



# Power Supply Upgrade Chalmers Street Substation Determination Report

Transport Projects Delivery Office

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# 1. Introduction

## 1.1. Background

Transport for NSW (TfNSW) is the NSW Government's lead public transport agency that ensures planning and policy is fully integrated across all modes of transport in NSW. It manages a multi-billion dollar budget allocation for rail, bus, ferry and taxi services and related infrastructure in NSW.

TfNSW is responsible for improving the customer experience of transport services, transport policy and regulation, planning and program administration, procuring transport services, and infrastructure and freight.

The Power Supply Upgrade (PSU) Program aims to improve electrical infrastructure to allow the Sydney Trains network to accommodate actual and projected increase in power demands. As part of the PSU program, TfNSW is proposing to replace the Prince Alfred Substation with two new substations; one at Lee Street and one at Chalmers Street. The construction and operation of the Lee Street substation is subject to a separate approval.

Transport for NSW is the proponent for the Chalmers Street Substation Project (referred to as 'the Proposed Activity' for the purposes of this document).

## 1.2. Chalmers Street Substation Review of Environmental Factors

TfNSW prepared a Review of Environmental Factors (REF) for the Proposed Activity, which details the scope of works and environmental impacts associated with the Proposed Activity (Appendix 1).

The REF was prepared by GHD on behalf of TfNSW, in accordance with clause 228 of the *Environmental Planning and Assessment Regulation 2000*.

## 1.3. Purpose of this Determination Report

Prior to proceeding with the Proposed Activity, the Secretary of TfNSW must make a determination in accordance with the provisions of Part 5 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act).

The objectives of this Determination Report are to:

- assess the environmental impacts with respect to the Proposed Activity which are detailed in the REF (and any proposed modifications, as detailed and assessed in this Determination Report)
- identify mitigation measures to minimise potential environmental impacts
- determine whether potential environmental impacts are likely to be significant
- address whether the provisions of the *Commonwealth Environment Protection & Biodiversity Conservation Act 1999* (the EPBC Act) applies to the Proposed Activity.

This report has been prepared having regard to, among other things, the objectives of TfNSW under the *Transport Administration Act 1988*:

- (a) to plan for a transport system that meets the needs and expectations of the public,
- (b) to promote economic development and investment,

- (c) to provide integration at the decision-making level across all public transport modes,
- (d) to promote greater efficiency in the delivery of transport infrastructure projects,
- (e) to promote the safe and reliable delivery of public transport and freight services.

## **2. Description of the Proposed Activity**

### **2.1. Description of the Proposed Activity in the REF**

The proposed activity would upgrade the existing power supply in the vicinity of Central Station to meet the requirements associated with future timetables. The Proposed Activity as outlined in the REF comprises:

- constructing and operating a new two storey substation within the Sydney Trains Prince Alfred Sidings Precinct. The new substation would supply traction power to the Main Line tracks and the Eastern Suburbs Railway around Central Station, as well as power to the Sydney Trains 11 kV network. The substation would include electrical equipment as well as an administration office and staff amenities;
- Associated work at the existing Prince Alfred Substation would involve expanding the existing substation cable tunnels and reusing them as high voltage feeder cable routes;
- undertaking fire isolation works at the substation; and
- and constructing a new link room on the north-east corner of the Prince Alfred Substation, outside the existing building.

The need for, and benefits of the Proposed Activity are outlined in Chapter 4 of the REF.

### **2.2. Design modifications**

No changes have been made to the design outlined in the REF, however, some design modifications may result from the detailed design phase.

Should design modifications be required as a result of detailed design process, these modifications would be assessed to determine consistency with the approval, including significance of impact. Additional mitigation measures and/or consultation would be undertaken where necessary.

### 3. Consultation and assessment of submissions

#### 3.1. Initial consultation prior to the REF public display

Initial consultation was undertaken with key stakeholder groups prior to public display of the REF. Stakeholders included:

- Roads and Maritime Services;
- Heritage Division of the Office of Environment and Heritage;
- City of Sydney Council;
- Sydney Trains; and
- State Transit Authority of NSW.

#### 3.2. REF Public Display

The Chalmers Street Substation REF was placed on public display from 11 August to 2 September 2015 (inclusive). The consultation activities undertaken with the selected stakeholders and affected community receivers for the public display included:

- Distribution of approximately 450 flyers and door knocking activities at local businesses and residents within 200m of the project notifying them about the REF public display period and feedback opportunities; and
- Project information, including the REF and supporting technical studies were published on the TfNSW website and hard copies of the REF were displayed at:
  - Transport for NSW Community Information Centre; and
  - Transport for NSW offices (Level 5, Tower A, Zenith Centre, 821 Pacific Highway, Chatswood).

#### 3.3. REF Submissions

One (1) submission from City of Sydney Council was received by TfNSW as a result of the community consultation activities.

This submission raised a number of issues in relation to the Proposed Activity. Issues raised in this submission included:

- damage to council footpath and roadway;
- impact to tree roots and canopy; and
- traffic control and approvals.

A summary of all issues raised and associated TfNSW response is provided in Table 1 below.

**Table 1 Response to issues raised in submissions**

No.	Issues raised	TfNSW response
1	General	
1.1	Any damage to the	Noted.

	entrance to the site (on public land) caused by heavy machinery should be made good. This is particularly applicable to pedestrian and cycle routes	Condition of Approval (CoA) 34 outlines the mitigation measure (pre-construction road condition surveys) that would be implemented during construction,
<b>2</b>	<b>Traffic Control</b>	
2.1	<p>It is recommended that a Construction Traffic Management Plan (CTMP) be completed.</p> <p>The driveway to the site will be a major conflict point for pedestrians, cyclists, coffee customers of the mobile cafe and vehicles entering or leaving the site - this will be a safety issue during construction and when the sub-station becomes operational.</p>	<p>Noted</p> <p>Section 7.5.3 of the REF and CoA 33 and 35 outlines the mitigation measures that would be implemented during construction.</p> <p>CoA 33: Requires a Traffic Management Plan be prepared as part of the Construction Environmental Management Plan.</p> <p>CoA 35: Requires a Road Safety Audit to be completed during detailed design</p> <p>Section 7.5.2 of the REF indicates the operation of the proposal would result in negligible impacts to traffic or access, as access for maintenance purposes would be infrequent (approximately three per month) and not involve large numbers of vehicles.</p>
<b>3</b>	<b>Vegetation Impact</b>	
3.1	Prevent any activities which could potentially damage tree roots and/or canopy extending from Prince Alfred Park.	<p>Noted</p> <p>Section 7.4.2 of the REF outlines that there would be negligible impact on any intact or naturally occurring native vegetation as a result of the proposal.</p> <p>CoA 25 outlines the measures that would be implemented during construction for the trimming, cutting, pruning or removal of trees or vegetation where the impact has not already been identified in the REF.</p>

### 3.4. Future consultation

Should TfNSW proceed with the Proposal, consultation activities would continue, including notifications to residents, businesses and community members in the lead up to and during construction. The consultation activities would ensure that the community and stakeholders are notified in advance of any upcoming works, including:

- changes to pedestrian or traffic access arrangements and out of hours construction activities;
- accurate and accessible information is made available; and
- a timely response is given to issues and concerns raised by the community.



The TfNSW Infoline (1800 684 490) and TfNSW email address ([projects@transport.nsw.gov.au](mailto:projects@transport.nsw.gov.au)) would continue to be available during the construction phase. Targeted consultation methods, such as use of letters, notifications, signage and verbal communications, would continue to occur. The TfNSW would also include updates on the progress of construction.



## 4. Consideration of the environmental impacts

The REF and Determination Report have been examined and considered as follows:

### ***Environmental Planning and Assessment Act 1979 (EP&A Act)***

The REF addresses the requirements of section 111 of the EP&A Act. In considering the Proposed Activity, all matters affecting or likely to affect the environment are addressed in the REF and the Determination Report and associated documentation in accordance with the checklist of matters pursuant to clause 228(3) of the *Environmental Planning and Assessment Regulation 2000*.

In respect of the Proposed Activity an assessment has been carried out regarding potential impacts on critical habitat, threatened species, populations or ecological communities or their habitats, under section 112 of the EP&A Act.

The likely significance of the environmental impacts of the Proposed Activity have been assessed in accordance with the then NSW Department of Planning's 1995 best practice guideline *Is an EIS Required?* It is concluded that the Proposed Activity is not likely to significantly affect the environment (including critical habitat) or threatened species, populations of ecological communities, or their habitats. Accordingly, an environmental impact statement under Part 5.1 of the EP&A Act is not required.

### ***Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)***

As part of the consideration of the Proposed Activity, all matters of national environmental significance (NES) and any impacts on Commonwealth land for the purposes of the EPBC Act have been assessed. In relation to NES matters, this evaluation has been undertaken in accordance with Commonwealth Administrative Guidelines on determining whether an action has, will have, or is likely to have a significant impact. A summary of the evaluation is provided in Section 3.3.2 of the REF.

It is considered that the Proposed Activity described in the REF is not likely to have a significant impact on any Commonwealth land and is not likely to have a significant impact on any matters of NES.

### ***Heritage Act 1977***

Since the public display of the REF, the NSW Heritage Council has approved the TfNSW application for the Chalmers Street Substation Power Supply Upgrade under Section 60 of the *Heritage Act 1977* (Appendix 3), dated 11<sup>th</sup> October, subject to conditions requiring TfNSW to ensure that:

1. Development must be in accordance with:
  - a. Report entitled Statement of Heritage impact – Chalmers Street substation, prepared by Tonkin Zulaikha Greer, and dated August 2015.
  - b. Architectural drawings prepared by Tonkin Zulaikha Greer listed in the table 2.
  - c. Architectural drawings prepared by GHD listed in the table 3.

**Table 2 Tonkin Zulaikha Greer architectural drawings**

Dwg. No.	Rev.	Title
SK01	02	Site Plan
SK11	02	Ground Floor Plan
SK12	02	Level 1 Plan
SK21	02	Elevations 1
SK22	02	Elevations 2
SK23	02	North Elevation Overall
SK25	01	Façade Plan Setout and Detail Ground Floor

SK27	01	Façade Details 1
SK28	01	Façade Details 2
SK29	01	Finishes Schedule
SK31	02	3D View 1
SK32	02	3D View 2
SK33	02	3D View 3
SK35	02	3D View 1 – View From North
SK36	01	3D View 2 – View From Rail Corridor
SK37	01	3D View 3 – View From Park

**Table 3 GHD architectural drawings**

Dwg. No.	Rev.	Title
2656-2650-CSSR-AR-0002	C	Site Plan
2656-2650-CSSR-AR-0003	C	Basement Floor Plan
2656-2650-CSSR-AR-0004	C	Ground Floor Plan
2656-2650-CSSR-AR-0005	C	Level 1 Floor Plan

- d. Report entitled *Central Station Conservation Management Plan*, prepared by NSW Railcorp and Rapport Conservation Architects, dated June 2013.

EXCEPT AS AMENDED by the conditions of this approval:

**SITE PROTECTION & WORKS**

2. Develop a Temporary Protection Plan for the site to ensure that the Prince Alfred Substation and Former Railway Institute Building are adequately protected during the works. Protection systems must ensure significant historic fabric is not damaged or removed, potential impacts due to vibration are minimised, and traffic is appropriately managed during the works.
3. Prepare a dilapidation survey of the area proposed for the temporary construction compound, the Prince Alfred Substation and Former Railway Institute Building before and after the works. Repair any damage and undertake necessary repairs and cleaning under the guidance of a nominated heritage consultant at the conclusion of the works.
4. Salvage ground floor windows removed from Prince Alfred Substation in suitable safe storage on site. Windows to be stored with provenance to allow for possible future reinstatement.
5. Allow for the monitoring and repair of any damage of significant items (including the Prince Alfred Substation and Former Railway Institute Building) as a result of construction of the substation as part of the Contract. This should include an allowance for a nominated heritage consultant to inspect and report before, during and after completion of the works.

**NOMINATED HERITAGE CONSULTANT**

6. The nominated heritage consultant shall monitor the works to ensure that no unapproved loss or removal of significant fabric or elements occurs.
7. All work shall be carried out by suitably qualified tradespeople with practical experience in conservation and restoration of similar heritage items. The nominated heritage consultant shall be consulted prior to the selection of appropriate tradespeople.

## ARCHAEOLOGY

8. Manage archaeology in accordance with Unexpected Heritage Finds Guideline contained in TfNSW's Quality Management System. If any unanticipated archaeological deposits are identified during construction, work likely to impact on the deposit should cease immediately and the NSW Heritage Council and an archaeologist must be contacted. Where required, further archaeological work and/or consents would be obtained prior to works recommencing at the location.
9. Should any Aboriginal objects be uncovered by the work, excavation or disturbance of the area is to stop immediately and the Office of Environment & Heritage (Enviroline 131 555) is to be notified in accordance with Section 89A of the National Parks and Wildlife Act 1974 (NPW Act). Aboriginal objects in NSW are protected under the NPW Act. Unless the objects are subject to a valid Aboriginal Heritage Impact Permit, work must not recommence until approval to do so has been provided by the Office of Environment & Heritage.

## ARCHIVAL RECORDING

10. Prepare a photographic archival record before, during and after the works of areas affected by the work at the Prince Alfred Substation. This includes the electrical switches on the north east wall which are proposed to be removed, pump well doors, ground floor windows, north east and western corners of the building and either end of the basement cable tunnel.

## FUTURE USE

11. Develop a long term adaptive reuse strategy for the Prince Alfred Substation building
12. Develop an Interpretation Strategy for the Prince Alfred Sidings precinct. Implementation should be coordinated with a site-wide Interpretation Strategy and may be best online or within Central Station itself due to the site's location and inaccessibility.

## DURATION OF APPROVAL

13. This approval shall be void if the activity to which it refers is not physically commenced within five years after the date of the approval or within the period of consent specified in any relevant development consent granted under the Environmental Planning and Assessment Act 1979, whichever occurs first.



## 5. Conditions of Approval

If approved, the Proposed Activity would proceed subject to the Conditions of Approval included in Appendix 2.

## 6. Conclusion

Having regard to the assessment in the REF, the Section 60 Conditions of Approval and the consideration of the submissions received in this report, it can be concluded that the Proposed Activity is not likely to significantly affect the environment (including critical habitat) or threatened species, populations of ecological communities, or their habitats. Consequently, an environmental impact statement is not required to be prepared under Part 5.1 of the EP&A Act.

It is also considered that the Proposed Activity does not trigger any approvals under Part 3 of the EPBC Act.

In considering the environmental impacts, proposed mitigation and broader project benefits it is recommended that the Proposed Activity be approved.

The environmental impact assessment (REF and Determination Report) is recommended to be approved subject to the proposed mitigation and environmental management measures included in the Conditions of Approval.

## **Appendix 1: Review of Environmental Factors**

# Chalmers Street Substation

## Review of Environmental Factors

AUGUST 2015



Transport  
for NSW

This report has been prepared by GHD for Transport for NSW and may only be used and relied on by Transport for NSW for the purpose agreed between GHD and the Transport for NSW as set out in section 1.5 of this report.

GHD otherwise disclaims responsibility to any person other than Transport for NSW arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.



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# Glossary of terms

Term	Definition
Central Station site/group	Land that is generally associated with Lot 118 DP 1078271 and contains Central Station and the Sydney Yards (see below). Some other railway uses located outside of this allotment are also included in this site and group. This term is used for land which is covered for a variety of heritage listings, but is generally focused on the area covered by the State Heritage Register listing.
Circuit breakers	Manually or automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and interrupt current flow.
dB(A)	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
Feeders	In the context of the Traction Substations project a feeder is either <ul style="list-style-type: none"> <li>• A 33kV AC cable coming in to the substation from the RailCorp supply or from Ausgrid</li> <li>• A cable supplying 1,500V DC from the traction substation to the overhead wiring system.</li> </ul>
$L_{A90(\text{period})}$	The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90(15 \text{ min})}$ .
$L_{Aeq(\text{period})}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
Proposal	Refers the construction and operation of the Chalmers Street Substation.
Proposal site	The immediate location of the proposal, which is the area that has the potential to be directly disturbed by construction.
RailCorp	Former Rail Corporation of NSW, now referred to as Sydney Trains.
Rectifiers	An electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification.
Study area	Consists of land in the vicinity of, and including land that has the potential to be indirectly impacted by the proposal.
Switching station	An intermediate station between two substations or between a substation at load end and a generating station.
Sydney Trains	Formerly RailCorp. Operates passenger trains on the Sydney suburban rail network.
Sydney Trains Prince Alfred Sidings Precinct	The precinct consists of an area within the Sydney Central Yards (see below) generally located in the area previously occupied by the Prince Alfred Sidings on the eastern side of the rail corridor. This area currently contains the Prince Alfred Substation and the recently constructed CBD Network Base.
Sydney Central Yards	Refers to the rail corridor at Central Station and to the south of the station. This area is similar to the area described as the Central Station site/group.
Traction substation	A traction substation is an electrical substation that converts electric power from the form provided by the electricity provider to a voltage, current type, and frequency which can be used to supply the rail network with power to operate the rolling stock (trains).

# List of abbreviations

Abbreviation	Definition
CBD	central business district
CEMP	Construction Environmental Management Plan
DC	direct current
EME	electromagnetic energy
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	environment protection licence
ESR	Eastern Suburbs Railway
Existing substation	Prince Alfred Substation
GHD	GHD Pty Ltd
Goods Line	Darling Harbour Goods Line
Infrastructure SEPP	<i>State Environmental Planning Policy (Infrastructure) 2007</i>
kV	kilovolts
LGA	local government area
m	metre
m <sup>2</sup>	square metres
MW	megawatt
NSW	New South Wales
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
Proposed substation	Chalmers Street Substation
PSU Program	Power Supply Upgrade Program
REF	Review of Environmental Factors
RMS	Roads and Maritime Services
RTA	Roads and Traffic Authority (now Roads and Maritime Services)
SREP	<i>Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005</i>
Sydney LEP	<i>Sydney Local Environmental Plan 2012</i>
TSC Act	<i>Threatened Species Conservation Act 1995</i>

# Executive summary

## Overview

This Review of Environmental Factors (REF) considers the potential impacts of the construction and operation of a new traction substation at Chalmers Street, near Central Station. It has been prepared by GHD Pty Ltd on behalf of Transport for NSW to assess the potential impacts of the proposal and assist Transport for NSW in determining the proposal in accordance with the provisions of Part 5 of the NSW *Environmental Planning and Assessment Act 1979*.

Why is the proposal needed?

Transport for NSW is currently undertaking the Power Supply Upgrade Program to meet the actual and projected increase in power demands on the Sydney Trains electrical network. A power supply study undertaken as part of the program found that the existing Prince Alfred Substation needs to be replaced.

Transport for NSW is proposing to replace Prince Alfred Substation with two new substations; one at Lee Street and one at Chalmers Street. The two proposed substations would be located within the heritage listed precinct of Central Station, within or near the rail corridor. This REF only assesses the impacts of the proposed substation at Chalmers Street. The assessment of the proposed substation at Lee Street will be subject to a separate assessment and approval.

Where would the proposal be located?

The proposal site is located within the suburb of Chippendale, on land known as the Prince Alfred Sidings Precinct, which is owned by Sydney Trains. The proposal site is divided into two distinct areas within this precinct:

The new substation would be located on the hardstand area between the existing Prince Alfred Substation and the new Sydney Trains CBD Network Base: This site occupies part of the footprint of the former Lighting Depot and demountable buildings.

The proposal also includes works to the existing Prince Alfred Substation to allow the existing substation western cable tunnel to be extended and reused as a high voltage feeder cable route. Other works to the existing substation would involve fire isolating the substation building to enable it to be repurposed for other uses, and constructing a new link room on the north-east corner of the Prince Alfred Substation, outside the existing building.

What would the proposal involve?

The proposal involves constructing and operating a new two storey substation within the Sydney Trains Prince Alfred Sidings Precinct. The new substation would supply traction power to the Main Line tracks and the Eastern Suburbs Railway around Central Station, as well as power to the Sydney Trains 11 kV network. The substation would include electrical equipment as well as an administration office and staff amenities.

Associated work at the existing Prince Alfred Substation would involve expanding the existing substation cable tunnels and reusing them as high voltage feeder cable routes; undertaking fire isolation works at the substation; and constructing a new link room on the north-east corner of the Prince Alfred Substation, outside the existing building.

The new substation would be accessed via the existing access driveway to the Prince Alfred Sidings Precinct, which is located to the south of the pedestrian entrance at Central Station, near the intersection of Chalmers Street and Devonshire Street.

How long would the proposal take to construct?

It is anticipated that the proposal would take approximately 28 months to construct. The main civil construction activities would be completed within 16 months, the fit out of the substation would take six months and six months for commissioning works. Construction of the new substation is anticipated to commence in late 2016 with early works starting from early to mid-2016.

## Summary of the findings of the REF

During construction, the proposal could result in the following impacts:

- construction traffic and associated access impacts on pedestrians, cyclists and buses accessing Central Station, particularly in relation to access for oversized delivery vehicles
- noise due to the operation of machinery and equipment
- potential disturbance of any contaminated fill material associated with the rail corridor
- amenity impacts to the surrounding community.

These construction impacts would be relatively minor and short term, and would be mitigated by the implementation of the mitigation measures.

During operation, the main potential for impact relates to the introduction of a new structure within the curtilage of the State heritage listed Sydney Terminal and Central Railway Stations Group (referred to as the Central Station site/group). A Statement of Heritage Impact has been prepared by Tonkin Zulaikha Greer Heritage to assess the potential impacts of the proposal. The assessment concluded that the proposal would have minimal impact on the Sydney Terminal site and its significant elements, and minimal impact on nearby heritage items. It concluded that, on the whole, the proposal respects, conserves and minimises impact to the heritage significance of the site.

Under Section 57(1) of the *Heritage Act 1977* (Heritage Act), approval must be obtained from the Heritage Council for works to a place, building, work, relic, moveable object, precinct, or land listed on the State Heritage Register. As the proposal is not considered to be subject to any of the exemptions to approval under Section 57(2) of the Heritage Act, an application for approval by the Heritage Council will be submitted in accordance with Section 60 of the Act.

The potential for adverse environmental impacts would be minimised by implementing the mitigation measures outlined in this REF, including preparing and implementing a Construction Environmental Management Plan (CEMP).

## Where to from here?

The REF will be displayed and made publicly available, and the community and stakeholders will be encouraged to make submissions on the proposal and any potential environmental impacts. Following the display period, Transport for NSW will consider the issues raised in submissions. Transport for NSW will then determine whether to proceed with the proposal. If the proposal proceeds, it would be undertaken in accordance with the mitigation measures proposed in this REF and any conditions of approval that form part of the determination.



# 1. Introduction

## 1.1 Overview

Transport for NSW is currently undertaking the Power Supply Upgrade Program (the PSU Program) to meet the actual and projected increase in power demands on the Sydney Trains electrical network. A power supply study undertaken as part of the program found that the existing Prince Alfred Substation needs to be replaced.

Transport for NSW is proposing to replace the existing Prince Alfred Substation with two new traction substations; one at Chalmers Street and one at Lee Street. The two proposed substations would be located within the heritage listed precinct of Central Station, within or near the rail corridor.

The construction and operation of Chalmers Street Substation (referred to as ‘the proposal’ for the purposes of this document) is subject to assessment and determination under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (the EP&A Act). GHD Pty Ltd (GHD) was commissioned by Transport for NSW to undertake an assessment of the potential environmental impacts of the proposal, and prepare a Review of Environmental Factors (REF) in accordance with the EP&A Act.

The construction and operation of the Lee Street Substation is subject to a separate environmental assessment and approval process.

## 1.2 The Power Supply Upgrade Program

The PSU Program was initiated by RailCorp in 2005 to ensure that Sydney’s rail network would be capable of meeting the expected power requirements of future train timetables, and the requirements of the new generation of air conditioned trains (for example, Waratah trains). The PSU Program involves construction of new electrical infrastructure and upgrades to substations, section huts, overhead wiring and feeders across the network.

The objectives of the PSU Program are to:

- support the introduction of air conditioned trains into service
- provide additional power to operate trains on the network
- improve service reliability by reducing the risk of disruption to rail services.

The delivery of the PSU Program was transferred to Transport for NSW in 2012.

## 1.3 The proposal

The proposal involves the construction and operation of a new two storey substation within the Prince Alfred Sidings Precinct (owned by Sydney Trains). The new substation would supply traction power to the Main Line tracks and the Eastern Suburbs Railway around Central Station, as well as power to the Sydney Trains 11 kV network. It would include electrical equipment, together with office facilities and staff amenities.

The new substation would be accessed via the existing access driveway to the Prince Alfred Sidings Precinct, which is located to the south of the pedestrian entrance at Central Station, near the intersection of Chalmers Street and Devonshire Street.

The proposal also includes works to the existing Prince Alfred Substation to allow the existing substation western cable tunnel to be extended and reused as a high voltage feeder cable route. Other works to the existing substation would involve fire isolating the substation building

to enable it to be repurposed for other uses, and constructing a new link room on the north-east corner of the Prince Alfred Substation, outside the existing building.

The location of the proposal is shown in Figure 1.1.

A description of the proposal is provided in section 5.

## 1.4 Structure of the REF

The structure and content of the REF is summarised in Table 1.1.

**Table 1.1 Structure and content of the REF**

Section	Description
Section 1 – Introduction	An introduction to the REF.
Section 2 – Location and setting	A description of the location, site and study area.
Section 3 – Statutory framework	An overview of the statutory requirements for the proposal, including the requirements of relevant environmental planning instruments and legislation.
Section 4 – Strategic context, need and options considered	An overview of the strategic context for the proposal, need, and the proposal development process.
Section 5 – Description of the proposal	A description of the proposal.
Section 6 – Community and stakeholder consultation	A summary of the consultation process and the key issues raised.
Section 7 – Environmental impact assessment	An assessment of the potential environmental impacts, including summaries of specialist reports prepared for the proposal.
Section 8 – Environmental management and mitigation	An outline of the requirements for the proposal’s environmental management plan, and a summary of the mitigation measures identified by the REF.
Section 9 – Conclusion	A conclusion to the REF.
Section 10 – Reference list	Provides a list of references for the REF.

## 1.5 Scope and methodology

### 1.5.1 Scope and purpose of the REF

For an activity subject to Part 5 of the EP&A Act, section 111 of the Act imposes a duty on a determining authority to ‘examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity’. Determining authorities make a determination about whether a proposal can proceed, and on what basis.

The purpose of this REF is to summarise the results of the environmental impact assessment for the proposal and provide information about the proposal as an input to the determination process. Transport for NSW (as the determining authority) will consider the findings of the REF as part of the determination process.

In summary, the REF will assist Transport for NSW:

- Determine whether the proposal should be approved, taking into account to the fullest extent possible all matters affecting or likely to affect the environment (in accordance with section 111 of the EP&A Act).

- Determine whether the proposal is likely to have a significant effect on the environment or significantly affect threatened species, populations or ecological communities or their habitats.
- Develop appropriate conditions (based on the mitigation measures within the REF) to be attached to any approval granted.

Clause 228 of the *Environmental Planning and Assessment Regulation 2000* (the Regulation) lists, for the purposes of Part 5 of the EP&A Act, the factors to be taken into account when considering the likely impact of an activity on the environment. Appendix A considers the potential impacts of the proposal against these factors.

For the purposes of this REF, the following definitions have been applied:

- The 'proposal' refers to the construction and operation of the Chalmers Street Substation and associated works to the existing Prince Alfred Substation building.
- The 'proposed substation' refers to the Chalmers Street Substation.
- The 'existing substation' refers to the Prince Alfred Substation which is currently in operation.
- The 'proposal site' is defined as the immediate location of the proposal, which is the area that has the potential to be directly disturbed by construction. The proposal site is shown in Figure 1.1.
- The 'study area' consists of land in the vicinity of, and including, the proposal site. The study area is the wider area surrounding the proposal site, including land that has the potential to be indirectly impacted by the proposal (for example, as a result of any noise impacts).

Other terms are defined in the glossary at the beginning of the REF.

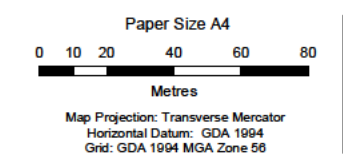
#### 1.5.2 Methodology

The REF has been prepared in consultation with relevant stakeholders, including the design team (GHD); Transport for NSW; and other relevant technical advisors and agencies. Preparing the REF has involved the following tasks:

- attending a project inception meeting/briefing
- receiving relevant information from Transport for NSW
- a site visit
- consultation and liaison with key stakeholders
- undertaking specialist impact assessments as an input to the REF:
  - Noise and Vibration Assessment (undertaken by GHD)
  - Statement of Heritage Impact (undertaken by Tonkin Zulaikha Greer Heritage)
  - Electromagnetic Fields Assessment (undertaken by EMC Services)
  - Contaminated Land Assessment (undertaken by GHD)
- reviewing specialist assessments being undertaken as part of the design process, and incorporating relevant information in the REF, including the geotechnical and contamination assessments
- a qualitative desktop assessment of other potential impacts, including reviews of existing information and database searches

- identifying mitigation measures to manage the impacts identified
- addressing the requirements of Part 5 of the EP&A Act and Clause 228 of the Regulation.

It is noted that although the REF team has consulted with members of the design team to prepare the REF, design personnel have not influenced the methodology or outcomes of the environmental impact assessment process in any way.



LEGEND	
	Proposal site/construction compound areas
	Prince Alfred Park
	Prince Alfred Siding Precinct
	Heavy rail



Transport NSW  
REF- chalmers St SS & PASH

Job Number	21-22993
Revision	0
Date	24 Jul 2015

Location of the proposal

Figure 1.1

N:\AU\Sydney\Projects\2122993\CADD\GIS\Maps\MXD\Deliverables\21\_2299314\_2003\_Location\_of\_proposal\_Chalmers\_St\_A4.mxd  
 © 2015. Whilst every care has been taken to prepare this map, GHD and NSW DEPARTMENT OF LANDS, GEOSCIENCE AUSTRALIA, NSW DEPARTMENT OF PRIMARY INDUSTRY, NEARMAP make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.  
 Data Source: NSW Department of Lands: Cadastre - Jan 2012; Geoscience Australia: 250k Data - Jan 2012; NSW Department of Primary Industry - Jan 2012; Imagery (nearmap, extracted (2015/03/30)). Created by: qjchung  
 Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

## 2. Location and setting

*This section provides information on the location of the proposal, the proposal site and its surrounds (the study area).*

### 2.1 Site location and description

#### 2.1.1 Location

The proposal site, which is shown in Figure 1.1, is located within the suburb of Chippendale, in the City of Sydney local government area (LGA). The site is identified as Lot 118 DP 1078271, which encompasses Central Station and other railway infrastructure located near Central Station (including the existing Prince Alfred Substation). The land is owned by Sydney Trains.

The proposal site is located within the Prince Alfred Sidings Precinct (shown on Figure 1.1), which is located on the eastern side of the rail corridor. The sidings precinct consists of a number of Sydney Trains facilities. The site for the proposed substation is located to the south of Prince Alfred Substation.

#### 2.1.2 Description of the site

The proposed substation would be located on land to the south of the Prince Alfred Substation. The majority of the site is currently a fenced hardstand area. An existing compressor room is located on the south-eastern side of the hardstand area (refer Figure 1.1 and Figure 2.1). The hardstand area is currently used for the movement and parking of vehicles within the Prince Alfred Sidings Precinct.

The fire isolation and tunnel works would be contained within the existing Prince Alfred Substation building. A new link room would also be installed outside the existing substation building, on its north-west corner.

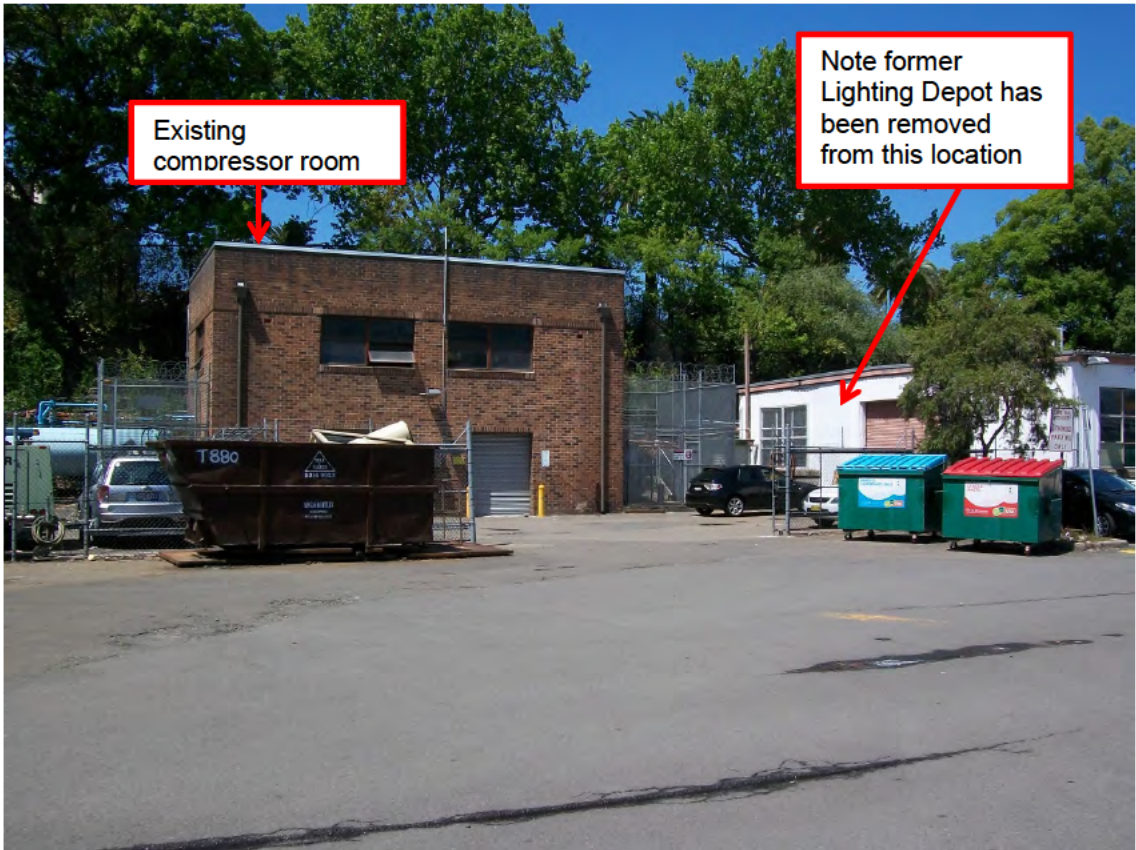
The proposal site is accessed via the existing entrance to the Prince Alfred Sidings Precinct, located just to the south of the Chalmers Street entrance to Central Station.

### 2.2 The study area and site context

The proposal site is located at the southern end of Sydney's central business district (CBD). Land to the west of the site is dominated by railway uses associated with Central Station, while land to the east of the site forms part of Prince Alfred Park (which includes a pool, tennis courts and basketball courts). Land further to the east consists of a mixture of commercial and residential uses.

The existing Prince Alfred Sidings Precinct is used for rail related purposes, and includes the recently constructed CBD Network Base and the Prince Alfred Substation. This precinct is accessed via an existing access, located to the south of the entrance to Central Station near the intersection of Chalmers Street and Devonshire Street.

The key features of the study area are shown on Figure 1.1.



Existing  
compressor room

Note former  
Lighting Depot has  
been removed  
from this location

**Figure 2.1 Location of the proposed substation, showing the existing compressor room and former lighting depot building**

## 3. Statutory framework

*This section provides an overview of the statutory framework relevant to the proposal, including the assessment requirements, relevant environmental legislation and planning instruments.*

### 3.1 Environmental Planning and Assessment Act 1979

The EP&A Act and the Regulation provide the statutory basis for planning and environmental assessment in NSW. The EP&A Act provides the framework for environmental planning and development approvals and includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the decision making process.

#### 3.1.1 Application of Part 5 of the EP&A Act

As a result of the application of the *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP), the proposal is subject to Part 5 of the EP&A Act (refer section 3.2.1). In relation to Part 5 activities, section 111 of the EP&A Act imposes a duty on a determining authority to 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'.

Section 110(1) defines a determining authority as 'a Minister or public authority and, in relation to any activity, means the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out'.

In accordance with clause 79 of the Infrastructure SEPP, Transport for NSW is the proponent and determining authority for the proposal. This REF has been prepared to satisfy Transport for NSW's requirements under the EP&A Act.

### 3.2 Environmental planning instruments

The environmental planning instruments that are relevant to the approval and assessment of the proposal are considered below.

#### 3.2.1 State environmental planning policies (SEPPs)

##### **State Environmental Planning Policy (Infrastructure) 2007**

The Infrastructure SEPP outlines the permissibility and development controls for infrastructure works and facilities. Clause 79 of the Infrastructure SEPP outlines which railway infrastructure facilities are permissible without the need for development consent under the EP&A Act. As the proposal meets the definitions of rail infrastructure facilities provided by clause 78, it is permissible without consent.

In addition, clause 79(2) of the Infrastructure SEPP permits the alteration, demolition and relocation of local heritage items, and the alteration or relocation of State heritage items for the purpose of rail infrastructure facilities, without the need for development consent.

Clauses 13 to 16 of the Infrastructure SEPP outline the requirements for consultation with councils and other public authorities for infrastructure development carried out by or on behalf of a public authority. The proposal would not trigger any of these requirements, and therefore consultation with the Council of the City of Sydney (Council) and other public authorities is not required under the Infrastructure SEPP. However, relevant agencies have been, and will continue to be, consulted in relation to the proposal. Further details of the consultation process are provided in section 6.



## Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

The proposal is located within the Sydney Harbour Catchment area as identified by the *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (the SREP). However, there are no specific provisions relevant to the proposal or proposal site as it is not located within any of the areas listed by clause 3(2). The proposal is considered to be consistent with the aims of the SREP.

### 3.2.2 Local environmental plans

The *Sydney Local Environmental Plan 2012* (the Sydney LEP) applies to land within the City of Sydney LGA. The proposal site is located within land which is zoned SP2 Infrastructure (Railways). The zone provisions provide that the proposal would be permitted with consent.

Clause 5.12 of the LEP states that ‘...this Plan does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007’.

As the proposal is permitted without consent under the Infrastructure SEPP, the consent requirements of the Sydney LEP do not apply to the proposal.

## 3.3 Other legislative considerations

Other environmental legislation that is relevant to the approval and/or assessment of the proposal is considered below.

### 3.3.1 NSW legislation

#### **Heritage Act 1977**

The *Heritage Act 1977* identifies and protects heritage items in NSW. Under the Heritage Act it is an offence to disturb an item of heritage significance without consent. Under section 57(1) of the *Heritage Act 1977*, approval must be obtained from the Heritage Council for works to a place, building, work, relic, moveable object, precinct, or land listed on the State Heritage Register. Under section 139, an excavation permit is required to disturb or excavate any land containing or likely to contain a relic.

The proposal is located within the curtilage of the Sydney Terminal and Central Railway Stations Group (Central Station site/group), which is listed on the State Heritage Register. A Statement of Heritage Impact has been prepared by Tonkin Zulaikha Greer Heritage Consultants to assess the potential impacts of the proposal. The assessment concluded that the proposal would have minimal impact on the Sydney Terminal site and its significant elements, and minimal impact on nearby heritage items. It concluded that, on the whole, the proposal respects, conserves and minimises impact to the heritage significance of the site.

As the proposal is not considered to be subject to any of the exemptions to approval under section 57(2) of the Heritage Act, an application for approval by the Heritage Council will be submitted in accordance with section 60 of the Act.

Further information is provided in section 7.1.

#### **Roads Act 1993**

Under section 138, Part 9, Division 3 of the *Roads Act 1993*, a person must not impact or carry out work on or over a public road otherwise than with the consent of the appropriate roads authority. In accordance with clause 5 of Schedule 2, public authorities are not required to obtain approval for works on unclassified roads.

The proposal would not result in impacts to any roads and therefore would not require an approval under section 138 of the *Roads Act 1993*.

#### **National Parks and Wildlife Act 1974**

The *National Parks and Wildlife Act 1974* provides the basis for legal protection and management of Aboriginal sites and objects in NSW. Under Section 87 of the Act, a heritage impact permit is required to harm or desecrate an Aboriginal heritage object.

A search of the Aboriginal Heritage Information Management System database was undertaken on 23 June 2015. The results of the search indicated that there are no recorded items located in or in the immediate vicinity of the proposal site. Furthermore, the proposal is unlikely to have an impact on unknown items of Aboriginal heritage significance and a heritage impact permit is not required.

#### **Protection of the Environment Operations Act 1997**

The *Protection of the Environment Operations Act 1997* (POEO Act) establishes, amongst other things, the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. Environment Protection Licences (EPLs) are generally issued for scheduled activities or scheduled development work. The proposal is not considered to be a scheduled activity under Schedule 1 of the POEO Act and therefore an EPL is not required for construction. Sydney Trains currently holds an EPL for the operation of the rail network (EPL no. 12208). The proposal would comply with the requirements of this licence as well as the general obligations of the POEO Act. No variation of this licence is considered to be required.

#### **Water Management Act 2000 and Water Act 1912**

The *Water Management Act 2000* and *Water Act 1912* control the extraction of water, the use of water, the construction of works such as dams and weirs and the carrying out of activities in or near water sources in NSW. The provisions of the Water Management Act are being progressively implemented to replace the Water Act. Since 1 July 2004 the new licensing and approvals system has been in effect in those areas of NSW covered by operational water sharing plans.

Excavation work would be undertaken as part of the proposal, and it is possible that groundwater would be intercepted. Under both the Water Management Act and the Water Act a licence is required for dewatering and interception of groundwater. However, subject to confirmation with the Office of Water, if Transport for NSW (as determining authority) determines that the proposal is a 'defined minimal impact aquifer interference activity', a license would not be required.

Further information on the potential for soil, water quality and groundwater impacts is provided in Section 7.2.

### 3.3.2 Commonwealth legislation

#### **Commonwealth Environment Protection and Biodiversity and Conservation Act 1999**

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

- An action which has, would have or is likely to have, a significant impact on 'matters of national environmental significance'.

- An action likely to have a significant impact on the environment in general (for actions by Commonwealth agencies or actions on Commonwealth land) or the environment on Commonwealth land (for actions outside Commonwealth land).

An action is considered to include a project, development, undertaking, activity or series of activities. An EPBC Act protected matters search was undertaken on 6 December 2013 for an area within a one kilometre radius of the proposal site. The results of the search are summarised in Table 3.1. As no impacts are predicted, an approval under the EPBC Act would not be required.

**Table 3.1 EPBC Act protected matters search results**

EPBC Act Protected matter	Matter located within search radius	Comments	Potential impact
World Heritage Property	None	The proposal would not impact on any World Heritage properties.	None
National Heritage Places	One. Cyrus Hellene Club – Australian Hall	The one National Heritage item located in the vicinity of the proposal is located over one kilometre to the north of the proposal site and therefore would not be impacted upon.	None
Wetlands of international significance (Ramsar sites)	None	The proposal would not impact on any wetlands.	None
Threatened ecological communities	Western Sydney Dry Rainforest and Moist Woodland on Shale.	The matter is listed as 'may occur' within the area. There are no records of its presence near the site. The proposal would not impact on any threatened ecological communities.	None
Threatened species	32 species including 12 birds, two frogs, seven mammals, 10 plant species and one reptile.	The proposal is located within a highly disturbed and developed urban area with limited vegetation (native or otherwise) that would provide habitat for threatened species.	None
Listed migratory species	19 species including seven migratory marine birds, eight terrestrial species, four wetlands species	The proposal is located within a highly disturbed and developed urban area with no vegetation (native or otherwise) that would provide habitat for migratory species.	None
Nuclear actions	None	The proposal does not involve a nuclear action.	None
Commonwealth Marine Areas	None	No Commonwealth marine areas are located within the search radius.	None
Great Barrier Reef Marine Park	None	The Great Barrier Reef Marine Park is outside the search radius.	None
Commonwealth land	Four Commonwealth properties, including Australian Broadcasting Corporation, Australian Postal Corporation, Telstra Corporation Limited and one undefined piece of land.	The proposal would not directly or indirectly impact on any Commonwealth land.	None

EPBC Act Protected matter	Matter located within search radius	Comments	Potential impact
A water resource, in relation to coal seam gas development and large coal mining development	Not relevant	Not relevant	None

### 3.4 Summary of approval requirements

As a result of the application of the Infrastructure SEPP the proposal does not require development consent and it is subject to assessment and determination under with Part 5 of the EP&A Act. An approval under section 60 of the *Heritage Act 1977* would be required.

## 4. Strategic context, need and options considered

*This section provides background information on the strategic and planning context for the proposal, why it is needed, and the options considered.*

### 4.1 Strategic context and need for the proposal

#### 4.1.1 Strategic context

The *NSW Long Term Transport Master Plan* (Transport for NSW, 2012) provides a framework for addressing transport challenges across NSW over the next 20 years. The master plan is designed to guide the prioritisation of available funds to deliver maximum benefits to NSW. The master plan includes 220 short, medium and long-term actions that are focused on transforming the NSW transport system over the next 20 years.

One of the actions within the master plan is to 'Expand the Sydney Trains fleet to include modernised double-deck and new single-deck trains'. Within the next 10 years, approximately 52 per cent of the existing fleet would be replaced, and the size of the fleet would increase by approximately 28 per cent. This would involve the introduction of new rolling stock to replace the remaining non-air conditioned fleet.

The proposal involves the provision of infrastructure required to meet the needs of the expanded Sydney Trains fleet, and is therefore consistent with the master plan.

#### 4.1.2 Need for the proposal

To meet the needs of the expanded and air conditioned rail fleet, an increase in the power supply on the Sydney Trains electrical network is required. A number of power supply studies have been undertaken for the Sydney Trains network, these identified that:

- the existing power supply in the vicinity of Central Station needs to be upgraded to meet the requirements associated with future timetables
- significant works would be required to upgrade Prince Alfred Substation to enable it to meet future requirements, including the provision of five new five mega watt (MW) rectifiers.

### 4.2 Proposal development process

Sydney Trains (formerly Rail Corporation New South Wales) undertook a study of the future traction power supply needs of the Sydney Trains network. This study is referred to as *Power Study 6*. The study identified that the existing Prince Alfred Substation near Central Station could not be easily upgraded to meet these requirements.

Further studies determined that the best solution would be to convert the Prince Alfred Substation to a switching station, and build two new traction substations in the vicinity of Central Station. Sites at Lee Street and Chalmers Street were identified for the proposed substations. Transport for NSW then developed 'pre-concept' layouts for the substations. Following a tender process, GHD was awarded a professional services contract to prepare concept designs for the substations. The concept design process also involves an options, geotechnical, heritage and environmental impact assessment process.

In March 2014, during the concept design development process, it was decided not to proceed with reusing the 33 kV switchgear within the Prince Alfred Substation and consolidate all the

required 33 kV functionality within the new Chalmers Street Substation. This was confirmed at a workshop held in May 2014 to evaluate the 33 kV options using a risk-based approach with economic appraisal. The workshop involved participants from Asset Standards Authority (ASA), Transport for NSW, Sydney Trains and other stakeholders. Following this workshop the refurbishment and conversion of the Prince Alfred Substation to a switching station was removed from the scope of this project with the substation to be decommissioned once the new substation is operational.

The results of the environmental impact assessment of the construction and operation of the proposed Chalmers Street Substation, and the works to the Prince Alfred Substation are summarised in this REF.

### 4.3 Objectives of the proposal

The objectives of the proposal are to:

- provide for the reliable operation of Waratah trains and transition to a 100 per cent air-conditioned fleet
- replace end-of-life equipment within the Prince Alfred Substation
- improve reliability and redundancy in the 11 kV network (which supplies the emergency services and lighting in the City Circle stations)
- reduce safety risk to personnel and infrastructure that currently co-exist inside Prince Alfred Substation building
- achieve regulatory compliance and meet all RailCorp and Australian Standards.

### 4.4 Options considered

A summary of the main options considered as part of the development of the proposal is provided below. Further information on the detailed options that have been developed and assessed is provided in the *Chalmers Street Substation Site Options Report*.

#### The 'do nothing' option

The 'do nothing' option involves not undertaking the proposal. Under this option, the Prince Alfred Substation would continue to operate in its current condition. This option is not considered to be acceptable, as it would result in the Sydney Trains electrical network not being able to meet the needs described in section 4.1. Studies have already shown that the existing power supply network cannot meet the future needs of Sydney Trains.

#### Upgrading the existing Prince Alfred Substation

One option would be to upgrade the existing Prince Alfred Substation to meet current and future demand levels. This would involve upgrading all four rectifiers to five MW units. A fifth rectifier would also need to be installed as an operational spare. This option would mean the system would operate in a similar fashion to the existing situation, as the substation would remain at the same location. However, upgrading the Prince Alfred Substation was not considered to be a viable option for the following reasons:

- much of the equipment within the existing substation is nearing the end of its economic life
- upgrading the existing substation would involve undertaking construction activities in an operational substation over long time durations (during rail shutdowns only), increasing the risk of network reliability issues

- the upgraded substation would not comply with existing building standards under the Building Code of Australia and *Australian Standard AS 2067-2008 Substations and high voltage installations exceeding 1 kV a.c.*, as a result of restrictions imposed by the site and its configuration
- it is a high cost option
- the Sydney Trains Electrical Operations Centre is located within the Prince Alfred Substation building and therefore any expansion within the building would also require the relocation of these operations.

A sub option considered was to upgrade the substation's transformers to use ester oil to cool the transformers. The use of such transformers would reduce the risk to personnel health and safety. This option was not considered to be feasible, It would involve long lead times to develop new standards and procedures, as this type of transformer is not currently used on the Sydney Trains network. These lead times would outweigh the health and safety improvements. This sub-option would also not be consistent with Sydney Train and Australian Standards.

### **Replacing Prince Alfred Substation with two new substations at Lee Street and Chalmers Street**

This option would involve three components:

- converting Prince Alfred Substation to a switching station (this was later removed from the scope as outlined in section 4.2)
- constructing a substation at Lee Street to supply traction power to the Sydney Central Yard tracks
- constructing a substation at Chalmers Street to supply traction power to the Main Line and Eastern Suburbs Line tracks around Central Station, and provide supply to the 11 kV network.

Replacing Prince Alfred Substation with the new substations would address the non-compliance issues, as the new substations would be built in accordance with current standards and building guidelines. It would also avoid the risk of network reliability issues associated with upgrading the existing substation.

Although the proposed substations at Lee Street and Chalmers Street can be constructed and operated individually, both are required to meet the objectives of the PSU Program.

### **Options for the location of the Chalmers Street Substation**

No other potential locations were identified for the Chalmers Street Substation, as there is limited space within the eastern side of the rail corridor, in particular within the Prince Alfred Sidings Precinct.

## **4.5 Preferred option**

In summary, the preferred option is to replace Prince Alfred Substation. To meet the objectives of the PSU Program, two substations are required. The Chalmers Street Substation, which is the subject of this REF, would supply traction power to the Main and Eastern Suburbs Lines tracks around Central Station and provide supply to the 11 kV network. The substation at Lee Street (which is the subject of a separate environmental assessment and approval process) would supply traction power to the Sydney Central Yard tracks.

## 5. Description of the proposal

*This section provides a description of the proposal, based on the design work undertaken to date. This includes an overview of the key components and design features of the substation, and a description of how it would be constructed and operated.*

### 5.1 The proposed substation

#### 5.1.1 Substation building and equipment

The proposed substation would comprise a two storey building with external, banded high voltage enclosures to house the electrical equipment and associated facilities, and ancillary exterior facilities.

The proposed substation would be constructed from reinforced concrete ground slab on concrete piers with first floor concrete slab and beam supported on concrete columns. Concrete shear walls would be provided at key locations. The roof structure would consist of internally exposed steel rafters supported on steel columns with insulated metal deck roof. Internal walls would be reinforced blockwork, fire rated where required between the three switch room compartments.

The façade treatment would comprise precast concrete panels with smooth finish to the ground floor perimeter and a vertical ribbed pattern to the first floor. This is punctuated at both levels by a series of full height ventilation louvres around three sides of the building to provide natural ventilation throughout both levels of the building. Only the Administration office will be air conditioned.

The five metre high precast wall panels are proposed for the bund yard perimeter walls but with two metre high vertical ribbed metal louvre above that will match the rib pattern on the precast concrete wall panels. Both the upper precast panels and the metal louvres would have vertical slots between the ribs to provide ventilation to the transformers.

The switch rooms would be located on the first floor of the building, and the ground floor would consist of cable zones, equipment rooms, administration rooms and amenities.

A cable pit would be located in the north-western corner of the building. This would connect into the cable tunnels to the rail corridor and to the existing cable tunnel located within the Prince Alfred Substation.

The maximum external height of the building would be nine m above the ground level of the Prince Alfred Sidings Precinct.

Overall, the proposed substation would have an enclosed floor area of approximately 1240 m<sup>2</sup>, comprising approximately 620 m<sup>2</sup> for both the switchrooms (first floor) and the ground floor (cable chamber area).

The proposed substation building would contain the following facilities and equipment on the first floor level in three fire isolated rooms:

- 33 kV switchroom containing the 33 kV Switchboard, consisting of four physically separate 33 kV sections, the three rectifiers and multiple low voltage switchboards
- 11 kV switchroom containing the 11 kV Switchboard, consisting of four physically separate 11 kV sections, and two SCADA cabinets
- 1,500 V switchroom for the following equipment:
  - four 1,500 V DC rectifier DC circuit breakers



- twenty three 1,500 V DC feeder DC circuit breakers, arranged in two 1,500 V DC bus sections
- two DC 1,500 V DC harmonic filter, one for each 1,500 V DC bus
- two 1,500 V DC test bays, one for each 1,500 V DC bus with one common spare DC circuit breaker
- one SCADA cabinet and adjoining communications panel
- two 1,500 V DC inter-trip panels.

Administration office and staff amenities would be located ground floor level. Three cable rooms corresponding to the switch rooms above would accommodate all the cabling from the equipment at first floor level. Also included within the 11 kV cabling room would be two dry cell battery rooms and two 11 kV/415 V auxiliary transformers.

The following facilities would be located in outside bunded yards, provided on the southern side of the proposed substation building:

- one 0.5 millihenry 6400 A DC reactor
- three 33 kV/600/600 V AC rectifier transformers
- three 33 kV/11 kV transformers to provide 11 kV power supplies to the City Circle stations
- in addition, an 11 kV harmonic filter would be installed on an elevated platform within the external transformer yard.

At basement level, below the north-west corner of the proposed substation, a cabling pit would be constructed. It would form tunnel connections under the western driveway towards the existing 1,500 V outdoor link area adjacent to the tracks and another connection into the cable tunnel area along the western side of the Prince Alfred Substation. An additional cable tunnel under the car park at the northern end of Prince Alfred Substation will provide connection to the existing Eastern Suburbs Railway cable shaft.

The existing banks of 1,500 V DC isolating and rail connect switches installed trackside would be reused to supply 1,500 V DC traction to the overhead wiring system serving the Main Line tracks.

Four new 1,500 V DC isolating and rail connect switches would be installed in a new 1,500 V link room, to be located on the north-east corner of, and external to, the Prince Alfred Substation to replace the existing wall mounted outdoor links. The link room would serve the overhead wiring systems in the Eastern Suburbs Railway (ESR) in the rail tunnels below via the new cable tunnel under the car park. Drawings showing the proposed layout of the substation and associated facilities are provided in Appendix B.

### 5.1.2 Building design

The concept design for the proposed substation building has been developed and is currently being refined by the design team, with input from stakeholders and the project's heritage consultant and façade architects (Tonkin Zulaikha Greer Architects). The proposed substation has been designed to integrate all relevant considerations, including:

- the heritage significance of the State heritage listed Central Station site/group
- urban design and visual considerations
- functional and operational needs and requirements
- access and maintenance
- security.

Appendix B provides indicative concept designs for the proposal.

The proposed substation would be naturally ventilated, with louvres provided on all walls excluding the transformer yard walls, to allow for air intake.

#### 5.1.3 Security fencing and lighting

The proposed substation would be located within the existing Sydney Trains Prince Alfred Sidings Precinct, which is classified as a secure area and therefore it would be secured via the existing fencing and lighting within this area, dedicated closed circuit television, monitored alarm systems and swipe-card access systems would be installed.

#### 5.1.4 Site access and car parking

Vehicular access to the proposed substation site would be via the existing driveway past the Railway Institute off Chalmers Street, just to the south of the pedestrian entrance to Central Station.

A parking space for one utility vehicle would be provided on site adjacent to the spare transformer yard.

The proposed substation building would be normally accessed via a ground-floor personnel entrance located on the south-western side of the substation, with a secure dock above for equipment loading directly into the main switch room.

#### 5.1.5 Chemical storage at the proposed substation

The following quantities of oil would be used within the oil-cooled transformers on site, which would be located within appropriately secure and bunded areas attached to the substation building:

- approximately 3,300 litres of oil in the reactor
- approximately 5,462 litres of oil in each of the three rectifier transformers, and
- approximately 6,900 litres of oil in each of the three power transformers.

The bunded areas would be designed and constructed in accordance with relevant Australian Standards. Each transformer would be positioned within its own bunded yard, which would be connected via compliant sump and flame-trap arrangements to the common oil-water separator. The oil-water separator would collect all run off from the outdoor yards. The water would then be treated to separate oil and water. Water would be discharged to the stormwater network, while oil would be removed from site for disposal at a licenced facility. The transformer alley would be enclosed at the western end with a sliding blast door.

#### 5.1.6 Service connections

The proposal would involve connections to Sydney Water's wastewater and potable water networks.

## 5.2 New cable tunnels and fire isolation of the Prince Alfred Substation tunnels

The proposal includes:

- fire isolation of the existing western cable tunnel at Prince Alfred Substation to allow the remainder of the substation building to be reused in the future
- extending the existing cable route within the Prince Alfred Substation to connect to the ESR 1,500 V Link Room and to the ESR Shaft.

These works will completely isolate the cable tunnel system from the remainder of Prince Alfred Substation building, including all electrical, fire and hydraulic services. The scope of work within the building is as follows:

- provide new two-hour fire walls and doors to cable tunnel on western side
- remove and/or relocate redundant electrical services
- underpin existing walls at southern end of tunnel to construct new stairs to connect tunnel to new cable pit
- form new openings in the northern wall of both tunnels and to the inner tunnel (No 3)
- construct new stairs and landing in the void below the existing stairs to the PA switch room level
- the outer tunnel (No 4) would connect to the ESR shaft via a new concrete services tunnel (No 4) located below the northern car park and partly below the new ESR Link Room
- at the southern end, the new tunnel would abut the ESR shaft wall, with new core holes through the wall for HV cable connection into the shaft.

Other work in the existing tunnels would include

- a new grating to the central drainage channel to provide a safer walking path
- fire stopping any existing services to remain that cross the fire wall
- sealing gaps around conduit bell mouths to reduce water ingress
- replacing the existing tunnel windows on the western side with storm proof louvres to provide permanent ventilation.

The Prince Alfred 33 kV Switch House (located within the substation) would not be upgraded as part of this project. However, minor works would be completed within the existing switch house cable basement as follows:

- relocate the existing nitrogen gas bottle installation at the City-end of the switch house to the southern cable tunnel extension for improved service access
- remove and infill the existing roof hatch on the southern cable extension to provide a level surface to the slab
- two 11 kV/415 V transformers would be located on the roof slab to serve the domestic power requirements of the Prince Alfred Sidings Precinct and the compressor house, including two distribution supply main switchboards (DSMSB) sited at ground level in front of the transformers.

## 5.3 Construction information

### 5.3.1 Indicative construction activities

Construction would involve the following main activities:

- site establishment:
  - establishment of the construction compound (refer section 5.3.4)
  - installation of safety fencing around the proposal site
- minor services relocation (refer section 5.3.6)
- early works consisting of:

- enabling works around the existing Prince Alfred Switch House cable basement extension, in the vicinity of the proposed link room and connection into the ESR Shaft to enable future works
- cleaning the Mortuary Station cable tunnel, and mechanical protection to existing feeder cables in this cable tunnel
- construction of the new high voltage cable route from the Prince Alfred Switch House to the Mortuary Station cable tunnel to allow existing high voltage feeders to be relocated prior to the construction of Chalmers Street Substation
- construction of new low voltage cable routes from the Prince Alfred Switch House cable basement extension to final destinations within the Prince Alfred Sidings to avoid disruptions of existing supplies during construction of Chalmers Street Substation
- preparatory works, including construction of the new 1,500 V feeder cable support structure in the existing Prince Alfred Substation 1,500 V outdoor link area, and upgrading the existing negative bars inside the Sydney Central Electric Watermain Tunnel
- cleaning the existing Prince Alfred Substation cable tunnel and Prince Alfred Switch House cable basement
- mechanical protection to existing feeder cables
- install new 800 kVA 11/0.433 kV transformers on the Prince Alfred Switch House cable basement extension and new DSMSBs adjacent to the extension
- install, test and pre-commission low voltage cables from the various Prince Alfred Sidings loads to the new DSMSBs adjacent to the Prince Alfred Switch House cable basement
- staged tunnel construction works to ensure continued access is available to the Prince Alfred Sidings via the single access road, including:
  - construct the 1,500 V DC cable tunnel and associated pit from Chalmers Street Substation towards the tracks
  - construct the interface cable tunnel from the Chalmers Street Substation to the existing cable tunnel on the western side of the Prince Alfred Substation
  - constructing the new high voltage cable tunnel from the northern end of Prince Alfred Substation to the ESR Shaft (can be constructed simultaneously with the above works)
  - fire rate infill walls to the existing Prince Alfred Substation western cable tunnels to fire isolate the building from the remainder of the basement area
  - construct new stairs at the northern end of the western cable tunnel to provide an egress route
  - connect existing tunnels with new tunnels at the northern and southern ends of the existing tunnel
  - complete any remediation works required to the ESR Shaft
- piling/excavation works:
  - construct the piles for the ground slab
  - excavate for oil/water separator tank and related services
- construct the Chalmers Street substation building
- construct the new ESR 1,500V Link Room
- electrical works and fit out

- staged commissioning of the Chalmers Street Substation, coupled with the complete electrical decommissioning of the Prince Alfred Substation.
- site clean-up.

### 5.3.2 Construction workforce

Construction of the proposal would involve a maximum workforce of approximately 20 people at any one time.

### 5.3.3 Equipment

Plant and equipment used during construction may include (but not be limited to):

- |   |                            |
|---|----------------------------|
| • water cart                              | • tip trucks               |
| • concrete saws                           | • concrete agitator trucks |
| • backhoes                                | • concrete pumps           |
| • hand tools                              | • air compressor           |
| • jack hammers                            | • generators               |
| • light commercial and passenger vehicles | • road sweepers            |
| • mobile crane                            | • large delivery trucks    |
| • on site crane                           | • low loader               |
|   | • piling rig.              |

### 5.3.4 Construction compounds, access and vehicle movements

#### **Construction compound/s**

There is limited space within the study area to establish a construction compound. Three potential locations are being considered.

The following locations have been identified as potentially being available for use as construction compounds:

- ESR Link Room construction area: This area is located at the northern end of the existing Prince Alfred Substation. This area would be used to construct the Link Room and could be used as a compound location. The availability of this area would need to be confirmed with Sydney Trains.
- Existing possessions office located within the existing Prince Alfred Switch House: This office may be available for use as a site office.
- Proposed substation site and CBD Network Base car parking: The extent of the area that may be available for use as a compound would be confirmed in consultation with Sydney Trains.

The location of the above sites is shown in Figure 1.1. Each of the above locations has been considered by this REF.

There is potential that a combination or all three of the above sites may be used. The final location/s would be confirmed by the construction contractor following consultation with relevant stakeholders.

As a result of the limited space available, the majority of construction equipment and materials would need to be stored off site and transported to site when required.

Once the contractor has determined the preferred location for the compound and any stockpile areas, consultation with Transport for NSW would be undertaken to confirm the suitability of the location and whether any additional environmental assessment is required.

The site/s would be securely fenced with temporary fencing. Signage would be erected advising the general public and Sydney Trains workers of access restrictions. Upon completion of construction, the temporary site compound, work areas and any stockpiles would be removed; the site/s would be cleared of all rubbish and materials, and reinstated.

### **Construction access and parking**

Access to the proposal site would be via the existing Prince Alfred Sidings Precinct access point, which is located to the south of the Central Station entrance located near the intersection of Chalmers Street and Devonshire Street.

Access to all facilities within the Prince Alfred Sidings Precinct would be maintained at all times during the construction period.

The arrangements for and availability of construction vehicle and employee parking would be confirmed by the construction contractor. Potential parking locations would include available hardstand areas or areas associated with the new CBD Network Base (subject to consultation with Sydney Trains). Both of these areas have limitations in term of space. Employees would be encouraged to use public transport to access the site or alternate parking would be sourced in the vicinity of the proposal (e.g. hire parking in a nearby parking garage).

### **Vehicle movements**

Construction would generate heavy vehicle movements associated with the transportation of construction machinery, equipment and materials to the site. Light vehicle movements would be associated with employees and smaller deliveries.

It is estimated that construction vehicle movements would involve a daily maximum of approximately:

- four heavy vehicles during the construction period - resulting in eight movements per day
- eight heavy vehicles during concrete pours - resulting in 16 movements per day
- ten light vehicles during the construction period (assuming that approximately half of the workforce would travel to the site via public transport) - resulting in 20 movements per day.

The delivery and removal of some equipment, such as transformers, would be considered oversized deliveries. These deliveries or removal would be undertaken in accordance with the requirements of relevant authorities.

#### 5.3.5 Construction timing, staging and work hours

### **Construction timing**

It is anticipated that construction would take approximately 28 months. The main civil construction activities would be completed within 16 months, the fit out of the proposed substation would take six months and six months for commissioning works. Construction of the new substation is anticipated to commence in late 2016 with early works starting from early to mid 2016.

## Work hours

Construction would occur during the standard hours set out in the *Interim Construction Noise Guideline* (DECC, 2009):

- Mondays to Fridays between 7 am and 6 pm
- Saturdays between 8 am and 1 pm
- No work would occur on Sundays or public holidays.

Out of hours works (including work on Sundays) would predominately be limited to scheduled track possession periods, however some out of hours works would be required outside of scheduled track possession periods. Works that may need to be undertaken during track possessions and out of hours include but are not limited to the connection to the overhead wiring system; installation of certain electrical equipment; and delivery of oversized equipment.

As the proposal site is located within an area that does not contain any live tracks, possessions are not required to construct the substation. It is likely that the two possessions available per year within the Central Station Sydney Yard would be used to connect the substation to overhead wiring structures. Controlled power outages would also be required and may need to occur out of hours.

If out of hours work is required, the contractor would obtain permission from Transport for NSW. All of out of hours work would be undertaken in accordance with Transport for NSW's *Construction Noise Strategy* (Transport for NSW, 2012).

High noise generating activities such as rock breaking and jack hammering, would be scheduled during the following hours, unless previously approved by Transport for NSW:

- 8 am to 12 noon, Monday to Saturday
- 2 pm to 5 pm, Monday to Friday.

### 5.3.6 Services relocations

The proposal would require the relocation of a number of existing services which are all owned by Sydney Trains. This would include communication infrastructure, compressed air lines, high voltage cables, low voltage cables and some hydraulic services. The exact requirements for service relocation would be undertaken during detailed design. All service relocations are located within the proposal site.

## 5.4 Operation of the proposal

The main functions of the proposed substation would be to convert the incoming 33 kV power supply to a form which can be used by rolling stock on the Sydney Trains network, and to provide power to rail signalling systems and the City Circle stations. The proposed substation would operate 24 hours a day to ensure that power supply is available to the network at all times.

No permanent staff members would be located on site.

Maintenance visits would be undertaken by Sydney Trains personnel approximately three times a month. These visits would generally consist of one utility vehicle accessing the site. In emergency situations additional vehicles may need to access the site.

The potential impacts of operation are considered in section 7.

## 6. Community and stakeholder consultation

*This section summarises the community and stakeholder consultation undertaken as an input to development of the proposal and the REF.*

### 6.1 Consultation during REF preparation

As outlined in section 3.2.1, formal statutory consultation under the Infrastructure SEPP is not required. Consultation during preparation of the REF involved consultation with relevant government agencies in the form of a letter providing information on the proposal and inviting input in terms of issues and/or assessment requirements. The following agencies were contacted:

- Roads and Maritime Services
- Heritage Division of the Office of Environment and Heritage
- Council of the City of Sydney
- Sydney Trains
- State Transit Authority of NSW.

A summary of the responses received is provided in Table 6.1.

**Table 6.1 Issues raised by government agencies**

Agency	Issues raised	Response/where addressed in the REF
Heritage Division of the Office of Environment and Heritage	Environmental assessment should include the preparation of a Statement of Heritage Impact which should include reference to existing document such as the Central Station Conservation Management Plan.	Section 7.1 and Appendix C.
	Heritage assessments should include consideration of visual impacts and potential archaeological issues.	Section 7.1 and Appendix C.
Sydney Trains	Impacts on heritage should be minimised through the design phase so that works do not detract from the heritage values. The design must be in line with the Central Station Conservation Management Plan.	Section 7.1 and Appendix C. The design of the substation has included elements (e.g. brick facades) to minimise impacts to heritage. The design of the substation is to be further developed and would continue to take into account heritage values and the conservation management plan.
	Consultation between Transport for NSW and Sydney Trains should continue throughout the design process in relation to heritage.	Sydney Trains would continue to be consulted in any matters related to the design which impact upon heritage.
	The preferred heritage outcome is to adaptively reuse and retrofit existing buildings, such as Rolling Stock Officers building or the Prince Alfred Substation, in preference to new buildings.	The refit of the Prince Alfred Substation was considered during development of the proposal. As outlined in section 4.4 this was not considered to be a viable option for a number of reasons.



Agency	Issues raised	Response/where addressed in the REF
	Where existing building cannot be reused, any new construction must be designed in architectural context to the heritage precinct and adjacent public spaces.	The design has been developed to ensure the new substation is consistent with the surrounding environment.
	Heritage elements in the vicinity of the proposal identified as 'high' heritage value should be retained in situ and conserved. Only in exceptional circumstances would it be acceptable to impact such elements.	The proposal would not directly impact on any heritage elements (refer section 7.1.3).
	Cumulative heritage impacts should be considered with other developments within the precinct.	Refer section 7.11.2.
	Potential heritage impacts to the Prince Alfred Sidings may also include limiting access to the southern portion of the heritage precinct. Current concept drawings indicate a wide building which spans the width of Prince Alfred Sidings. Access should be maintained to the remainder to the heritage precinct (to the south) so that maintenance works can occur etc.	Access to the southern end of the sidings would be provided at all times. The existing storage fenced storage area would be removed as part of the project and this land would be used to provide access around the proposed substation.
	The Prince Alfred Sidings has archaeological potential. This archaeological potential must be adequately assessed and, if required, investigated prior to commencement of construction works.	Refer to section 7.1.
	The NSW Industrial Noise Policy should be considered for operational noise impacts, including impacts on sleep disturbance.	Refer to section 7.3.
	Consideration should be given to Sydney Trains document, Guide to Noise and Vibration from Rail Facilities.	Refer to section 7.3 and Appendix D.
	The environmental assessment should consider the energy efficiency performance of the substation.	<p>The use of energy for auxiliary services within the substation would be a small proportion of the total load. As the substation would be an unattended site, auxiliary energy usage would be sporadic and would occur when visits to the site are made by the operators or maintenance staff (about three times a month).</p> <p>The following is a summary of the initiatives to minimise energy use:</p> <ul style="list-style-type: none"> <li>• The substation building would be naturally ventilated with the exception of a small air-conditioner within the office area, which would only operate when personnel are on site.</li> </ul>

Agency	Issues raised	Response/where addressed in the REF
		<ul style="list-style-type: none"> <li>Internal lighting within the substation would only be used when personnel are on site.</li> <li>The small hot water heater on site would only be used when personnel are on site.</li> </ul>
	The environmental assessment should give due consideration to the Australian National Health and Medical Research Council interim guidelines relating to the impacts of magnetic field exposure during operation.	Refer to section 7.8.
	The Prince Alfred Substation site is listed on the RailCorp contaminated sites list. Previous investigations have identified elevated levels of a number of substances.	Refer to section 7.2.

## 6.2 Consultation during public exhibition

### 6.2.1 Exhibition of the REF

This REF will be placed on public exhibition for a period of three weeks, during which time written submissions will be accepted. The REF would be exhibited at Transport for NSW Community Information Centre, Ground Floor, 388 George Street, Sydney, Monday to Friday 9am to 5pm.

The REF would also be available through the Transport for NSW website at: [www.transport.nsw.gov.au/projects](http://www.transport.nsw.gov.au/projects).

Surrounding landowners and occupants would be contacted prior to the exhibition period. This would involve provision of a letter providing information on the exhibition.

Throughout the exhibition period the following contact mechanisms would be available to the community:

- Transport for NSW's 1800 number (1800 684 490)
- Transport for NSW's project email address ([projects@transport.nsw.gov.au](mailto:projects@transport.nsw.gov.au))
- Transport for NSW's project webpage ([www.transport.nsw.gov.au/projects](http://www.transport.nsw.gov.au/projects)).

### 6.3 Post-exhibition consultation activities

Following the REF exhibition, Transport for NSW will consider the issues raised in the submissions and prepare a report to:

- summarise issues raised in submissions and respond to the issues raised
- provide any new information concerning the proposal
- identify any changes to the proposal and the potential impacts of those changes.

Anyone who makes a submission (and provides their contact details) would be notified when the proposal's determination report is available for viewing on the Transport for NSW website.

Should Transport for NSW proceed with the proposal, consultation with the community and key stakeholders would be ongoing in the lead up to, and during, the construction of the proposal.

Transport for NSW's information line and email address would continue to be available.

Targeted consultation methods, such as letters, notifications, signage and verbal communications, would occur as required.

# 7. Environmental impact assessment

*This section summarises the environmental impact assessment undertaken for the proposal and includes summaries of the specialist studies undertaken.*

## 7.1 Non-Aboriginal heritage

An assessment of the potential heritage impacts of the proposal has been undertaken by Tonkin Zulaikha Greer Heritage Consultants in July 2015, and a Statement of Heritage Impact has been prepared. The results of this assessment are summarised below. The full assessment report is provided in Appendix C.

### 7.1.1 Assessment approach and methodology

The assessment involved:

- identifying listed heritage items in the vicinity of the proposal site:
  - searching relevant databases including the Australian Heritage Places Inventory and the NSW State Heritage Inventory
  - reviewing the heritage listings and maps under the Sydney LEP.
- a site survey and photographic inventory
- reviewing the proposal description
- preparing a Statement of Heritage Impact in accordance with *Statements of Heritage Impact* (Heritage Office and Department of Urban Affairs & Planning, 1996) and *Assessing Heritage Significance* (Heritage Office, 2001) and in accordance with the principles contained in *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*.

### 7.1.2 Existing environment

#### Heritage listed items

The proposal site is located within a historically important area of Sydney as a result of its inner urban location and its vicinity to Central Station. It is within the curtilage of the following heritage listed items:

- Sydney Terminal and Central Railway Stations Group (listed on the State Heritage Register)
- Central Railway Station and Sydney Terminal Group (listed on the RailCorp's Section 170 Heritage Register)
- Central Railway Station group including buildings, station yard, viaducts and building interiors (listed on the Sydney LEP)
- Central Railway Station (National Trust of Australia; non-statutory listing).

