoring network comprising sites throughout NSW, with particular focus on the main population centres of Sydney, the lower Hunter and the Illawarra. The information provided below is based on monitoring data from that network.

The last exceedance of the carbon monoxide (CO) standard in NSW was recorded in the CBD in 1998, and since 2002, maximum 8-hour concentrations have been half the standard. The Air National Environment Protection Measure (NEPM) standard for CO is no longer exceeded anywhere within the monitoring network in NSW.

The introduction of unleaded petrol in 1985, the progressive reduction of the lead content of petrol and the subsequent ban on lead in petrol from 2002 have reduced ambient concentrations of atmospheric lead in Sydney. Lead levels today are well below the Air NEPM standard of 0.5 micrograms/m^3 (µg/m^3).

In Sydney, the largest source of oxides of nitrogen (NO_X) emissions is on-road vehicles, which contribute over 71% of total NOX emissions. Current maximum nitrogen dioxide (NO_2) concentrations in NSW are well below both the one-hour and annual standards.

In Sydney, no exceedances of the one-hour sulphur dioxide (SO_2) standard have ever been recorded. The maximum one-hour concentrations are typically less than 20% and less than 30%, respectively, of the standard.

There are many sources of particles in the air, arising from both natural processes and human activity. The dominant source of PM10 from human activity in Sydney is industry (37%), but domestic sources and on-road mobile sources make up a greater proportion of PM_{10} emissions in Sydney than in the rest of NSW. The annual domestic sector contribution to PM_{10} emissions in Sydney comes largely from wood heating (93%). There is a strong seasonality to PM_{10} levels. In Sydney, the majority of exceedances occur in spring and summer (81%).

7.11 Electric & magnetic fields

Electric and magnetic fields (EMF) are found everywhere. They are part of the natural environment and are present in the atmosphere. They are produced wherever electricity or electrical equipment is in use.

The strength of EMF reduces quite rapidly with distance.

Electric fields are shielded by most objects, including trees, buildings and skin and their strength reduces rapidly as you move away from the source. In contrast, magnetic fields pass through most materials. Although electric fields were the primary focus of scientific attention more than 20 years ago, today most interest and research centres on magnetic fields.

EMF is measured in milliGauss (mG). **Table 7.6** provides an indication of the relative levels of EMF experienced on a typical day around our home and those relating to the electricity networks.

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.

Table 7.6 – Typical magnetic field measurements around common home electrical appliances and electricity network infrastructure

COMMON EMF SOURCES	RANGE OF MEASUREMENTS (mG)
ELECTRIC STOVE	2–30
PC	2–20
TV	0.2–2
ELECTRIC BLANKET	5–30
HAIR DRYER	10–70
REFRIGERATOR	2–5
TOASTER	2–10
KETTLE	2–10
FAN	0.2–2
SUBSTATION	1–8 (AT SUBSTATION FENCE)
TRANSMISSION LINE: – UNDER LINE – EDGE OF EASEMENT	10–200 2–50
DISTRIBUTION LINE: – UNDER THE LINE – 10M AWAY	2–30 0.5–10

Note: Appliance measurements taken at normal user distance (Source: ARPANSA)

8 Visual amenity

8.1 Conventional substation design

The modern era of electricity substation design sees architects and local communities playing a part in developing projects to meet the needs of electricity users across EnergyAustralia's network.

EnergyAustralia is committed to meeting the challenge of providing new infrastructure in a location that ensures a high quality power supply – often in built up areas – and developing the Project in a way that is complementary to the local neighbourhood.

A key to modern substations in residential or high profile commercial locations is the indoor or predominantly indoor layout with no apparent electrical equipment, which is architecturally designed to blend into the local streetscape, from suburban homes to prime CBD property.

Also playing a part in ensuring substations are acceptable to the neighbouring community is the modern technology equipment with compact design and low noise emissions.

EnergyAustralia actively seeks input from the local community into the exterior design, including architectural features, landscaping, fencing and building materials, ensuring a best possible balance with the technical, environmental and financial limitations of the Project.

Examples of modern substation developments provided below include the Campbell Street Zone Substation in Surry Hills, the new City North Zone Substation under construction in the heart of Sydney's CBD, as well as substations in suburban settings under construction for example at Kogarah.

Figure 8.1 Photomontage of City North Zone Substation currently under construction (Sussex and Erskine Streets, Sydney)

Figure 8.2 Campbell Street Zone Substation (Surry Hills)

Figure 8.3 Photomontage of Kogarah Zone Substation currently under construction (corner of Railway Parade and English Street)

8.2 Assessment

A design review process was conducted for the Belmore Park Zone Substation and commercial development, details of which are contained in the Belmore Park zone substation and commercial development EAR.

A landscape and visual impact assessment of the Project was undertaken by PoD Landscape Architecture. A full copy of the report is provided in **Volume 2**, **Appendix B**. Extracts of the report are presented below.

Belmore Park Zone Substation

The visual and physical impacts of the proposed Belmore Park Zone Substation in response to location, scale, materials and street activation are reviewed and assessed in **Table 8.1** below.

Table 8.1 Assessment of Belmore Park Zone Substation

Scale	**Impact**
The location and appearance of the substation facilities are integrated with the overall building form.	Low impact in terms of substation scale. Integrated into overall built form.
The horizontal frontage of the substation is continuous along the pedestrian laneway.	The large single horizontal form of the facade creates a potentially monotonous frontage.
Materials and Finishes	
Building façade has significant presence in the streetscape and should be designed to integrate with materials from buildings nearby.	Building façade should be articulated, and integrate with local building forms and materials. Exterior façade of the substation building to be cohesive with the building design for the Belmore Park Zone Substation Site.
Street Activation	
The substation is located along the street edges of Campbell St and Hay St and fronting the new pedestrian lane.	The building use presents a blank façade and does not activate the street.
Views	
Views are created through the site along the new pedestrian lane – through site link.	View corridor established between Campbell St and Hay St, with views to Belmore Park.

The proposed Belmore Park Zone Substation and integrated commercial/retail development has been designed to be sympathetic to the streetscape (including Belmore Park) and nearby heritage buildings. The building design is in keeping with the locality and maintains its identity as a bold, modern addition to the area.

The Belmore Park Site offers opportunities to:

- orientate the building to Belmore Park with its mature trees and landscaped setting;
- define a built edge to Belmore Park and encourage greater use and surveillance of the park;
- activate the Hay, Campbell and Pitt Street frontages within the proposed commercial/retail development;
- provide an integrated pedestrian through-site mid-block connection between Hay and Campbell Streets;
- incorporate Ecologically Sustainable Design (ESD) by adopting the principles of a 5 star base office building under the Green Star rating scheme and a 4.5 star base building under the Australian Building Greenhouse Gas Rating (ABGR);
- create an integrated development outcome with a high quality design overlay to an otherwise functionally driven zone substation; and
- incorporate in the pedestrian through-site connection public environmental art, sculpture or installation that would focus on the themes of place, porosity and urban transformation. The use of lighting for night time expression would be explored. The artworks would become identified with the Project and the place and mark the transformation of the site and its relationship to the public domain.

Figure 8.4 Photomontage of Belmore Park Zone Substation (indicative view from Pitt St)

The design review process included input from key stakeholders including the Department of Planning, City of Sydney, EnergyAustralia and leading architects and substation designers. The design review process included:

- a presentation of design investigations conducted by EnergyAustralia and leading architects;
- feedback on the design investigations; and
- design refinements and improvements.

For further details refer to Section 8.1 of the separate Belmore Park Zone Substation and Commercial Development Project EAR.

Riley Street STSS

An artist's impression of the Riley Street STSS from the corner of Riley Street and Ann Street is shown in **Figure 8.5**.

The impacts of the proposed STSS in response to location, scale, materials and street activation are assessed in **Table 8.2** below.

Figure 8.5 Artist's impression of Riley Street STSS (indicative subject to design review)

Table 8.2 Assessment of Riley Street STSS

Scale	Impact
The proposed building of 1-2 storeys above ground level is within scale of the surrounding buildings.	Low impact in terms of height and views retained over built form.
The horizontal scale of the building creates a large single building form along the street edge.	The large single horizontal form of the building is in contrast with the surrounding buildings, in particular along Ann Street and Riley Street.
Mass	
The bulk and form of the building takes up only a small portion of the site.	The relative small size of the building allows the mass of the overall development area to be articulated.
The orientation of the building form along the street front creates a large built mass on the street edge.	The mass of the building along a single street front is in contrast with the other building form along the street.
Materials and finishes	
Building façade and roofing would have significant presence in the streetscape and should be designed to integrate with materials from the diverse range of buildings nearby.	Building façade should integrate with local building forms and materials.
Street activation	
The STSS is located along the street edge.	The building use presents a blank façade and does not activate the street.
Views	
The STSS building façade will be visible from the street and neighbouring properties.	The building façade would have a significant impact on the streetscape.
Residences and commercial properties to the rear of the site would overlook the STSS building.	The height and form of the proposed building would have minimal impact on views from buildings at the rear of the site.

Services Control Room

Although the preferred option is to locate this facility at the Riley Street Site, the alternative is to locate the facility in the vicinity of Cook & Phillip Park. The impacts of the proposed services control room facility in response to scale, mass and materials and views are assessed in **Table 8.3** below.

Table 8.3 Assessment of alternative Services and Control Room

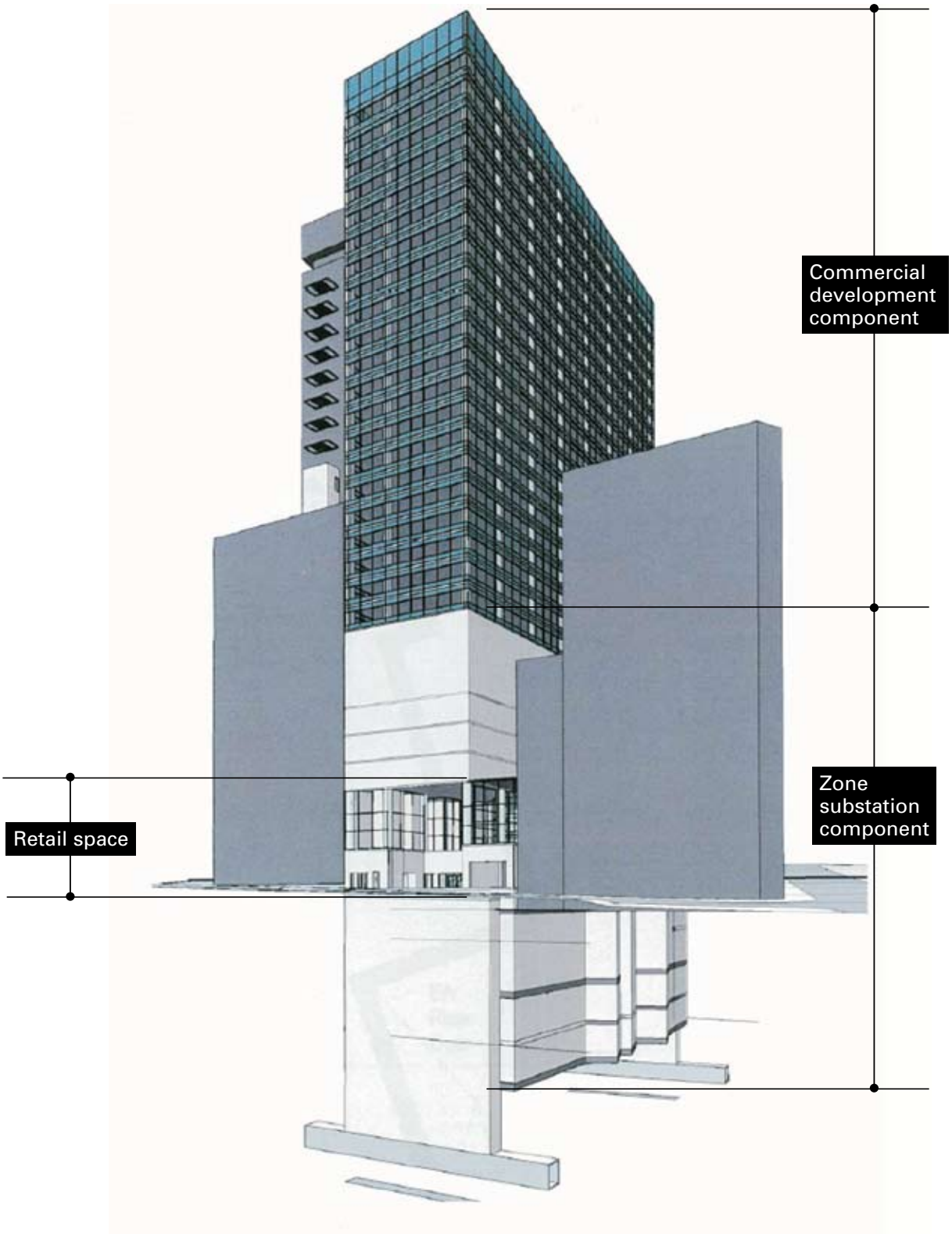
Scale	Impact
The size of the shaft and the Services Control Room is of a size that would be visible within the park.	The facility would be a relatively small-scale element if located within the grassed or planted areas within the park.
The size and form of the shaft the Services Control Room may create a physical obstruction within the park.	The facility would create a minor obstruction to through movement in the park.
Noise	
It is expected that the ventilation shaft and the Services Control Room would be audible within the park.	The noise would create a level of disturbance within the quieter areas of the park.
Materials and finishes	
The exterior finishes would have a significant presence in the park and surrounds.	The exterior materials and finishes should integrate with local building forms and materials.
Views	
The Services Control Room would be visible within the park when viewed from a distance.*	The facility would contrast with the surrounding green park landscape, but would integrate with walls buildings adjacent.
The shaft and the services control room would create obstacles to views within the park from a close distance.	The facility would create a visual barrier within the park.

** Note: the Site on the south side of St Marys Road is visible from St Marys Road up to 130 metres distance. On the north side of St Marys Road, the Site is partially visible from Sir John Young Crescent and obscured by tree planting, and also visible from St Marys Road up to 120 metres distance.*

City East Zone Substation

Figure 8.6 below shows an indicative view of City East Zone Substation and integrated commercial development proposed for the vicinity of Phillip/Bent/Bligh/O'Connell Streets. It should be noted that as an exact site has not been identified, this figure shows only a proposed layout which would be subject to further design development. It is anticipated the development would include a zone substation with the residual space used for commercial purposes. The exact height of the development would be subject to height restrictions of the area and the adjacent built form but may be of the order of 30 stories.