The following heritage items are located in the vicinity of the proposal site:

- Railways Institute Building (listed on the State Heritage Register and Sydney LEP)
- Prince Alfred Park (listed on the Sydney LEP)
- Royal Exhibition Hotel at 86 Chalmers Street (listed on the Sydney LEP).

The Sydney Terminal and Central Railway Stations Group (the Central Station site/group) includes a number of individual elements that are located in the vicinity of the proposal site. These are as follows:

- Prince Alfred Sidings Precinct – located to the south of the proposal site
- Prince Alfred Substation Group – located within and adjacent to the proposal site
- Former Draftsman's and District Engineer's Office – located at the southern end of the Prince Alfred Sidings Precinct.

The above items are shown in Figure 7.1, with the significance of each item outlined in Table 7.1.

## **Heritage significance**

### ***Conservation management plan***

The statement of significance for the Central Station site/group notes that it has high heritage significance at a State level. This is as a result of its role within the rail network, its historical, aesthetic, technical values, and its research potential. This overall significance level does not automatically apply to the individual elements of the site/group. A conservation management plan has been prepared for Central Station. This plan seeks to provide guidance for the conservation of components of the station which have conservation value. The heritage assessment has taken into account this document.

The Central Station Conservation Management Plan (Rappoport Conservation Architects and Heritage Consultants and NSW Government Architect's Office, 2013) outlined the significance of particular elements of the Central Station site/group listings. The sections below outline the significance of these elements.

The Prince Alfred Sidings are considered to have a high significance due to their historical associations with the development of the Sydney rail network and the first two terminuses.

The area in the vicinity of the proposal site has the potential to contain remnant, although most likely disturbed, evidence of the footings of former buildings which were demolished to make way for the existing substation. Evidence of track work within the sidings area may also be present.

Two of the elements within the sidings, the Prince Alfred Substation and Prince Alfred Workshops, are considered to have high significance.

The adjacent parkland (Prince Alfred Park) is considered to have high significance, while the potential remains of the Goods Shed would have a significance of little to moderate.

### ***Railway Institute Building listing***

The Railway Institute Building is considered to be culturally significant as it is the first railway institute building erected in Australia, and was an important educational facility at the end of the 19th century and during the 20<sup>th</sup> century. The original section of the building also has architectural significance as a rare and fine example of the Federation Anglo Dutch style.

### ***Prince Alfred Park listing***

Prince Alfred Park is historically significant as the first park in Australia laid out for the purpose of holding an Agricultural Society Intercolonial Exhibition in 1870. The layout and mature vegetation are very important historical items. The park has high historical and aesthetic significance, and is also of social significance.

## Archaeological significance

The Prince Alfred Sidings precinct has low to moderate historical archaeological potential associated with the post 1880s development of the sidings. This area has been railway land since the 1850s. There is potential for a number of archaeological remains of former buildings or tracks to be present within the proposal site.

The Central Station Conservation Management Plan notes that the land on which the proposal site is located is considered to have low archaeological potential. The plan states that caution should be made during works and that an archaeologist is only required when items are found. The Prince Alfred Sidings Precinct is identified by the Sydney LEP as having low archaeological potential. Due to the past use of the land there is potential for remanent items, however development in the area over the years has resulted in many of the original features being removed.

### 7.1.3 Impact assessment

#### Construction

Potential building related construction vibration impacts are considered in section 7.3.4.

There is the potential that the movement of construction vehicles and equipment could result in accidental damage to individual elements associated with the Central Station site/group. This potential impact would be minimised by the implementation of measures provided in section 7.1.4.

Due to past development and land disturbance in the Prince Alfred Sidings Precinct, and the low archaeological potential classification noted by the Central Station Conservation Management Plan, it is considered unlikely that any archaeological items would be discovered and/or disturbed.

As a result, the proposal is not expected to impact on archaeology. Mitigation measures outlined in section 7.1.4 would be implemented in the event archaeological deposits are discovered during construction.

#### Operation

The proposed new Chalmers Street Substation has been designed to read as a distinctly contemporary, yet recessive, element within the context of the heritage listed Central Station and the Prince Alfred Sidings. It will have minimal impact on key views within the curtilage of the Central Station.

Table 7.1 provides an outline of the potential impact of each of the proposed aspects of the project. A more detailed discussion of these impacts can be found in Table 10 in Appendix C.

A robust, simple palette of materials is proposed for the façade of the new substation building, which has a functional industrial aesthetic appropriate to its rail yard setting. The façade of the building has been designed to interpret the movement of trains in the Sydney Yard through the use of vertical ribbed concrete to the upper walls. The vertical emphasis of the façade, with bays of vertical louvres, is also intended to relate to both its historic counterpart, the Prince Alfred Substation, and the proposed Lee Street Substation, located across the rail corridor. The siting, scale, materials and detailing of the new building are considered appropriate to this highly significant setting.

The heritage assessment concludes that the proposal will have minimal impact on the heritage significance of Central Station as a whole, the Prince Alfred Sidings precinct and significant elements within it.

As noted in section 3.3.1, an application for approval from the Heritage Council will be submitted in accordance with section 60 of the *Heritage Act 1977*.

**Table 7.1 Summary of heritage impacts**

Proposed works	Potential impacts	Heritage impact
Establishment of temporary compound	The proposal site is currently hardstand of sufficient size to establish a construction compound. Access to other areas within the sidings would be maintained at all times.	Minor adverse, but acceptable, heritage impact (temporary)
Site levelling and excavation for new footings and slabs	Potential impacts to former goods shed which was located to the south of the existing substation station.	Minor adverse, but acceptable, heritage impact
New cable gantry	An existing cable gantry is located over the East Hills and Airport Line. There may be a requirement to include a second gantry. There are currently a number of gantries within the rail corridor.	Neutral heritage impact
Construction of new substation	The introduction of a new two storey substation into the Prince Alfred Sidings precinct. The new substation would be viewed from the rail corridor, however views from Prince Alfred Park would be minimal. The substation has been designed to minimise impacts on the heritage precinct while ensuring it remains contemporary. Further discussion of the potential impacts of the proposal is provided in Table 10 in Appendix C.	Minor adverse, but acceptable, heritage impact
Construction of basement level cable tunnel to Prince Alfred Substation	The tunnel would not be visible and the potential impacts would be minimal. There would be potential for impacts during excavation activities if archaeological remains are located in this area.	Minor adverse, but acceptable, heritage impact
Alterations and additions to the Prince Alfred Substation	Many of the works would be located below ground and therefore would have minimal impacts, with the exception of the potential for impact to any archaeological remains located in the proposal site. Impacts on the existing building structure would be monitored to ensure no damage occurs. Works on the Prince Alfred Substation would also include the following works which would potentially result in impacts: <ul style="list-style-type: none"> <li>• New link room</li> <li>• Repairs and security treatment to pump room</li> <li>• Replacement of existing ground floor windows</li> </ul> Further discussion of these potential impacts is provided in Table 10 in Appendix C.	Minor adverse, but acceptable, heritage impact.  The repairs and treatment of the pump room are considered to have a neutral heritage impact.

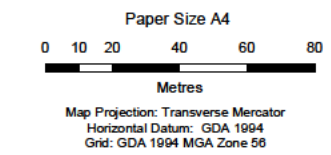
Proposed works	Potential impacts	Heritage impact
Construction of a new steel framed platform and security mesh enclosure for a new harmonic filter, switchboards and transformers	The new structure would not be visible from the public domain due to elevation differences between Prince Alfred Park and the Prince Alfred Sidings.	Minor adverse, but acceptable, heritage impact.

#### 7.1.4 Mitigation measures

The following mitigation measures would be implemented to minimise the potential impacts to the heritage significance of the study area, and individual heritage listed items:

- Prepare a dilapidation survey of the area proposed for the temporary construction compound and the Prince Alfred Substation and other heritage listed buildings located in the vicinity of the proposal before and after the works. Any damage would be repaired at the conclusion of the works.
- Prepare a photographic archival recording of areas of the Prince Alfred Substation that would be impacted prior to construction. This includes the electrical switches on the north east wall which are proposed to be removed, pump well doors, ground floor windows, north east and western corners of the building and either end of the basement cable tunnel.
- Salvage and store the ground floor windows proposed to be removed for possible future reinstatement.
- All heritage items in the immediate vicinity of the site would be identified on site plans, fenced off where appropriate, and protected during construction.
- Manage archaeology in accordance with *Unexpected Heritage Finds Guideline* contained in Transport for NSW Quality Management System. If any unanticipated archaeological deposits are identified during construction, work likely to impact on the deposit would cease immediately and the NSW Heritage Council and an archaeologist would be contacted. Where required, further archaeological work and/or consents would be obtained prior to works recommencing at the location.
- Allow for the monitoring and repair of any damage of significant items as a result of construction of the substation, such as the corners of the Prince Alfred Substation where underpinning is proposed. This would include an allowance for a nominated Heritage Architect to inspect and report before, during and after completion of the works.
- Develop a Heritage Interpretation Strategy for the Prince Alfred Sidings precinct.





LEGEND	
	Prince Alfred Siding Precinct
	Proposal site
	Approximate location of historic Prince Alfred Sidings
	Prince Alfred Park
	Central Station site/group
	Heavy rail



Transport NSW  
REF- chalmers St SS & PASH

Job Number 21-22993  
Revision A  
Date 09 Apr 2015

Heritage items

Figure 7.1

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 © 2015. Whilst every care has been taken to prepare this map, GHD and NSW DEPARTMENT OF LANDS, GEOSCIENCE AUSTRALIA, NSW DEPARTMENT OF PRIMARY INDUSTRY, NEARMAP make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.  
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 Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

## 7.2 Soils and water quality

### 7.2.1 Existing environment

#### Geology, topography and soils

The *1:100,000 Geological Series Sheet for Sydney* (Geological Survey of NSW, sheet 9130, Edition 1, 1983) shows that the proposal site overlies Ashfield Shale of the Wianamatta Group, and Hawkesbury Sandstone. The site is situated on a topographic high, and it is expected that bedrock would occur at a relatively shallow depth.

The site is located within the Blacktown soil landscape as shown on the *Soil Landscapes of Sydney 1:100,000 Sheet* (Chapman et al 1983). This landscape is characterised by shallow to moderately deep red and brown podzolic soils on crests, upper slopes and well drained areas and deep yellow podzolic soils on lower slopes and areas of poor drainage.

Geotechnical investigations undertaken by GHD (2014a) identified that the majority of the site is likely to be underlain by areas of imported fill to depths between 0.5 and 1.3 m. The fill material generally contained ash, brick and ballast. The fill material is underlain by weathered Ashfield Shale bedrock. The bedrock is typically highly to moderately weathered and of very low to medium strength.

It is likely that most of the soils in the vicinity of the proposal site are fill, imported during construction of surrounding land uses.

#### Contamination

A search of the EPA's Contaminated Land Record was undertaken on the 24 February 2015 for the City of Sydney LGA. No contaminated sites were identified in the vicinity of the proposal site. A search of the list of NSW contaminated sites notified to the EPA was also undertaken for the suburbs of Chippendale, Haymarket and Surry Hills. The nearest contaminated site notified to the EPA is located approximately 450 m to the north-east of the site on Foveaux Street.

The contamination assessment for the subject proposed site undertaken by GHD (2014a) highlighted that concentrations of heavy metals within the soil material and groundwater tested was all below the adopted guidelines.

#### Hazardous materials

A hazardous building material inspection report (GHD 2014b) was completed for the Prince Alfred Substation buildings to determine whether any potentially hazardous materials are present. The following hazardous materials were identified:

- asbestos: three samples were positively identified as containing asbestos. This included one sample which was classified as friable.
- lead paint: A number of instances of lead paint were identified .
- lead dust: Lead dust was identified in a number of locations and is assumed to be located through much of the basement levels of the substation.
- polychlorinated Biphenyl's (PCBs): No positive instances of PCBs were identified during the investigations, however a number of potential sources within inaccessible areas (florescent light fittings within the rectifier room and 33 kv switch room) are considered likely.
- synthetic Mineral Fibres: No materials containing synthetic mineral fibres were identified during the investigations.

## Surface water

The site is drained by a stormwater network which is located within the hardstand area. This includes kerb and gutters which collect water via a number of stormwater drains.

There are no watercourses or drainage lines in the vicinity of the proposal site.

## Groundwater

Groundwater monitoring equipment was installed as part of the GHD geotechnical investigations (GHD 2014a). Groundwater was identified at a depth of about 3.3 metres. The depth to groundwater is considered to be variable (e.g. higher following wet weather). The contamination assessment undertaken by GHD (2015a) found that groundwater was not found to contain any contamination (i.e. above the relevant criteria). Groundwater was found to have concentrations of total xylene which are above the levels to which groundwater can be discharged to Sydney Water's wastewater system as part of the trade waste agreement.

## Water quality

The quality of surface water runoff in the vicinity of the proposal site would be impacted by existing land uses, including the rail corridor.

### 7.2.2 Impact assessment

## Construction

### **Soil disturbance**

The proposal would require some earthworks to construct the foundations for the proposed substation and also the cable pit located within the basement and the associated cable tunnels. The proposal site is located in an area which is likely to have been heavily disturbed in the past as a result of construction of the existing facilities. The proposal would result in the exposure of soils which could be subject to erosion and sedimentation impacts during periods of wind and rainfall. Any erosion and sedimentation impacts would be temporary and short-term in duration, and would be minimised by the implementation of the mitigation measures provided in section 7.2.3.

### **Contamination issues**

The proposal is not considered likely to impact upon any contaminated soil as none was identified during contamination investigations. The approach to managing any unexpected contaminated material that may be uncovered during construction would be specified in the CEMP.

The proposal would also have the potential to result in soil and water contamination via any accidental fuel or chemical spills from plant and equipment. The installation and commissioning of electrical equipment (for example, the transformers) would involve injecting oils and other chemicals on site. The potential for impacts as a result of any spills or leaks would be managed by the implementation of measures provided in section 7.2.3.

### **Hazardous materials**

A number of hazardous materials were identified during investigations (refer to section 7.2.1). These materials have the potential to result in health impacts for construction workers and the general public if works within the substation are not undertaken using the correct methods. The mitigation measures outlined in section 7.2.3 would be implemented to ensure that impacts of hazardous materials is minimised.

## **Groundwater**

The footings and basement levels (including cable tunnels) for the proposed substation would potentially intersect groundwater due to the depth of the proposed footings and depths of groundwater in the vicinity of the proposal. The proposal would not significantly impact on groundwater levels in the area, as only a small amount of dewatering would occur. Groundwater would be treated (for xylene) as required, prior to being discharged as per Transport for NSW's *Water Discharge and Re-use Guideline* (2012).

## **Operation**

During operation, the proposal would not result in any impacts to soils or water quality. Appropriate bunding would be incorporated into the design of the proposed substation to contain any chemical spills or leaks (refer section 5.1.5).

### 7.2.3 Mitigation measures

## **Construction**

The measures provided below would be implemented during construction:

### **Soil disturbance**

A soils and water quality sub-plan would be prepared as part of the CEMP. It would include the following measures:

- Sediment and erosion control devices would be installed to minimise transport of sediment in accordance with *Managing Urban Stormwater, Soils & Construction, Volume 1* (Landcom, 2004). These devices would be inspected regularly and immediately after rainfall to ensure effectiveness over the duration of works. Any damage to erosion and sediment controls would be rectified immediately.
- Temporary stormwater control devices or erosion and sedimentation controls would be implemented at stormwater drains to prevent sediment-laden runoff entering the local stormwater system.
- Maintenance and checking of the erosion and sedimentation controls would be undertaken on a regular basis and records kept. Sediment would be cleared from behind barriers/sand bags on a regular basis and all controls would be managed to ensure they work effectively at all times.
- Any material transported onto pavement surfaces would be swept and removed at the end of each working day when it is safe to do so.
- Any soils excavated that are to be used as backfill would be appropriately stored until required.
- Disturbed areas would be restored at the completion of works.
- Spill kits would be maintained on site at all times.
- Machinery would be checked daily to ensure that no oil, fuel or other liquids are leaking.
- Refuelling of plant and equipment would not be undertaken within the proposal site.
- All water discharges would be undertaken in accordance with Transport for NSW's *Water Discharge and Re-use Guideline* (2012).
- The existing drainage systems would remain operational during construction.
- Clean water would be diverted around the worksite in accordance with *Managing Urban Stormwater: Soils and Construction*.

### **Contamination**

- An unexpected findings protocol would be prepared and included in the CEMP to assist with the identification, assessment, management, health and safety implications, remediation and/or disposal (at an appropriately licenced facility) of any potentially contaminated soil and/or water.
- In the event that indicators of contamination are encountered during construction (such as odours or visually contaminated materials), work in the area would cease until an environmental consultant can advise on the need for remediation or other action.

### **Groundwater**

- Should groundwater be encountered during construction activities, appropriate management measures such as water testing, dewatering, temporary water storage and treatment would be implemented to manage any groundwater that seeps into excavations.
- Surface water diversions to be put in place to ensure that water does not enter any pile or excavations.

### **Hazardous materials**

- A hazardous materials management plan would be prepared as part of the CEMP. It would include the following measures.
- The removal, handling and disposal of any asbestos waste would be undertaken by an appropriately licensed contractor, and in accordance with:
  - *Code of Practice for the Safe Removal of Asbestos 2005*
  - *Code of Practice for the Management and Control of Asbestos in Workplaces 2005.*
- The occupational hygienist would be responsible for conducting asbestos fibre air monitoring, visual clearance inspections and issuing clearance certificates after the completion of any removal works.
- Work would cease in the vicinity of any potential asbestos materials which have not been previously identified. The material would be analysed for the presence of asbestos. In the event the material is disturbed prior to work ceasing, the provisions of an Asbestos Removal Control Plan or similar would be followed, including seeking advice from a suitably qualified and experienced professional.
- Lead dust would be removed from the substation building by a qualified hazardous material removal contractor and should be subject to ongoing monitoring and inspections by an Occupational Hygienist to ensure compliance with the relevant legislation and Australian Standards.
- All known and presumed occurrences of polychlorinated biphenyl's would be handled and disposed of in accordance with the procedure documented within ANZECC *Identification of PCB-containing Capacitors – An information booklet for electricians and electrical contractors 1997*. Removal would be undertaken by a suitable licenced hazardous material removal contractor and would be disposed of to a suitably licenced facility.
- In the event synthetic material fibres are found on site, they would be handled and disposed of in accordance with the *National Code of Practice for the Safe Use of Synthetic Mineral Fibres*.

### **Operation**

No mitigation measures are required.

### 7.3 Noise and vibration

A noise and vibration assessment of the proposal was undertaken by GHD. The results of this assessment are summarised below. The full assessment report is provided in Appendix D.

#### 7.3.1 Assessment approach and methodology

The noise and vibration assessment involved the following:

- Background noise monitoring was not undertaken as part of the assessment. Data from the Sydney to Burwood Compressor House Detailed Design Project (GHD, 2012) was used, as it is considered to be representative of the background noise environment.
- An assessment of the potential for construction noise and vibration impacts was undertaken in accordance with:
  - *Interim Construction Noise Guideline* (DECC, 2009)
  - *Construction Noise Strategy* (Transport for NSW, 2012)
  - *Assessing Vibration: a Technical Guideline* (DEC, 2006)
  - *Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013).
- An assessment of the potential for operation noise impacts was undertaken in accordance with the *Industrial Noise Policy* (EPA, 2000).

Further information on the assessment approach and detailed results is provided in section 4.2.1 and 5.1 of Appendix D.

#### 7.3.2 Existing environment

Noise and vibration sensitive receivers were defined based on the type of occupancy and the activities undertaken. A list of the potentially sensitive receivers and land uses identified in the study area for the purpose of the assessment is provided in Table 2-1 of Appendix D. The location of the receivers is shown in Figure 7.2.

The background noise in the study area is typical of an inner urban area, and is influenced by rail, road traffic and general noise associated with surrounding land uses.

A summary of the measured noise levels at a location to the south of the proposal site, within the Prince Alfred Sidings Precinct is provided in Table 7.2.

**Table 7.2 Noise monitoring results; dB(A)**

Rating background level 90 <sup>th</sup> percentile $L_{A90(15min)}$ (dB(A))			Ambient noise levels, $L_{Aeq(period)}$ (dB(A))		
Day	Evening	Night	Day	Evening	Night
48	48	45	56	55	53

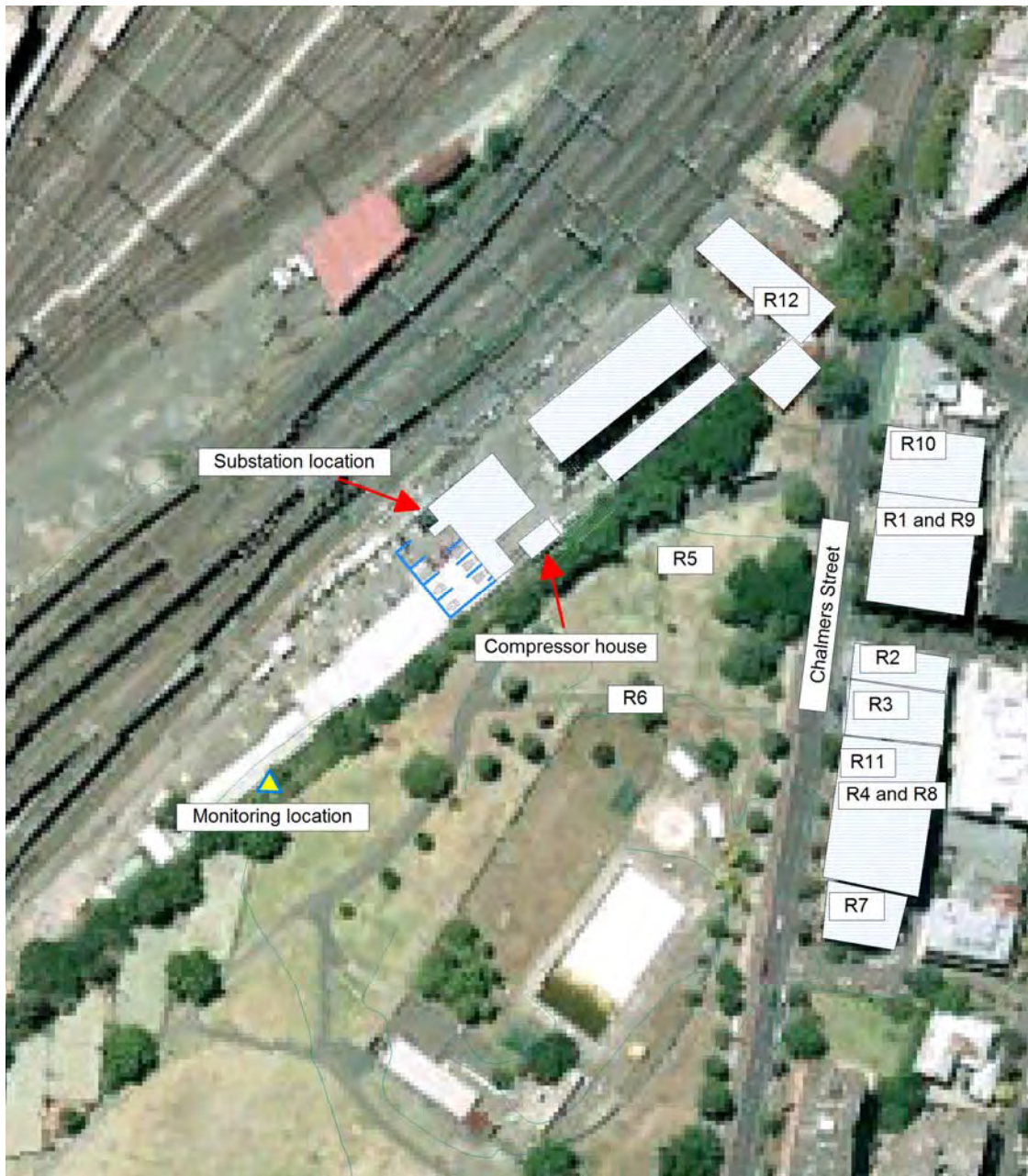


Figure 7.2 Proposed location of receivers in the vicinity of the proposal

### 7.3.3 Assessment criteria

Section 3 of Appendix D describes how the assessment criteria were derived for the following:

- construction noise management levels
- construction vibration – human comfort
- construction vibration – structural damage
- operational noise – intrusive criteria
- operational noise – amenity criteria
- traffic noise during construction and operation
- sleep disturbance during construction and operation.

Table 7.3 and Table 7.4 provide the noise criteria for the proposal based on the *Interim Construction Noise Guideline* (DECC, 2009) and *Industrial Noise Policy* (EPA, 2000) and

Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities (Sydney Trains 2013) respectively. Table 7.5, Table 7.6 and Table 7.7 provide the vibration criteria for the proposal for human comfort and also structure damage.

**Table 7.3 Proposal specific construction noise criteria**

Receiver <sup>1</sup>	Construction noise management level, $L_{Aeq(15min)}$ (dB(A))					Sleep disturbance screening text $L_{Amax}$ (external)
	During standard recommended hours		Outside of standard recommended hours			
	Noise affected	Highly noise affected	Day 7 am to 8 am and 1 pm to 6 pm Saturday, 8 am to 6 pm Sunday & Public Holidays	Evening 6 pm to 10 pm Monday to Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays
Residential (R1 to R4)	58	75	53	53	50	60
Recreation (R5)	60	-	-	-	-	-
Recreation (R6)	65	-	-	-	-	-
Recreation (R7)	45 internal (55 external)	-	-	-	-	-
Recreation (R8)	25-30 internal (45 external)	-	-	-	-	-
Commercial (R9 – R12)	70	-	-	-	-	-



**Table 7.4 Proposal specific operational noise criteria**

Receiver	Time period	Amenity criteria (acceptable noise level) <sup>1,2</sup> L <sub>Aeq</sub> (period)	RBL, L <sub>Aeq</sub> (15min)	Intrusive criteria, L <sub>Aeq</sub> (15min)	Proposal specific noise criteria (external)	Sleep disturbance screening text (external)
Residential receivers (R1 to R4)	Day	60	48	53	53 L <sub>Aeq</sub> (15min)	-
	Evening	50	48	53	50 L <sub>Aeq</sub> (evening)	-
	Night	45	45	50	45 L <sub>Aeq</sub> (night)	60 L <sub>Amax</sub>
Passive recreational area (R5)	When in use	55	-	-	55 L <sub>Aeq</sub> (period)	-
Active recreation area (R6)	When in use	60	-	-	60 L <sub>Aeq</sub> (period)	-
Place of worship (R7, internal)	When in use	40 (internal)	-	-	50 L <sub>Aeq</sub> (period)	-
Theatre (R6, internal)	When in use	25-30 (internal)	-	-	40 L <sub>Aeq</sub> (period) <sup>3</sup>	-
Commercial premises (R9 to R12)	When in use	65	-	-	65 L <sub>Aeq</sub> (period)	-

Note 1: With consideration of the *Industrial Noise Policy* (EPA, 2000) 'noise amenity area' classification, the residential receivers surrounding the Chalmers Street substation have been classified as 'urban'.

2: Attended observations during the site visit noted that there were no significant industrial noise sources in the area therefore no adjustments have been applied for the proposal.

3: A 10 dB(A) noise reduction is assumed from outside to inside the building for the theatre and place of worship

**Table 7.5 Human comfort intermittent vibration limits (BS 6472-1992)**

Receiver type	Period1	Intermittent vibration dose value (m/s <sup>1.75</sup> )	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26
Educational institutions	When in use	0.4	0.8

Note 1: Day is between 7 am and 10 pm and night is between 10 pm and 7 am

**Table 7.6 Guidance on effects of vibration levels for human comfort (BS 5228.2 – 2009)**

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

Currently, there is no Australian Standard that sets criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures* (refer to Table 7.7).

**Table 7.7 Guidance values for short term vibration on structures**

Type of structure	Guideline values for velocity, (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz <sup>1</sup>
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10

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

### 7.3.4 Impact assessment

#### Construction noise

Table 7.8 lists the modelled construction noise levels for all potential receivers. The results of modelling indicate that the noise generated by construction is predicted to exceed the noise affected noise management levels at residential receivers R1 (100-114 Chalmers Street) and R2 (116-118 Chalmers Street) by up to three and one dB(A) respectively. The noise affected noise management levels are also predicted to be exceeded at the following non-residential receivers:

- Prince Alfred Park (R5) by up to 11 dB(A)
- Tom Mann Theatre (R8) by up to eight dB(A).

The above exceedences would be mitigated through the implementation of the standard noise mitigation measures provided by the *Construction Noise Strategy* (Transport for NSW, 2012) would be implemented where feasible and reasonable (refer section 7.3.5). All potentially impacted receivers would be informed of the nature of the works, expected noise levels, duration of works and a method of contact.

#### ***Out of hours work and sleep disturbance***

Out of hours work (e.g. connection of substation to overhead wiring structures and installation of some equipment) is not expected to cause adverse impacts at sensitive receivers. If out of hours work is required, contractor would obtain approval from Transport for NSW, prior to works being undertaken. All out of hour works and activities outside the recommended standard hours are to be undertaken with additional mitigation measures in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012).

#### ***Traffic noise***

In accordance with the Road Noise Policy (DECCW 2011), construction traffic noise is considered acceptable when it is within two dB(A) of the existing noise levels. The doubling of traffic on a road is considered to generally result in an approximate three dB(A) increase in noise levels. The proposal would only result in a small increase in vehicles (44 movements) which when compared to existing traffic levels is minor.

The proposal would therefore not result in any exceedance of the road traffic noise criteria.

**Table 7.8 Predicted construction noise levels, dB(A)**

Receiver	Standard hours criteria	Site clearing and demolition works		Earth works		Construction works	
		Ground floor	First floor	Ground floor	First floor	Ground floor	First floor
R1: 100-114 Chalmers St (Ground to fourth floor)	58	<b>59 (+1)</b>	<b>61 (+3)</b>	57 (-1)	58 (0)	<b>59 (+1)</b>	<b>61 (+3)</b>
R2: 116-118 Chalmers St (First and second floor)	58	-	<b>59 (+1)</b>	-	57 (-1)	-	<b>59 (+1)</b>
R3: 120-124 Chalmers St (Ground to second floor)	58	54 (-4)	58 (0)	52 (-6)	56 (-2)	54 (-4)	58 (0)
R4: 126-140 Chalmers St (First to fifth floor)	58	-	57 (-1)	-	55 (-3)	-	56 (-2)
R5: Prince Alfred Park	60	<b>71 (+11)</b>	-	<b>69 (+9)</b>	-	<b>71 (+11)</b>	-
R6: Prince Alfred Park swimming pool	65	62 (-3)	-	60 (-5)	-	62 (-3)	-
R7: Presbyterian Church, 142-144 Chalmers St	55	52 (-3)	-	50 (-5)	-	51 (-4)	-
R8: Tom Mann Theatre, 126-140 Chalmers St (Ground floor)	45	<b>53 (+8)</b>	-	<b>51 (+6)</b>	-	<b>53 (+8)</b>	-
R9: Reprise Media Australia, 100 Chalmers St (Ground floor)	70	59 (-16)	-	57 (-18)	-	59 (-16)	-
R10: Australian Online Solutions, 94-98 Chalmers St	70	62 (-8)	63 (-7)	58 (-12)	59 (-11)	60 (-10)	62 (-8)
R11: Ground floor commercial premises along 116-140 Chalmers St	70	53 (-17)	-	52 (-18)	-	53 (-17)	-
R12: Railway Institute, 101 Chalmers St	70	64 (-6)	67 (-3)	56 (-14)	58 (-12)	64 (-6)	67 (-3)

Note 1: **Bolded** results indicate exceedances to noise affected construction noise management levels.

Note 2: **Bolded red** results indicate exceedances to highly noise affected construction noise management levels

## Construction vibration

### **Human comfort**

The assessment indicates that there is the potential for some vibration (human comfort) impacts at sensitive receivers where ground compaction is undertaken within 50 m of receivers. Piling activities would be required, and any potential impacts would be temporary and short-term. The implementation of the mitigation measures provided in section 7.3.5 would further reduce the potential significance of any impacts.

### **Potential for building damage – general buildings**

The assessment concludes that the predicted magnitude of ground vibrations would not be sufficient to cause damage to buildings located further than 13 m from the proposal. Some buildings/structures are potentially located within 13 m of potential work areas and therefore there is potential for some damage to these buildings. The contractor would undertake a dilapidation survey and compliance vibration monitoring for all buildings located within 13 m of compaction equipment would be undertaken. Mitigation measures would be implemented where possible to minimise any vibration impacts.

### **Potential for building damage – heritage listed buildings and structures**

The building damage vibration criteria for heritage listed buildings are more stringent. Vibration generated by construction may exceed the building damage criteria during vibration intensive activities (particularly any percussive activities) for heritage listed building such as the Prince Alfred Substation. The nature of any impacts is currently unknown as the preferred construction method (particularly in relation to piling) would be determined by the selected contractor. Monitoring would be undertaken in the vicinity of heritage structures. Should vibration levels be deemed to be above the relevant criteria, alternate construction methods (with lower vibration impacts) would be considered and implemented.

Mitigation measures provided in section 7.3.5 would be implemented to minimise the potential impacts to these items.

## Operation

### **Noise**

The results of the assessment (Table 7.9) indicate that the predicted noise levels during operation of the transformers and rectifiers at full load would not exceed the noise criteria at nearby residential dwellings. As a result, no operational impacts are expected.

Tripping of the circuit breakers is expected to result in the operational noise criteria being exceeded (Table 7.10). Any potential impacts would be reduced by the fact that such events are infrequent (approximately three per year) and therefore are unlikely to adversely impact any surrounding residences..

Staff would occasionally access the site out of normal business hours to perform maintenance works. Vehicle movements associated with servicing and maintenance would be infrequent and are not expected to cause noise impacts in an urban area. Therefore no operational traffic noise impacts are anticipated at sensitive receivers.

### **Vibration**

There would be no vibration issues associated with the operation of the proposal.

**Table 7.9 Predicted operational noise levels during normal operations**

Receiver	Operational criteria , LAeq(night)	Predicted noise levels, LAeq(night), dB(A)	
		Receiver height	
		1.5 m	4.5 m
R1: 100-114 Chalmers St (Ground to fourth floor)	45	34 (-11)	35 (-10)
R2: 116-118 Chalmers St (First and second floor)	45	32 (-13)	34 (-11)
R3: 120-124 Chalmers St (Ground to second floor)	45	31 (-14)	33 (-12)
R4: 126-140 Chalmers St (First to fifth floor)	45	30 (-15)	31 (-14)
R5: Prince Alfred Park	55	43 (-12)	45 (-10)
R6: Prince Alfred Park swimming pool	60	37 (-23)	39 (-21)
R7: Presbyterian Church, 142-144 Chalmers St	50	28 (-22)	29 (-21)
R8: Tom Mann Theatre, 126-140 Chalmers St (Ground floor)	40	30 (-10)	31 (-9)
R9: Reprise Media Australia, 100 Chalmers St (Ground floor)	65	34 (-31)	35 (-30)
R10: Australian Online Solutions, 94-98 Chalmers St	65	34 (-31)	35 (-30)
R11: Ground floor commercial premises along 116-140 Chalmers St	65	31 (-34)	32 (-33)
R12: Railway Institute, 101 Chalmers St	65	40 (-25)	40 (-25)

**Table 7.10 Predicted operational noise levels during circuit breaker tripping**

Receiver	Sleep disturbance criteria. LAmax	Predicted noise levels (dB(A))	
		Receiver height	
		1.5 m	4.5 m
R1: 100-114 Chalmers St (Ground to fourth floor)	60	64 (+4)	66 (+6)
R2: 116-118 Chalmers St (First and second floor)	60	63 (+3)	65 (+5)
R3: 120-124 Chalmers St (Ground to second floor)	60	62 (+2)	64 (+4)
R4: 126-140 Chalmers St (First to fifth floor)	60	60 (0)	62 (+2)

### 7.3.5 Mitigation measures

#### Construction noise

The following mitigation measures would be implemented to minimise noise impacts during construction:

- A noise and vibration management plan would be prepared as part of the CEMP in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012) and the EPAs Interim Construction Noise Guidelines (DECC, 2009). It would include the following measures.
- Mitigation measures documented in *Construction Noise Strategy* (Transport for NSW, 2012) would be adopted where feasible and reasonable, as specified in Table 6-1 and 6-2 of Appendix D.

- Sensitive receivers would be identified and marked on plans.
- Works would be scheduled during recommended standard hours where practicable.
- All equipment and construction methodologies would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.
- All site workers would be educated as to the potential for noise impacts of sensitive receivers and land uses and encouraged to take practical and reasonable measures to minimise impact during the course of their activities. This would include toolbox talks covering:
  - avoid the use of outdoor radios during the night period
  - avoid shouting and slamming doors
  - where practicable, machines would be operated at low speed or power and switched off when not being used, rather than left idling for prolonged periods
  - avoiding dropping materials from height and metal to metal contact where practicable.
- Truck drivers would be informed of designated vehicle routes, parking locations and the requirement to minimise engine idling.
- Non-tonal reversing beepers (or an equivalent mechanism) would be used by construction vehicles and plant.
- Where noise and vibration levels during the works are predicted to exceed acceptable levels after implementation of general work practices, the additional mitigation measures included in Table 6-1 and 6-2 of Appendix D would be implemented where reasonable and feasible.
- If out of hours works are required, the contractor would prepare and submit a Transport for NSW Out of Hours Work Assessment (3TP-PR-065) and Application Form (9TP-FT-079) for approval prior to the works being undertaken. All out of hours works to be undertaken in accordance with Transport for NSWs *Construction Noise Strategy* (Transport for NSW, 2012).
- If out of hours work is required, beyond those assessed in this REF (section 7.6.4) the contractor would obtain approval from Transport for NSW, prior to works being undertaken. All out of hour works and activities outside the recommended standard hours are to be undertaken with additional mitigation measures in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012).
- Nearby receivers would be notified of the works prior to commencement. The notification would include expected noise levels, duration of the works and a method of contact.

### Construction vibration

The following mitigation measures would be implemented to minimise potential vibration impacts during construction:

- Sensitive receivers within the safe working distance buffers would be informed of the nature of the works, duration and provided with contact details.
- A dilapidation survey would be prepared for all heritage buildings and structures located within 13 m of construction involving vibration intensive compaction equipment.

- Compliance vibration monitoring would be undertaken during operation of any vibration intensive construction equipment to ensure compliance with the building damage criteria for heritage buildings or structures.
- A trigger alarm system would be implemented to notify site personnel in the event that vibration limits are close to being exceeded. Where exceeded, works must stop, be reassessed and revised.
- Provide alternative equipment or construction methodologies where feasible and reasonable.

## Operation

The following mitigation measures would be implemented to minimise impacts on noise and vibration during operation:

- Any noise complaints would be investigated in accordance with Sydney Trains' standard operational procedures.
- Scheduling maintenance operations during the day time period to minimise potential for adverse impacts at sensitive receivers.
- Investigating and addressing noise complaints.
- Conducting post construction operational noise monitoring to assess compliance against operational noise criteria and undertake remedial measures to achieve compliance if required.

## 7.4 Flora and fauna

### 7.4.1 Existing environment

A desktop assessment, involving searches of relevant databases, was undertaken to determine the potential conservation significance of the study area, and to identify the likelihood that any threatened flora and fauna species, populations and ecological communities would be present in the study area and proposal site. The following documentation was reviewed prior to the field investigations:

- Department of the Environment (DotE) Protected Matters Search Tool for relevant matters of national environmental significance listed under the EPBC Act (October 2013 – within a drawn polygon centred on the study area, buffered at 10 kilometres).
- The Office of Environment and Heritage Atlas of NSW Wildlife database (OEH, 2013a) for threatened species listed under the TSC Act (October 2013 – within a 10 kilometre radius of the study area).

The results of the desktop assessment are provided in Appendix E.

The results of the desktop assessment were confirmed by a site inspection undertaken by a GHD ecologist on 6 November 2013. The purpose of this inspection was to identify whether any native vegetation or potential habitat (for threatened or migratory biota listed under the TSC and/or EPBC Acts) was present on or near the proposal site.

The proposal site is a highly modified area within an urban environment. The majority of the groundcover is hardstand (concrete or asphalt) and no native soil is likely to be present. Buildings, roads and the railway surround the majority of the site. Prince Alfred Park is located to the south-east of the site. A number of large planted native Port Jackson Figs (*Ficus rubiginosa*) and introduced Plane Trees (*Platanus xhispanica*) are located immediately adjacent to the site within Prince Alfred Park.

No native vegetation communities are present. Given the lack of native vegetation, no natural soils to contain seedbank, and mostly hardstand areas, no threatened ecological communities or threatened flora species are present or are likely to occur.

A range of introduced species occur along the embankment adjacent to Prince Alfred Park. Species included Oleander (*Nerium oleander*), Phoenix Palm (*Phoenix canariensis*), Morning Glory (*Ipomoea indica*), and Pellitory (*Parietaria judaica*). Pellitory is listed as a Class 4 noxious weed in the City of Sydney local government area. The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its flowering and reproduction.

The site does not contain habitat of importance for any native fauna species. The introduced Rock Dove (*Columba livia*) was observed in the area and introduced rats (*Rattus* spp.) are likely to occur in the groundcover along the embankment. No migratory birds are likely to occur within the proposal site. The vulnerable Grey-headed Flying-fox may forage on occasion in Port Jackson Figs within Prince Alfred Park, while the vulnerable Eastern Bentwing Bat may forage in open areas within the park. No other threatened fauna are likely to occur in the study area given the lack of native vegetation and connectivity with other areas of known habitat.

#### 7.4.2 Impact assessment

There would be no impact on any intact or naturally occurring native vegetation as a result of the proposal. Given the absence of native vegetation or communities, the proposal would not impact any threatened ecological communities or threatened flora species.

The site does not contain habitat of importance for native fauna species. There would be no direct impact on the Port Jackson Figs located within Prince Alfred Park. No indirect impacts are likely, as works would be undertaken during the day in an already highly disturbed and modified environment. The proposal would not therefore impact any threatened or migratory species.

The proposal would not impact on any native fauna species, threatened or migratory biota.

No assessments of significance are required for threatened species listed under the TSC Act and a Species Impact Statement is not required. No assessments of significance are required for threatened or migratory biota listed under the EPBC Act, and the proposal does not need to be referred to the Minister for the Environment based on ecological grounds.

#### 7.4.3 Mitigation measures

The measures provided below would be implemented to minimise the spread of noxious weeds:

- Weeds would be managed and disposed of in accordance with the requirements of the *Noxious Weeds Act 1993* and/or the *Weeds of National Significance Weed Management Guide*.

## 7.5 Traffic and transport

### 7.5.1 Existing environment

The road network in the vicinity of the proposal is shown in Figure 1.1 and summarised below.

#### **Chalmers Street**

The proposal site is located to the west of Chalmers Street. Chalmers Street, which is not a classified road, travels between Elizabeth Street (at the northern end of Central Station) to the north, and Phillip Street, Redfern (near Redfern Oval) to the south. In the vicinity of the proposal, Chalmers Street is a one way street with all traffic travelling in a northerly direction. The road is four lanes wide with the easternmost lane a dedicated bus lane. The most recent



traffic counts available indicate that, in 2005, Chalmers Street (at Bedford Street 200 m south of the proposal site entrance) had a vehicle count of 15,524 vehicles per day.

### **Public transport**

Chalmers Street forms part of the bus interchange at Central Station to the north of the site. There are also bus stops located adjacent to the site entrance just to the south of the Central Station entrance located near the intersection of Chalmers Street and Devonshire Street.

### **Pedestrian and cyclists**

The proposal site is located away from public areas and therefore pedestrian traffic is limited to Sydney Trains personnel within the Prince Alfred Sidings Precinct. The entrance to the precinct on Chalmers Street is located in a highly trafficked area for both pedestrians and cyclists accessing buses, trains or travelling through the site to surrounding areas. A cycle route travels past the site entrance where it then travels through Prince Alfred Park.

### **Access to surrounding land uses**

The proposal site forms part of the Prince Alfred Sidings Precinct which is accessed via an existing driveway located to the south of the Chalmers Street access to Central Station. This driveway provides the only access to all Sydney Trains operations located within the precinct (including Prince Alfred Substation).

## 7.5.2 Impact assessment

### **Construction**

Information regarding the proposed arrangements in terms of construction site access, parking and vehicle movements is provided in section 5.3.4.

### **Vehicle movements**

Construction vehicle movements would result in a temporary increase in traffic along the road network in the study area. An estimate of the likely construction traffic generation is provided in section 5.3.4. The construction traffic that would be generated by the proposal (up to a maximum of approximately 44 vehicle movements per day) would be a very small proportion of the existing traffic levels on Chalmers Street and surrounding streets. This increase is not expected to result in any impacts on the operation of the road network.

### **Oversized deliveries**

The construction of the proposal would require delivery of oversized pieces of equipment and materials, such as transformers, rectifiers and pre-cast panels. These deliveries would be undertaken in consultation with relevant agencies and in accordance with the traffic management plans to be developed as part of the CEMP. Such deliveries would generally be undertaken out of hours to minimise the potential for impacts to the surrounding road network.

### **Access to the Prince Alfred Sidings Precinct**

Access to the proposal site would be via the existing access located to the south of the Central Station entrance at Chalmers Street. During construction, access would need to be maintained to the following facilities within the precinct:

- Prince Alfred Substation (which would remain operational until the Chalmers and Lee Street Substations are operational)
- compressor building (located to the east of the proposed substation location)

- Sydney Train buildings located south of the proposal site (e.g. CBD Network Base). Depot facilities located at south-western end of the precinct.

During construction, access throughout the Prince Alfred Precinct would not be interrupted, unless consultation has been undertaken and agreement reached with all potentially impacted stakeholders. The proposal includes a package of early works (such as construction of cable tunnels and realignment of existing utilities) to ensure that, once construction of the proposed substation commences, access to the existing facilities is maintained.

### **Parking**

Construction vehicles would park within the construction compounds where possible, however as space is limited within the Prince Alfred Sidings Precinct there may be a need to arrange other parking areas in the local area (e.g. a parking garage). Workers would be encouraged to access the proposal site via public transport, to minimise the number of vehicles accessing the site.

### **Public transport, pedestrian and cyclist impacts**

The entrance to the proposal site is located directly adjacent to the Chalmers Street entrance to Central Station and also a number of bus stops. Impacts to the operation of these facilities, including movement of people, would be limited to vehicles accessing the site.

Mitigation measures outlined in section 7.5.3 would be implemented to minimise any impacts on public transport and the associated pedestrian movements.

### **Operation**

As noted in section 5.1.4, vehicular access to the proposal site would continue to be via the existing access point on Chalmers Street. Access past the proposed substation would be provided to the west (via the existing open storage area which is to be removed) to provide access to the southern end of the Prince Alfred Sidings Precinct. Parking for maintenance vehicles would be available within the precinct.

Operation of the proposal would not result in any impacts to traffic or access, as access for maintenance purposes would be infrequent (approximately three per month) and not involve large numbers of vehicles.

## 7.5.3 Mitigation measures

### **Construction**

The following mitigation measures would be implemented during construction:

- A traffic management sub-plan would be prepared as part of the CEMP.
- Traffic and access would be managed in accordance with *Traffic Control at Work Sites* (RTA, 2010) and in consultation with Roads and Maritime Services and City of Sydney Council.
- Residents, property owners and operators would be notified of any access restrictions in advance of work commencing. Site access and work scheduling arrangements would be finalised in consultation with the owners and operators of adjoining sites, to minimise the potential impacts on the operation of, and access to, these sites.
- Appropriate traffic management would be implemented, including precautionary signs, illuminated warning devices, manual and/or electronic traffic control, and the provision of temporary barriers and markers, to control pedestrians and traffic access to and around the proposal site.

- Safe access points to work areas from the adjacent road network would be established, including safety measures such as security fencing and/or barriers, maintaining sight distance requirements, signage and the provision of traffic management measures.
- The requirements of the *Roads Act 1993* would be followed at all times prior to and during all work (including notice requirements, consultation and consent/concurrence requirements for work within public and classified roads).
- Heavy vehicles would be restricted to specified routes.
- Oversized deliveries would be undertaken in accordance with the requirements of City of Sydney Council, Roads and Maritime Services and NSW Police.
- Workers would be encouraged to access the proposal site via public transport.
- Access to the proposal site via the existing entrance would be avoided where possible during peak periods when pedestrian and cyclist traffic is high.
- Access to facilities within the Prince Alfred Precinct to be maintained at all times, unless consultation with the potentially affected stakeholders has occurred.
- Parking is to be provided on site (in designated areas and subject to consultation with Sydney Trains), with vehicles not to be parked on surrounding streets.

## Operation

No mitigation measures are required.

## 7.6 Air quality

### 7.6.1 Existing environment

A search of the National Pollutant Inventory undertaken on 24 February 2015 identified 31 air pollutant substances from five sources in the City of Sydney LGA, for the 2012 to 2013 reporting period. The closest identified source of air pollutant is a commercial facility (Spotless Facility Service Roseberry) located approximately 3 km south of the proposal site.

The main contributors to air quality within the study area are emissions from motor vehicles on the surrounding road network, and the operation of diesel train services on the adjoining rail corridor.

The nearest sensitive receivers are the residential properties located approximately 200 m to the south-east on the eastern side of Chalmers Street (near Chalmers Lane).

### 7.6.2 Impact assessment

## Construction

The proposal would have minimal impact on air quality as it would not involve substantial clearing, earthworks or other land disturbance with the potential to generate significant quantities of dust. Small amounts of dust may be produced by the minor excavation associated with piling, and the movement of construction vehicles.

Dust impacts have the potential to impact on the amenity of people in nearby buildings or passing the proposal site. Due to the small amount of dust expected and the relatively short duration of works, these impacts are considered to be minimal.

The operation of plant, machinery and trucks may also lead to increases in exhaust emissions in the study area, however these impacts would be minor and short term.

Implementation of standard air quality management controls (listed in section 7.6.3) would minimise the potential for air quality impacts.

## Operation

### *Air quality*

The operation of the proposal would not result in any air quality impacts.

### *Greenhouse gases*

Sulfur hexafluoride gas (SF<sub>6</sub>) would be used as an insulator within the new switchgear at the Chalmers Street substation. SF<sub>6</sub> has the potential to contribute to greenhouse gas emissions as it has a high greenhouse gas equivalence of 23,900 times that of carbon dioxide. SF<sub>6</sub> is sealed within gas-tight compartments inside the switchgear. Leakage could occur during maintenance activities or through poor work practices. This would be managed through the mitigation measures proposed in Section 7.6.3.

### 7.6.3 Mitigation measures

#### Construction

The following mitigation measures would be implemented to minimise impacts on air quality during construction:

- An air quality management sub-plan would be prepared as part of the CEMP. It would include the following measures.
  - All plant and machinery would be fitted with emission control devices complying with the Australian Design Standards.
  - Machinery would be turned off when not in use and not left to idle for prolonged periods.
  - Vehicle movements would be limited to designated entries and exits, haulage routes (to be determined during the preparation of the traffic management plan in consultation with RMS and Council) and parking areas.
  - Dust generation would be monitored visually, and where required, dust control measures such as water spraying and covering stockpiles would be implemented to control the generation of dust.
  - Materials transported to and from the site would be covered to reduce dust generation in transit.
  - Access points would be inspected to determine whether sediment is being transferred to the surrounding road network. If required, sediment would be promptly removed from roads to minimise dust generation.
  - Stabilisation of any excavated areas as soon as practicable.
  - Fixed hoses would be used to dampen exposed surfaces to minimise dust generation, where required.
  - Shade cloth would be fastened to the perimeter fence on the construction compound to minimise dust transported from the site during construction.

#### Operation

The following mitigation measures would be implemented to minimise impacts on air quality during operation:

- Maintenance of switchgear and management of SF<sub>6</sub> would be undertaken in accordance with Sydney Trains existing management procedures.

## 7.7 Land use, social and visual environment

### 7.7.1 Existing environment

#### **Land use**

The existing land uses of the site and surrounds are described in sections 2.1 and 2.2.

The proposal site is located within the Prince Alfred Sidings Precinct at Central Station, which contains a number of Sydney Trains buildings which are used as depot and administration buildings. The precinct also contains the existing Prince Alfred Substation. Land use to the east of the site is dominated by recreational uses associated with Prince Alfred Park. A mix of commercial and residential land uses are located along the eastern side of Chalmers Street. Land to the west of the site is used for railway uses associated with Central Station.

#### **Visual landscape**

The proposal site is located on the eastern edge of the Central Station railway precinct, with the visual landscape to the west of the site dominated by railway infrastructure. The Prince Alfred Sidings Precinct (and the rail corridor) is partially located within a cutting and views of the site are partially screened to the east. Vegetation also lines the western edge of Prince Alfred Park. As a result, views to the site from nearby receptors are minimal. Any views available from the east to the site are currently dominated by railway infrastructure. Various heritage items and elements of the Central Station site/group (refer to section 7.1.2) also contribute to the visual landscape of the proposal site.

#### **Socio-economic environment**

The community in the study area consists of predominately public transport users, users of Prince Alfred Park and rail workers. The community also includes residents and workers within the residential and commercial buildings in the surrounding areas.

### 7.7.2 Impact assessment

#### **Construction**

##### ***Land use***

During construction the proposal is not expected to result in any impacts on other uses located within the Prince Alfred Sidings Precinct as access to these uses would be maintained via a new access road to be positioned through the existing open storage area located adjacent to the proposal site. The loss of this storage area is not considered significant as alternate areas are available within the precinct.

The operation of the existing Prince Alfred Substation would not be impacted upon during construction. Any works which potentially impact on the operation of the substation would be undertaken during rail closedown periods when power on the network is switched off and therefore the substation is not required.

##### ***Amenity impacts***

The proposal has the potential to result in some indirect impacts on the amenity of the surrounding community and/or users of adjoining areas during construction. This could include those properties located in close proximity to the proposal site. These potential impacts include

noise, traffic and access, air quality, and visual impacts, and are assessed in sections 7.3, 7.5, 7.6 and below respectively.

### **Visual impacts**

During construction, the positioning of the work site and the site compound/s would result in some short term impacts on the visual amenity for properties located in close proximity to the site.

Overall, the potential visual impacts of construction activities are considered to be minimal as the works would be temporary and short term. Potential impacts would be managed by the implementation of measures provided in section 7.7.3.

There is potential for night works to be required. During night works, the erection of lighting would be required to ensure a safe working environment. The potential impacts of night works would be minimal, as the works are located within a cutting (i.e. below the surrounding land) and are screened by vegetation and therefore the likelihood of light spill to sensitive properties to the east is minimal.

### **Operation**

The operation of the proposed substation would not result in any impacts on land use, as it would involve use of existing rail land for rail purposes.

The existing Prince Alfred Substation would no longer be used for rail purposes, however its future use is yet to be confirmed.

Potential visual impacts relate to the presence of the new substation structure in the landscape. An indicative description of the potential appearance of the proposal is provided in section 5.1. The new substation would be consistent with the existing visual environment, which is dominated by rail infrastructure and other multi-storey buildings. The new substation building façade has been designed to be sympathetic with the neighbouring heritage listed buildings meaning visual impacts would be reduced. Appendix B includes drawings which show the scale of the proposal in relation to the surrounding buildings.

The proposed substation has been designed to integrate all relevant considerations, including urban design and visual considerations. Further design phases would continue to consider the visual impacts.

The Statement of Heritage Impact considered the potential for impacts to views of heritage items and elements in the vicinity of the proposal site (refer section 7.1.1 and Appendix C). No significant impacts were identified.

#### **7.7.3 Mitigation measures**

### **Construction**

The following mitigation measures would be implemented to minimise impacts during construction:

- Material would be attached to the site fencing to minimise views of the worksite.
- The worksite would be left in a tidy manner at the end of each work day.
- Directional lighting would be mounted to avoid light spill into adjoining residential buildings during any night works, in particular during the rail shutdown periods.

### **Operation**

The following mitigation measures would be implemented to minimise impacts during operation:

- The detailed design of the proposal would take into account relevant urban design and visual considerations.

## 7.8 Electromagnetic energy

An electromagnetic energy report for the proposal was undertaken by EMC Services Pty Ltd in December 2013. The results of this assessment are summarised below. The full assessment report is provided in Appendix F.

### 7.8.1 Impact assessment

Electromagnetic energy is invisible and found everywhere electricity is present. An electric field is a region where electric charges experience an invisible force. The strength of this force is related to the voltage, or the pressure which forces electricity along wires. Electric fields are strongest close to their source, and their strength diminishes rapidly as we move away from the source.

A magnetic field is a region where magnetic materials experience an invisible force produced by the flow of electricity, commonly known as current. Unlike electric fields, magnetic fields are only present when electric current is flowing.

The strength of a magnetic field depends on the size of the current (measured in amps), and decreases rapidly once we move away from the source. While electric fields are blocked by many common materials, this is not the case with magnetic fields.

There are two components to an electromagnetic field, the electric field strength which is very weak at the proposed voltage (1,500 V) and the magnetic field strength which decreases in an inverse square relationship close to the source and at a higher rate approximating an inverse cubic relationship at further distances.

In recent years there has been an increase in community concerns over the long term health effects on people living and working near power lines and facilities, particularly high voltage power lines. The Australian Radiation and Nuclear Protection Safety Agency (ARPANSA) has published on its website a Draft Standard for exposure to magnetic fields which advocates a full-time exposure limit of 100 microtesla (a microtesla is a unit of measurement for magnetic strength), and a higher value for occupational exposure.

An assessment of the potential electromagnetic fields for the proposal has been undertaken by EMC Services. This assessment found that the strongest magnetic field outside the substation building is predicted to occur along the eastern side of the building. The strengths of the electromagnetic fields in this location (eight microtesla at the boundary of the substation) are predicted to be below the permissible exposure limit of 100 microtesla for exposure to the public. The levels within the substation are also below the acceptable limits, however these areas would only be accessed by appropriately qualified persons.

Without accounting for shielding within the substation, when the substation is operating at full capacity, the electric fields within 41 m of the substation would not exceed the applicable limit for urban broadcast reception of 0.316 mV/m applicable from 0.15 MHz to 1.7 MHz. Within 41 m of the substation, radio receptions would be impacted, especially for AM reception and high frequency bands, though the latter would generally be less of a concern, as is typically used by amateur radio operators. These levels would be reduced somewhat once shielding from the substation is factored in. The proposal is not expected to result in any interference to FM radio or television signals as the increase in EME would not significantly add to the existing ambient environment.

## 7.8.2 Mitigation measures

The following mitigation measures would be implemented during operation to manage electromagnetic energy:

- During commissioning of the substation, monitoring would be undertaken to determine the electromagnetic energy levels within and outside the substation. Should exceedances of the criteria be found, methods to reduce these exceedances would be implemented.
- In the event exclusion zones around equipment cannot be provided, magnetic shielding would be considered.

## 7.9 Aboriginal heritage

### 7.9.1 Existing environment

A search of the Aboriginal Heritage Information Management System was undertaken on 23 July 2015 for Lot 118 DP1078271. This search identified that there are no known Aboriginal heritage items located within this lot.

### 7.9.2 Impact assessment

As the study area has been substantially modified by development of the rail network and surrounding development, and subject to previous ground disturbance, the risk of encountering any unknown Aboriginal heritage items is considered to be extremely low.

### 7.9.3 Mitigation measures

The following mitigation measure would be implemented to minimise impacts during construction:

- Should Aboriginal heritage items be uncovered all work in the vicinity will cease and the Project Manager and Transport for NSW staff will be notified immediately. OEH will be notified in accordance with the *National Parks and Wildlife Act 1979*. The local Aboriginal Land Council will be notified and an assessment by an archaeologist will be arranged to determine the significance of the objects and any other requirements before work resumes.

## 7.10 Waste

### 7.10.1 Waste generation

#### **Construction**

Waste generated during construction would mainly be surplus building materials, such as concrete, brick, and cladding, and spoil. General waste, such as surplus pipe and cabling associated with connecting the site to services would also be produced. Careful planning of construction activities would ensure that the volume of surplus materials is minimised. The small scale of this building means that a small volume of waste in comparison to other larger infrastructure construction projects is likely to be generated as a result of surplus materials.

The fit out stage is also likely to generate small volumes of waste associated with off cuts from communications and electrical cables.

All wastes would be collected and stored on-site prior to disposal in accordance with *Waste Classification Guidelines* (EPA, 2014). Where possible, this material would be reused or recycled in preference to disposal.



The conversion of Prince Alfred Substation would involve removal of redundant equipment, which would be reused (where practicable), recycled or disposed of at an appropriately licenced facility.

### Operation

The only waste generated during operation would be that related to periodic maintenance activities. This would include materials such as electrical wiring that would be disposed of in accordance with Sydney Trains' existing procedures and the *Waste Classification Guidelines* (EPA, 2014).

#### 7.10.2 Mitigation measures

### Construction

The following mitigation measures would be implemented during construction:

- Wastes generated by the proposal would be managed in accordance with the *Waste Classification Guidelines* (EPA, 2014) and in accordance with the waste minimisation hierarchy as follows:
  - avoidance, where possible
  - treated, as required and reused on-site
  - recycled, either within the process or off-site
  - where other alternatives are not possible, wastes would be disposed of at appropriately licensed waste management facilities.

### Operation

No mitigation measures are required.

## 7.11 Cumulative impacts

### 7.11.1 Existing or potential projects

A number of projects are being undertaken in the vicinity of the proposal site by Transport for NSW and Sydney Trains, including the Sydney to Burwood Compressor Houses Project.

The Sydney Light Rail Project is also being undertaken in the study area to the north of Central Station. This project includes the construction of a light rail stop in the vicinity of the Chalmers Street entrance to Central Station.

The Lee Street Substation would also be constructed at a similar time as the proposal.

### 7.11.2 Impact assessment

A number of large scale developments are currently underway or would potentially occur during the construction phase of the proposal. Compared to these projects, this proposal is considered to be relatively small in scale, and therefore would not contribute significantly to any cumulative impacts. As potential impacts associated with the proposal would be short term and impacts would be localised, the potential for significant cumulative impacts is considered to be minimal. Potential impacts would relate mainly to the impacts of construction traffic on the surrounding road network, these impacts would be minimised through consultation with the contractors with the Sydney Light Rail Project to ensure there are no conflicts and that access to the proposal site is always available.

It is unlikely that construction of the Lee Street and Chalmers Street substations at the same time would result in any cumulative impacts as they are located on opposite sides of the Sydney Yards.

It is not considered that operation of the two substations (at Lee and Chalmers Streets) would result in any significant cumulative EME impacts, as neither substation would not result in any impacts individually, and the distance between the two substations would minimise the likelihood of any cumulative EME impacts.

Impacts on heritage as a result of other projects within the Central Station site/group has also been considered. As the proposal would result in minimal impacts, it would not considerably contribute to any cumulative impacts to the heritage value of the Central Station site/group.

### 7.11.3 Mitigation measures

#### **Construction**

The following mitigation measures would be implemented to minimise impacts during construction:

- Transport for NSW and/or the construction contractor would consult with the proponents of any major developments in the vicinity of the proposal site to address any potential cumulative impacts.

#### **Operation**

No mitigation measures are required.

## 8. Environmental management and mitigation

*This section provides an outline of the environmental management requirements for the proposal, and a consolidated list of mitigation measures that form the environmental management framework.*

### 8.1 Environmental management plans

#### 8.1.1 Construction

Transport for NSW's ISO 14001 accredited environmental management system (EMS) would be used to manage the proposal. The management system would provide the framework for implementing the environmental management measures documented in this REF, and any conditions of other approvals, licences or permits.

A construction environmental management plan (CEMP) would be prepared for the proposal. The CEMP would provide a centralised mechanism through which all potential environmental impacts would be managed. The CEMP would document mechanisms for achieving compliance with the commitments made in this REF, the conditions of approval and other relevant statutory approvals (such as approvals under the Heritage Act). The plan would address (at a minimum) the following elements:

- traffic and transport management
- heritage management
- noise and vibration management
- water and soil management
- air quality management
- waste management
- community and stakeholder communication.

The plan would be prepared by the contractor/s for the proposal and would be reviewed and endorsed by Transport for NSW prior to the commencement of construction. Implementation and compliance with the CEMP would be monitored by Transport for NSW for the duration of construction. One of the minimum requirements in terms of the tender for the contractor/s is that they have an environmental management plan capable of meeting the requirements of ISO 14001.

#### 8.1.2 Operation

For the operational phase, environmental issues and impacts would be managed under Sydney Trains existing operational EMS and through the mitigation measures in section 8.2. The proposed substation would operate in accordance with Sydney Trains existing EPL (EPL No. 12208).

### 8.2 Summary of mitigation measures

The REF has identified a range of environmental impacts with the potential to occur as a result of the proposal. Table 8.1 provides a summary of the measures proposed to mitigate and manage the potential impacts of the proposal.

The measures listed in Table 8.1 may be revised in response to submissions raised during public display of the REF. Transport for NSW would consider the final environmental management commitments when making a determination on the proposal. Following determination, the finalised mitigation measures would guide subsequent phases of the proposal. Any contractor/s selected to undertake work would be required to undertake all works in accordance with these measures, the conditions of approval and any other relevant statutory approvals.

Environmental management measures to be implemented during the proposal are listed in Table 8.1. These measures have been consolidated from those included in section 7 of the REF.

**Table 8.1 Mitigation measures**

Issue	Mitigation measures
<b>Non-Aboriginal</b>	<ul style="list-style-type: none"> <li>• Prepare a dilapidation survey of the area proposed for the temporary construction compound and the Prince Alfred Substation and other heritage listed buildings located in the vicinity of the proposal before and after the works. Any damage would be repaired at the conclusion of the works.</li> <li>• Prepare a photographic archival recording of areas of the Prince Alfred Substation that would be impacted prior to construction. This includes the electrical switches on the north east wall which are proposed to be removed, pump well doors, ground floor windows, north east and western corners of the building and either end of the basement cable tunnel.</li> <li>• Salvage and store the ground floor windows proposed to be removed for possible future reinstatement.</li> <li>• All heritage items in the immediate vicinity of the site would be identified on site plans, fenced off where appropriate, and protected during construction.</li> <li>• Manage archaeology in accordance with <i>Unexpected Heritage Finds Guideline</i> contained in Transport for NSW Quality Management System. If any unanticipated archaeological deposits are identified during construction, work likely to impact on the deposit would cease immediately and the NSW Heritage Council and an archaeologist would be contacted. Where required, further archaeological work and/or consents would be obtained prior to works recommencing at the location.</li> <li>• Allow for the monitoring and repair of any damage of significant items as a result of construction of the substation, such as the corners of the Prince Alfred Substation where underpinning is proposed. This would include an allowance for a nominated Heritage Architect to inspect and report before, during and after completion of the works.</li> <li>• Develop a Heritage Interpretation Strategy for the Prince Alfred Sidings precinct.</li> </ul>
<b>Soils and water quality</b>	<p><b>Construction</b></p> <p>The measures provided below would be implemented during construction:</p> <p><i>Soil disturbance</i></p> <p>A soils and water quality sub-plan would be prepared as part of the CEMP. It would include the following measures:</p> <ul style="list-style-type: none"> <li>• Sediment and erosion control devices would be installed to minimise transport of sediment in accordance with <i>Managing Urban Stormwater, Soils &amp; Construction, Volume 1 (Landcom, 2004)</i>. These devices would be inspected regularly and immediately after rainfall to ensure effectiveness over the duration of works. Any damage to erosion and sediment controls would be rectified immediately.</li> <li>• Temporary stormwater control devices or erosion and sedimentation controls would be implemented at stormwater drains to prevent sediment-laden runoff entering the local stormwater system.</li> </ul>

Issue	Mitigation measures
	<ul style="list-style-type: none"> <li>• Maintenance and checking of the erosion and sedimentation controls would be undertaken on a regular basis and records kept. Sediment would be cleared from behind barriers/sand bags on a regular basis and all controls would be managed to ensure they work effectively at all times.</li> <li>• Any material transported onto pavement surfaces would be swept and removed at the end of each working day when it is safe to do so.</li> <li>• Any soils excavated that are to be used as backfill would be appropriately stored until required.</li> <li>• Disturbed areas would be restored at the completion of works.</li> <li>• Spill kits would be maintained on site at all times.</li> <li>• Machinery would be checked daily to ensure that no oil, fuel or other liquids are leaking.</li> <li>• Refuelling of plant and equipment would not be undertaken within the proposal site.</li> <li>• All water discharges would be undertaken in accordance with Transport for NSW's <i>Water Discharge and Re-use Guideline (2012)</i>.</li> <li>• The existing drainage systems would remain operational during construction.</li> <li>• Clean water would be diverted around the worksite in accordance with <i>Managing Urban Stormwater: Soils and Construction</i>.</li> </ul>
	<p><i>Contamination</i></p> <ul style="list-style-type: none"> <li>• An unexpected findings protocol would be prepared and included in the CEMP to assist with the identification, assessment, management, health and safety implications, remediation and/or disposal (at an appropriately licenced facility) of any potentially contaminated soil and/or water.</li> <li>• In the event that indicators of contamination are encountered during construction (such as odours or visually contaminated materials), work in the area would cease until an environmental consultant can advise on the need for remediation or other action.</li> </ul>
	<p><i>Groundwater</i></p> <ul style="list-style-type: none"> <li>• Should groundwater be encountered during construction activities, appropriate management measures such as water testing, dewatering, temporary water storage and treatment would be implemented to manage any groundwater that seeps into excavations.</li> <li>• Surface water diversions to be put in place to ensure that water does not enter any pile or excavations.</li> </ul>
	<p><i>Hazardous materials</i></p> <ul style="list-style-type: none"> <li>• A hazardous materials management plan would be prepared as part of the CEMP. It would include the following measures.</li> <li>• The removal, handling and disposal of any asbestos waste would be undertaken by an appropriately licensed contractor (an occupational hygienist who is also a licensed asbestos assessor), and in accordance with: <ul style="list-style-type: none"> <li>→ <i>Code of Practice for the Safe Removal of Asbestos 2005</i></li> <li>→ <i>Code of Practice for the Management and Control of Asbestos in Workplaces 2005</i>.</li> </ul> </li> <li>• The occupational hygienist would be responsible for conducting asbestos fibre air monitoring, visual clearance inspections and issuing clearance certificates after the completion of any removal works.</li> <li>• Work would cease in the vicinity of any potential asbestos materials which have not been previously identified. The material would be analysed for the presence of asbestos. In the event the material is disturbed prior to work ceasing, the provisions of an Asbestos Removal Control Plan or similar would be followed, including seeking advice from a suitably qualified and experienced professional.</li> <li>• Lead dust would be removed from the substation building by a qualified</li> </ul>

Issue	Mitigation measures
	<p>hazardous material removal contractor and should be subject to ongoing monitoring and inspections by an Occupational Hygienist to ensure compliance with the relevant legislation and Australian Standards.</p> <ul style="list-style-type: none"> <li>• All known and presumed occurrences of polychlorinated biphenyl's would be handled and disposed of in accordance with the procedure documented within <i>ANZECC Identification of PCB-containing Capacitors – An information booklet for electricians and electrical contractors 1997</i>. Removal would be undertaken by a suitable licenced hazardous material removal contractor and would be disposed of a suitably licence facility.</li> <li>• In the event synthetic material fibres are found on site, they would be handled and disposed of in accordance with the <i>National Code of Practice for the Safe Use of Synthetic Mineral Fibres</i>.</li> </ul> <p><b>Operation</b></p> <p>No mitigation measures are required.</p>
Noise and vibration	<p><b>Construction</b></p> <ul style="list-style-type: none"> <li>• A noise and vibration management plan would be prepared as part of the CEMP in accordance with the <i>Construction Noise Strategy</i> (Transport for NSW, 2012) and the EPAs <i>Interim Construction Noise Guidelines</i> (DECC, 2009). It would include the following measures.</li> <li>• Mitigation measures documented in <i>Construction Noise Strategy</i> (Transport for NSW, 2012) would be adopted where feasible and reasonable, as specified in Table 6-1 and 6-2 of Appendix D.</li> <li>• Sensitive receivers would be identified and marked on plans.</li> <li>• Works would be scheduled during recommended standard hours where practicable.</li> <li>• All equipment and construction methodologies would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.</li> <li>• All site workers would be educated as to the potential for noise impacts of sensitive receivers and land uses and encouraged to take practical and reasonable measures to minimise impact during the course of their activities. This would include toolbox talks covering: <ul style="list-style-type: none"> <li>→ avoid the use of outdoor radios during the night period</li> <li>→ avoid shouting and slamming doors</li> <li>→ where practicable, machines would be operated at low speed or power and switched off when not being used, rather than left idling for prolonged periods</li> <li>→ avoiding dropping materials from height and metal to metal contact where practicable.</li> </ul> </li> <li>• Truck drivers would be informed of designated vehicle routes, parking locations and the requirement to minimise engine idling.</li> <li>• Non-tonal reversing beepers (or an equivalent mechanism) would be used by construction vehicles and plant.</li> <li>• Where noise and vibration levels during the works are predicted to exceed acceptable levels after implementation of general work practices, the additional mitigation measures included in Table 6-1 and 6-2 of Appendix D would be implemented where reasonable and feasible.</li> <li>• If out of hours works are required, the contractor would prepare and submit a Transport for NSW Out of Hours Work Assessment (3TP-PR-065) and Application Form (9TP-FT-079) for approval prior to the works being undertaken. All out of hours works to be undertaken in accordance with</li> </ul>

Issue	Mitigation measures
	<p>Transport for NSWs <i>Construction Noise Strategy</i> (Transport for NSW, 2012).</p> <ul style="list-style-type: none"> <li>• For activities outside the recommended standard hours, noise monitoring and letter box drops would be undertaken at residences and other non-residential receivers where noise levels are clearly audible.</li> <li>• Nearby receivers would be notified of the works prior to commencement. The notification would include expected noise levels, duration of the works and a method of contact.</li> </ul> <p><b>Construction vibration</b></p> <ul style="list-style-type: none"> <li>• Sensitive receivers within the safe working distance buffers would be informed of the nature of the works, duration and provided with contact details.</li> <li>• A dilapidation survey would be prepared for all heritage buildings and structures located within 13 m of construction involving vibration intensive compaction equipment.</li> <li>• Compliance vibration monitoring would be undertaken during operation of any vibration intensive construction equipment to ensure compliance with the building damage criteria for heritage buildings or structures.</li> <li>• A trigger alarm system would be implemented to notify site personnel in the event that vibration limits are close to being exceeded.</li> <li>• Provide alternative equipment or construction methodologies where feasible and reasonable.</li> </ul> <p><b>Operation</b></p> <ul style="list-style-type: none"> <li>• Any noise complaints would be investigated in accordance with Sydney Trains' standard operational procedures.</li> <li>• Scheduling maintenance operations during the day time period to minimise potential for adverse impacts at sensitive receivers.</li> <li>• Investigating and addressing noise complaints.</li> <li>• Conducting post construction operational noise monitoring to assess compliance against operational noise criteria and undertake remedial measures to achieve compliance if required.</li> </ul>
Flora and fauna	<ul style="list-style-type: none"> <li>• Weeds would be managed and disposed of in accordance with the requirements of <i>the Noxious Weeds Act 1993</i> and/or the <i>Weeds of National Significance Weed Management Guide</i>.</li> </ul>
Traffic and transport	<p><b>Construction</b></p> <ul style="list-style-type: none"> <li>• A traffic management sub-plan would be prepared as part of the CEMP.</li> <li>• Traffic and access would be managed in accordance with <i>Traffic Control at Work Sites</i> (RTA, 2010) and in consultation with Roads and Maritime Services and City of Sydney Council.</li> <li>• Residents, property owners and operators would be notified of any access restrictions in advance of work commencing. Site access and work scheduling arrangements would be finalised in consultation with the owners and operators of adjoining sites, to minimise the potential impacts on the operation of, and access to, these sites.</li> <li>• Appropriate traffic management would be implemented, including precautionary signs, illuminated warning devices, manual and/or electronic traffic control, and the provision of temporary barriers and markers, to control pedestrians and traffic access to and around the proposal site.</li> <li>• Safe access points to work areas from the adjacent road network would be established, including safety measures such as security fencing and/or barriers, maintaining sight distance requirements, signage and the provision of traffic management measures.</li> <li>• The requirements of the <i>Roads Act 1993</i> would be followed at all times prior to and during all work (including notice requirements, consultation and consent/concurrence requirements for work within public and classified roads).</li> </ul>

Issue	Mitigation measures
	<ul style="list-style-type: none"> <li>• Heavy vehicles would be restricted to specified routes.</li> <li>• Oversized deliveries would be undertaken in accordance with the requirements of City of Sydney Council, Roads and Maritime Services and NSW Police.</li> <li>• Workers would be encouraged to access the proposal site via public transport.</li> <li>• Access to the proposal site via the existing entrance would be avoided where possible during peak periods when pedestrian and cyclist traffic is high.</li> <li>• Access to facilities within the Prince Alfred Precinct to be maintained at all times, unless consultation with the potentially affected stakeholders has occurred.</li> <li>• Parking is to be provided on site (in designated areas), with vehicles not to be parked on surrounding streets.</li> </ul> <p><b>Operation</b></p> <p>No mitigation measures are required.</p>
<b>Air quality</b>	<p><b>Construction</b></p> <ul style="list-style-type: none"> <li>• An air quality management sub-plan would be prepared as part of the CEMP. It would include the following measures. <ul style="list-style-type: none"> <li>→ All plant and machinery would be fitted with emission control devices complying with the Australian Design Standards.</li> <li>→ Machinery would be turned off when not in use and not left to idle for prolonged periods.</li> <li>→ Vehicle movements would be limited to designated entries and exits, haulage routes (to be determined during the preparation of the traffic management plan in consultation with RMS and Council) and parking areas.</li> <li>→ Dust generation would be monitored visually, and where required, dust control measures such as water spraying would be implemented to control the generation of dust.</li> <li>→ Any waste produced on site would be stored and stockpiled for removal off site daily, to reduce the production of dust.</li> <li>→ Materials transported to and from the site would be covered to reduce dust generation in transit.</li> <li>→ Access points would be inspected to determine whether sediment is being transferred to the surrounding road network. If required, sediment would be promptly removed from roads to minimise dust generation.</li> <li>→ Stabilisation of any excavated areas as soon as practicable.</li> <li>→ Fixed hoses would be used to dampen exposed surfaces to minimise dust generation, where required.</li> <li>→ Shade cloth would be fastened to the perimeter fence on the construction compound to minimise dust transported from the site during construction.</li> </ul> </li> </ul> <p><b>Operation</b></p> <ul style="list-style-type: none"> <li>• Maintenance of switchgear and management of SF6 would be undertaken in accordance with Sydney Trains existing management procedures.</li> </ul>



Issue	Mitigation measures
<b>Land use, social and visual environment</b>	<p><b>Construction</b></p> <ul style="list-style-type: none"> <li>• Material would be attached to the site fencing to minimise views of the worksite.</li> <li>• The worksite would be left in a tidy manner at the end of each work day.</li> <li>• Directional lighting would be mounted to avoid light spill into adjoining residential buildings during any night works, in particular during the rail shutdown periods.</li> </ul> <p><b>Operation</b></p> <p>The following mitigation measures would be implemented to minimise impacts during operation:</p> <ul style="list-style-type: none"> <li>• The detailed design of the proposal would take into account relevant urban design and visual considerations.</li> </ul>
<b>Electromagnetic energy</b>	<ul style="list-style-type: none"> <li>• During commissioning of the substation, monitoring would be undertaken to determine the electromagnetic energy levels within and outside the substation. Should exceedances of the criteria be found, methods to reduce these exceedances would be implemented.</li> <li>• In the event exclusion zones around equipment cannot be provided, magnetic shielding would be considered.</li> </ul>
<b>Aboriginal heritage</b>	<ul style="list-style-type: none"> <li>• Should Aboriginal heritage items be uncovered all work in the vicinity will cease and the Project Manager and Transport for NSW staff will be notified immediately. OEH will be notified in accordance with the <i>National Parks and Wildlife Act 1979</i>. The local Aboriginal Land Council will be notified and an assessment by an archaeologist will be arranged to determine the significance of the objects and any other requirements before work resumes.</li> </ul>
<b>Waste</b>	<p><b>Construction</b></p> <ul style="list-style-type: none"> <li>• Wastes generated by the proposal would be managed in accordance with the Waste Classification Guidelines (EPA, 2014) and in accordance with the waste minimisation hierarchy as follows: <ul style="list-style-type: none"> <li>→ avoidance, where possible</li> <li>→ treated, as required and reused on-site</li> <li>→ recycled, either within the process or off-site</li> <li>→ where other alternatives are not possible, wastes would be disposed of at appropriately licensed waste management facilities.</li> </ul> </li> </ul> <p><b>Operation</b></p> <p>No mitigation measures are required.</p>
<b>Cumulative impacts</b>	<ul style="list-style-type: none"> <li>• Transport for NSW and/or the construction contractor would consult with the proponents of any major developments in the vicinity of the proposal site to address any potential cumulative impacts.</li> </ul>

## 9. Conclusion

*This section provides a conclusion to the REF, including a summary of the proposal justification and the findings of the REF.*

This REF considers the potential impacts of the proposal to construct a new substation at Chalmers Street, Chippendale, and associated works to the existing Prince Alfred Substation. It has been prepared by GHD on behalf of Transport for NSW to assist with determination of the proposal under Part 5 of the EP&A Act.

### 9.1 Justification of the proposal

The proposal forms part of Transport for NSW's Power Supply Upgrade Program, which is being undertaken to meet the actual and projected increase in power demands on the Sydney Trains electrical network. The power supply study undertaken for the network identified that the existing power supply in the vicinity of Central Station would reach capacity with the introduction of new timetables, and that the existing Prince Alfred Substation could not be easily upgraded to meet these requirements.

The construction of the Chalmers Street Substation (together with the Lee Street Substation) would increase the capacity of the power supply network in the vicinity of Central Station.

Without this increase in power supply, the rail network would not have sufficient capacity to meet the power supply needs of the increase in the number of trains, and the increase in the number of air-conditioned trains.

### 9.2 Summary of REF findings

The REF has considered the potential impacts of the proposal. It has been prepared in accordance with Part 5 of the EP&A Act, and in particular, the requirements of section 111 of the Act, and clause 228 of the Regulation. The REF has documented the potential environmental impacts of the proposal, considering both potential positive and negative impacts, and recommending management and mitigation measures to protect the environment where required.

#### 9.2.1 Clause 228 considerations

Clause 228 of the Regulation specifies the matters that must be taken into account, for the purposes of Part 5 of the Act, when consideration is being given to the likely impact of an activity on the environment. The potential impacts of the proposal have been considered in sections 7 to 13 of the REF. The clause 228 matters and how they relate to the proposal are considered in Appendix A.

#### 9.2.2 Ecologically sustainable development

Transport for NSW is committed to ensuring that its projects are implemented in a manner that is consistent with the principles of sustainable development. These principles would be incorporated into the management systems for the proposal.

Appendix A summarises how the principles of ecologically sustainable development adopted by the EP&A Act have been addressed by the REF process.

### 9.2.3 Significance of impacts

Whilst some potentially negative impacts may result from the proposal, these impacts would be short term and localised and are not considered to be significant. Section 8.2 of the REF provides the mitigation measures that would be implemented to reduce the potential for impacts and manage the environmental performance of the proposal.

## 9.3 Conclusion

The REF identifies that the proposal would have the potential for both positive and negative impacts, and it identifies mitigation measures to reduce or manage the negative impacts.

Environmental investigations were undertaken during preparation of the REF to assess the potential environmental impacts. These included specialist assessments of heritage, noise and vibration and electromagnetic energy.

There are considered to be no significant environmental issues associated with the proposal. The main potential impacts that would require management are:

- construction traffic and associated impacts on pedestrians, cyclists and buses accessing Central Station, in particular oversized vehicles for equipment delivery
- construction noise and vibration impacts to nearby sensitive receivers
- heritage impacts as a result of the proposal being located within the Central Station site/group heritage precinct.

Any potential adverse impacts resulting from the proposal are considered to be manageable through the implementation of mitigation measures in section 8.2.

In conclusion, the proposal is needed to ensure that the power supply for the rail network has sufficient capacity for future increases in the number of services and also the type of rolling stock. It is considered that the adverse environmental impacts would be generally short term and localised in nature. With the adoption and implementation of the proposed mitigation and management measures listed in section 8.2, the potential environmental impacts of the proposal would be adequately mitigated and managed, and are not considered to be significant.

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# Appendices

# Appendix A – Clause 228 factors and ecologically sustainable development considerations under the EP&A Act

**Table A.1 Clause 228 considerations**

Clause 228 factor	Summary of results	Potential impact
(a) Any environmental impact on a community	The proposal has the potential to result in amenity related impacts in the vicinity of the works. These impacts would be managed through the implementation of the proposal environmental management plan. No long term environmental impacts are predicted.	Short term – negative Long term – none
(b) Any transformation of a locality	The proposal would be positioned on Sydney Trains owned land and would be located in an area which is dominated by railway infrastructure. The proposal would result in the introduction of a new building, however its design minimises the impact on the locality. This includes minimising impacts on the heritage precinct in which the proposal is located.	Short term – negative Long term – none
(c) Any environmental impact on the ecosystems of the locality	No ecosystem impacts were identified.	None
(d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality	The proposal had the potential to impact on amenity in the short term as a result of the construction activities. The limited nature of the proposed surface works would limit the potential significance of these impacts. In the long term, no negative impacts on the aesthetic, recreational, scientific or other environmental qualities of the study area were predicted.	Short term – minor negative Long term – none
(e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations	The proposal is located within the curtilage of the Central Station site/group which is listed under a number of heritage lists. The proposal is also located in close proximity to a number of items which are considered to have some significance as part of the wider precinct. The proposal is not considered to result in any significant impacts to the wider Central Station precincts heritage significance, while impacts to the individual items in close proximity to the proposal would also be minimal. The proposal includes the development of the design to include some brickwork so as to ensure that it is consistent with other heritage items in the vicinity of the proposal.	Short term – minor negative  Long term – none
f) Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)	No impacts on protected fauna within the meaning of the <i>National Parks and Wildlife Act 1974</i> were predicted.	None
(g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air	The proposal would not endanger any species of plant, animal or other form of life.	None
(h) Any long-term effects on the environment	The proposal is not considered to have any long term impacts on the environment.	None
(i) Any degradation of the quality of the environment	The proposal had the potential to result in impacts to environmental quality (mainly amenity) during the construction period. These impacts would be managed through the implementation of mitigation measures. No long term impacts to the quality of the environment are predicted.	Short term - minor negative Long term - none
(j) Any risk to the safety of the environment	The construction of the proposal is not considered to result in any risk to the safety of the environment. Safety in the vicinity of the proposal would be managed by the contractor/s.	Short term – minor negative Long term - none

Clause 228 factor	Summary of results	Potential impact
(k) Any reduction in the range of beneficial uses of the environment	The proposal would be positioned on land which is currently owned by Sydney Trains and is used for railway purposes. The proposal would not result in any other impacts on land use.	None
(l) Any pollution of the environment	The proposal had the potential to result in minor short term impacts. These impacts would be managed through the implementation of the proposal environmental management plan. The proposal would not produce any emissions and no long term pollution impacts are predicted.	Short term - minor negative Long term – none
(m) Any environmental problems associated with the disposal of waste	Waste created during the works period would be removed from site and recycled where possible.	None
(n) Any increased demands on resources (natural or otherwise) that are, or are likely to become in short supply	The proposal would not increase the demand on any resources that are or are likely to become in short supply.	None
(o) Any cumulative environmental effect with other existing or likely future activities	No significant cumulative impacts were identified as a result of the interaction of the proposal with other projects.	None
(p) any impact on coastal processes and coastal hazards, including those under projected climate change conditions	The proposal would not impact on coastal processes and coastal hazards.	None

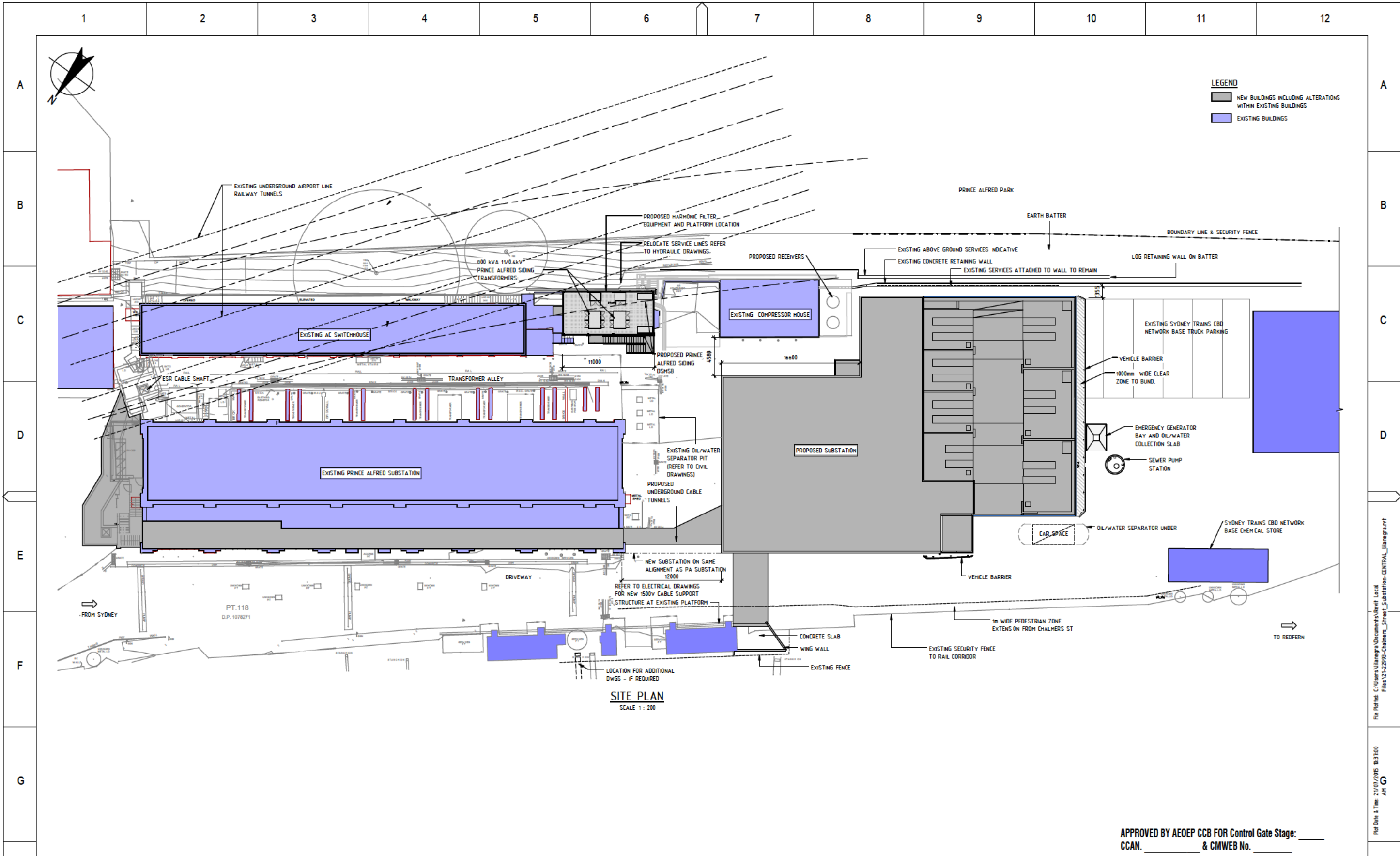
**Table A.2 ESD considerations under the EP&A Act**

Principle	Definition	Comment
Precautionary principle	This principle states that 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'.	A range of environmental assessments have been undertaken during the preparation of this REF to ensure that the potential environmental impacts can be understood with a high degree of certainty. There are not considered to be any threats of serious or irreversible environmental damage.  The proposal has evolved to avoid environmental impact where possible and mitigation measures would be implemented to minimise impacts. No mitigation measures have been deferred due to a lack of scientific certainty. The proposal is therefore considered to be consistent with the precautionary principle.
Intergenerational equity	The principle states, 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations'. In other words, we should ensure that future generations do not inherit a degraded environment.	The majority of the proposal site has been previously disturbed during development of the Sydney Trains Depot and the Prince Alfred Substation. The proposal would not result in any impacts that are likely to impact on the health, diversity or productivity of the environment for future generations. The proposal would benefit future generations as the increase in power supply would allow more trains services to be introduced on to the network which would improve public transport.

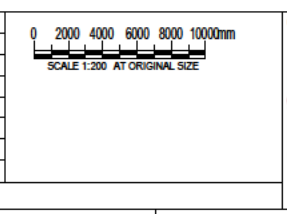


Principle	Definition	Comment
Conservation of biological diversity and ecological integrity	This principle states that the 'diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival'.	The study area is a highly modified built urban environment. No potential impacts to biological diversity and ecological integrity were identified.
Improved valuation, pricing and incentive mechanisms	This principle requires that 'costs to the environment should be factored into the economic costs of a project'.	<p>The cost of environmental resources includes the costs incurred to protect the environment. The mitigation measures imposed to minimise the adverse impacts of this proposal would result in economic costs to the construction and operation of the proposal. This indicates the valuation of environmental resources has been assigned.</p> <p>The proposal has been designed to minimise adverse impacts on the environment by confining work to a defined area and implementing appropriate mitigation measures when impacts are expected.</p>

# Appendix B – Concept design plans



No.	BY	DATE	DESCRIPTION	APPRO.
D	LL	21.07.2015	(CONCEPT ISSUE SOH)	FP
C	HP	01.04.15	CONCEPT ISSUE	MN
B	HP	19.02.15	CONCEPT ISSUE	MN
A	LS	20.12.13	CONCEPT ISSUE	MN
AT Original				



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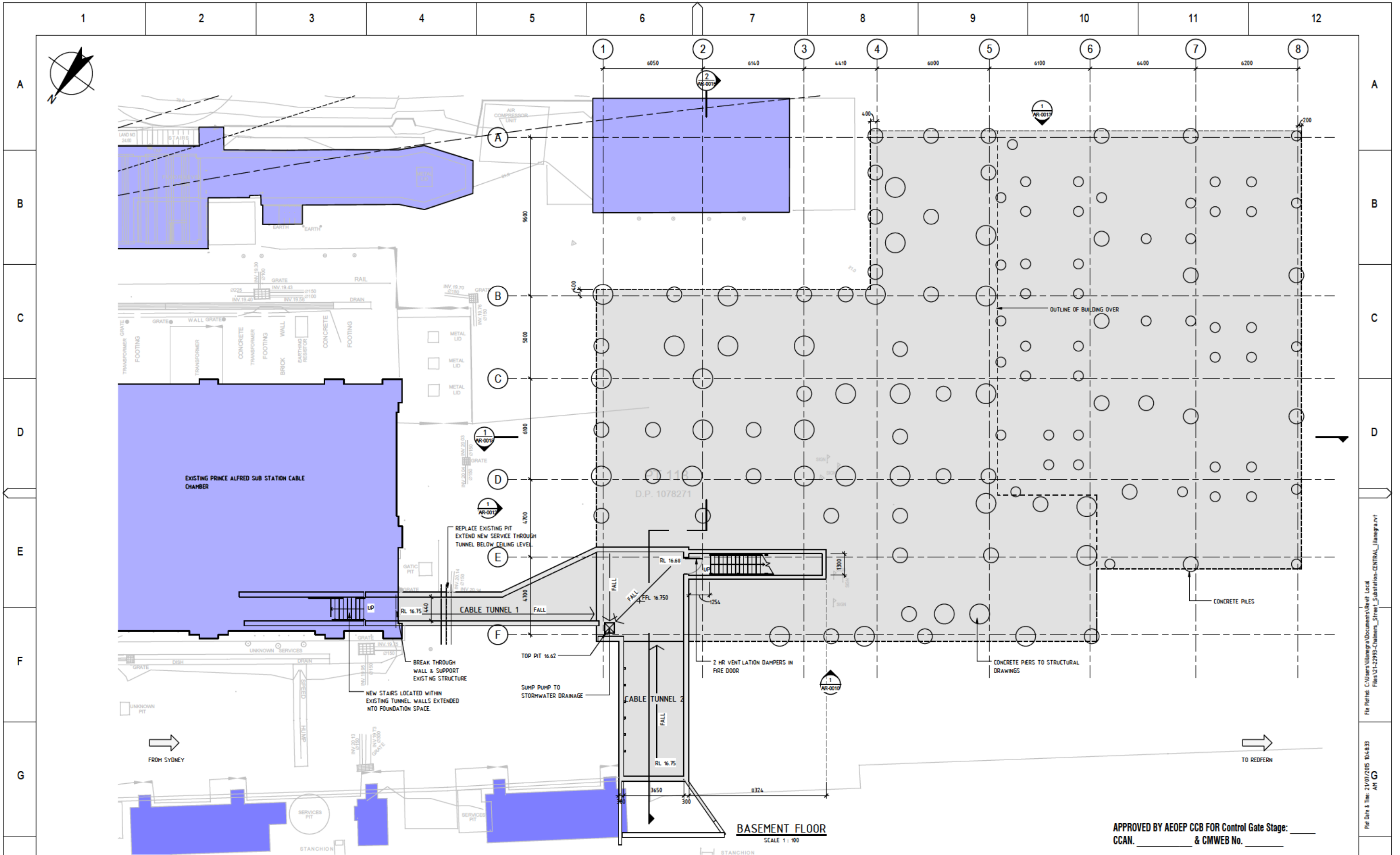
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**CHALMERS STREET**  
 AIRPORT LINE 0.352 km  
**SUBSTATIONS - POWER SUPPLY UPGRADE**  
 SITE PLAN

FILE No. 21-22993	1 OF 1
STATUS CONCEPT DESIGN	
DRG No. 2656-2650-CSSS-AR-0002	EDMS No. CV0561930

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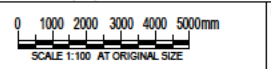
APPROVED BY AEOP CCB FOR Control Gate Stage:   
 CCAN.   
 & CMWEB No.   
 \_\_\_\_\_

**CHALMERS STREET**  
 AIRPORT LINE 0.352 km  
**SUBSTATIONS - POWER SUPPLY UPGRADE**  
**BASEMENT FLOOR**  
 PLAN

FILE No. 21-22993	1 OF 1
STATUS CONCEPT DESIGN	
DRG No. 2656-2650-CSSS-AR-0003	EDMS No. CV0561931

No.	BY	DATE	DESCRIPTION	APPRO.
D	LL	21.07.2015	(CONCEPT ISSUE SOH)	FP
C	HP	01.04.15	CONCEPT ISSUE	MN
B	HP	19.02.15	CONCEPT ISSUE	MN
A	LS	20.12.13	CONCEPT ISSUE	MN

At Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D.



CLIENT

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DRAWN	A. WANG	21.07.2015
DESIGNED	E. BULLO	21.07.2015
DRG CHECK	H. PAPADIMITRIOU	21.07.2015
DESIGN CHECK	A. MILLER	21.07.2015
APPROVED	F. PALMERO	21.07.2015

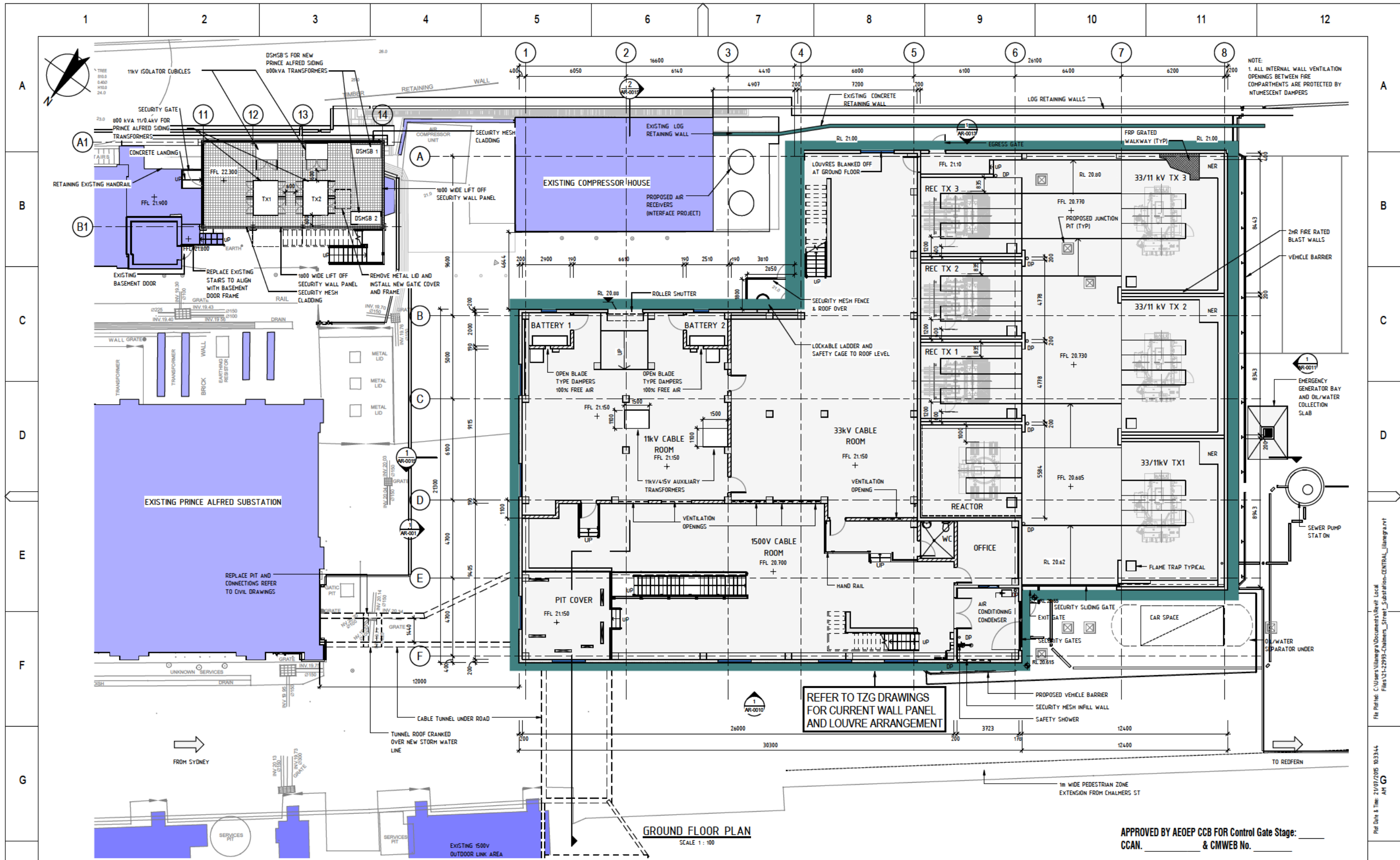
GHD Level 17, 100 Castles Street Sydney NSW 2000 Australia  
 G: 61 2 9230 7000 F: 61 2 9230 7000 E: ghd.com.au W: www.ghd.com

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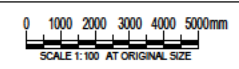
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No.	BY	DATE	DESCRIPTION	APPRO.
D	LL	21.07.2015	(CONCEPT ISSUE SOH)	FP
C	HP	01.04.15	CONCEPT ISSUE	MN
B	HP	19.02.15	CONCEPT ISSUE	MN
A	LS	20.12.13	CONCEPT ISSUE	MN



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CLIENT: Transport for NSW

DESIGNER: GHD

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 DRG CHECK: H. PAPADIMITRIOU 21.07.2015  
 DESIGN CHECK: A. MILLER 21.07.2015  
 APPROVED: F. PALMERO 21.07.2015

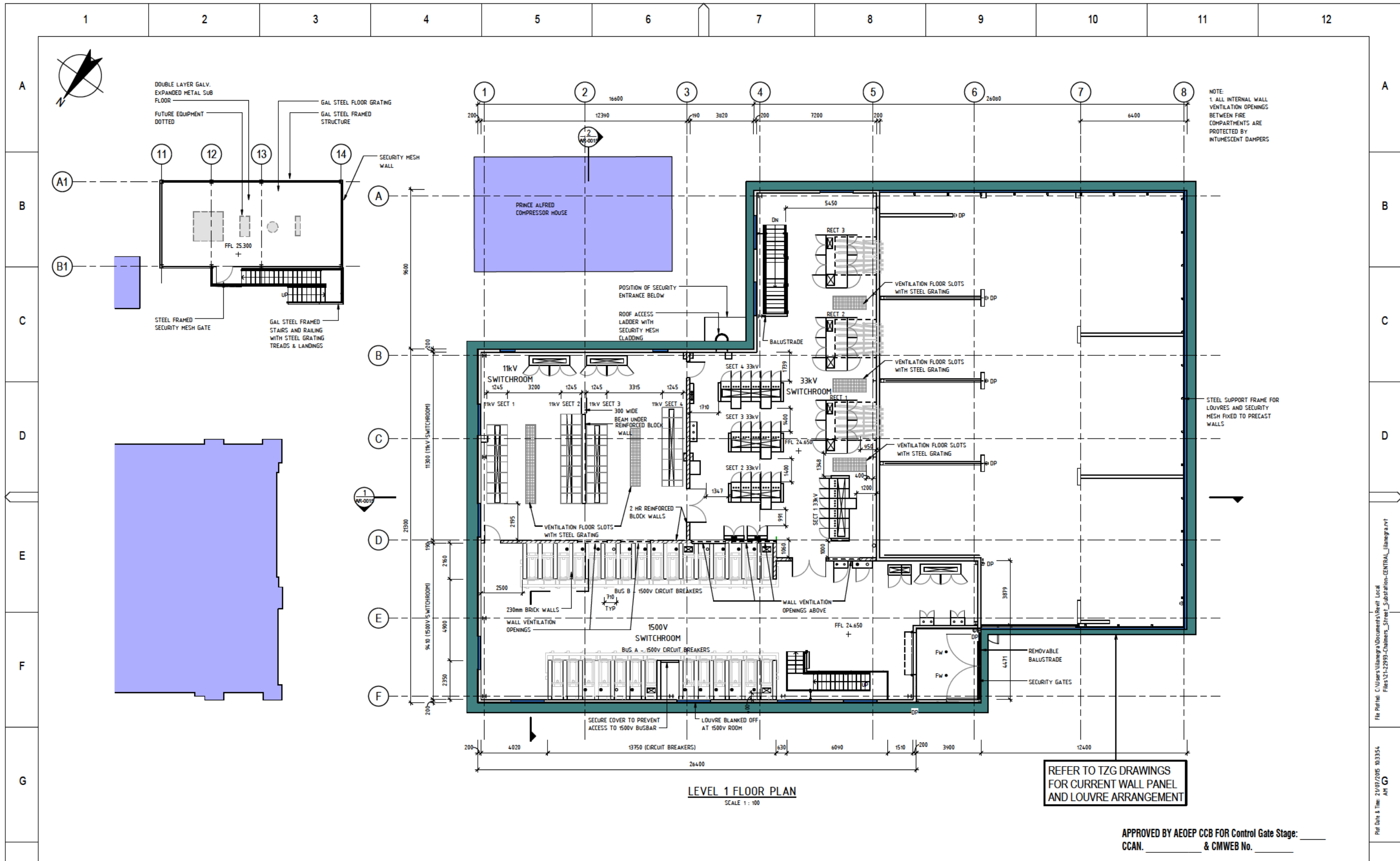
APPROVED BY AEOEP CCB FOR Control Gate Stage: CCAN. & CMWEB No.

**CHALMERS STREET**  
AIRPORT LINE 0.352 km  
SUBSTATIONS - POWER SUPPLY UPGRADE  
GROUND FLOOR PLAN

FILE No. 21-22993  
STATUS: CONCEPT DESIGN  
DRG No. 2656-2650-CSSS-AR-0004

1 OF 1  
EDMS No. CV0561932

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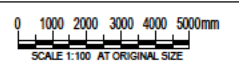


LEVEL 1 FLOOR PLAN  
SCALE 1 : 100

REFER TO TZG DRAWINGS  
FOR CURRENT WALL PANEL  
AND LOUVRE ARRANGEMENT

APPROVED BY AEOP CCB FOR Control Gate Stage: CCAN  
& CMWEB No.           

No.	BY	DATE	DESCRIPTION	APPRO.
E	LL	17.07.2015	(CONCEPT ISSUE SOH)	FP
D	HP	24.08.15	REVISED IN ACCORDANCE WITH COMMENTS REGISTER	FP
C	HP	01.04.15	CONCEPT ISSUE	MN
B	HP	19.02.15	CONCEPT ISSUE	MN
A	LS	20.12.13	CONCEPT ISSUE	MN



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 DESIGNED: E. BULLO 21.07.2015  
 DRG CHECK: H. PAPADIMITRIOU 21.07.2015  
 DESIGN CHECK: A. MILLER 21.07.2015  
 APPROVED: E. PALMERO 21.07.2015

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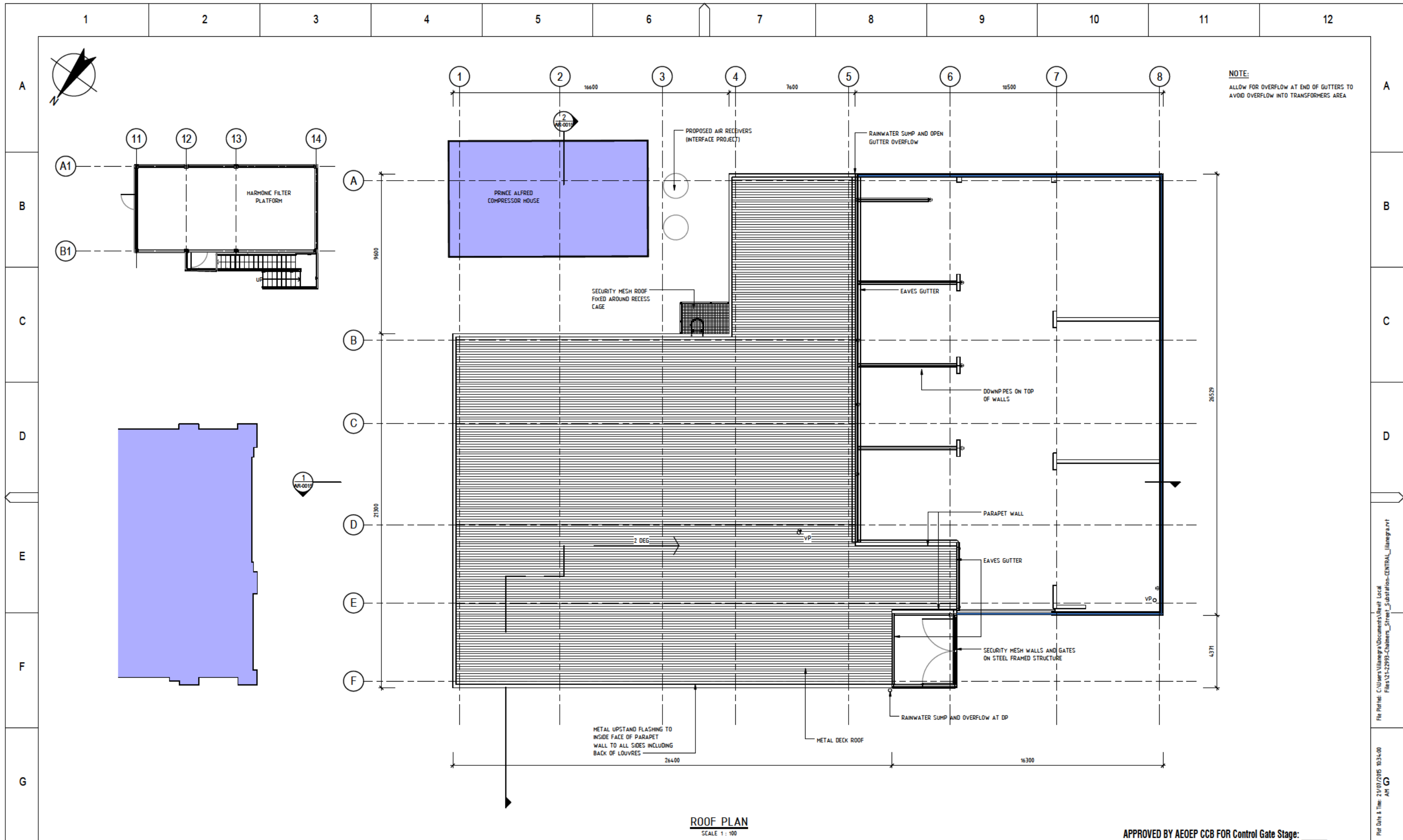
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TITLE: \_\_\_\_\_  
DATE: \_\_\_\_\_

**CHALMERS STREET**  
AIRPORT LINE 0.352 km

**SUBSTATIONS - POWER SUPPLY UPGRADE**  
**LEVEL 1 FLOOR PLAN**

PLAN  
FILE No. 21-22993 1 OF 1  
STATUS CONCEPT DESIGN  
DRG No. 2656-2650-CSSS-AR-0005 E EDMG No. CV0561933

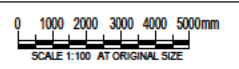
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**ROOF PLAN**  
SCALE 1 : 100

APPROVED BY AE0EP CCB FOR Control Gate Stage: \_\_\_\_\_  
CCAN. \_\_\_\_\_ & CMWEB No. \_\_\_\_\_

No.	BY	DATE	DESCRIPTION	APPRO.
D	LL	17.07.2015	(CONCEPT ISSUE SOH)	FP
C	HP	01.04.15	CONCEPT ISSUE	MN
B	HP	19.02.15	CONCEPT ISSUE	MN
A	LS	20.12.13	CONCEPT ISSUE	MN
AT Original				



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 DESIGN CHECK: A. MILLER 21.07.2015  
 APPROVED: F. PALMERO 21.07.2015

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DATE: \_\_\_\_\_

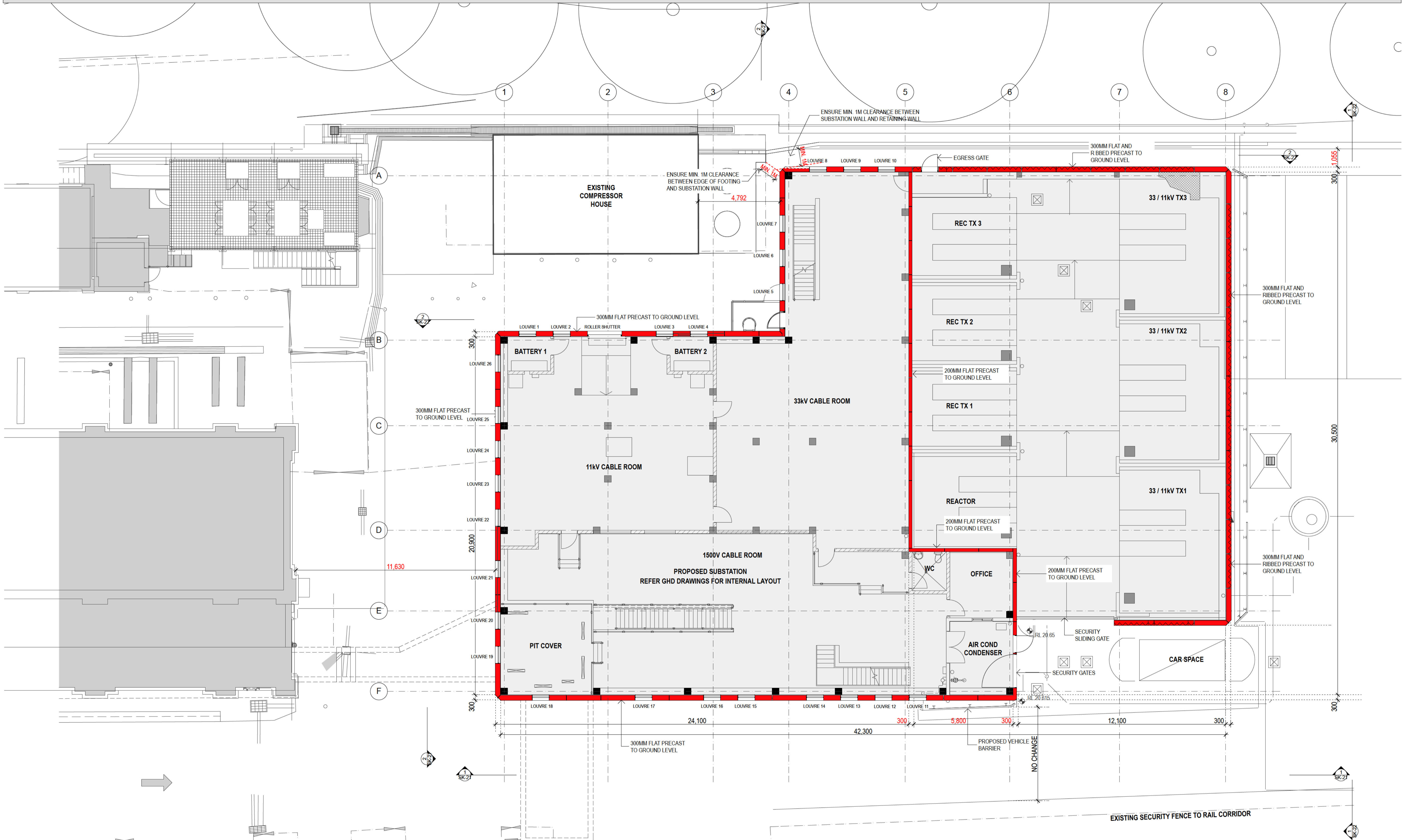
**CHALMERS STREET**  
AIRPORT LINE 0.352 km  
SUBSTATIONS - POWER SUPPLY UPGRADE  
ROOF  
PLAN

FILE No. 21-22993 1 OF 1  
STATUS: CONCEPT DESIGN  
DRG No. 2656-2650-CSSS-AR-0006 D EDMS No. CV0561934

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**DESCRIPTION:**

Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. External dimensions increase by 100mm – affected dimensions indicated in **RED**. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.

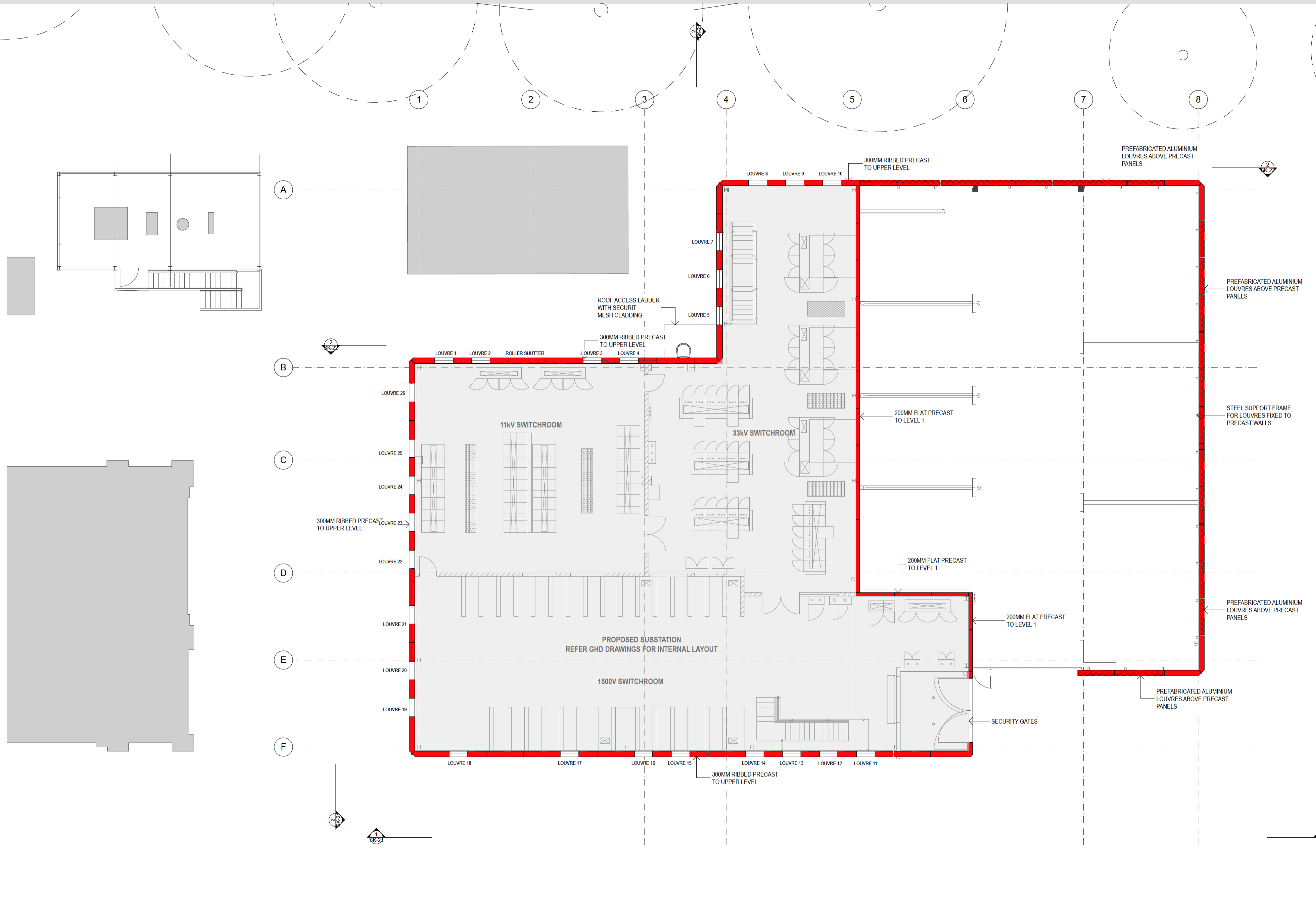


DATE	REV	NOTES	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT:	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD Phone: 02 9239 7439 Email: stephen.pusepjak@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	GROUND FLOOR PLAN	TF KN
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET							15019	ARCHITECTS	SKETCH DESIGN	CHECKED
NOTES: Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.											SCALES	REVISION
											:100	TG
											PHASE	SK-11
											DRAWING NO	02
											REVISION	



**DESCRIPTION:**

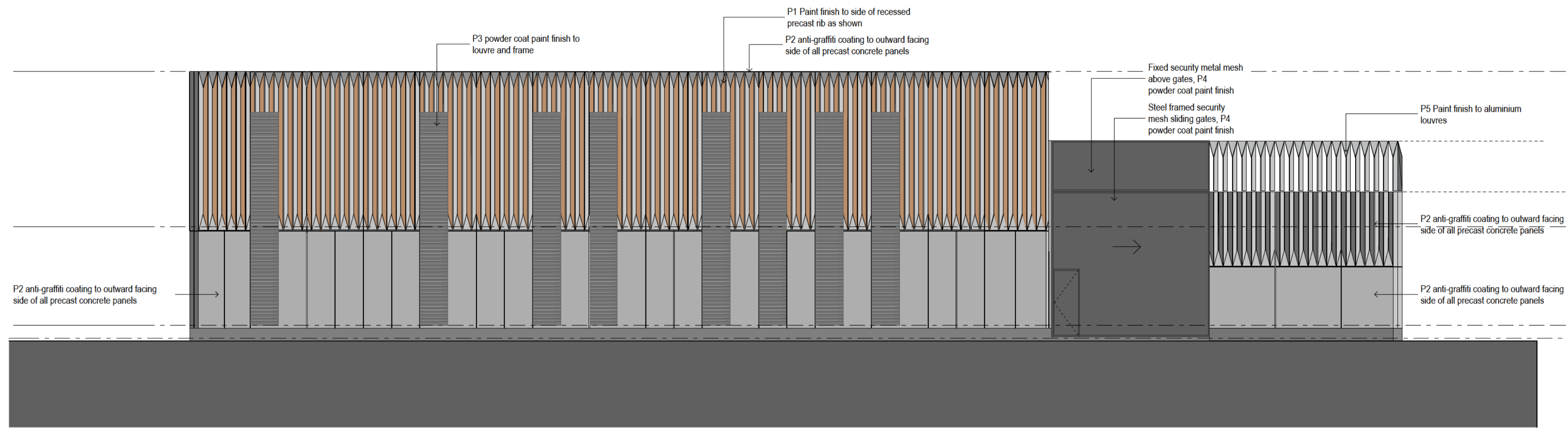
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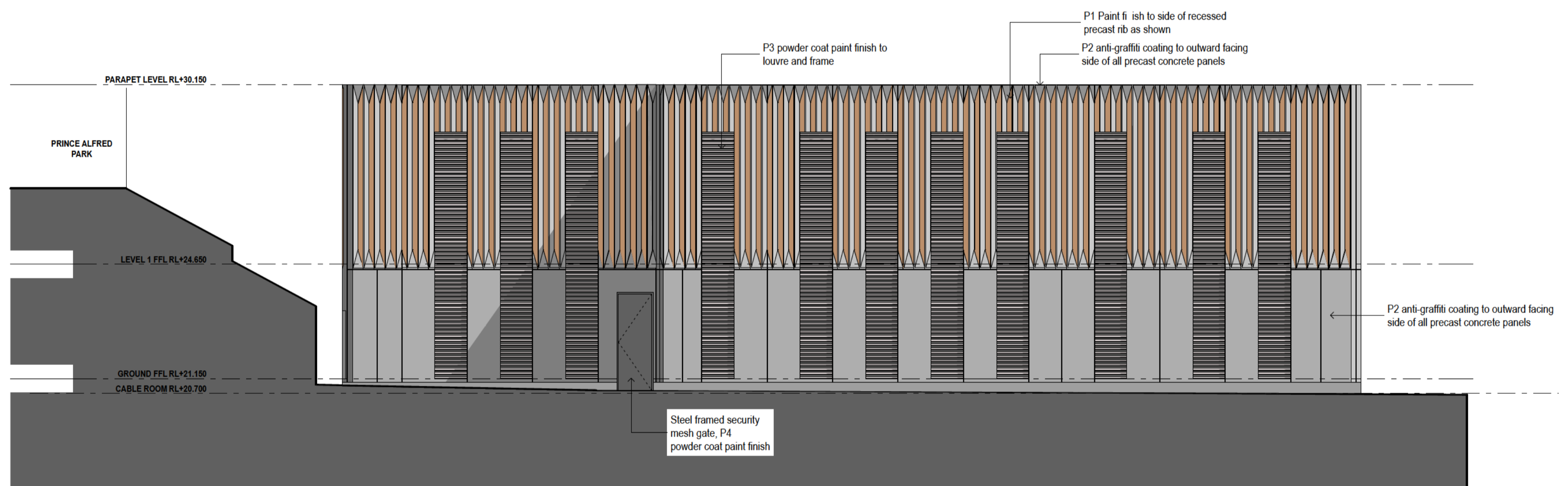
DATE	REV	NOTES	NOTES:	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT:	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW	Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	LEVEL 1 PLAN	TF KN
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET								15019	ARCHITECTS	SCALE	CHECKED
												:100	TG
												PHASE	REVISION
												SKETCH DESIGN	02
												DRAWING NO	
												SK-12	

**DESCRIPTION:**

Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. External dimensions increase by 100mm – affected dimensions indicated in RED. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.



1 NORTH-WEST ELEVATION  
1:100

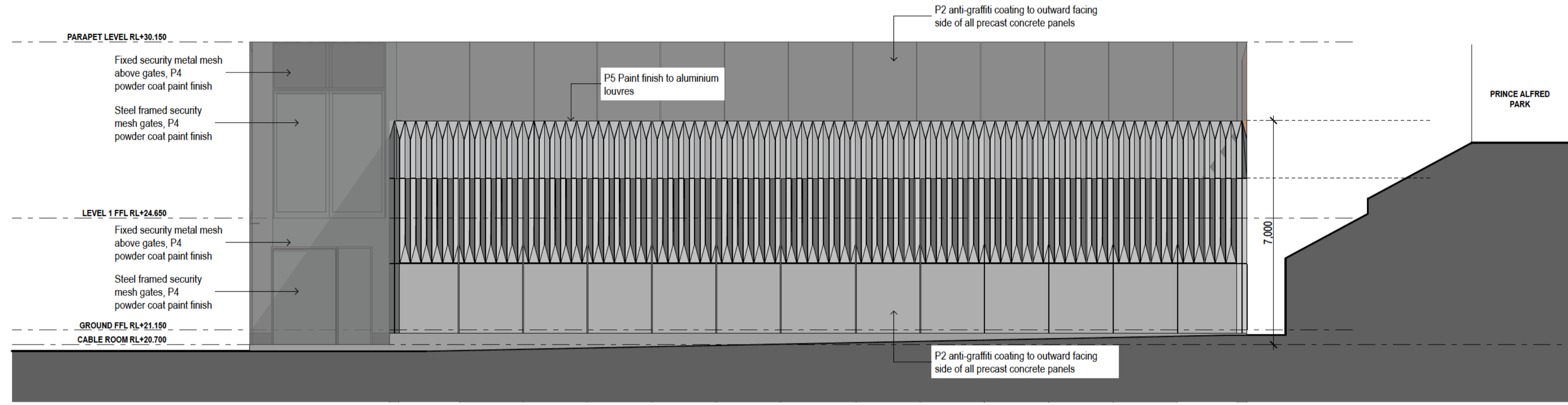


2 NORTH-EAST ELEVATION  
1:100

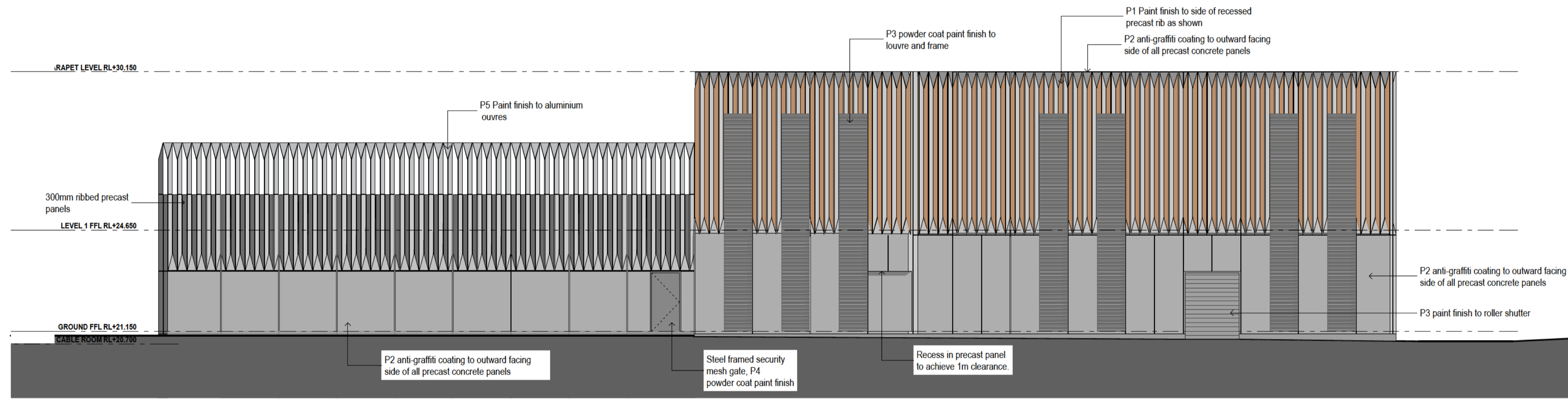
DATE	REV	NOTES	<p><b>NOTES:</b> Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.</p>	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	<p>PROJECT: <b>CHALMERS STREET SUBSTATION</b></p>	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD		TONKIN ZULAIKHA GREER ARCHITECTS	ELEVATIONS 1	TF KN
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET							117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tjg.com.au WEB: www.tjg.com.au	15019	SKETCH DESIGN	TG	
										SCALES	:100	REVISION	02
										PHASE	SKETCH DESIGN	DRAWING NO	SK-21

**DESCRIPTION:**

Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. External dimensions increase by 100mm – affected dimensions indicated in RED. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.



1 SOUTH-WEST ELEVATION  
1:100



2 SOUTH-EAST ELEVATION  
1:100

DATE	REV	NOTES	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT:	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD Phone: 02 9238 7439 Email: stephen.puseerak@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tazg.com.au WEB: www.tazg.com.au	ELEVATIONS 2	TF KN
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET									SKETCH DESIGN	CHECKED
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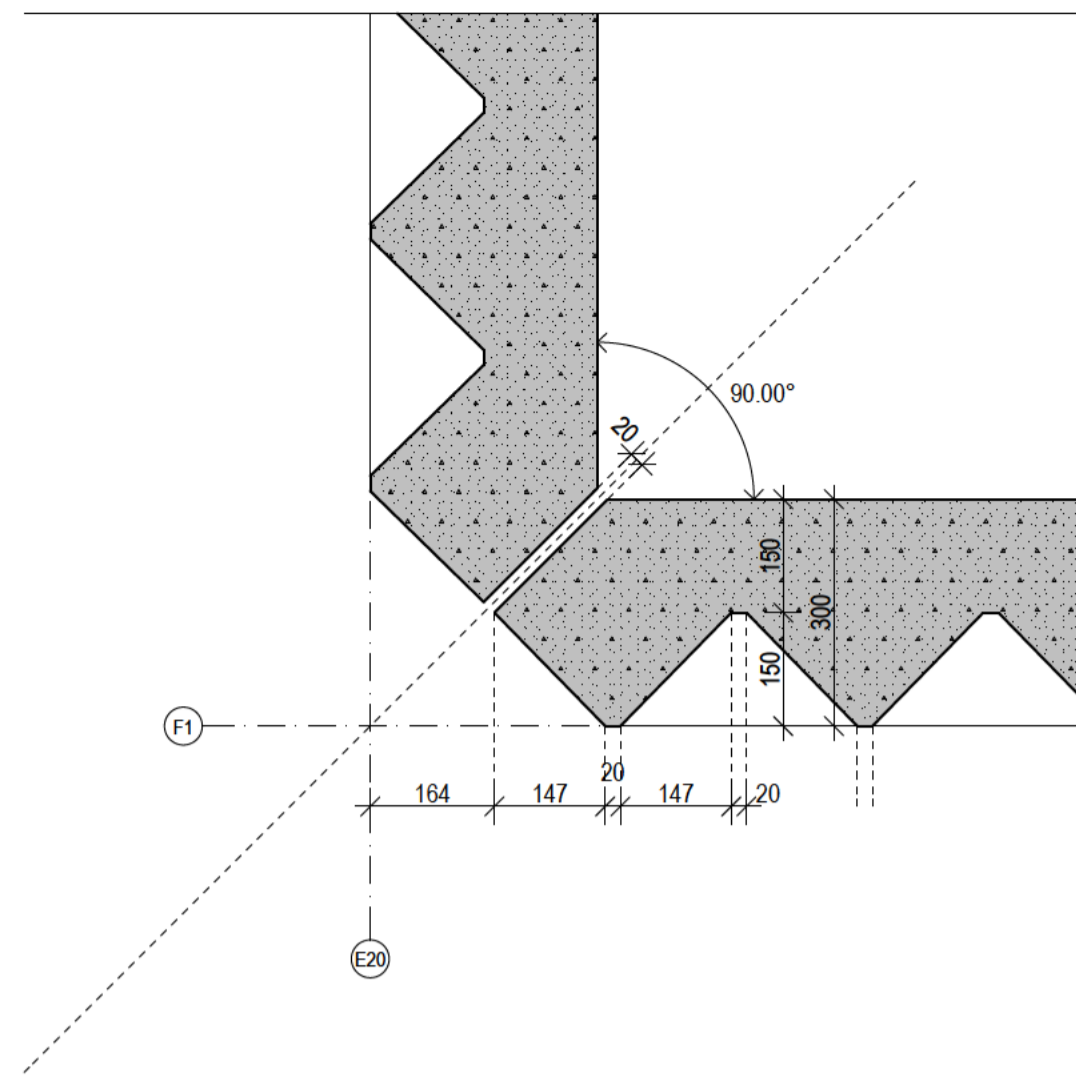
**DESCRIPTION:**

Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. Externa dimensions increase by 100mm – affected dimensions indicated in **RED**. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.

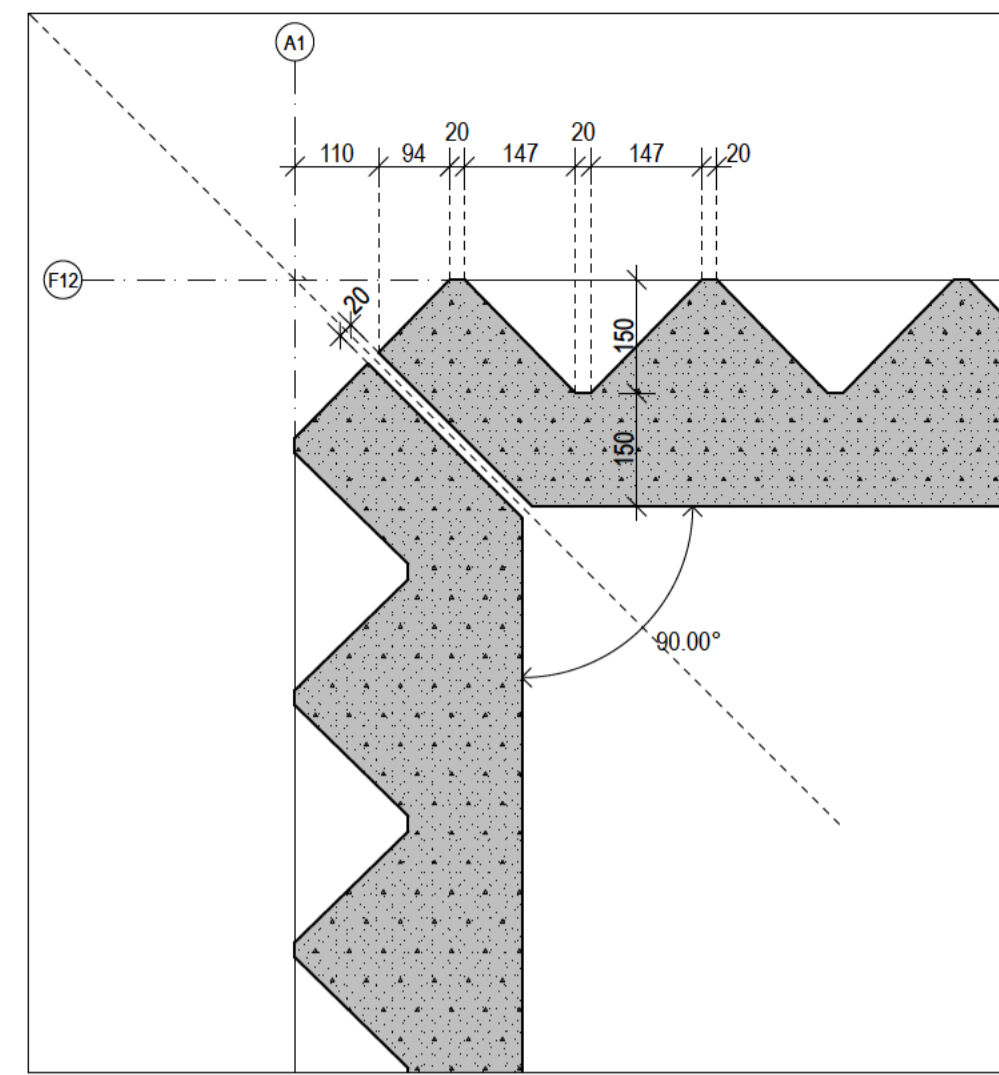


1 OVERALL NORTH ELEVATION  
1:200

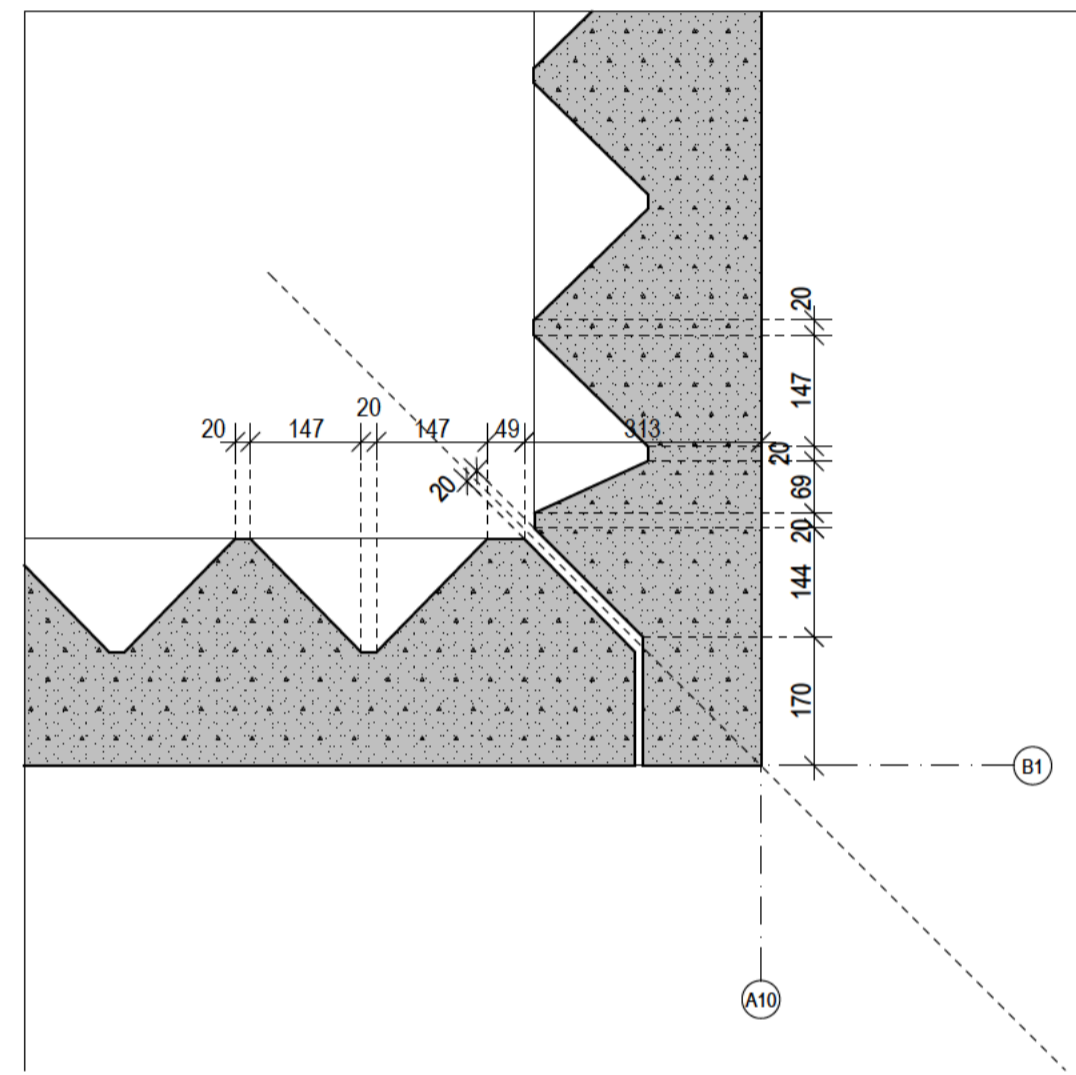
DATE	REV	NOTES :	NOTES: Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT: GHD Phone: 02 9239 7439 Email: stephen.puseerjak@ghd.com	PROJECT : CHALMERS STREET SUBSTATION 15019	ARCHITECT TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE 02 9215 4900 FAX 02 9215 4901 EMAIL tim@tzg.com.au WEB www.tzg.com.au	DRAWING TITLE E/N North Elevation Overall	DRAWN BY TF KN	
06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER				SCALES :100	CHECKED TG	
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET										PHASE SKETCH DESIGN	DRAWING NO SK-23	REVISION 02