Figure 8.6 Indicative view of City East Zone Substation and commercial development (subject to site selection and design development)



The impacts of the proposed City East Zone Substation in response to scale, materials and street activation of the substation frontage are assessed in **Table 8.4** below.

Table 8.4 Assessment of City East Zone Substation

Scale	Impact
The proposed substation facilities to be within scale of the development and surrounding buildings.	Low impact in terms of substation scale. Integrated into overall built form.
Materials and finishes	
Building façades have significant presence in the streetscape and should be designed to integrate with materials from buildings nearby.	Building façade should be articulated, and integrate with local building forms and materials. Exterior façade of the substation building to be cohesive with the building design for the City East Zone Substation site.
Street activation	
The substation should be located away from street frontage as practicable.	The substation use presents a blank façade and does not activate the street.

Dalley Street Zone Substation

The impacts of the proposed Dalley Street Zone Substation in response to scale, materials and street activation of the substation frontage are assessed in **Table 8.5** below.

Table 8.5 Assessment of Dalley Street Zone Substation

Scale	Impact
The proposed substation facilities to be within scale of the development and surrounding buildings.	Low impact in terms of substation scale. Integrated into overall built form.
Materials and finishes	
Building façades have significant presence in the streetscape and should be designed to integrate with materials from buildings nearby.	Building façade should be articulated, and integrate with local building forms and materials. Exterior façade of the substation building to be cohesive with the building design for the Dalley Street Zone Substation site.
Street activation	
The street has minimal existing street front activity.	The substation use presents a blank façade and does not activate the street.

It should be noted that **Table 8.5** relates only to the option of replacing the Dalley Street Zone Substation, and not the potential option of refurbishing the facility.

Other surface works

Other surface works would be undertaken at numerous locations for the Project.

Where proposed works require access to the surface for site works, tunnelling and access shafts, there would be temporary impacts on the immediate environment. The impacts are not long term, and are focussed on the construction period.

8.3 Mitigation measures and safeguards

The outcomes of the design review process conducted for the Belmore Park Site are detailed in the separate Belmore Park Zone Substation and Commercial Development Project EAR.

A similar design review process would apply to new buildings forming part of the Project. The design review process would therefore apply to the following Project components and would need to be conducted during the preparation of future project approval EARs:

- Riley Street STSS;
- City East Zone Substation; and
- Dalley Street Zone Substation refurbishment or replacement

Belmore Park Zone Substation

During construction the following mitigation measures/safeguards would be developed:

- where practicable, existing street trees on footpath to be retained and protected during construction;
- new tree planting to be in accordance with City of Sydney requirements / standards;
- pavement and lighting upgrade to City of Sydney public domain standards;
- maintenance of built works, and public domain fixtures and fittings; and
- planting establishment.

Riley Street STSS/City East Zone Substation/Dalley Street Zone Substation

During the preparation of future project approval EARs the following investigations would be undertaken:

- develop options for the location and orientation of the design within the site to achieve best outcome for urban frontage;
- review exterior materials and facade design in association with the design of the overall site development and building design; and
- review public domain impacts / design for streetscape.

During construction the mitigation measures/safeguards developed for Belmore Park Zone Substation would be adopted.

Services Control Room

In the event of the alternative location being adopted, the following investigations would be undertaken during the preparation of a future CECT project approval EAR:

- develop options for the location and orientation of the Services Control Room within the local area and the Cook and Phillip Park / The Domain site to achieve preferred location with the least visual and physical intrusion;
- review shaft design;
- review the Services Control Room materials and design to determine appropriateness for location;
- review any potential impacts on trees; and
- review public domain design / proposals for areas of the park or street that are impacted by works.

During construction the mitigation measures/safeguards generally developed for Belmore Park Zone Substation and integrated development would be adopted. In addition, site protection and temporary pedestrian deviations would be installed as required.

Other surface works

During the preparation of future project approval EARs the following investigations would be undertaken:

- develop refined understanding of local construction impacts;
- review construction proposals;
- review any potential impacts on trees;
- review public domain design / proposals for areas of the parks or streets that are impacted by works; and
- determine any disruption to pedestrian or traffic movements in the construction period or in the long term, and period of construction on site.

During construction the mitigation measures/safeguards generally developed for Belmore Park Zone Substation and integrated development would be adopted. In addition, site protection and temporary pedestrian deviations would be installed as required.

9 Traffic & access

9.1 Assessment

The following information was extracted from the Traffic and Transport Assessment Report prepared by Samsa Consulting. A full copy is found in **Volume 2**, **Appendix C**.

Construction

Construction-related traffic would be generated by a number of construction activities and sources. This includes site establishment, site demobilisation, spoil removal, materials delivery and staff transport. Of these activities, spoil removal is anticipated to generate the bulk of heavy vehicle traffic.

Most spoil generated by tunnelling activities would be removed via the Riley Street construction site. Assuming a bulking factor of 50% on the in situ volume of excavated material, this would necessitate the transport of approximately 24,000 m^3 of material over a period of approximately seven months in 2010/11 (from the site) and another 57,000 m^3 of material over an approximate 14 month period in 2011/13 (from tunnelling activities). Smaller volumes generated by excavation of the other shafts and stub tunnels would be removed directly from the respective sites.

The other significant spoil removal activities would be from bulk excavation works associated with the Belmore Park and City East zone substation construction sites. The Belmore Park site would necessitate the removal of approximately 60,000 m^3 of material in total. The commercial component of Belmore Park may be excavated at a later stage and would contribute 21 000 m^3 of the total excavated volume. The volume excavated from the City East site will depend on the basement depth of the existing building, however, assuming there is minimal below ground excavation, the volume of spoil removed from this site is likely to be similar to that for Belmore Park. In addition, the stub tunnel connection to the CECT would contribute a further 5 250m^3.

Estimated spoil quantities for the various construction activities are shown in **Table 12.1**.

Heavy vehicle traffic would be generated by a number of construction activities such as spoil removal, materials delivery (eg. concrete pours, cable delivery, pre-cast concrete segments, etc.), site establishment and project demobilisation.

An estimate of the number of heavy vehicles that would be generated during each construction activity is shown in **Table 9.1**. Each 'truck' equates to a movement in and out (that is, two movements).

Table 9.1 Estimated heavy vehicle traffic generation

Construction activity	Approximate timing	Estimated heavy vehicle traffic
Bulk excavation of Belmore Park Site	May 2009 – Apr 2010	1-2 deliveries per day plus peak of 20 spoil truck movements per day
Construct Belmore Park Zone Substation	Apr 2010 – Mar 2012	1-2 deliveries per day
Construct commercial development at Belmore Park Site	2012 – 2014	3-4 deliveries per day plus peak of 20 spoil truck movements per day
Establishment of Riley Street Site and preliminary construction activities	Aug 2010 – Nov 2010	General deliveries, say 1 per day
Bulk excavation of Riley Street Site[1]	Nov 2010 – Mar 2011	1-2 deliveries per day plus peak of 20 spoil truck movements per day
Excavate launch chamber and CSCT Extension	Mar 2011 – Oct 2011	1-2 deliveries per day plus 4-5 spoil trucks per day
Construct lining for CSCT Extension and tunnel fit-out.	Oct 2011 – Mar 2012	1-2 concrete deliveries per day during April 2011
Mobilise and assemble CECT TBM	Oct 2011 – Dec 2011	Included above
Excavate TBM tunnel between Riley Street Site and City North Zone Substation.	Dec 2011 – Apr 2013	Segment delivery of 5 trucks per day for approx. 200 days plus spoil removal of 10-15 trucks per day

Construction activity	Approximate timing	Estimated heavy vehicle traffic
Remove TBM backup assembly and demobilise.	May 2013	General construction traffic only
CECT tunnel fitout	May 2013 – Jul 2014	1-2 trucks every three days
Services Control Room (if required at Cook & Phillip Park)	Mar 2012 – Aug 2011	2-3 trucks per day for spoil removal plus general deliveries
Dalley Street Zone Substation shaft and stub tunnel	Apr 2013 – Sep 2013	2-3 trucks per day for spoil removal plus general deliveries
General surface works (cable trenching around Dalley, Gresham, Bent Streets)	Sep 2013 – Apr 2014	1-2 trucks per day
Bulk Excavation for City East Zone Substation	Apr 2012 – Nov 2012	1-2 deliveries per day plus peak of 20 spoil truck movements per day
City East Zone Substation shaft and stub tunnel.	Sep 2012 – Oct 2013	2-3 trucks per day for spoil removal plus general deliveries
Construct City East Zone Substation	Oct 2013 – Dec 2015	1-2 deliveries per day for Substation 3-4 deliveries per day plus peaking during concrete pours for commercial development
Fitout Riley Street services control room	Aug 2014 – Apr 2015	1-2 per day: general deliveries only
Reinstate Riley Street Site and demobilise	Apr 2015 – Jun 2015	1 truck per day
132kV cable Installation – Belmore Park	Nov 2012 – Mar 2014	Semi trailer and crane (cable delivery) – once every 3 weeks plus general deliveries over the period
132kV cable Installation – Riley Street	Apr 2015 – Nov 2016	Semi trailer and crane (cable delivery) – once every 3 weeks plus general deliveries over the period
132kV cable Installation – City East	Jun 2015 – May 2016	Semi trailer and crane (cable delivery) – once every 3 weeks plus general deliveries over the period
132kV cable Installation – Dalley Street	Oct 2016 – Mar 2018	Semi trailer and crane (cable delivery) – once every 3 weeks plus general deliveries over the period

1. *Note that the Riley Street Site has already been demolished to previous basement levels and a hoarding is currently installed around the perimeter of the site.*

The dates shown are based on a preliminary program and may change during detailed design and project development

From the above table, the peak heavy vehicle traffic generation would occur when the CECT is being excavated in conjunction with either the Belmore Park commercial development or City East Zone Substation construction activities as well as construction of the ventilation shafts (and Services Control Room), City East Zone Substation shaft and stub tunnel or Dalley Street Zone Substation shaft and stub tunnel. It is estimated that this combination of activities would generate a maximum of approximately 45 heavy vehicles per day, or some 90 heavy vehicle movements per day. These heavy vehicles would not all travel along the same routes to access the different construction sites, however as a worst case for traffic assessment, the total traffic generation would be used to determine traffic impacts on the road network.

The majority of other traffic generation would be associated with project and construction staff movements to and from construction sites as well as any visitors to construction sites. This traffic generation has been assumed to be generally light vehicles.

Staff at each work-site would comprise project management, various trades, and general construction staff. The estimated maximum number of staff required at each site would be as follows:

- **Belmore Park Site** (for construction of the zone substation and the commercial development): approximately 100 staff during peak construction activity periods;
- **Riley Street Site** (for construction the CSCT Extension and CECT): approximately 50 staff during peak construction activity periods;
- **Services Control Room** (if required at Cook & Phillip Park): approximately 15 staff during peak construction

activity;

- **Riley Street Site** (for construction of the Riley Street STSS): approximately 75 staff during peak construction activity period (note that there may be some overlap with the CSCT Extension and CECT works);
- **City East Zone Substation:** approximately 100 staff during peak construction activity periods; and
- **Dalley Street Zone Substation** refurbishment or replacement: approximately 100 staff during peak construction activity periods.

Traffic generation attributable to staff would be largely governed by the availability of parking, which is limited in the southern CBD, northern CBD and Surry Hills precincts. This, in combination with plentiful nearby public transport services, would encourage the use of public transport by construction staff and reduce traffic generation.

It is assumed that traffic generation would be influenced by the number of on-site parking spaces at each construction site, i.e. staff and visitor vehicle numbers would equate to available parking space numbers. Therefore, based on on-site parking spaces, light vehicle traffic generation would be approximately 10 cars (or 20 trips per day) to-from the Belmore Park Site, approximately 10 cars (or 20 trips per day) to-from the Riley Street Site, and approximately 10 cars (or 20 trips per day) to-from the City East and Dalley Street zone substations sites, respectively.

Roads identified, to date, that may need to be temporarily or partially closed during construction include:

- Little Albion Street (for the CSCT Extension works);
- Dalley and Underwood Streets (for the Dalley Street Zone Substation works); and
- other roads yet to be identified in relation to the chosen site for the City East Zone Substation.

Road closures would cause temporary impacts on travel routes.

To provide suitable access to the construction sites temporary possession of the following kerbside parking spaces would be required:

- Belmore Park Site - Campbell and Hay Streets, approximately three kerbside parking spaces on each street;
- Riley Street Site (for the CSCT Extension, the CECT and Riley Street STSS construction) - approximately five kerbside parking spaces on the eastern side of the street; and
- City East Zone Substation - Bent and Phillip Streets (for example), approximately three kerbside parking spaces at each access location on each street.

Furthermore, additional parking spaces may be required in the vicinity of St Mary's Road should the alternative Services Control Room for the CECT go ahead at that location.

The creation of construction site accesses would require controlled and managed construction vehicle access across adjacent footpaths.

Figures 9.1 to **9.3** illustrate the proposed heavy vehicle routes for the Belmore Park Zone Substation, Riley Street STSS and the City East Zone Substation sites respectively.

A comparison of traffic generation from the proposed major development sites with existing traffic flows along key road sections and intersections shows that the addition of traffic generation from a worst-case combination of the proposed development sites, only constitutes a maximum increase of approximately 0.7% in traffic movements at a couple of locations. This minor level of increase is well within any expected traffic flow variations that are likely to occur on the background road network over a daily period. Therefore, the addition of a relatively minor amount of construction traffic from the proposed developments would have an insignificant affect on the road sections and intersections in the surrounding areas.

Operation

Operational traffic movements for the Project would be minor and limited to regular maintenance inspections and activities.

The commercial/retail development of the Belmore Park Site would generate movements from the use of the proposed basement carparking spaces and deliveries and maintenance activities.

Commercial/retail development for other sites would be assessed in the future project approval EARs.