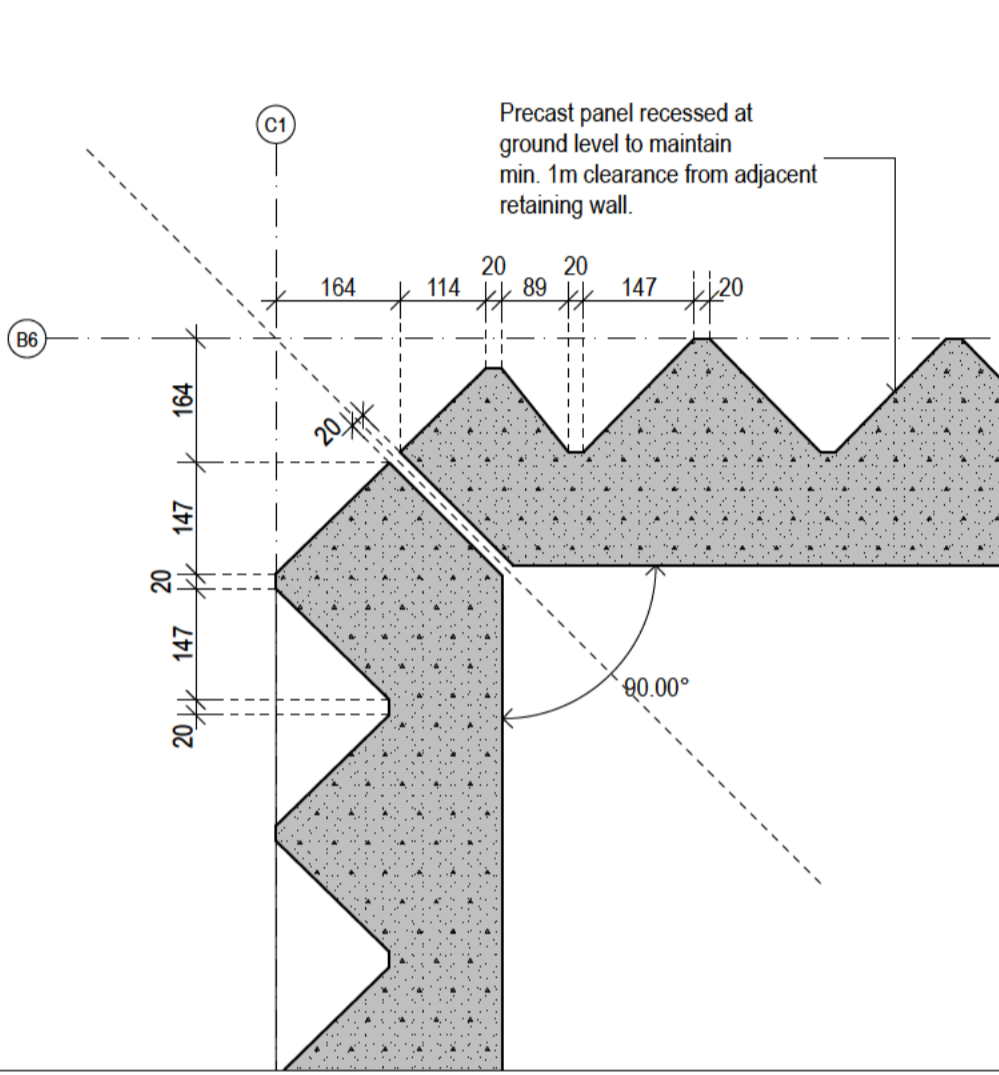
PLAN DETAIL 1  
1:10



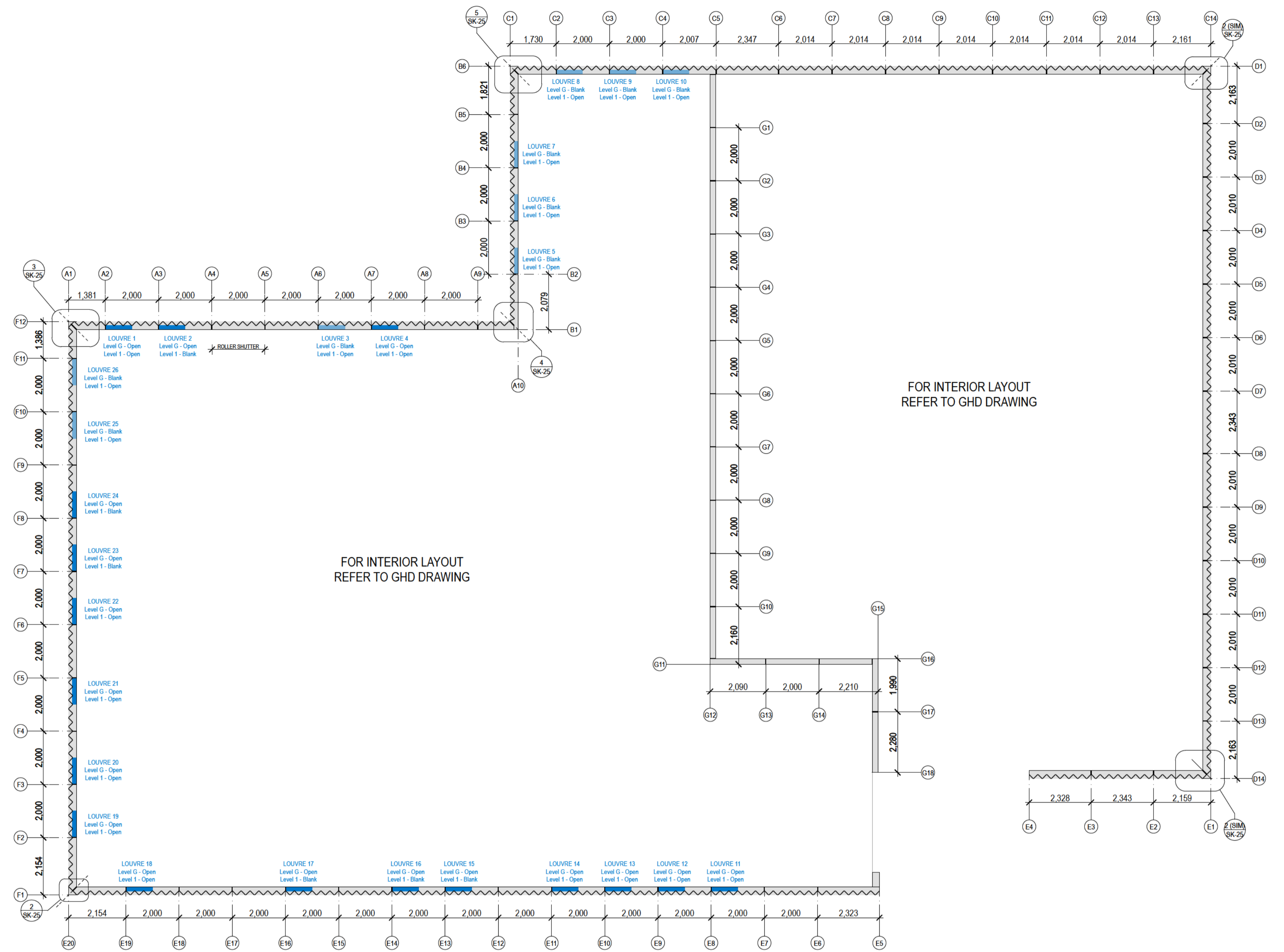
PLAN DETAIL 2  
1:10



PLAN DETAIL 3  
1:10



PLAN DETAIL 4  
1:10

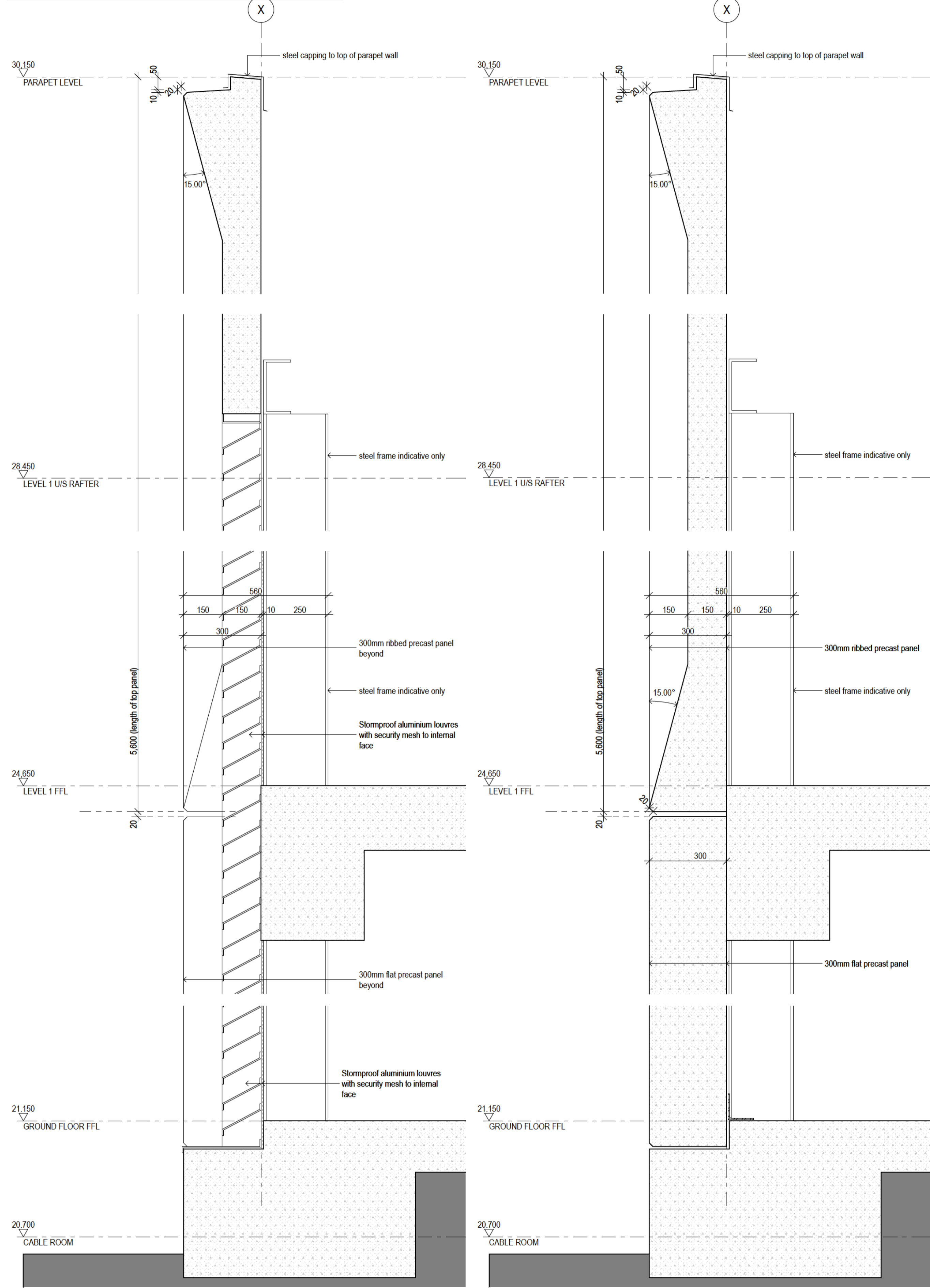


PRECAST PANEL SETOUT  
1:100

FOR INTERIOR LAYOUT  
REFER TO GHD DRAWING

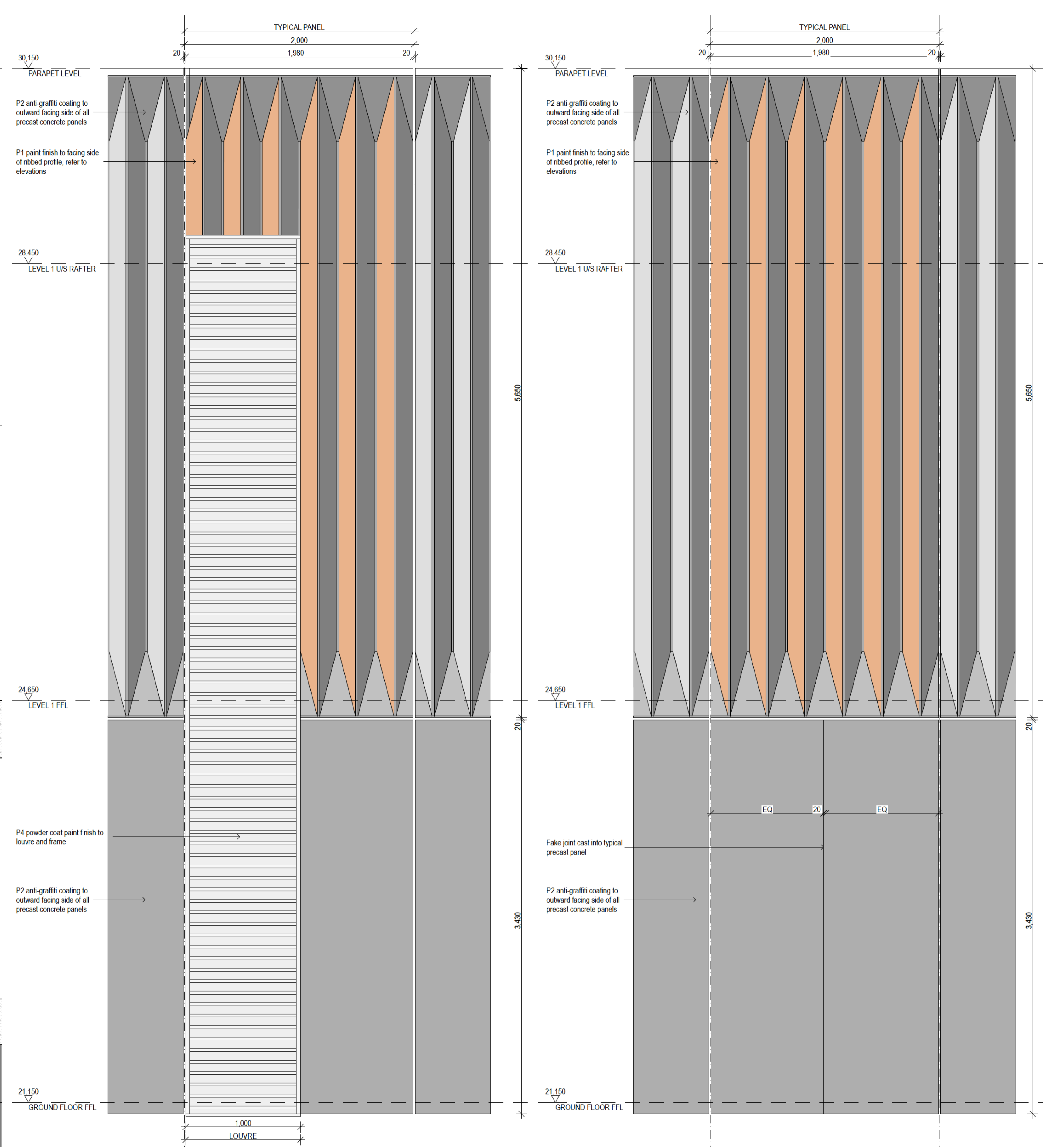
FOR INTERIOR LAYOUT  
REFER TO GHD DRAWING

DATE 17/07/2015	REV 01	NOTES ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET	NOTES Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	CONTRACTOR ESD	CIVIL ENGINEER STRUCTURAL ENGINEER	ELECTRICAL ENGINEER HYDRAULIC ENGINEER	MECHANICAL ENGINEER FIRE ENGINEERING	PCA TOWN PLANNER	CLIENT GHD Phone: 02 9238 7438 Email: stephen.puseerak@ghd.com	PROJECT CHALMERS STREET SUBSTATION 15019	ARCHITECT TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tjg.com.au WEB: www.tjg.com.au	DRAWING TITLE FACADE PLAN SETOUT AND DETAIL - GROUND FLOOR	DRAWN BY TF KN CHECKED TG	
		SCALES :100, 1:10									PHASE SKETCH DESIGN		DRAWING NO SK-25	REVISION 01



4 FACADE SECTION - through louvres 1:10

3 FACADE SECTION - through precast 1:10



2 PRECAST PANEL ELEVATION LOUVRED 1:20

1 PRECAST PANEL ELEVATION TYPICAL 1:20

DATE	REV	NOTES
17/07/2015	01	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET

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ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER

CLIENT:  
GHD  
Phone: 02 9238 7438  
Email: stephen.puseerak@ghd.com

PROJECT:  
CHALMERS STREET  
SUBSTATION

ARCHITECT  
TONKIN ZULAIKHA GREER ARCHITECTS  
117 Reservoir Street  
ABN: 4600272349  
PHONE: 02 9215 4900  
FAX: 02 9215 4901  
EMAIL: tim@tzig.com.au  
WEB: www.tzig.com.au

DRAWING TITLE  
FACADE DETAILS 1

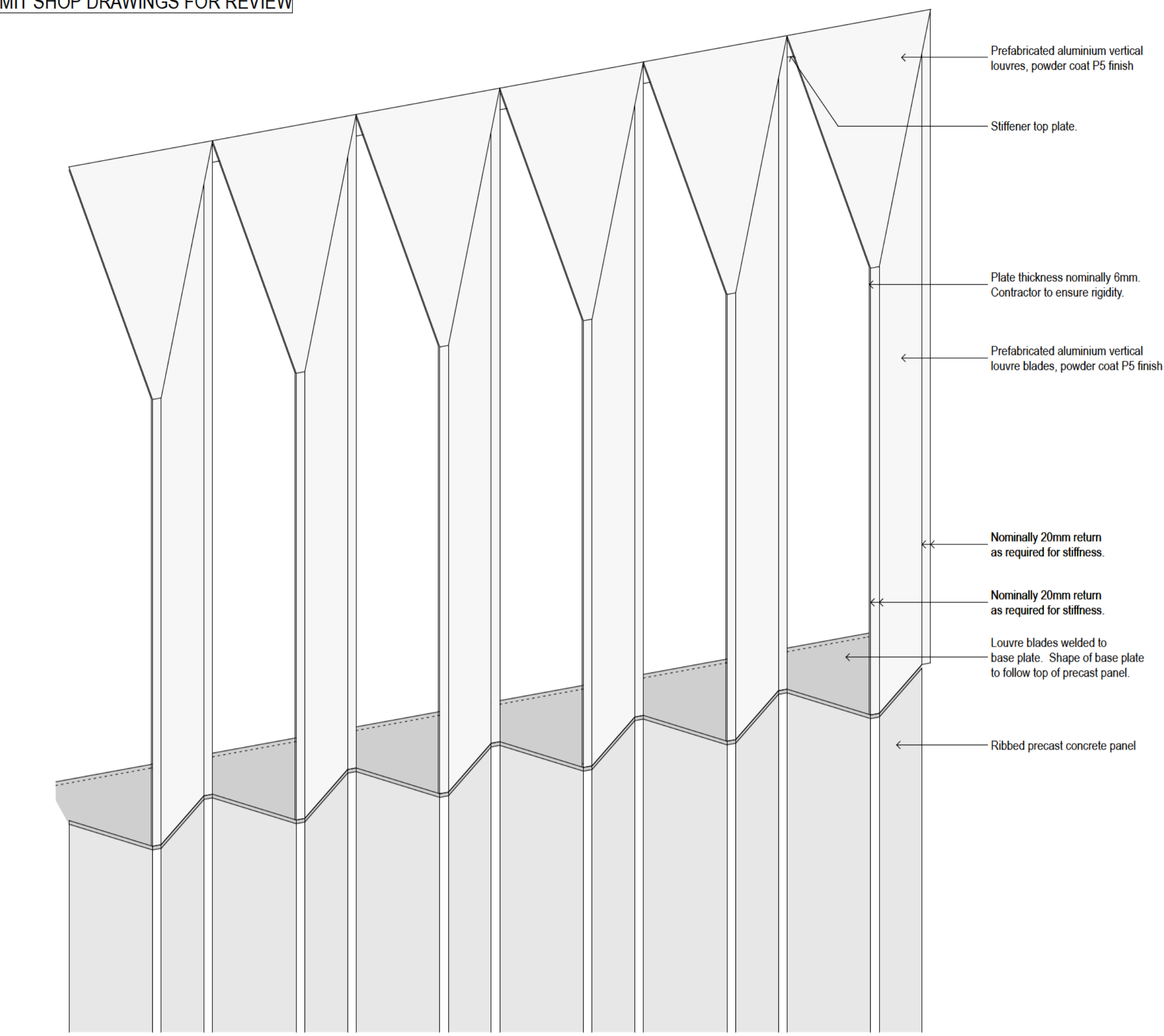
SCALES :20, 1:10

PHASE SKETCH DESIGN

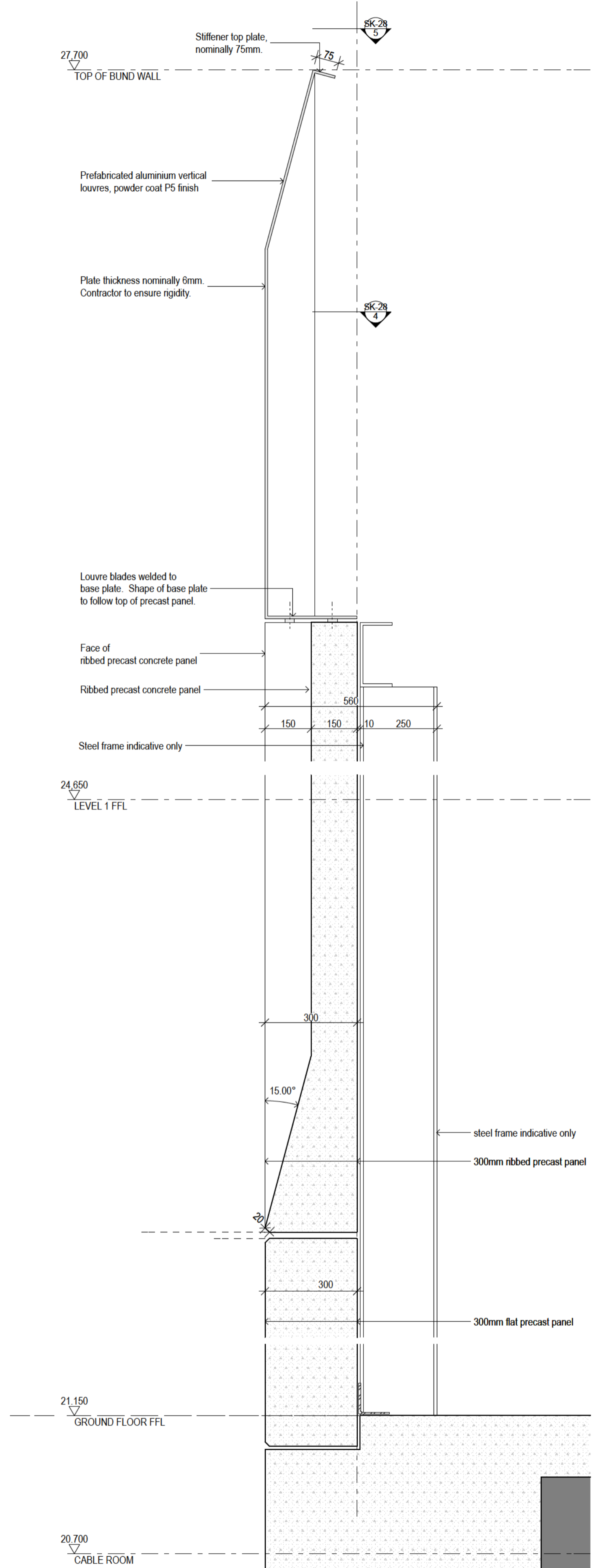
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REVISION

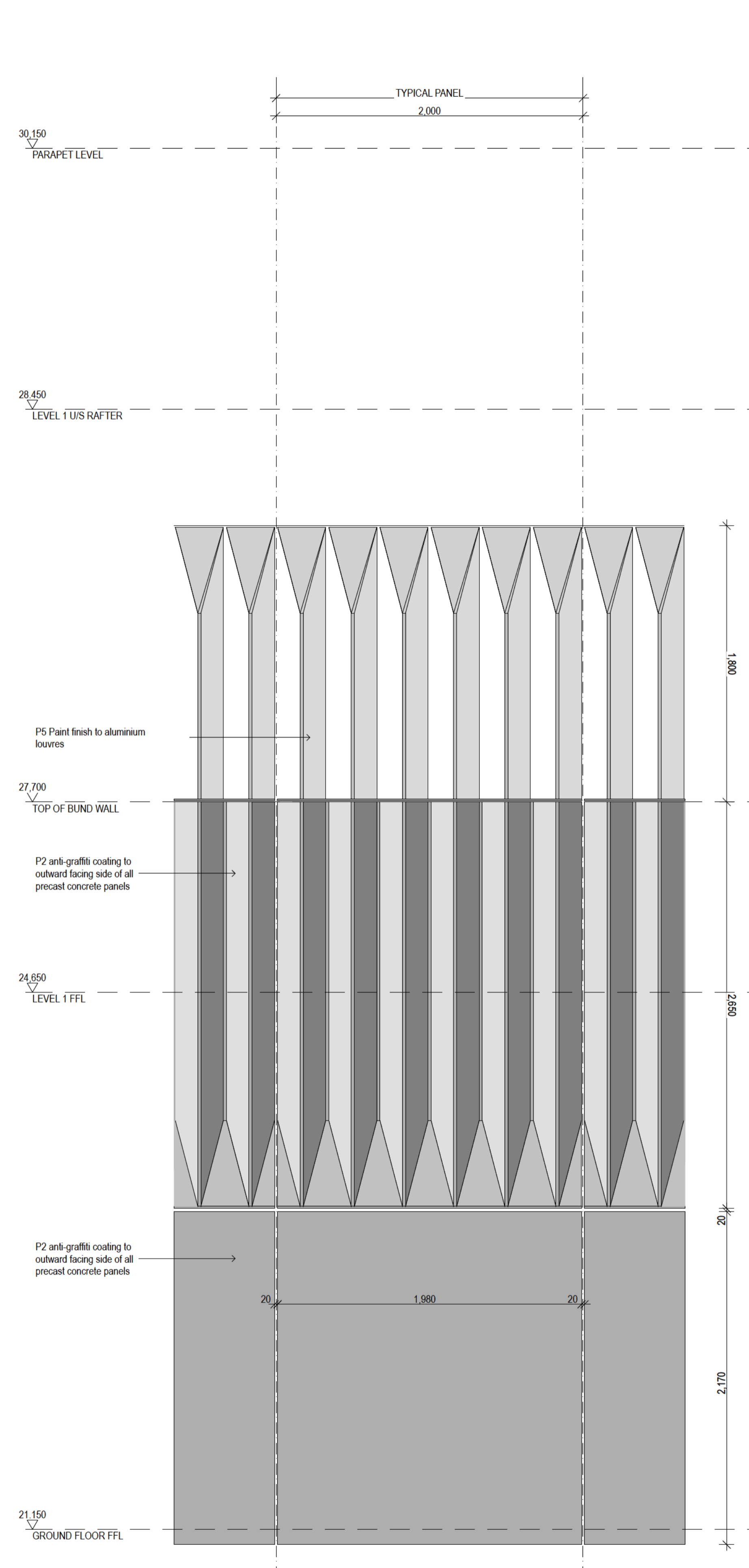
DRAWN BY TF KN  
CHECKED TG  
REVISION 01



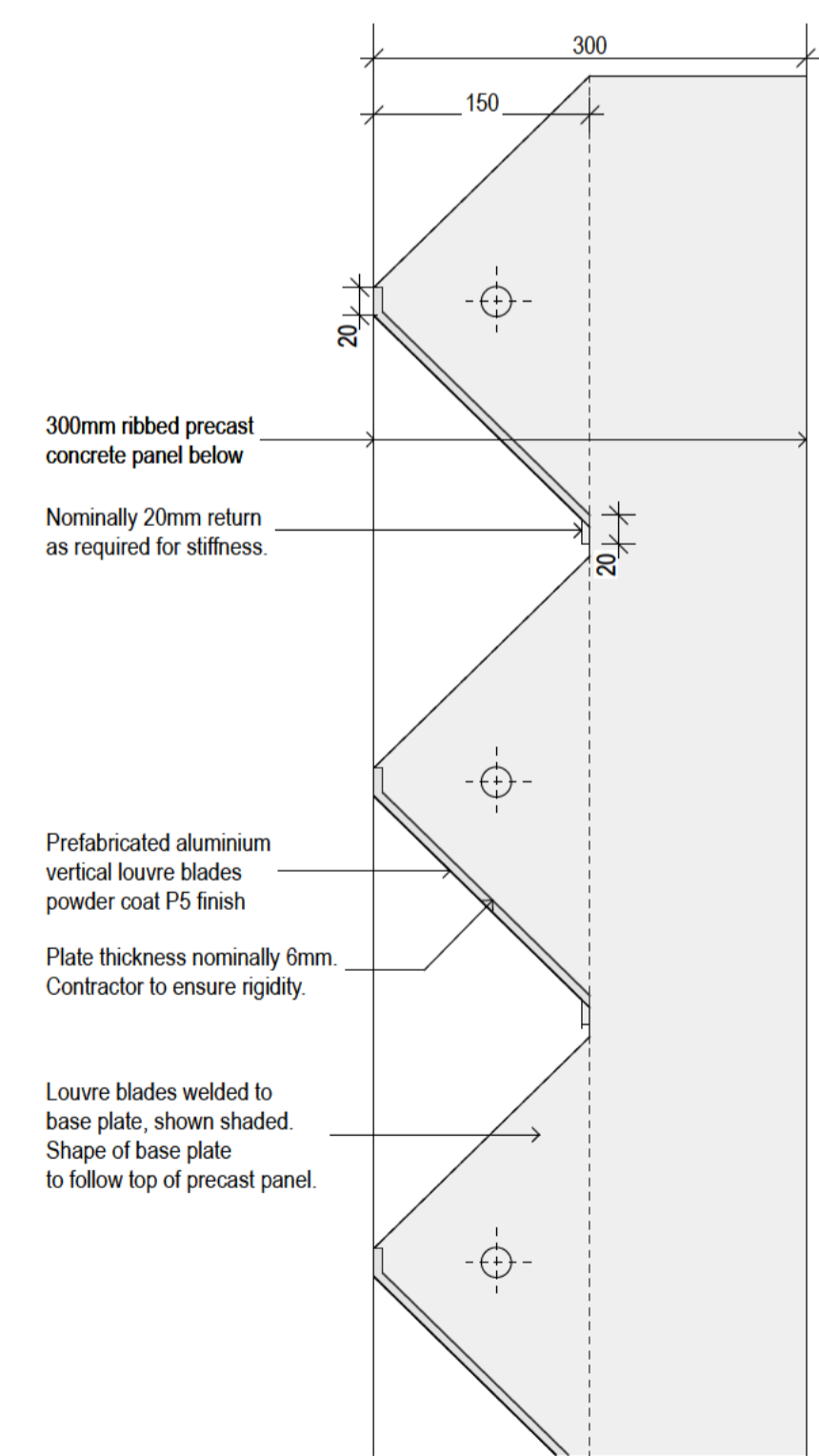
3 ALUMINIUM LOUVRE AXONOMETRIC 1:10



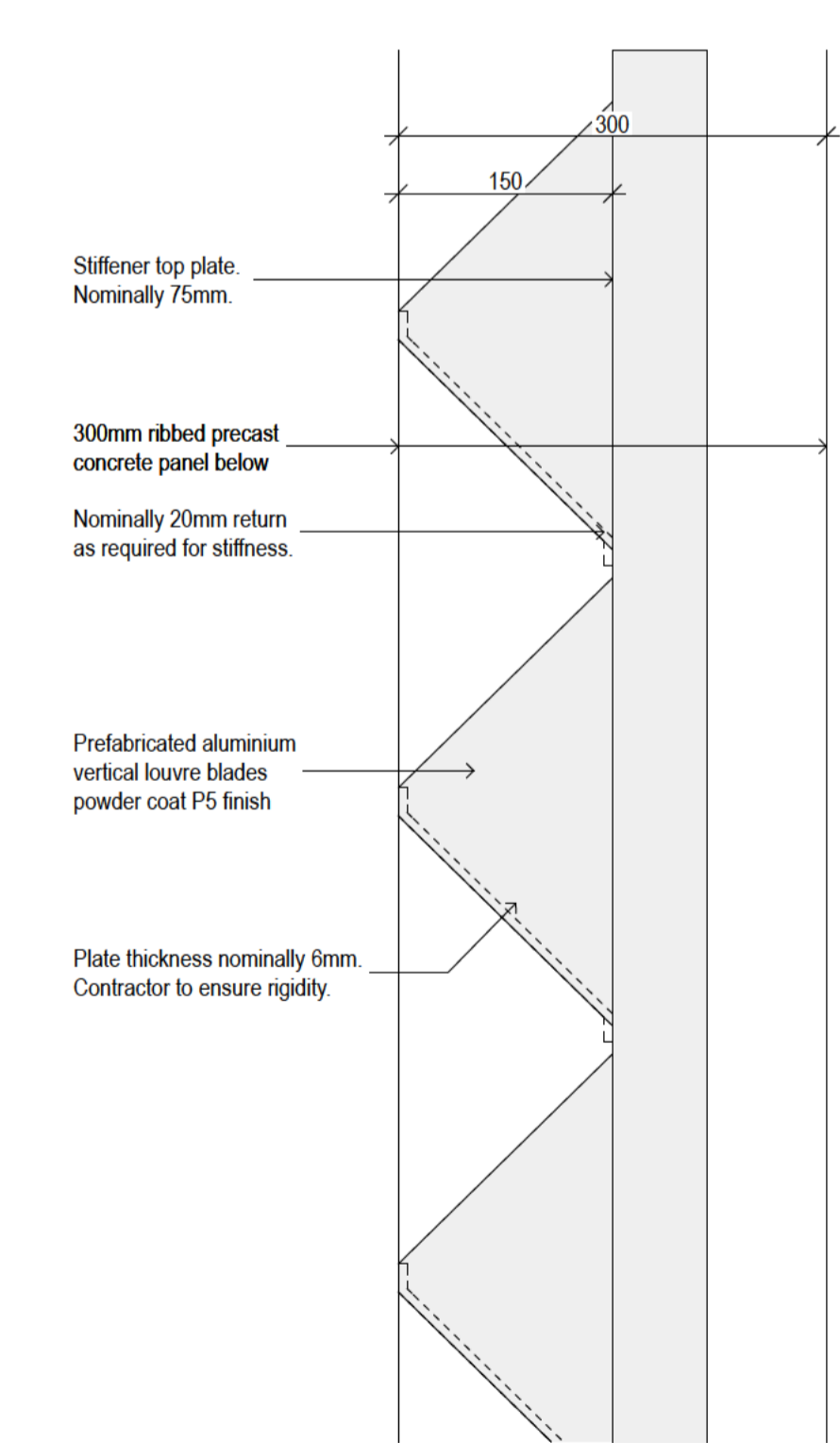
2 FACADE SECTION BUND WALL 1:10



1 PRECAST PANEL ELEVATION -BUND WALL 1:20



4 ALUMINIUM LOUVRE PLAN DET. 1 1:5



5 ALUMINIUM LOUVRE PLAN DET. 2 1:5

DATE 17/07/2015	REV 01	NOTES ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET	CONTRACTOR ESD	CIVIL ENGINEER STRUCTURAL ENGINEER	ELECTRICAL ENGINEER HYDRAULIC ENGINEER	MECHANICAL ENGINEER FIRE ENGINEERING	PCA TOWN PLANNER	CLIENT: GHD 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	PROJECT: CHALMERS STREET SUBSTATION	ARCHITECT TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	DRAWING TITLE FACADE DETAILS 2	DRAWN BY TF KN
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**FINISHES SCHEDULE**

- CO2** Precast Concrete Panel, Class 2C, Tone 2, Special Class Concrete with colour control
- P1** Dulux Weathermax Paint, gloss finish, colour: Dulux 'Ambit'
- P2** Anti-Graffiti coating, lower precast panel, clear finish
- P3** Powder coat paint finish, colour: Dulux ' Malay Grey'
- P4** Powder coat paint finish, colour: Dulux ' Raku'
- P5** Powder coat paint finish, colour to match colour of Precast Concrete Panel

**NOTE**

Contractor to submit samples of all colour selections for approval prior to construction.



**C02**

TILT-UP PRECAST CONCRETE PANEL  
STANDARD NOT LESSER THAN CLASS 2C, TONE 2

Type of finish: Design metal formwork and construct to provide off-form surfaces of a standard not lower than class 2 as described in AS 3610 Formwork for concrete Special Class Concrete  
Colour control: Tone 2, AS 3610, for 90% of readings  
Colour tone range may be between tone 1 and 5 for 10% maximum of finish

Location: precast concrete panels



**P1**

PAINT TYPE 1 - Dulux Weathermax Paint, gloss finish, colour: Dulux 'Ambit' Code: P10E8

Location: Feature access to precast concrete ribs on upper level precast panel



**P3**

PAINT TYPE 3 - Powder coat paint finish, colour: Dulux ' Malay Grey' Code: PG2C6

Location: External storm proof louvres and external door leaves



**P4**

PAINT TYPE 4 - Powder coat paint finish, colour: Dulux ' Raku' Code: PG2C7

Location: External door frames and security mesh gates



**P5**

PAINT TYPE 5 - Powder coat paint finish, colour to match precast concrete panel colour

Location: Aluminium louvres above transformer yard Bund walls

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17/07/2015	01	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHG Phone: 02 9239 7439 Email: stephen.puseerak@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE 02 9215 4900 FAX 02 9215 4901 EMAIL tim@tzg.com.au WEB www.tzg.com.au	FINISHES SCHEDULE	TF KN
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										PHASE SKETCH DESIGN	DRAWING NO SK-29	REVISION 01





ALUMINIUM LOUVRES TO TOP OF BUND WALL

300MM RIBBED PRECAST TO BUND WALLS

STEEL FRAMED SECURITY MESH GATE

200MM FLAT PRECAST TO SUBSTATION WALLS

ALUMINIUM LOUVRES TO TOP OF BUND WALL

300MM RIBBED PRECAST TO SUBSTATION WALLS

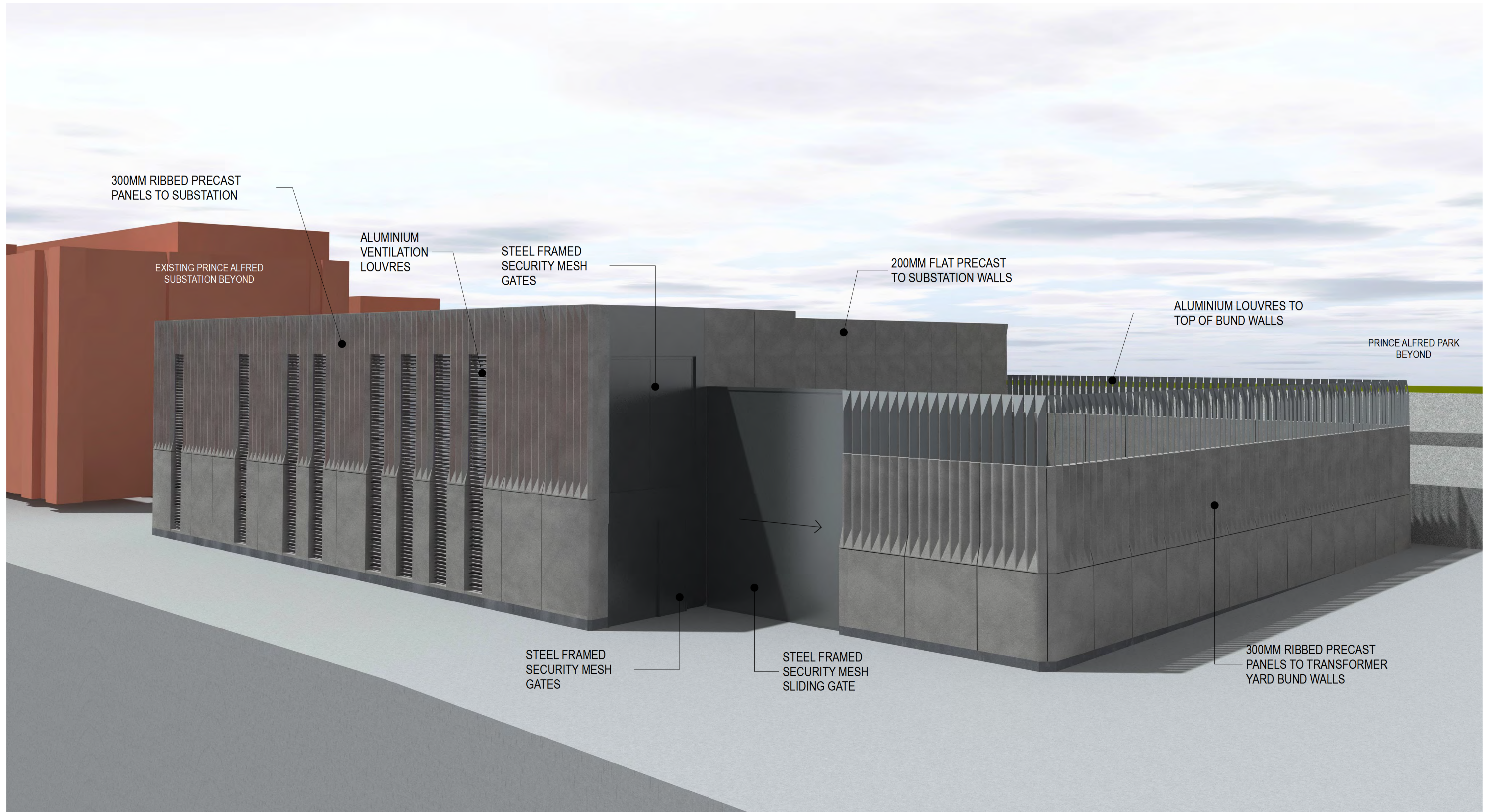
ALUMINIUM VENTILATION LOUVRES

EXISTING PRINCE ALFRED SUBSTATION BEYOND

PRINCE ALFRED PARK

VIEW FROM PRINCE ALFRED PARK

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06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER		15019	ARCHITECTS tonkin zulaikha greer	SCALES	CHECKED TG
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											DRAWING NO SK-31		



VIEW FROM THE RAILWAY TRACKS

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06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER		15019	ARCHITECTS tonkin zulaikha greer	SCALES	CHECKED TG
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											DRAWING NO SK-32		



1 VIEW FROM RAILWAY TRACKS

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06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER		15019	ARCHITECTS tonkin zulaikha greer	SCALES	CHECKED TG
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET										PHASE SKETCH DESIGN	REVISION 02
											DRAWING NO SK-33		



1 VIEW FROM NORTH

DATE	REV	NOTES :	NOTES:	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT :	ARCHITECT	DRAWING TITLE	DRAWN BY	
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17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET								15019	ARCHITECTS tonkin zulaikha greer	SCALES	CHECKED	
												PHASE	DRAWING NO	REVISION
												SKETCH DESIGN	SK-35	02



1 VIEW FROM RAIL CORRIDOR

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VIEW FROM PRINCE ALFRED PARK

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					STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER			ARCHITECTS tonkin zulaikha greer	PHASE SKETCH DESIGN	DRAWING NO SK-37	REVISION 01

# Appendix C – Statement of Heritage Impact

# STATEMENT OF HERITAGE IMPACT

CHALMERS STREET SUBSTATION

AUGUST 2015

117 RESERVOIR ST SURRY HILLS 2010 NSW AUSTRALIA | +61 2 9215 4900 | julie@tzc.com.au | www.tzc.com.au





Front cover: Portion of the Water Board's, *Map of the City of Sydney 1888*  
Source: State Records, AO Plan no 2125.

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## 1.0 INTRODUCTION

### 1.1 Background

Transport for NSW (TfNSW) is currently undertaking a Power Supply Upgrade Program to meet the actual and projected increase in power demands on the Sydney Trains electrical network. A power supply study, undertaken as part of the program, found that the existing Prince Alfred Substation needs to be replaced and TfNSW propose to construct two new substations: one at Lee Street and one at Chalmers Street.

This report was commissioned by GHD, on behalf of Transport for NSW (TfNSW), to assess the heritage impacts of the proposed substation at Chalmers Street and to provide recommendations as to how to mitigate the potential for these impacts. The site, currently occupied by the Prince Alfred Sidings Group, is located within the curtilage of Central Station adjacent to Prince Alfred Park, which are both identified as heritage items on the State Heritage Register.

Property:	Prince Alfred Sidings
Address:	Chalmers Street, Surry Hills, NSW, 2010 Parish of St Lawrence, County of Cumberland City of Sydney Local Government Area
Location:	Approximate Lat: -33.885998 Long: 151.206017
Heritage Listings:	<p>Sydney Terminal and Central Railway Stations Group Heritage Act – State Heritage Register #01255</p> <p>Sydney Terminal and Central Railway Stations Group Heritage Act – S170 NSW State Agency Heritage Register</p> <p>State Rail Authority Heritage Register Study, 1999, Database #4801296</p> <p>Sydney Terminal and Central Railway Stations Group Heritage Item 824 City of Sydney LEP 2012</p> <p>Central Railway Station, Register of the National Estate #2196 (Non Statutory)</p> <p>Sydney Terminal and Central Railway Stations Group National Trust of Australia (NSW) Register #C61721 (Non Statutory)</p>
Prepared by:	<p>Julie Mackenzie , BSc(Arch)BArchMHeritCons, Registered Architect Rebecca Zulaikha, BFA(Hons)BLArchCHeritCons Tonkin Zulaikha Greer Architects Ph: 9215 4900 Fax: 9215 4901</p>
For:	TfNSW, c/o GHD

## 1.2 Limitations

Assessments of cultural significance made by others have been adopted for this report. In the opinion of the author, the recommendations in this report would not be materially altered by any further primary research.

## 1.3 Methodology and Terminology

This report has been prepared in accordance with the Heritage Office and Department of Urban Affairs and Planning publication *Statements of Heritage Impact*, revised in 2002 (published as part of the *NSW Heritage Manual*).

In order to achieve a consistency in approach and understanding of the meaning of conservation by all those involved a standardized terminology for conservation processes and related actions should be adopted. The terminology in *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013* (The Burra Charter) is a suitable basis for this.

The following terms apply to the historic fabric of the site and are included here to assist in understanding of the intent of the conservation requirements in this section.

*Place* means site, area, land, landscape, building or other work, group of buildings or other works, and may include components, contents, spaces and views.

*Cultural significance* means aesthetic, historic, scientific, social or spiritual value for past, present or future generations.

*Fabric* means all the physical material of the place including components, fixtures, contents, and objects.

*Conservation* means all the processes of looking after a place so as to retain its cultural significance.

*Maintenance* means the continuous protective care of the fabric and setting of a place, and is to be distinguished from repair.

*Repair* involves restoration or reconstruction.

*Preservation* means maintaining the fabric of a place in its existing state and retarding deterioration.

*Restoration* means returning the existing fabric of a place to a known earlier state by removing accretions or by reassembling existing components without the introduction of new material.

*Reconstruction* means returning the place to a known earlier state and is distinguished from restoration by the introduction of new material.

*Adaptation* means modifying a place to suit the existing use or a proposed use.

*Use* means the functions of a place, as well as the activities and practices that may occur at the place.

*Compatible use* means a use, which respects the cultural significance of a place. Such a use involves no, or minimal, impact on cultural significance.

*Setting* means the area around a place, which may include the visual catchment.

*Related place* means a place that contributes to the cultural significance of another place.

*Interpretation* means all the ways of presenting the cultural significance of a place.

#### 1.4 Location

Chalmers Street Substation is proposed on an elongated piece of land adjacent to the Central Station Rail corridor. (Figure 1) Prince Alfred Park is located to the southeast of the site whilst to the northeast is the Former Railway Institute building. The proposed Lee Street Substation is located on the opposite side of the railway corridor.



Figure 1: Aerial photograph showing subject site circled red. Proposed Lee Street Substation is circled blue. Source: Google Maps, 2015.

The proposed Chalmers Street Substation is located within the curtilage of Central Station in the Prince Alfred Sidings precinct. (Figure 2)

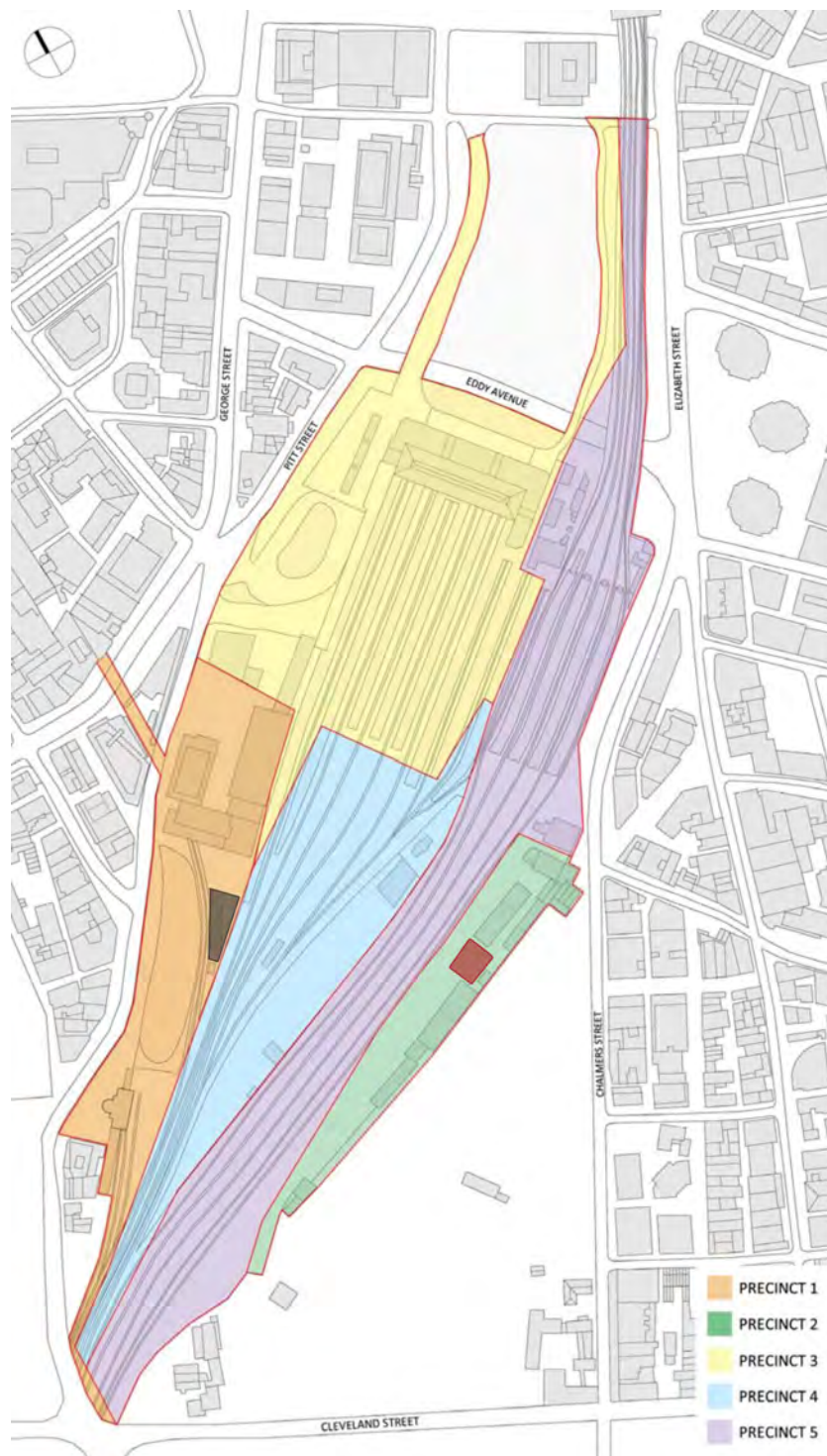


Figure 2: Precinct Map of Central Station: Precinct 1 - The Western Yard, Precinct 2 - Prince Alfred Sidings, Precinct 3 - Sydney Terminal, Precinct 4 - Sydney Yards and Precinct 5 - Central Electric. Location of subject site highlighted red. Location of proposed Lee Street Substation highlighted grey. Source: Central Sydney Conservation Management Plan (CMP), June 2013, p.173.

### 1.5 The Study Area

The proposed Chalmers Street Substation is located in Precinct 2: Prince Alfred Sidings, within the curtilage of Central Station. This precinct contains the Railway Institute Building (1891) in the north-eastern corner and the Prince Alfred Substation (c1926) adjacent to the site of the new proposed substation. The former District Engineers Office and Draughtsman's Office (both currently unused) are located at the southern end of the Precinct. Centrally located between the existing substation and the former Engineers Office and Draughtman's Office is several recently constructed demountable buildings, a car park area and materials storage area. Prince Alfred Park forms the eastern boundary of the Precinct and includes a number of mature trees.<sup>1</sup> The park has recently undergone a major upgrade including the construction of a new pool by City of Sydney and is very popular with local residents and workers.

---

<sup>1</sup> NSW Railcorp and Rappoport Conservation Architects and Heritage Consultants, Precinct 2: Prince Alfred Sidings in Central Station CMP, June 2013, p5.



## 2.0 STATUTORY CONTEXT

### 2.1 The Heritage Act 1977

The *NSW Heritage Act 1977* (the *Heritage Act*) provides protection to items of environmental heritage in NSW. Under the *Heritage Act*, 'items of environmental heritage' include places, buildings, works, relics, moveable objects and precincts identified as significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. State significant items are listed on the NSW State Heritage Register (SHR) and are given automatic protection under the *Heritage Act* against any activities that may damage an item or affect its heritage significance.

The *Heritage Act* also protects 'relics', which can include archaeological material, features and deposits. Section 4(1) of the *Heritage Act* (as amended 2009) defines 'relic' as follows:

*"relic means any deposit, artefact, object or material evidence that:*

*(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*

*(b) is of State or local heritage significance."*

Under Section 57 of the *Heritage Act*, approval is required for works to an item listed on the State Heritage Register. Division 3, Subdivision 1 sets out the method by which approval should be sought and determination made. For works to a SHR item, a Section 60 application must be made for works that are not exempt under Section 57(2) of the *Heritage Act*.

Sections 139-145 of the *Heritage Act* prevent the excavation or disturbance of land known or likely to contain relics, unless in accordance with an excavation permit. Excavation permits are issued under Section 140 of the *Heritage Act*, or Section 60 for sites listed on the State Heritage Register. An Archaeological Research Design must support Excavation Permit Applications.

If the proposed works are minor and would have minimal impact on the heritage significance of the place or site, they may be granted an exception or exemption under Section 139 (4) of the *Heritage Act*.

The works proposed do not qualify for exemption from approval under Section 57(2) of the *Act*, therefore this Statement of Heritage Impact has been prepared to accompany an application to the NSW Heritage Council under Section 60 of the *Heritage Act*.

### 2.2 The State Heritage Register

The State Heritage Register (SHR) was established under Section 22 of the *Heritage Act* and is a list of places and objects that are considered important to the people of NSW. The SHR is administered by the Heritage Branch of the Office of Environment & Heritage and includes a diverse range of over 1500 items, in both private and public ownership. To be listed, an item must be deemed to be of heritage significance for the whole of NSW.

Sites or relics that are listed on the SHR (or are the subject of an Interim Conservation Order) are provided statutory protection under the *Heritage Act*. A Section 60 application can be determined by the Heritage Council of NSW, or in some cases the Heritage Division under delegation.

The proposal is located within the curtilage of SHR listed Sydney Terminal and Central Railway Stations Group (#01255) and therefore subject to the provisions of the *Heritage Act*.

### 2.3 Section 170 Register

The *Heritage Act* requires all government agencies to identify and manage heritage assets in their ownership and control. Under Section 170 of the *Heritage Act*, government bodies must establish and keep a register which includes all items of environmental heritage listed on the SHR, an environmental planning instrument or which may be subject to an interim heritage order that are owned, occupied or managed by that government body. All government agencies must also ensure that all items entered on its register are maintained with due diligence in accordance with State Owned Heritage Management Principles approved by the Minister on advice of the NSW Heritage Council. These principles serve to protect and conserve the heritage significance of identified sites, items and objects and are based on relevant NSW heritage legislation and statutory guidelines.

The subject site is located within the curtilage of Central Railway Station and Sydney Terminal Group (#4801296), which is listed as an item of State Heritage Significance on this Register. Any works carried out within the curtilage of Central Railway Station should be recorded and the Section 170 Register listing updated upon completion.

### 2.4 The Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) establishes a framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act requires that environmental impacts are considered prior to land development; this includes impacts on cultural heritage items and places as well as archaeological sites and deposits. The EP&A Act also requires that Local Governments prepare planning instruments, such as Local Environmental Plans (LEPs) and Development Control Plans (DCPs), in accordance with the Act to provide guidance on the level of environmental assessment required.

As a result of the application of the State Environmental Planning Policy (Infrastructure) 2007 (the Infrastructure SEPP), the proposal is subject to Part 5 of the EP&A Act.

### 2.5 State Environmental Planning Policy (Infrastructure) 2007

The Infrastructure SEPP outlines the permissibility and development controls for infrastructure works and facilities. Clause 79 of the Infrastructure SEPP outlines which railway infrastructure facilities are permissible without the need for development consent under the EP&A Act. As the proposal meets the definitions of rail infrastructure facilities provided by clause 78, it is permissible without consent.

In addition, clause 79(2) of the Infrastructure SEPP permits the alteration, demolition and relocation of local heritage items, and the alteration or relocation of State heritage items for the purpose of rail infrastructure facilities, without the need for development consent.

Clauses 13 to 16 of the Infrastructure SEPP outline the requirements for consultation with councils and other public authorities for infrastructure development carried out by or on behalf of a public authority. The proposal would not trigger any of these requirements, and therefore consultation with the Council of the City of Sydney (Council) and other public authorities is not required under the Infrastructure SEPP. However, relevant agencies have been, and will continue to be, consulted in relation to the proposal by TfNSW.<sup>2</sup>

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<sup>2</sup> GHD/Transport for NSW – Chalmers Street Substation Review of Environmental Factors.

## 2.6 Sydney LEP 2012

The current study area falls within the boundaries of the City of Sydney Council local government area. The site is located within the curtilage of Central Railway Group and in close proximity to a number of Heritage Items listed in Schedule 5 – Environmental Heritage of the Sydney LEP 2012. (Figure 3)

Item #	Item	Significance
#1824	Central Railway Group, including the buildings, station yard, viaducts and building interiors	State
#1472	Former Railway Institute building (within curtilage of Central Railway Group)	State
#1046	Prince Alfred Park, including the fence, tree plantings, ground and coronation cent	Local
#1471	Royal Exhibition Hotel at 86 Chalmers street	Local

Table 1: Table of heritage items in the vicinity listed in Sydney LEP 2012

Cleveland Gardens Conservation Area (C62) lies to the east of the site, whilst the Redfern Estate (C56) and Chippendale Conservation Areas (C9) fall to the south and west respectively. These Conservation Areas are considered to be of local significance. Part 5.10 of the LEP sets out controls related to Heritage Conservation.



Figure 3: Detail of Sydney LEP 2012 - Heritage map sheet HER\_016 showing approximate location of subject site circled in red; heritage items and conservation areas.

## 2.7 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation. The EPBC Act enables the Australian Government to join with the states and territories in providing a national scheme of environment and heritage protection and biodiversity conservation. The EPBC Act focuses Australian Government interests on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of state and local significance.<sup>3</sup> Under the EPBC Act 1999, nationally significant heritage items are protected through their listing on the Commonwealth Heritage List or the National Heritage List.

No items located within or near the study area are listed on the Commonwealth Heritage List or National Heritage List.

## 2.8 Non Statutory Listings

Listing on non-statutory registers does not provide any legal protection to heritage items or sites, but does demonstrate the recognised heritage value of items.

### 2.8.1 Register of the National Trust

The Register of the National Trust was established in 1949 and is maintained by the National Trust of Australia. Following its survey and assessment of the natural and cultural environment, the National Trust of Australia (NSW) maintains a Register of landscapes, townscapes, buildings, industrial sites, cemeteries and other items or places which the Trust determines have cultural significance and are worth of conservation.<sup>4</sup>

Currently, there are some 12,000 items listed on the Trust's Register. They are said to be Classified and Sydney Terminal and Central Railway Stations Group is included on this register as item C61721.

### 2.8.2 Register of the National Estate

The Register of the National Estate is a list of some 13,00 places of natural, Indigenous and historic significance throughout Australia that was originally established under the Australian Heritage Commission Act 1975. The Register of the National Estate ceased to be a statutory register in 2012 and is now maintained on a non-statutory basis as a publicly available archive and educational resource.<sup>5</sup> Central Railway Station is listed on the Register of the National Estate as item #2196.

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<sup>3</sup> <http://www.environment.gov.au/topics/about-us/legislation/environment-protection-and-biodiversity-conservation-act-1999/about-epbc>

<sup>4</sup> <http://www.nationaltrust.org.au/nsw/heritage-register>

<sup>5</sup> <http://www.environment.gov.au/topics/heritage/heritage-places/register-national-estate>

### 3.0 HISTORICAL CONTEXT

#### 3.1 Aboriginal History

The "Eora people" was the name given to the coastal Aborigines around Sydney. Central Sydney is therefore often referred to as "Eora Country". Within the City of Sydney local government area, the traditional owners are the Cadigal and Wangal bands of the Eora. With the European occupation of Sydney region from 1788, the Cadigal and Wangal people were decimated but there are descendants still living in Sydney today.

#### 3.2 Central Station

The following history of Central Station is based on that contained in the NSW Heritage Office listing for *Central Railway Station and Sydney Terminal Group* listing on the NSW Heritage Office Register, the *Central Station Conservation Management Plan* prepared by NSW Railcorp and Rappoport Conservation Architects and Heritage Consultants in 2013 and the *Chalmers street Substation Statement of Heritage Impact* prepared by Rappoport Conservation Architects and Heritage Consultants in 2015.

The crossing of the Blue Mountains in the early 18<sup>th</sup> Century paved the way for the interior of NSW to flourish. The growth of the wool industry and the need to move people around the country led to a driving interest in a rail system connecting regional NSW to Sydney.

In 1855, the Sydney Railway Company constructed the first railway terminus between Devonshire and Cleveland Streets, on land that was known at the time as the Cleveland Paddocks. ( Figure 5 and Figure 6) The first station included timber and corrugated iron station buildings, an engine shed, carriage shed and goods shed. (Figure 8) A branch line to the Darling Harbour wharves and goods yards ran from the western side of the rail yard. The sandstone overbridge constructed in c1855 that carried Parramatta Road across the branch line is the oldest piece of railway infrastructure in the NSW system.<sup>6</sup>

In 1866, the station and the Sydney Yard attached to it were extended, and a new sandstone engine house was constructed on the eastern side. The remaining portion of the Cleveland Paddocks was dedicated as a public reserve and named Prince Alfred Park.

In 1869, the Mortuary Station was constructed in the western yard, to connect to the new general cemetery at Rookwood. Designed by colonial architect James Barnett, it provided a siding with an elaborate gothic station building, which included a chapel and waiting rooms, for the transportation of coffins and mourners to the cemetery. The Mortuary Station building is considered the only surviving example of such a station in situ in the NSW system and is evidence of the first phase of the Sydney Yard (Figure 7).<sup>7</sup>

A 'second station' replaced the original Central Railway Station building in 1876. (Figure 9 and Figure 10) The new station was a neo-classical building constructed of brick with decorative detail using polychromatic and relief work designed by John Whitton, the Engineer-in-Chief.

Between 1876 and 1902, the second station group and its associated yard underwent constant upgrades and expansions, with the addition of carriage sheds, goods sheds, workshops, new sidings and other railway infrastructure.

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<sup>6</sup> NSW Heritage Office Website – Central Railway Station and Sydney Terminal Group Listing, <http://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=4801296>

<sup>7</sup> *ibid*

At its peak there were thirteen platforms in the 1876 station as well as the Mortuary Station. By 1890 a sea of sheds and platform canopies engulfed Whitton's station building.<sup>8</sup>

In June 1888, Edward Miller Gard Eddy was appointed Chief Railway Commissioner and began work on the quadruplication of the Western line to Homebush and the duplication of other suburban lines. As part of this project Eddy proposed that an alternative site be found for Sydney Terminal closer to the city and in 1891 the present site of Central Station was chosen as the site for the third Sydney station. Prior to construction, the land was occupied by the former Devonshire Street cemetery (closed to burials since the 1860s), the Benevolent Asylum (c1818) and a police barracks. (Figure 4)

In 1890, on the eastern side of the yard facing Chalmers and Devonshire Streets, an elaborate Railway Institute building was built to accommodate railway workers as both an educational facility and social clubhouse. A design competition was held and won by the architect Henry Robinson with his Queen Anne Revival style design.<sup>9</sup> (Figure 12)

In 1901, work commenced on the third Sydney station, Central Railway Station, and included the exhumations, excavations and demolition of buildings on the site, as well as, construction of the station. Designed by the Government Architect Walter Liberty Vernon, the station was officially opened on 4 August 1906 despite the building still being incomplete.

For the next two decades work continued to finish the station. The clocktower and upper levels were completed c1916-1921. (Figure 13) Electrification of the lines occurred in 1926 and the Prince Alfred Substation was constructed at this time.

Passengers referred to the new station as '*Central Station*' although its official name was '*Sydney Station*'. (Figure 14 and Figure 15) In 1997 it was recognised as '*Sydney Central Station*' and then renamed '*Central Station*' in 1999.

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<sup>8</sup> NSW Heritage Office Website – Central Railway Station and Sydney Terminal Group Listing, <http://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=4801296>

<sup>9</sup> The Railway Institute was moved to Petersham Station in the late 1970s and the building itself has been converted to commercial office space.

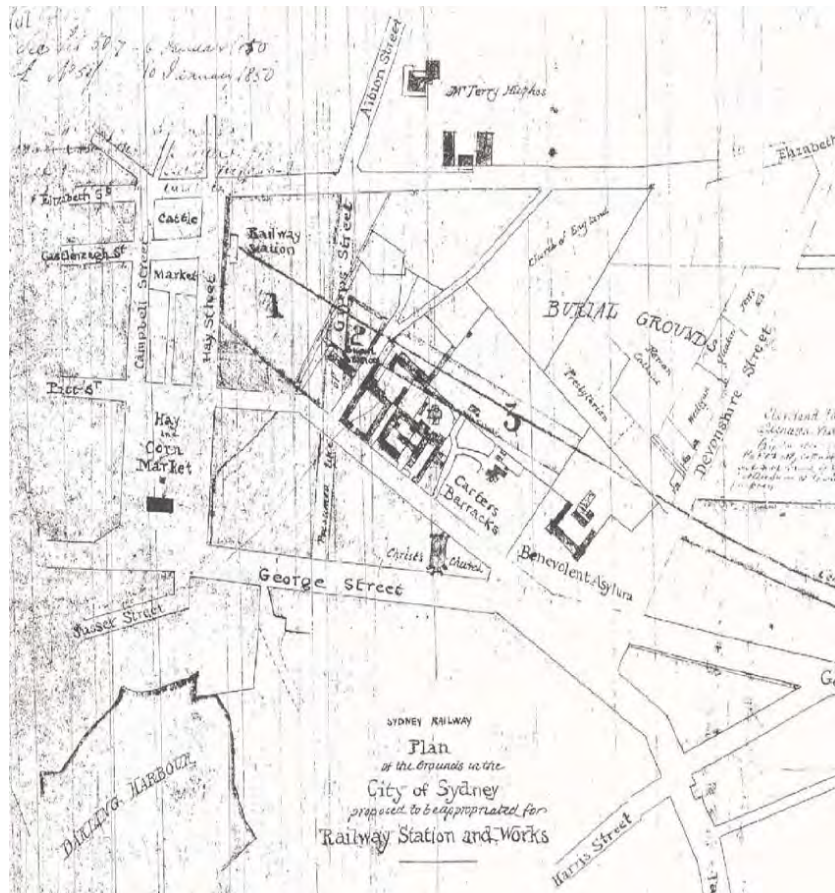


Figure 4: 1848, Plan of the City of Sydney from the Surveyor General's sketch books, showing the location of the buildings demolished to make way for the new station. Source: CBD Metro Archaeological Assessment, p12.



Figure 5: Cleveland Paddocks looking towards Darling Harbour c1853. Source: Central Station CMP, 2013, p32.

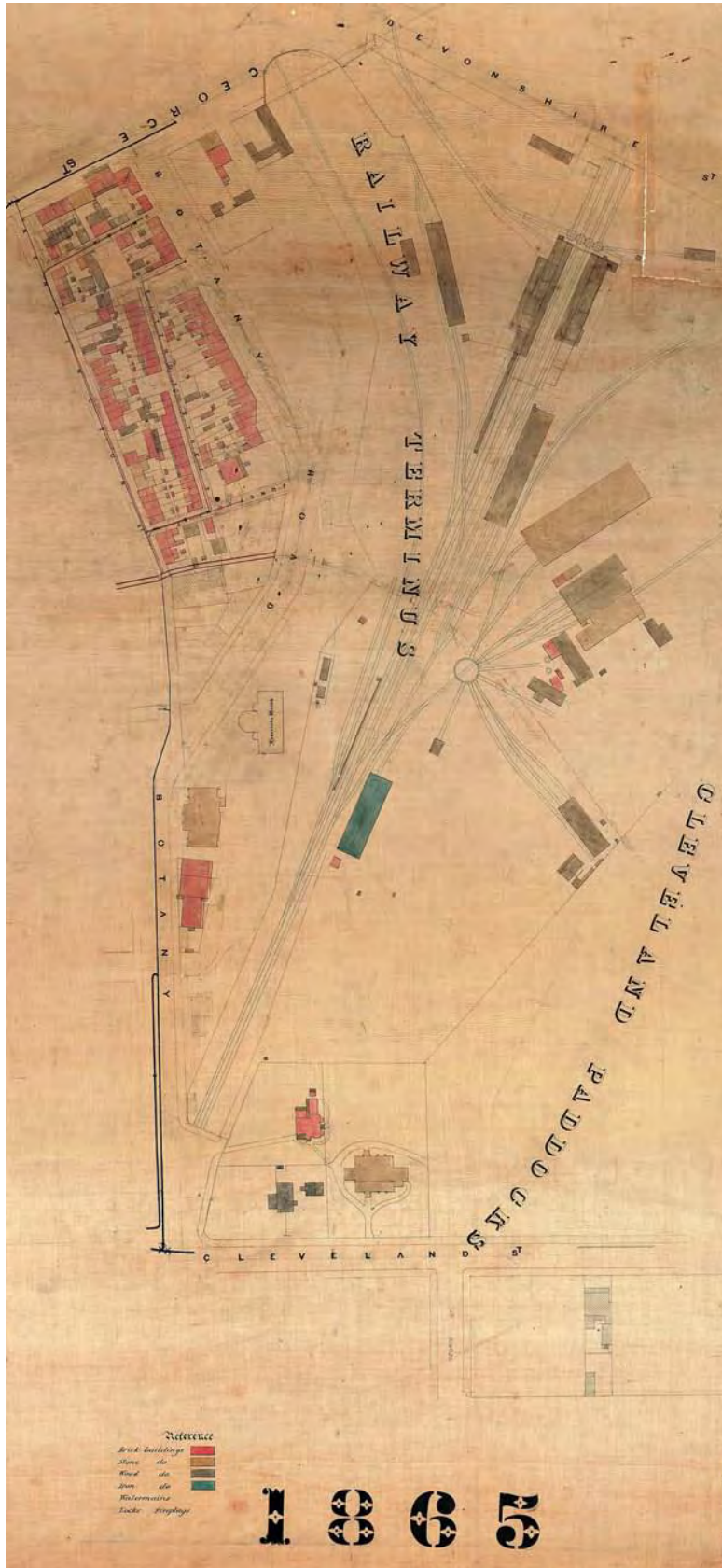


Figure 6: Trigonometric Survey of Sydney (Block S2) showing Cleveland Paddocks in relation to first Sydney Station c1865. Source: Trig Survey of Sydney, 1855-1865, City of Sydney Council website.





Figure 7: c1869 Mortuary Station. Source: MacKillop, *Century of Central*, p9.



Figure 8: Original Sydney Station, 1871. Source: McKillop, *Century of Central*, p.8.



Figure 9: Second Sydney Station, 1874. Source: McKillop, *Century of Central*, p.10.



Figure 10: 1877 View of exhibition building in Prince Alfred Park.  
Source: National Library of Australia, nla.pic-an10608594-100, accessed 13 July 2015.



Figure 11: Southeast view of second Sydney Station, c1890. Central Station CMP, Inventory Sheets p.6.



Figure 12: The Railway Institute Building, c1891.  
Source: NSWRI, Index 129.



Figure 13: The clock tower under construction. Source: Oakes, *Central*, p31.



Figure 14: The completed Station, with the west tram ramp in the foreground, 1924.  
Souce: McKillop, *Century of Central*, p45.

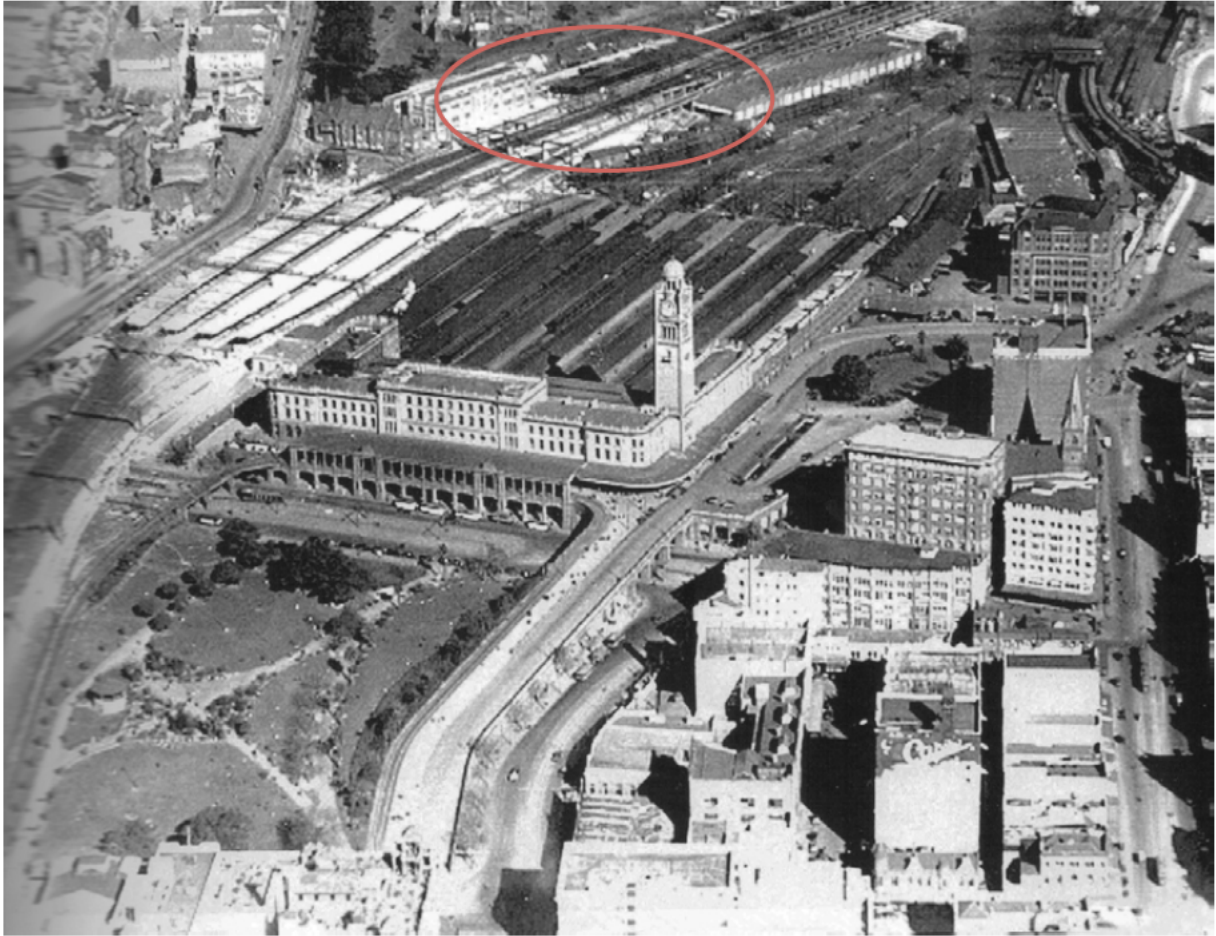


Figure 15: c1930 Aerial view of Central Station looking south. Site location circled red. Note the Railway Institute Building, Prince Alfred Substation and subject site.  
Source: Central Station CMP, 2013, front cover.

### 3.3 Precinct 2 - Prince Alfred Sidings

The following historical summary of the Prince Alfred Sidings is based on that contained in the *Central Station Conservation Management Plan* prepared by NSW Railcorp and Rappoport Conservation Architects and Heritage Consultants in 2013<sup>10</sup> and the *Chalmers street Substation Statement of Heritage Impact* prepared by Rappoport Conservation Architects and Heritage Consultants in 2015.

The Prince Alfred Sidings was part of the original Sydney Yard associated with the first Sydney Railway Terminal that opened circa 1855. The yard was primarily used as storage sheds for produce and goods, (Figure 16) and included a twin gabled Goods Shed (Figure 17), as well as holding various other railway workshops and the first carriage shed.

The Prince Alfred Workshops originally consisted of four similarly designed brick buildings build in the late 1870 to early 1880s. The workshops were used by railway staff and included the Blacksmith's Workshop, the Carpenter's Workshop, the District Engineer's Office (later used as the Safety and Training Offices) and the Draughtsman's Office (later used as the Survey Section and Electric Train Running Section Offices). In the 1990s, the former Draughtsman's Office was temporarily restored and functioned as an office but was soon vacated along with the former District Engineers Office. The District Engineers Office and the Draughtsman's Office are the only surviving buildings from the 1870s station yard. Currently both remnant buildings are vacant and boarded up (Figure 18).

In 1926, the Prince Alfred Substation complex was constructed in order to supply electrification to the newly constructed electric suburban railway network, as conceived by the railway engineer John Bradfield. The Prince Alfred Substation is one of three substations that were designed by Bradfield himself - the other two are at Hurstville and Marrickville.

The construction of Central Electric saw the demolition of the majority of the produce and goods sheds, carriage sheds and some workshops. The width of the area was reduced and the sidings became used for the maintenance and holding of Central Electric rail carriages.

The area was further reduced in the mid 20<sup>th</sup> century with the construction of prefabricated demountable buildings, which have recently been replaced by modern demountables. (Figure 21)

In the 1990s, the use of the sidings as an area for carriage storage and maintenance was completely phased out and the construction of the Airport Rail Link and tunnel resulted in the demolition of the Carpenter's and Blacksmith's Workshop.

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<sup>10</sup> NSW Railcorp and Rappoport Conservation Architects and Heritage Consultants, Precinct 2: Prince Alfred Sidings in Central Station CMP, June 2013, pp2-5.



Figure 16: c1872, View of goods yard of First Sydney Station.  
Source: Precinct 2: Oakes, Central, p10.



Figure 17: c1871, view of twin gabled sandstone Goods Shed constructed in c1860s and demolished in the 1920s to make way for the construction of Central Electric.  
Source: RailCorp CD, photographer unknown, State Rail Authority of NSW Collection, 0398.



Figure 18: District Engineers Office (middle) and Draughtman's Office (right), c1870s. Source: Sheedy, *Sydney Yard Conservation Plan*, 1988.



Figure 19: Carpenters Workshop (now demolished) circa late 20<sup>th</sup> century. Source: Sheedy, *Sydney Yard Conservation Plan*, 1988.



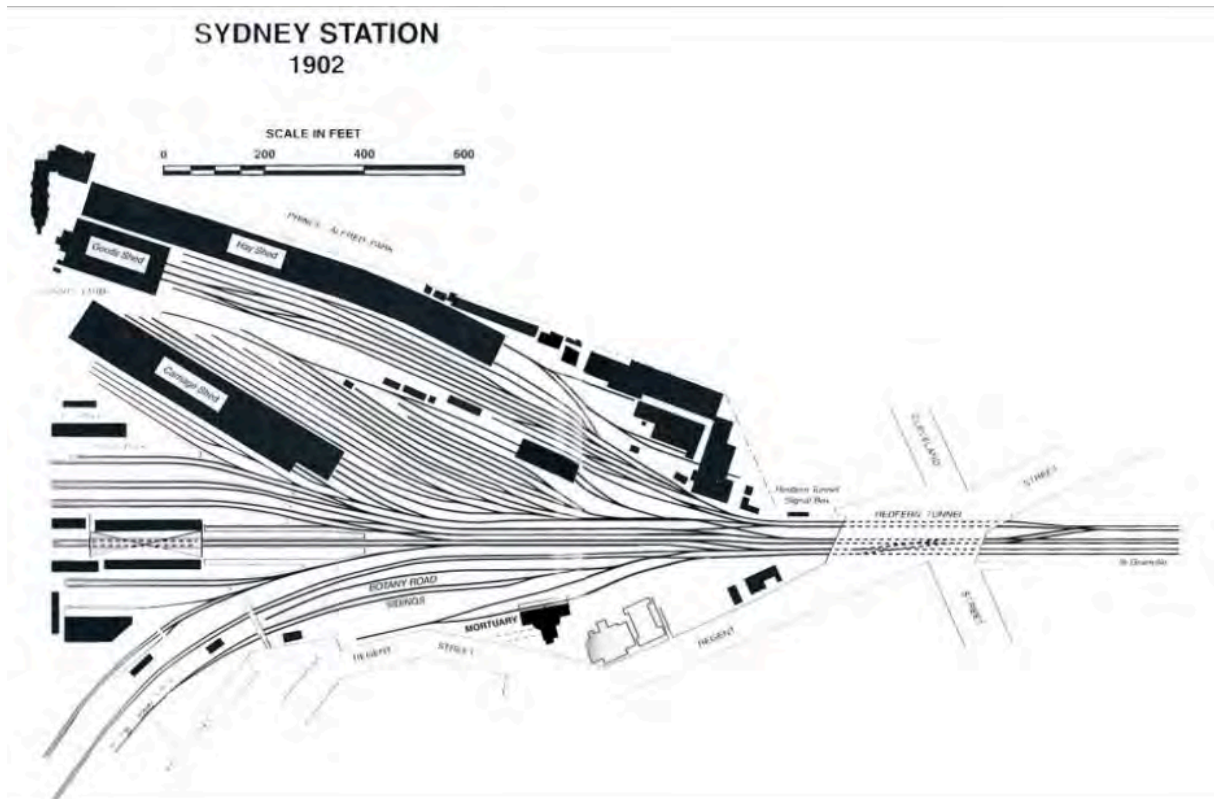


Figure 20: 1902 Plan: The second Sydney Yard.  
 Source: Oakes, *Central*, p12.



Figure 21: 2013: View south of prefabricated buildings referred to in CMP, since demolished. New demountables have been erected in their place. Source: *Precinct 2 - Prince Alfred Sidings in Central Station CMP*, 2013, p2.

## 4.0 SITE AND FABRIC ASSESSMENT

### 4.1 General Setting

Central Station Conservation Management Plan (CMP) identifies the site as being located within Precinct 2 – the Prince Alfred Sidings, an area that lies to the east of Central Station. Prince Alfred Park and Chalmers Street are located to the east of the precinct, with the Devonshire Pedestrian Subway to the north, railway tracks and the Airport Link line to the west and the Cleveland Street Bridge to the south. (Figure 22 to Figure 33)



Figure 22: Looking southeast towards site from end of Platform 17, Central Station.



Figure 23: Looking east across Chalmers Street towards the Royal Exhibition Hotel.



Figure 24: Southeast corner elevation of former Railway Institute Building taken from Chalmers Street.



Figure 25: Interpretation signage for former Railway Institute Building on Chalmers Street fence.



Figure 26: Looking north west from Chalmers Street towards site access road. Entrance to Central Station is on right.



Figure 27: View east from site access road. Former Railway Institute Building is on right.



Figure 28: Looking southeast across park towards Prince Alfred Park Pool.



Figure 29: Looking south across Prince Alfred Park.

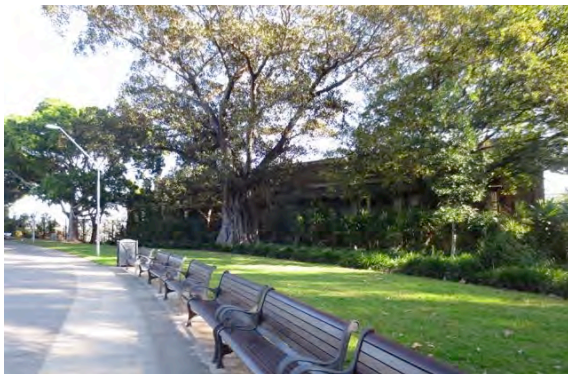


Figure 30: Looking southwest towards boundary of site from Prince Alfred Park.



Figure 31: Looking west towards boundary of site from Prince Alfred Park. Former Railway Institute Building is in view.



Figure 32: Boundary of site and Prince Alfred Park. Mature Fig Trees grow along perimeter.



Figure 33: Looking west into site from Prince Alfred Park. Prince Alfred Substation is in view.

#### 4.2 Central Station Precinct 2 – Prince Alfred Siding

The Prince Alfred Sidings Precinct includes the former Railway Institute Building, the Prince Alfred Substation and associated ancillary buildings, the Former District Engineer's Office and Draughtsman's Office. Centrally located are recently constructed demountable buildings that are used as offices for railway staff, a carpark area and storage areas. The eastern boundary of the precinct is defined by a steep embankment and retaining wall to Prince Alfred Park, which is located at the higher level. (Figure 34 to Figure 56).

The Central Station CMP describes the Precinct in the Inventory Sheet as follows:

*The Prince Alfred Sidings are located on the eastern perimeter of the site, forming the boundary between the Railway yards and Prince Alfred Park. The site is bounded by the Central Electric flyovers on the west, the Devonshire Street Pedestrian Subway to the north and the Cleveland Street Bridge to the south.*

*The precinct contains a number of interesting and substantial buildings. In the north eastern corner of the precinct is the Railway Institute Building, an impressive red brick building with sandstone detailing in the Queen Anne Revival style, constructed in 1891, featuring moulded semi plastic bricks of over twenty different profiles used to form sills, stringcourses and parapets, Dutch Gables occur over the three projecting side bays and to the hipped gallery and a steeply sloping tile roof surmounted by a lead lantern. A library annexe was added in 1898, with a second extension added in 1924. The precinct also contains a large brick substation complex constructed in c. 1926 to supply the new electric suburban system constructed at the time.*

*At the southern end of the precinct are two two storey brick buildings with tiled roofs (being the former District Engineers Office and the former Draughtsman's Office, both currently unused), the only extant parts of the 1870s workshop complex. The Blacksmiths and Carpenters Workshops were demolished in the late 1990s to make way for construction of the Airport Rail Link. Between the substation and the former District Engineers Office and the former Draughtsman's Office are several mid 20th Century demountable buildings, areas of carparking and some material storage. Included in this area are slabs of sandstone that were removed from the Western Forecourt and Hay Street ramp during waterproofing works. They are likely to be former paving stones.*

*The eastern boundary of the precinct is adjacent to Prince Alfred Park, much of which is a steep embankment, and includes a number of mature trees.*

*Demolition: With the construction of the Airport Rail Link and the tunnel under Prince Alfred Park in the late 1990s, the Blacksmiths and Carpenters Workshops were demolished.*

*The remnant working sidings of the mid 1990s have been removed.<sup>11</sup>*



Figure 34: South elevation of former Railway Institute Building.



Figure 35: View southeast towards site. Former Railway Institute Building is on the left.



Figure 36: North elevation of former Railway Institute Building.



Figure 37: View southeast along site access road towards site. Prince Alfred Substation is on left.



Figure 38: Looking east between former Railway Institute Building and Prince Alfred Substation.



Figure 39: North-east façade of Prince Alfred Substation with non original external switches.

<sup>11</sup> Central Station CMP, Prince Alfred Sidings Inventory Sheet, 2013, pp. 5-6.



Figure 40: West elevation of Prince Alfred Substation. Note brick piers and corbelled top. The building has a strong vertical emphasis.

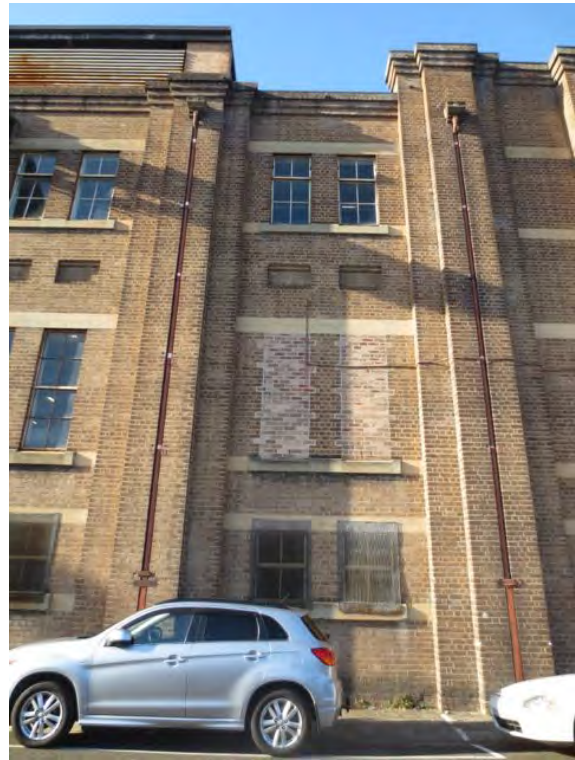


Figure 41: West elevation of Prince Alfred Substation showing infilled windows. Note security mesh covering to ground floor windows.



Figure 42: South elevation of Prince Alfred Substation.



Figure 43: Looking north with Prince Alfred substation on the left and Switching House on the right.



Figure 44: Detail of Pump Well doors.



Figure 45: North west elevation. Pump well doors under stairs on left side.



Figure 46: West elevation of Compressor House. Source: *Prince Alfred Substation in Central Station CMP*, 2013, p2.



Figure 47: Ground floor windows with security mesh over.



Figure 48: View northeast across carpark area towards Prince Alfred Substation and boundary of site.



Figure 49: View southeast towards maintenance facility and office demountable buildings.



Figure 50: Perimeter fence and cable gantry.



Figure 51: Retaining wall and embankment along eastern boundary of site towards Prince Alfred Park.



Figure 52: Hazard materials storage in containers located on northern boundary.



Figure 53: Former Engineer's Office and Draughtsman Office located beyond fence at southern end of the Prince Alfred Sidings.



Figure 54: View of Airport Line and tunnel showing its close proximity to the Draughtsman's Office to left.



Figure 55: Former District Engineer's Office west façade, fenced off and boarded up.



## 5.0 HERITAGE SIGNIFICANCE

Central Railway Station Precinct is listed on the State Heritage Register, Railcorp's S170 Register and Sydney LEP 2012 and the *Central Station Conservation Management Plan* should be used to guide works within the curtilage of the station. Full heritage listings are contained in the Appendices at the rear of this report.

### 5.1 SHR Statement of Heritage Significance Sydney Terminal and Central Railway Stations Group

The significance of the Sydney Terminal and Central Railway Stations Group is summarised in the NSW State Heritage Register Listing #01255 as follows:

#### *THE SYDNEY TERMINAL AND YARDS:*

- *As the site of the first Sydney Terminal and the starting point of the main line, from which the NSW rail network grew;*
- *For its continuity of railway use since 1855;*
- *As the site of one of the first passenger stations in NSW;*
- *As a major terminal by world standards, comparable with late Victorian and Edwardian metropolitan stations in Europe, Great Britain and North America;*
- *Containing the Mortuary Station, one of five pre 1870 stations surviving in the State;*
- *As the first major terminus to be constructed in Australia and the only example of a high level terminus in the country;*
- *As a unique terminal, in NSW, not only in extent but also for the high standard of design of the associated buildings in particular the Mortuary Station, Railway Institute and the Parcels Post Office;*
- *Containing two of the three station buildings, in NSW designed by the Colonial or Government Architect in NSW;*
- *As one of the two longest continuously operating yard/workshop complexes in Australia, dating from the 1850s. Although many of the original functions have been superseded, or operations transferred to other sites, evidence of the working 19th century yard remains extant;*
- *As a major multi-level transport interchange between pedestrians, vehicular traffic and trains and later trams and subsequently buses. Since its establishment in 1855 it has been one of the busiest transport interchanges in Australia;*
- *As the largest formally planned addition to the urban fabric of Sydney prior to World War I, intended to form a gateway to the city;*
- *As the site of the Benevolent Asylum and Carters Barracks and Devonshire Street Burial Ground and Stations, evidence of which is likely to be found in the archaeological record;*
- *As a major public work undertaken in numerous stages between 1855 and 1930 by two branches of the Department of Public Works, the Railway and Tramway Construction Branch and the Colonial (later Government) Architects Branch;*
- *For the evidence provided of the changing technology of train travel from steam to electric trains, indicated not only by the declining yard workforce but also by the changes in yard layout and signalling work practices;*
- *As point of entry to the city for visitors from country NSW and a major departure point for travellers within Australia;*
- *The railway yards, the Mortuary Station, Railway Institute Building, terminus and clock tower are familiar Sydney landmarks, particularly to rail travellers.*

#### *PRECINCT 1: THE WESTERN YARD:*

- *For their continual operation as a rail yard since the introduction of railways to NSW in 1855;*
- *As site of the first and second Sydney Terminals and the Mortuary Station;*
- *Whitten virtually abandoned Sydney work in order to construct the main line network in the country areas.*

*THE DARLING HARBOUR BRANCH LINE*

- *Containing one of the first overbridges and cuttings constructed in Australia, part of the first phase of railway construction in NSW;*
- *As a vital link with Darling Harbour and for the export of wool and other agricultural products from country NSW;*
- *For the surviving fabric which provides evidence of change embankment and retaining wall and bridge construction techniques.*

*THE MORTUARY STATION*

- *As one of a pair of purpose built mortuary or receiving stations, the only known example in Australasia. Whilst the station at Sydney remains in its original location, the Rookwood Station has been relocated;*
- *As a fine, rare example of 19th century Venetian Gothic;*
- *As the finest example of a covered single platform type station in Australia and the most elaborately detailed stations, of its period. The detail includes a rare example of a tiled platform, elaborately carved stonework and joinery, furniture and decorative wrought iron work;*
- *As one of few Gothic Revival buildings designed by the Colonial Architect James Barnet, a highly praised design, marking a high point in his career and considered to be one of his finest designs;*
- *For its association with Victorian rituals surrounding death and mourning. The building was designed as an elaborate setting for the example of the use of trains rather than horse drawn carriages to transport coffins to cemeteries;*
- *As one of few Gothic revival buildings of the period that were designed for a function other than for churches or schools. The style was selected to provide an appropriate atmosphere for the mourners;*
- *As an early example of the introduction of Venetian Gothic motifs including the colonnade which screens the platform;*
- *As a fine example of stone masonry including an arcade with foliated capitals and carved intrados (soffit), metal and wood work.*
- *For the role played by the colonial Architect James Barnet in encouraging the art of stone masonry through his designs;*
- *For its association with the development of the Rookwood Necropolis, one of the largest garden cemeteries in the world;*
- *As a local landmark, visible from locations such as Prince Alfred Park, the Cleveland Street Bridge and the forecourt of Sydney University.*

*THE WEST CARRIAGE SHEDS*

- *One of few surviving working buildings on the site, whose industrial character, specialised layout and form demonstrate former functions and operations;*
- *As the smaller, and remaining of two carriage sheds, built for the servicing of carriages;*
- *Part of the extension of the Sydney Terminal shortly after the turn of the century;*
- *The disuse of the carriage sheds provides evidence of the changing nature of rail travel and work practices, such labour intensive processes no longer being undertaken within the Sydney Yards.*

*PRECINCT 2: THE PRINCE ALFRED SIDINGS*

- *Contain the only remains of a workshop building within the Sydney Terminal complex, which date from the 1870s, and also the Railway Institute;*
- *Mark the eastern boundary of the once extensive Sydney yards.*

*THE RAILWAY INSTITUTE*

- *The first Railway Institute to be established in Australia;*
- *A fine example of the Queen Anne revival style, based on English precedent. The building exhibits characteristic features of the style including Dutch Gables, the use of moulded brickwork and Marseille roof tiles;*
- *For its role in the continuing education of the railway employees, through evening classes;*
- *A setting for social activities for the railway employees;*

- *Containing significant plaques and memorials to railway employees;*
- *Containing a rare, and largely intact, example of a small scale, late Victorian Hall.*

#### *PRECINCT 3: THE SYDNEY TERMINAL - THE TERMINUS*

- *The first major terminus, and the only high level terminal, to be constructed in Australia, the design of which was overseen by experts from NSW, Victoria and Queensland. Comparative in scale and quality of design to the major European and American termini;*
- *A major transport interchange, with numerous tram lines on different levels, the most complex in Australia;*
- *A major planned urban design aimed at improving Sydney, in contrast to the haphazard beginning and former unplanned growth of the rail termini. The only major building of this period in Sydney where the urban setting was consciously designed to complement, and provide views of the main structure;*
- *A symbol of the progress of the development of the city and the railway;*
- *A major public building designed by the Government Architect WL Vernon, and detailed by GM Blair, and completed by his successor George McRae. The only railway station designed by Vernon, and his most adventurous free classical design;*
- *A major sandstone building, one of the few to be constructed, in Sydney, outside of the heart of the CBD. The use of sandstone reflected the status of the building as a major public building;*
- *For its design as an elaborate progression of spaces, from the tram portico to the booking hall to the concourse and into the (proposed) train shed, enhancing the sense of journey. This contrasted with the previous station which had grown into an unplanned conglomeration of platforms;*
- *The largest station to have been constructed in NSW, previously the major country stations such as Albury were grander both in scale and decorative detail than the Sydney Terminal;*
- *The Sydney Terminal would have been even grander had the train shed been constructed covering the platforms. The changing of the design as a cost cutting measure reflects the economic conditions of the time. The construction of Stage Two during the war years, however, reflects the importance of this transport link to the Australian economy;*
- *A rare example, in Sydney, of the use of multi level vehicular approaches, the separate approaches for tram, pedestrian and vehicle, being identified at the outset as being a particular feature;*
- *The clocktower, completed as part of the second stage, is a well known Sydney landmark, nicknamed "the working mans watch";*
- *Containing such planning innovations as separate subways for passengers and baggage handling and the main assembly platform [concourse];*
- *Further investigation may reveal the main assembly platform to be one of the earliest uses of reinforce concrete floor slabs in NSW;*
- *Marking a period of prosperity for the railways and a subsequent decline in other forms of transport, in particular the more unreliable coastal shipping, following construction of the north coast Railway 1910-1922;*
- *The manner in which different structural systems, such as the three pin and crescent truss roofs, were used throughout the design to form a variety of spaces;*
- *The original floor plan indicates separate waiting facilities for different classes of passenger and for women. These distinctions have largely disappeared, with the exception of the use of a system of classes on the transcontinental trains and the XPT and Explorers;*
- *For the inclusion, in the design, of up-to-date technology including telephones and telegraphs.*

#### *THE PARCEL POST OFFICE*

- *The only purpose built post office building, of this period in Sydney;*
- *An indication of the importance of rail in carrying parcels;*
- *An example of the work of the Government Architects Vernon and McRae and their principal design architect, GM Blair;*
- *A fine example of neo-classical detailing on one of the few brick and sandstone public buildings in inner Sydney;*
- *A landmark in Railway Square;*

- *An early example of a concrete and steel framed office building of fire proof construction.*

#### *PRECINCT 4: THE SYDNEY YARD*

- *The yard contains one of the earliest sewers in Metropolitan Sydney, built by the newly formed Department of Public Works in the mid 1850s;*
- *The site of the workshops which were the heart of the working yard in the mid to late 19th century;*
- *Containing evidence of the changing technology of train travel, commencing with steam locomotives in the mid 1850s;*
- *Showing the impact of the decentralisation of railway functions, which began in the 1880s, on the Sydney Yard.*

#### *PRECINCT 5: THE CENTRAL ELECTRIC STATION*

- *Association with JJC Bradfield and the construction of the City Electric Railway, and the Sydney Harbour Bridge in the late 1920s;*
- *One of a number of inner Sydney stations designed by JJC Bradfield, of which two are above ground, Milsons Point and Central Electric;*
- *Containing the most elaborate station entrance (Elizabeth Street), of the City Circle stations;*
- *For the continuation of the neo-classical architectural vocabulary and the use of sandstone for the station building and the viaduct;*
- *For its continuous use as a commuter station for the Sydney suburban lines;*
- *For the use of 'state of the art' reinforced concrete construction.*

The full SHR citation is contained in Appendix A.

## **5.2 S170 Statement of Heritage Significance Central Railway Station and Sydney Terminal Group**

The significance of Central Railway Station and Sydney Terminal Group is stated in the S170 listing, NSW Heritage Inventory Database #4801296 as follows:

*Extracted from 2013 CMP:*

*Central Station is the largest railway station and transport interchange in NSW and is of State significance for its historical, aesthetic, technical values and for its research potential. With its grand sandstone edifices and approaches it is a well known landmark in Sydney.*

*The site contains the original Sydney Railway Company grant on which the first Sydney Station and yards were opened, in 1855, and so represents over 150 years of railway operations in the same place, making it the oldest and the longest continuously operated yard in Australia.*

*The Sydney Terminal precinct has a high level of historic significance associated with its early government and institutional uses, as well as being the site of Sydney's second major burial ground, the Devonshire Street cemetery. Archaeological evidence of the government and institutional uses is rare and has high research potential.*

*Central Station site contains evidence of the first phase of railway construction in NSW and has been the major hub of rail transportation in NSW since the mid 19th century and has the ability to demonstrate the evolution of changes in the NSW railways and in railway technology over the past 150 years, from steam to electric, reflected in the changes in yard layout and in signaling work practices. The Darling Harbour branch line and associated sandstone Ultimo Railway Overbridge is the only remaining example of railway infrastructure built for the Sydney Railway Company and is the oldest piece of railway infrastructure in NSW. The Prince Alfred Sidings contains some of the oldest remaining workshops in the NSW railway system. The Prince Alfred Substation is part of the Bradfield 1926 electrification works and was designed by Bradfield himself. The site has technical heritage value in such elements as: the Darling Harbour Dive; Central Electric's flyovers; the elliptical arch construction of the Elizabeth Street Viaduct; the western approach ramp underbridge the three pin truss roof of the*

*porte-cochère; the Devonshire Street subway (probably the first of its type in Australia); the underground men's toilets; and the early mail, parcels and luggage subway system.*

*The main terminus building, accentuated by its clock tower and approach ramps, exemplifies the predominant use of sandstone at the site and it has been sited to dominate its surroundings and to mark the importance of the railway to both the city and the State. The construction of the Sydney Terminus was the largest planned intervention into the urban fabric of Sydney at the time and it was the only major complex of the period where the urban setting was consciously designed to enhance and provide views to and from the main structure. With its multi layered access modes and above ground level platforms not only was the development extraordinarily innovative but also the largest incursion into the southern part of Sydney prior to World War I.*

*Some of Sydney's most notable 19th and 20th century architects and engineers have worked on the Central Station site, including: James Wallace and William Randle who together designed and built the first railway from Sydney to Parramatta and the associated Darling Harbour Branch Line; the last serving Colonial Architect, James Barnet (Mortuary Station); the first NSW Government Architect, Walter Liberty Vernon (the main Terminus building and the Parcels Post Office); and the Chief Engineer for the City Underground and Sydney Harbour Bridge, Dr John Jacob Crew Bradfield (Central Electric). Mortuary Station, the main terminus building and the Parcels Post Office were the only designs undertaken for the NSW Railways by the Colonial Architect and the Government Architect within the Department of Public Works.*

*The main terminus building is enhanced by its Neo-classical architectural features together with the high quality workmanship and materials it contains, from carved sandstone, marble and terrazzo to cedar joinery, acid etched glazing and metalwork balustrades.*

*The same fine quality in design, materials and workmanship is seen in Mortuary Station, the Railway Institute and also in the Neo-classical Chalmers Street Entrance, the Central Electric Station main façade and the Parcels Post Office, all of which tends to unify these buildings with the main terminus. The Mortuary Station is a fine and rare example by James Barnet of the Gothic Revival architectural style and is the only remaining example of a mortuary station in NSW. The exemplary Federation Anglo-Dutch architectural style of the Railway Institute is significant and it was as the first institute of its type in Australia, demonstrating 19th century initiatives in railway workers educational and recreational facilities. The Parcels Post Office contains fine brickwork and sandstone detailed facades and documents the association of the site with railway postal services.*

*The significance of Central Station is widely appreciated by the broad community for its sense of place and theatre; as an extraordinary place of work for employees past and present and their families; and by many specialist transport and heritage community groups.*

The full S170 citation is contained in Appendix A.

### **5.3 Central Station CMP 2013 Statement of Significance**

The Central Station CMP contains Inventory Sheets for the Prince Alfred Sidings that describe the history and significance of the Precinct and provides conservation policies for each built element.

#### **5.3.1 Significance Precinct 2 - Prince Alfred Sidings**

The Central Station CMP Inventory Sheet contains an overview of Heritage Significance for Precinct 2: Prince Alfred Siding as follows:

*The Prince Alfred Sidings has historical associations with the development of the Sydney rail network and the first and second Sydney terminuses. It is the site of the original rail yards at the Sydney Terminal, commenced in 1855. It also contains the only extant workshops at the Sydney Terminal, which were contemporary with the second Devonshire Street Station.*

*Within this precinct, is the first Railway Institute in Australia.*

It is possible that the area designated as the site for the proposed substation may contain remnant, although most likely disturbed, evidence of the footings of the goods shed and other associated structural features constructed in the area c1871 and demolished in the 1920s to make way for the electric substation. Some evidence of trackwork from the former sidings may be evident in the open area that is currently used as a carpark.<sup>12</sup>



Figure 56: Precinct 2: Prince Alfred Sidings showing the areas of significance. Buildings at both the north east and south west of the site are considered to be of high significance. Buildings centrally located are considered to be of little significance. Subject site circled in red.

### 5.3.2 Grading of Significance Precinct 2 - Prince Alfred Sidings

The overall precinct, Prince Alfred Substation and Prince Alfred Workshops are considered to be of High significance. The Pre-Fabricated buildings are considered to be of Little Significance.

No.	Item	Significance
2.0	Overall Precinct	HIGH
2.1	Prince Alfred Substation	HIGH
2.2	Pre-Fabricated Buildings	LITTLE
2.3	Prince Alfred Workshops	HIGH

*Note that although the Railway Institute Building is contained within this precinct, it is no longer owned or managed by the Responsible Government Agency.*

Table 2: Table showing Prince Alfred Sidings ratings of significance.

<sup>12</sup> Prince Alfred Sidings – Precinct 2 in Central Station CMP, p7.

<b>Element</b>	<b>Grading</b>	<b>Condition</b>
Adjacent Parkland including mature trees (owned by Sydney City Council)	HIGH	Unknown (owned by City of Sydney Council)
Potential Goods Shed	LITTLE TO MODERATE	Unknown
Potential Archaeology – trackwork	NIL	Unknown – likely disturbed

Table 3: Table showing Prince Alfred Sidings Gradings of Significance and Condition from CMP.

## 5.4 Heritage Items within Precinct 2: Prince Alfred Sidings

### 5.4.1 Prince Alfred Substation

The Prince Alfred Substation (2.1) borders the site and is considered to be of high heritage significance. The following overview of Heritage Significance for the Prince Alfred Substation has been extracted from the CMP:

*Of historical technical significance because the building was pivotal to Bradfield's 1926 electrification of the City Circle line and the new Central Electric Station. The Prince Alfred Substation is one of three substations in Sydney designed by Bradfield. The building displays aesthetic significance in the features of the Inter War Stripped Classical architectural style it contains.<sup>13</sup>*

<b>Element</b>	<b>Grading</b>	<b>Condition</b>	<b>Comment</b>
Prince Alfred Substation Overall	HIGH	Fair	
Views and Vistas	LITTLE	N/A	
Context and Setting	LITTLE	N/A	
Main Substation and Annexe	HIGH	Fair	
Ancillary Switching Station	MODERATE	Fair	
Roofs	LITTLE	Good	Recently modified
Brick Facades	HIGH	Fair	Except for brick infill of windows (eastern façade main SS). Brick parapet addition, roof level, northwest corner main SS - intrusive
Doors and Windows	HIGH	Fair	Except where in filled
External Staircases	LITTLE	Fair	
Drainage and Downpipes	MODERATE	Poor	
'NSWGR' Clock by Seth Thomas	MODERATE	Good	Upper office level SS
Timber Roll of Honour	HIGH	Good	
Archaeological Potential	LITTLE to MODERATE	Some potential	In open area to south of substation
Interior elements	LITTLE	Unknown	Note access to interior was not possible in 2013. Assessment is based on 1996 CMP, Inventory Sheet 2.5.1.

Table 4: Table showing Prince Alfred Substation gradings of significance and condition. The substation is considered to be of High significance overall. Source: Prince Alfred Substation – Precinct 2: Prince Alfred Sidings in CMP, p4.

<sup>13</sup> Prince Alfred Substation, Precinct 2: The Prince Alfred Sidings in Central Station CMP, p4.

### 5.3.2 Pre-Fabricated Buildings

The Pre-Fabricated Buildings (2.2) referred to in the CMP, of little significance, have recently been replaced with new demountable buildings.<sup>14</sup>

### 5.3.3 Prince Alfred Workshops

The Prince Alfred Workshops are located at the south western corner of the site and considered to have heritage significance. The following overview of Heritage Significance for the Prince Alfred Workshops has been extracted from the CMP:

*The Prince Alfred workshops are located on part of the original mid 19th Century grant to the Sydney Railway Company and constitute the only remaining buildings on the Central Station site which date back to the 1870s station and yard. The Prince Alfred Sidings themselves are rare being part of the oldest railway yards in NSW. The workshops are some of the oldest remaining workshops in the NSW rail system. While the buildings may not be highly intact, they represent part of the layout of the Prince Alfred Sidings during the Victorian era of the second Sydney Station and appear to be able, to an extent, to demonstrate workshop practices of that era.<sup>15</sup>*

<b>Element</b>	<b>Grading</b>	<b>Condition</b>	<b>Comment</b>
Prince Alfred Workshops Overall	HIGH	Poor	
Views and Vistas	MODERATE	N/A	
Context and Setting	LITTLE	N/A	
Former Draughtsmans Office	HIGH	Very Poor	
Former District Engineers Office	HIGH	Very Poor	
Eastern Embankment	MODERATE	Fair	
Airport Tunnel Entrance	MODERATE	Good	Intersects original eastern embankment
Remnant Sandstone Blocks	HIGH	Fair	
Archaeological Potential	LITTLE to MODERATE	Some potential	Potential for artefact deposits within building cavities.

Table 5: Table showing Prince Alfred Workshops ratings of significance.

All buildings are considered to have High significance.

Source: Prince Alfred Workshops – Precinct 2: Prince Alfred Sidings in CMP, p3.

<sup>14</sup> Pre-Fabricated Buildings, Precinct 2: The Prince Alfred Sidings in Central Station CMP, p3.

<sup>15</sup> Prince Alfred Workshops, Precinct 2: The Prince Alfred Sidings in Central Station CMP, p5.



## 5.4 Curtilage

The NSW Heritage Office publication *Heritage Curtilages* defines 'heritage curtilage' as the area of land surrounding an item or area of heritage significance that is essential for retaining and interpreting its heritage significance.<sup>3</sup>

The proposed site is located within the curtilage of Central Station. (Figure 57).

The listing boundary in the State Heritage Register listings is:

*The listing boundary is formed by Cleveland St overbridge to the south, the property boundary along Prince Alfred Park, Chalmers and Elizabeth Streets, Hay St to the north and Pitt, Lee and Regent Streets to the west.*

The listing boundary in the S170 Register listings is:

*North: the Northern side of the Campbell Street underbridge and south side of Hay Street to include Belmore Park; South: the northern side of the Cleveland Street overbridge (excluding the bridge), East: property boundary line of Prince Alfred Park and the former Railway Institute Building along Chalmers Street and Elizabeth Street; West: property boundary line along Pitt Street, Lee Street and Regent Street. Note the Mortuary Station is included within the curtilage and is also subject to a separate listing (4803219). The adjacent Railway Square underbridge is subject to a separate listing (4801079). The Institute Building, former Parcels Office and Belmore Park are not in RailCorp ownership but are included within the curtilage as they are considered integral to the significance of the site.*

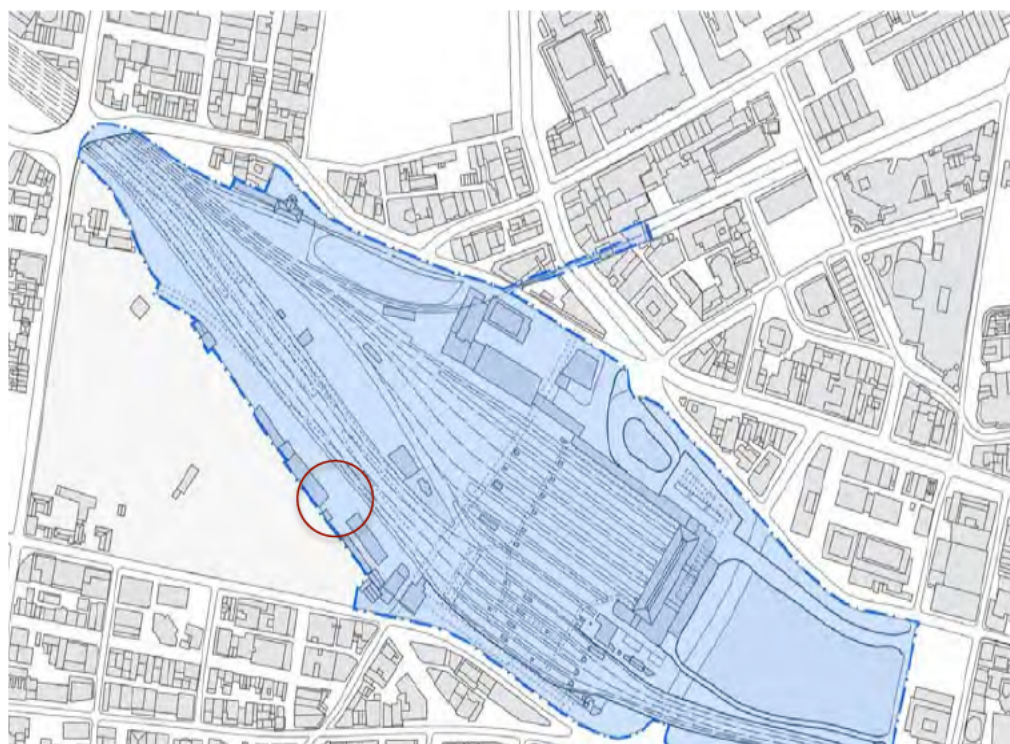


Figure 57: Central Station Curtilage established by CMP, subject site circled.  
Source: Central Station CMP, p.100.

Key views and vistas are shown in Figure 58 below. The site, whilst visible from the end of the platforms and the train line, is not located in an identified key view line.

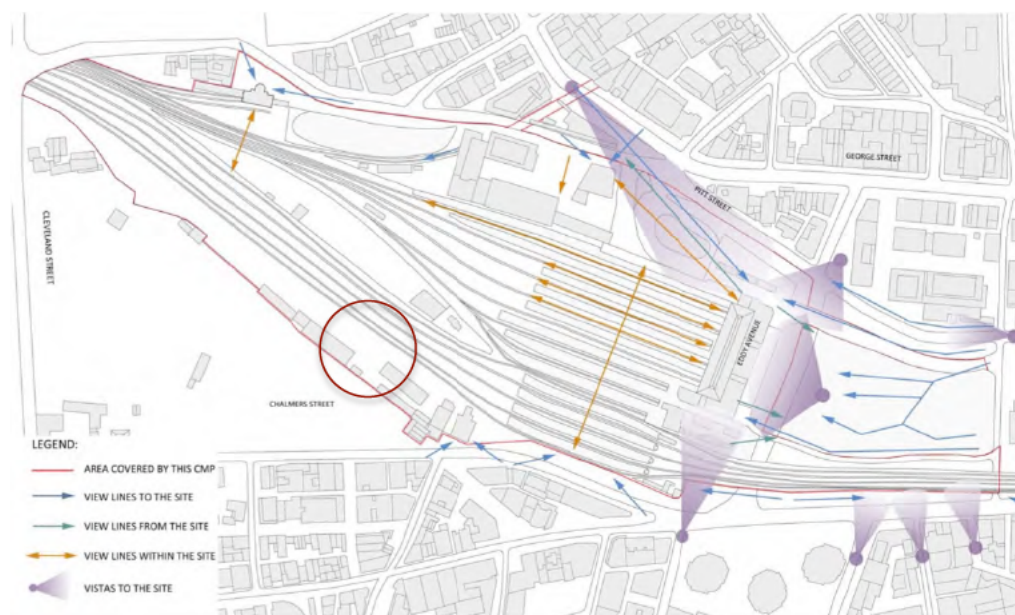


Figure 58: Key Views and Vistas Central Station established by CMP, subject site circled.  
Source: Central Station CMP, p.100.

## 5.5 Heritage Items in the Vicinity

### 5.5.1 Railway Institute Building – NSW Heritage Database #5014176

The Railway Institute Building is included within Precinct 2: Prince Alfred Sidings, however, is no longer owned by TfNSW and hence has its own listing. The building is currently used as commercial offices.

The significance of The Railway Institute Building is summarised in the NSW State Heritage Register Listing #01257 as follows:

*The Railway Institute is culturally significant for the following reasons:*

*It is historically significant as the first Railway Institute building to be erected in Australia, and an important educational facility at the end of the nineteenth and during the twentieth century.*

*The 1891 section of the building is a rare and fine example of the Federation Anglo Dutch style, demonstrating a high degree of architectural quality and detail, particularly on its exterior. Later additions complement this original portion in scale and quality of materials.*

*The building is an important and rare known example of the work of architect Henry Robinson.*

*The building has rare technical significance because it is an outstanding and relatively intact example of a Railway Institute Building and demonstrates the activities which were carried out in association with adult education in the late nineteenth and early twentieth centuries.*

*The building has representative social significance arising out of its seminal role as a railway institute and is still valued by a section of the community.<sup>16</sup>*

<sup>16</sup> NSW Heritage Register Listing – The Railway Institute Building;  
<http://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=5014176>

### 5.5.2 Prince Alfred Park – NSW Heritage Database #2424675

Prince Alfred Park forms the south east boundary of the Prince Alfred Sidings Precinct.

Prince Alfred Park is listed as Heritage Item #1406 in the Sydney LEP which contains the following summary of the park's significance:

*Historically significant as the first park in Australia laid out for the purpose of holding an Agricultural Society Intercolonial Exhibition in 1870. The layout and mature vegetation are extremely important historical items. The park has immense historical and aesthetic significance, and is also of social significance. The park has historical associations with the NSW Agricultural Society and with Benjamin Backhouse, Architect.<sup>17</sup>*

### 5.6 Places of Aboriginal Significance in the vicinity

The area of Central Station is known to be located on Cadigal land, a tribe of the Eora people, and a continued Aboriginal presence has remained despite the documented decimation of the Eora people in the late eighteenth century.<sup>18</sup> The NSW Atlas of Heritage Places and Central Station CMP indicate that there are no particular places of Aboriginal significance on or near the subject site, however the broader area of Central Station and its surrounds contains many historical indigenous associations.

### 5.7 Prince Alfred Sidings Historical Archaeological Potential

The Central Station CMP Inventory Sheet for the Prince Alfred Sidings describes the historical archaeological potential of the Precinct as follows:

*The Prince Alfred Sidings precinct has low to moderate historical archaeological potential associate with post 1880s development of the sidings. This area has been railway land since the 1850s and the establishment of the first Redfern Railway Station.*

*The 1855 survey shows some elongated lightweight structures along the eastern boundary of the precinct, which also forms the eastern boundary of the site as a whole. There are no railway lines within the precinct at this time. By 1865 many of these lightweight buildings are gone. At this time there are few buildings within the precinct with the exception of some sheds at the terminus of a set of sidings extending southwest from the central turntable. These sheds were in the location later occupied by the carpenter's workshop (1880s), which in turn was removed by the Airport Rail Link development in the mid 1990s. It is unlikely any substantial evidence of these pre 1880s sheds or sidings will survive in the archaeological record.*

*By 1884, numerous sheds and sidings are shown in the Prince Alfred Sidings precinct. All of these, except the former District Engineer's Office and former Draughtsman's Office have since been demolished. Many of the sheds in this area appear to have been lightweight, but the large carpenters and blacksmiths shops at the southern end of the precinct were brick and the c. 1871 goods shed at the northern end of the precinct was sandstone (Figure 5). The goods shed was demolished in the 1920s to make way for the electric substation. Some disturbed evidence of the footings of the goods shed and other associated structural features may remain under the open area to the south of the substation. Structural evidence of the carpenters and blacksmiths shops are likely to have been largely removed by construction of the Airport Rail Link.*

*The open areas currently used for carparking on the eastern side of the extant buildings may contain some evidence of trackwork from the former sidings.*

<sup>17</sup> NSW Heritage Register Listing – The Railway Institute Building; <http://www.environment.nsw.gov.au/heritageapp/ViewHeritageltemDetails.aspx?ID=2424675>

<sup>18</sup> Central Station CMP, NSW Railcorp and Rappoport Conservation Architects and Heritage Consultants, June 2013, p.31.

The following diagram (Figure 59) extracted from the Central Station CMP shows that there is potential for archaeological remains to be found within the Prince Alfred Sidings Precinct. As a result, an Archaeological Work Method Statement has been prepared to accompany this application.

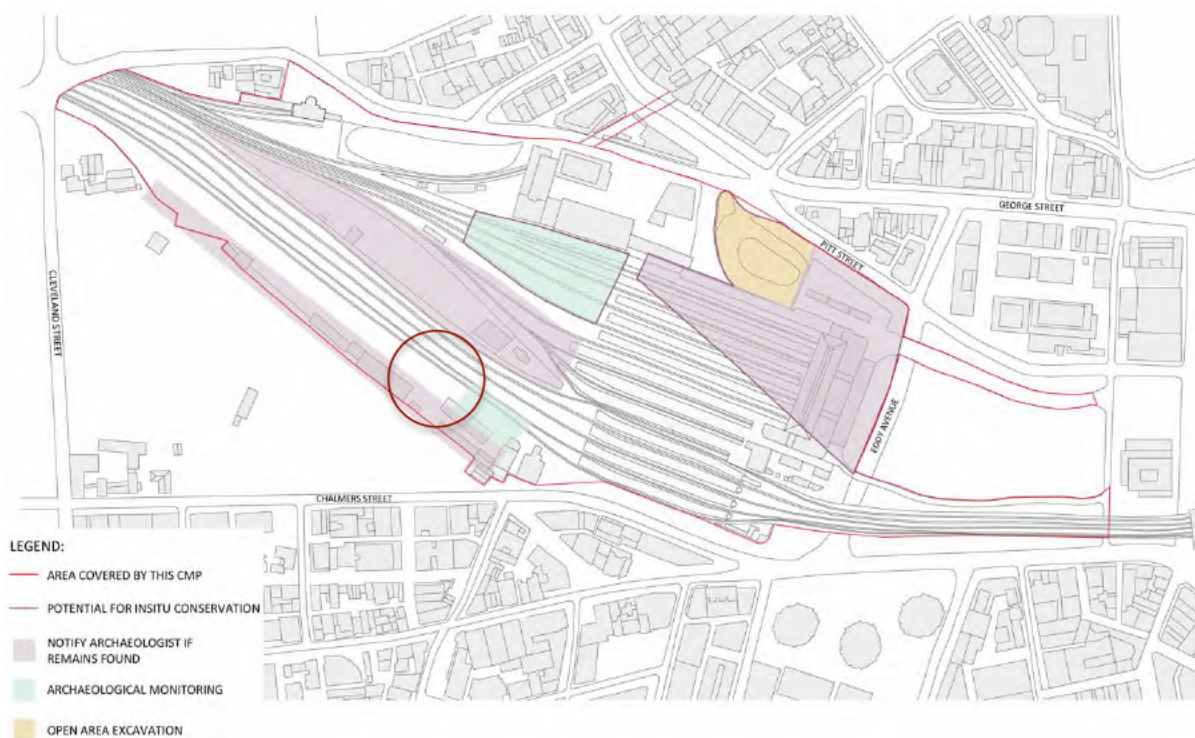


Figure 59: Archaeological management for area of Central Station. Subject site indicated by red circle.  
 Source: Central Station CMP, p114.

## 6.0 CONSERVATION POLICIES

### 6.1 Prince Alfred Sidings Conservation Policies

The following policies extracted from the Central Station CMP, Prince Alfred Sidings Inventory Sheet are relevant to the site. The policies and their relevance to the subject site are shown in Table 6 below;

Policy No.	Policy	Relevance To Subject Site
<b>1. Follow Overall Conservation Policies</b>	See Part 4 and the Conservation Policy Summary at 1.2. in CMP.	<p>The proposal has been developed with an understanding of the significance of the site and the conservation management policies contained in the Central Station Conservation Management Plan (CMP).</p> <p>TfNSW acknowledge the site's heritage values and have referred to the CMP as the principal document to guide heritage management. The CMP should be made available to all contractors working on the project to ensure a full understanding of the heritage values of Central Station.</p>
<b>2. Implement Fabric Guidelines</b>	See Part 5 in this CMP: Fabric Conservation Guidelines.	This policy refers to alterations and maintenance of existing fabric, rather than new buildings and should be followed for any works involving alterations to the Prince Alfred Substation.
<b>3. Heritage Process</b>	<p>When considering change follow the Heritage Flow Charts that form an Appendix to this CMP:</p> <p>A Major Works Heritage process Flow Chart: or</p> <p>B Minor Works Heritage Process Flow Chart</p>	<p>Refer to Flow Charts located at Appendix A and Appendix B, Central Station CMP.</p> <p>Recommended procedures contained in the Central Station CMP should be implemented to carry out the works.</p>
<b>4. Item Specific Policy: Heritage Listing</b>	<p>Ensure appropriate statutory approvals or exemptions are obtained prior to change on the site because:</p> <ul style="list-style-type: none"> <li>- The precinct is within the overall listing on the State Heritage Register under the NSW Heritage Act 1977 for Sydney Terminal and Central Railway Stations Group.</li> <li>- The precinct is within the overall listing of the Central Railway Station and Sydney Terminal Group on RailCorp's Heritage and Conservation Register under Section 140 of the NSW Heritage Act 1977.</li> </ul>	All appropriate statutory approvals and exemptions should be obtained prior to any change on the site due to its SHR, S170 and COS heritage listings.
<b>5. Item Specific Policy: Embankment</b>	Retain the alignment of the boundary between Prince Alfred Park and the Railway Yard.	The proposed substation should not impact on the embankment at the boundary and its alignment between Prince Alfred Park and the Railway Yard.

Policy No.	Policy	Relevance To Subject Site
<b>6. Item Specific Policy: Embankment</b>	<i>Commission and implement a Landscape Maintenance Plan that identifies, and contains provisions for the retention of, any significant planting. Liaise with the City of Sydney to facilitate retention of mature vegetation along embankment along eastern boundary of site.</i>	The proposal does not include any works to the embankment.
<b>7. Item Specific Policy: Development</b>	<i>There is scope for future development on parts of this precinct, particularly where the pre-fabricated buildings are currently relocated. Any development should have limited heritage impact on the adjoining Sydney Yards, Prince Alfred Workshops, Substation or Prince Alfred Park. Carry out a detailed archival recording prior to any works.</i>	Development is possible in parts of the precinct provided it has limited heritage impact on the Prince Alfred Workshops, Substation and Prince Alfred Park.  A site dilapidation survey should be undertaken prior to the works and a detailed archival recording made of specific parts of any heritage items, such as the Prince Alfred Substation, to be changed prior to carrying out the works.
<b>8. Item Specific Policy: Archaeology</b>	<i>If any remnant evidence of the former goods shed needs to be disturbed, this will need to be done under the supervision of a suitably qualified and experienced archaeologist under approval or exemption pursuant to s60 of the NSW Heritage Act.</i>	Works to be carried out in accordance with this policy.

Table 6: Table showing Conservation Policies related to The Prince Alfred Sidings and relevance to subject site. Source: Precinct 2: 2.0 Prince Alfred Sidings, Central Station CMP, pp.6-7.

## 6.2 Prince Alfred Substation Conservation Policies

The following policies extracted from the CMP Inventory Sheet are relevant to the Prince Alfred Substation. Policies 1-4 are general policies as per those for the Prince Alfred Sidings and the policy for archaeology is also the same. The item specific policy for use is relevant to the proposal. It is stated in Table 7 below;

Policy No.	Policy	Relevance To Subject Site
<b>5. Item Specific Policy: Use</b>	<i>Continue the use of these buildings as sub stations, to provide power for the City Electric network. Should the existing use be no longer required, investigate adaptive reuse opportunities of all or part of the complex. Suitable uses could include staff facilities, workshops, or commercial or community use with access from Prince Alfred Park.</i>	The Prince Alfred Substation has outlived its original purpose. The equipment is at the end of its serviceable life and no longer meets the requirements of the BCA for a Class 8 building. The upper levels of the building would be suitable for future adaptive reuse.

Table 7: Table showing Conservation Policies related the Prince Alfred Substation. Source: Precinct 2: Prince Alfred Sidings Inventory Sheet, Central Station CMP, p.5.

### 6.3 Pre-fabricated Buildings Conservation Policies

The policy below relates to the site of the Pre-fabricated buildings, which were previously located to the immediate south of the subject site and have since been replaced with modern demountables. Policy 5 relates to the relationship between redevelopment to Prince Alfred Park and is contained in Table 8 below;

Policy No.	Policy	Relevance To Subject Site
<b>5. Item Specific Policy: Redevelopment</b>	<i>Development on this site is acceptable, as long as the scale of any new structure does not impact upon the context of Prince Alfred Park.</i>	The subject site is located between the demountables and the Prince Alfred Substation. The new substation must not impact upon the context of Prince Alfred Park.

Table 8: Table showing Conservation Policies related the Administration and Services Group.  
Source: Precinct 2: Prince Alfred Sidings Inventory Sheet, Central Station CMP, pp.3-4.

### 6.4 Prince Alfred Workshops Conservation Policies

The Prince Alfred Workshops are located beyond the demountable buildings to the south of the subject site and none of the item specific policies are relevant to the current proposal.

### 6.5 Conservation Policy Summary

In summary the CMP permits redevelopment of the subject site provided it is done sensitively so that it has minimal impact on the heritage significance of Central Station, the Prince Alfred Substation, Prince Alfred Park and other heritage items within the vicinity. The proposed substation should not impact on the embankment at the eastern boundary and its alignment between Prince Alfred Park and the Railway Yard.

A site dilapidation survey should be undertaken prior to the works and a detailed archival recording made of specific parts of any heritage items, such as the Prince Alfred Substation, to be changed prior to carrying out the works. Adaptive reuse of the Prince Alfred Substation and ancillary buildings is permissible.

With respect to archaeology, the CMP Gradings of Significance and Condition for Prince Alfred Sidings grades potential archaeology as *nil, condition unknown – likely disturbed* however for the Prince Alfred Substation it grades potential archaeology *little to Moderate – some potential in open area south of substation*. This is the area of the subject site.

Prince Alfred Sidings Conservation Policy 8 and Prince Alfred Substation Conservation Policy 5 states:

*If any remnant evidence of the former goods shed needs to be disturbed, this will need to be done under the supervision of a suitably qualified and experienced archaeologist under approval or exemption pursuant to s60 of the NSW Heritage Act.*

The Archaeological Management Plan contained in the CMP indicates that an archaeologist should be notified if remains are found in the area.

## 7.0 THE PROPOSAL

### 7.1 Background

Transport for NSW is currently undertaking the Power Supply Upgrade Program to meet the actual and projected increase in power demands on the Sydney Trains electrical network. A power supply study undertaken as part of the program found that the existing Prince Alfred Substation needs to be replaced.

Transport for NSW is proposing to replace Prince Alfred Substation with two new substations; one at Lee Street and one at Chalmers Street. The two proposed substations would be located within the heritage listed precinct of Central Station, within or near the rail corridor.<sup>22</sup>

In April 2015 a proposal to construct the Chalmers Street Substation, a new two-storey substation adjacent the Prince Alfred Substation, was prepared by GHD. (Figure 63) In May 2015 Tonkin Zulaikha Greer Architects were engaged by TfNSW to prepare façade studies for the substation. This commission was extended in June 2015 to include the documentation of an alternate façade for the building. The TZG façade forms part of the current proposal.

### 7.2 Description of the Proposal

The proposed site is accessed via the existing roadway entrance to the Prince Alfred Sidings Precinct, located to the south of the Chalmers Street entrance to Central Station. The proposal involves construction of a new substation on the hardstand area between the existing Prince Alfred Substation and the new Sydney Trains CBD Network Base. This site occupies part of the footprint of the former Lighting Depot and demountable buildings. The proposal also involves works to the existing Prince Alfred Substation building.

The *Chalmers Street Substation, Review of Environmental Factors* (REF) prepared by GHD describes the proposal as follows:

*The proposal involves the construction and operation of a new two-storey substation within the Prince Alfred Sidings Precinct (owned by Sydney Trains). The new substation would supply traction power to the Main Line tracks and the Eastern Suburbs Railway around Central Station, as well as power to the Sydney Trains 11 kV network. It would include electrical equipment, together with office facilities and staff amenities.*

*The new substation would be accessed via the existing access driveway to the Prince Alfred Sidings Precinct, which is located to the south of the pedestrian entrance at Central Station, near the intersection of Chalmers Street and Devonshire Street.*

*The proposal also includes works to the existing Prince Alfred Substation to allow the existing substation western cable tunnel to be extended and reused as a high voltage feeder cable route. Other works to the existing substation would involve fire isolating the substation building to enable it to be repurposed for other uses, and constructing a new link room on the north-eastern corner of the Prince Alfred Substation, outside the existing building.<sup>23</sup>*

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<sup>22</sup> GHD, Transport for NSW, *Power Supply Upgrade Program, Chalmers Street Substation, Central Station, Review of Environmental Factors*, April 2015

<sup>23</sup> *ibid*



The proposal has been designed to integrate all relevant considerations, including:

- the heritage significance of the State heritage listed Central Station site/group
- urban design and visual considerations
- functional and operational needs and requirements
- access and maintenance
- security.

The proposal includes the following works:

#### **Site works**

- Establish temporary construction compound
- Site leveling, excavation and piling for new footings and slabs
- Possible duplication of existing overhead wiring structure

#### **New Substation**

- Construct a new two storey substation with natural grey flat precast concrete panels to the lower level and natural grey vertically ribbed precast panels to the upper level, with one face of the ribs painted a colour and vertical bays of ventilation storm louvres between the precast panels. Storm louvres, security mesh, roller shutters and other personnel doors are proposed to be metal with a powder coat paint finish.
- Construct a basement level cable tunnel to connect to existing Prince Alfred Substation cable tunnel.

#### **Alterations and additions to the Prince Alfred Substation**

##### *Underground*

- Excavation associated with the extension of the cable tunnels and fire egress under the driveway to connect to the new substation at basement level
- Construction of new stairs at basement level below the existing north east stairs
- Construction of a new staircase inside the basement cable tunnel between the proposed building and the main Prince Alfred Substation building
- New openings at basement level to connect the cable tunnel beyond.
- Underpinning of corners of existing substation adjacent cable tunnel connection
- New cable tunnel under driveway to connect to track side with wing walls to cable head wall in the rail cutting

##### *Above ground*

- Construction of a new Eastern Suburbs Rail Link Room (the link room) to the north east facade of the Prince Alfred Substation connecting to the existing cable tunnels in Prince Alfred Substation
- Repairs and security treatment to the pump well doors at the north east end of the north west façade which are to be fixed shut
- Replacement of the existing ground floor windows with steel ventilation louvres backed with security mesh (18 off)

#### **Ancillary Works**

- Construction of a new steel framed platform and security mesh enclosure for a new harmonic filter, switchboards and transformers.

The proposal is described in the following architectural drawings titled, *Chalmers Street, Airport Line 0.352km, Substations – Power Supply Upgrade*, prepared by TZG and GHD, which are included as an Appendix at the rear of this report:

Firm	Number	Drawing	Revision
TZG	SK-01	Site Plan	02
TZG	SK-11	Ground Floor Plan	02
TZG	SK-12	Level 1 Plan	02
TZG	SK-21	Elevations 1	02
TZG	SK-22	Elevations 2	02
TZG	SK-23	North Elevation Overall	02
TZG	SK-25	Façade Plan Setout and Detail – Ground Floor	01
TZG	SK-27	Façade Details 1	01
TZG	SK-28	Façade Details 2	01
TZG	SK-29	Finishes Schedule	01
TZG	SK-31	3D View 1	02
TZG	SK-32	3D View 2	02
TZG	SK-33	3D View 3	02
TZG	SK-35	3D View 1 – View from North	02
TZG	SK-36	3D View 2 – View from Rail Corridor	01
TZG	SK-37	3D View 3 – View from Park	01
GHD	2656-2650-CSSS-AR-0002	Site Plan	D
GHD	2656-2650-CSSS-AR-0003	Basement Floor Plan	C
GHD	2656-2650-CSSS-AR-0004	Ground Floor Plan	D
GHD	2656-2650-CSSS-AR-0005	Level 1 Floor Plan	E
GHD	2656-2650-CSSS-AR-0006	Roof	D
GHD	2656-2650-CSSS-AR-0010	North West Elevation	E
GHD	2656-2650-CSSS-AR-0011	South West Elevation	D
GHD	2656-2650-CSSS-AR-0012	North East Elevation	D
GHD	2656-2650-CSSS-AR-0013	South East Elevation	D
GHD	2656-2650-CSSS-AR-0015	Sections	D
GHD	2656-2650-CSSS-AR-0020	Perspectives	D
GHD	2656-2650-CSSS-AR-0030	PA Substation Cable Tunnel	D
GHD	2656-2650-CSSS-AR-0031	ESR 1500V Link Room and Environs	D
GHD	2656-2650-CSSS-AR-0032	ESR 1500V Link Room	C
GHD	2656-2650-CSSS-AR-0033	ESR 1500V Link Room PA SS Cable Shaft	B
GHD	2656-2650-CSSS-AR-0034	Prince Alfred Substation Elevations	A

Table 9: Drawing list.



Figure 60: View from access road looking south past Prince Alfred Substation. TZG, 2015



Figure 61: View from the rail corridor looking north east. TZG, 2015





Figure 64: Existing survey Prince Alfred Substation. Degotardi, Smith & Partners, 2015



Figure 65: Proposed elevations Prince Alfred Substation. Degotardi, Smith & Partners, 2015

### 7.3 Options Considered

The existing equipment in the Prince Alfred Substation is at the end of its working life and the building, whilst in relatively good condition, is no longer considered fit for purpose as it does not meet the requirements of many current standards including the Earthquake Code and the BCA.

Many options were considered in the design process prior to TZG's involvement ranging from doing nothing, to upgrading the Prince Alfred Substation and to constructing two new substations at Lee Street and Chalmers Street to replace the existing substation and adaptively reusing the building for another purpose.

The REF noted:

*Upgrading the Prince Alfred Substation was not considered to be a viable option for the following reasons:*

- *much of the equipment within the existing substation is nearing the end of its economic life*
- *upgrading the existing substation would involve undertaking construction activities in an operational substation over long time durations (during rail shutdowns only), increasing the risk of network reliability issues*
- *the upgraded substation would not comply with existing building standards under the Building Code of Australia and Australian Standard AS 2067-2008 Substations and high voltage installations exceeding 1 kV a.c, as a result of restrictions imposed by the site and its configuration*
- *it is a high cost option*
- *the Sydney Trains Electrical Operations Centre is located within the Prince Alfred Substation building and therefore any expansion within the building would also require the relocation of these operations.<sup>24</sup>*

As a result, doing nothing was not really considered a viable option, nor was upgrading the existing Prince Alfred Substation.

The preferred option involved replacing the Prince Alfred Substation with two new substations and Lee Street and Chalmers Street. The Lee Street substation is located on the opposite side of the rail corridor and has been submitted as a separate s60 application. This substation has been designed to supply traction power to the Sydney Central Yard tracks. The proposed new substation at Chalmers Street has been designed to supply traction power to the Main Line and Eastern Suburbs Line tracks around Central Station and to provide supply to the 11kV network.

The REF concludes:

*Replacing Prince Alfred Substation with the new substations would address the non-compliance issues, as the new substations would be built in accordance with current standards and building guidelines. It would also avoid the risk of network reliability issues associated with upgrading the existing substation.*

*Although the proposed substations at Lee Street and Chalmers Street can be constructed and operated individually, both are required to meet the objectives of the PSU Program.<sup>25</sup>*

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<sup>24</sup> GHD, Transport for NSW, *Power Supply Upgrade Program, Chalmers Street Substation, Central Station, Review of Environmental Factors*, April 2015

<sup>25</sup> *ibid*

### 7.3.1 Previous Façade Proposal

The façade to the Chalmers Street substation designed by GHD comprised a combination of pre cast concrete panels, brick faced precast concrete panels, steel framed security mesh and aluminium louvres in a vertical arrangement as illustrated below. (Figure 66)



Figure 66: 2015 Proposal for Chalmers Street Substation, GHD.

Rappoport Heritage Consultants assisted GHD with this design to mitigate the potential for heritage impacts and prepared a Statement of Heritage Impact to accompany the proposed new substation, works to the Prince Alfred Substation and ancillary works. Rappoport describe the proposed new substation as follows:

*The design of the proposed building primarily reflects its technical function. Rappoport has worked with the architects to inflect the design so as to both sympathise with the site and preserve the distinct identity of the adjacent Prince Alfred Substation group. The materials would be primarily brick, in colours reflecting those of the site: the dark brown of the existing Substation and several other buildings across the Central Station site (including the proposed Lee Street substation), and the lighter colour of the nearby former Railway Institute. The facades of the building would be divided into vertical sections, as well as by full height louvred openings, to reflect the vertical emphasis of both Substation and Institute. At the same time there is no attempt to mimic those buildings; the design is frankly contemporary, rendering it distinguishably contemporary as required by Article 22.2 of the Burra Charter and preserving the legibility and significance of the Substation group.<sup>26</sup>*

<sup>26</sup> Rappoport Heritage Consultants, *Statement of Heritage Impact, New Chalmers Street Substation & Associated Works, Prince Alfred Sidings, Central Station, Sydney, NSW, April 2015*

### 7.3.2 Tonkin Zulaikha Greer Architect's Façade Options

TZG worked with GHD to design the recently submitted Lee Street Substation and hence are familiar with the heritage constraints of the Central Station site. The Chalmers Street substation is located across the rail corridor opposite the site of the Lee Street Substation, and it was considered important that there be a dialogue between these two contemporary elements within this historic railyard setting and that they hence share a common language. The relationship to the context, particularly the neighbouring Prince Alfred Substation, was also critical to the design in terms of character, scale, form, siting, materials, colour and detailing.

At the outset of the current project Tonkin Zulaikha Greer Architects (TZG) inspected the site and reviewed the recommendations for the Prince Alfred Sidings Precinct contained in the CMP. Constraints and opportunities were then identified to inform the design process.

At preliminary design stage, five options were developed for the substation enclosure that responded to the urban and heritage context and that met all of the functional requirements behind the 'skin' of the building. These façade options were workshoped with key TfNSW stakeholders and also assessed from a heritage perspective. Key views were considered and the relationship between the new building and the Prince Alfred Substation assessed. The preferred option was then developed to form the basis of the current proposal.

The substation comprises two interlocking forms – the two storey substation itself and the adjacent transformer yard which is open to the sky. The facade options shared a common design approach to the building, treating it as a distinctly contemporary freestanding sculptural element that interpreted the movement of trains in its façade treatment. A vertical emphasis to the façade was adopted to achieve this aim and to relate it to the brick piers of the neighbouring Prince Alfred Substation and to the Lee Street Substation proposed across the tracks.

All façade options experimented with a moiré effect, similar to the design for the Lee Street Substation, to accentuate the sense of movement perceived when passing the substation from the rail corridor. This was achieved through the repetition of evenly spaced vertical elements. The substation at Chalmers Street is larger than that at Lee Street and has a much greater ventilation requirement, requiring full height louvres. The relationship to the heritage listed Prince Alfred Substation influenced the proportioning of the façade elements at Chalmers Street, making it different to Lee Street, but from the same family, utilising a similar architectural language and palette of materials.



### Option 1

In Option 1, the substation walls comprised of bays of aluminium louvres sitting on a 1m high concrete upstand for protection. The bund walls to the transformer yard were detailed as 200mm thick flat precast concrete panels. (Figure 67-69) This option was the least expensive, however did not have a good relationship to either the Prince Alfred Substation nor the Lee Street Substation.

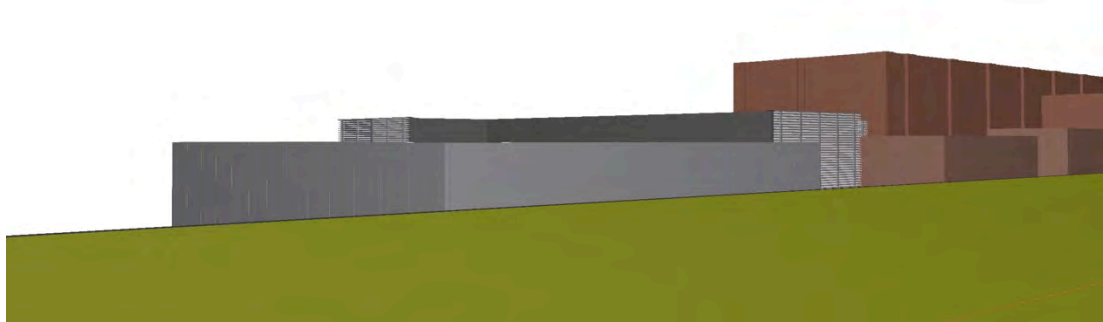


Figure 67: Option 1 View 1, TZG Architects

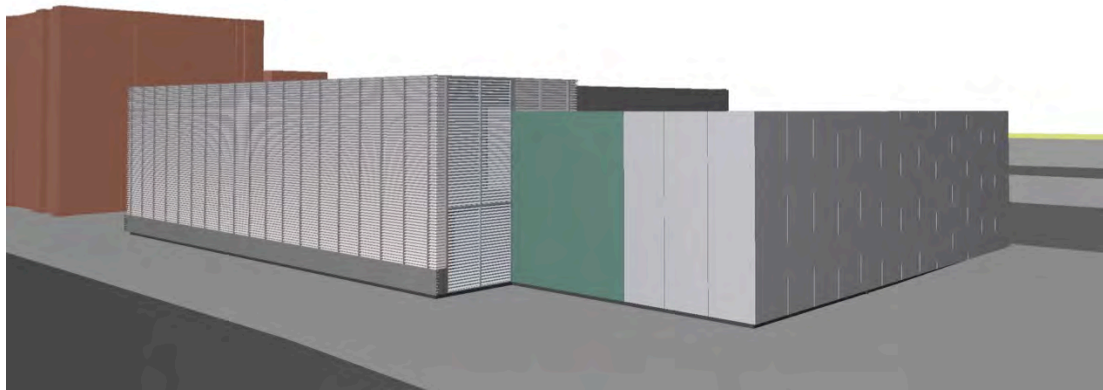


Figure 68: Option 1 View 2, TZG Architects

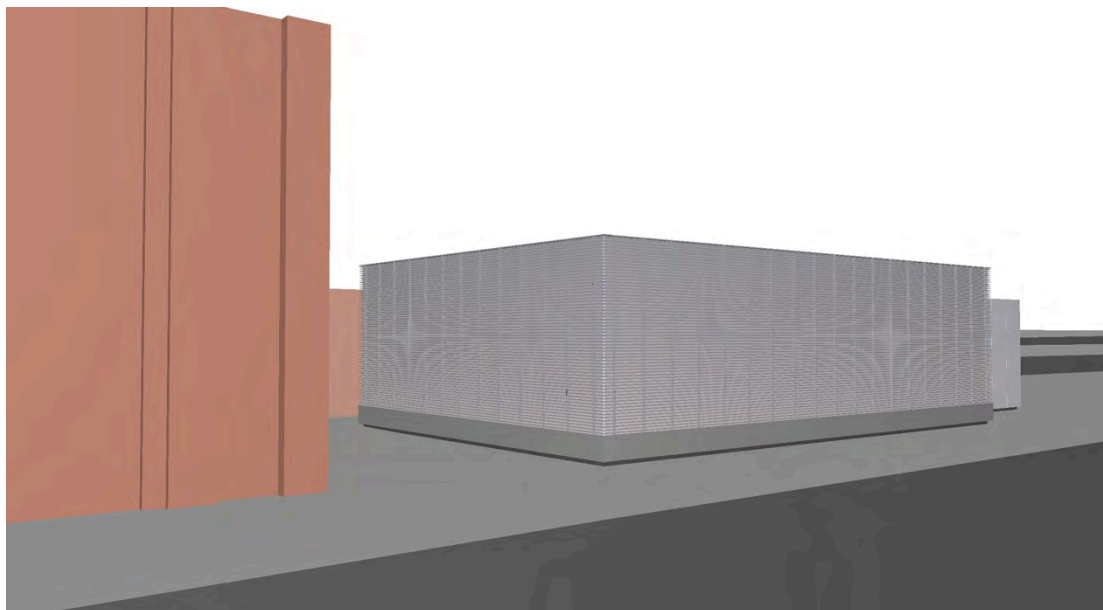


Figure 69: Option 1 View 3, TZG Architects

## Option 2

After concerns about the extensive use of metal in a potentially live electrical environment were voiced, Option 2 was developed where the façade of the substation was made up of precast concrete panels with a vertical ribbed detail to the upper level and flat precast panels to the lower level, similar to that proposed at Lee Street. The overall wall thickness of the panels was increased to 300mm. (Figure 70- 72). The proportion of the louvre bays was not considered appropriate and the bund walls impractically high.

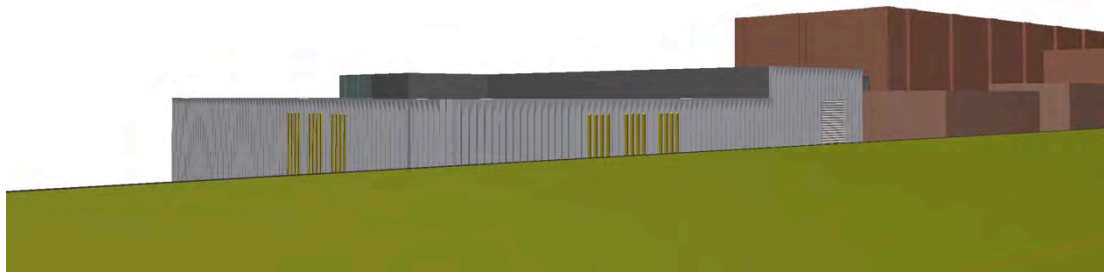


Figure 70: Option 2 View 1, TZG Architects

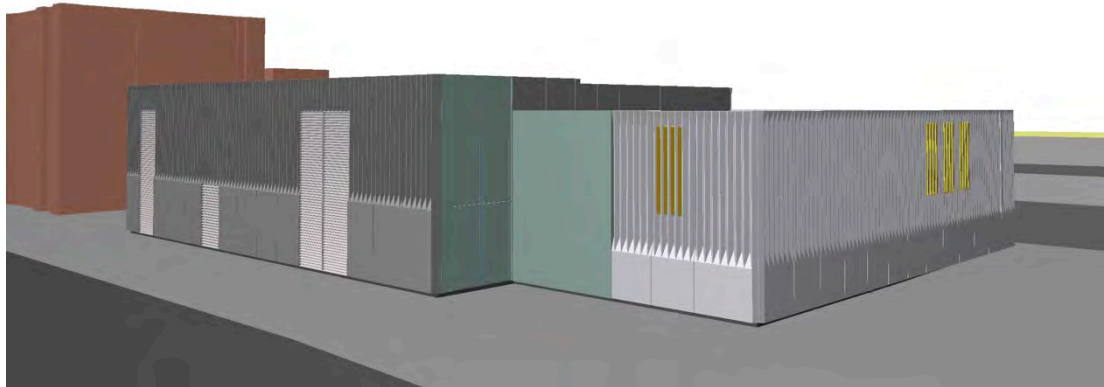


Figure 71: Option 2 View 2, TZG Architects

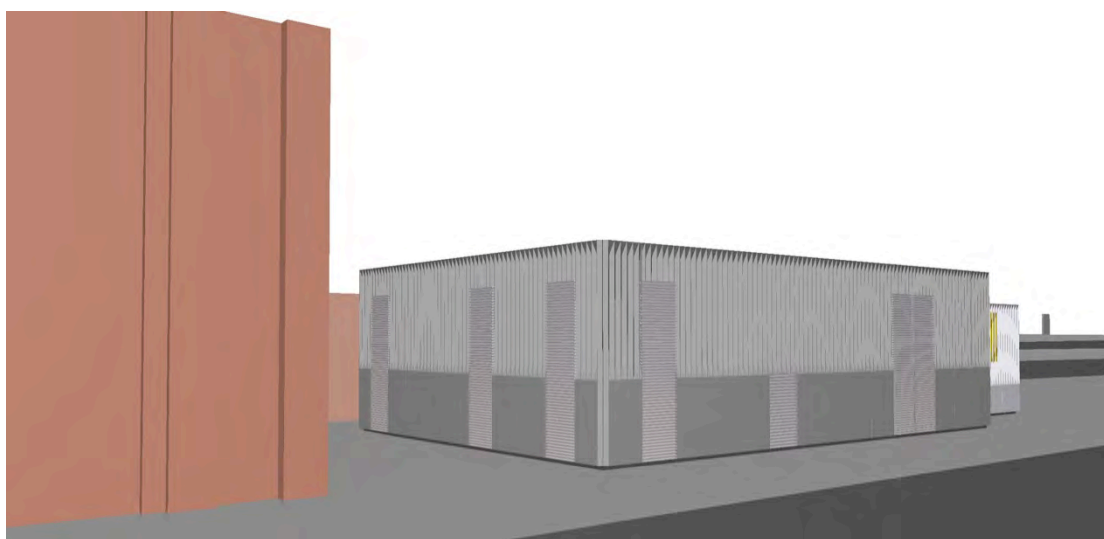


Figure 72: Option 2 View 3, TZG Architects

### Option 3

Option 3 differs from Option 2 in the detailing of the flat precast panels at ground level. This option was developed in response to GHD's initial concerns about achieving clearances between the new substation and adjacent building structures and site elements. Therefore in this option, the ground level precast elements were reduced to 200mm thickness with the upper level panels projecting. (Figure 73– 75). The proportion of the vertical louvre bays was also not considered sympathetic to the Prince Alfred Substation in this option.

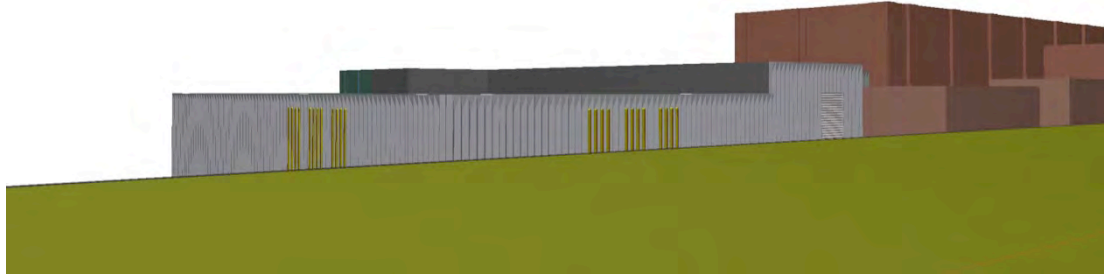


Figure 73: Option 3 View 1, TZG Architects

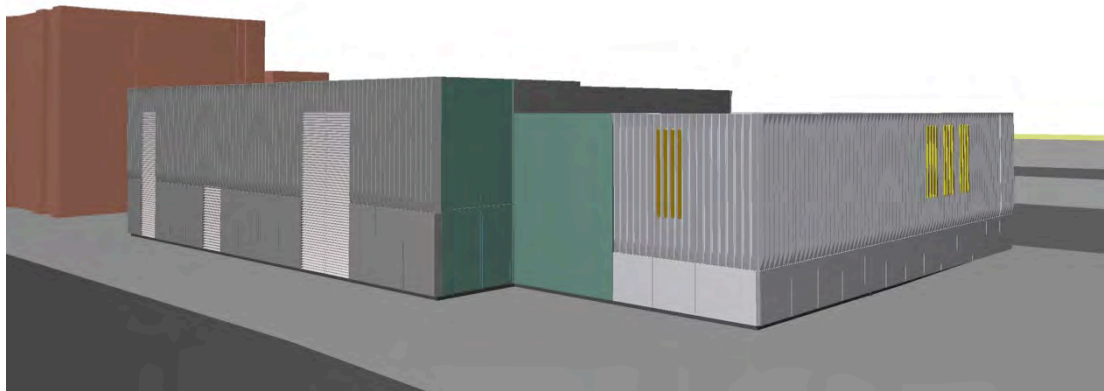


Figure 74: Option 3 View 2, TZG Architects

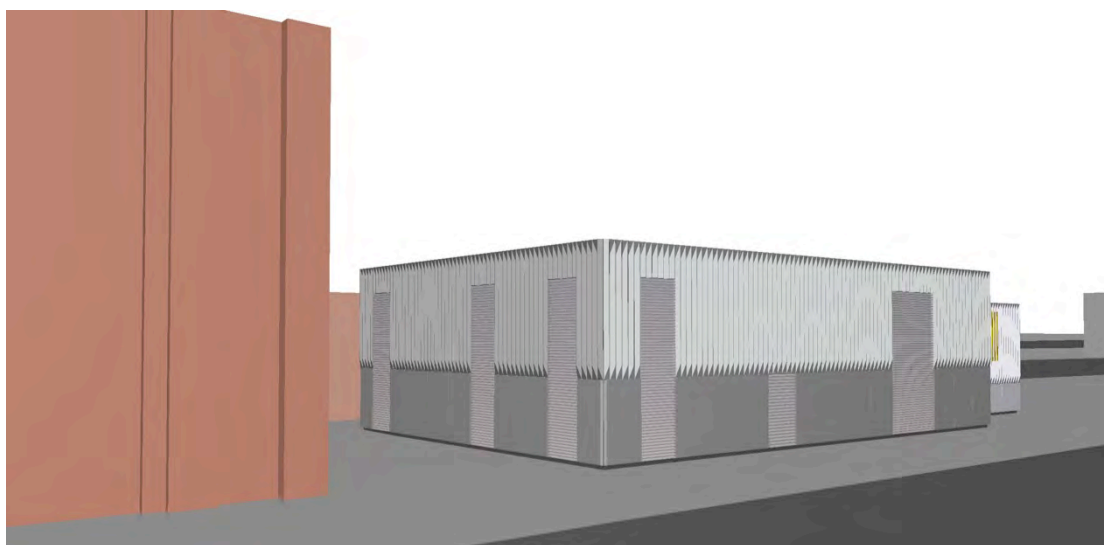


Figure 75: Option 3 View 3, TZG Architects

### Option 4

Following relevant stakeholders' review of the first three options, it was decided that Option 2 was the most favoured option to be developed further. Therefore, Options 4 and 5 were evolved to provide a more detailed investigation into the approved option.