Figure 9.1 Belmore Park Site heavy vehicle routes

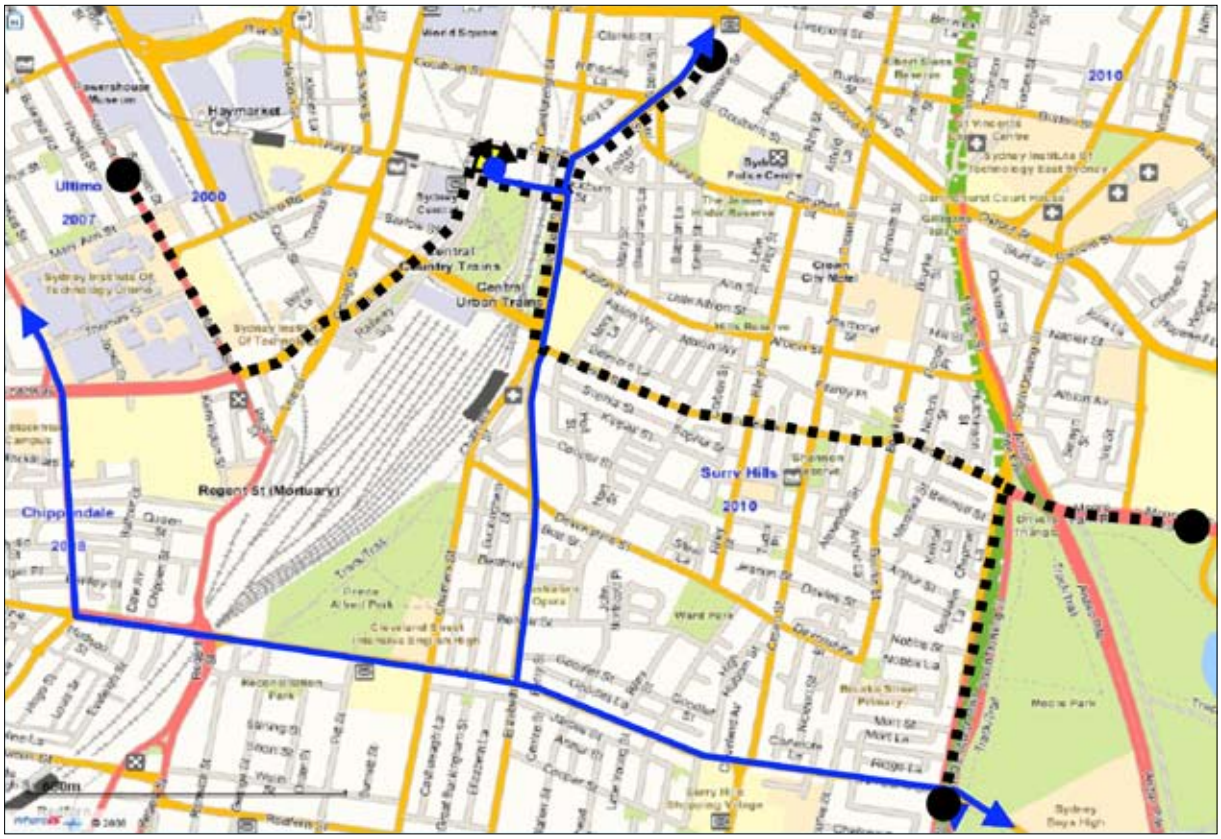


Figure 9.2 Riley Street Site heavy vehicle routes

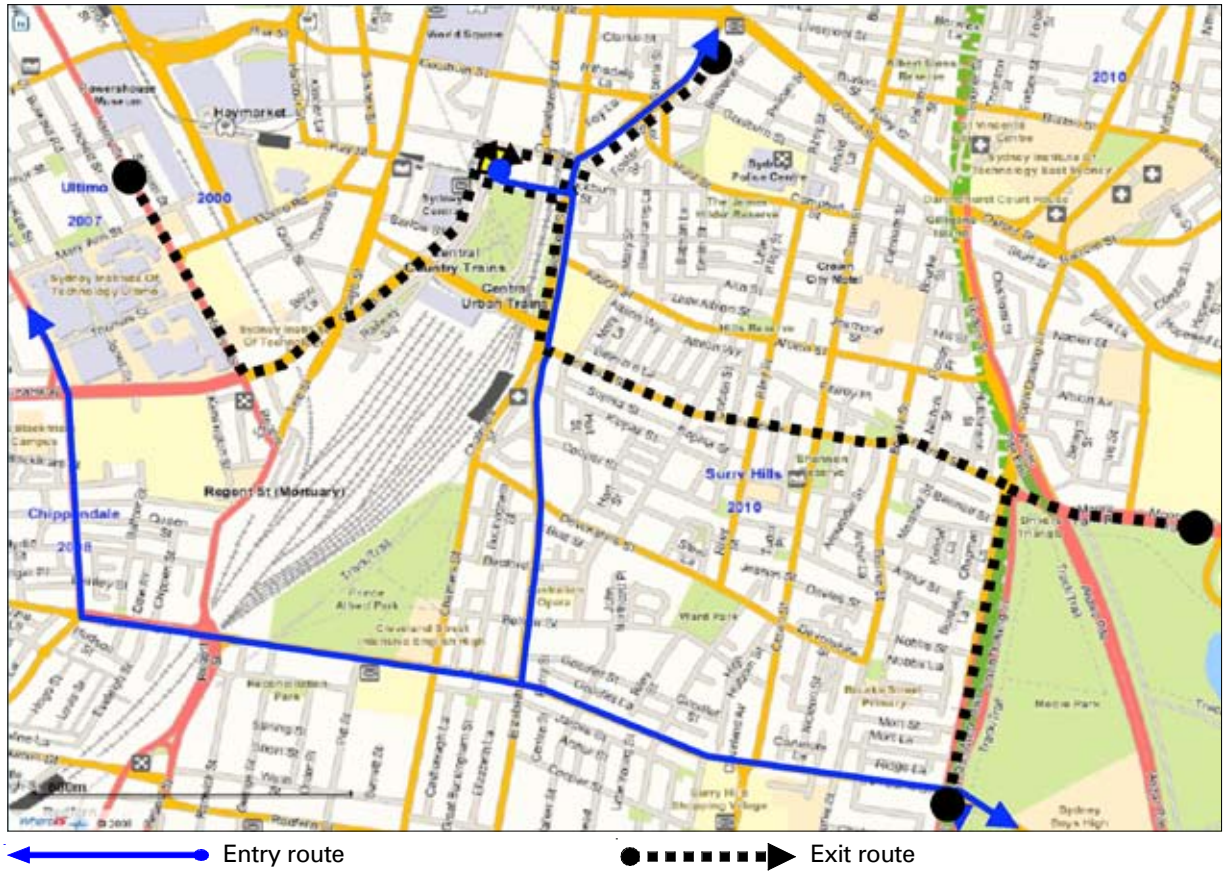
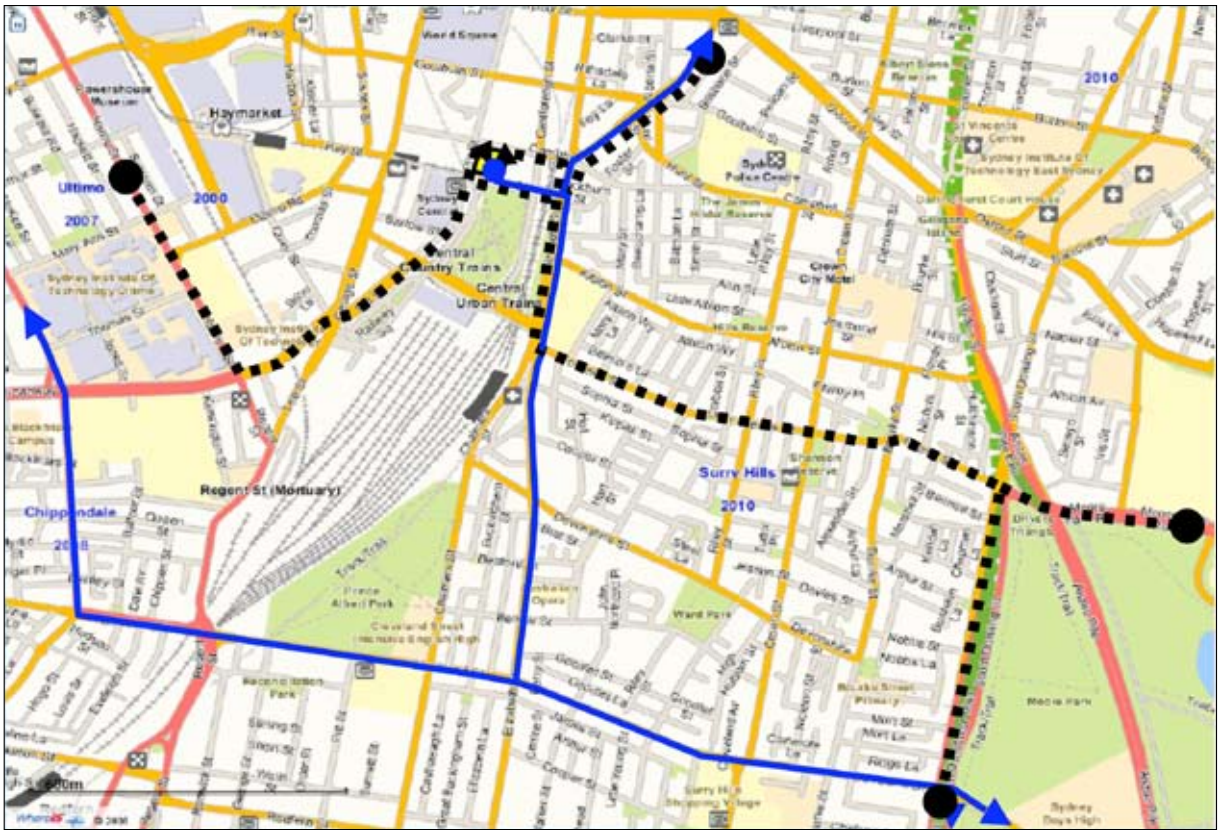


Figure 9.3 City East Zone Substation heavy vehicle routes



9.2 Mitigation measures and safeguards

A summary of the key mitigation measures and safeguards is provided below. Further details can be found in **Volume 2**, **Appendix C**.

Belmore Park Site

During construction the following specific measures are proposed to manage traffic and transport impacts at the Belmore Park Site:

- Construction traffic would be restricted to separate entry and exit accesses with a one-way flow through the site. Entry would be off Campbell Street and exit to Hay Street. This would mitigate and reduce congestion and manoeuvring, particularly by heavy vehicles.
- Advance warning signage to identify the construction site, and warn of construction traffic and changed traffic conditions would be provided on all approaches to the construction site area, eg. Pitt Street (north of Campbell Street and south of Hay Street), Hay Street (west of Castlereagh Street), Campbell Street (west of Castlereagh Street).
- Suitable traffic management and controls (to be detailed by the contractor prior to commencing works) would be maintained at all times during construction to aid heavy vehicles turning into and out from the site on Campbell Street and Hay Street.
- Provide warning and guidance signage and detours for pedestrians along the southern side of Campbell Street and the northern side of Hay Street in the vicinity of site vehicle accesses. In conjunction with this, provide pedestrian management while vehicles are entering and leaving the site.
- A Construction Traffic Management Plan (CTMP) would be prepared prior to the commencement of construction works. The CTMP would be prepared in consultation with relevant stakeholders and as part of the Construction Environmental Management Plan (CEMP).

A more detailed summary of the mitigation measures and safeguards developed for the Belmore Park Zone Substation are provided in **Chapter 9** of the Belmore Park Zone Substation and Commercial Development Project EAR.

Riley Street Site (CECT, CSCT Extension and STSS)/City East Zone Substation/Dalley Street Zone Substation/Alternative Service and Control Room

During the preparation of future project approval EARs for the above Project elements the following investigations would be undertaken:

- assessment of site access and potential spoil disposal routes for heavy vehicles to/from the work site during construction;
- assessment of impacts on parking, public transport, pedestrian and cyclist access in the vicinity of the work site during both construction and operation phases;
- obtaining traffic flow data along key sections of the road network in the vicinity of each of the construction work sites and along surrounding spoil and delivery routes during construction;
- assessment of traffic generation impacts on the surrounding road network's traffic flows during both construction and operation phases; and
- development of possible traffic and transport mitigation measures for both construction and operation phases, including the impacts of any road closures.

Construction phase mitigation measures and safeguards for these Project elements have been developed and are found in **Volume 2**, **Appendix C**. However, they would be further refined during the preparation of the future project approval EARs.

10 Noise and vibration

10.1 Assessment

The following information was extracted from the Noise and Vibration Assessment prepared by Heggies Pty Ltd. A full copy is found in **Volume 2**, **Appendix D**.

10.1.1 Construction (airborne) noise assessment criteria

The Department of Environment and Climate Change (DECC), being the published guidelines in its *Environmental Noise Control Manual* (Chapter 171-1) for the control of construction noise.

In summary, the DECC's preferred approach to the control of construction noise involves the following:

- noise level restrictions;
- time restrictions; and
- silencing.

Noise level restrictions

The *Environmental Noise Control Manual* (ENCM) recommends that the $L_{A10\ (15minute)}$ (average maximum construction noise levels assessed over a 15-minute period) arising from a construction site and measured within the curtilage of an occupied noise-sensitive premises (ie at the boundary or within 30 m of the noise-sensitive premises, whichever is the lesser) should not exceed the levels indicated in **Table 10.1**.

Table 10.1 Recommended DECC noise criteria for construction works

Period of noise exposure	**$L_{A10(15minute)}$ Construction noise goal**
Cumulative noise exposure period not exceeding 4 weeks	$L_{A90(15minute)}$ plus 20 dBA
Cumulative noise exposure period of between 4 weeks and 26 weeks	$L_{A90(15minute)}$ plus 10 dBA
Cumulative noise exposure period longer than 26 weeks	$L_{A90(15minute)}$ plus 5 dBA

Time restrictions

- Monday to Friday: 0700 hours to 1800 hours.
- Saturday: 0700 hours to 1300 hours if inaudible at residential premises otherwise, 0800 hours to 1300 hours.
- No work on Sundays or Public Holidays.

Should any construction works be undertaken outside these hours, a separate assessment of their impacts would be carried out once the nature and extent of those works is known.

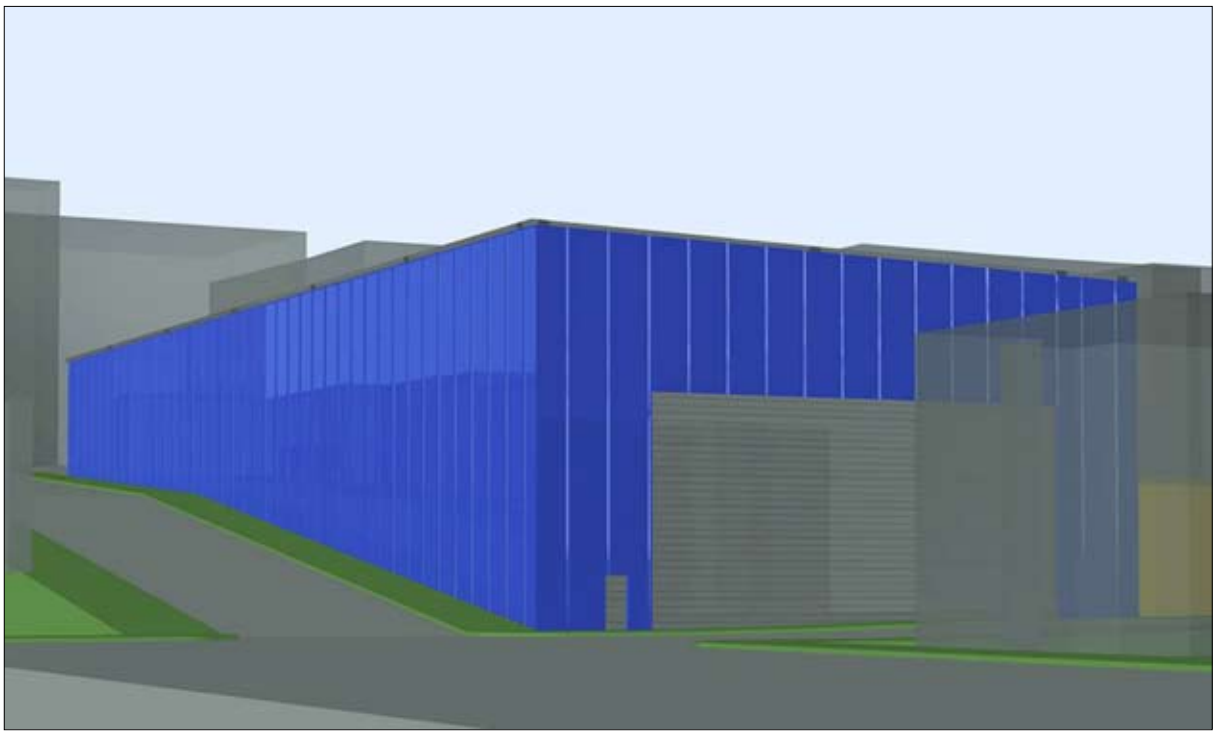
(Note that it is a Project requirement for all tunnelling works to be undertaken on a continuous basis, as far as practicable and possible, and this would be subject to a rigorous assessment of the noise and vibration impacts of undertaking night-time tunnelling works).

Silencing

All practical measures should be used to silence construction equipment, particularly in instances where extended hours of operation are required. Furthermore, silencing can be achieved by the use of specially designed acoustic cladding around noisy tunnel construction activities such as the Riley Street Site.

At the Riley Street Site, it is envisaged that an acoustic enclosure over the construction site would be installed – in a similar manner to what has been adopted by EnergyAustralia at the City West Cable Tunnel Project compound at Mary Ann Street, see **Figure 10.1**.

Figure 10.1 Model of acoustic enclosure during Riley Street Site tunnel construction phase



10.1.2 Regenerated (structure-borne) noise assessment criteria

The Project would involve significant tunnelling activities, which are proposed to be conducted using a roadheader machine and TBM, to be launched from the Riley Street Site for the CSCT Extension and the CECT, respectively.

Whilst regenerated noise was not identified in the Director General's Requirements and input from agencies (see **Volume 2**, **Appendix A**), there is potential for regenerated noise to be an issue for noise-sensitive receivers near to construction (excavation) sites and near to (above) the tunnel alignment, with the potential for greater impact when the proposed tunnel alignment is closer to the ground surface and therefore foundations of noise-sensitive premises.

Regenerated noise in buildings is caused by the transmission of ground-borne vibration rather than by the direct transmission of noise through the air. Vibration may be generated by construction equipment such as TBMs and transmitted through the ground into the adjacent building structures. After entering a building, this vibration causes the walls and floors to faintly vibrate and hence to radiate noise (also commonly referred to as 'structure–borne' or 'ground-borne' noise).

Structure-borne noise is not usually a significant disturbance to building occupants during daytime periods due to higher ambient noise levels which mask the audibility of structure-borne noise emissions. During night-time periods however, when ambient noise levels are often much lower, structure-borne noise is more prominent and may result in adverse comment from building occupants.

Table 10.2 provides a summary of the structure-borne noise objectives that have been applied on recent tunnelling projects in NSW.

Table 10.2 Structure-borne noise objectives on recent NSW tunnel projects

Construction project	Structure-borne noise objectives (residential)	
	Daytime	Night-time
Cross-City Tunnel	Vibration objectives only (BS 6472)	L_{A90}(15minute) 40 dBA (6 pm to 10 pm) L_{A90}(15minute) 35 dBA (10 pm to 7 am)
EnergyAustralia 132kV cable tunnels in CBD	Vibration objectives only (BS 6472)	L_{A90}(15minute) 40 dBA (6 pm to 10 pm) L_{A90}(15minute) 35 dBA (10 pm to 7 am)
Lane Cove Tunnel	Vibration objectives only (BS 6472)	L_{A90}(15minute) 40 dBA (6 pm to 10 pm) L_{A90}(15minute) 35 dBA (10 pm to 7 am)
Epping to Chatswood Rail Line	L_{A90}(15minute) 45 dBA	L_{A90}(15minute) 40 dBA (6 pm to 7 am) L_{A90}(15minute) 35 dBA > 7 Days (10 pm to 7 am)

On this basis, it is likely for the Project that the same criteria that were applied to the 132kV cable tunnels in Sydney CBD are appropriate, and on this basis, this document adopts these criteria, being:

- daytime: vibration objectives only (BS 6472).
- night-time: L_{A90}(15minute) 40 dBA (6 pm to 10 pm), L_{A90}(15minute) 35 dBA (10 pm to 7 am).

10.1.3 Vibration assessment criteria

The effects of vibration in buildings can be divided into two main categories:

- those in which the occupants or users of the building are inconvenienced or possibly disturbed (Human Comfort); and
- those in which the integrity of the building or the structure itself may be prejudiced (Structural Damage).

The Department of Environment and Climate Change (DECC) requires an assessment of vibration in accordance with (DECC's document), *Assessing Vibration: A Technical Guideline,* (August 2006) specifically **Table 2.2** and **2.4**. These tables (and indeed the whole document) in the DECC *Technical Guideline* only take Human Comfort into account. They provide acceptable values for continuous and impulsive vibration in terms of vibration acceleration (m/s^2) 1 to 80 Hz and also acceptable values for intermittent vibration in terms of Vibration Dose Value (VDV) ($m/s^{1.75}$).

The means by which the criteria set out in the DECC *Technical Guideline* are measured and assessed (acceleration and dose) are not straightforward to measure, and, in the case of acceleration particularly, would impose an onerous burden upon the Project if assessment was required to be undertaken in this manner, with no additional benefit to the community. It is far more straightforward to assess vibration in terms of Peak Particle Velocity (PPV).

On past, similar projects, Heggies Pty Ltd has determined equivalent vibration criteria consistent with the values in the DECC *Technical Guideline*, but expressed in terms of PPV. The *Technical Guideline* is based upon some of the references set out below in the British Standards (BS 6472).

Humans are far more sensitive to vibration than is commonly realised. They can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2-1975. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in **Table 10.3**.

Table 10.3 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hz to 80 Hz.

Table 10.3 suggests that people would just be able to feel floor vibration at levels of about 0.15 mm/s and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

10.1.4 Construction traffic noise assessment criteria

For traffic operating on public roads to and from construction sites the DECC "*Environmental Criteria for Road Traffic Noise*" 1999 (ECRTN) are appropriate for assessing road traffic noise. The DECC's recommended criteria for collector roads are set out in **Table 10.4.**

Table 10.4 DECC road traffic noise criteria

Development	Day (7.00 am to 10.00 pm)	Night (10.00 pm to 7.00 am)
7. Land use development with potential to create additional traffic on FREEWAYS/ ARTERIAL roads	L_{A90}(15hour) 60 dBA	L_{A90}(9hour) 55 dBA
8. Land use development with potential to create additional traffic on COLLECTOR roads	L_{A90}(1hour) 60 dBA	L_{A90}(1hour) 55 dBA
13. Land use development with potential to create additional traffic on LOCAL roads	L_{A90}(1hour) 55 dBA	L_{A90}(1hour) 50 dBA

Where L_{Aeq} noise levels already exceed the above targets, a 2 dBA increase in the overall traffic noise levels is normally regarded as an alternative target (having investigated the application of all feasible and reasonable noise mitigation) in order to maintain the general acoustic amenity of the area.

It is likely that on the roads immediately adjacent to the various work sites, the community would associate truck movements with the Project. Once the trucks move further from each of the sites, the truck noise may be perceived as part of the general road traffic.

10.1.5 Construction noise

Construction noise goals for airborne noise emission, (when established *in accordance with relevant NSW Government and DECC policies and guidance*) are based on the existing ambient or background noise levels within a given area and an allowable increase due to the temporary nature of construction works.

In some instances, construction noise goals may also be based on the sensitivity of particular building spaces. For example, the acceptable noise level within a factory would be much higher than for a recording studio.

On the basis of Project scheduling information presented in **Figure 4.2** and **Table 9.1**, it is likely that work at most, if not all work sites that form part of the Project would require construction activities of 26 weeks or greater. Based on the ENCM criteria presented in **Table 10.1**, airborne noise emission from Project construction activities would be assessed for compliance with *relevant NSW Government and DECC policies and guidance* based on a Rating Background Noise Level (RBL) **Background (RBL) + 5 dBA** criterion for residential receivers.

Specifically, this means that noise from construction activities should be managed such that the LA_{10} noise level, measured over a period of not less than 15 minutes, should not exceed the background LA_{90} noise level by more than 5 dBA.

For commercial and retail buildings, it is generally accepted that receivers are 5 dBA to 10 dBA less sensitive to construction noise emissions than residential receivers. For commercial and retail receivers such as the outdoor eating areas, restaurants, take away shops, hair salons, and the like, an $LA_{10(15minute)}$ noise objective of Background (RBL) + 10 dBA has conservatively been applied.

The establishment and derivation of airborne noise criteria for residential receivers was undertaken as part of a construction noise assessment for the Belmore Park Zone Substation and the stub tunnel connection from the existing CSCT. Details are presented in Chapter 9 of the Belmore Park Zone Substation and Commercial Development Project EAR.

For the remaining Project elements subject to future project approval EARs commitments have been proposed to conduct the necessary investigations which establish and derive airborne noise criteria.

10.1.6 Construction noise & vibration assessment

Tunnelling activity associated with the CECT and the CSCT Extension would primarily warrant acoustical assessment in terms of regenerated (structure-borne) noise and vibration.

There would be a 12 metre tunnel section, (CSCT stub tunnel), which connects the Belmore Park Zone Substation with the existing tunnel infrastructure, this section of tunnelling would be undertaken as part of the Belmore Park Zone Substation bulk excavation works. It is expected that a small excavator or roadheader machine would be used to break through the small section of rock.

Further details of the development can be found in the separate EAR seeking project approval under Part 3A of the EP&A Act.

Construction noise

Airborne noise emission would also require consideration at the locations where the TBM and roadheader machine are launched (Riley Street Site), where spoil is brought to the surface and transported from (also Riley Street) and where the tunnel is required to interface with the surface (eg at any vertical shafts mid-tunnel and at the CBD zone substations).

Construction vibration

It is anticipated that the most significant potential long-term source of construction-related vibration would be the use of the TBM and roadheader machine, used to construct the CECT and the CSCT Extension. Based on the findings presented by the Australian Acoustical Society (Technical Meeting, December 2003), at a slant distance of 65 metres, vibration due to the operation of a tunnel boring machine is likely to meet the human 'threshold of perception (0.15 mm/s), at 30 metres the vibration would be 'barely noticeable' and at distances closer than 30 metres, the vibration would become increasingly noticeable.

Safe working distances for typical items of 'above-ground' vibration-intensive plant are listed in **Table 10.5**. These distances are indicative only and can vary depending upon the particular item of plant and geotechnical conditions. For the purpose of this study, a 'safe distance' would correspond to the distance at which the maximum vibration level generated by the operation of a subject plant item is predicted not to exceed 2 mm/s.

Table 10.5 Safe working distances for vibration intensive plant items

Item	Rating	Safe working distance	Comments
Rockbreaker	Light (eg Krupp HM 170)	5 metres	Based on a 5 mm/s criterion
	Medium (eg Krupp HM 580)	10 metres	Based on a 5 mm/s criterion
	Heavy (eg Krupp HM 960)	30 metres	Based on a 5 mm/s criterion
Vibratory Hammer (Piling)	12 t Down force	15 metres minimum	Based on a 5 mm/s criterion
Hand held jack hammer	-	1 metre (nominal)	Avoid contact with structure

Note: The safe working distances apply to structural damage of typical buildings and typical geotechnical conditions. They do not address heritage structures or human comfort considerations. Vibration monitoring is recommended to confirm the safe working distances at specific sites.

Construction regeneration noise

It is anticipated that the most significant potential long-term source of construction-related regenerated noise would be the use of the TBM and the roadheader machine, used to construct the CECT and the CSCT Extension respectively. Based on findings presented by the Australian Acoustical Society (Technical Meeting, December 2003), at 50 metres slant distance, the operation of a tunnel boring machine results in regenerated noise levels of approximately 35 dBA, and a distance of 30 metres results in 40 dBA.

At this stage of the Project, it is reasonable to consider allowing a buffer distance of:

- 50 metres between the crown of the CECT tunnel and surface (residential) structures on the basis of regenerated noise control (assuming a Project preference to undertake tunnelling on a continuous basis, including during the 10.00 pm to 7.00 am night-time period); and
- 30 metres between the crown of the CECT tunnel and surface (residential) structures on the basis of regenerated noise control (assuming a project preference to undertake tunnelling during 6.00 pm and 10.00 pm).

10.1.7 Operations

Operations have the potential to generate noise and vibrations from activities such as:

- noise would be generated by the operation of the proposed zone substations and STSS; and
- minimal noise would be generated by the operation of the tunnel (ventilation fans and similar) as these are likely to be located underground.

An operational noise and vibration assessment was conducted for the Belmore Park Zone Substation development (see separate Belmore Park Zone Substation and Commercial Development EAR seeking project approval).

For the Project elements subject to concept approval, further investigations would be conducted during future project approval EARs.

10.2 Mitigation measures and safeguards

A summary of the key mitigation measures and safeguards is provided below. Further details can be found in **Volume 2**, **Appendix D**.

Belmore Park Site

A range of noise and vibration mitigation measures were developed for the Belmore Park Zone Substation and integrated development.

Details of the mitigation measures and safeguards developed for the Belmore Park Zone Substation are provided in **Chapter 9** of the separate Belmore Park Zone Substation and Commercial Development Project EAR.