In Option 4, the overall 300mm precast wall thickness was retained and the visual relationship between the existing Prince Alfred Substation and the new substation improved by the vertical articulation of the new façade elements. The precast panel bays, which are based on a 2m wide module combined with a 1m wide louvre module, ensured a façade rhythm, which closely referenced the scale and spacing of the Prince Alfred piers. The colour black was used as a recessive element to one side of the precast ribs. (Figure 76- 78).

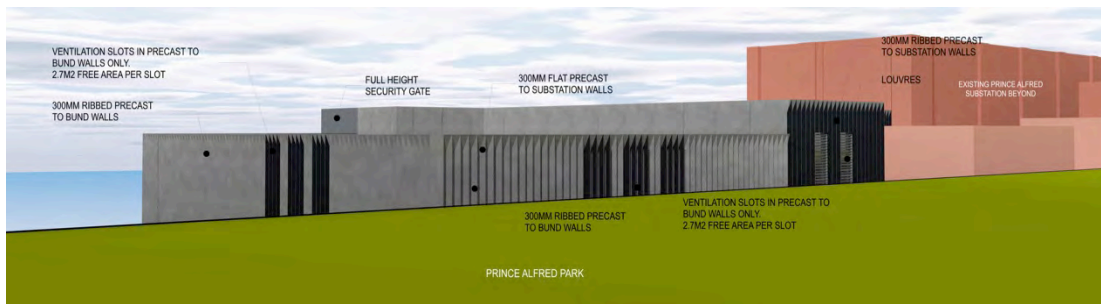


Figure 76: Option 4 View 1, TZG Architects

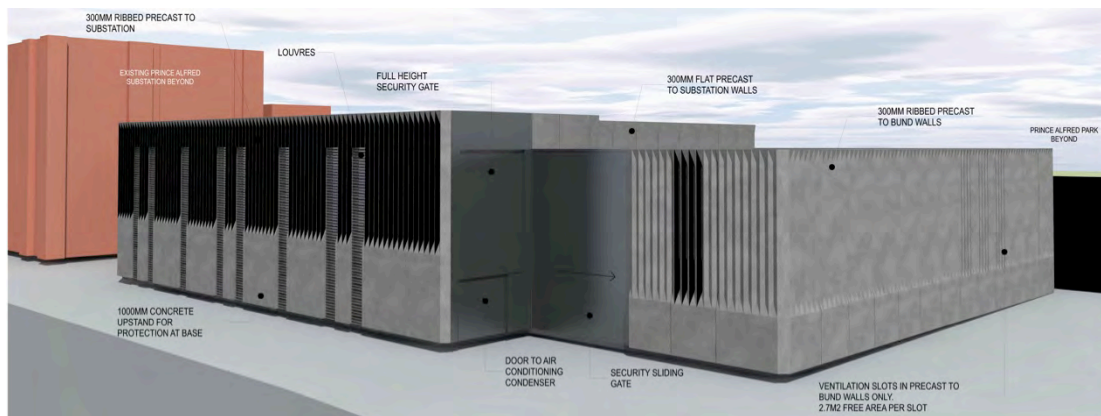


Figure 77: Option 4 View 2, TZG Architects

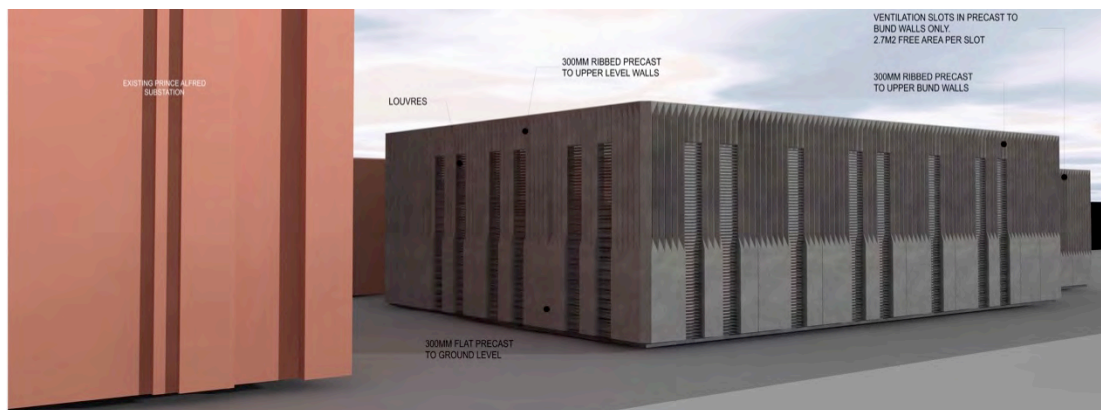


Figure 78: Option 4 View 3, TZG Architects

### Option 5

Option 5 provided an alternative to Option 4 in that both the precast and louvre modules were based on a 2m width and the paint colour to one side of the precast ribs was related to the brick colour of the existing Prince Alfred Substation. (Figure 79- 80).

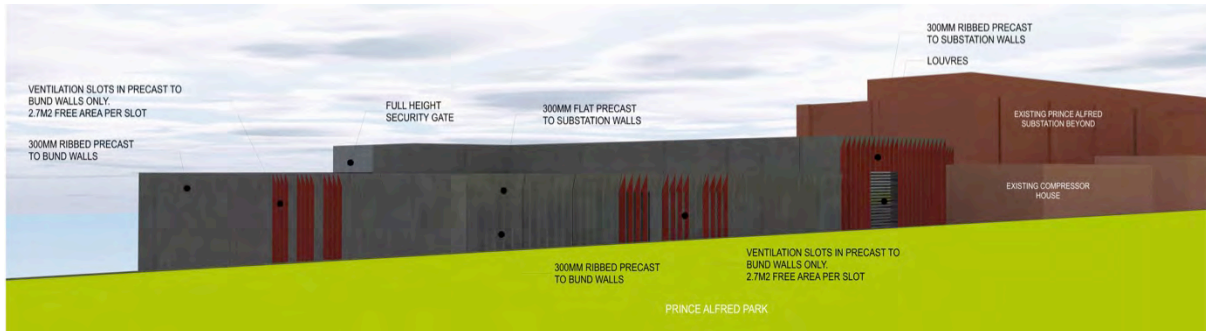


Figure 79: Option 5 View 1, TZG Architects

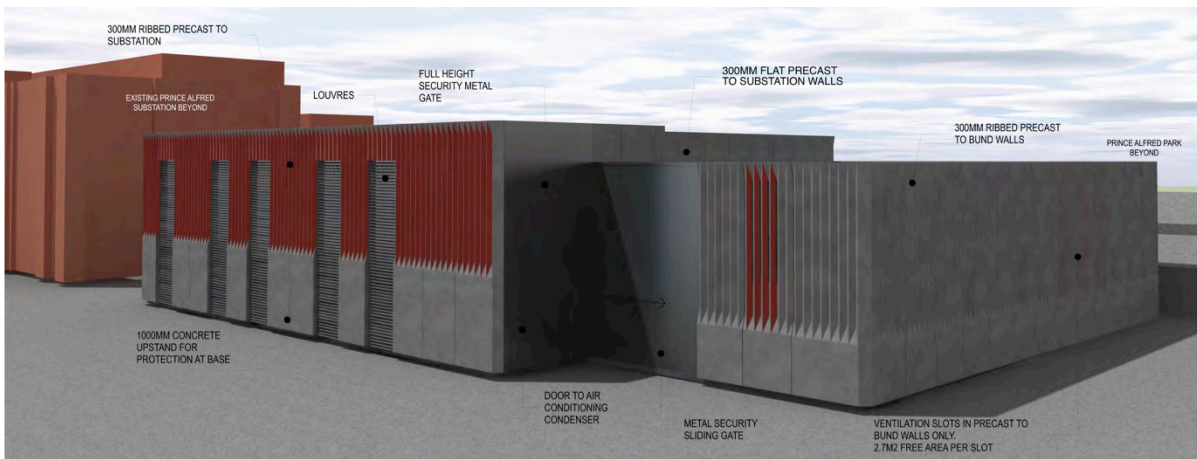


Figure 80: Option 5 View 2, TZG Architects



Figure 81: Option 5 View 3, TZG Architects

## Final Option

After meeting with stakeholders it was agreed that a combination of Options 4 and 5 was the preferred final option for the façade of the new substation. (Figures 82-84) Works to the Prince Alfred Substation and ancillary structures remained as per the original GHD documentation with minor alterations to take on board heritage concerns.

In the final option the proposed substation walls are precast concrete, with a vertical ribbed arrangement to the upper level and flat precast panels to the lower level, similar to that proposed at the Lee Street Substation, to accentuate the sense of movement in the façade. The walls are divided into bays with vertical banks of louvres in a 1m wide module, resulting in a similar scale and façade rhythm to the piers of the neighbouring Prince Alfred Substation.

The bund walls to the transformer yard are similarly detailed in concrete to the lower portion, however, have a sculptural aluminium 1800mm high top section to reduce the wind load on the wall. The folded form of the aluminium louvres closely relate to the ribs of the precast panels, which ensures that the change of the material does not result in loss of visual coherence of the façade. Concrete and aluminium, with an industrial aesthetic, are considered appropriate materials for the building's rail yard setting.

Coloured treatments to one side of the ribs were explored during the design process and ranged from black to a colour similar to the bricks of the Prince Alfred Substation, the latter has been chosen as the final colour. The colour to one face of the vertical ribs is recessive, yet, will accentuate the moiré effect and help identify the building as an integral part of the rail yard operations.

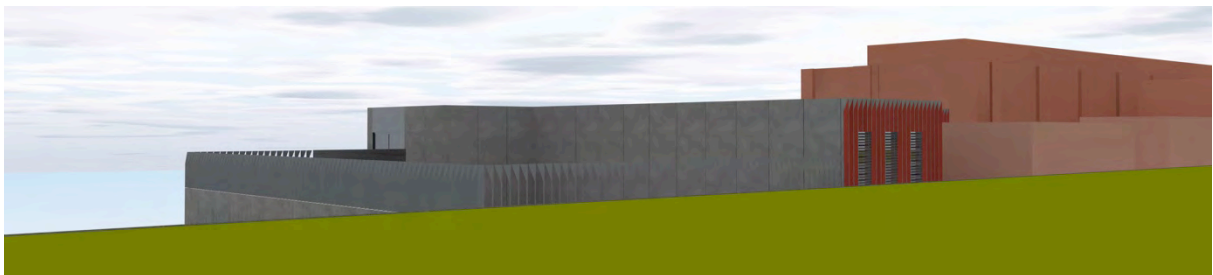


Figure 82: Final Option View 1, TZG Architects

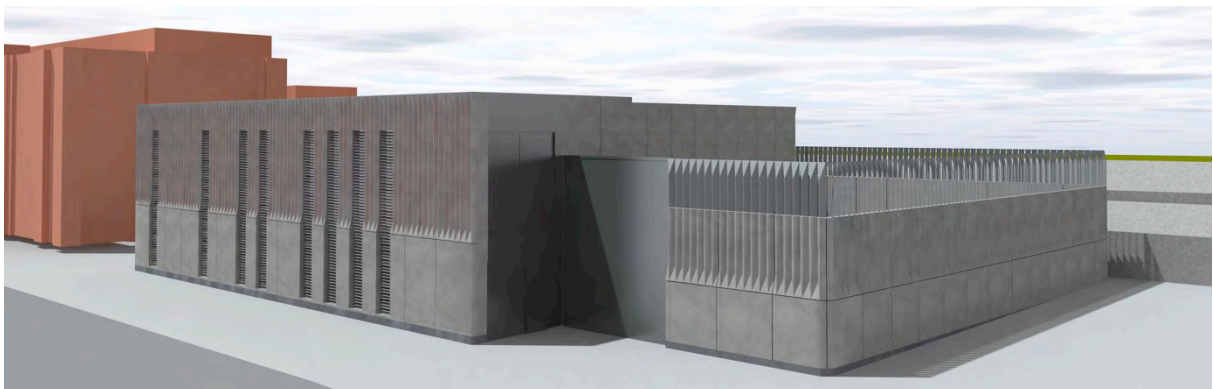


Figure 83: Final Option View 2, TZG Architects



Figure 84: Final Option View 3, TZG Architects

## 8.0 STATEMENT OF HERITAGE IMPACT

### 8.1 Discussion of Heritage Impacts

The proposed Chalmers Street Substation has been designed to provide the required power to the rail network, whilst respecting the heritage significance of Central Station and the Prince Alfred Sidings Precinct. Works are also required to the Prince Alfred Substation to achieve this aim. The following table discusses the heritage impacts of the proposed works and recommends mitigation measures:

Proposed works	Discussion of Heritage Impacts	Heritage Impact
Establish temporary construction compound	<p>The subject site is currently hardstand of sufficient size to establish a construction compound and provide site accommodation. Access will need to be maintained past the site during construction to the demountable buildings and rail corridor beyond.</p> <p>A dilapidation survey of the area proposed for the temporary construction compound should be prepared before and after the works and any damage repaired and necessary cleaning carried out at the conclusion of the works.</p>	Minor adverse, but acceptable, heritage impact. (Temporary)
Site levelling and excavation for new footings and slabs	<p>The CMP Gradings of Significance and Condition for Prince Alfred Sidings grades potential archaeology as nil, condition unknown – likely disturbed however for the Prince Alfred Substation it grades potential archaeology little to Moderate – some potential in open area south of substation. This is the area of the subject site.</p> <p>Prince Alfred Sidings Conservation Policy 8 and Prince Alfred Substation Conservation Policy 5 states: <i>If any remnant evidence of the former goods shed needs to be disturbed, this will need to be done under the supervision of a suitably qualified and experienced archaeologist under approval or exemption pursuant to s60 of the NSW Heritage Act.</i></p> <p>The archaeological management plan contained in the CMP indicates that an archaeologist should be notified if remains are found in the area.</p>	Minor adverse, but acceptable, heritage impact.
Possible duplication of existing overhead wiring structure	An overhead wiring structure runs over the airport line at present. It may be necessary to duplicate this structure to carry additional cables. There are many similar structures in the rail corridor.	Neutral heritage impact.



Proposed works	Discussion of Heritage Impacts	Heritage Impact
<p><b>New substation</b></p> <p>Construct a new two storey substation with natural grey flat precast concrete panels to the lower level and natural grey vertically ribbed precast panels to the upper level, with one face of the ribs painted a colour and vertical bays of ventilation storm louvres between the precast panels.</p> <p>100mm louvres, security mesh, roller shutters and other personnel doors are proposed to be metal with a powdercoat paint finish.</p>	<p>The new substation building is required to supply power to the rail network and has a functional industrial aesthetic appropriate to its railyard setting.</p> <p>The new substation will have a visual impact on the Prince Alfred Sidings precinct as viewed from trains approaching Central Station and from the southern end of the platforms. This has been minimized through careful design. The substation will be barely visible from Prince Alfred Park, which is located at a higher level.</p> <p>The building has been designed to read as a sculptural object comprising two interlocking forms. The substation comprises two storeys, whilst the transformer yard is open to the sky, with walls of a lower height.</p> <p>The building has been sited to align with the neighbouring Prince Alfred Substation to the north west, scaled to read as secondary to this heritage listed interwar, utilitarian building and detailed to respond to its character. The façade of the original brick substation has a vertical emphasis with brick piers and a corbelled top.</p> <p>The vertical bays of louvres break down the scale of the facade and relate to the piers of the neighbouring Prince Alfred Substation.</p> <p>Similar to the proposed substation at Lee Street, the new substation has flat lower level precast walls whilst the upper level has a ribbed patterning to give a moiré effect. The colour to one face of the vertical ribs responds to the colour of the masonry of the adjacent substation and will accentuate this effect.</p> <p>The building has been designed to be recessive from a distance, with metal detailing finished in a dark colour, however, close up the level of detailing is similar to that of its counterpart, the Prince Alfred Substation.</p> <p>The building is distinctly contemporary and reversible, should at any time in the future the site be needed for another function.</p>	<p>Minor adverse, but acceptable, heritage impact</p>
<p>Construct a basement level cable tunnel to connect to existing Prince Alfred Substation cable tunnel.</p>	<p>A new basement level tunnel is required to connect to the existing Prince Alfred Substation basement to provide egress and run cables. This will not be seen as it is located underground.</p> <p>Excavation and site disturbance should be kept to a minimum and an archaeologist notified if any remains are found.</p>	<p>Minor adverse, but acceptable, heritage impact.</p>

Proposed works	Discussion of Heritage Impacts	Heritage Impact
<b>Alterations and additions to the Prince Alfred Substation</b>		
<i>Underground</i>	These works will not be visible above ground.	Minor adverse, but acceptable, heritage impact
Excavation associated with the extension of the cable tunnels and fire egress under the driveway to connect to the new substation at basement level	The cable tunnels and fire egress are required to be extended to connect the two substations.  Excavation and site disturbance should be kept to a minimum and an archaeologist notified if any remains are found.	Minor adverse, but acceptable, heritage impact.
Construction of new stairs at basement level below the existing north east stairs	New stairs are required for egress. These stairs are located underground.  Excavation and site disturbance should be kept to a minimum and an archaeologist notified if any remains are found.	Minor adverse, but acceptable, heritage impact.
Construction of a new staircase inside the basement cable tunnel between the proposed building and the main Prince Alfred Substation building	New stairs are required for egress. These stairs are located underground.  Excavation and site disturbance should be kept to a minimum and an archaeologist notified if any remains are found.	Minor adverse, but acceptable, heritage impact.
New openings at basement level to connect the cable tunnel beyond.	Two new openings are required at basement level to connect the cable tunnel and egress path between the two substations. Care should be taken when making the new openings to ensure the stability of the building is not jeopardised. Refer underpinning below. The proposal will not be seen above ground and involves a minimal loss of fabric.  Carry out an archival recording of the area prior to undertaking the works.	Minor adverse, but acceptable, heritage impact.
Underpinning of corners of existing substation adjacent cable tunnel connection	Underpinning should be undertaken in a careful methodical manner in order to ensure the stability of the buildings corners adjacent the proposed new openings. Monitor the upper level walls throughout the works for any signs of cracking.	Minor adverse, but acceptable, heritage impact.
New cable tunnel under driveway to connect to track side with wing walls to cable head wall in the rail cutting	The new cable tunnel network is required to be extended to connect to the track-side.  Excavation and site disturbance should be kept to a minimum and an archaeologist notified if any remains are found.	Minor adverse, but acceptable, heritage impact.

Proposed works	Discussion of Heritage Impacts	Heritage Impact
<b>Alterations and additions to the Prince Alfred Substation</b>		
<i>Above ground</i>		
Construction of a new Eastern Suburbs Rail Link Room (the link room) to the north-east facade of the Prince Alfred Substation connecting to the existing cable tunnels in Prince Alfred Substation. Removal of non-original switches from facade.	The proposed link room is a single storey brick structure proposed to the north-east facade. The link room is proposed behind the existing egress stair and will not be visually dominant. A matching brick bond pattern and brick colour is proposed to further minimize the impact of the addition. The new addition is clearly articulated from the original substation by recessing the brickwork at the join.	Minor adverse, but acceptable, heritage impact.
Repairs and security treatment to the pump well doors at the north east end of the north west facade which are to be fixed shut	The existing timber doors are proposed to be repaired with security treatment added to the interior face and fixed shut, maintaining the existing appearance from the public domain.	Neutral heritage impact.
Replacement of the existing ground floor windows with steel ventilation louvres backed with security mesh (18 off)	Secure ventilation is required to the cable tunnel of the existing substation building. The existing ground floor windows are covered by steel security mesh, face fixed. The proposal includes removal of this non-original mesh and replacement of the windows with metal ventilation louvres backed with security mesh. The louvres and their frames would be colour matched to the colour of the steel window frames and would include a central mullion to match the original windows respecting the original configuration  It is recommended that the louvres be fitted into the existing window frames. If this is not achievable, the existing window frames should be salvaged and stored for potential reuse in the future.  Archival recording should be undertaken prior to carrying out these works.	Minor adverse, but acceptable, heritage impact.
<b>Ancillary Works</b>		
Construction of a new steel framed platform and security mesh enclosure for a new harmonic filter, switchboards and transformers	This structure is proposed to be steel framed with security mesh infill panels, all powder coated black. It is sited near the embankment to the north east of the proposed substation and straddles the brick and concrete roofed cable tunnel. It has been designed to read as a transparent, recessive contemporary element. The top of the structure is 2m above the ground level of Prince Alfred Park, however, it will be barely visible from the public domain due to its location, detailing and screening by the existing park security fence and embankment planting including large trees.	Minor adverse, but acceptable heritage impact

Table 10: Discussion of heritage impacts of the proposal.

## 8.2 Assessment Against CMP Conservation Policies

### 8.2.1 General Conservation Policies

The Central Station CMP recommends conservation policies for each item of significance. Table 11, below, lists those common to all items.

Policy No.	Policy	Assessment
<b>1. Follow Overall Conservation Policies</b>	See part 4 of CSCMP and the Conservation Policy Summary at 1.2	Relevant overall Conservation Policies contained in the Central Station CMP will be implemented. Refer Table 11 below.
<b>2. Implement Fabric Guidelines</b>	See Part 5 of the CSCMP.	These guidelines pertain largely to alterations and additions to existing fabric rather than to new buildings and should be followed for any works involving alterations or additions to existing buildings on site.
<b>3. Heritage Process</b>	<p><i>When considering change follow the Heritage Flow Charts that form an Appendix to this CMP:</i></p> <p><i>A Major Works Heritage process Flow Chart: or</i></p> <p><i>B Minor Works Heritage Process Flow Chart</i></p> <p>Refer to Flow Charts located at Appendix A and Appendix B , Central Station CMP.</p>	Recommended procedures contained in the Central Station CMP will be implemented.
<b>4. Heritage Listing</b>	<i>Ensure appropriate statutory approvals or exemptions are obtained prior to change on the site ....</i>	All appropriate statutory approvals and exemptions will be obtained prior to any change on the site due to its SHR, S170 and COS heritage listings.

Table 11: Assessment of the proposal against general conservation policies.

Table 12, below, assesses the proposal against the policies contained in Section 1.2 of the Central Station CMP – Summary of Heritage Conservation Policies and Strategies

Policy No.	Strategies	Assessment
<b>3. Managing Change</b>	<i>3.4 Ensure all works likely to impact on heritage values of the overall site or of an individual element are accompanied by a Statement of Heritage Impact (SOHI).</i>	This SoHI accompanies the proposal in accordance with this policy.
	<i>3.5 Ensure all works likely to impact on heritage values of the overall site or of an individual element are preceded by an archival recording of the element in its configuration.</i>	It is recommended that a dilapidation survey be prepared before and after the works and that any damage be rectified prior to handover.  Archival recording is recommended prior to carrying out any works to the Prince Alfred Substation in the areas affected by changes including the new openings to connect the cable tunnels in the basement, works associated with the link room including the removal of redundant switches, pump well doors repairs and the removal of security mesh and insertion of new louvres to the ground floor window openings.
	<i>3.6 Ensure new work, new fabric and new service installations:</i>	a) The proposal recognizes the heritage status of the Central Station CMP area and respects the Prince Alfred Sidings precinct and heritage items located in the vicinity including the Prince Alfred Substation, Railway Institute Building, Former District Engineer's and Draughtsman's Offices and Prince Alfred Park.
	<i>a) recognise the major heritage status of the Central Station CMP area, in particular elements of exceptional and high significance, and do not result in a lessening of the heritage significance of an area, or of an element;</i>	
	<i>b) are located where possible in areas of no or low significance;</i>	The new substation is proposed in an area that has previously been disturbed and is currently used for hardstand carparking.
<i>c) are based on an understanding of the original design concept and are compatible with the high quality of Central Station in terms of design, detail, materials and workmanship;</i>	The Prince Alfred Substation has outlived its original purpose and will be made available for adaptive reuse once the works are completed. The proposed new substation is a utilitarian building that is required to provide power to the rail network. The design, details, materials and workmanship will combine to create a high quality, functional, industrial aesthetic appropriate to the Prince Alfred Sidings railyard setting.	
<i>d) can be easily identified as new work and, where possible, are reversible; and</i>	The new substation can easily be identified as new work and is reversible, in so far as it could be demolished in the future. The changes to the Prince Alfred Substation are sympathetic, yet easily identified as new work.	

Policy No.	Strategies	Assessment
	<p>e) <i>are sympathetic to, but do not mimic, significant fabric and spatial qualities in terms of scale, proportioning, colour, and texture.</i></p>	<p>The Prince Alfred Substation is a utilitarian interwar brick building, that features a corbelled top and brick piers that divide the façade into vertical bays punctuated by openings. The proposed new substation is a two storey building, of a lesser scale than the existing substation, sited to align to the north-west with its historic counterpart. The simple interlocking forms of the new substation and transformer yard reflect the utilitarian nature of the building's use and respond to the simple forms of the Prince Alfred Substation. The precast concrete façade of the new building is plain at the lower level and ribbed at the upper level, with one face painted, to create a sense of movement or moiré effect when viewed from moving trains. This also relates to the recently approved Lee Street Substation located opposite the site adjacent the Darling Harbour Cutting, tying the two new elements together. Vertical bays of ventilation louvres break down the scale of the substation and relate it to the vertical bays of the Prince Alfred Substation. The notion of a corbelled top is maintained in the transformer yard through the use of aluminium top piece, shaped to match the precast detail to the top of the substation. The proposed new substation is sympathetic to the Prince Alfred Substation without mimicking it through the use of appropriate scale, proportioning, materials, detailing and colour. Significant fabric and spatial qualities are retained by the proposal.</p>
<p><b>5. Setting, Views and Landscape</b></p>	<p>5.1 <i>Encourage new uses and developments adjacent to the Central Station CMP area that are compatible with the primary railway use of the site and provide opportunities to celebrate and interpret the heritage values of Central Station and minimise negative heritage impacts.</i></p>	<p>The proposed use of the site for a substation that provides power to the rail network is considered compatible with the primary railway use of the site and appropriate to the Prince Alfred Sidings precinct.</p> <p>The new building interprets rail movement through the use of vertical patterned ribbing to the upper walls and relates to both the adjacent Prince Alfred Substation and the proposed Lee Street Substation located across the rail corridor in terms of architectural language.</p> <p>Upon completion of the new substation, the upper levels of the Prince Alfred Substation will be available for adaptive reuse.</p>

Policy No.	Strategies	Assessment
<b>6. Archaeological Management</b>	<i>6.1 Follow the precinct and element specific policies for archaeological management outlined in the inventory sheets of this CMP.</i>	An Archaeological Work Method Statement has been prepared to mitigate any potential impacts.
<b>7. Heritage Conservation &amp; Major Works</b>	Policy as per 3.6	See response to policy 3.6

Table 12: Assessment of the proposal against Sections 1.2 and 4 of Central Station CMP.

### 8.2.2 Prince Alfred Sidings Conservation Policies

Policy No.	Policy	Assessment
<b>5. Item Specific Policy: Embankment</b>	<i>Retain the alignment of the boundary between Prince Alfred Park and the Railway Yard.</i>	The proposed substation will not impact on the boundary and its alignment between Prince Alfred Park and the Railway Yard.
<b>6. Item Specific Policy: Embankment</b>	<i>Commission and implement a Landscape Maintenance Plan that identifies, and contains provisions for the retention of, any significant planting. Liaise with the City of Sydney to facilitate retention of mature vegetation along embankment along eastern boundary of site.</i>	The proposal does not include any works to the embankment.
<b>7. Item Specific Policy: Development</b>	<i>There is scope for future development on parts of this precinct, particularly where the pre-fabricated buildings are currently relocated. Any development should have limited heritage impact on the adjoining Sydney Yards, Prince Alfred Workshops, Substation or Prince Alfred Park. Carry out a detailed archival recording prior to any works.</i>	The proposed works will have minimal impact on the Prince Alfred Workshops, Railway Institute Building, Sydney Yards and Prince Alfred Park. The new substation will partially obscure the lower portion of the southern elevation of the Prince Alfred Substation.  Detailed archival recordings are recommended for areas to be changed prior to carrying out any works. Refer Policy 3.6.
<b>8. Item Specific Policy: Archaeology</b>	<i>If any remnant evidence of the former goods shed needs to be disturbed, this will need to be done under the supervision of a suitably qualified and experienced archaeologist under approval or exemption pursuant to s60 of the NSW Heritage Act.</i>	Archaeology will be managed in accordance with <i>Unexpected Heritage Finds Guideline</i> contained in TfNSW's Quality Management System.

Table 13: Assessment of the proposal against site-specific Prince Alfred Sidings policies, Central Station CMP.

### 8.2.3 Prince Alfred Substation Conservation Policies

Policy No.	Policy	Relevance To Subject Site
<b>5. Item Specific Policy: Use</b>	<i>Continue the use of these buildings as sub stations, to provide power for the City Electric network. Should the existing use be no longer required, investigate adaptive reuse opportunities of all or part of the complex. Suitable uses could include staff facilities, workshops, or commercial or community use with access from Prince Alfred Park.</i>	The Prince Alfred Substation has outlived its original purpose. The equipment is at the end of its serviceable life and no longer meets the requirements of the BCA for a Class 8 building. Upon completion of the new substation, the upper levels of the Prince Alfred Substation will be available for adaptive reuse.
<b>5. Item Specific Policy: Archaeology</b>	<i>If any remnant evidence of the former goods shed needs to be disturbed, this will need to be done under the supervision of a suitably qualified and experienced archaeologist under approval or exemption pursuant to s60 of the NSW Heritage Act.</i>	Archaeology will be managed in accordance with <i>Unexpected Heritage Finds Guideline</i> contained in TfNSW's Quality Management System.

Table 14: Assessment of the proposal against site-specific Prince Alfred Substation policies, Central Station CMP.

### 8.3 Assessment of Proposal

The following is a discussion of the potential impacts as a result of the proposal.

- **The following aspects of the proposal respect or enhance the heritage significance of the item or conservation area for the following reasons:**

The new substation will provide necessary power to the rail network, retaining the use of the site for rail purposes. The design of the façade of this utilitarian building is distinctly contemporary, yet recessive and adopts an industrial aesthetic appropriate to the railyard setting. The palette of materials is robust and simple comprising concrete and steel, with vertical ribbed precast panels to the upper walls, painted one side, to give a moiré effect, interpreting the movement of trains in the Sydney Yards. The design has a relationship to both it's historic counterpart - the Prince Alfred Substation and its contemporary counterpart - the proposed Lee Street Substation, located on the opposite side of the rail corridor.

- **The following aspects of the proposal could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:**

The proposal involves the replacement of the Prince Alfred Substation with a new substation. The Prince Alfred Substation has outlived its original purpose. The electrical equipment is at the end of its serviceable life and the building no longer meets Code requirements. Whilst this is not ideal in heritage terms, the upper levels of the Prince Alfred Substation will be available for adaptive reuse once the substation has been decommissioned. The new substation has been designed to align with the old substation to the north-west however to read as a secondary element, of a lower scale and importance.

The removal of the ground floor windows of the Prince Alfred Substation and replacement with louvres could be perceived as having a negative impact, however, increased ventilation is required for operational purposes.



The impact of this change will be mitigated to a degree by photographic archival recording and salvaging and storing the original windows for potential reuse at a later date. Further the louvres are to be detailed to relate to the original steel window break up, with a central mullion and the frames painted a colour to match the original.

The new single storey Link Room proposed to the north-east elevation of the original substation could be seen as having a negative impact, however, this has been mitigated by detailing the addition as a simple contemporary element and by articulating the junction between the old and the new.

- **The following sympathetic solutions have been considered and discounted for the following reasons:**

A range of sympathetic options for the façade of the substation was considered in the design phase, which are illustrated in Section 7.3 of this report.

The final option is considered the most appropriate to both the rail environment and the specific site. The final proposal incorporates interpretation of both rail movement and relates to the Prince Alfred Substation, its historic counterpart, and results in a calm, recessive building appropriate to its context.

### 8.3.1 Demolition

#### *New Substation*

Site levelling, excavation and piling are all required to construct the new substation and associated cable tunnels.

#### *Prince Alfred Substation*

Two new openings are required at basement level to connect the existing cable tunnel to the new substation and the proposed new link room. Removal of the existing face fixed security mesh to the ground floor windows and replacement of the glazing with metal louvres with security mesh behind is also required.

- *Is demolition essential for the heritage item to function?*  
Site levelling, excavation and piling are all required to construct the new substation and associated cable tunnels.  
Two new openings are required in the basement walls to connect the existing cable tunnels to the proposed new substation and link room.  
Ventilation is required for operational reasons on the ground floor that necessitates removal of the existing windows and replacement with metal louvres.
- *Are important features of the item affected by the demolition?*  
Underground works will have minimal impact on important features of the Prince Alfred Substation.

Removal of the existing security mesh to the ground floor windows will improve the façade presentation. Removal of the ground floor windows, whilst not desirable from a heritage perspective, is required from an operational point of view. It is recommended that these windows be salvaged and stored for potential reuse in the future. The new louvres will be detailed in steel frames with a central mullion, colour matched to the original windows to minimise this impact.

- *Can all of the significant elements of the heritage item be kept and any new development be located elsewhere on the site?*  
Increased ventilation is required to the ground floor of the existing substation building. This cannot be provided in any other location.
- *If the partial demolition is a result of the condition of the fabric, is it certain that the fabric cannot be repaired?*  
Partial demolition is not required as a result of the condition of the fabric. It is required to accommodate the functional requirements of a substation that serves the rail network.
- *Has the advice of a heritage consultant been sought? Have the consultant's recommendations been implemented? If no, why not?*  
The advice of Rappoport Heritage Consultants and Tonkin Zulaikha Greer Heritage has been sought and implemented.

### 8.3.2 Alterations and Additions to Prince Alfred Substation

- *How is the impact of the alterations and addition on the heritage significance of the item to be minimised?*  
The proposal includes the addition of a single storey link room to the north-east façade of the Prince Alfred Substation and extensions to the existing basement level cable tunnels underground. It also includes fixing the Pump Well doors shut and adding security treatment to the back side and removing the non original security mesh from the ground floor windows and replacing the glass with ventilation louvres.
- *Can the additional area be located within an existing structure? If no, why not?*  
It is not possible to locate the proposed Link Room within the existing structure as it is required to connect to the underground cable tunnel network.
- *Will the alterations and additions tend to visually dominate the heritage item?*  
The proposed single storey brick clad Link Room addition is located behind the existing egress stair and will in no way dominate the Prince Alfred Substation.

The cable tunnel additions are located underground and will not be seen from the public domain.

The Pump Well doors will be repaired, fixed shut and security treatment added to the back side, minimising the impact on their appearance.

The non-original security mesh is proposed to be removed from the ground floor north-west window openings and the windows are proposed to be replaced with ventilation louvres required for internal operations. The louvre frames will be colour matched to the existing window frames and have a central mullion similar to the existing windows. The new louvres will not dominate the building and all other windows are retained. The removal of the security mesh will improve the appearance of the façade and it is recommended that the original windows are salvaged and stored for possible future reinstatement. Photographic archival recording of areas to be changed is recommended prior to carrying out the works.

- *Is the addition sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered?*  
The addition is not sited on any known or potentially significant archaeological deposits.

- *Are the additions sympathetic to the heritage item? In what way (e.g. form, proportions, design)?*  
The Link Room addition is detailed in brickwork, in a matching bond and colour to the original substation. It is recommended that the addition be articulated from the original building through an indentation in the brickwork at the join to clearly distinguish the addition.

### 8.3.3 New development adjacent to a heritage item

#### *New Substation*

The proposal involves construction of a new two storey substation and transformer yard and new steel framed platform and security mesh enclosure for a new harmonic filter, switchboards and transformers.

- *How is the impact of the new development on the heritage significance of the item or area to be minimised?*  
The new substation has been designed as a contemporary element, utilising a limited, yet high quality, palette of materials with an industrial aesthetic sympathetic that is sympathetic to the neighbouring Prince Alfred Substation and appropriate to its railyard setting. Precast concrete is proposed for the walls to the lower levels, vertically ribbed to the upper levels with bays of vertical steel framed louvres. The vertical ribs, painted one side, match the colour of the brickwork and create a moiré effect when passing by that interprets the movement of trains in the Sydney Yards and relates it to the proposed Lee Street Substation located on the other side of the tracks.

The harmonic filter enclosure is a simple contemporary element, set to the rear of the site against the embankment and will have minimal visual impact.

- *Why is the new development required to be adjacent to a heritage item?*  
The building is utilitarian in nature and must be located within the Central Station curtilage in order to provide power to the rail network it serves – as it is the heart of the network. This site has been deemed the most appropriate of those considered due to its proximity to the station, engineering factors and a lack of suitable alternative sites.

The Prince Alfred Substation is no longer fit for purpose and it is not possible to locate the additional area required for the substation within the existing buildings on the site.

- *How does the curtilage allowed around the heritage item contribute to the retention of its heritage significance?*  
The curtilage around Central Station is vast, encompassing the Station, the tracks, the railyard and the many buildings that service the railway. The proposed substation is required to provide power to the rail network within this curtilage.
- *How does the new development affect views to, and from, the heritage item? What has been done to minimise negative effects?*  
There are no key views within the Central Station curtilage identified in the CMP that will be affected by the proposal.

The new substation and harmonic filter platform are screened by planting and will be barely visible from the public domain.

The south-western view of the lower portion of the Prince Alfred Substation will be obscured by the proposal from a distance, however, remain unobscured from a closer view point as there is a large separation between the two buildings.

Within the Prince Alfred Sidings precinct, the visual connection between the Prince Alfred Substation, Switch House, Compressor House and Former Engineer and Draughtsman's Office will be again affected from a distance, however, available for closer inspection. The new single storey link room to the north-east façade of the Prince Alfred Substation is proposed behind the existing access stair and will not be visually dominant.

- *Is the development sited on any known, or potentially significant archaeological deposits? If so, have alternative sites been considered? Why were they rejected?*  
 Alternatives were considered however the proposed site is considered the most appropriate for this key piece of infrastructure that supplies power to the rail network. With respect to archaeology, the CMP Gradings of Significance and Condition for Prince Alfred Sidings grades potential archaeology as *nil, condition unknown – likely disturbed* however for the Prince Alfred Substation it grades potential archaeology *little to Moderate – some potential in open area south of substation*. This is the area of the subject site.

Prince Alfred Sidings Conservation Policy 8 and Prince Alfred Substation Conservation Policy 5 states:

*If any remnant evidence of the former goods shed needs to be disturbed, this will need to be done under the supervision of a suitably qualified and experienced archaeologist under approval or exemption pursuant to s60 of the NSW Heritage Act.*

The site may also contain remnant tracks, sleepers or other artefacts associated with the Prince Alfred Sidings. The Archaeological Management Plan contained in the CMP indicates that an archaeologist should be notified if remains are found in the area.

Archaeology will be managed in accordance with *Unexpected Heritage Finds Guideline* contained in TfNSW's Quality Management System.

- *Is the new development sympathetic to the heritage item? In what way (e.g. form, proportions, design)?*  
 The bulk and scale of the building is dictated by functional requirements, however, are considered appropriate to the setting, within the Central Station curtilage. Located adjacent the Prince Alfred Substation, the new substation is sited to align with the north-western façade, however, is of a lower scale deferring to its historic counterpart. The new building responds to the vertical rhythm of the brick piers and bays and the old building's corbelled top in a contemporary manner.

The Prince Alfred Substation is a utilitarian interwar building detailed in brickwork with steel windows. Similarly a limited palette of materials is proposed for the new substation, which is detailed in a complementary yet contemporary way - concrete and steel are the materials proposed for the new substation.

The use of ribbed precast concrete to the upper levels, painted one side to match the colour of the brickwork of the Prince Alfred Substation, creates a moiré effect, interpreting the movement of trains on the adjacent tracks. Further the use of a similar architectural language to the proposed Lee Street Substation unifies these contemporary elements located on opposite sides of the rail corridor forming a gateway to the historic Central Station precinct.

The Chalmers Street substation has been designed as a distinctly contemporary, utilitarian building that has a sympathetic relationship to the neighbouring Prince Alfred Substation in terms of siting, scale, detailing and materials and is appropriate to its railyard setting.

- *Will the new development visually dominate the heritage item? How has this been minimised?*  
The new substation will not visually dominate Central Station, nor the Prince Alfred Sidings precinct, rather the building has been designed to fit into its context in a sympathetic way.

The proposed substation building is sited to align with the heritage listed Prince Alfred Substation to the north-west and is of a lower bulk and scale. The vertical emphasis of the façade and detailing to the top of the wall references the detailing of the masonry to the Prince Alfred Substation.

Whilst the new substation will partially obscure the lower walls of the Prince Alfred Substation from afar, it will not dominate it and the physical separation between the two buildings is sufficient to permit inspection of this façade from a closer view point.

The Compressor House, which is the least significant building of the Prince Alfred Sidings group of buildings will also be visually obscured from afar but able to be viewed from closer up.

- *Will the public, and users of the item, still be able to view and appreciate its significance?*  
The public will still be able to view and appreciate the significance of Central Station and the Prince Alfred Sidings precinct. The proposed new substation and alterations to the existing building have been designed to be contemporary yet sympathetic and to have minimal visual impact on the other heritage items in the vicinity including the Prince Alfred Substation, Railway Institute Building, Former Engineer and Draughtsman's Office and Prince Alfred Park which are all located some distance away. No primary views across the Sydney Yards are affected by the proposal.

#### 8.3.4 Change of Use

- *Has the advice of a heritage consultant or a structural engineer been consulted? Has the advice been implemented? If not, why not?*  
The advice of a heritage consultant has been sought and implemented.
- *Does the existing use contribute to the significance of the heritage item?*  
The site proposed for the new substation is currently used as hardstand carparking. This does not contribute to the significance of the place.
- *Why does the use need to be changed?*  
The Prince Alfred Substation is no longer fit for purpose and needs to be replaced. A new substation is required to serve the rail network. The adjacent site is an ideal location for such a facility given its proximity to the associated infrastructure, underground cable connections and the railway tracks. Once the work is completed the upper levels of the Prince Alfred Substation will be available for adaptive reuse.
- *What changes to the fabric are required as a result of the change of use?*  
Underground connections to the existing basement level cable tunnel, construction of a single storey link room and the insertion of ventilation louvres to the ground floor window openings of the Prince Alfred Substation are required to connect the new substation to the existing system. An additional cable gantry may be required across the rail corridor.

- *What changes to the site are required as a result of the change of use?*  
The change of use of the site requires excavation, site levelling and construction of a new two storey substation and transformer yard with underground cable tunnel connections to the existing Prince Alfred Substation. It also requires construction of a new steel framed platform for a new harmonic filter, switchboards and transformers.

### 8.3.5 New Services

New services proposed include hydraulic, electrical and fire services. A new steel framed platform and security mesh enclosure is proposed to the north east of the substation near the embankment for a new harmonic filter, switchboards and transformers.

An extension of the existing underground cable tunnel system is also proposed. Duplication of one existing gantry may be required over the Airport Line to take the weight of the additional cables.

- *How has the impact of the new services on the heritage significance of the item been minimised?*  
The impact of new services has been minimised by containing most of them within the new substation.

The underground cable tunnels connect directly to the existing cable tunnel to minimise their runs, and hence the disturbance of the ground within the precinct. This work will need to be carried out in a careful manner and the north-west corners of the Prince Alfred Substation underpinned in the vicinity of the join.

The addition of the Link Room will require the removal of non-original switches mounted externally. These switches are no longer used and will be replaced by new switches inside the Link Room and cannot be retained insitu due to the lack of space. The switches are located in an area with minimal public access and their removal will have minimal impact on the significance of the Prince Alfred Substation. It is recommended that a photographic archival recording of this area be made prior to carrying out these works.

The new steel framed platform and security mesh enclosure for a new harmonic filter, switchboards and transformers proposed to the north east of the substation near the embankment will have minimal impact on the heritage significance of the precinct. It is proposed to be painted a dark recessive colour.

- *Are any of the existing services of heritage significance? In what way? Are they affected by the new work?*  
The proposed works affect no known services of heritage significance. The proposal does not affect industrial archaeology contained within the Prince Alfred Substation.
- *Has the advice of a conservation consultant (e.g. architect) been sought? Has the consultant's advice been implemented?*  
The advice of a conservation consultant and an archaeologist has been sought and implemented.
- *Are any known or potential archaeological deposits (underground and under floor) affected by the proposed new services?*  
With respect to archaeology, the CMP Gradings of Significance and Condition for Prince Alfred Sidings grades potential archaeology as *nil, condition unknown – likely disturbed* however for the Prince Alfred Substation it grades potential archaeology *little to Moderate – some potential in open area south of substation*. This is the area of the subject site.

Prince Alfred Sidings Conservation Policy 8 and Prince Alfred Substation Conservation Policy 5 states:

*If any remnant evidence of the former goods shed needs to be disturbed, this will need to be done under the supervision of a suitably qualified and experienced archaeologist under approval or exemption pursuant to s60 of the NSW Heritage Act.*

The site may also contain remnant tracks, sleepers or other artefacts associated with the Prince Alfred Sidings. The Archaeological Management Plan contained in the CMP indicates that an archaeologist should be notified if remains are found in the area.

Archaeology will be managed in accordance with *Unexpected Heritage Finds Guideline* contained in TfNSW's Quality Management System.

### **8.3.6 Fire Upgrading**

Fire services are required to meet code requirements for a building of this type. These services will have minimal impact on the heritage significance of the place.

### **8.3.7 New landscape works and features**

No landscape works or features are proposed for the new development, which is in keeping with the railyard setting.

### **8.3.8 Tree removal or replacement**

No trees are to be removed or replaced.

### **8.3.9 New signage**

Statutory signage and is proposed to meet code requirements.

## 9.0 CONCLUSION

### 9.1 Assessment of Heritage Impacts

The existing equipment in the Prince Alfred Substation is at the end of its working life and the building, whilst in relatively good condition, is no longer considered fit for purpose as it does not meet the requirements of many current standards including the Earthquake Code and the BCA for a building of this use classification.

A new substation is required within the curtilage of Central Station to provide power to the rail network to replace the existing Prince Alfred Substation. The upper levels of the Prince Alfred Substation will be suitable for adaptive reuse once the substation has been decommissioned.

The proposed new Chalmers Street Substation has been designed to read as a distinctly contemporary, yet recessive, element within the context of Central Station and the Prince Alfred Sidings and will have minimal impact on key views within the curtilage of the Station.

A robust, simple palette of materials is proposed for the façade of the new two storey substation building, which has a functional industrial aesthetic appropriate to its railyard setting. The façade of the building has been designed to interpret the movement of trains in the Sydney Yard through the use of vertical ribbed concrete to the upper walls, which create a moiré effect. The vertical emphasis of the façade, with bays of vertical louvres, is also intended to relate to both its historic counterpart, the Prince Alfred Substation and the proposed Lee Street Substation, located across the rail corridor. The siting, scale, materials and detailing of the new building are considered appropriate to this highly significant setting.

The site is identified as having *little to moderate* archaeological potential and archaeology will be managed in accordance with *Unexpected Heritage Finds Guideline* contained in TfNSW's Quality Management System.

The proposal will have minimal impact on the heritage significance of Central Station as a whole, the Prince Alfred Sidings precinct and significant elements within it, and is recommended for approval.



## 9.2 Recommendations

The following recommendations are suggested to further mitigate any potential heritage impacts:

- Prepare a dilapidation survey of the area proposed for the temporary construction compound and the Prince Alfred Substation and other heritage listed buildings located in the vicinity of the proposal before and after the works. Repair any damage and undertake necessary repairs and cleaning at the conclusion of the works.
- Prepare a photographic archival recording of areas of the Prince Alfred Substation affected prior to carrying out the work. This includes the electrical switches on the north east wall which are proposed to be removed, pump well doors, ground floor windows, north east and western corners of the building and either end of the basement cable tunnel.
- Salvage and store the ground floor windows proposed to be removed for possible future reinstatement.
- All heritage items in the immediate vicinity of the site should be identified on site plans, fenced off where appropriate and protected during construction.
- Manage archaeology in accordance with *Unexpected Heritage Finds Guideline* contained in TfNSW's Quality Management System. If any unanticipated archaeological deposits are identified during construction, work likely to impact on the deposit would cease immediately and the NSW Heritage Council and an archaeologist would be contacted. Where required, further archaeological work and/or consents would be obtained prior to works recommencing at the location.
- Allow for the monitoring and repair of any damage of significant items as a result of construction of the substation as part of the Contract, such as the corners of the Prince Alfred Substation where underpinning is proposed. This should include an allowance for a nominated Heritage Architect to inspect and report before, during and after completion of the works.
- Develop a Heritage Interpretation Strategy for the Prince Alfred Sidings precinct. Implementation may be best online or within Central Station itself due to the site's location and inaccessibility.
- Develop a long term adaptive reuse strategy for the Prince Alfred Substation building.

## 10.0 REFERENCES

Australian Heritage Database

Australia ICOMOS, *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*, 2013.

<http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf>

City of Sydney website.

GHD/Transport for NSW – Chalmers Street Substation Review of Environmental Factors, April 2015.

NSW Environment and Heritage Database #01255, Sydney Terminal and Central Railway Group.

NSW Environment and Heritage S170 Register #4801296, Central Railway Station and Sydney Terminal Group.

NSW Transport RailCorp website.

Rappoport Conservation Architects and Heritage Consultants, *New Chalmers Street Substation & Associated Works, Prince Alfred Sidings, Central Station, Sydney NSW, Statement of Heritage Impact*, April 2015.

Rappoport Conservation Architects and Heritage Consultants and NSW Government Architect's Office, *Central Station Conservation Management Plan*, June 2013.

## 11.0 APPENDICES

- 11.1 Appendix A - State Heritage Register #01255 Citation  
Sydney Terminal and Central Railway Stations Group
- 11.2 Appendix B - S170 Register Citation  
Central Railway and Sydney Terminal Group
- 11.3 Appendix C - Local Government Citation  
Central Station Railway Group
- 11.4 Appendix D - Central Station CMP - Policies and Strategies Summary
- 11.4 Appendix E - Drawings  
Chalmers Street Substation  
TZG and GHD, April 2015

11.1 Appendix A - State Heritage Register Citation  
Sydney Terminal and Central Railway Stations Group #01255



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## Sydney Terminal and Central Railway Stations Group

### Item details

Name of item: Sydney Terminal and Central Railway Stations Group  
 Other name/s: Central Railway; Central Station; Underbridges  
 Type of item: Complex / Group  
 Group/Collection: Transport - Rail  
 Category: Railway Platform/ Station  
 Location: Lat: -33.8849069994 Long: 151.2051879090  
 Primary address: Great Southern and Western Railway; Illawarra Rail, Syd  
 Local govt. area: Sydney

### Property description

Lot/Volume Code	Lot/Volume Number	Section Number	Plan/Folio Code	Plan/Folio Number
PART LOT	18		DP	1062447
LOT	116		DP	1078271
LOT	117		DP	1078271
PART LOT	3		DP	804113
LOT	30		DP	877478

### Boundary:

The listing boundary is formed by Cleveland St overbridge to the s boundary along Prince Alfred Park, Chalmers and Elizabeth Street north and Pitt, Lee and Regent Streets to the west.

### All addresses

Street Address	Suburb/town	LGA	Parish	County	Type
Great Southern and Western Railway; Illawarra Rail	Sydney	Sydney			Primary Address
Railway Square	Sydney	Sydney			Alternate Address
Chalmers Street	Sydney	Sydney			Alternate Address
Regent Street	Sydney	Sydney			Alternate Address
Eddy Avenue	Sydney	Sydney			Alternate Address

### Owner/s

Organisation Name	Owner Category	Date Ownership Updated
RailCorp	State Government	16 Nov 98

## Statement of significance:

### THE SYDNEY TERMINAL AND YARDS:

- As the site of the first Sydney Terminal and the starting point of the main line, from which the NSW rail network grew;
- for its continuity of railway use since 1855;
- As the site of one of the first passenger stations in NSW;
- As a major terminal by world standards, comparable with late Victorian and Edwardian metropolitan stations in Europe, Great Britain and North America;
- Containing the Mortuary Station, one of five pre 1870 stations surviving in the State;
- As the first major terminus to be constructed in Australia and the only example of a high level terminus in the country;
- As a unique terminal, in NSW, not only in extent but also for the high standard of design of the associated buildings in particular the Mortuary Station, Railway Institute and the Parcels Post Office;
- Containing two of the three station buildings, in NSW designed by the Colonial or Government Architect in NSW;
- As one of the two longest continuously operating yard/workshop complexes in Australia, dating from the 1850s. Although many of the original functions have been superseded, or operations transferred to other sites, evidence of the working 19th century yard remains extant;
- As a major multi-level transport interchange between pedestrians, vehicular traffic and trains and later trams and subsequently buses. Since its establishment in 1855 it has been one of the busiest transport interchanges in Australia;
- As the largest formally planned addition to the urban fabric of Sydney prior to World War 1, intended to form a gateway to the city;
- As the site of the Benevolent Asylum and Carters Barracks and Devonshire Street Burial Ground and Stations, evidence of which is likely to be found in the archaeological record;
- As a major public work undertaken in numerous stages between 1855 and 1930 by two branches of the Department of Public Works, the Railway and Tramway Construction Branch and the Colonial (later Government) Architects Branch;
- For the evidence provided of the changing technology of train travel from steam to electric trains, indicated not only by the declining yard workforce but also by the changes in yard layout and signalling work practises;
- As point of entry to the city for visitors from country NSW and a major departure point for travellers within Australia;
- The railway yards, the Mortuary Station, Railway Institute Building, terminus and clock tower are familiar Sydney landmarks,

particularly to rail travellers.

#### THE WESTERN YARD:

- For their continual operation as a rail yard since the introduction of railways to NSW in 1855;
- As site of the first and second Sydney Terminals and the Mortuary Station;
- Whitten virtually abandoned Sydney work in order to construct the main line network in the country areas.

#### THE DARLING HARBOUR BRANCH LINE

- Containing one of the first overbridges and cuttings constructed in Australia, part of the first phase of railway construction in NSW;
- As a vital link with Darling Harbour and for the export of wool and other agricultural products from country NSW;
- For the surviving fabric which provides evidence of change embankment and retaining wall and bridge construction techniques.

#### THE MORTUARY STATION

- As one of a pair of purpose built mortuary or receiving stations, the only known example in Australasia. Whilst the station at Sydney remains in its original location, the Rookwood Station has been relocated;
- As a fine, rare example of 19th century Venetian Gothic;
- As the finest example of a covered single platform type station in Australia and the most elaborately detailed stations, of its period. The detail includes a rare example of a tiled platform, elaborately carved stonework and joinery, furniture and decorative wrought iron work;
- As one of few Gothic Revival buildings designed by the Colonial Architect James Barnet, a highly praised design, marking a high point in his career and considered to be one of his finest designs;
- For its association with Victorian rituals surrounding death and mourning. The building was designed as an elaborate setting for the example of the use of trains rather than horse drawn carriages to transport coffins to cemeteries;
- As one of few Gothic revival buildings of the period that were designed for a function other than for churches or schools. The style was selected to provide an appropriate atmosphere for the mourners;
- As an early example of the introduction of Venetian Gothic motifs including the colonnade which screens the platform;
- As a fine example of stone masonry including an arcade with foliated capitals and carved intrados (soffit), metal and wood work.
- For the role played by the colonial Architect James Barnet in encouraging the art of stone masonry through his designs;
- For its association with the development of the Rookwood Necropolis, one of the largest garden cemeteries in the world;
- As a local landmark, visible from locations such as Prince Alfred Park, the Cleveland Street Bridge and the forecourt

of Sydney  
University.

#### THE WEST CARRIAGE SHEDS

- One of few surviving working buildings on the site, whose industrial character, specialised layout and form demonstrate former functions and operations;
- As the smaller, and remaining of two carriage sheds, built for the servicing of carriages;
- Part of the extension of the Sydney Terminal shortly after the turn of the century;
- The disuse of the carriage sheds provides evidence of the changing nature of rail travel and work practices, such as labour intensive processes no longer being undertaken within the Sydney Yards.

#### PRECINCT 2: THE PRINCE ALFRED SIDINGS

- Contain the only remains of a workshop building within the Sydney Terminal complex, which date from the 1870s, and also the Railway Institute;
- Mark the eastern boundary of the once extensive Sydney yards.

#### THE RAILWAY INSTITUTE

- The first Railway Institute to be established in Australia;
- A fine example of the Queen Anne revival style, based on English precedent. The building exhibits characteristic features of the style including Dutch Gables, the use of moulded brickwork and Marseille roof tiles;
- For its role in the continuing education of the railway employees, through evening classes;
- A setting for social activities for the railway employees;
- Containing significant plaques and memorials to railway employees;
- Containing a rare, and largely intact, example of a small scale, late Victorian Hall.

#### PRECINCT 3: THE SYDNEY TERMINAL - THE TERMINUS

- The first major terminus, and the only high level terminal, to be constructed in Australia, the design of which was overseen by experts from NSW, Victoria and Queensland. Comparative in scale and quality of design to the major European and American termini;
- A major transport interchange, with numerous tram lines on different levels, the most complex in Australia;
- A major planned urban design aimed at improving Sydney, in contrast to the haphazard beginning and former unplanned growth of the rail termini. The only major building of this period in Sydney where the urban setting was consciously designed to complement, and provide views of the main structure;
- A symbol of the progress of the development of the city and the railway;
- A major public building designed by the Government Architect WL Vernon, and detailed by GM Blair, and completed by his successor George McRae. The only railway station



designed by Vernon, and his most adventurous free classical design;

- A major sandstone building, one of the few to be constructed, in Sydney, outside of the heart of the CBD.

The use of sandstone reflected the status of the building as a major public building;

- For its design as an elaborate progression of spaces, from the tram portico to the booking hall to the concourse and into the (proposed) train shed, enhancing the sense of journey.

This contrasted with the previous station which had grown into an

unplanned conglomeration of platforms;

- The largest station to have been constructed in NSW, previously the major country stations such as Albury were grander both

in scale and decorative detail than the Sydney Terminal;

- The Sydney Terminal would have been even grander had the train shed been constructed covering the platforms.

The

changing of the design as a cost cutting measure reflects the economic conditions of the time. The construction of Stage Two

during the war years, however, reflects the importance of this transport link to the Australian economy;

- A rare example, in Sydney, of the use of multi level vehicular approaches, the separate approaches for tram, pedestrian and

vehicle, being identified at the outset as being a particular feature;

- The clocktower, completed as part of the second stage, is a well known Sydney landmark, nicknamed "the working mans

watch";

- Containing such planning innovations as separate subways for passengers and baggage handling and the main assembly

platform [concourse];

- Further investigation may reveal the main assembly platform to be one of the earliest uses of reinforce concrete floor slabs in

NSW;

- Marking a period of prosperity for the railways and a subsequent decline in other forms of transport, in particular the more

unreliable coastal shipping, following construction of the north coast Railway 1910-1922;

- The manner in which different structural systems, such as the three pin and crescent truss roofs, were used throughout the

design to form a variety of spaces;

- The original floor plan indicates separate waiting facilities for different classes of passenger and for women. These distinctions

have largely disappeared, with the exception of the use of a system of classes on the transcontinental trains and the XPT and

Explorers;

- For the inclusion, in the design, of up-to-date technology including telephones and telegraphs.

#### THE PARCEL POST OFFICE

- The only purpose built post office building, of this period in Sydney;

- An indication of the importance of rail in carrying parcels;

- An example of the work of the Government Architects Vernon and McRae and their principal design architect, GM Blair;
- A fine example of neo-classical detailing on one of the few brick and sandstone public buildings in inner Sydney;
- A landmark in Railway Square;
- An early example of a concrete and steel framed office building of fire proof construction.

#### THE SYDNEY YARD

- The yard contains one of the earliest sewers in Metropolitan Sydney, built by the newly formed Department of Public Works in the mid 1850s;
- The site of the workshops which were the heart of the working yard in the mid to late 19th century;
- Containing evidence of the changing technology of train travel, commencing with steam locomotives in the mid 1850s;
- Showing the impact of the decentralisation of railway functions, which began in the 1880s, on the Sydney Yard.

#### PRECINCT 5: THE CENTRAL ELECTRIC STATION

- Association with JJC Bradfield and the construction of the City Electric Railway, and the Sydney Harbour Bridge in the late 1920s;
- One of a number of inner Sydney stations designed by JJC Bradfield, of which two are above ground, Milsons Point and Central Electric;
- Containing the most elaborate station entrance (Elizabeth Street), of the City Circle stations;
- For the continuation of the neo-classical architectural vocabulary and the use of sandstone for the station building and the viaduct;
- For its continuous use as a commuter station for the Sydney suburban lines;
- For the use of 'state of the art' reinforced concrete construction.

(Conservation Manage Plan Sydney/Central Station  
Author: Department of Public Works & Services Year:  
1996 Page: 128-135)

*Note: There are incomplete details for a number of items listed in NSW. The Heritage Branch intends to develop or upgrade statements of significance and other information for these items as resources become available.*

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## Description

Physical description:

#### PRECINCT 1: WESTERN YARD

Central Railway Station has buildings concentrated on its northern boundaries that are fed by large rail yards behind. Together they form part of the fabric of the city of Sydney and form boundaries to its inner suburbs. The location of this station is on land that has been in continuous government use since the commencement of European settlement. Various forms of public transport have radiated from this site since 1855.

The open space of the rail yards adds to the experience of arrival to the city from the north and south by opening up vistas to the imposing Sydney Terminal with its landmark tower. This open space permits the imposing Terminus and its Tower to be visible when viewed from a distance much as it was intended when originally built. The terminus and its approaches define formal urban spaces in the city fabric.

Devonshire Street Tunnel demonstrates the influence of the city on the complex. This tunnel was created on a pre-existing street to facilitate cross town pedestrian traffic as well as for the benefit of rail passengers.

#### PRECINCT 1: WESTERN YARD

The Western Rail Yard Precinct is an area that is west of No.1 Main line extending to Regent Street boundary, Devonshire Street Subway and Cleveland Street Bridge. The track layout of this yard has remained virtually unchanged since 1906.

The rail sidings that take up the bulk of the land area were known as the Botany Road Yards. These siding lines are still in service but are seldom used.

The lines were used as storage yards for making up passenger trains and for goods being loaded and unloaded at the Parcel and Goods Sidings. This was a major activity at the Sydney Terminal that has become obsolete due to the introduction of technological changes such as fixed sets of rail cars, and the phasing out of locomotive pulled trains, the use of a branch line cuts through the precinct providing access to Darling Harbour Goods Yard. The underpass and overbridge date from 1855.

The Mortuary Station with its siding and platform are on the boundary of Regent Street and are visible from Railway Square because of the low scale of buildings in the Western Yard. Rail access to the Mortuary Station was from the main lines near the Cleveland Street Bridge, and has remained in service since the mid 1860s.

Nearer to the present main station building there is the West Carriage Shed that is the last remaining carriage shed at Central Station. While no longer in use, it remains largely intact. The six rail lines that enter the shed were connected to the yard through tunnels at the end of Platform No.1.

The Parcel Dock is physically connected with the main station complex and has four platforms. The use of rail transportation for parcel delivery has declined considerably. These platform sidings are still in use for temporary portable offices mounted on rail flat cars. The sidings closest to Platform No.1 are used for the loading of automobiles for the Indian Pacific.

The Yard was designed for locomotive hauled trains. As this technology has gone out of use except for the Indian Pacific and Special Trains the yard has little present functional use. With locomotive hauled trains the train was marshalled for running in one direction, it has the locomotive at the head of the train and a brake van near the rear. This meant that trains when ending their journey had to be remarshalled before commencing their journey out of Sydney Station. The introduction of trains

with driving positions at both ends of the train no longer require this process. As the station originally handled locomotive hauled passenger trains for suburban, country and interstate service this activity was considerable. Most of the steam loco facilities and trackwork has been removed.

The decline in shunting and the removal of coal and water storage has seen a reduction in the level of activity in the yard.

Although it has progressed through various configurations, the landscape has maintained the same ground level since 1856 with its final layout being enlarged in 1906 by the removal of some houses and the realignment of Regent Street to its present format.

#### PRECINCT 2: PRINCE ALFRED SIDINGS

The Prince Alfred Sidings are on the eastern perimeter of the site, making up the boundary with Prince Alfred Park. The PA electric car sidings were built only after the flyovers.

The precinct and adjacent area has a number of functions, its present rail use is for storage of City Rail's Electric rail car sets. Prior to the construction of the electric lines the yard was a goods yard containing Produce and Goods Sheds as well as the first carriage shed. All have been removed from this precinct.

The Yard is a small part of the original Sydney yard, of which a number of buildings remain which date from 1870. Later additional buildings are associated with the 1926 Electric Suburban System. The construction of the electric system reduced the width of the Prince Alfred Sidings.

Trains within this yard need to be protected because of vandalism. The Electric Sub Station is part of the 1926 electrification works and is linked with the sub station at the Sydney Harbour Bridge. It also contains air compressors for the operation of pneumatic points within the Yard and the City Circle Lines.

A retaining wall forms the boundary with Prince Alfred Park, the retaining wall has been incorporated into the rear wall of the blacksmiths workshops. A number of mature trees are growing on the boundary, the larges being a Moreton Bay Fig at least 80 years old.

#### PRECINCT 3: SYDNEY TERMINAL

Sydney Terminal is a high level, main line rail terminal. It is sited to dominate its surroundings and to mark the importance of the railways and its service to the state and the city. This elevated siting also permits the use of the topography to gain road access to more than one level enabling the development of an extensive subterranean luggage network and separation of differing modes of transport. The commanding position of the Terminus with large areas of open space sloping away from the building continues the public domain of Railway Square whilst maintaining a clear vista of the Terminus from the square. The Terminus, and in part the Parcels Post Office, create a formal edge to Railway Square.

The terminus comprises a colonnade and porte cochere, which originally provided an undercover area for passengers transferring to and from trams.

The Main Assembly platform is the centre of the terminus, around which all of the ancillary functions, such as refreshment rooms, waiting rooms and the booking hall were arranged. This "platform" was accessed from both the East and West deck.

Sydney Terminal now contains seven double platforms and one single platform, each with an awning, servicing a total of 15 tracks. Platforms 1-3 are for country and interstate services, while the remainder are for interurban services. The platforms run perpendicular to the main station concourse and all are dead end with the buffer stop.

Platforms 1-10 have a centre run-round track, this was for locomotive hauled trains. It enabled the locomotive to uncouple from its train and either depart or re-couple on the other end to pull the train to the next destination. There was extreme pressure on the speed to ready a train for then ext destination due to the lack of platform space and a steady growth of rail patronage. These centre lines are now used for storage of electric rail car sets in off peak times. The platforms feature long timber framed canopies over some of the platforms (incorporating Howe trusses). Timber was used in lieu of steel because of the high cost at the time of importing steel.

The only locomotive hauled trains now using Sydney Terminal are the Indian Pacific and special trains which usually use Platform 1. Platform 1 has always been the main out of Sydney Station with the longest platform. Platforms 1 and 2-3 were lengthened to their present length in 1962 covering the skylights to the Devonshire Street Subway for diesel hauled trains like the Southern Aurora.

To the west of the southern end of Platform 1 is the Inwards Parcel Office. This was the loading dock for parcels and mail from the post office. The mail was loaded via a tunnel from the post office.

The Parcels Post Office is an unusual urban building, being designed to be viewed from three sides. Its symmetrical, boldly modelled elevations and its siting in the middle of an open space give it the presence of a public monument or sculpture. Due to the oblique road approaches to the Railway Square this building forms a strong element within the Sydney Terminal Precinct.

#### PRECINCT 4: SYDNEY YARDS

The Sydney Yard Precinct is located south of the Devonshire Street Tunnel extending to the Cleveland Street Bridge and between the Central Electric and the Western Yard Precincts. The track layout to Platforms 1-15 have remained virtually unchanged since they were originally laid out in 1906.

Major items from its period as a steam locomotive hauled train yard have been removed. These include the Eastern Carriage shed, Coal Stages, and Engine Docks at the head of each platform. Ash pits and water columns that were part of the yard have also been removed.

There is only one "yard controller" remaining within the Yard. Previously, at least 2 Signal Boxes would have been located in the Yard at any one time, but these have been removed due to the mechanical interlocking system being computerised and pneumatically operated.

The Yard buildings have been altered significantly since the Eastern Carriage Shed was demolished. This large shed divided the central yard from the central electric lines. The land where the shed once stood is vacant and the only remaining structures adding to this division of the yard are the Cleaners Amenities and the former Timetable Office with the garden.

The rail Yard connects to the passenger platforms of Sydney Terminal which are as originally designed and built, with the infrastructure for steam locomotives having been removed - these being water columns between each track near the buffers. However, the concrete plinths remain.

#### PRECINCT 5: CENTRAL ELECTRIC

The Central Electric System runs near to the eastern boundary of the entire site.

Developed in 1926 as part of the electrification and expansions of the Sydney suburban lines, it also linked through the City Circle underground rail system and the North Shore over the Sydney Harbour Bridge. The Electric Station was part of the construction works overseen by Bradfield that included the excavation of the underground tunnels, the building of the Harbour Bridge, and electrification of the suburban rail network. It was run separately from the rest of the rail yard.

At the northern end of the precinct, six tracks leave the underground tunnels near Goulburn Street, and pass over Hay and Campbell Streets and Eddy Avenue where they enter the platform area. The four platforms allow four eight trains to use the station, four trains in each direction. Leaving the platforms to the south, the tracks enter the unique flyover system. The construction of the flyovers was to allow the transfer of trains from the designated platforms to the relevant line.

There are two major pedestrian entrances to Central Electric: one at Elizabeth Street and one at the top of Eddy Avenue ramp. Both are constructed of Maroubra sandstone with classical detailing.

(Conservation Management Plan Sydney/Central Station  
Author: Department of Public Works & Services Year:  
1996 Page: 92-97)

#### Movable Items

Train controllers desk, (AA15), third floor Sydney terminus

Doors linking train controllers offices, (AD07), third floor Sydney terminus

Physical Condition is good.

Physical  
condition  
and/or  
Archaeological  
potential:

Date condition updated: 08 Aug 08

Current use: Railway Station; transport interchange  
Former use: Railway Station; Cemetery (Devonshire Street)

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## History

**Historical notes:** A SYDNEY TERMINAL

Although the Sydney Railway Company first applied to the government for four blocks of land between Hay and Cleveland Streets in 1849, the Surveyor General favoured Grose Farm, now the grounds of the University of Sydney. It was further from the city and less costly to develop.

The Company finally exchanged land in the first, second and third blocks, between Hay and Devonshire Streets, for an increased area of twenty acres in the fourth block, the Government Paddocks, between Devonshire and Cleveland Streets. Hence the site of the first Sydney railway terminus was located here from 1855.

When the third station was built in 1906, it moved one block north, closer to the city. It fronted Garden Road, which was realigned to from Eddy Avenue. If Belmore Park is included, all the land now occupied by the railway at Central and Redfern coincides with the Company's original selection of four blocks between Hay and Cleveland Streets.

In major metropolitan areas the rail terminus tended to be located within the inner core of the city. The site of the first and second station termini was inconveniently located for the city. Initially a horse-bus service operated from the station to the city, and both Engineer-in-Chief, John Whitton, and Chief Commissioner for Railways, BH Martindale, recognised the urgency of a city rail extension.

In 1877 John Young, a prominent Sydney builder and local politician proposed a scheme to provide a circular city extension to the railway. The route included stations at Oxford Street, William Street and Woolloomooloo in the east, Circular Quay, then Dawes Point and a line parallel to Darling Harbour in the west. John Whitton designed a grand city terminus at the corner of Hunter and Castlereagh Streets two years later. Neither of these schemes eventuated.

In 1897 Norman Selfe drew up a scheme for the gradual enlargement and extension of the railway to the northern end of the city and in the same year Railway Commissioner, EMG Eddy, proposed a terminal city station at the corner of Elizabeth Street and St James' Road. The route of the latter was virtually the same as that for 1879, however, the new site for the terminus included half of the northern end of Hyde Park. Although 16 acres of the burial ground in Devonshire Street was offered as compensation, public sentiment still opposed the loss of Hyde Park.

The Royal Commission in 1897 again considered the city railway extension because of dangerous congestion at Redfern and recommended using Hyde Park. Then, after an investigative trip overseas, Henry Deane, Engineer-in-Chief, prepared alternative proposals for a new railway terminal for the government in 1900.

The second scheme proposal called for the resumption of the Devonshire Street cemeteries, but this was cheaper

and less contentious than the acquisition of Hyde Park. It was the second scheme which was eventually adopted.

#### A GATEWAY TO THE CITY

During Governor Macquarie's term, the future site of the Sydney Terminal was beyond the limits of settlement, which were marked by the tollhouse located at the end of George Street and at the entrance to Railway Square.

The Benevolent Asylum fronted present Railway Square. It was demolished to make way for the building of the third railway terminal, Sydney Terminal.

Although Railway Square no longer signifies the entrance to the interior of the colony, at the junction of George and Pitt Streets, it has always channelled traffic from the southern parts of the city and out west to Parramatta. From the building of the first railway terminus at Devonshire Street in 1855, it was an important focus for the arrival of country persons to the city and later commuters into the city.

The importance of the relationship between the Sydney Terminus and Railway Square is reflected in the elevations of the main building. Here the dominating presence of the clock tower, completed in 1921, marked the arrival and departure times, the beginning and the end of a workman's day. Before the spread of the suburbs, a workman could make a return trip home to eat dinner in his lunch hour.

On a continuous axis with the first station building, Belmore Park originally fronted the first Hay and Corn Markets in Hay Street. When the third station was located one block further north, it linked up with the southern side of Belmore Park. The park then fortuitously provided a green foil to the commanding city front of the station.

The 1908 Royal Commission for the Improvement of the City of Sydney and its Suburbs offered two schemes which, in providing vehicular access, attempted to resolve the discrepancy in scale between Belmore Park and the station building. The scheme presented by John Sulman consisted of two circular roadways, one above the other, around Belmore Park. The Commissioners, however, favoured a less grandiose Scheme prepared by Normal Selfe.

"Its main feature is the raising of Belmore Park to the level of the station platform between raised roads in the eastern half of a widened Pitt-street on the one hand and the western half of a widened Elizabeth-street on the other, with a connecting viaduct along Eddy-avenue and a retaining-wall to support the raised park along its Hay-street alignment".

Although neither scheme was attempted, Selfe proposal is recalled in the Elizabeth Street ramp which was built in 1925 to allow the extension of an electric connection to the city. The park, needless to say, was never raised to the height of the assembly platform.

The Elizabeth Street facade of the Sydney Terminus has received less attention. Facing the working class terraces in Surry Hills, the eastern wing was finished in brick rather than stone when shortage of funds hurried completion of the first stage of the station in 1906. It was the obvious location for expansion when new platforms were added to



the original complex to provide the electrical city and suburban connection in 1926. The grand station building is eclipsed from view at street level by the Elizabeth Street ramp and the later semi-circular classical entrance portico to the city connection is in refined contrast to the rusticated blocks and heavy treatment of the main building.

#### ELECTRIFICATION

The original proposal for electrification was for the Hornsby-Milsons Point Line, a separate line which could be electrified without impact on the remainder of the rail system. However, due to the necessity of building the City Underground Railway and the proposal for a Sydney Harbour Bridge, not to mention the expansion of the Illawarra and Bankstown lines, the program was altered in order that the electrification could be linked with these proposed expansions.

From Well Street Redfern eight tracks would continue as the City Railway whilst four would carry the country trains to the Sydney Terminal. An above ground station which would include a link to allow the transfer of passengers and baggage to the Sydney Terminal. This new station was constructed on the east.

The planning for electrification involved the following works:

- a new above ground station
- extensions to the Cleveland Street Bridge
- flyovers
- extensions to the Devonshire Street subway
- extension to the Devonshire Street wall
- construction of new bridges over Eddy Avenue, Campbell Street and Hay Street, and the Elizabeth Street retaining wall.
- construction of the City Railway Tunnels

#### MODERNISATION OF CENTRAL STATION

Modernisation programs were undertaken in 1955 and again in 1964. In the 1955 work a booking hall was created (in the former refreshment room, now the railway bar). Murals depicting railway scenes lined the walls and a terrazzo map of Australia was installed on the floor. In October 1980 a modernisation program at the Sydney Terminal commenced. The objective of the work was to improve the facilities for both passenger convenience and comfort. The start of this modernisation program coincided with the 125th Anniversary of the NSW Railways and it was at a time when many major service advances were being made to the State Rail System.

#### HISTORICAL OUTLINE: BUILDINGS & YARDS

##### THE DEVONSHIRE STREET STATIONS

The first Sydney passenger station, located just south of Devonshire Street, was a temporary timber and corrugated iron building, constructed rapidly in late August to early September 1855, in time for the opening of the line to Parramatta for passenger trains. This building was demolished in the early 1870s and replaced by a more substantial brick station building.

The first, and the second station buildings, often referred to as Redfern Station were both in the form of a shed which covered the main line. A photograph of the exterior of the first station taken in 1871 shows vertical boarding, windows with a hood and a corrugated iron roof, with a

roof vent. Internally the stud framing and timber truss roof members were exposed. The offices and public facilities were contained in the adjacent lean-to, which faced George Street. Only one platform and the main up-line served the passenger station. A similar platform and line layout was used for the Mortuary Station, constructed 15 years later, however, the level of detail and materials varied considerably.

The first station building was extended almost immediately, a shed being constructed at the southern end to cover an additional 100ft of platform.

The second station building was constructed on the site of the first station, the main hall spanning the up and down mainlines. Separate platforms and facilities were provided for arriving and departing passengers. The new station building appears to have taken three years to complete, the drawings are dated 1871, the official opening was in 1874.

The second station, like the first, was constructed to allow for a future extension of the line into the city, the lines initially extending just far enough past the building to accommodate a steam locomotive.

John Whitton, the Engineer-in-Chief designed a neo-classical station building to be constructed of brick, with the decorative detail formed using polychromatic and relief work.

Almost immediately the demand for platform space during peak times resulted in additional branch lines and platforms being constructed adjacent to the passenger station. These lines were brought in front of the station, obscuring it from view and isolating the verandah. By 1890 Whitton's station building had become engulfed within a sea of sheds and tram platform canopies.

The second Redfern station, demolished following the completion of the first stage of the main terminal building c.1906, was a gloomy building, the glass in the roof lantern not permitting a great deal of light to enter and the soot from the steam locomotives coating the surfaces with grime.

#### THE DARLING HARBOUR LINE

In addition to the construction of the main trunk line between Sydney and Parramatta in 1855, a branch line between Darling Harbour and the Sydney Yard, with a cutting and underpass to carry the line under George Street, was also constructed. This line was to allow for the transfer of goods to be exported by ship primarily wool bales.

In the first decades of settlement goods were loaded and unloaded in Sydney Cove, however, as the city expanded the wharves extended round into Cockle Bay (Darling Harbour). The presence of the rail link would have influenced the development of this harbour.

The Darling Harbour Line is one of the first cuttings and overbridges to be constructed as part of the NSW Rail network. In contrast to later structures sandstone is used to line the walls of the underpass and to form the over bridge. The Darling Harbour Line partially followed the line of an existing water course, the Blackwattle Creek.

Subsequent alterations to the layout of Railway Square have resulted in extensions to the overbridge.

#### THE SYDNEY YARD

The first Sydney railway workshop, constructed c.1855 was a substantial two storey sandstone building with arched openings to both floors and a slate roof. A boiler, for the production of steam, was located at the southern end of the building. By 1865, a timber extension had been constructed over a section of track to allow the locomotives to be worked on under cover. A blacksmiths forge was located in an adjacent single storey building.

In contrast with the first Redfern Station building [Sydney Terminal] the main workshop building was an elaborately detailed sandstone building, with a rock faced ashlar base, quoins and sills. The use of substantial and well detailed sandstone buildings on the site was to continue with the construction of the twin gabled goods shed, the Mortuary Station and finally the present Station Building and its approaches.

Originally the Sydney yard occupied the area between the passenger station and the two storey workshop building. Initially timber and corrugated iron sheds were built however, these were soon replaced with more substantial masonry building. Gable-ended locomotive and carriage workshops were built here. Although no architectural drawings of these buildings have been located it is assumed that metal roof trusses and cast iron internal columns were used, similar to the structural system favoured in England, and later employed at Eveleigh.

Of these sheds the most elaborate was the Second Goods Shed, built in the late 1860s. The building was as, if not more, elaborate than many English examples. It was unusual, even in the 19th century for this level of decorative detail to be employed on such a utilitarian structure as a goods shed, the standard of building obviously representing the level of importance of the yard.

Extensive facilities were required to keep the locomotives in good working order. The Sydney/Redfern yards were extended towards Elizabeth Street and the Exhibition Ground (Prince Alfred Park). Until the construction of the railway workshops at Eveleigh in the mid 1880s the majority of the maintenance work was undertaken at the Sydney/Redfern Yard.

In 1884 the yards included a gasworks (c.1882) and gas holder, a carriage works, the locomotive shop (by 1865). A turntable connected the now considerably extended main workshop building, one of the two blacksmiths shops and the repairing shed. All of these structures have been demolished.

Further towards the park, in the area now known as the Prince Alfred Sidings were located the carpenters shop, the second blacksmiths shop and an office.

These buildings are the only remnants of the Sydney Yard. Little physical evidence remains of the layout or the functioning of this once extensive railway yard as many of the structures were removed to allow for the construction of platforms 16-23 and subsequently the city electric station.

#### THE MORTUARY STATION

The Mortuary Station, or the Receiving House as it was known was originally constructed for funeral parties, the mourners accompanying the coffin on the journey to the necropolis at Rookwood. Most documentary sources date the building as being constructed in 1869 however, the outline of the station first appears on the 1865 MWS&DB plan. The rail lines had not yet been constructed.

The inner Sydney cemetery or New Burial Ground, also known as the Sandhills or Devonshire Street station was located in the Brickfields, a site now occupied by the main terminal building. By the 1840s this cemetery was overcrowded and a new location, within close proximity to a railway line, was required.

In the early 1860s a site at Haslem's Creek was selected for the new cemetery. To distinguish the cemetery from the surrounding residential area of Haslem's Creek the cemetery became known as the Rookwood Necropolis. A station was constructed within the Haslem's Creek Cemetery (the Rookwood Necropolis).

The Colonial Architect James Barnet designed both receiving houses (mortuary stations) in the mid 1860s. The station within the Necropolis has subsequently been relocated and modified to form the nave of All Saints, Church of England, Ainslie, ACT. Although both stations are Gothic Revival in style, the plan and detailing of each varies considerably.

Barnet's two station buildings were designed to celebrate the passage of the coffin to and from the train. In the Victorian Era mourning the dead was a prolonged ritual with elaborate rules concerning behaviour and dress. The train trip to Rookwood became part of this ritual.

The regular funerary train service to Haslem's' Creek cemetery (the Rookwood Necropolis) commenced in 1867, two years before Mortuary Central and the Rookwood Station had been completed. By 1908 there were four stations within the necropolis, named Mortuary Stations 1-4, the Sydney receiving house was known as Mortuary Central.

Mortuary Central was built by Stoddart & Medway from Prymont sandstone and completed in March 1869. The carvings were executed by Thomas Duckett and Henry Apperly. From the variation claim submitted by the builders it would appear that a slightly larger building, with more decoration was built than originally intended.

The form of the Mortuary Station, with the large porte-cochere clearly indicates that it is not a church. A colonnade of trefoil arches and foliated capitals forms a screen to the platform. The same arch form being employed for both ends of the platform and for the octagonal porte-cochere to the west. The station building is above street level, a flight of stairs lead to the platform level. Ramps to the north and south were used for carriages. Internally were the ticket office, two vestibules and retiring rooms.

Photographs taken in the early 1870s clearly show the decorative detail of the building. Two colours of stone were employed, a darker shade of the arches and the surrounds to the medallions, the lighter shade being reserved for the ashlar work. The two shades of stone were employed internally in the same manner.

The arcade covering the platform is very elaborate, with its curved queen post truss roof, with ripple iron above following the curve, blind arcading to the west that mirrors the eastern arcade, and geometric tiled floor. Even the platform benches follow the Gothic Revival theme of the design, resembling pews. This platform would have contrasted with the more utilitarian Redfern station building, designed by John Whitton and constructed in the early 1870s.

The stonework of the Mortuary Station was very delicately worked, with a number of different foliage motifs forming the capitals, the trefoil spandrel panel within the main arches and the medallions. A star and zia-zag motif was used on the soffit of the arch, ball flowers on the cornice brackets and a zig-zag on the cornice.

The original roof covering was slate, with a pattern of half round and diamond slates being employed at the ridge and above the eaves. The octagonal porte-cochere terminates in a bell-cote, whose detail is a miniature of the main trefoil arch and medallion motif. The bellcote was roofed with lead.

Decorative metalwork is also employed, as finals, as a cresting and as balustrades. A leaf motif was used for the balustrade to the porte-cochere, and repeated in the panels of the elaborate timber gates that lead to the platform.

A palisade fence that stepped down to follow the slope and matching gates separated the station from the street and a picket fence lined the ramps. The spire of Mortuary Station (the Bellcote) was a distinctive townscape element it could be seen from the Exhibition Grounds (Prince Alfred Park) and from Sydney University.

The arcade detail, of Mortuary Central with its pointed trefoil arches, medallions and foliated capitals is reminiscent of the hotel at St Pancras Station by Sir George Gilbert Scott, designed in 1865 and constructed 1868-73. There are few other station buildings, either in Australia or the United Kingdom with this level of decorative detail. The construction of special mortuary stations is rare, no other examples have been located.

By the late 1970s the station had deteriorated, slates were missing from the roof and the stonework, black from pollution was also covered from graffiti. A restoration program was undertaken in 1983.

#### THE RAILWAY INSTITUTE, Chalmers Street

The Railway Institute was constructed as a venue for the Railway employees, providing a setting for both educational activities and social functions. It is reputed to be the first Railway Institute in Australia and provided a range of services for railway employees such as evening classes and a library.

A competition was held for the design, which was won by the Architect Henry Robinson. It is a Queen Anne Revival style building, based on English prototypes such as the London Board Schools. The design was the first use of Marseille roof tiles for public buildings in Australia. Many public buildings were designed by competition c.1890, during the period of transition between the Colonial and Government Architects Offices. The practice was

abandoned in the mid 1890s due to lack of partially of the judges.

When the Railway Institute was constructed in 1891, the building was located on the corner of Devonshire Street and Elizabeth Street, at the north eastern corner of the Sydney rail yard. The surrounding streets and the carriage way have subsequently been modified. A carriage-way lead to the porte-cochere, enabling people attending social functions to enter the building without getting wet.

In addition to the library there were two halls, a large hall, with a stage, and a smaller hall on the ground floor. The detail of this space is largely intact and there are few examples of small scale halls of this period remaining in Sydney.

A single storey addition to the building, designed by the Government Architect Walter Liberty Vernon was added in 1898 to the south east of the main building.

Classes, such as engineering drafting, and examinations for railway employees were held in the Institute. The building was also utilised during emergencies such as the 1919 Influenza epidemic when women volunteers manufactured face masks (for railway employees).

There are few examples of Institutes of this period that provided such a high level of facilities for the benefit of the employees. The names on the Honour Board reads as a who's who of railway personalities.

#### THE SYDNEY TERMINUS - INITIAL PROPOSALS

In 1895 the Parliamentary Standing Committee on Public Works advised that a Royal Commission should be constituted to "inquire into the question of bringing the railway from its present terminus at Redfern into the city". The findings of this Commission, favouring a site in St James Road, were released in 1897. The term Central Station was now in common use.

The public Works Annual report of 1896-7 noted that "the Railway Construction Branch was called upon to furnish voluminous plans and estimates of the cost of the various proposals brought before the commission. After a most exhaustive investigation, the Royal Commission reported, almost unanimously, in favour of the extension of the railway into the city by the route and according to the plan as described as the St James Road Scheme".

The initial designs for a near Sydney Terminal were prepared by Henry Deane, the Engineer-in-Chief of Railway Construction in consultation with the Railway Commissioners. Mr Deane is reputed to have prepared ten schemes for the Royal Commission. Although the St James location was preferred, a scheme that did not involve the disturbance of or use of land in Hyde Park was sought.

The extension of Belmore Park was initially proposed in the 1897 scheme as compensation for the use of the north western corner of Hyde Park as a Railway Station. Following a change of government the St James scheme was abandoned and Henry Deane prepared, c.1899, a further two schemes, one of which was for the Old Burial Ground Site.

The earlier schemes to extend the lines further into the city would have been prohibitively expensive and would

have required large scale resumptions. The site of the Old Burial ground was, in comparison, relatively easily obtainable as no private land was involved. Due to the extent of the resumption there would, in addition to a terminus be room for the extension of the goods yard and the erection of a carriage shed and post office.

The existing lines were at a higher level than the Burial Ground so rather than lower the existing railway track the tramlines were to be raised to serve a high level station.

The Public Works Committee passed the design on 7 June 1900 however, a much modified building was actually constructed.

The total estimated cost of the works was to be 561,000 pounds with the General Works estimated at 138,000 pounds, the Station Building estimated at 233,000 pounds and the Resumptions estimated at 140,000 pounds. Almost immediately these estimate proved conservative, there was much public concern regarding the removal of bodies from the Old Burial ground and a new cemetery, the Botany Cemetery, had to be constructed, at public expense at La Perouse.

The following properties were resumed:

- Steam Tram Depot, corner of Pitt Street and Garden Road
- Convent of the Good Samaritan (part of the Carters Barracks)
- Sydney Female Refuge (part of the Carters Barracks)
- Police Superintendent's Residence, Pitt Street
- Christ Church Parsonage
- Benevolent Asylum
- Police Barracks
- Devonshire Street Cemetery and South Sydney Morgue
- Residential Property, Railway Place

Mr E O'Sullivan, the Minister for Works, in 1901 established the [Central] Station Advisory Board, comprising railway experts to "investigate the question of the design and arrangements of the station". The members included:

- The Engineer-in-Chief for Railway Construction, NSW, Henry Deane
- The Government Architect NSW, Walter Liberty Vernon
- The Engineer-in-Chief for Existing Lines, NSW, Mr TR Firth
- The Engineer-in-Chief for Railways, Queensland, Mr HC Stanley
- The Chief Engineer for Existing Lines, Victoria, Mr CW Norman.

The committee also considered a suitable design for the new Flinders Street Station in Melbourne. The design for the Sydney Terminus was to be a collaboration between the architect and the railway engineers. The layout was largely determined by the planning requirements of the railway engineers, to which an appropriate architectural style was overlaid. However, the initial scheme did not contain the require accommodation and an enlargement of the building was approved by the Minister. The cost estimate was now 610,000 pounds. The Board were to fulfil the wishes of the Minister that "the building should be a monumental work of stateliness and beauty".

An early proposal for the new terminus, and the changes to the surrounding area were reported in the Sydney Main in 1901:

"One of the reforms to be incidentally effected will be the widening of Pitt Street near the railway to 100ft. The width will be secured by taking in land on the right already resumed or in Government hands, and including the Benevolent Asylum grounds, the convent along the northern side of Pitt Street where it debouches upon George Street. The result will be a fine, broad thoroughfare, tree bordered to form the entrance to the city...

...Mr O'Sullivan is also conferring with Mr S Horden to see if an arrangement can be made for the purpose of widening Gipps Street, at present a narrow thoroughfare before any new buildings are erected. By planting these broad streets on each side with trees, Mr O'Sullivan contends that a magnificent entrance to the city will be established and the trees will set off the new station.

He considers that this opportunity for the improvement and ornamentation of Sydney should not be lost, especially as it will not entail a very heavy cost upon the tax payer, most of the land utilised already being the property of the crown.

There will be four double and four single platforms, or practically twelve single platforms in all... Between the end of the docks and the main buildings is the assembly platform, 70ft wide. On the platform level will be booking offices, waiting rooms, cloak and luggage offices, lavatories, convenient refreshment rooms, dining rooms, etc. The basement will be devoted to kitchens, stores, baggage rooms, offices for minor officials, and a dining room for the Railway Commissioners and their staffs, including the clerical, professional, traffic and audit branches.

The railway is to cross Devonshire Street, which as a street for heavy traffic will cease to exist. It will be lowered and modified, to suit pedestrian, cab and light traffic only, with a width of 50ft. The heavy traffic hitherto taken over Devonshire Street will be diverted along Belmore Road and a new street which is to be made on the east side of the station.

Cabs will enter the station from Devonshire Street. The exit for cabs will lead into Pitt Street by an inclined ramp and subway, thus avoiding any crossing on the level of the path of either pedestrians or tramcars. The main approach to the station will be opposite the intersection of George and Pitt Street, and foot passengers, and cabs and other vehicles will enter here. Departure for vehicles will be effected by means of a ramp, descending from the north west corner of the building to Belmore Road.

"A subway for pedestrians to enter the building is to be provided from a point in Pitt Street, nearly opposite the north western corner of the building. The tramway approaches have been so designed as to take them completely clear of all other classes of traffic and congestion, and interference and risk of injury will be altogether obviated.

It is intended that the railway traffic should run as now arranged over the Castlereagh and Pitt Street route, but, instead of approaching the station on the ground level, the



two lines begin to rise from a point in Belmore Park on a grade of 1 in 20, where they will terminate with a wide colonnade of (sic) platform level."

This design, with pavilions and a Mansard roof was strongly influenced by French Renaissance chateaux. The scale of the building, arrangement of the approaches and viaducts, the ground level colonnade and the position of the clocktower are all similar to the subsequent scheme, which was actually constructed.

By June 1901 work had begun on forming the site of the New Station at Devonshire Street, the PWD Annual Report for 1900/01 noting that "a great deal of preliminary work has had to be done in the preparation of the site for the new station and the extension of the railway, owing to the necessity of removing the bodies from the old cemetery and providing a new cemetery to receive the remains, as well as the demolition of the buildings and disposal of the material. The work of clearing and levelling is now well in hand." "Private removals were commenced on the 29th of February 1901 and at the end of the year 1,145 bodies had been removed." Families could remove the remains to a cemetery of their choosing however, the majority of bodies removed were relocated, at government expense, to the new cemetery at La Perouse. The Belmore Park to Fort Macquarie Electric Tramway was also constructed in 1900-1.

The earlier brick and sandstone design, with a mansard roof was abandoned in favour of an all sandstone terminus building which largely incorporated the same passenger, tram and vehicle separation as the earlier scheme. During 1899 a Parliamentary Standing Committee had debated whether the major public buildings should be constructed of brick with a sandstone trim or all sandstone. This committee determined that, for major public buildings, sandstone should be used.

Two designs, by members of the Government Architects Branch, were submitted for the facades in October 1901 to the Minister for Public Works and to the Railway Commissioners with the accompanying comment by the "Board of Experts" advising on the design of Central Station "we are of the opinion that either one or the other of the architectural designs which accompany this report may with confidence be adopted". Of the two facade options that of Gorrie McLeish Blair was reputedly selected.

The 1901/02 Annual Report describes the progress a year later, "work has progressed vigorously during the year. All the old buildings and human remains have been removed from the site and the foundation stone was laid at the corner of Pitt-street and the New Belmore road on the 30th April. The information of New-Street, 2 chains in width, the extension of Castlereagh-street and the widening of Hay and Elizabeth Streets is well forward. The levelling of the whole site is practically finished, and great improvements have been made to Belmore and Prince Alfred Parks by filling in with the spoil excavated for the foundations".

A more detailed account is given of the excavation "the excavation to the docks and main building containing some 80,000 cubic yards, has been taken out and the material removed to Belmore Park, where it forms the tramway embankments and raises the general level of the

park. About 30,000 cubic yards of material from the Castlereagh-street cutting have been utilised in improving the level of Prince Alfred Park.

In early 1902 the design of the terminus building was changed yet again, at the request of the "Board of Experts" advising on the design of Central. "...the station building has been increased in height by one storey, and considerably in length of front, and an east wing added. A tower also of fine proportions has been included. The completed building consequently shows a much larger building than originally proposed, but it is thought in the future it will come into use. In the meantime, certain parts can be left out and added afterwards, but in spite of all such reduction the estimated cost of the new building and the main road will amount to about 400,000 pounds as compared with 230,000 pounds".

Henry Deane, in a lecture given to the Sydney University Engineering Society in 1902 describes the layout of the Central Railway Station that was currently under construction. "On the northern front of the Station, the roadway has a total width, including the footpaths, of 165 ft, so that not only the wheel traffic to the station, the tramway traffic to and from the City and Western Suburbs and the sports traffic, but also the heavy traffic diverted from Devonshire Street may be commodiously accommodated. This street will be continued to George Street and made 100ft wide. Steps are being taken to widen Pitt Street and make it 100ft wide.

Hay Street and Elizabeth Street, where skirting the park, have been widened by the abolition of the pathway running alongside the park and the utilisation of the avenue in the park for the purpose. A new street, 100ft wide on the East side of the station ground connects Elizabeth Street at the junction of Foveaux and Castlereagh Street, Redfern.

An inclined approach, including a width of forth feet for cabs, twenty feet for pedestrians and a sufficient width for the tramway runs parallel to Pitt Street, between Hay Street and the Station. The return tramway descent...is made on the east side of the station. These inclined approaches will have flat earthware slopes towards the park which will be ornamentally planted.

At the southern end of the station, Devonshire Street, where it passes through traffic or skirts the railway property, will be closed to all but pedestrian traffic, the latter being accommodated by a subway.

With regards to the Tramways, the Castlereagh and Pitt Street lines will be brought up by inclines to the platform level of the station... The tramway running through Belmore Park has now been abolished and deviated via Elizabeth Street and the road in front of the station...

...From the north or City end, access to the station for pedestrians will be by a footpath twenty feet wide, starting from Hay Street and rising up with a one in sixteen grade to the colonnade in front of the main building. From the west access will be obtained by a passenger subway fifteen feet wide opposite the new street, between George and Pitt Streets, with a one in twelve grade to platform level.

A striking peculiarity and advantage in the arrangements

of this station is that there are separate approaches for pedestrians, road traffic and tramways, so that there will be none of the clashing and danger incident on the present arrangement between George Street and the existing station."

The general design of the new station was also discussed. "A great amount of attention was been devoted to the treatment of the front and west sides, and there is an additional of a wing on the east side. The tower, which will be situated near the north west corner of the station will be a commanding feature, and will be provided with a clock which will be visible from most parts of the city.

It is expected that the whole will produce an imposing architectural effect. The space enclosed between the wings of the building, and which is covered by the main roof, includes the assembly platform, 72 ft wide, five docks with three roads each and intervening platforms. Outside the building, on the east side, some lines will be laid which can eventually be extended into the city should that work be authorised by Parliament.

It is intended that the accommodation for the public shall be specially commodious. It will be of a character that will not only be suitable and sufficient for many years to come, but it has been architecturally designed so as to be an object of admiration to visitors.

A special feature of the Central Station design is its assembly platform (or one might say assembly platforms) because for the passengers leaving by train there is wide covered space to the north of the building, which to a certain extent serves the same purpose as the larger one, situated between the two wings of the building. This latter is 348 ft long and 72 ft wide. Although it has an analogue in space in front of the station at Redfern (Devonshire St) where arrivals from Sydney congregate, it differs in important respects from that one.

Although a busy place, it will not be subject in the same way to the rush of arrivals and departures, and those using it will not only be better protected from the weather, from the hot and cold blasts and the damp that afflict the passengers at Redfern (Devonshire St), but they will have better opportunities for considering their whereabouts and looking up the traffic directions than they now enjoy. Before them, in one line will be the barriers with openings leading on to the different platforms, and indicators plainly marked which can be read from a distance will show them the times and destinations of each departing train.

The booking hall will, in accordance with modern practice be of a large size, namely 110 ft long by 54 ft broad by 36 ft high. It is intended that it shall be a work of art and probably some special display of the latest style in station adornment will be found.

Waiting rooms will be provided for both ladies and gentlemen and the best attention will be devoted towards giving those using them the latest and best designed lavatories and conveniences. A barber's shop will be provided, accessible from the assembly platforms and to meet a demand that is often felt by those arriving by train and wishing to get rid of the dust of travelling, and to change their clothes so as to fit them to meet their friends or visit places of entertainment, there will be baths and dressing rooms...

The refreshment buffet is nearly 60 ft long by a width of 41 ft, and will be got up in the latest style. Adjoining is the ladies' and gentlemen's' dining and tea rooms 86 ft by 53, with separate entrances from the assembly platform, the servery for which are in direct communication with the kitchens in the basement where every adjunct of the latest type is provided.

The public telegraph and telephone offices...are situated in the west wing and are approached from the inside platform and also from the cab arrival platform on the outside. The baggage room... is convenient to the cab arrival platform. Two large lifts are provided in which the baggage is taken to the basement to be distributed through the subways and up the lifts to the various platforms. On the other side of the arched opening to the platform is the cloak room...fitted up specially for the ready reception and delivery of parcels. Lifts are provided for the reception and delivery of goods to large stores in the basement.

At the southern end of the west wing of the main building is situated the main parcels office Here special facilities will be provided for parcels inwards and outwards; there is a separate road 40 ft wide, for inward and outward traffic, with all the necessary raised platforms &c.

Under the cab approach and departure roads, and facing Pitt Street, there will be 24 shops with colonnade in front... There will also be nine similar shops in the basement of the main building facing the new street.

On the upper floors of the building the Railway Commissioners and their officers will be accommodated. For the convenience and comfort will be accommodated. For the convenience and comfort of the staff, who are thus situated some distance from the centre of the town, a special dining-room and reading-room have been provided on the street level with access by lift and staircase from the offices above".

In his lecture Henry Deane also discusses many of the technical aspects of the design including luggage handling, the lifts, the water towers, the train shed roof, which was subsequently deleted as a cost cutting measure, the platforms and signalling.

A novel method of luggage handling was designed for Central to "get rid of the objectionable luggage-trolley, which is always frightening nervous people". A overhead luggage carrying system had been developed in England however, in the case of Central station "the levels permit of its being carried on underground by means of subways and lifts at suitable points". The mail was also to be transferred by subway.

The train shed roof was to be designed to have a central span of 198 ft with two sides spans of 78 ft. Three pin trusses were to be employed, which were to be brought to the ground to provide intermediate support. The roof was to be continuous. This truss and roof configuration was to be based on that of the Union Station, St. Louis, visited by Deane in 1894. Such a roof would have rivalled those of the major metropolitan termini in Europe and America.

The platform area was to be double that of the earlier

station and correspondingly double the number of passengers could be accommodated. The maximum number of passengers that the Devonshire Street station could accommodate with 20,000. The new station would be able to accommodate 40,000.

The location of the cab rank was also discussed, it having been decided not to incorporate a cab rank inside the building so that the new station could be "kept entirely free from the smell, which the standing of horses under the roof must certainly involve".

In 1902 the Railway and Tramway Construction Branch, headed by Mr Deane, reported that "plans and detail drawings have been prepared in the office for the whole of the retaining wall and shops in Pitt-Street, both north and south of the new road in front of the Station, also for the Devonshire-Street subway and for the whole of the basement floors, including drainage, telephone tunnels, &c." At this stage, the estimated cost of the works was 561,600 pounds, however, it was "probable that his estimate will be exceeded".

The necessary tramway deviations, 2 miles and 60 chains of track, were laid in 1901-2 using day labour. The track consisted of rails laid on sleepers. The curve and the poles were manufactured by local engineering firms including the Clyde Engineering Co. The Permanent Way (i.e. track) was imported either from England or America.

The construction of the first stage of the station began in June 1902 and was completed in August 1906. By 30 June 1903 the following works had been completed: "the total quantity earth removed is about 250,500 cubic yards. This has been used to level up the station site as required. Belmore Park has been raised to carry the tramways to the station... The Sports Grounds Moore Park (cycling ground) have been formed and the best of the clay had been disposed of to Messrs. Goodlet & Smith at their brickworks...

...The whole of the foundations to the main buildings have been taken out and concreted. On 21st July, 1902, the first order for building stone was given to Mr Saunders, at Pymont Quarry. On the 6th of August Inspector Murray went to Pymont Quarry to arrange for starting work dressing stone. On the 7th August eleven masons started work, and on the 18th the first dressed stone was landed on the works from Pymont Quarry and was set in place on No. 3 Pier, arrival bridge, on the 19th August; and since that date 127,000 cubic feet have been built into place.

This stone has been used in the building of retaining wall, Pitt-street, between Hay-street and the Ambulance Depot, near Devonshire-street; the tramway arrival and departure bridges, the piers of which have been carried up to impost and girder-bed level. Shop fronts and arcades in Pitt-street...the whole of [the] arcade with shop fronts and front wall to the main building from Pitt-street to the extreme eastern end of the building, including the east wing have been carried up to the first floor level (Department of Public Works & Services, 1996, 25-28 & 39-72)

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## Historic themes

Australian theme (abbrev)	New South Wales theme	Local theme
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Railway Station-
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Rail transport-
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Administering the public railway system-
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Development in response to railway lines-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Planning relationships between key structures and town plans-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Creating landmark structures and places in urban settings-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	20th Century infrastructure-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Creation of railway towns-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Impacts of railways on urban form-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Shaping inland settlements-
4. Settlement-Building settlements, towns and cities	Utilities-Activities associated with the provision of services, especially on a communal basis	Public Transport - suburban railway lines-
4. Settlement-Building settlements, towns and	Utilities-Activities associated with the provision of services, especially on a communal basis	Railways to inland settlements-

cities		
4. Settlement-Building settlements, towns and cities	Utilities-Activities associated with the provision of services, especially on a communal basis	Railways to inland settlements-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	Providing foreign government embassies-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	Building and operating public infrastructure-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public activities.	Developing roles for government - building and administering rail networks-

## Assessment of significance

### SHR Criteria THE SYDNEY TERMINAL & YARD

a)

[Historical significance]

The primary historical importance of the Sydney Terminal and the associated yards is the continuation of use of this site, for railway purposes, since the construction of the first line, from Sydney to Parramatta, in 1855. Three successive Sydney Termini, the Mortuary Station and the Central Electric Station have been built on this site.

The construction of the Sydney Railway yards and terminal is associated with the introduction of railways to NSW in 1855 and the subsequent construction of a rail network throughout the state, and interstate, initially by a private company and subsequently by the government. The establishment of the railways in NSW and Victoria was undertaken during the same period albeit using differing technology and standards.

The development of the Sydney yards commenced in 1855 and was one of the first two yards in Australia, the other being in Melbourne. Extensive workshop facilities were established to enable the repair of locomotives. From the late 1880s the working functions of the Sydney Yards have gradually been transferred, initially to Eveleigh and, during the 20th century further afield. Following the erection of the main terminus, and later the Parcels Post Office, in the 20th century the focus of the goods handling activities has transferred from the eastern to the western side of the site. The majority of the working yard area disappeared with the construction of the City Electric lines however, a small pocket remains along the boundary with Prince Alfred Park.

The construction of the Darling Harbour Branch Line and the establishment of an extensive area for goods storage and transfer indicate the importance of the Sydney Terminal and yards in the distribution of produce from country NSW.

The construction of the Central Station or the Sydney Terminal on the site of the Old Burial ground was one of

the largest planned interventions into the urban fabric of Sydney undertaken prior to World War 1 and is a rare example of a scheme that not only included a formal public building but also parkland and roadway. The deliberate creation of the formal approaches, the widening of the streets to form avenues and create vistas, the separation and multi-layering of tramlines, vehicular and pedestrian access and the creation of subways resulted in the creation of an urban environment of a scale and character not before seen in Sydney, a character that would have been in sharp contrast to the residential character of Redfern, Chippendale and Surry Hills.

The development of the main terminus resulted in an increase in the commercial activity around Railway Square and influenced the choice of the site for department stores.

Following the introduction of trams, Railway Square and later Central Station became a major tram interchange with links to the suburbs and Circular Quay. In 1900, 60% of the 100 million trips on Sydney's public transport system were by tram and only 15% by train. The link between Circular Quay and the Railway Station being a popular route, carrying in the order of 11 million passengers in 1911. During peak hour the George Street trams were 29 seconds apart.

The separation of the trams from other forms of traffic at the Sydney Terminal would have speeded up the flow of the trams. Little evidence of the existence of the complicated tram layout around Central Station remains.

With the expansion of the rail network across the state the coastal shipping network declined. Train travel was more reliable, the train timetable was not reliant on good weather conditions and the loading and unloading of freight was less hazardous. Little trace remains of a once extensive coastal shipping network. Rather than Sydney Harbour, the Sydney Terminal became the main point of entry or departure for travellers to and from country NSW and for the movement of goods.

The construction of a city rail loop was proposed around the turn of the century and provision left adjacent to the main terminal building. Construction did not occur until the mid 1920s. The demand for trams would have been lessened following the introduction of the city loop and the construction of the Central Electric Station.

#### SYDNEY TERMINUS

Central Station, constructed to serve the expanding population of Sydney, was the first major metropolitan rail terminus to be constructed in Australia and is the main NSW terminus. There have been three successive passenger termini on this site, each successive station designed to provide a much greater level of passenger accommodation than the former.

The debate concerning the location of the main terminal for Sydney occurred on and off during the last two decades of the 19th century. The technical difficulties associated with extending the line further north and the associated cost as well as changing governments resulted in the creation and abandonment of numerous station designs and almost as many locations.



The design and erection of a major terminal for Sydney, which allowed for future expansion indicated a climate of optimism regarding the future growth of Sydney metropolitan area.

The earlier station designs had allowed for the line to be continued northwards. The final scheme adopted involved the moving of the terminal to the northern side of Devonshire Street allowing the second Station to continue to function until the new terminal was operational. The third Terminal did not allow for the continuation of the lines, resulting in the construction of the adjacent Central Electric Station, when an extension into the city was agreed.

The design of the Sydney Terminal was modified for cost cutting purposes however, it still represented considerable expenditure by the State Government. The second stage of the main terminus was one of the largest of the limited building projects, undertaken by the government during World War 1. The two stages are almost imperceptible and the overall character of the initial design was continued in the second stage. The second stage was not completed, plinths were constructed for the cupolas flanking the central bay but the cupolas themselves were not constructed.

#### THE MORTUARY STATION

There are few other known examples of a purpose built mortuary stations anywhere in the world. The other stations which may have been solely Mortuary Stations exist in England, Sutherland and Sandgate. The pair of Mortuary Stations are the only examples in Australasia.

The Mortuary Stations is one of the oldest surviving stations in Australia, there a few remaining examples of stations which date from pre 1870. Four other examples remain in NSW and a series of five identical stations were built in Victoria c.1862-3.

The development of this station is not only associated with the expansion of the Sydney yards but also with the development of the Rookwood Necropolis at Haslem's Creek (Lidcombe), one of the largest and most intact Victorian garden cemeteries in the world.

The erection of a permanent Mortuary Stations, within 15 years of the commencement of the rail network in NSW is an indication of not only the rapid expansion of the railway but that it had rapidly become accepted as a mode of transport by the citizens of Sydney.

#### RAILWAY INSTITUTE

The Railway Institute was the first such institution of its type in Australia, providing a high level of facilities for the employees.

#### PARCELS POST OFFICE

The Parcel Post Office was constructed in this location as the majority of parcels were carried by rail. Many of the Sydney Department Stores ran a mail order catalogue, sending goods to country NSW. The size of the building indicates the volume of parcels handled, or planned for.

#### DARLING HARBOUR LINE

Together with the remaining structures and works on the Sydney main line to the old Parramatta station. The Dive is one of the earliest surviving cuttings and overbridges in NSW. Built as a branch off the initial railway line from Sydney to Parramatta, to provide a link with Darling harbour and to enable goods to be transferred to and from ships, the Darling Harbour Branch Line formed part of an extensive trade network to provide for the export of Australian grown wool.

This rail link was influential in the development of Darling Harbour in the second half of the 19th century. The use of Sydney Cove for trade purposes declined, as access by land became more congested, and there was a corresponding increase in the use of Darling Harbour. This link, although disused, is retained for emergency purposes.

Conservation Manage Plan  
 Sydney/Central Station  
 Author: Department of Public Works & Services  
 Year: 1996  
 Page: 103-104 (The Sydney Terminal & Yard)  
 Page: 106-107 (Sydney Terminus)  
 Page: 109 (The Mortuary Station)  
 Page: 110 (The Railway Institute)  
 Page: 111 (The Parcel Post Office)  
 Page: 112 (The Darling Harbour Line)

SHR Criteria c)  
 [Aesthetic significance]

THE SYDNEY TERMINAL & YARD : AESTHETIC & TECHNICAL SIGNIFICANCE

The developments of the railways in Europe were closely followed in Australia and initially the locomotives, carriages, rolling stock and rails were imported from England. The technology was imported directly with little or no modification. The railway lines in NSW were designed and built by engineers who trained under the prominent British railway engineers.

Between 1855 and 1930 the majority of the construction work within the Central Station complex, the sewers, the railway lines, the Mortuary Station, the Main Terminus and approaches, the road re-alignments, the tramlines and the construction of the Parcels Post Office was undertaken by branches of the Public Works Department.

The Colonial or Government Architects Branch designed the Mortuary Station and the Main Terminus. The overall layout, approaches and the Eddy Avenue level, as well as the remainder of the stations in NSW constructed prior to 1920 were designed by the Railway Construction Branch. Railway construction was separated from remainder of the Department of Public Works during the construction of the second stage of the main terminus.

With the exception of the Central Electric Station, the station buildings were designed for steam trains. The tank engines required constant maintenance and supplies of fuel and water which were available at nearby Eveleigh.

Associated with the passenger station were working yards which provided evidence of the changing technology of train travel, from steam to electrification and diesel. The railway yards were necessary to allow for the shunting of trains as well as to store and maintain carriages and for the transfer of goods. Traces of the workings of the yards

during the steam train era remain including water tanks and columns.

The changes in the predominant building materials, and the way in which they are employed, with sandstone and corrugated iron being used until c.1870 for even the most utilitarian buildings such as workshops, then polychromatic brickwork, then sandstone for the more important buildings, and brick with sandstone dressings for the lesser buildings, indicates not only changes in technology, but also the changing fashions for the use of a particular material. After the 1899 inquiry into building materials for public buildings sandstone was used for all major public buildings. The use of sandstone therefore indicates the status of a particular building.

Particular building styles, details and material were associated with the railways and were used for the construction of the early stages of the Sydney Terminal complex. The remaining workshop buildings feature standard windows that are also found in the Eveleigh and Honeysuckle workshop buildings. Moulded and polychromatic bricks were used in the second station building and its additions, other examples of this style of station building, designed by John Whitton remain in country NSW locations such as Albury. In contrast the main terminus is of a scale and character that is unique in NSW.

The construction of the railways utilised large quantities of bricks not only for buildings but also for the creation of flyovers, bridges, embankments and retaining walls. There exists a tradition of recycling of building elements from railway buildings, particularly the cast iron elements such as canopy brackets (which could be utilised for verandah or platform canopies), columns and trusses, not only within the yard but also to other railway complexes. Examples of such recycling can be found within the station complex.

#### THE SYDNEY TERMINAL & YARD : LANDMARK SIGNIFICANCE

The first and second Devonshire stations both fronted Railway Square however, the expansion of the platforms in front of the second terminus building diminished any sense of formal approach.

The bellcote of the Mortuary Station and later the clocktower of the main terminal building could be seen from a great distance when first constructed. The main terminus forms a prominent Sydney landmark and was designed to act as gateway to the city. The formal approaches and surrounding avenues enhance this characteristic. The clocktower remains visible from Railway Square, Pitt Street and part of Surry Hills.

The workings of the railway yard have always been visible from the Cleveland Street Bridge and Prince Alfred Park, however, plantings in the park in the 20th century have lessened the visibility of the yard. There is considerably less manual activity within the yard than in the 19th century, however, the frequency of trains has increased considerably.

#### SYDNEY TERMINUS : AESTHETIC & TECHNICAL SIGNIFICANCE

The design of the Sydney Terminal was overseen by an Advisory Board of experts, whose members included the chief railway engineers from Victoria, NSW and Queensland and the NSW Government Architect. This Advisory Board were also involved in the design of the Flinders Street Station in Melbourne. In scale and character the design of Sydney Station and the Sydney Terminal, is of a similar quality as the major European and American RAILS Termini.

In contrast with the second Station where the lines passed through the new building, Station was a true terminal, the main building and concourse preventing any further extension of the line. The majority of railway stations in Australia are located at a point along a railway line rather than forming the end point of the line.

Sydney Station, as constructed, contains many innovations not previously seen or rare in NSW, the viaducts for the trams, the three pin truss roof to the portico, the assembly platform [concourse], the Devonshire Street subway, the mail and luggage subways and the subterranean gentlemen's toilet, beneath the assembly platform.

The first stage of the main terminal building is reputed to be the first large scale use of reinforced concrete slab construction in NSW.

The design of the Sydney Terminal were easily accessible from the main concourse, or assembly platform where a destination board detailed the arrivals and departures. In major termini such boards have largely been replaced by computerised arrival and departure displays. The display board from the Sydney Terminal is now held in the Powerhouse Museum.

The concourse, or assembly platform, was designed as a place of assembly and was one of the largest covered public spaces in the city. Other large spaces accessible by the public were the Centennial Hall in the Town Hall, the Exhibition building in Prince Alfred Park and the Queen Victoria market building.

The design was a collaboration between the railway engineers, in particular Henry Deane and the Government Architect, WL Vernon. Both men were trained in Europe and subsequently travelled there to inspect the latest projects. Vernon studied a variety of building types whilst Deane concentrated on railway and tramway installations. Deane was particularly impressed by the American Stations, and modelled the proposed three pin truss train shed roof on Union Station, St Louis.

The influence on overseas precedents can be seen in the form and layout of the building, the architectural style and in the use of the three pin truss. There are few precedents for the multi-level segregation of trams, pedestrian and vehicular traffic.

#### SYDNEY TERMINUS : LANDMARK SIGNIFICANCE

The Sydney Terminus was designed to form a landmark. When completed in 1920 the clocktower would have been visible from many parts of the city as it was the tallest tower in the city. By creating the park and the wide avenues adjacent to the station the views to the clocktower were accentuated.

A formal approach to the station, either through Belmore Park or up the ramps to the portico or via the cab ramp formed an elaborate sequence of spatial experiences unequalled in Sydney. This progression was continued within the station building, through the booking hall, assembly platform [concourse] and onto the platforms.

The approaches to the terminus were to form the gateway to the city, tree lined avenues were created and Pitt Street widened. George Street not Pitt Street however, has developed to form the main thoroughfare north to south through the city.

The multiple levels of the main station building were designed to separate the types of traffic, vehicular, tram and pedestrian in the aim of preventing accidents. Over the time the ordered separation has become less apparent, with the removal of tramway and bus services.

The Devonshire Street subway was the first major subway in NSW, probably in Australia, introducing an urban form more common in the major European and American cities of the time.

The station was one of the largest buildings in the city, rivalling the town hall and the main government department in Bridge Street.

#### THE MORTUARY STATION : AESTHETIC & TECHNICAL SIGNIFICANCE

The Mortuary Stations are considered to be one of the finest designs by the Colonial Architect James Barnet and were, at the time of their construction the most elaborate stations in Australia. A series of identical Gothic Revival stations (with residence attached) were constructed in Victoria in the early 1860s however, the design, and decorative detail is nowhere near as elaborate as the Mortuary Station.

The Mortuary Station is considered to be an exceptional example of the Gothic revival style, one of the finest in Australia and is comparable with English examples of the period. James Barnet designed four major Gothic Revival buildings: the GPO in Martin Place, the Andersen Stuart Building at Sydney University and the two Mortuary Stations. He based his design, not only on Venetian Gothic prototypes, popularised through the writings of Ruskin but also on the work of the prominent architect Sir George Gilbert Scott such as the (unbuilt) Foreign Office.

The Gothic theme carries through the decorative motifs used throughout the design and the carved furniture, which resembled pews. In contrast with the majority of stations the platform was tiled not asphalt. The level of detail is far higher than any other railway station of the period on the NSW system.

The sandstone elements were finely carved, including the medallions, the foliated capitals and the intrados (soffits). The Colonial Architect, James Barnet, through his designs played an important role in encouraging the craft of stone masonry in NSW.

Coincidentally, the station building used the same platform layout as the first temporary terminal at Devonshire Street building, i.e. a single platform. Its level of decorative

detail was much higher and more permanent material were employed in its construction. The Mortuary Station is the finest example of this type of station in Australia.

#### THE MORTUARY STATION : LANDMARK SIGNIFICANCE

The Mortuary Station was a local landmark, clearly visible from Prince Alfred Park, the Cleveland Street Bridge, from the grounds of Sydney University and seen by passengers arriving and departing from the Sydney Terminal. This context has been largely submerged by 20th century developments.

#### RAILWAY INSTITUTE : AESTHETIC & TECHNICAL SIGNIFICANCE

During the early 1890s a number of public buildings were undertaken by competition. These designs reflected the up-to-date trends in architectural design. The use of the Queen Anne Revival follows English trends, the style having been popularised by the London Board schools. The choice of materials, in particular the moulded bricks and the red tiled roof are prominent features of the Queen Ann style.

This building features Marseille roof tiles for the first time in a building in Australia.

The large hall still retains much of its decorative detail and is a rare surviving example of a small hall of the late Victorian period. Other intact examples, the Town Hall and St Georges Hall are much larger spaces.

The building is one of few known examples of the work of the architect Henry Robinson.

#### RAILWAY INSTITUTE : LANDMARK SIGNIFICANCE

The Railway Institute is prominent when viewed from the Railway yards and from Chalmers Street.

#### PARCELS POST OFFICE : AESTHETIC & TECHNICAL SIGNIFICANCE

The building is one of three major buildings on the site designed by the Colonial or Government Architects Branch. The neo-classical detailing of both the Parcel Post Office and the Sydney Terminal was designed by GM Blair. The building was designed in stages, as was the main Terminal building probably for funding reasons.

The roofscape of the building is unusually prominent when viewed from a distance. There are few other office buildings in Sydney where the roofscape is so visible.

The Parcel Post is an early example of an office building, with an internal frame design which provides for the maximum free floor area. It was designed before the introduction of fully framed buildings. The facade is load bearing masonry.

#### PARCELS POST OFFICE : LANDMARK SIGNIFICANCE

The Parcel Post Office adds to the distinctive character of Railway Square.

#### DARLING HARBOUR LINE : AESTHETIC & TECHNICAL SIGNIFICANCE

The Darling Harbour Line is one of the few remaining structures which relate to the first phase of construction of the terminal and yard, when sandstone was the predominant material in the early phase of development. It provides an indication of the extent of civil engineering works required to construct the first terminal and yards.

Conservation Manage Plan  
 Sydney/Central Station  
 Author: Department of Public Works & Services  
 Year: 1996

Aesthetic and Technical Significance:  
 Page: 104-105 (The Sydney Terminal & Yard)  
 Page: 107-108 (Sydney Terminus)  
 Page: 109-110 (The Mortuary Station)  
 Page: 110 (The Railway Institute)  
 Page: 111 (The Parcel Post Office)  
 Page: 112 (The Darling Harbour Line)

Landmark Significance:  
 Page: 106 (The Sydney Terminal & Yard)  
 Page: 108-109 (Sydney Terminus)  
 Page: 110 (The Mortuary Station)  
 Page: 111 (The Railway Institute)  
 Page: 111 (The Parcel Post Office)

#### SHR Criteria SYDNEY TERMINAL & YARD

d)  
 [Social  
 significance]

The Sydney Terminus has always been a major passenger interchange. In contrast with the first two termini where the subsequent development was haphazard, the interchange between the various forms of transport at Central Station was carefully designed to lessen the chance of accidents.

Each station building also improved on the last in terms of passenger comfort, the first Redfern or Sydney Station being a hastily erected shed, the second station being designed to separate the arriving and departing passengers. The third passenger station was constructed complete with numerous platforms, a covered assembly area and separate waiting and dining facilities for ladies and gentlemen.

A large workforce was once required to maintain and refuel the steam locomotives. Following the establishment of the workshop complex at Eveleigh the workshop facilities in the Sydney yards declined. There are no longer workshop facilities at the Sydney Terminal, not even for electric and diesel trains.

Many of the operations of the yards, such as signalling were once operated manually. With the introduction of hydraulic and later electronic signalling the number of staff required to operate the yards has declined. This trend is not peculiar to the Sydney yards.

The development of the suburban train system allowed workers to commute rather than having to reside near to their place of work. Vast numbers of commuters use 'Central Station' as an interchange on a regular basis.

The development of the rail network allowed fast and comfortable travel available to all. The journey to Bathurst by stagecoach took 18 hours. The train would have been considerably faster and provided a higher level of facilities.

The Sydney Terminal was the point of departure for many travellers.

#### SYDNEY TERMINUS

The new terminus was designed with a capacity to double the passenger number, to an expected maximum of 40,000 per day. With the increase in the use of the private car in the late 20th century the reliance on public transport has lessened however, Sydney Terminal Station is still used a large number of commuters on a daily basis.

The Sydney Terminus was designed with an elaborate and impressive booking hall, which was not only experienced by passengers buying tickets but also glimpsed by passengers passing through onto the assembly platform [concourse]. The experience of buying a ticket in such an elaborate and formal space would have heightened the sense of romance associated with travel.

Associated with the assembly platform [concourse] were a series of amenities which reflect the attitudes and customs of the period, separate dining, tea and waiting facilities were provided for ladies and gentlemen. A barber and change facilities, including baths, were provided to allow passengers to clean up after their journey.

A reading room and dining room were provided for the railway commissioners and their staff, to mitigate against the fact that the terminal building has been located away from the centre of town.

#### THE MORTUARY STATION

The erection of the receiving stations at Sydney and within the Rockwood Necropolis was to enable the dignified transfer of the coffins from carriages onto the funeral train. The station was designed to provide an elaborate setting for the mid to late Victorian rituals associated with both death and mourning. The Gothic Revival style, generally more commonly associated with ecclesiastical or collegiate buildings, was employed to provide a suitable atmospheric setting favoured for funeral designs during the period.

#### RAILWAY INSTITUTE

One of the aims of the institute was to provide for the continuing education of the railway employees. Evening Classes and examinations were undertaken within the building.

The Honour Boards record the names of important people in railway history.

The building has continued to operate as a facility for Railway employees for over a century and the halls within the Institute have been utilised for a wide range of social functions and during emergencies.

#### PARCELS POST OFFICE

The Parcel Post Office was designed for an all male work force, there were no toilet facilities for women included in the original scheme. The original scheme also included detectives galleries, to allow for the surveillance of the floor.



Conservation Manage Plan  
 Sydney/Central Station  
 Author: Department of Public Works & Services  
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 Page: 105-106 (The Sydney Terminal & Yard)  
 Page: 108 (Sydney Terminus)  
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 Page: 110-111 (The Railway Institute)  
 Page: 111 (The Parcel Post Office)

SHR Criteria THE SYDNEY TERMINAL & YARD  
 e)

[Research potential]

In addition to the extant remains of the early stages of development of the site such as the Darling Harbour Branch Line and the imprint of the demolished heavy goods shed, evidence remains in the archaeological record of the former uses of the site. The site of the main terminus was formerly occupied by the Benevolent Asylum, Carters Barracks and the Devonshire Street cemetery. Re-location of the graves and demolition of the structures was recorded in the documentary evidence. As the site levels were raised to create the new station it is unlikely that all foundations were removed. Other contemporary building projects were constructed leaving the former foundations in-situ.


PARCELS POST OFFICE

The Parcel Post Office is a reprehensive example of state of the art fire proof construction and its application to multistorey construction techniques.

DARLING HARBOUR LINE

The rail line under George Street was one of the first underpasses to be constructed as part of the NSW rail network. George Street was initially carried across the track by a bridge. In contrast to the Cleveland Street Bridge, the George Street overbridge remains largely intact.

Conservation Manage Plan  
 Sydney/Central Station  
 Author: Department of Public Works & Services  
 Year: 1996  
 Page: 106 (The Sydney Terminal & Yard)  
 Page: 111 (The Parcel Post Office)  
 Page: 112 (The Darling Harbour Line)

Assessment criteria: Items are assessed against the  [State Heritage Register \(SHR\) Criteria](#) to determine the level of significance. Refer to the Listings below for the level of statutory protection.

Procedures /Exemptions

Section of act	Description	Title	Comments	Action date
57(2)	Exemption to allow work	Standard Exemptions	SCHEDULE OF STANDARD EXEMPTIONS HERITAGE ACT 1977 Notice of Order Under Section 57 (2) of the Heritage Act 1977  I, the Minister for Planning,	Sep 5 2008

		<p>pursuant to subsection 57(2) of the Heritage Act 1977, on the recommendation of the Heritage Council of New South Wales, do by this Order:</p> <p>1. revoke the Schedule of Exemptions to subsection 57(1) of the Heritage Act made under subsection 57(2) and published in the Government Gazette on 22 February 2008; and</p> <p>2. grant standard exemptions from subsection 57(1) of the Heritage Act 1977, described in the Schedule attached.</p> <p>FRANK SARTOR Minister for Planning Sydney, 11 July 2008</p> <p>To view the schedule click on the Standard Exemptions for Works Requiring Heritage Council Approval link below.</p>
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 [Standard exemptions](#) for works requiring Heritage Council approval

## Listings

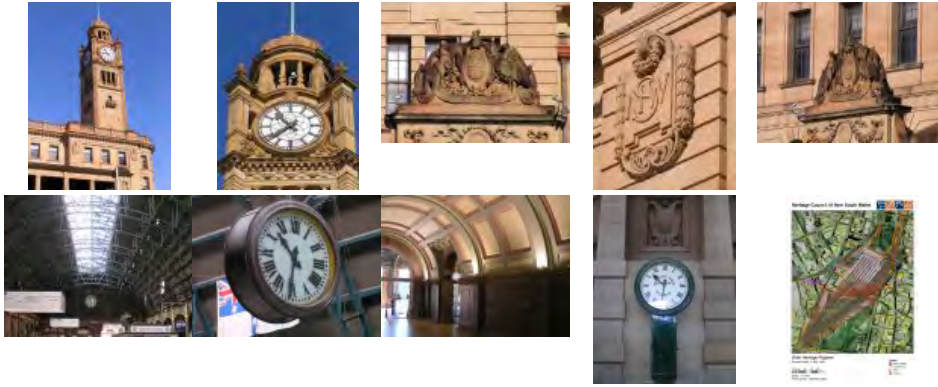
Heritage Listing	Listing Title	Listing Number	Gazette Date	Gazette Number	Gazette Page
Heritage Act - State Heritage Register		01255	02 Apr 99	27	1546
Heritage Act - s.170 NSW State agency heritage register					

## References, internet links & images

Type	Author	Year	Title	Internet Links
Tourism		2007	Central Station	<a href="#">View detail</a> 
Tourism	Attraction Homepage	2007	Central Station	<a href="#">View detail</a> 
Written	Department of Public Works & Services Heritage Group	1996	Conservation Management Plan - Sydney/Central Station	

Note: internet links may be to web pages, documents or images.





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## Data source

The information for this entry comes from the following source:

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11.2 Appendix B - S170 Register Citation  
Central Railway and Sydney Terminal Group



[Home](#) > [Heritage sites](#) > [Searches and directories](#) > NSW heritage search

# Central Railway Station and Sydney Terminal Group

## Item details

Name of item: Central Railway Station and Sydney Terminal Group  
 Other name/s: Sydney Central Yard; Sydney Steam and Sydney Electric Station  
 Type of item: Built  
 Group/Collection: Transport - Rail  
 Category: Railway Platform/ Station  
 Primary address: Eddy Avenue, Sydney, NSW 2000  
 County: Cumberland  
 Local govt. area: Sydney

## Boundary:

North: the Northern side of the Campbell Street underbridge and s Street to include Belmore Park; South: the northern side of the Cle overbridge (excluding the bridge), East: property boundary line of l and the former Railway Institute Building along Chalmers Street ar West: property boundary line along Pitt Street, Lee Street and Reg Mortuary Station is included within the curtilage and is also subject (4803219). The adjacent Railway Square underbridge is subject to (4801079). The Institute Building, former Parcels Office and Belmo RailCorp ownership but are included within the curtilage as they are integral to the significance of the site.

## All addresses

Street Address	Suburb/town	LGA	Parish	County	Type
Eddy Avenue	Sydney	Sydney		Cumberland	Primary Address
Railway Square	Sydney	Sydney		Cumberland	Alternate Address
Chalmers Street	Sydney	Sydney		Cumberland	Alternate Address
Regent Street	Sydney	Sydney		Cumberland	Alternate Address
Great Southern and Western Railway Lines		Unknown			Alternate Address

## Owner/s

Organisation Name	Owner Category	Date Ownership Updated
RailCorp	State Government	
RailCorp	State Government	

RailCorp	State Government	
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## Statement of significance:

Extracted from 2013 CMP:

Central Station is the largest railway station and transport interchange in NSW and is of State significance for its historical, aesthetic, technical values and for its research potential. With its grand sandstone edifices and approaches it is a well known landmark in Sydney.

The site contains the original Sydney Railway Company grant on which the first Sydney Station and yards were opened, in 1855, and so represents over 150 years of railway operations in the same place, making it the oldest and the longest continuously operated yard in Australia. The Sydney Terminal precinct has a high level of historic significance associated with its early government and institutional uses, as well as being the site of Sydney's second major burial ground, the Devonshire Street cemetery. Archaeological evidence of the government and institutional uses is rare and has high research potential.

Central Station site contains evidence of the first phase of railway construction in NSW and has been the major hub of rail transportation in NSW since the mid 19th century and has the ability to demonstrate the evolution of changes in the NSW railways and in railway technology over the past 150 years, from steam to electric, reflected in the changes in yard layout and in signaling work practices. The Darling Harbour branch line and associated sandstone Ultimo Railway Overbridge is the only remaining example of railway infrastructure built for the Sydney Railway Company and is the oldest piece of railway infrastructure in NSW. The Prince Alfred Sidings contains some of the oldest remaining workshops in the NSW railway system. The Prince Alfred Substation is part of the Bradfield 1926 electrification works and was designed by Bradfield himself. The site has technical heritage value in such elements as: the Darling Harbour Dive; Central Electrics flyovers; the elliptical arch construction of the Elizabeth Street Viaduct; the western approach ramp underbridge the three pin truss roof of the porte-cochère; the Devonshire Street subway (probably the first of its type in Australia); the underground men's toilets; and the early mail, parcels and luggage subway system.

The main terminus building, accentuated by its clock tower and approach ramps, exemplifies the predominant use of sandstone at the site and it has been sited to dominate its surroundings and to mark the importance of the railway to both the city and the State. The construction of the Sydney Terminus was the largest planned intervention into the urban fabric of Sydney at the time and it was the only major complex of the period where the urban setting was consciously designed to enhance and provide views to and from the main structure. With its multi layered access modes and above ground level platforms not only was the development extraordinarily innovative but also the largest incursion into the southern part of Sydney prior to World War I.

Some of Sydney's most notable 19th and 20th century

Some of Sydney's most notable 19th and 20th century architects and engineers have worked on the Central Station site, including: James Wallace and William Randle who together designed and built the first railway from Sydney to Parramatta and the associated Darling Harbour Branch Line; the last serving Colonial Architect, James Barnet (Mortuary Station); the first NSW Government Architect, Walter Liberty Vernon (the main Terminus building and the Parcels Post Office); and the Chief Engineer for the City Underground and Sydney Harbour Bridge, Dr John Jacob Crew Bradfield (Central Electric). Mortuary Station, the main terminus building and the Parcels Post Office were the only designs undertaken for the NSW Railways by the Colonial Architect and the Government Architect within the Department of Public Works.

The main terminus building is enhanced by its Neo-classical architectural features together with the high quality workmanship and materials it contains, from carved sandstone, marble and terrazzo to cedar joinery, acid etched glazing and metalwork balustrades.

The same fine quality in design, materials and workmanship is seen in Mortuary Station, the Railway Institute and also in the Neo-classical Chalmers Street Entrance, the Central Electric Station main façade and the Parcels Post Office, all of which tends to unify these buildings with the main terminus.

The Mortuary Station is a fine and rare example by James Barnet of the Gothic Revival architectural style and is the only remaining example of a mortuary station in NSW. The exemplary Federation Anglo-Dutch architectural style of the Railway Institute is significant and it was as the first institute of its type in Australia, demonstrating 19th century initiatives in railway workers educational and recreational facilities. The Parcels Post Office contains fine brickwork and sandstone detailed facades and documents the association of the site with railway postal services.

The significance of Central Station is widely appreciated by the broad community for its sense of place and theatre; as an extraordinary place of work for employees past and present and their families; and by many specialist transport and heritage community groups.

Date significance updated: 30 Jul 09

*Note: There are incomplete details for a number of items listed in NSW. The Heritage Branch intends to develop or upgrade statements of significance and other information for these items as resources become available.*

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## Description

Designer/Maker: NSW Government Architect, WL Vernon

Builder/Maker: NSW Department of Public Works

Construction years: 1855-1970

Physical description: See the Conservation Management Plan prepared by Government Architect's Office, June 2013 for detailed inventory sheets of each precinct.

SYDNEY TERMINAL PRECINCT  
Main Station Building (1901-1906)  
Clocktower (1921)

~~STRUCTURES (1906-1979)~~

Main Concourse (1906)  
 Platforms 1-15 (1906)  
 Underground tunnels and services (1906)

## CENTRAL ELECTRIC PRECINCT

Elizabeth St and Eddy Avenue Entrance (1926)  
 Suburban Platforms 16-23 (1926-32)  
 Eastern Suburbs Railway (ESR) Platforms 24 and 25 (1979)  
 Devonshire Street Tunnel (c.1906, 1979)  
 Disused Tunnels and Platforms (1979)

## SYDNEY YARDS PRECINCT

Yard and Modern Structures  
 Flyover Junctions (1932)

## WESTERN YARDS PRECINCT

Parcel Dock (1906)  
 Rail Sidings and Yard (1906)  
 Former Parcels Office

## PRINCE ALFRED SIDINGS PRECINCT

Former Workshop Office Buildings (c.1870)  
 Prince Alfred Substation (1926)

## BRIDGES

Hay Street Underbridge (1923)  
 Campbell Street Underbridge (1923)  
 Eddy Avenue Underbridge (1923)  
 Cleveland Street Overbridge (1891)

## LANDSCAPE

## ARCHAEOLOGY

## SYDNEY TERMINAL PRECINCT

## MAIN STATION BUILDING (1901-1906)

The Main Station Building (Sydney Terminal) is a landmark Federation Free Classical building with highly detailed sandstone façade, colonnades, columns and arcades on the exterior, with the use of bricks, decorative steel, iron and sandstone for the internal spaces providing fine visual transitions between the public spaces. The building comprises a sandstone colonnade and porte cochere, which originally provided an undercover area for passengers transferring to and from trams and is now used for the Metro Light Rail. The terminus itself forms a U shaped block fronting Eddy Avenue, Pitt Street and the electric city rail lines to the east. The Pitt Street frontage is a long sandstone arched colonnade containing shops and offices, driveway entry into the loading docks of the station and a vehicle entry ramp driveway to the main passenger pick up and set down entrance to the station. The central section (facing Eddy Avenue) of five stories, including Eddy Avenue shop fronts and colonnade, tramway entrance and three stories of offices. This is flanked by two four storey wings. The interiors feature marble and terrazzo stairs, decorative balustrades and banisters, and stained and etched glass panels. Offices in the main building have been recently refurbished and are of modern design and fit out.

Sydney Terminal is a high level, main line rail terminal. It's elevated siting permits the use of the topography to gain road access to more than one level enabling the development of an extensive



enabling the development of an extensive subterranean luggage network and separation of differing modes of transport. The commanding position of the terminus with large areas of open space sloping away from the building continues the public domain of Railway Square whilst maintaining a clear vista of the terminus from the square. The terminus creates a formal edge to Railway Square.

#### CLOCKTOWER (1921)

Above the northwest corner is the Central Railway Station Clock tower which reaches 85.6 metres above street level. The clock has four faces, each 4.77 metres in diameter, with minute hands 2.1 metres long. The tower is essentially hollow to the clock level with a staircase of 272 steps giving access.

#### MAIN CONCOURSE (1906)

The main assembly concourse is the centre of the terminus, around which all of the ancillary functions, such as refreshment rooms, waiting rooms and the booking hall were arranged. This concourse is accessed from both the east and west decks. The concourse has a high domed ceiling with exposed curved truss supports with aluminium and fibreglass roof sheeting, while the concourse is tiled with terrazzo tiles. The truss supports also hold a large station clock. The concourse is an open plan area, with new information booth and ticket facilities (c2000) located approximately in the middle.

The northern side wall of the concourse is of brick and sandstone with arched openings to shops and offices and two pedestrian arch walkways to the light rail station and Eddy Avenue access. The concourse also contains a heritage centre in the converted main booking office with decorative ceilings, railway offices, a number of cafes and small fast food restaurants, a newsagent and a bar area. These are located in the former refreshment rooms and retain the moulded ceilings and carved mural of Australian historic and railway scenes around the top panel of the walls. A small inlaid clock is positioned above the north door inside the refreshment rooms. The Station Managers office is located close to the entrance to the platforms in the southeast corner of the concourse.

The southern side of the concourse is open to the platforms and is fringed with a decorative iron lattice work grille on top of iron columns.

#### PLATFORMS 1-15 (1906)

Sydney Terminal now contains seven double platforms and one single platform, each with an awning, servicing a total of 15 tracks. Platforms 1-3 are for country and interstate services, while the remainder are for inter-urban services. The platforms run perpendicular to the main station concourse and all are dead end with the buffer stop.

Platforms 1-3 are covered with relatively recent awnings (c1990s) supported with steel columns. Platforms 4-15 are covered with gabled ended awnings (c1920s) with exposed steel lattice trusses supported with hardwood timber columns.

Platforms 1-10 have a centre run-round track which was for locomotive-hauled trains. It enabled the locomotive to uncouple from its train and either depart

locomotive to uncouple from its train and either depart or re-couple on the other end to pull the train to the next destination. These centre lines are now used for storage of electric rail car sets in off-peak times. There are long timber-framed awnings over some of the platforms (incorporating Howe trusses). Timber was used in lieu of steel because of the high cost of importing steel at the time of the awnings' construction.

The only locomotive-hauled trains now using Sydney Terminal are the Indian Pacific and special trains which usually use Platform 1. Platform 1 has always been the main out-of-Sydney station with the longest platform. Platforms 1, 2 and 3 were lengthened to their present lengths in 1962 (covering the skylights to the Devonshire Street subway) for diesel hauled trains.

To the west of the southern end of Platform 1 is the Inwards Parcel Office. This was the loading dock for parcels and mail which was loaded via a tunnel from the post office. This was converted for use as a backpacker hostel in 2000. The eastern external wall of this building forms the edge of the platform area.

#### UNDERGROUND TUNNELS AND SERVICES (1906)

The subterranean levels are criss-crossed with service and pedestrian tunnels that provide access to platforms above, offices, maintenance depots, kitchens and loading docks. Some of these were upgraded and lined for pedestrian usage for the 2000 Sydney Olympics; others remain as service tunnels with services and lines exposed. The design of the station to allow separate pedestrian, train, tram and vehicle movements, as well as the extensive underground system of tunnels and subways to transport luggage, mail and other items without interference in the public space is all part of the complex design of the station to ensure smooth and safe operation.

#### CENTRAL ELECTRIC PRECINCT

The Central electric system runs near to the eastern boundary of the entire site.

#### ELIZABETH ST AND EDDY AVENUE ENTRANCE (1926)

There are two major pedestrian entrances to the Central Electric Precinct: one at Elizabeth Street and one at the top of the Eddy Avenue ramp. Both are constructed of Maroubra sandstone with classical detailing.

#### SUBURBAN PLATFORMS 16-23 (1926-32)

At the northern end of the precinct, six tracks leave the underground tunnels near Goulburn Street and pass over Hay and Campbell Streets and Eddy Avenue where they enter the platform area. The four platforms allow eight trains to use the station, four trains in each direction. The platforms are covered with gabled awnings from the 1920s supported with steel columns and with exposed steel trusses.

#### EASTERN SUBURBS RAILWAY (ESR) PLATFORMS 24 AND 25 (1979)

The ESR occupies Platforms 24 and 25. They comprise an island platform accessed via two banks of two escalators (original) or stairs. The platforms are open

Locomotives (originally of steam) are platform ends open at each end with the platform office located in the centre area. The platform is tiled with small white tiles with concrete columns tiled in dark green. Elements of platform tiling and signage are original.

#### DEVONSHIRE STREET TUNNEL (c.1906, 1979)

Access to the southern end of the station is via the Devonshire Street tunnel, a long pedestrian tunnel which extends between George Street and Elizabeth Street. The tunnel is tiled with digital print murals of railway history and scenes on panels along its length. The Elizabeth Street entrance includes a ticket booking office, ticketing machines, newsagent and take away food outlets.

#### DISUSED TUNNELS AND PLATFORMS (1979)

Above the ESR platforms are two disused or 'ghost' platforms which were constructed as part of the ESR project but never completed. These platforms are bare concrete and include tunnel openings and areas for installation of office space or equipment. They are not open to the public.

### SYDNEY YARDS PRECINCT

#### YARD AND MODERN STRUCTURES

The Sydney Yard Precinct is located south of the Devonshire Street tunnel extending to the Cleveland Street Bridge and between the Central electric precinct and the Western Yard precinct. The track layout to platforms 1-15 has remained virtually unchanged since it was originally laid out in 1906.

Major items from the Sydney Yard's period as a steam locomotive-hauled train yard have been removed. These items included the eastern carriage shed, coal stages and engine docks at the head of each platform. Ash pits and water columns that were part of the yard have also been removed.

There is only one "yard controller" remaining within the Sydney Yard Precinct. It is a small two storey brick building located at the southern end of the yard approximately 100 metres from the southern end of Platform 8/9, close to the junction of the former Darling Harbour Goods line. The building, which dates from the c1960s, was not inspected internally during this study (2009). Previously, at least two signal boxes would have been located in the yard at any one time, but these have been removed due to the mechanical interlocking system being computerised and pneumatically operated.

The yard buildings have been altered significantly since the eastern carriage shed was demolished. This large shed divided the central yard from the central electric lines. The land where the shed once stood is vacant and the only remaining structures adding to this division of the yard are the cleaners amenities, a four wing (the two centre wings were extended to the west post 1943) two storey gabled office building with iron roof and timber double hung sash windows and the former timetable office, a two storey c1960s brick office now used as the Train Crew Superintendent Office and its associated garden. These buildings were not inspected internally for this study.

The rail yard connects to the passenger platforms of Sydney Terminal which are as originally designed and built, with the infrastructure for steam locomotives having been removed (these being water columns between each track near the buffers).

The status of the communications tunnel under the yard (c.1906) is unconfirmed.

#### FLYOVER JUNCTIONS (1932)

The flyover junctions are two levels of railway tracks between Cleveland Street and Central electric station. The city-bound (Up) tracks are on the top level and the outbound (Down) tracks are on the lower level. By a system of carefully located brick piers and supporting steel beams, the upper-level city-bound trains can change tracks across the full width of this elevated railway, moving transversely (sideways) west to east and vice versa using cross-overs. A similar arrangement on the lower (ground) level enables outbound trains to do likewise, independently of train movements above. The structure supporting the upper level is of simple construction: a series of brick piers carrying simply supported steel beams or girders, some encased in concrete, others with jack arches between, so as to form a ballasted running deck for the Up trains. The Down trains run on an excavated bed and weave their way through the brick piers.

#### WESTERN YARD PRECINCT

##### PARCEL DOCK (1906)

The Parcel Dock is physically connected with the main station complex and has four platforms. The use of rail transportation for parcel delivery has declined considerably. These platform sidings are still in use for temporary portable offices mounted on rail flat cars. The sidings closest to platform 1 are used for the loading of automobiles for the Indian Pacific.

##### RAIL SIDINGS AND YARD (1906)

The Western Rail Yard precinct is an area that is west of the No. 1 main line extending to the Regent Street boundary, Devonshire Street subway and Cleveland Street Bridge. The track layout of this yard has remained virtually unchanged since 1906.

The rail sidings that take up the bulk of the land area were known as the Botany Road yards. These siding lines are still in service but are seldom used. A branch line cuts through the precinct providing access to the Darling Harbour Goods Yard. The underpass and overbridge date from 1855 and are subject to a separate listing (No. 4801079).

The yard was designed for locomotive-hauled trains. As this technology has gone out of use except for the Indian Pacific and special trains the yard has little present functional use. With locomotive-hauled trains the train was marshalled for running in one direction. It has the locomotive at the head of the train and a brake van near the rear. This meant that after a journey, trains had to be remarshalled before commencing their journey out of Sydney Station. (Today's trains with driving positions at both ends of the train do not require this process.) As the station originally handled locomotive-hauled passenger trains

for suburban, country and interstate services this activity was considerable. Most of the steam loco facilities and trackwork has been removed. The decline in shunting and the removal of coal and water storage has seen a reduction in the level of activity and associated infrastructure in the yard.

The former West Carriage Shed was demolished c1999-2000 to make way for new office buildings and an associated plaza. It had been the last remaining carriage shed at Central Station. A number of other buildings and structures associated with the Western Yard were demolished at this time, including an elevated water tank and water column, a series of brick sheds and offices and amenities blocks. These are covered in detail in Rod Howard Heritage Consultants Pty Ltd report on the redevelopment of Henry Deane Park undertaken for Australand in February 1998.

Although it has progressed through various configurations, the landscape has maintained the same ground level since 1856 with its final layout being enlarged in 1906 by the removal of some houses and the realignment of Regent Street to its present format.

#### PRINCE ALFRED SIDINGS PRECINCT

The Prince Alfred sidings are on the eastern perimeter of the site, making up the boundary with Prince Alfred Park. Prior to the construction of the electric lines the yard was a goods yard containing produce and goods sheds as well as the first carriage shed. The sidings area is now largely used for car parking. The tunnel portal for the airport line is located in the southern section of this sidings area. With the construction of the airport line saw the demolition of most of the remaining workshops in this area.