Riley Street Site (CECT, CSCT Extension and STSS)/City East Zone Substation/Dalley Street Zone Substation/Alternative Service & Control Room

During the preparation of future project approval EARs for the above Project elements the following investigations would be undertaken:

- undertake a noise survey;
- derive construction noise emission criteria in accordance with the principles set out in **Volume 2**, **Appendix D**;
- conduct a detailed construction noise assessment;
- assess the need for required noise controls during the construction stage;
- this noise and vibration assessment should be refined for the future project approval EARs for each work site and tunnel alignment. Site-specific regenerated noise and vibration rules can be established following early works, the results of which may require increased buffer distances to be allowed, alternatively, may permit a smaller buffer distance where closer-to-surface tunnelling works are preferable (and the regenerated noise and vibration impacts are proven to be less than anticipated at this Concept EA stage); and
- an operational noise and vibration assessment would be conducted for the zone substations and STSS generally following the methodology used to assess the Belmore Park Zone Substation.

CSCT Extension

Based on Heggies Pty Ltd review of the site, it is recommended that a week-long unattended noise survey is undertaken in Little Albion Street, Surry Hills. The most suitable location for the survey appears to be any of the terraced houses at 14-22 Little Albion Street.

Riley Street Site

It is recommended that a week-long unattended noise survey is undertaken in up to four locations around the work site. The most suitable locations for the survey appear to be:

- East of work site - Rear of strata units at 329 Crown Street
- North of work site - Front of terrace house at 82 Ann Street
- West of work site - Front of townhouse at 299 Riley Street
- South of work site - Mid/upper floor balcony of a residential unit in 300 Riley Street/127 Albion Street facing Albion Street

11 European heritage and Aboriginal archaeology

11.1 Assessment

11.1.1 Non Aboriginal heritage

The following non-Aboriginal heritage information was extracted from the Non-Indigenous Archaeological Assessment prepared by Casey & Lowe. A full copy is found in **Volume 2**, **Appendix E**.

In order to determine the nature of a site's potential archaeological remains, the historical development of each area that would be impacted needs to be researched. This is a process of working through relevant plans and other sources to develop a picture of the land-use history of each area. This would enable, when coupled with an assessment of archaeological potential, to predict what kind of archaeological remains might be present and their level of heritage significance.

A series of plans identified slow development of the subject sites until 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 that century.

City East Zone Substation

Harper's Plan of Sydney 1827 shows a building on the corner of Bent and Phillip Streets, with another building to the west off Bligh Street. These buildings are gone by 1837 when the area is shown as vacant, with various buildings, including stores, outbuildings and offices to the south of the site. This was later the Union Club site.

A plan known as Commercial Sydney 1844-48 is based on directories of the period. While 1854 and 1856 plans show additional buildings on the block, there were no substantial change between this period and the 1840 plans. The site appears to have been used as the garden for the Union Club during this period.

Two metropolitan detail plans, one dated 1895 and one that appears to be slightly earlier, show that substantial growth had taken place on the block since the 1850s. The 1895 plan suggests that the Union Club has been completed and some changes made to that block.

A 1910 plan shows the ongoing commercial development of the site[1]. By 1924 a large portion of the block is dominated by the Union Club.

The 1949 Surveyors detail sheet shows the block in a form more recognisable today, with the Qantas Building, Wentworth Hotel, Bligh House and the relocated Union Club, now on Bent Street.[2]

In 1963 the most significant buildings on the site are identified as the Stock Exchange and the South British Insurance Building at the southeast end of the block.[3]

Dalley Street Zone Substation

The general area was built upon once the Tank Stream was enclosed and no longer flooded the adjacent area. A plan thought to be 1837 shows the subject area as primarily being part of the Female Orphan House Grounds.[4]

An 1854 plan shows significant but unidentified development on the site.[5] Several small buildings are located in the area bounded by Queens 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.[6]

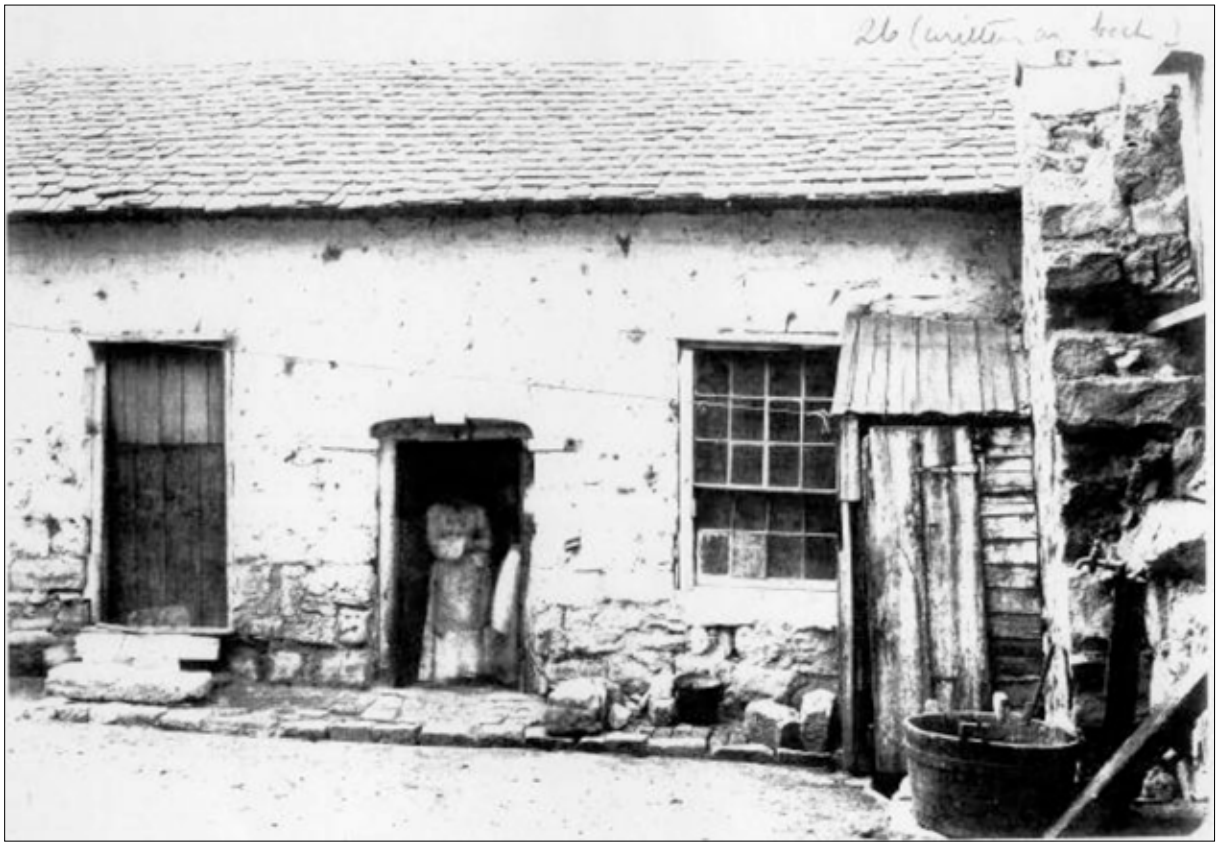
1 Roberts and Moffatt. City of Sydney (Central), 1910. Sydney City Archives, no ref number.
2 City Building Surveyors Detail sheet 1949. Sheet , Sydney City Archives. No ref number.
3 259 George Street, Public Auction, 1963, SP811.1712/27 - Sydney
4 Section 47 Government Grants 1837? ZM2 811.1715/1837?/1
5 Woolcott & Clarke. Map of the City of Sydney, 1854. Sydney City Archives. No ref number
6 City of Sydney. Metropolitan Detail Series section 47, 1884 MSER 4 811.17/1

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 (**Figure 11.1**).[7] 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.[8] Queens Court appears to be demolished in 1922 as part of post plague resumptions.

By 1949 there appears to have been an amalgamation of sites with fewer, larger sites now evident such as Latec House, General House, carparking and the telephone exchange (Fig. 30).[9]

Figure 11.1 Queen's Place, c1875



Services Control Room (if located at Cook & Phillip Park)

The relevant part of this area appears to have remained undeveloped apart from clearing until its development as park area. The initial park area was developed with a relatively low key landscape. Some development took place on the perimeter such as the bowling green near College Street. In the late twentieth century the Cook and Phillip Park area underwent major redevelopment which included removal of the bowls club, addition of new recreational facilities and hard landscaping of the area immediately surrounding St Mary's Cathedral.

Belmore Park Site

The site was initially part of the Brickfields, where the production of bricks, roofing tile and pottery production was concentrated from early 1788. From 1829 the site was used for cattle markets, apparently open air fenced yards. These open markets were replaced in 1869 by the Belmore Markets building which housed Sydney's main produce markets.

The main building on the site was the Hotel Sydney which opened about 1918. Its demolition left the present carpark.

7 Queens Place, c1875. ML SPF
8 Fire Underwriters Association of NSW Detail Survey Map. Nock and Kirby's Block 125. CRS 928 Sydney City Archives
9 City Building Surveyors Detail sheet 1949. Sheet , Sydney City Archives. No ref number.

Riley Street Site

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".[10] The most recent building on the site was a building listed on Council's LEP as a heritage item, the Former Industrial Sugar Mills Pty Ltd, a two-storey inter-war warehouse. This building has since been demolished, leaving a basement level hole.

Assessment of archaeological potential

The archaeological potential of the above sites is as follows:

Belmore Park Site

This site was archaeologically assessed and tested by Casey & Lowe in 1996. The assessment indicated that the site had been part of the early brickfields and that evidence for brick and making and pottery and roofing tile manufacturing may be present. Later uses included the Cattle Market, the Belmore Market, and the Hotel Sydney.

Based on the results of this testing, the site's archaeological potential is regarded as low.

Services Control Room (if located at Cook & Phillip Park)

The historical research has not identified any substantial buildings or land use in this area. It appears to have been always open space with no structures or buildings that could be considered to have left archaeological features or deposits.

City East Zone Substation (located within the vicinity of Bent and Phillip Streets)

On the plans of the first half of the nineteenth century, the site appears to be built upon but by the middle of the century the northern end of the block is occupied by a garden presumably associated with the adjacent Union Club. When the Wentworth Hotel was built the Union Club moved to the corner site. As buildings in the vicinity have lower ground floor levels, the potential for archaeological remains is considered to be restricted to deeper features such as wells (or the basements of former buildings). There is potential for remains dating to the early 1800s.

Riley Street Site

Substantial excavation has already occurred at the site. The site is considered to have no archaeological potential.

Dalley Street Zone Substation

This site is situated towards the mudflats at the mouth of the Tank Stream. It appears to be immediately adjacent to the rock-cut tanks that had been cut out of bedrock to store water and which gave the stream its name. This implies that exposed bedrock was present in the immediate area and that the mudflats proper were further north. The site of the proposed work should be within the Tank Stream valley and therefore 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 sub-station.

Summary

Even though the study areas for the sites have not been able to be exactly determined due to the lack of available site plans at this stage the following summary could be made:

- The Dalley Street and Bent Street sites contain a range of potential archaeological remains associated with the history and development of Sydney. Among these remains are soil profiles in the Tank Stream valley, the early Female Orphan School, early nineteenth-century residential occupation and later nineteenth-century slum housing.
- The Belmore Park Site has a low level of archaeological potential.
- The remaining sites have little or no archaeological potential.

10 *Sands Directory*, 1902 and 1913.

11.1.2 Aboriginal archaeology

Aboriginal Archaeological information was extracted from the Aboriginal Cultural Heritage Assessment by Navin Officer Heritage Consultants. A full copy is provided in **Volume 2**, **Appendix F**.

The detection of sixteen Aboriginal sites in the vicinity of the anticipated areas of development impact demonstrates 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.

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.

Greatest potential for subsurface archaeological deposits can be predicted to occur within:

- the pre-European foreshore zone, up to 200 metres 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;
- 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 any archaeological potential, due to the high level of disturbance and soil extraction required during construction.

The potential for direct impact to surviving archaeological deposits by the proposed Project is considered to be very limited.

11.2 Mitigation measures and safeguards

11.2.1 Non Aboriginal heritage

Belmore Park Site

- The Belmore Park Site should be monitored during initial earthworks to determine whether any remains dating to the brickfield period are present.

Dalley Street & City East zone substations

During the preparation of future project approval EARs for the above Project elements the following investigations would be undertaken:

- the archaeological potential and significance of the Dalley Street and City East zone substation sites should be reassessed once the exact study areas and nature of impacts are known. This would require additional historical research; and
- the Dalley Street and City East zone substations' sites are likely to require archaeological testing to determine the nature and integrity of archaeological remains. If substantive remains are identified these would need to be subject to a detailed archaeological recording programme.

Services Control Room (if located at Cook & Phillip Park)

During the preparation of future CECT project approval EARs for the Project elements the following investigations would be undertaken:

- the nature of possible remains in the Cook and Phillip Park area should be revisited once the location of the Services Control Room is known.

11.2.2 Aboriginal archaeology

It is recommended that:

- No further Aboriginal archaeological investigation is required for the Project.
- The limited potential for remnant and dispersed Aboriginal artefacts to occur should be considered when excavations associated with the proposed tunnel connections and/or extensions for the proposed Project

occur. An appropriately trained archaeologist should be available (on call) during excavations to identify Aboriginal Objects and provide advice where necessary.

- In the unlikely event that Aboriginal Objects are uncovered by construction or excavation works, it is recommended that the following response strategy be adopted and incorporated into contingency management plans prior to the commencement of works:
  - stop all impactive works or actions which may disturb the area of the find or exposed Aboriginal Object (objects may include: stone artefacts, bones, midden shells and hearth remnants);
  - contact Project archaeologist and organise for inspection of site/material;
  - consult with the Department of Conservation and Climate Change, regarding an appropriate course of action;
  - consult with the Metropolitan Local Aboriginal Land Council regarding an appropriate course of action; and
  - carry out any requirements indicated by the DECC and the Metropolitan Local Aboriginal Land Council.
- Three copies of Navin Officer's report (**Volume 2**, **Appendix F**) should be forwarded to the NSW DECC; and
- One copy of this draft report should be forwarded to the Metropolitan Land Aboriginal Land Council for their consideration and comment.

12 Spoil & waste management

12.1 Assessment

The excavation of the substations' sites, tunnels and shafts would generate considerable quantities of spoil.

It is envisaged material excavated during night shift operations would need to be stockpiled on site overnight and then transported off site by heavy vehicles during standard construction hours. The possibility may exist to encounter potentially contaminated soils.

Table 12.1 describes the proposed spoil quantities for the Project.

Table 12.1 Proposed spoil quanatities *

Description	Location of spoil removal	Estimated spoil quantity (m^3) *
Belmore Park Site	Bulk excavation of zone substation Bulk excavation of commercial component	40,000 21,000
City East Zone Substation	Bulk excavation of zone substation	47,000
Stub Tunnel to CSCT	Campbell Street	300
Riley Street Site	Bulk excavation of approximately half the site	40,000
CECT launch cavern	Riley Street Site	3,000
CSCT Extension	Riley Street Site	3,543
City East Cable Tunnel	Riley Street Site	57,000
Potential stub tunnels (x3) at shaft locations detailed below.	From shaft locations	5,670
Potential Underwood St shaft	Underwood Street (or potentially Gresham Street)	1,620
Potential Services Control Room shaft	Cook & Phillip Park vicinity	3,240
Potential City East Shaft	City East Substation location	3,240
Surface works (general)	Around Dalley, Bent, Bridge and Gresham Streets	3,480
Contingency	Various	3,600
Total		**229,000**

** Allows for a 50% bulking factor*

Traffic and transport impacts have been considered in **Chapter 9**.

At this stage no details regarding the potential re-use of the Virgin Excavated Natural Material (VENM) has been identified.

In the event of contaminated material being found during construction it would be appropriately managed and disposed of in accordance with statutory requirements.

12.2 Mitigation measures and safeguards

A number of mitigation measures and safeguards have been developed and would be further investigated during the preparation of future project approval EARs:

- wherever practicable spoil would be reused as part of the Project;
- sites for the disposal of surplus soil would be selected according to the rate of development activity and the volume of material generated elsewhere;
- spoil that is not VENM would be transported to approved landfill sites and/or off-site recycling depots;
- spoil haulage routes identified in **Chapter 9** would be used; and
- as part of the CEMP a Spoil Handling and Management Sub Plan would be prepared which would identify how spoil will be handled, stockpiled, re-used and disposed. It would address the principles of all relevant legislation.

Further mitigation measures and safeguards have been developed for Belmore Park Zone Substation and can be found in **Chapter 12** of the separate Belmore Park Zone Substation and Commercial Development Project EAR.

13 Hazards & risks

13.1 Screening of potential hazards

Health, safety, risks and hazards for the Project include:

- security of the cable tunnel and substations;
- likelihood of cable being damaged;
- potential to damage other infrastructure during construction (eg water and sewer pipelines);
- identification of other risks/hazards posed by the construction and operation of the cable tunnel and substations;
- description of hazard and emergency management measures for both the construction and operation stages;
- security of the site to avoid vandalism and securing risk to adjoining sites;
- potential for fire events and proposed fire management strategy; and
- potential releases of sulphur hexafluoride into the atmosphere.

As part of the preparation of the EAR two preliminary reviews of risks and hazards were conducted by EnergyAustralia for the Belmore Park Zone Substation and the remaining elements of the Project respectively.

The results of the two reviews are contained in **Volume 2**, **Appendix G**.

13.2 Electric & magnetic fields

13.2.1 Assessment

The issue of electric and magnetic fields is an integral part of the process for planning the Project.

This section provides a summary of the key EMF considerations for the Project. More detailed information can be found in **Chapter 13** of the Belmore Park Zone Substation and Commercial Development Project EAR. Further investigation of mitigation measures and safeguards would be undertaken during the preparation of future project approval EARs.

13.2.2 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 fields decrease rapidly as you move away 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.

13.2.3 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 for the purpose of trying to determine whether or not human exposure to EMF is related to adverse health effects. Consistently, none has ever found a basis 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. The National Health and Medical Research Council has issued Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic

fields.

These guidelines are aimed at preventing immediate health effects resulting from exposure to these fields. 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) (NHMRC 1989).

EnergyAustralia operates its powerlines, substations and other electrical infrastructure well within these interim guideline limits.

In December 2006 ARPANSA released a draft new standard for EMF exposure in Australia. Following public comment this new standard is expected to be finalised and implemented in late 2008.

13.2.4 EnergyAustralia's position on EMF

- Provide balanced, accurate information to our employees and customers, including electric and magnetic field measurements and advice.
- Take reasonable steps to limit field exposures from new facilities by locating and operating our electrical installations prudently within the latest Australian health guidelines.
- Closely monitor engineering and scientific research, overseas policy development and major reviews of scientific, medical and engineering research regarding electric and magnetic fields and health.
- Cooperate fully with any bodies established by governments in Australia to investigate and report about power frequency electric and magnetic fields.

13.2.5 Mitigation measures and safeguards

- EnergyAustralia would take a number of steps to minimise EMF around the proposed Project elements. 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 transmission cables would be located in a concrete lined tunnel at a depth of 10 to 70 metres below ground level. The EMF from these cables would be indiscernible from typical background levels.
- Design of the Belmore Park Zone Substation for example has incorporated a number of mitigation measures including:
  - restricting access to the Site to limit exposure to higher fields within the substation to the general public;
  - 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 will be balanced with minimum zero sequence current;
  - where possible, cables will be positioned in trefoil arrangement to reduce phase separation distances. Trefoil has the lowest fields compared to other configurations;
  - where possible, cable trays will be positioned away from adjacent adjoining property boundaries;
  - no exposed busbars will be present within the substation apart from the transformer connections within the transformer bays;
  - incoming and outgoing connections will be installed underground using the most compact construction technically practicable;
  - use of 132kV GIS (gas insulated switchgear) instead of conventional air-insulated equipment;
  - five transformers positioned in a single line (single loaded) to reflect the optimum location furthest away from neighbouring buildings on both sides of the Site.

Further information can be found in **Chapter 13** of the separate Belmore Park Zone Substation and Commercial Development Project EAR.

13.3 Construction and operational risk management

Mitigation measures and safeguards were developed for Belmore Park Zone Substation and can be found in **Chapter 13** of the separate Belmore Park Zone Substation and Commercial Development Project EAR.

A number of mitigation measures and safeguards have been developed and would be further investigated during the preparation of future project approval EARs.

The risks and hazards can be managed through the development of construction phase risk management planning and operation phase risk management planning.

13.3.1 Mitigation measures and safeguards

- EnergyAustralia would identify the services potentially affected by construction activities to determine requirements for diversion, protection and/or support. EnergyAustralia would ensure that existing cathodic protection systems are not adversely affected and that appropriate measures are put in place to minimise stray currents.
- EnergyAustralia's contractors would prepare and implement Construction Safety Sub Plans to manage hazardous incidents and public safety during the construction of the Project.
- EnergyAustralia would prepare and implement Operation Emergency Sub Plans to manage emergency events that may arise in relation to operation of the Project.
- EnergyAustralia would prepare and implement an Operation Security and Crime Management Strategies to prevent unauthorised public ingress or access to relevant components of the Project during its operation, and to minimise the potential for crime in the vicinity of cable infrastructure (for example, vandalism, loitering, illegal dumping etc). The strategies would be generally in accordance with the principles outlined in the former Department of Urban Affairs and Planning publication entitled "Crime Prevention and the Assessment of Development Applications" dated 2001.

14 Property, land use and settlement

14.1 Assessment

A preliminary basement survey of buildings was undertaken in July 2008 along the proposed alignment of the City East Cable Tunnel (CECT). The primary objective of the survey study was to identify potential conflicts between the proposed tunnel alignments and existing underground basements and building support structures generally, and to determine whether the presence of any existing building structures would necessitate an adjustment of the tunnel alignment(s) being considered during the feasibility and planning stages of the Project.

The basement survey was completed to a level suitable for input into the feasibility design of tunnel alignments and to facilitate assessment of likely design clashes.

The preferred tunnel alignment is the shallowest option (Option 3 – Yurong Street Alignment) of those put forward in the feasibility design and is thus considered most likely to have potential conflict with basement structures.

The basement survey undertaken indicates that minimal clashes exist between the preferred CECT tunnel alignment and existing building basements. However, it is noted that the tunnel alignment does pass directly beneath some building structures, with the assessment of whether adequate clearances exist to these buildings to be assessed during the detailed design of the tunnel.

Interfaces identified with existing structures include the following:

- 275 Kent Street;
- 45 Clarence Street;
- The Domain Car Park; and
- 1 Yurong Parkway.

14.1.1 Construction

The Belmore Park Site and Riley Street Site have been acquired by EnergyAustralia. Property investigations are underway to acquire property for the City East Zone Substation.

The proposed tunnels would be predominantly aligned under publicly owned lands, publicly owned road easements and several privately owned properties. It is envisaged the tunnel would pass between 10 to 70 metres beneath the surface of the ground, under a range of urbanised land uses. Key design considerations would be identifying existing basements, underground car parks and existing and future infrastructure corridors.

At the northern end of the tunnel alignments, particularly in the vicinity of Dalley Street Circular Quay, and in the low lying areas around Riley Street and Yurong Streets Woolloomooloo, there may be potential for settlement if substantial drawdown of the water table occurred in the alluvium and sediment/fill.

Although changes to the water table could potentially result in settlement of buildings founded on alluvium and/or fill as a result of groundwater drawdown, this is unlikely to occur because the CECT is progressively lined during construction (providing a 'proper concrete structure' underground) and has been designed to exclude groundwater seepage.

14.1.2 Operation

EnergyAustralia proposes to acquire an underground stratum for the tunnels which would protect them from future development.

The proposed tunnels are not expected to cause measurable settlements in the structures along the route given that significant structures are founded on Hawkesbury Sandstone. The tunnel alignments would be designed to accommodate requisite clearances to existing structures.

The tunnels would be fully lined to control groundwater seepage and would be effectively dry tunnels.

14.2 Mitigation Measures and Safeguards

14.2.1 Further investigations

The following investigations have been identified:

- Further investigations and design are required to assess the risks of settlement in potential areas of groundwater drawdown. It is proposed to prepare a detailed assessment of these issues in future project approval EARs, develop mitigation measures and outline construction phase management sub-plans.
- Where the tunnel alignment passes directly beneath or adjacent to large building structures, further assessment would be required during detailed design to verify the preliminary basement survey findings and to confirm that the assessed clearances are suitable.
- Prior to construction dilapidation/condition surveys would be undertaken for properties identified to be potentially impacted by construction activities.

14.2.2 Monitoring

Wherever practical, impacts on potentially affected properties would be avoided or reduced by design measures.

Settlement monitoring would be undertaken during the construction phase, this may also include 'real time' monitoring regimes where the CECT in particular is in close proximity to existing tunnels, such as the Cross City Tunnel.

14.2.3 Consultation

The acquisition of any land would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. EnergyAustralia would notify the owner of any property that is to be adjusted, acquired or for which an easement or stratum is to be obtained. This notice would contain sufficient details to identify the land of interest being adjusted/acquired and is to include dimensions, location with respect to boundaries and any other information necessary to enable the identification of the land in relation to the development.

Consultation with key stakeholders would continue during the development of the design for the Project, during the preparation of future project approval EARs and during the construction phase.

15 General environmental aspects

15.1 Surface and groundwater management

Under Section 120 of the Protection of the Environment Operations Act 1997, an individual or organisation may be charged with an offence for polluting waters. EnergyAustralia recognises this obligation, which applies equally to both the construction and operating phases of the Project. An assessment of likely impacts and control measures is detailed below.

15.1.1 Assessment

Construction

The main issues during construction would be:

- inflows of groundwater to the tunnel during excavation and the potential to discharge contaminated groundwater to the stormwater system, and thus the receiving waters.
- the prevention of erosion and containment of any sediment generated to prevent discharge into stormwater systems;
- the potential for chemical spills; and
- stormwater run-off could potentially contain elevated silt loads from tunnel spoil deposited by trucks.

In some areas of the CECT alignment, higher water pressures may be encountered. High pressures and/or flows may necessitate grouting to be completed in this area prior to the tunnel advancing below the paleovalleys.

Although the CECT would be fully lined to exclude or limit the seepage of groundwater, no lining is completely waterproof. It is anticipated that small quantities of groundwater would collect in the tunnel, approximately 300 litres/100 metres/ day

During construction, temporary pumping systems would be installed to pump groundwater and other water generated during the works to the surface for discharge to the stormwater system following treatment.

Given the construction and lining methodology proposed, and the level of groundwater inflows expected along the tunnel alignment, the likelihood of flooding, even in cases of pump failure, is minimal. Backup pumping systems would be employed on site and the Contractor's Environmental and Safety Management Plans would include measures for evacuating the tunnel, if required, and for dealing with failures in construction pumping equipment.

It is expected that groundwater would be intercepted which may contain relatively high levels of manganese and/or iron. Any groundwater intercepted during both the construction and operational stages of the Project would be treated to an accepted level and discharged to stormwater in accordance with ANZECC guidelines. This would be carried out in consultation with DECC, Sydney Water Corporation and/or City of Sydney.

Although changes to the water table could potentially result in settlement of buildings founded on alluvium and/or fill as a result of groundwater drawdown, this is unlikely to occur because the CECT is progressively lined during construction (providing a 'proper concrete structure' underground) and has been designed to exclude groundwater seepage.

Potential surface water, erosion and sedimentation impacts are likely to be restricted to exposed areas during construction (the proposed construction sites) and those points where water from the tunnel is discharged during construction.

The receiving waters most likely to be affected by the proposal are Darling Harbour and more specifically Cockle Bay.

Operation

A sump and pump-out facility would be included at the lowest point/s of the cable tunnel, with drainage channels throughout the tunnel length to direct seepage water to these points. Water from the sump would then be pumped into the City South Cable Tunnel and treated at the existing water treatment plant located at Campbell Street Zone Substation. Initial assessment indicates that the water treatment plant can accommodate inflows from the CSCT, CWCT, and CECT. This plant treats water to comply with the Australian and New Zealand Environment and Conservation Council (2000) guidelines before discharge into Cockle Bay. However, further detailed design would confirm this initial assessment.

The operation of the Belmore Park Zone Substation and commercial/retail development may require the use of a water treatment plant. If required, it is envisaged that groundwater flows associated with the substation component of the development would also be pumped to the existing water treatment plant located at Campbell Street Zone Substation (via the existing CSCT). The commercial/retail component of the development would include provision for a new treatment plant facility.

Other elements of the Project would have their own water treatment plant. Otherwise, they would utilise another water treatment plant forming part of the Project.

During operations the Project is not expected to increase the proportion of impervious surfaces or have a significant impact on the nature of land uses within the catchment.

15.1.2 Mitigation measures and safeguards

Construction

Soil and Water/Groundwater Quality Management Sub-Plans would be prepared as part of the Construction Environmental Management Plans (CEMP) for the Project. The Sub Plans would be prepared in accordance with the Department of Housing's guidelines *Managing Urban Stormwater – Soils and Construction* and would detail how soil and water-related mitigation measures would be implemented at the various construction stages.

The plans would be developed in consultation with stakeholders to ensure the appropriate mitigating measures and safeguards are incorporated and would be updated as the Project progresses.

The plans would identify the means of minimising the entry of surface water and groundwater to the tunnel and the means of disposal of any such water entering the tunnel. This would include identification of any proposed use of existing drainage infrastructure and the means of minimising any adverse impacts, including capacity limitations within the drainage system.

Soil and Water Quality Management sub-plans would detail treatment processes and associated water quality objectives to be achieved by the construction treatment facilities prior to discharging waters to the receiving waters. The Sub-Plans would also include proposed water quality monitoring regimes to be adopted during construction, and emergency management plans addressing key issues such as tunnel flooding and unexpected discharge of contaminated waters.

Project inductions for all site personnel and visitors would include training in the key environmental aspects and risks associated with the Project, and the mitigation measures and emergency response procedures detailed in the Soil and Water Quality Management Sub-Plans.

Operation

Water Quality Treatment and Monitoring

It is proposed that groundwater would be collected in the CECT, the CSCT Extension, and Belmore Park Zone Substation via drainage sumps, and then pumped to the existing CSCT water treatment plant using dedicated pumping systems. Initial assessment indicates that the existing water treatment plant can accommodate these additional inflows.

The CSCT Water Treatment Plant has been in operation since 2004 and discharges treated water to Cockle Bay, via the existing stormwater system.

The water treatment plant water quality goals set for this existing facility are outlined in **Table 15.1** and have been derived from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000).

It should be noted that these are ideal performance parameters against which the operation of the plant can be evaluated over the longer term. They are not limits that would necessarily trigger an operational response should they be breached.

Table 15.1 Water Quality Goals

Chemical component	Concentrations
Total suspended solids (TSS)	<10 mg/L
Turbidity	<10 NTU
Colour (True)	10° Hazen
Dissolved Oxygen (mg/L)	8-11
Oil and grease	<10 mg/L with no visible oil and grease
pH range	7.0-8.5 pH units
Filtrable Iron (as Fe)	<300 ug/L
Total Iron (as Fe)	<2000 ug/L
Filtrable Manganese (as Mn)	<1250 ug/L
Total Manganese (as Mn)	<1250 ug/L
Aluminium (as Al)	<41.3 ug/L
Arsenic (as As)	<4.5 ug/L
Cadmium (as Cd)	<5.5 ug/L
Chromium (as Cr)	<4.4 ug/L
Copper (as Cu)	<8.0 ug/L
Lead (as Pb)	<4.4 ug/L
Mercury (as Hg)	<0.4 ug/L
Nickel (as Ni)	<70 ug/L
Zinc (as Zn)	<25 ug/L

EnergyAustralia's existing Operational Environmental Management Plan for the CSCT details the water quality monitoring regime currently in place for the existing water treatment plant and is summarised below.

To ensure that treated water from the proposed infrastructure via the existing water treatment plant meets the water quality goals set out in **Table 15.1**, regular sampling and analysis of discharge water would be undertaken. Turbidity and pH are continuously monitored through permanent probes contained within the existing plant to provide "real-time" indications of water quality exceedences.

At monthly intervals, samples are tested for total and soluble iron, and total and soluble manganese. Every 3 months, samples are tested for all analytes listed in **Table 15.1** to ensure that no significant changes in water quality have taken place.

After commissioning of the CECT, the CSCT Extension, and Belmore Park Zone Substation pumping systems, and increased testing of water quality parameters from the water treatment plant would be undertaken to confirm that the additional flows would not affect the discharge quality from the plant. Once this has been confirmed, the water quality monitoring program would revert to that currently in place.

Flooding

The CECT would be connected to the Riley Street STSS, City East, Dalley Street and City North zone substations. Access to the tunnel would be via the Riley Street STSS. All these substations are enclosed structures that contain appropriate ground and roof drainage. Thus, under normal conditions there is minimal potential for floodwaters or stormwater to enter the tunnel.

Given the proposed lining design for the tunnel, the main sources of potential tunnel flooding include:

- operation of the fire system within the tunnel; and
- failure of the duty and standby tunnel water pumps.

An automated fire system may be installed in the tunnel. Should the fire system operate, it is envisaged that the drainage pumps in the tunnel would be adequately sized to accommodate this occurrence.

Under normal operating conditions, it is highly unlikely that both duty and standby drainage pumps would fail at the same time. SCADA controls would monitor the water levels in the tunnel and the functionality of the pumping system and alarms would be generated to the appropriate control centre to immediately advise of any failures or flooding in the tunnel.

Should this occur, other portable pumps would be delivered to the tunnel to assist in dewatering tasks.

Operating Plans

Prior to commissioning of the CECT, CSCT Extension, and Belmore Park Substation, EnergyAustralia would develop Operating Plans and Operational Environmental Management Plans (OEMP) for the new tunnel and substation infrastructure.

The Operating Plans for the CECT, CSCT Extension, and Belmore Park Substation would include procedures for operating and maintaining drainage and water treatment facilities and equipment. The Plans would also include emergency response procedures dealing with a range of potential emergency situations.

The OEMP(s) would:

- outline legislative and management requirements;
- identify key environmental risks and mitigation measures;
- identify roles and responsibilities;
- outline monitoring, auditing and reporting requirements; and
- provide contingency plans and procedures for dealing with non-compliances and/or emergency events.

All EnergyAustralia staff and Contractor's involved in the operation and maintenance of the CECT, CSCT Extension, and Belmore Park Zone Substation would be trained in the provisions of the Operating Plans and OEMP.

15.2 Greenhouse gas and air quality

15.2.1 Assessment

The following information was extracted from the Air Quality Assessment prepared by Pacific Air and Environment. A full copy of the report can be found in **Volume 2**, **Appendix H**.

Construction

There is potential for emissions of combustion gases and dust to be generated during demolition and construction works of the existing zone substations and integrated commercial developments as well as during excavation and tunnelling construction works and spoil handling activities.

The main pollutants of interest are total suspended particulates (TSP) and particulate matter less than 10 micrometres in aerodynamic diameter (PM_{10}) that may be emitted due to the proposed demolition and construction works.

Site preparation, shaft excavations and spoil removal would involve surface earthworks and construction and materials handling activities, which have potential to generate dust emissions. Dust emissions are predicted to be negligible when managed appropriately and would have localised impacts only, if any.

Excavation in the tunnel using a TBM and/or roadheader machine would generate dust at the working face and during handling and transport of spoil material. Both types of tunnelling machines use cutting or cooling fluid, predominantly water, which would reduce the amount of dust generated. The tunnels would be mechanically ventilated to ensure that clean air is available to workers in the tunnels. During the construction period, dust laden air from the tunnel would be treated via a filtration system to remove dust particles before the air is exhausted from the tunnel. The design of the filtration system would meet the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2002* (as amended) and the filtration system would control any dust emissions at acceptable levels.

Spoil material would be stockpiled and loaded into trucks after being removed from the tunnel via the access shafts. The majority of the spoil would be removed via the Riley Street Site. It should be noted that Riley Street Site is an excavated area. Loading of spoil into trucks for transport off-site would occur at the low point of the site, which would help to reduce potential dust impacts on nearby receptors. The depth of the site would help to protect the loading operations from wind and if dust emissions are generated, then a higher proportion is likely to resettle within the site than if the site was exposed.

Combustion emissions, i.e. oxides of nitrogen (NO_X), fine particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO) and sulfur dioxide (SO_2) from construction vehicles are also likely to be released. At the peak of construction activity for the Project a TBM, roadheader machine, general delivery vehicles, spoil trucks, semi-trailers (for concrete segment delivery), grout rig, gantry crane, front-end loader, excavator, dump truck and general tools and equipment may be operating simultaneously, which could include up to 20 truck movements a day. Combustion emissions from the proposed Project activities are considered to have insignificant impact on air quality when compared to emissions from existing sources in the area such as motor vehicles on nearby roads.

Emission factors and equations for calculating greenhouse gas emissions from automotive fuel use are provided in the *National Greenhouse Accounts (NGA) Factors (2008)*. The activity data required is the amount of fuels used.

Estimated greenhouse gas emissions from the combustion of diesel in construction equipment for the Project are as follows:

- Scope 1 GHG Emissions (t) = Activity (kL) x Energy Content of Fuel (GJ/kL) x EF (kg CO_{2-e}/GJ)/1000 = (88 x 38.6 x 69.5)/1000= 236 tonnes CO_{2-e}; and
- Scope 3 GHG Emissions (t) = Activity (kL) x Energy Content of Fuel (GJ/t) x EF (kg CO_{2-e}/GJ) /1000 = (88 x 38.6 x 5.3)/1000= 18 tonnes CO_{2-e}.

Operations

Tunnel control and ventilation

During operations, the CECT would be ventilated from the Riley Street Site or through a tunnel air intake located in close proximity to Cook & Phillip Park. The ventilation air would be exhausted at the City North Zone Substation.

Air emissions during operation would be clean air at an elevated temperature and adverse air quality impacts are not expected.

Air from the tunnel would be exhausted from the City North Zone Substation and from the Riley Street Site.

Belmore Park Zone Substation

For Belmore Park Zone Substation it is proposed to use sulfur hexafluoride (SF_6) gas which is contained in the gas insulated transformers and other switchgear. It is non-toxic and typically held in relatively small quantities within the switch room. The switchgear is very reliable equipment and therefore the risk of gas leakage is extremely low. However, should a major leak occur, gas leakage alarms and an appropriately designed ventilation system would ensure the safety of personnel. As the gas is non-toxic, there is no exposure limit.

However, due to its high global warming potential and its long atmospheric lifetime, SF_6 gas is included in the greenhouse gases of the Kyoto protocol.

The Belmore Park Zone Substation would use 5 transformers (each using 1,000 kg SF_6) and 16 gas insulated circuit breakers (each using 120 kg SF_6). Therefore the total amount of SF_6 in operation on site is 6,920 kg.

Applying the annual leakage rate of 0.005 (i.e. 0.5%) gives:

- an annual loss of SF_6 (kg) = 0.005 x 6,920 kg = 34.6 kg of SF_6; and
- multiplying the 34.6 kg of SF_6 by its global warming potential of 23,900 gives a total annual emission of approximately 827 tonnes of CO_{2-e}.

Emissions of any spills would be calculated using the same emission factors and equations. However, this should not be required if appropriate methods and procedures are followed to eliminate the risk of spills.

Electricity used to power the Belmore Park Zone Substation would be considered as Scope 2 and emissions attributable to upstream energy production are considered as Scope 3, indirect greenhouse gas emissions. Emission factors and equations for calculating greenhouse gas emissions from electricity from the grid are provided in the *National Greenhouse Accounts (NGA) Factors (2008)*. It should be noted that transmission and distribution losses are reported by energy distributors elsewhere as Scope 2 emissions.

The estimated annual electricity consumption for Belmore Park Zone Substation is 14,000 kWh. Therefore, estimated emissions from electricity consumption are as follows:

- Scope 2 Greenhouse Gas Emissions (t CO_{2-e}) = (14,000 x 0.89 / 1000 = 12.5 tonnes per annum; and
- Scope 3 Greenhouse Gas Emissions (t CO_{2-e}) = (14,000 x 0.085 / 1000 = 1.2 tonnes per annum.

15.2.2 Mitigation measures and safeguards

Construction

- during tunnel construction all air would be ventilated through a scrubber unit;
- exposed surface areas would be managed via dust mitigation measures;
- for substation works numerous demolition and construction mitigation measures have been identified and are further detailed in the separate Belmore Park Zone Substation and Commercial Development Project EAR;

- access to construction sites would be via existing sealed roadways and the surface of trafficked areas within sites would be sealed with bitumen or gravel;
- 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 potential to generate dust, if necessary;
- water would be used to suppress particles potentially generated during the erection of boundary fences, barriers, screens and other ancillary structures;
- areas of disturbed soils would be minimised during the construction period;
- 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;
- the 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;
- the tunnelling excavation face would be kept damp, as required, to minimise dust generation;
- spoil stockpiles would be damped as necessary;
- longer term spoil stockpiles would be treated with surface binding agents, sealed by seeding with vegetation or covered with secured tarpaulins;
- potentially dusty materials would be handled as little as possible;
- exhaust emissions would not discharge straight at the ground;
- 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;
- loading and unloading would take place within the site; and
- all waste would be removed from site and disposed to an appropriately licenced waste facility.

Operation

- adopt measures to reduce fuel use or improve energy efficiency to reduce emissions of greenhouse gases due to combustion;
- options for mitigating SF_6 gas leakages from the Belmore Park Zone Substation that are within EnergyAustralia's control are focused on best practice monitoring of leakage during operation, maintenance and end of life dismantling procedures; and
- methods for improving leak detection monitoring and handling of SF_6 gas during operations and maintenance would also minimise emissions.
- The management of the end of life gas insulated equipment should follow industry best practice guidelines. In particular, the treatment of SF_6 gas for recycling, i.e. 'cradle to cradle', or if the contamination due to arc switching is too high, from 'cradle to grave' should be managed.
- The electricity distribution network industry via the peak body, Energy Networks Association, is currently developing a Guideline on the Management of SF_6 gas. The guidelines will assist the industry to reduce emissions of SF_6, by ensuring that all aspects of SF_6 management are addressed in a consistent manner by individual utilities such as EnergyAustralia.

15.3 Socio-economics

15.3.1 Assessment

The proposed Project responds to the increased development pressures in the Sydney CBD including:

- increased floor space for residential and employment populations; and
- redevelopment or conversion to more intensive land uses and increased floor space.

The potential impacts of the proposed Project are concentrated around surface works (construction sites, substations and tunnel entrances). However, the actual alignment of the CECT and CSCT Extension could range in depth from approximately 10 to 70 metres below existing ground level and the therefore minimal construction impacts are expected. These are outlined below.

Construction

- Increases in noise, dust, vehicle emissions and changes to traffic and access conditions.
- Capital cost of the Project has been estimated to be approximately $800 million.
- Job creation involving 290 construction jobs.
- Indirect economic impacts i.e. incomes and employment would be generated.
- Construction of the Project would be undertaken to 2018.
- Increased reliability and supply of electricity.
- The tunnels would be fully lined to control groundwater seepage and chemistry and changes to the water table and the settlement of buildings.
- Changes to the visual amenity.
- Specifically, the Riley Street Site (tunnel entrance) would experience construction activities including tunnel excavation, spoil removal, tunnel fit-out (between 2010 and 2015), and construction of the Riley Street STSS (between 2013 and 2015).

Operation

Operational impacts from the CECT and CSCT Extension are expected to be minimal. The underground location would ensure that impacts on existing services and infrastructure are negligible during operation. The impacts to the proposed Project area and Sydney CBD during the operation of the tunnel and substations include:

increased reliability and supply of electricity for the Sydney CBD, indirectly benefiting metropolitan Sydney and beyond; and

job creation involving 18 operational jobs.

15.3.2 Mitigation measures and safeguards

The mitigation measures already identified for the Project would generate socio-economic benefits.

Consultation has focused on those stakeholders likely to be directly affected by the proposed Project including local and State government organisations, community groups, major project groups, businesses and the general community. EnergyAustralia has placed a high priority on consultation for the Project and has involved all stakeholders from the outset of the Project and which would continue through construction and operation.

15.4 Cumulative impacts

15.4.1 Assessment

The construction and operation of other major developments in the Sydney CBD could result in cumulative impacts. Key areas of concern include:

- traffic;
- noise and vibration; and
- property issues.

The timing for the construction of other developments may overlap with the Project, and as such cumulative impacts may occur. At present a limited amount of information is known for two major projects, Barangaroo and the North West Metro.

Construction works at Bararangaroo are scheduled to commence after the proponent is appointed in mid 2009. The $2.5 billion project would then continue until 2020.

The construction of the proposed North West Metro from Rouse Hill to St James Station is currently scheduled to commence in 2010 with estimated completion by 2017. This project would also include significant tunnelling works.

Assessment of other known projects suggests that the Project would not result in any significant adverse effects on the environment.

However, any potential construction cumulative impacts would be specifically dependent upon the final location of the proposed development in relation to these projects, as well as timing between projects. Specific issues that would need to be considered include but are not necessarily limited to:

- haulage of waste material routes through the Sydney CBD to their final destination;
- total number of truck movements through the Sydney CBD to their final destinations;
- potential noise and vibration impacts in instances where the construction sites associated with the various projects overlap or are in close proximity;
- impacts on total water usage; and
- impacts on air quality.

15.4.2 Mitigation measures and safeguards

EnergyAustralia would endeavour to ensure that cumulative impacts can be avoided through co-ordination and consultation with other projects and communication with other authorities.

In general, the development and implementation of the construction and operational environmental management plans in response to the proposed Statement of Commitments and Conditions of Consent would prevent, avoid, minimise, and manage the various impacts associated with the Project and any unknown proposals that overlap the Project.

As part of the CEMP, EnergyAustralia would identify significant developments occurring in the vicinity of the tunnel and substation construction areas and sensitive community groups. EnergyAustralia would also identify environmental impacts, which have the potential for cumulative effects to be monitored during construction.

15.5 Ecologically sustainable development

The construction and operation impacts of the Project have been considered in regards to ecologically sustainable development (ESD) principles. The ESD principles adopted by this report are those set out in Section 6.(2) of the Protection of the Environment Administration Act 1991, Schedule 2 of the *Environmental Planning and Assessment Regulation 2000 and Part 1, Section 3A of the Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) which includes:

- the integration principle – integration of environmental, social and economic considerations into decision making processes;
- the precautionary principle - lack of scientific certainty is not used as a reason for postponing measures to prevent environmental degradation;
- the intergenerational principle - to support conservation of the environment for the benefit of future generations;
- the biodiversity principle – taking account for and conservation of biological diversity and ecological integrity; and
- the valuation principle – taking account of and improve valuation, pricing and incentive mechanisms to ensure that true cost of activities (environmental, social and economic) is recognised.

Of relevance to this Project, EnergyAustralia has previously implemented ESD principles on the City South Cable Tunnel (CSCT) project, from Haymarket to Surry Hills, and has followed through on those principles on the most recent City West Cable Tunnel (CWCT) project, which is currently under construction. The measures that EnergyAustralia has undertaken in order to achieve significantly positive and potentially lasting ESD results include:

Construction

Implementation of a construction management plan that stipulates strict environmental measures to be adhered to which include but are not necessarily limited to:

minimising the number of vehicle movements when and where possible from the respective construction sites, and selecting the most effective and efficient transport routes, particularly in regard to the haulage of waste material;

- implementation of noise management measures at tunnel adit and construction areas involving surface works;
- implementation of water treatment facilities and adoption of recycling measures to minimise impacts from waste water on the local water system;
- implementation of dust suppression techniques to ensure the local amenity and air quality is relatively unchanged; and
- restrictions for working hours for construction activities involving surface works to minimise impacts to the local community.

These measures have proven to be successful in the construction of previous CBD cable tunnel projects. However, EnergyAustralia would attempt to improve where possible, on the measures previously adopted in order to achieve a higher level of ESD outcomes. This would be achieved by EnergyAustralia reviewing all practices prior and during the construction phase of the Project to ensure that ESD principles are effectively implemented.

Operation

The nature of the Project, particularly the tunnel components, does not attract attention especially as they are structures that are not open to public use. Hence, the immediate impacts from operation of the tunnel and the nodal substations would appear to be minimal. In many respects that is true especially in regards to the local environment.

Importantly, the decision by EnergyAustralia to proceed with this Project has significant positive social and economic outcomes for Sydney, New South Wales and Australia. The operation of the Sydney CityGrid Project ensures reliable power supply to Australia's largest commercial centre and the hub of Australia's financial activities. The Sydney CBD generates $70 billion of economic activity (value-added), or nearly nine percent of the total Australian economy.

16 Statement of commitments

16.1 Introduction

During the assessment of key issues and general environmental aspects of the Project, numerous mitigation measures and safeguards were recommended.

These mitigation measures and safeguards were, wherever possible, presented under three categories:

- investigations to be undertaken during the preparation of future project approval EARs;
- construction phase; and
- operations phase.

For this concept approval EAR it is considered that the construction and operations phase mitigation measures and safeguards would need to be further developed and refined during the preparation of future project approval EARs for the Project.

The identification of investigations to be undertaken during the preparation of future project approval EARs is an important next step in the approval process. This category therefore forms the basis of the draft statement of commitments presented below.

16.2 Draft statement of commitments for concept approval

Table 16.1 Draft statement of commitments – investigations for future project approval EARs

Key Issue	Commitment
Visual amenity	**Riley Street STSS and Services Control Room/City East Zone Substation/Dalley Street Zone Substation** A similar design review process as that conducted for Belmore Park Zone Substation would apply to new buildings forming part of the Project. The design review process would therefore apply to the following Project components and would need to be conducted during the preparation of future project approval EARs: • Riley Street STSS and Services Control Room (preferred location); • City East Zone Substation; and • Dalley Street Zone Substation refurbishment or replacement. **Riley Street STSS and Services Control Room /City East Zone Substation/Dalley Street Zone Substation** During the preparation of future project approval EARs the following investigations would be undertaken: • develop options for the location and orientation of the design within the site to achieve best outcome for urban frontage; • review exterior materials and facade design in association with the design of the overall site development and building design; and • review public domain impacts / design for streetscape. **Services Control Room** In the event of this alternative location being adopted, the following investigations would be undertaken during the preparation of a future project approval EAR: • develop options for the location and orientation of the Services Control Room within the local area and the Cook and Phillip Park / The Domain site to achieve preferred location with the least visual and physical intrusion; • review shaft design; • review Services Control Room exterior materials and design to determine appropriateness for location; • review any potential impacts on trees; and • review public domain design / proposals for areas of the park or street that are impacted by works.

Key Issue	Commitment
Visual amenity	**Other surface works** During the preparation of future project approval EARs the following investigations would be undertaken: • develop refined understanding of local construction impacts; • review construction proposals; • review any potential impacts on trees; • review public domain design / proposals for areas of the parks or streets that are impacted by works; and • determine any disruption to pedestrian or traffic movements in the construction period or in the long term, and period of construction on site.
Traffic & access	**Riley Street STSS and Services Control Room/City East Zone Substation/Surry Hills STS/Dalley Street Zone Substation/Alternative Services and Control Room** During the preparation of future project approval EARs for the above Project elements the following investigations would be undertaken: • assessment of site access and potential spoil disposal routes for heavy vehicles to/ from the work site during construction; • assessment of impacts on parking, public transport, pedestrian and cyclist access in the vicinity of the work site during both construction and operation phases; • obtaining traffic flow data along key sections of the road network in the vicinity of each of the construction work sites and along surrounding spoil and delivery routes during construction; • assessment of traffic generation impacts on the surrounding road network's traffic flows during both construction and operation phases; • development of possible traffic and transport mitigation measures for both construction and operation phases, including the impacts of any road closure; and • construction phase mitigation measures and safeguards for these Project elements have been developed and are found in Volume 2, Appendix C. However, they would be further refined during the preparation of the future project approval EARs.
Noise & vibration	**Riley Street STSS and Services Control Room & CECT/City East Zone Substation/ CSCT Extension/Dalley Street Zone Substation/Alternative Services Control Room** During the preparation of future project approval EARs for the above Project elements the following investigations would be undertaken: • undertake a noise survey; • derive construction noise emission criteria in accordance with the principles set out in **Volume 2, Appendix D**; • conduct a detailed construction noise assessment; • assess the need for required noise controls during the construction stage; • an operational noise and vibration assessment would be conducted for the Substations and STSS generally following the methodology used to assess the Belmore Park Zone Substation. • this noise and vibration assessment should be refined for at the future project approval EAR for each work site and tunnel alignment. Site-specific regenerated noise and vibration rules can be established following early works, the results of which may require increased buffer distances to be allowed, or, alternatively, may permit a smaller buffer distance where closer-to-surface tunnelling works are preferable (and the regenerated noise and vibration impacts are proven to be less than anticipated at this concept approval stage).

Key Issue	Commitment
Noise & vibration	**Riley Street STSS, Services Control Room & CECT** It is recommended that a week-long unattended noise survey is undertaken in up to four locations around the work site. The most suitable locations for the survey appear to be: • east of work site - rear of strata units at 329 Crown Street; • north of work site - front of terrace house at 82 Ann Street; • west of work site - front of townhouse at 299 Riley Street; and • south of work site - mid/upper floor balcony of a residential unit in 300 Riley St/ 127 Albion Street facing Albion Street. **CSCT Extension** Based on Heggies Pty Ltd review of the site, it is recommended that a week-long unattended noise survey is undertaken in Little Albion Street, Surry Hills. The most suitable location for the survey appears to be any of the terraced houses at 14-22 Little Albion Street.
European heritage & Aboriginal archaeology	**Dalley Street & City East zone substations** During the preparation of future project approval EARs for the above Project elements, the following investigations would be undertaken: • the archaeological potential and significance of the Dalley Street and City East one substation's sites should be reassessed once the exact study areas and nature of impacts are known. This would require additional historical research; and • The Dalley Street and City East zone substation's sites are likely to require archaeological testing to determine the nature and integrity of archaeological remains. If substantive remains are identified these would need to be subject to a detailed archaeological recording programme. **Services Control Room (if located at Cook & Phillip Park)** During the preparation of future project approval EARs for the above Project, elements the following investigations would be undertaken: • the nature of possible remains in the Cook and Phillip Park area should be revisited once the location of the control centre is known.
Spoil & waste management	A number of mitigation measures and safeguards have been developed and would be further investigated during the preparation of future project approval EARs: • wherever practicable spoil would be reused as part of the Project; • sites for the disposal of surplus soil would be selected according to the rate of development activity and the volume of material generated elsewhere; • spoil that is not VENM would be transported to approved landfill sites and/or off-site recycling depots; • spoil haulage routes identified in Chapter 9 would be used; and • as part of the CEMP a Spoil Handling and Management Sub Plan would be prepared which would identify how spoil would be handled, stockpiled, re-used and disposed. It would address the principles of all relevant legislation.
Soil and water/ groundwater quality	Soil and Water Quality Management Sub-Plans would be prepared as part of the CEMP. Sub-Plans would be prepared in accordance with the Department of Housing's guidelines *Managing Urban Stormwater – Soils and Construction* and would detail how soil and water-related mitigation measures would be implemented at the various construction stages. It will also: • detail treatment processes and associated water quality objectives to be achieved by the construction treatment facilities prior to discharging waters to the receiving waters; • include proposed water quality monitoring regimes to be adopted during construction and emergency management plans addressing key issues such as tunnel flooding and unexpected discharge of contaminated waters; • be developed in consultation with stakeholders to ensure appropriate mitigation measures and safeguards are incorporated and would be updated as the Project progresses; and • identify the means of minimising the entry of surface water and groundwater to the tunnel and the means of disposal of any such water entering the tunnel including identification of any proposed use of existing drainage infrastructure and the means of minimising any adverse impacts.

Key Issue	Commitment
Greenhouse gas emissions	EnergyAustralia would follow industry best practice guidelines in relation to management of SF6, This will be addressed in more detail in the project specific EARs.
Hazards & risks	A number of mitigation measures and safeguards have been developed for construction and operational risk management and EMF and would be further investigated during the preparation of future project approval EARs.
Property, land use and settlement	Further investigations and design are required to assess the risks of settlement in potential areas of groundwater drawdown. It is proposed to prepare a detailed assessment of these issues in future EARs required for the Project, develop mitigation measures and outline construction phase management sub-plans.
Cumulative impacts	EnergyAustralia would endeavour to ensure that cumulative impacts can be avoided through precise management of projects and communication with other authorities.

16.3 Implementation

The draft statement of commitments presented above would be taken into consideration during the Department of Planning's determination of the project.

Should the Project be approved, conditions of approval would be developed which would specify the investigations necessary for the future project approval EARs.

The future project approval EARs would assess and inform the design and lead to the development of a draft statement of commitments focused upon the management of construction and operational impacts.

17 Conclusion

During the next decade, EnergyAustralia must replace critical infrastructure in the Sydney CBD which is due for retirement and comply with new licence requirements for operation of its substations and transmission feeders.

EnergyAustralia has developed an integrated replacement strategy to reconstruct or refurbish its existing electricity distribution infrastructure, while maintaining sufficient spare capacity to ensure an ongoing and reliable electricity supply.

A range of alternatives were considered as part of the refinement of the Project.

The environmental assessment of key issues and other general aspects identified numerous mitigation measures and safeguards to minimise potential environmental impacts. These mitigation measures and safeguards would be implemented during respective stages of Project implementation.

It is concluded that the Project be granted concept approval subject to the mitigation measures and safeguards identified in this concept approval EAR.

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