A number of mature trees are growing on the boundary, the largest being a Moreton Bay fig which is at least 80 years old.

#### FORMER WORKSHOP OFFICE BUILDINGS (c.1870)

Only the former District Engineer's Office, restored and used as offices and Former Draughtsman's Office, vacant and boarded up, remain in the sidings area. A retaining wall forms the boundary with Prince Alfred Park. The retaining wall has been incorporated into the rear wall of the blacksmiths workshops.

#### PRINCE ALFRED SUBSTATION (1926)

The electric substation and switching house is part of the 1926 electrification works and is linked with the substation at the Sydney Harbour Bridge. The substation is a three storey brick building with steel framed windows (the eastern façade windows now bricked in), it has reinforced concrete floors with rendered brick walls and steel stairways. All original machinery was reported removed prior to 1988. The substation includes air compressors for the operation of pneumatic points within the yard and the City Circle lines. The switching house is a similar design, being brick of two storeys with flat roof with a gantry walkway along its eastern façade allowing access to office space. Neither was inspected internally as part of this study.

## BRIDGES

### HAY STREET UNDERBRIDGE (1923)

The Hay Street Underbridge is a stone and reinforced concrete single span, barrel, elliptical arch of clear span 24.86 metres (81.5 feet). Designed by engineering staff, Way and Works Branch, NSWGR and built by Metropolitan Railway Construction Branch in 1923.

### CAMPBELL STREET UNDERBRIDGE (1923)

The Campbell Street Underbridge is a single stone and reinforced-concrete span, barrel, elliptical arch of clear span 15.25 m (50 feet) built in 1923 as part of the city underground system.

### EDDY AVE UNDERBRIDGE (1923)

A wide reinforced concrete beam and slab bridge in which the parallel ribs have their soffits curved to simulate arches but there is no arch construction or action, it is purely an architectural treatment. There are three main spans of 13.9 m (45.5 feet). The central span was originally used by trams turning to and from Elizabeth Street, flanked by one-way roads then footway spans of 4 metres (13 feet). Designed by engineering staff, Way and Works Branch, NSWGR and built by Metropolitan Railway Construction Branch in 1923.

Eddy Ave Steel tram underbridge is a riveted-steel plate girder underbridge with decorative iron balustrades. The underbridge is set on stone piers and is approached from the north by a ramp through Belmore Park.

### CLEVELAND STREET OVERBRIDGE (1891)

Defining the southern limits of the Central Station precinct is the Cleveland Street Overbridge. The structure is a six span overbridge comprised of: Spans 1 - 4 are 8.8m span brick arches; Span 5 is an 8.8m brick and jack arch; Span 6 is a 15.2m jack arch. All original spans have been extended with PSC girders. The bridge is excluded from the listing.

## LANDSCAPE

Central Railway Station Group is a landmark feature on the southern boundary of the city and has a number of landscape features associated with it. As part of the development of between 1901 and 1906 of Central Railway Station, and due to its elevated position, a series of large sandstone retaining walls were constructed along Pitt Street and Elizabeth Street, which also acted to carry tram lines and the electric city underground line. The retaining walls act as visual boundaries to the main Station building and are important elements of the Station group design.

The retaining walls enclose Belmore Park which lies directly north of Central Railway Station across Eddy Avenue. Belmore Park is a medium sized urban park, covering one city block, with pedestrian pathways, exotic and native plantings, large lawn areas and public shelters and a rotunda. It is often used for small festivals and public events. Although the Park is a separate element to Central Railway Station, its location in front of the Station acts as an important

approach way to Central and is part of the wider landscape of the railway precinct.

On the western frontage is a small formal garden that sits adjacent to the vehicle ramp near Railway Square. Although this has been a larger more prominent feature of the station entrance in the past, it is currently a small lawn and garden space. The space is enclosed with a sandstone boundary fence with decorative iron palisade uprights and heavy iron link chain. Two sandstone columns are also set within the wall, one marking the southern entry to the garden, the other set in the middle of the western side of the low wall. The garden is divided by a curved bitumen path through the centre. To the east a number of mature trees are set along the boundary towards the northern end, while to the south the area is a lawn with a small formal garden planting with flowers. A small memorial to 'Donna' a hearing guide dog is located in the eastern section. This consists of a sandstone plinth with brass dogs head statue.

Physical condition and/or Archaeological potential: Overall, the Central Railway Station Group is currently in good but being functionally sound, showing minor wear and tear but

#### ARCHAEOLOGY

The Central Railway Station Group has been built on the site of the two earlier Sydney railway terminals, the former Devonshire Street cemetery, a number of colonial era buildings including the Benevolent Society Asylum, as well as having a number of earlier railway buildings, such as the Eastern and Western carriage sheds demolished in various phases of expansion. As such there is likely to be archaeological potential across the site relating to these various phases of development. See the Conservation Management Plan prepared by Government Architect's Office, June 2013 for a detailed archaeological zoning plan.

Modifications and dates: Date condition updated: 31 Jul 09  
The Central Railway Station Group, including the station and yards has undergone a series of major and minor changes from the opening in 1906.

1900-1901: Demolition of old Central Railway Buildings  
1921: Clock Tower  
1926: Central Electric Station  
1958: Removal of tram lines  
1979: Eastern Suburbs Railway  
1980: Restoration of platforms and concourse, includes new aluminium and fibre glass domed roof on concourse  
1984-1985: Restoration of clock and clock tower  
c1991: New coach (bus) terminal built on Eddy Avenue  
1993: Conversion of parcels and luggage subways for use as pedestrian subways  
1995: Old male toilets on concourse closed  
1996: Re-instatement of Metro Light Rail tram Lines  
1998: Sale and conversion of Parcels Post Office to apartments  
1998-2002: Demolition of Western yard Carriage Sheds, includes removal of elevated water tank and water column  
1999: Airport Line and Tunnel Portal, including demolition of Prince Alfred siding workshops  
2004: Conversion of Inwards Parcels Office for

backpacker accommodation  
2011: Completion of Sandstone restoration to  
clocktower, new entrance structure to Devonshire St  
Tunnel  
2012: Upgrade to ESR tiling

Current use: Railway Station

Former use: Nil

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## History

Historical notes: See the Conservation Management Plan prepared by Government Architect's Office, June 2013 for detailed inventory sheets of each precinct and a summary of historical analysis.

In 1849, the newly formed Sydney Railway Company applied to the government for four blocks of land between Hay and Cleveland streets to construct a Sydney Railway terminal. Although the Surveyor General favoured Grose Farm (now the grounds of the University of Sydney), which was further from the city and less costly to develop, the company was finally granted land in the Government Paddocks between Devonshire and Cleveland Streets for the construction of the first Sydney railway terminus which was located there from 1855. The first station included timber and corrugated-iron station buildings, an engine shed, carriage shed and goods sheds. A branch line to the Darling Harbour wharves and goods yard ran from the western side of the rail yard. The overbridge that carried Parramatta Road across this line remains as the oldest piece of railway infrastructure in the NSW system (see entry 4801079).

The position of the station was at the southern end of the town, at the point where journeys into the interior of the colony began. With the addition of the new railway station, this part of the town grew in importance as an entry point to the city. Shops began to be built around the station and in the adjacent streets. By the turn of the twentieth century, major department stores were positioned in George and Pitt Streets to take advantage of the growing number of commuters coming through the area. This was particularly the case after 1879 when the first steam tramline to the station was installed, linking it with the Hunter Street in the city.

As the importance of the railways increased, the station and the Sydney Yard attached to it were also extended. A new sandstone engine house was constructed in 1866 on the eastern side.

In 1869, the Mortuary Station was constructed in the western yard, to connect to the new general cemetery at Rookwood. The station, designed by Colonial Architect James Barnett, provided a siding with an elaborate gothic station building, which included a chapel and waiting rooms, for the transport of coffins and mourners to the cemetery where a sister receiving station had also been constructed. Mortuary Station at Sydney is the only surviving example of such a station in situ in the NSW system and is a rare survivor of the first phase of the Sydney Yard. Mortuary Station is written about in more detail on a separate listing (No: 4803219)



In 1876 the original Central Railway Station building was replaced by a new brick station building (the second station). John Whitton, the Engineer-in-Chief, designed a neo-classical station building to be constructed of brick with decorative detail using polychromatic and relief work.

Almost immediately the demand for platform space during peak times resulted in additional branch lines and platforms being constructed adjacent to the original passenger station.

Between 1876 and 1902, Whitton's second station group and the yard were undergoing constant upgrades and expansions, with the addition of carriage sheds, goods sheds, workshops, new sidings and other railway infrastructure. At its peak there were 13 passenger platforms in the 1876 station as well as the Mortuary Station on the western edge of the yard. By 1890 Whitton's station building had become engulfed within a sea of sheds and platform canopies.

In 1890, on the eastern side of the yard facing Chalmers and Devonshire Streets, an elaborate Railway Institute building was built. The Institute was built for use by the railway workers providing both an educational facility and a social club. A design competition was held, won by the architect Henry Robinson. The building was built in a Queen Anne Revival style and was the first public building in Australia to use Marseille roof tiles. The building continued to function in its intended role until the later 1970s. It has more recently (2007-08) been converted for non-railway uses.

In 1888, the then Railway Commissioner, Edward MG Eddy began work on the quadruplication of the Western Line to Homebush and the duplication of other suburban lines. As part of this project he proposed a new Sydney terminal station closer to the city. The first proposal was for a station in King Street in the city. This would have resulted in large-scale demolitions and resumptions, including much of Hyde Park. Eddy submitted an alternative proposal in 1891 for a site north of the existing station on the land occupied by the former Devonshire Street cemetery (closed to burials since the 1860s), the Benevolent Asylum (c1818) and a police barracks. This site was chosen for a new grand station complex to be built, not least as it was already in government hands and largely devoid of major structures.

Work began on the third Sydney station, Central Railway Station, in 1901, with the removal of the cemetery being the first priority. The bulk of the construction work occurred between 1902 and 1906, including the exhumations, excavations, demolition of buildings on the site and construction of the station. The construction work began in mid 1902, with the foundation stone being laid on 30 April 1902 by the Secretary for Public Works, the Hon EW O'Sullivan. By mid 1903 it was reported that the general earthworks were completed and work on the various subways was underway, with a second foundation stone at the base of the clock tower being unveiled in September 1903.

The station was officially opened on 4 August 1906 despite the main building not being completely finished. Construction had only been completed as far as the first floor, but included all the underground subways for the transfer of luggage and mail as well as pedestrian subways (Devonshire Street tunnel). The new station had

subways (Devonshire Street tunnel). The new station had moved one block north from the previous incarnations, closer to the city. If Belmore Park is included, all the land now occupied by the railway at Central and Redfern coincides with the Sydney Railway Company's original selection of four blocks between Hay and Cleveland Streets.

The main terminal building was built using Pyrmont sandstone to a design of the Government Architect WL Vernon. A feature of the design was the deliberate separation of passenger, vehicle, train and tram services, all of which entered the station from different levels and directions, eliminating the danger of accidents which had been a feature of the previous station arrangements. The new design created a multi-level transport interchange, able to handle major traffic and pedestrian flows effectively and safely. The trams entered the station via two underbridges at the western and eastern ends of Eddy Avenue. The eastern-end underbridge was a steel bridge with decorative ironwork balustrades and a riveted steel plate girder. It remains as a rare piece of Sydney's original tramway infrastructure and since 1997 has been in use for the Sydney light rail system.

Another feature was the prominent positioning of the station at the southern end of the city. The relatively low rise of the city at the time of the station's completion meant it was a major landmark, visible from much of the city. The inclusion of the existing Belmore Park in the wider railway complex design, the planting of gardens on the western side facing George Street and the main vehicle entrance, and the location of Prince Alfred Park to the south of the new station placed the complex in a garden setting, further enhancing its status as a city landmark.

From the time of opening, work continued on both the station building and the Sydney Yard associated with it. In August 1906 Platforms 9 and 10 were opened, while overhead signal boxes were opened as lines and platforms were completed. At first, four signal boxes were required, using a mechanical system of signals. These were reduced to two boxes from 1910 when electro-pneumatic technology was introduced. By the early 1920s, a complicated series of lines, cross-overs, junctions and points was in place directing trains in and out of the station and yard complex.

In 1921 the clock tower was completed with the clock beginning to operate from March of that year. The clock tower was the last of the major built elements in the first phase of the station to be completed. The top of the dome sits 64.3 metres above the concourse or 85.6 metres above mean sea level. Even more so than the station itself, the clock tower became a major city landmark, with the clock being utilised by workers in the surrounding factory districts as their daily time piece, earning it the nickname 'the worker's watch'.

In 1915, before work on the main station was completed, the first extension began. Following recommendations for a city railway system and underground network from a royal commission into Sydney's planning in 1909, approval was given via the City and Suburban Electric Railways Act, 1915, to begin construction on a suburban electrification and underground railway. Although excavations got under way in late 1916, they ceased in 1918 as funds were diverted away from the project into the war effort. Work

diverted away from the project into the war effort. Work resumed in earnest in February 1922. A new entrance at Elizabeth Street was constructed to serve the electric platforms. The entrance was built using sandstone to match the main station, with four ionic columns as features. New baggage subways and electric lifts were also installed and linked to the existing tunnel network.

Eight new platforms were built to the east of the original 1906 station platforms at a higher level to take the new electric trains between 1922 and 1926. These platforms were named 'Central' to distinguish them from the 'Sydney' or steam-train platforms.

As well as new entries, subways and platforms, a complicated series of flyovers was built to carry the new electric lines. The flyovers were built using steel beams on brick piers with large concrete foundations. As part of their construction, an old carriage shed and several storage sheds were demolished, while an old sewer was also diverted. The flyovers allowed for trains on the Up line (heading towards Sydney) to go up and over trains on the Down line (heading away from Sydney) without interfering with each other or requiring point cross overs. When completed, this was the largest collection of flyovers in the world.

Adjacent to the northern end of the flyovers, on the eastern side, a new substation was built in 1925-26. Known as the Prince Alfred substation, it was constructed as part of the electrification of the suburban lines. The substation was one of fifteen built for the electrification between 1926 and 1932, and one of three 'Bradfield' designs, the other two being at Meeks Road (Marrickville) and Hurstville, both of which remain in use.

The first electric train ran from Central Station on 1 March 1926. In December the new line to the first section of the Sydney underground also opened, with trains to Museum and St James. The underground system required the construction of new underbridges from Central north across Eddy Avenue, Hay and Campbell Street. This bridge was built using an innovative combination of 5-span continuous reinforced concrete beams with variable depths that creates the impression of arch construction. This was a pioneering and complicated use of reinforced concrete in railway bridge design.

A change in train locomotion technology began to appear at Central from the 1940s, when four diesel-electric shunting engines were leased from the US Army, originally intended for work at the munitions factories but utilised instead by the NSW Railways in the Sydney Yard. Two were eventually acquired outright in 1948, with the other two transferred to Commonwealth ownership. In 1951, the first diesel electric locomotive on main line service was introduced in NSW. Initially only on goods trains, from 1955 dieselisation of passenger trains began to replace steam. The last steam train on a regular service left Central in October 1969. The end of steam saw the removal of much of the associated infrastructure such as water columns, water tanks, coal hoppers and storage.

In the 1951, an interstate booking hall was created (in the former refreshment room, now the railway bar). Murals depicting railway scenes lined the walls and a terrazzo map of Australia was installed on the floor. Modernisation programs were undertaken in 1955 and again in 1964. This was followed in 1970 by the opening of the Eastern

This was followed in 1977 by the opening of the Eastern Suburbs Railway (ESR) and Illawarra Lines on platforms 24 and 25. Construction had begun on these in 1948 but had been on again off again until the mid 1970s. Above these platforms, two other platforms were excavated for future extensions that never happened. These remain as 'ghost platforms' 26 and 27. The pedestrian subway to the ESR includes the railway war memorial honour boards.

In October 1980 a modernisation program at the Sydney Terminal commenced. The objective of the work was to improve the facilities for passenger convenience and comfort. The start of this modernisation program coincided with the 125th anniversary of the NSW Railways and it was at a time when many major service advances were being made to the state rail system. Further work was carried out between 1983 and 1986, with renovations on the clock tower and Mortuary Station.

In the mid-1990s, a new branch line to Sydney Airport was constructed, requiring a new tunnel under Prince Alfred Park commencing near Cleveland Street. This work required the removal of the remaining 1870s workshop buildings from the original workshops complex, leaving only the former District Engineers Office building, which was restored and is currently in use as offices and the former Draughtsman's Office which is currently vacant and boarded up. The line was opened in 2000, in time for the Sydney Olympic Games. A new bus terminal was then created progressively up to 2006 in the western edge of the yard which also saw the removal of the remaining old workshops and buildings in the western yard.

A major conservation program is currently underway (2009) on the sandstone frontage of the Pitt Street and Eddy Avenue colonnade and walls.

## Historic themes

Australian theme (abbrev)	New South Wales theme	Local theme
3. Economy-Developing local, regional and national economies	Communication-Activities relating to the creation and conveyance of information	Mail trains and parcels services-
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Making railway journeys-
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Building the railway network-
4. Settlement-Building settlements, towns and cities	Accommodation-Activities associated with the provision of accommodation, and particular types of accommodation – does not include architectural styles – use the theme of Creative Endeavour for such activities.	Servicing and accomodating passengers-

Criteria		
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Impacts of Railways on Urban Form-
4. Settlement-Building settlements, towns and cities	Utilities-Activities associated with the provision of services, especially on a communal basis	Making gas/generating electricity-
5. Working-Working	Labour-Activities associated with work practises and organised and unorganised labour	Railway operations workers-
7. Governing-Governing	Defence-Activities associated with defending places from hostile takeover and occupation	Remembering the fallen-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	Railway time-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	Railway Administration-
8. Culture-Developing cultural institutions and ways of life	Creative endeavour-Activities associated with the production and performance of literary, artistic, architectural and other imaginative, interpretive or inventive works; and/or associated with the production and expression of cultural phenomena; and/or environments that have inspired such creative activities.	Evolution of design in railway engineering or architecture-
8. Culture-Developing cultural institutions and ways of life	Creative endeavour-Activities associated with the production and performance of literary, artistic, architectural and other imaginative, interpretive or inventive works; and/or associated with the production and expression of cultural phenomena; and/or environments that have inspired such creative activities.	Railway Gardens-
9. Phases of Life-Marking the phases of life	Events-Activities and processes that mark the consequences of natural and cultural occurrences	Railway celebrations and commemorations-
9. Phases of Life-Marking the phases of life	Persons-Activities of, and associations with, identifiable individuals, families and communal groups	Significant railway identities-

## Assessment of significance

SHR Criteria a)  
[Historical significance]

The Central Railway Station group and associated yard and structures have historical significance at a state level as the major railway terminal on the NSW system. The station was built within the original grant area of the Sydney Railway Company and on the site of the first railway terminal, which opened in 1855, making it the oldest continually operating train yard in NSW.

The construction of the Central Railway Station or the Sydney Terminal on the site of the old burial ground was one of the largest planned interventions into the urban fabric of Sydney undertaken prior to World War I and is a rare example of a scheme that not only included a formal public building but also parkland and roadway. The deliberate creation of the formal approaches, the widening of the streets to form avenues and create vistas, the separation and multi-layering of tramlines, vehicular and pedestrian access and the creation of subways resulted in the creation of an urban environment of a scale and character not before seen in Sydney, a character that would have been in sharp contrast to the residential character of the surrounding suburbs of Redfern, Chippendale and Surry Hills.

The development of Central Railway Station resulted in an increase in the commercial activity around Railway Square and influenced the choice of the site for department stores. Following the introduction of trams, Railway Square and later Central Station also became a major tram and transport interchange with links to the suburbs and Circular Quay.

Associated buildings such as the Mortuary Station and the Railway Institute were important additions to serve the railway workers and the wider community beyond the workings of the station proper.

SHR Criteria b)  
[Associative significance]

The Central Railway Station group is associated with the lives and work of a number of important and prominent people in NSW including WL Vernon, Government Architect who designed the station buildings, EG Eddy the Railways Commissioner (remembered in the naming of Eddy Avenue which the station faces) who proposed the new station, Colonial Architect James Barnett who designed the Mortuary Station and Dr JJC Bradfield who designed and oversaw the construction of the city underground network.

The station is also associated with the Sydney Railway Company, the first private railway company established in 1855 to build the new railway system. The overbridge under Parramatta Road on the former Darling Harbour line in the western yard is the only remaining piece of railway infrastructure in NSW associated with that first railway company.

SHR Criteria c)  
[Aesthetic significance]

Central Railway Station has aesthetic significance as a major and prominent landmark in the Sydney urban landscape. The dominant use of sandstone for its construction, including its clock tower, sets it out as a major public building in the Sydney collection of sandstone buildings and one of the largest public structures in the city. Its highly detailed sandstone façade, colonnades, columns and arcades on the exterior and the use of bricks, decorative steel, iron and sandstone for the internal spaces provide fine visual transitions between the public spaces. The office spaces and foyers, marble and terrazzo stairs, balustrades and banisters, stained and etched glass panels

and canopies, stairs and stairs glass panels are fine examples of public architectural features. The clock tower remains as a prominent landmark figure in the city. The surrounding public parks and railway gardens add to the landmark quality of the station complex. Associated structures such as the Mortuary Station and the former Railway Workers Institute are highly decorative examples of public railway buildings. The Mortuary Station is a finely detailed sandstone gothic station which is itself a prominent landmark on the western edge of the Sydney yard. It is dealt with specifically in a separate listing (No 4803219).

The Central Railway Station Group is also technically significant as a major public work, built for the most part by the NSW Public Works Department, Railway Construction Branch.

The changes in the predominant building materials and the way in which they are employed - with sandstone and corrugated iron being used until c1870 for even the most utilitarian buildings such as workshops, then polychromatic brickwork, then sandstone for the more important buildings and brick with sandstone dressings for the lesser buildings - indicates not only changes in technology, but also the changing fashions for the use of a particular material. After the 1899 inquiry into building materials for public buildings, sandstone was used for all major public buildings. The use of sandstone therefore indicates the status of a particular building.

Technical innovation in design can be seen in the flyovers built for the electrification of the suburban lines. The flyovers are a complex group of raised lines to allow Up line and Down line trains to pass each other and to cross to their required platforms and suburban lines without the need for a complicated switching and point system. When built they were the largest such collection in the world.

The design of the station to allow separate pedestrian, train, tram and vehicle movements, as well as the extensive underground system of tunnels and subways to transport luggage, mail and other items without interference in the public space is all part of the complex design of the station to ensure smooth and safe operation.

SHR Criteria d)  
[Social significance]

Central Railway Station has a high level of social significance as the major train terminal for Sydney commuters, intra and interstate railway users for over 100 years, and as a site for the main railway terminal in Sydney since 1855.

The station was designed with a capacity to double the passenger number to an expected maximum of 40,000 per day. With the increase in the use of the private car in the late twentieth century the reliance on public transport has lessened, however Central Railway Station is still used by a large number of commuters on a daily basis.

The Central Railway Station was designed with an

elaborate and impressive booking hall which was not only experienced by passengers buying tickets but also glimpsed by passengers passing through onto the assembly platform [concourse]. The experience of buying a ticket in such an elaborate and formal space would have heightened the sense of romance associated with travel.

Associated with the assembly platform [concourse] was a series of amenities which reflect the attitudes and customs of the period, for example separate dining, tea and waiting facilities were provided for ladies and gentlemen. A barber and change facilities, including baths, were provided to allow passengers to clean up after their journeys.

A reading room and dining room were provided for the railway commissioners and their staff to mitigate the distance of the terminal building from the centre of town.

Associated buildings such as the Mortuary Station and the Railway Institute are socially significant as places of special use by community groups and the public. The Mortuary Station was in use from the 1870s until the 1930s for funeral trains, with a chapel for mourners provided on site. The Railway Institute was in use until the 1970s as a social venue for railway workers and provided an important role in the educational and social development of the employees.

SHR Criteria e)  
[Research potential]

Central Railway Station has research potential for its archaeological resource. In addition to the extant remains of the early stages of the site's development (such as the Darling Harbour Branch Line and the imprint of the demolished heavy goods shed), evidence of the former uses of the site remains in the archaeological record. The site of the main terminus was formerly occupied by the Benevolent Asylum, Carters Barracks and the Devonshire Street cemetery. Relocation of the graves and demolition of the structures was recorded in the documentary evidence. While it is unlikely that much remains of these structures due to the excavation and then raising of levels to create the new station, some potential for archaeology does exist across the site, including evidence of the first station building's yard. Other contemporary building projects were constructed leaving the former foundations in situ.

SHR Criteria f)  
[Rarity]

Central Railway Station is a rare example of a major city railway terminal and station building and is the largest example of such a complex in NSW. The overbridge at Railway Square (Separate Listing No 4801079), associated with the original Darling Harbour Goods Line, opened the same day as the main railway in 1855 and is the oldest piece of railway infrastructure remaining in NSW and the only known feature built by the original Sydney Railway Company. Within the Sydney yard, the flyovers built for the electrification of the suburban lines are the largest examples in the world and a unique engineering solution to the complexities of a large suburban network. The Mortuary Station is



rare and thought to be the only surviving mortuary station in situ in Australia. The Railway Institute is a rare surviving example of a nineteenth-century Railway Institute building on a grand scale and was the first public building to utilise Marseilles tiles for its roof. The steel tram underbridge at the east end of Eddy Avenue is a unique feature of the station and a rare piece of surviving infrastructure from Sydney's original tramway system.

SHR Criteria g)  
[Representativeness]

Central Railway Station is a fine representative collection of buildings and structures of the NSW Public Works Department Railway construction branch work on NSW government railways. The Prince Alfred substation is a good representative of the three 'Bradfield Design' substations built for the electrification of the suburban line. The Campbell Street and Hay Street underbridges are good representations of concrete arch construction and are comparable to those built at Milsons Point as part of the Sydney Harbour Bridge construction.

Integrity/Intactness: Overall, despite ongoing modifications and upgrades to suit new railway technology and expansion, the Central Railway Station Group retains a high level of intactness and integrity in relation to its design function. In particular, the Station Building and platform areas are largely intact retaining much of the original fabric, layout

and design features. A number of individual items have been removed in the Station's history including the workshops of the Prince Alfred sidings and the carriage sheds and buildings of the western yard and most structures from the first and second phase of the railway station and yard. Items associated with steam travel have also been removed as technology changed and steam was phased out. Except for the intrusion of the Airport Railway, the flyovers retain their original fabric and structure. Campbell Street, Eddy Ave and Hay Street underbridges retain their original fabric and structure. Cleveland Street overbridge has been altered considerably with the addition of PSC girders.

Assessment criteria: Items are assessed against the [State Heritage Register \(SHR\) Criteria](#) to determine the level of significance. Refer to the Listings below for the level of statutory protection.

### Recommended management:

Manage site in accordance with the Conservation Management Plan prepared by Government Architect's Office, June 2013

### Listings

Heritage Listing	Listing Title	Listing Number	Gazette Date	Gazette Number	Gazette Page
Heritage Act - s.170 NSW State agency heritage register	SRA s.170 Register				

## Study details

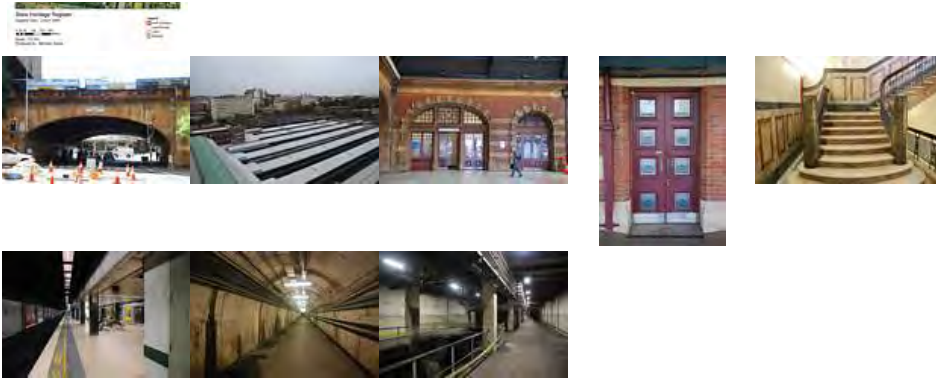
Title	Year	Number	Author	Inspected by	Guidelines used
State Rail Authority Heritage Register Study	1999	SRA296	State Rail Authority		No
S170 Heritage & Conservation Register Update	2009		Godden Mackay Logan		Yes

## References, internet links & images

Type	Author	Year	Title	Internet Links
Written	Department of Public Works & Services Heritage Group	1996	Conservation Management Plan - Sydney/Central Station	
Written	Don Fraser	1995	Bridges Down Under	
Written	DR Keenan and HR Clark H R Clark		First Stop Central	
Written	Heritage Group State Projects	1999	Sydney/Central Station Conservation Management Plan	
Written	Howard Tanner & Associates	1987	Sydney Central Station and Sydney Yard Conversation Management Plan	
Written	JJC Bradfield	1926	Railway Electrification V	
Written	John Forsyth		Historical Notes for the City and North Shore Railways, 1960s	
Management Plan	John Oakes	2007	Sydney's Central: The history of Sydney's Central Railway Station	
Written	Rappoport Heritage Consultants	2012	Research Materials prepared for Central Station CMP	
Written	Staff writer	1925	City Railway, Flyover in Central Station Yard	

Note: internet links may be to web pages, documents or images.





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## Data source

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11.3 Appendix C - Local Government Citation  
Central Station Railway Group

[Home](#) > [Heritage sites](#) > [Searches and directories](#) > NSW heritage search

## Central Railway Station Group Including Buildings, Station Yard, Viaducts and Bu

### Item details

Name of item: Central Railway Station Group Including Buildings, Station and Bu  
 Type of item: Built  
 Group/Collection: Transport - Rail  
 Category: Railway Platform/ Station  
 Location: Lat: -33.8829018914842 Long: 151.205409920674  
 Primary address: , Haymarket, NSW 2000  
 Local govt. area: Sydney

### All addresses

Street Address	Suburb/town	LGA	Parish	County	Type
	Haymarket	Sydney			Primary Address
Eddy Avenue	Haymarket	Sydney			Alternate Address

### Statement of significance:

The Central Railway Station Terminus forms a landmark feature at the southern end of Central Sydney. It is a vast structure of particular architectural merit located to dominate its surroundings. It is the only true terminus building in Australia preventing further extension of rail lines and is significant as one of the largest covered public

spaces in the city. It is one of the finest examples of the classically inspired Beaux Arts style in Railway buildings in Australia. It has historic significance as being an important design of the Colonial Architect Walter Liberty Vernon. It was one of the first major rail termini to be constructed in Australia and has had a lengthy association with rail transport in New South Wales and with a variety of historically important persons. It has scientific significance for its unique use in New South Wales (and probably in Australia), of the three pin truss to the porte-cochere for the trams, which was similar to the Galerie des Machines in Paris. It is significant for the multi level segregation of trams, trains and vehicular traffic. It was reputed to be the first large scale use of reinforced concrete slab construction in New South Wales. The building is socially significant as a purpose built railway terminus demonstrating the growth and change of transport, and as an important symbol for the social history of the nation.

Central Railway Station Yard is associated with the

introduction of railways to New South Wales. The Central Railway Station Yard is significant for its part in the distribution of produce from regional New South Wales. It was one of the largest planned interventions undertaken in the urban fabric of Sydney prior to World War One. The Yard has significance for its association with the development of Central Railway Station and with a variety of historically important persons in New South Wales. It has historic significance as an important design of the Railways Engineer, H Dearne. Central Railway Station Yard has scientific significance as part of one of the few true railway termini to prevent further extension of rail lines in Australia. The Yard is significant for the part it played in the growth and development of commerce and industry in New South Wales.

Central Railway Station Viaducts are significant as part of the Central Railway Station, and are associated with the introduction of railways to New South Wales. The Viaducts are significant for their association with the now decommissioned tramways and as part of one of the largest planned interventions undertaken in the urban fabric of Sydney prior to World War One. The Viaducts have historic significance as an important part of the design of Railways Engineer, H Dearne, as well as for its association with a variety of other historically important persons. The Viaducts have aesthetic significance forming part of the landmark feature of the Sydney Terminus, and are representative as part of a form of transportation used in the early nineteenth century.

Date significance updated: 06 Dec 05

*Note: There are incomplete details for a number of items listed in NSW. The Heritage Branch intends to develop or upgrade statements of significance and other information for these items as resources become available.*

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## Description

Designer/Maker: W L Vernon (Government Architect); H. Dearne (Railways Engineer)

Builder/Maker: Unknown

Construction years: 1855-1901

Physical description: Central Railway Station Yard is located south of the Devonshire Street Tunnel extending to the Cleveland Street bridge, between the Central Electric and Western Yard Precincts. The Yard connects to the passenger platforms of the Sydney Terminal which are as originally designed and built. Major items from its period as a steam locomotive hauled train yard have been removed, however the concrete plinths of the water columns between each track remain. There is only one 'yard controller' remaining within the Yard. The Yard slopes down the hill to the Cleveland Street bridge. The yard is generally made up of railway sidings and has few remaining original structures. The most significant structures are found in the Western Yard and include the Mortuary Station, the Parcel Dock the West Carriage Shed. Its function as a shunting facility has been greatly reduced due to the introduction of rail car sets and the removal of the eastern carriage shed. The land where the shed once stood is vacant and the only remaining structures adding to this division of the yard are the Cleaners Amenities and the former Timetable Office with

garden.

The Yards are still functioning and maintained in operating condition. The original 1906 track layout to Platforms 1-15 has remained unchanged. The Yard has been altered significantly since the Eastern Carriage Shed was demolished. Category: Group of Buildings. Style: NA. Storeys: NA. Sprinkler System: No.

The Central Terminus sandstone building was designed in the Beaux Arts style by the Government Architect, Walter Liberty Vernon. Its dominant location and elevated siting permits use of the topography to gain road access to several levels, enabling the development of an extensive subterranean luggage network, the separation of modes of transport, and commercial space. It is a classically inspired Beaux Arts building consisting of a sandstone and brick structure organised in a "U" form that encloses a steel framed Main Hall and platforms. The interior of the Hall features a skylight barrel vaulted steel truss roof, clad with corrugated iron. The internal brick walls are banded and the asymmetric arrangement of archways and ticket office entries have sandstone entablatures, pilasters and Gibbs surrounds. Access to the Hall is from the east and west through barrel vaulted entries with coffered ceilings and horizontal banding similar to that of the Main Hall. Central Terminal now contains seven double platforms and one single platform, each with an awning, servicing a total of fifteen tracks. It demonstrates innovative functional organisation, and unique use of three pin truss to porte-cochere for the trams. Category: Group of Buildings; Individual Building. Style: Federation Free Classical / Beaux Arts. Storeys: 3. Facade: Sandstone. Side/Rear Walls: Sandstone. Internal Walls: Face brick, sandstone.. Roof Cladding: Corrugated steel sheeting. Internal Structure: Reinf. conc. column & beam, steel column & truss.. Floor: Reinf. conc., terrazzo.. Roof: Steel trusses, steel framing.. Ceilings: Susp. plasterbd.. Stairs: A series of escalators and reinforced concrete stairs access the main hall level from street level and metropolitan lines.. Sprinkler System: Yes. Lifts: Modern lifts installed.

The Viaducts are modelled in a Federation Free Classical style, and located to the north of the Central Railway Station Complex, connecting the station's porte-cochere with Belmore Park. These are former tramways, previously connected to a network of tram lines. Because of the station's height above street level, the viaducts ramp from Hay Street to the level of the main assembly platform of the Station. There are two Viaducts which include the arrival ramp and the departure ramp arranged in an elongated 'U' form encircling Belmore Park. The Viaducts are suspended above King Street and Eddy Avenue. The viaducts feature arched rusticated sandstone abutments supporting reinforced concrete barrel vaulting with sandstone retaining walls to Belmore Park and shops under on Eddy Avenue. The vaulting is surmounted by a projecting sandstone entablature and carved sandstone balusters. At street level the ramps feature trachyte and sandstone kerbing, and a number of painted cast iron balusters formerly separating pedestrian and vehicular traffic.

The Viaducts are still functioning and maintained in

operating condition. They have remained unchanged since they were originally laid out in 1906.  
 Category: Other Feature. Style: Federation Free Classical. Storeys: N/A. Facade: Sandstone, reinf. conc..  
 Side/Rear Walls: Sandstone, reinf. conc.. Sprinkler System: No.

**Physical condition and/or Archaeological potential:** Generally the building and associated structures are in good condition. The exterior walls have not been significantly altered and remain on the whole in their original condition. The interior spaces have undergone several stages of alteration and modernisation resulting in inconsistent detailing. AirConditioned: Yes  
 FireStairs: Intrusive Elements: Interior fitouts of the offices, fitout and materials of the kiosks, fibreglass seating and plant boxes.

Date condition updated: 06 Dec 05

**Modifications and dates:** Terminus: 1901, 1915

Yard: from 1855

**Further information:** Viaducts: 1901  
 Terminus:  
 High Significance: Form, material and detailing of the Terminus building including; the booking hall, main assembly platform, former refreshment rooms, former waiting rooms, left luggage area, basement service area, office accommodation (upper levels), colonnade, porte-cochere, awning and clocktower. Medium Significance: Electric Station Platforms and interchange. Low Significance: Reproduction joinery, modern alterations and shop fitouts to concourse and lower concourse areas, furniture and fittings to booking office, bar and cafe, computerised arrival and departure notices.

Yard:  
 High Significance: Configuration of platforms 1-15, associated awnings, extension of assembly platform. Medium Significance: Sydney Yard: Cleaners Office, Prince Alfred Sewer. Central Electric: Northern concourse, Elizabeth St entry, Eddy Ave entry, Eddy Ave ramp, above ground platforms, flyovers. Country Platforms: Devonshire St tunnel skylights, goods lifts, 'hand' signs on platform awnings, cast iron downpipes and drains, hardwood buffer.

Viaducts:  
 High Significance: Sandstone retaining wall with engaged piers to Pitt Street, Eddy Avenue bridge to arrival ramp, and Eddy Avenue bridge to departure ramp. Medium Significance: Battered earth slopes of arrival and departure ramps to Belmore Park.

Current use: Railway Station

Former use: Railway Station

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## History

**Historical notes:** The "Eora people" was the name given to the coastal Aborigines around Sydney. Central Sydney is therefore often referred to as "Eora Country". Within the City of Sydney local government area, the traditional owners are the Cadigal and Wangal bands of the Eora. There is no written record of the name of the language spoken and currently there are debates as whether the coastal peoples



spoke a separate language "Eora" or whether this was actually a dialect of the Dharug language. Remnant bushland in places like Blackwattle Bay retain elements of traditional plant, bird and animal life, including fish and rock oysters.

With the invasion of the Sydney region, the Cadigal and Wangal people were decimated but there are descendants still living in Sydney today. All cities include many immigrants in their population. Aboriginal people from across the state have been attracted to suburbs such as Pyrmont, Balmain, Rozelle, Glebe and Redfern since the 1930s. Changes in government legislation in the 1960s provided freedom of movement enabling more Aboriginal people to choose to live in Sydney.

(Information sourced from Anita Heiss, "Aboriginal People and Place", Barani: Indigenous History of Sydney City <http://www.cityofsydney.nsw.gov.au/barani> )

In 1855 railways were introduced to New South Wales. Initial construction of the network was undertaken by a private company and subsequently by the government. Rail networks were appearing in Victoria at the same time albeit using different technology and standards. Development of the Sydney Yards commenced in the same year and was one of the first two yards in Australia. Extensive workshop facilities were established to enable repair of locomotives. Since the late 1880's the working function of the Sydney Yards has gradually been transferred, initially to Eveleigh, and further afield during the twentieth century. The focus of goods handling was transferred from the eastern to the western side of the site following the erection of the main terminus and then later the Parcels Office. The construction of the Darling Harbour Branch Line and the establishment of an extensive area for goods storage and transfer, indicates the importance the Sydney Yards in the distribution of produce from regional New South Wales. The majority of the working yard area disappeared with the construction of the City Electric lines, however a small pocket remains along the boundary of the Prince Alfred Park.

Much debate from the 1880's through to 1897 over the extension of the railway line further into the centre of the city, culminated in a rail terminal being located in Redfern at the corner of Devonshire Street. In 1897 because of dangerous congestion at Redfern, the New South Wales Parliamentary Standing Committee proposed to move the Terminal to the northern side of Devonshire Street. Initial designs for the railway terminus were prepared by Henry Deane, who was reputed to have prepared over ten schemes before the Royal Commission decided on the site. The Public Works Department passed the design in June 1900, although a much modified building was eventually designed by Government Architect W L Vernon. After the removal of graves from the existing Devonshire Street Cemetery, preliminary works began. These were completed in 1902 and commemorated by a foundation stone laid by the Hon. E.W. Sullivan, Secretary for Public Works. Work on the stone piers for the tramway approach began and the following year the Hon. Sir John See laid the foundation stone for the clock tower which was to be built at a later stage. By 1906 only the booking hall, concourse, basement, north, west and east facades and temporary roof were completed due to a lack of funding. Nevertheless, it opened to the public in June, 1906. Later that year the old and new station's lines were connected

that year the old and new station lines were connected and the old station was demolished. In 1915 the second construction phase began under G. McRae of the Government Architect's Branch, involving extensions to the north and west wings and the clock tower. By 1918 the stonework had been completed on the north and west wings. The clocktower structure was constructed of reinforced concrete. The building was completed in 1921. In the mid 1920's suburban lines were electrified and Platforms 16-23 were constructed. The Central Electric Station was completed in 1929.

## Assessment of significance

SHR Criteria a) Central Railway Terminus was the first major rail terminus to be constructed in Australia, and has a lengthy association with rail transport in New South Wales. It has significance for its association with a variety of historically important persons. It also has historic significance as being an important design of the Government Architect's office.

[Historical significance]

The Yard is associated with the introduction of railways to New South Wales, one of the largest planned interventions undertaken in the urban fabric of Sydney prior to the First World War. It has historic significance for its part in the rural development of the state. It has association with a variety of historically important persons, including Railways Engineer, H. Dearne.

The Viaducts are associated with the introduction of railways to New South Wales, one of the largest planned interventions undertaken in the urban fabric of Sydney prior to the First World War. The Viaducts were also associated with the now decommissioned tramways. They have historic significance as an important design of Railways Engineer, H Dearne, and for their association with a variety of other historically important persons.

Has historic significance at a State level.

SHR Criteria c) Sydney Terminus has scientific significance as it is one of the few true terminus buildings to prevent further

[Aesthetic significance]

extension of rail lines in Australia. The use of the three pin truss to the porte-cochere for the trams, was similar to the Galerie des Machines in Paris. It is constructed on the site of the Devonshire Street cemetery and therefore has archaeological potential. Has aesthetic significance at a State level. Cultural: The Sydney Terminus forms a landmark feature, as a vast structure of particular architectural merit located to dominate its surroundings. The design of Central Station is equivalent in scale and character to international examples built at the turn of the century. The influence of overseas precedent can be seen in the form and layout of the building. The building is significant as a design of the Government Architect Walter Liberty Vernon.

Central Railway Station Yard has scientific significance as part of one of the few true railway termini to prevent further extension of rail lines. Has aesthetic significance at a State level. Cultural: The Yard forms part of the landmark feature of the Sydney Terminus. In scale and character the design of Central Station and the surrounding yard and facilities is equivalent to international examples built at the turn of the century.

The Viaducts form part of the landmark feature of the Sydney Terminus, a vast structure which dominates its surroundings.

SHR Criteria d) [Social significance] It is significant as a purpose built railway terminus demonstrating the growth and change of the transport, and as an important symbol for the social history of the nation. Has social significance at a State level. The Sydney Terminus forms a landmark feature, as a vast structure of particular architectural merit located to dominate its surroundings. The design of Central Station is equivalent in scale and character to international examples built at the turn of the century. The influence of overseas precedent can be seen in the form and layout of the building. The building is significant as a design of the Government Architect Walter Liberty Vernon.

The Yard is associated with the introduction of railways to New South Wales and with the earlier Redfern railway terminus. Has social significance at a State level. Has social significance locally. The Yard forms part of the landmark feature of the Sydney Terminus. In scale and character the design of Central Station and the surrounding yard and facilities is equivalent to international examples built at the turn of the century.

The Viaducts are associated with the introduction of railways to New South Wales and also with tramline and vehicular transport to and from Central Railway Station. Has social significance at a State level. Has social significance locally. The Viaducts form part of the landmark feature of the Sydney Terminus, a vast structure which dominates its surroundings.

SHR Criteria f) [Rarity] There are few other precedents for the multi level segregation of trams, trains and vehicular traffic. It is reputed to be the first large scale use of reinforced concrete slab construction in New South Wales. The Hall is one of the largest covered public spaces in the city. Is rare at a State level.


The Yard is significant as one of the largest planned interventions undertaken in the urban fabric of Sydney prior to World War One. It is significant as the largest working railway yard in New South Wales.

The Viaducts are significant as part of the infrastructure of the Central Railway complex. Is rare at a State level.

SHR Criteria g) [Representativeness] The Terminus is representative of an international style of building used for public rail transport at the turn of the century.

The yard is representative of the part played in the growth and development of commerce and industry in New South Wales.

The Viaducts are representative for their association with forms of transport used in the early twentieth century.

Assessment criteria: Items are assessed against the  [State Heritage Register \(SHR\) Criteria](#) to determine the level of significance. Refer to the Listings below for the level of statutory protection.

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## Recommended management:

General: The existing conservation plan should be updated as required and used to guide future use and maintenance of the place. The form, and scale of the building, and detailing of the external facades should be conserved. Other uses may be acceptable in office and administration areas provided significant fabric is not compromised. Surfaces never intended for painting, notably sandstone, should remain unpainted, while surfaces such as timber or render which were originally painted should continue to be painted in appropriate colours. Exterior: Surviving significant fabric of the Terminus building and the configuration of the main facades should be conserved. This fabric includes the colonnade, porte-cochere, awning, clocktower, neoclassical detailed sandstone, brickwork to eastern facade, joinery, etched or lead light glazing, cast iron rain water heads bearing the year and the initials NSW GR, and arched entrances to the main assembly platform. Early fabric which has been damaged or concealed by later work, should be restored. Window and door openings should not be enlarged or filled in and any replacements should be to the original detail. Intrusive elements such as the fibreglass furniture should be removed. Interior: Significant features such as the original ceiling, oeil-de-boeuf windows, archways to side passages, porte cochere and main assembly platforms, sandstone consol brackets, ashlar work, marble dado, leadlight windows and joinery, stairs to strongroom, and replica heavy panel doors of the Booking Hall, should all be conserved. The Whitton bust and configuration of the Main Assembly Hall should also be conserved. Remaining features of refreshment room (hidden behind modern panelling), and the 1952 fittout of the Railway Bar should be conserved. The marble staircase and clock machinery of the Clocktower should be retained. Internal alterations to the office areas may be acceptable provided they do not adversely impact on significant features. The building should be retained and conserved. A Heritage Assessment and Heritage Impact Statement, or a Conservation Management Plan, should be prepared for the building prior to any major works being undertaken. There shall be no vertical additions to the building and no alterations to the façade of the building other than to reinstate original features. The principal room layout and planning configuration as well as significant internal original features including ceilings, cornices, joinery, flooring and fireplaces should be retained and conserved. Any additions and alterations should be confined to the rear in areas of less significance, should not be visibly prominent and shall be in accordance with the relevant planning controls.

## Listings

Heritage Listing	Listing Title	Listing Number	Gazette Date	Gazette Number	Gazette Page
Local Environmental Plan	Sydney LEP 2012	1824	14 Dec 12		
Heritage study					

## References, internet links & images

				<a href="#">Internet</a>
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Type	Author	Year	Title	Links
Written	Anita Heiss		Aboriginal People and Place, Barani: Indigenous History of Sydney City	
Written	AWT Ensignt	1995		
Written	Brian McDonald	2000		
Written	David Sheedy	1999	Heritage Impact Assessment	
Written	David Sheedy	1993	Heritage report	
Written	Godden Mackay, Clive Lucas	1997	Heritage Impact Assessment	
Written	Howard Tanner	1996	Heritage Impact Assessment	
Written	McDonald & McPhee	1993	Heritage Impact Assesment	
Written	Noel Bell Ridley Smith	1997	Heritage Impact Assessment	
Written	PWD	1995	Central Station Conservation Management Plan	
Written	Trueman & Ludlow	1995	Heritage report	

Note: internet links may be to web pages, documents or images.



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11.4 Appendix D - Central Station CMP – Conservation Policies and Strategies Summary

## 1.2 SUMMARY OF HERITAGE CONSERVATION POLICIES & STRATEGIES

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
<b>1.</b>	<b>OVERALL HERITAGE MANAGEMENT OF CENTRAL STATION</b>			
	<p>The government agency/ies responsible for the Central Station CMP area should continue to implement a heritage management structure for the CMP area that:</p> <ul style="list-style-type: none"> <li>i. integrates development and heritage conservation with the overall management of the Central Station (including tenancy management);</li> <li>ii. provides for the long term conservation of the significant fabric of the Central Station;</li> <li>iii. disseminates the intention, aims and policies of this Conservation Management Plan to all those responsible for the maintenance and development of Central Station; and</li> <li>iv. outlines the responsibility at each staff level and of any permanent or temporary commercial tenants.</li> </ul>	<p>1.1 The government agency/ies responsible for Central Station should formally acknowledge the site's heritage values and adopt this Conservation Management Plan (CMP) as the principal document to guide ongoing heritage management.</p> <p>1.2 All staff managing change, maintenance and repair within the Central Station CMP area should have ready access to this CMP (online and in hard copy) and should be encouraged to use it.</p> <p>1.3 Regular staff heritage induction sessions should be held: creating a positive attitude to the heritage of Central Station; introducing the CMP, explaining the heritage management processes (Appendices A &amp; B) and the need for external heritage approvals and/or exemption notifications for certain types of works.</p>	<p>Provide face to face heritage induction workshop sessions. Such sessions could coincide with an annual event to celebrate the heritage of Central Station.</p>	<p>Asset Owner 2013</p> <p>Asset Maintainer; Asset Manager; &amp; Internal Asset Stakeholders. 2014</p> <p>Asset Maintainer; &amp; Asset Manager. 2014</p>

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
2.	<p><b>ONGOING USE AS A MAJOR TRANSPORT COMPLEX</b></p> <p>The government agency/ies responsible for the Central Station CMP area should:</p> <ul style="list-style-type: none"> <li>i. recognise that the continuing and sustainable use of Central Station as a major transport hub in NSW is an essential part of its outstanding heritage value;</li> <li>ii. recognise that the outstanding heritage values can be successfully balanced with the need for Central Station to continue as a major transport interchange in NSW including both major change and the management of ongoing minor technical adaptation, maintenance and repair; and</li> <li>iii. ensure continuing or re-instated regular public access to those major spaces of heritage significance within Central Station originally intended to be public space.</li> </ul>	<p>2.1 Encourage new uses and developments at Central Station that are compatible with the primary railway use of the site and provide opportunities to celebrate and interpret the heritage values of Central Station and minimise negative heritage impacts.</p> <p>2.2 Ensure external heritage professionals and/or internal heritage specialists with familiarity and understanding of the significance of Central Station are employed to advise on:</p> <ul style="list-style-type: none"> <li>a) Masterplanning;</li> <li>b) Adaptation to new uses</li> <li>c) Facilities upgrades</li> <li>d) New installations (e.g. services, signage)</li> <li>e) Maintenance and repair</li> </ul> <p>2.3 Establish an annual stakeholder meeting with relevant representatives from the responsible Government Agencies and key stakeholders to discuss implementation of the CMP, and other heritage matters relevant to Central Station.</p>	<p>Build on the existing (draft) Central Station Masterplan 2011 with regard to ensuring continuing or reinstated regular public access to those major spaces of heritage significance within Central Station originally intended to be public spaces.</p> <p>Continue to have dedicated in-house heritage officers in the agencies responsible for the care and development of Central Station.</p> <p>Ensure all asset projects include heritage, and where appropriate, archaeological, expertise on the project teams.</p> <p>Particularly relevant during Masterplanning or planning major works.</p>	<p>Asset Owner; Asset Maintainer; Asset Manager; &amp; Internal Asset Stakeholders.</p> <p>ONGOING</p> <p>Asset Manager 2014</p>



#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
<b>3.</b>	<b>MANAGING CHANGE</b>			
	<p>Manage and implement all conservation and associated development works to the Central Station in accordance with:</p> <ul style="list-style-type: none"> <li>i. this CMP;</li> <li>ii. the Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (the Burra Charter) whilst aiming to enhance the heritage significance as set out in the Statement of Significance;</li> <li>and</li> <li>iii. any other heritage guideline documents adopted by a statutory approval body or by any Government agency managing change at Central Station.</li> </ul>	<p>3.1 To guide Change utilise the summary information and guidance in the relevant CMP precinct inventory sheets (Precincts 1-5); and the relevant CMP fabric conservation recommendations (Part 6).</p> <p>3.2 Utilise all other heritage management documents adopted by the Managing Agencies (including compliance documents such as signage, lighting, and services manuals).</p> <p>3.3 When appropriate consider the performance standards of the National Construction Code and other relevant statutory documents and develop 'deemed to comply' place specific solutions rather than following set designs developed for non-heritage places.</p> <p>3.4 Ensure all works likely to impact on heritage values of the overall site or of an individual element are accompanied by a Statement of Heritage Impact (SOHI). SOHIs should be prepared for in-house confirmation that heritage impacts have been managed appropriately, even if a statutory heritage approval or notification process is not required. Implement standard SOHI templates for complex and simple works for ease of use.</p> <p>3.5 Ensure all works likely to impact on heritage values of the overall site or of an individual element are preceded by an archival</p>	<p>Keep the Intranet up to date with access to relevant conservation and other relevant guidelines.</p> <p>Engage appropriate consultants experienced in developing 'deemed to comply' place specific solutions for heritage places.</p> <p>Implement a standard archival recording template for ease of use.</p>	<p>Asset Maintainer; Asset Manager; &amp; Internal Asset Stakeholders.</p> <p>2013 &amp; ONGOING</p> <p>Asset Manager 2014</p>

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
		<p>recording of the element in its configuration.</p> <p>3.6 Ensure new work, new fabric and new service installations:</p> <ul style="list-style-type: none"> <li>a) recognise the major heritage status of the Central Station CMP area, in particular elements of exceptional and high significance, and do not result in a lessening of the heritage significance of an area, or of an element;</li> <li>b) are located where possible in areas of no or low significance;</li> <li>c) are based on an understanding of the original design concept and are compatible with the high quality of Central Station in terms of design, detail, materials and workmanship;</li> <li>d) can be easily identified as new work and, where possible, are reversible; and</li> <li>e) are sympathetic to, but do not mimic, significant fabric and spatial qualities in terms of scale, proportioning, colour, and texture.</li> </ul> <p>3.7 Demolition or removal of significant fabric should be conditional on new works being approved and construction commencing.</p> <p>3.8 Modifications to significant areas, or fabric, of Central Station for short term or temporary uses should not be permitted.</p>		

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
4.	<p><b>MASTERPLANNING</b></p> <p>Continue to use the draft Masterplan, including formally adopting or updating it, to guide ongoing vision and planning for the overall heritage conservation of Central Station.</p>	<p>4.1 The conservation of heritage significance of Central Station must be a key consideration when decisions are made on preferred Masterplan options.</p> <p>4.2 Carefully consider Masterplan options giving preference to those that have minimal heritage impact on areas, items or archaeology of exceptional or high heritage significance.</p> <p>4.3 Masterplans should ensure continuing or reinstated regular public access to those major spaces of heritage significance within Central Station originally intended to be public spaces.</p>	<p>An overall adopted Masterplan for Central Station will ensure that heritage significance is integrated into development decisions, and that short term solutions with negative heritage impacts are minimised.</p> <p>Any Masterplan needs to be able to demonstrate that solutions with less heritage impact have been considered and, if they are not the preferred option, explain why they had to be discarded.</p> <p>Complete the proposed Masterplan works current at the time of completion of this CMP including:</p> <ul style="list-style-type: none"> <li>i. de-cluttering and removal of intrusive elements from major public areas; and</li> <li>ii. reuse of former Booking Hall as a public travel and information centre.</li> </ul>	<p>Asset Owner &amp; Asset Manager.</p> <p>2013 &amp; ONGOING</p>

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
5.	<p><b>SETTING, VIEWS &amp; LANDSCAPE</b></p> <p>Ensure that the urban setting of Central Station, both within and adjacent to the CMP area, is treated in an appropriate manner which recognises its outstanding heritage values (including significant views and landscape elements) and its listing as a major part of a Special Area in the Sydney LEP 2012.</p>	<p>5.1 Encourage new uses and developments adjacent to the Central Station CMP area that are compatible with the primary railway use of the site and provide opportunities to celebrate and interpret the heritage values of Central Station and minimise negative heritage impacts.</p> <p>5.2 Retain and conserve existing significant relationships between retaining walls, trees, pavements, lighting, furnishings and other landscaping elements.</p> <p>5.3 Prepare, implement and provide for the regular review of a:</p> <ul style="list-style-type: none"> <li>a) Signage Strategy (including RailCorp, wayfinding, statutory, commercial and interpretive signage);</li> <li>b) Public Domain Furniture Strategy (including RailCorp, and commercial furniture);</li> <li>c) New services Strategy (including consideration of sustainability, communication services);</li> <li>d) Lighting Strategy including RailCorp, security, and commercial lighting);</li> <li>e) Landscape Maintenance Program (allow</li> </ul>	<p>New uses, especially commercial tenancies, should enhance the significant transport use of the site and its heritage values.</p> <p>Lease conditions should control impacts on heritage values.</p> <p>Encourage communication and consultation with adjacent land owners and with Sydney City Council.</p> <p>Seek guidance from a suitable landscape heritage consultant when planning works.</p> <p>Work with Sydney City Council to retain these relationships outside the site.</p> <p>Having comprehensive design and implementation documents is considered best practice for all large urban sites and building complexes, and in particular those of heritage significance (e.g. The Rocks in Sydney).</p> <p>Such strategic documents seek to maintain a high quality public domain and staff environment and minimise heritage impacts.</p> <p>The documents should be prepared with input from relevant heritage</p>	<p>Asset Owner &amp; Asset Manager.</p> <p>2013 &amp; ONGOING</p> <p>Asset Owner &amp; Asset Manager.</p> <p>ONGOING</p> <p>Asset Maintainer &amp; Asset Manager.</p> <p>2014</p>

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
		<p>for replacement of dead or ageing trees. The former locations, and species, should be re-used)</p> <p>5.4 Through this CMP request that the Sydney City Council and/or other approval authorities actively protect vistas of the approach walls, bridges, clock tower and the main terminal building, from Surry Hills, Railway Square, Rawson Place and Pitt Street; and control the bulk and scale of development in the vicinity so that it respects the heritage values.</p> <p>5.5 Through this CMP request that Sydney City Council base the design of public domain landscaping works, both hard and soft works, in the vicinity and in Belmore Park on an understanding of the heritage significance of Central Station.</p>	<p>specialists.</p> <p>See Figure 3 Central Station Significant Views and Vistas.</p> <p>Encourage early consultation from adjacent land owners on developments that have the potential to impact on the townscape values of Central Station.</p> <p>Encourage communication and consultation with Sydney City Council.</p>	<p>Asset Owner &amp; Asset Manager.</p> <p>2013</p> <p>Asset Owner &amp; Asset Manager.</p> <p>2013</p>
<b>6.</b>	<b>ARCHAEOLOGICAL MANAGEMENT</b>			
	<p>Excavation in areas of identified archaeological potential will be subject to approval or exemption pursuant to section 57 (1) of the NSW Heritage Act, 1977.</p> <p>Ensure that archaeological advice is sought at the planning stages of any excavation work in the areas requiring archaeological monitoring and/or archaeological excavation and that the appropriate approval or exemption is obtained prior to work commencing.</p>	<p>6.1 Follow the precinct and element specific policies for archaeological management outlined in the inventory sheets of this CMP.</p> <p>6.2 Ensure that any archaeological investigation is allocated the necessary funding and time to allow both on-site investigation and post-excavation reporting and conservation.</p> <p>6.3 Use the archaeological management strategies in Figure 52 of this CMP.</p>	<p>The recommended archaeological management strategies for the central Station site is shown in Figure 52 of this CMP, while Figure 51 shows the approximate position of the railway institutional uses of the site. Adopt the flow chart at Appendix A for major development, major technological change and Masterplanning. Adopt the flow chart at Appendix B for minor development, or work with little or no heritage or archaeological impact.</p>	<p>Asset Maintainer; Asset Manager; &amp; Internal Asset Stakeholders.</p> <p>2013</p>

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
<b>7.</b>	<b>HERITAGE CONSERVATION &amp; MAJOR WORKS</b>			
	<p>Ensure the following actions are undertaken for major works within the CMP area:</p> <ul style="list-style-type: none"> <li>i. involvement of appropriate heritage professionals at an early stage including consideration of heritage opportunities and constraints surrounding the works prior to design work commencing;</li> <li>ii. submission of a Section 60 application under the NSW Heritage Act 1977 when required;</li> <li>iii. submission of a Development Application to, or consultation with, Sydney City Council as appropriate.</li> </ul>	<p>7.1 Put procedures in place that ensure that heritage consideration is integrated into major and minor development and change, including change of use.</p> <p>7.2 Ensure new work, new fabric and new service installations:</p> <ul style="list-style-type: none"> <li>a) recognises the major heritage status of the Central Station CMP area, particular elements of exceptional and high significance, and does not result in a lessening of the heritage significance of the area, or of the element;</li> <li>b) is based on an understanding of the original design concept and matches the high quality of its execution in terms of design, detail, materials and workmanship;</li> <li>c) can be easily identified as new work and, where possible, reversible and dated;</li> <li>d) is sympathetic to, but does not mimic, significant fabric and spatial qualities in terms of scale, proportioning, colour, and texture.</li> </ul> <p>7.3 Provide for the ongoing conservation of the elements of Central Station identified in this CMP as being of Exceptional or High heritage significance, and that the heritage significance of other elements is a head of consideration when considering adaptive reuse or other change. Place new</p>	<p>Adopt the flow chart at Appendix A for major development, major technological change and Masterplanning.</p> <p>Implement internal standard procedures for project development. Include these in the relevant flow charts and/or report templates.</p> <p>Use of specialist heritage consultants to design, document and oversee new works.</p>	<p>Asset Manager. ONGOING</p> <p>Asset Manager. ONGOING</p>
			<p>Utilise the summary information and guidance in the relevant CMP overall precinct inventory sheets; together with the relevant CMP individual element inventory sheets (Precincts 1 – 5); and the relevant CMP fabric conservation recommendations (Part</p>	<p>Asset Manager. ONGOING</p>

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
		works/developments in areas of no or little significance.	5). Provide easy access to these documents on the Intranet and attach copies of the Inventory Sheets and Fabric Policy sheets to Project Briefs.	
	7.4	Ensure all works likely to impact on heritage values of the overall site or of an individual element are accompanied by a Statement of Heritage Impact (SOHI). SOHIs should be prepared for in-house confirmation of that heritage impacts have been managed appropriately, even if a statutory heritage approval or notification process is not required.	Implement standard SOHI templates for complex and simple works for ease of use.  Archive such reports to provide an accurate record of the changes to the significant fabric of the Central Station.	Asset Manager.  ONGOING
	7.5	Ensure all works likely to impact on heritage values of the overall site or of an individual element are preceded by an archival recording of the element in its configuration.	Implement a standard archival recording template for ease of use. Archive such reports to provide an accurate record of the changes to the significant fabric of the Central Station.	Asset Manager.  ONGOING
	7.6	Ensure demolition or removal of significant fabric is conditional on new works being approved and construction commencing.	Implement internal standard conditions prior to giving site owner's consent for new works. Include these in the relevant flow charts and/or report templates.	Asset Manager.  ONGOING
	7.7	Ensure modifications to significant areas, or fabric, of Central Station for short term or temporary uses are not permitted.	Implement internal standard conditions prior to giving site owner's consent for new works. Include these in the relevant flow charts and/or report templates.	Asset Manager; Asset Maintainer.  ONGOING

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
<b>8.</b>	<b>HERITAGE EXEMPTIONS</b> Ensure those responsible for the management of Central Station have a thorough understanding of what types of work can be considered exempt from obtaining formal heritage approvals under the <i>NSW Heritage Act 1977</i> and when notifications may be required for exempted works.	<p>8.1 Provide face to face heritage induction workshop sessions at least every 12 months. Such sessions could coincide with an annual event to celebrate the heritage of Central Station.</p> <p>8.2 Provide an on-line heritage induction to be completed by all relevant staff.</p>	<p>Adopt the flow chart at Appendix B for minor development, or work with little or no heritage or archaeological impact.</p> <p>Provide access to all relevant Exemption guidelines on the Intranet.</p>	<p>Asset Manager; Asset Maintainer.</p> <p>ONGOING</p>
<b>9.</b>	<b>MOVABLE HERITAGE, FIXTURES &amp; FITTINGS</b> Movable heritage, fixtures and objects contributing to the heritage significance of Central Station should be retained on site in their original location.	<p>9.1 The retention and conservation of movable heritage, fixtures and fittings contributing to the heritage significance of Central Station should form part of any brief for new works at Central Station and any impacts should be addressed in the Statement of Heritage Impact.</p>	<p>Consider a comprehensive survey and conservation strategy for movable heritage, fixtures and fittings at Central Station.</p> <p>Refer also to guidelines issued by the Heritage Branch including <i>"The Maintenance of Heritage Assets: A Practical Guide" 1998</i>, <i>"Movable Heritage Principles" 2000</i> and <i>"The Heritage Council Policy on Managing Change to Heritage Items"</i>.</p>	<p>Asset Manager; Asset Maintainer.</p> <p>ONGOING</p>
<b>10.</b>	<b>HERITAGE AND CODE COMPLIANCE</b> When undertaking upgrade or adaptive reuse works develop place specific solutions which minimise the heritage impact.	<p>10.1 When appropriate develop 'deemed to satisfy' place specific solutions in accordance with consider the performance standards of the National Construction Code and other relevant statutory documents, rather than following set designs developed for non-heritage places.</p>	<p>The use of experienced consultants will assist in resolving some tensions between statutory standards and the minimization of impacts on heritage values.</p>	<p>Asset Manager; Asset Maintainer.</p> <p>ONGOING</p>



#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
<b>11.</b>	<b>HERITAGE KNOWLEDGE, SKILLS AND EXPERIENCE</b> The conservation of the Central Station Complex should make use of relevant specialist heritage skills and techniques and should build on prior heritage conservation experience at the site.	<p>11.1 Utilise high quality consultants who have a track record in successfully balancing heritage issues with the requirements for change.</p> <p>11.2 Utilise trades people who are specialise and are experienced in heritage fabric conservation.</p>	Ensure consultancies, contractors and sub-contractors are reviewed and information on qualified heritage consultancies, contractors and sub-contractors is regularly updated.	Asset Manager; Asset Maintainer.  ONGOING
<b>12.</b>	<b>MAINTENANCE &amp; REPAIR</b> Ensure Central Station is managed in accordance with Minimum Standards of Maintenance & Repair under the NSW Heritage Act 1977, and that all significant items identified in this CMP are integrated into asset routine/major periodic maintenance planning programs.	<p>12.1 Put procedures in place to ensure heritage considerations are integrated into ongoing maintenance and repair.</p> <p>12.2 Fund and prioritise maintenance work based on grading of heritage significance and physical condition (see Inventory Sheets).</p> <p>12.3 Consider developing specific maintenance plans for significant elements or materials, eg. a Sandstone Maintenance Plan; and/or Maintenance Plan for Central Electric Platforms.</p> <p>12.4 Ensure the Maintenance Plan/s for the Central Station site are reviewed in light of this CMP and are updated at least every 5-10 years.</p>	<p>For most maintenance work adopt the flow chart at Appendix B for minor development, minor technological change, or work with little or no heritage or archaeological impact. Note major maintenance and/or services upgrades may need to adopt the flow chart for major development.</p> <p>See the Inventory Sheets for each element for an assessment of condition and take action accordingly.</p> <p>Attach the Inventory Sheets and the Fabric Guidelines to the Maintenance Plan and to Maintenance and Repair Works Orders.</p>	<p>Asset Maintainer.  ONGOING</p> <p>Asset Maintainer. 2013 / 2014</p> <p>Asset Maintainer. 2013/2014</p> <p>Asset Maintainer.</p>

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
<b>13.</b>	<b>CONSULTATION</b>			
	For major development proposals, major technological change and for overall site Masterplans consider appropriate consultation during the design development stage so that any heritage stakeholders concerns can be addressed (known as pre-DA consultation).	13.1 Prepare a communication strategy for major development proposals, technological changes and for Masterplanning, including consideration of engagement with heritage stakeholders at the pre-DA stage.	Use of RailCorp's Website and other IT strategies to facilitate consultation	Asset Owner; Asset Manager.  ONGOING
<b>14.</b>	<b>HERITAGE INTERPRETATION</b>			
	Pursue and encourage special activities aimed at providing a greater understanding of the significance of the Central Station CMP area as part of the interpretation strategy for the site.	14.1 Commission an interpretation strategy for the Central Station CMP area.	Consider a dynamic web based interpretive experience. Include the ability for the community to add their own stories, e.g. <a href="http://www.flindersstreetstation.com.au/index.php">http://www.flindersstreetstation.com.au/index.php</a> .	Asset Owner; Asset Manager.  2014
		14.2 Pursue and encourage special activities aimed at providing a greater understanding of the significance of the Sydney Station CMP area.	Consider an annual celebration for Central Station. Take opportunity for tours to usually non-public areas, provide access to special groups, take opportunities for displays/exhibitions when available.	Asset Owner; Asset Manager.  2014
<b>15.</b>	<b>STRATEGIC HERITAGE MANAGEMENT DOCUMENTS</b>			
	Ensure this Conservation Management Plan and other documents related to the heritage management of Central Station remain publicly accessible and relevant.	15.1 Manage this CMP by: a) Circulating the final version of this 2013 CMP to heritage and other stakeholders (including public libraries) and make a copy publicly accessible on the internet b) Reviewing this 2013 CMP when new information comes to light; as part of any major redevelopment process; or at least every 5-10 years.	This CMP should be adopted by the responsible Government Agencies, and a copy provided to the following key stakeholders: - The heritage staff of RailCorp; - The NSW Heritage Council and the Office of Environment & Heritage; - Sydney City Council; and Community heritage groups such as	Asset Maintainer; Asset Manager; & Internal Asset Stakeholders. ONGOING

#	CONSERVATION POLICIES	STRATEGIES	IMPLEMENTATION GUIDANCE	RESPONSIBILITY PRIORITY
		<p>c) Ensuring that this CMP and any other heritage management documents for Central Station are archived.</p> <p>15.2 Utilise other heritage management policies and documents adopted by the Managing and Statutory Approval Agencies (including compliance documents such as signage, lighting, and services manuals) in addition to this CMP.</p> <p>15.3 As part of a future review of this CMP conduct appropriate consultation to better understand the contemporary community esteem for the heritage values of the Central Station CMP area, including any Indigenous heritage values.</p>	<p>the National Trust and the Railway Historical Society</p> <p>Provide easy access to such documents on the Intranet. Include heritage guidelines, SOHIs and archival recordings.</p>	<p>Asset Owner. 2013</p> <p>Asset Owner. 2018</p>

11.5 Appendix E – Architectural Drawings  
Chalmers Street Substation  
TZG and GHD

# CHALMERS STREET SUBSTATION

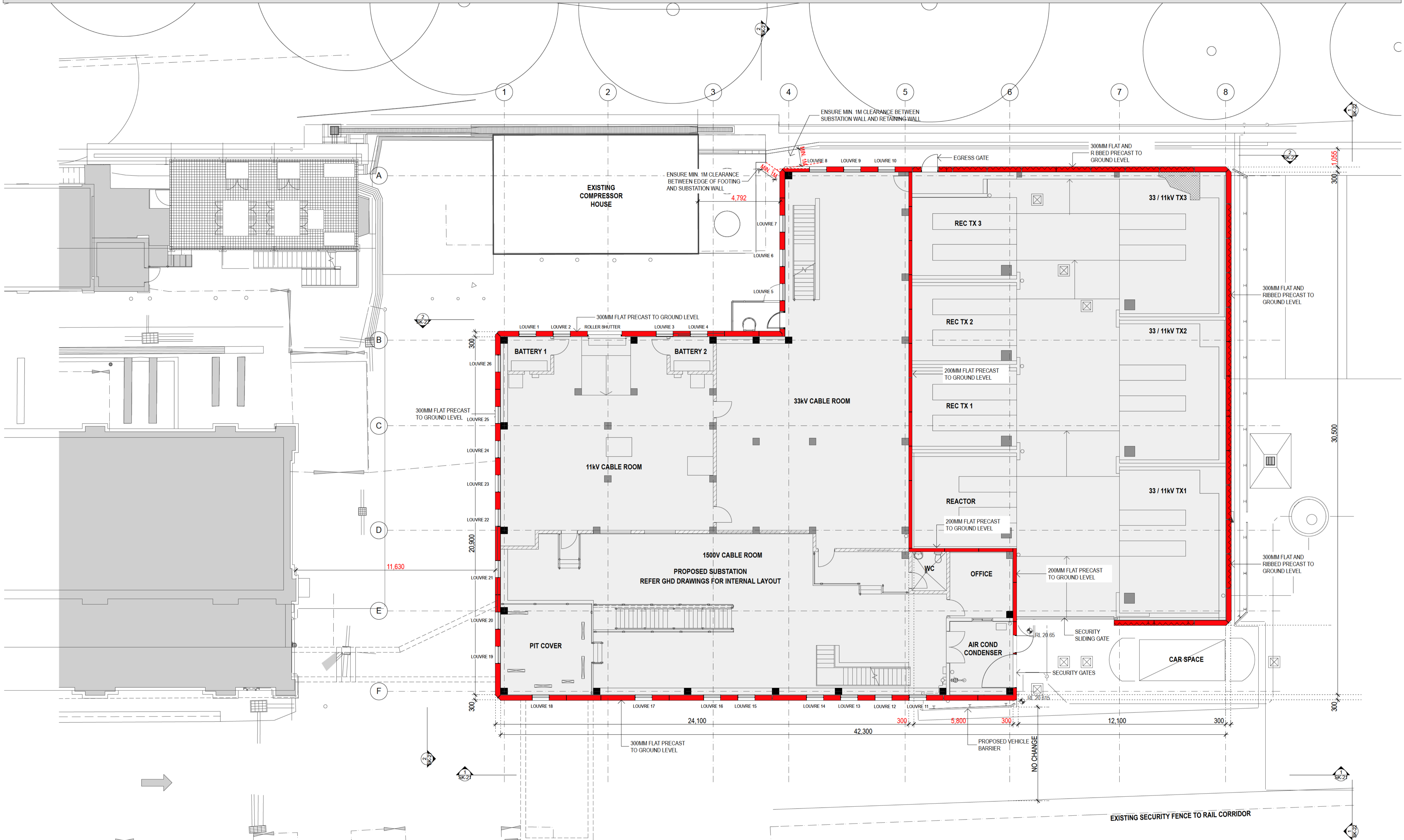
## FACADE DOCUMENTATION



DATE	REV	NOTES	NOTES:	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT:	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW	Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD Phone: 02 9238 7438 Email: stephen.pusey@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzig.com.au WEB: www.tzig.com.au	SITE PLAN	TF KN
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET								15019	ARCHITECTS	SCALES	CHECKED
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**DESCRIPTION:**

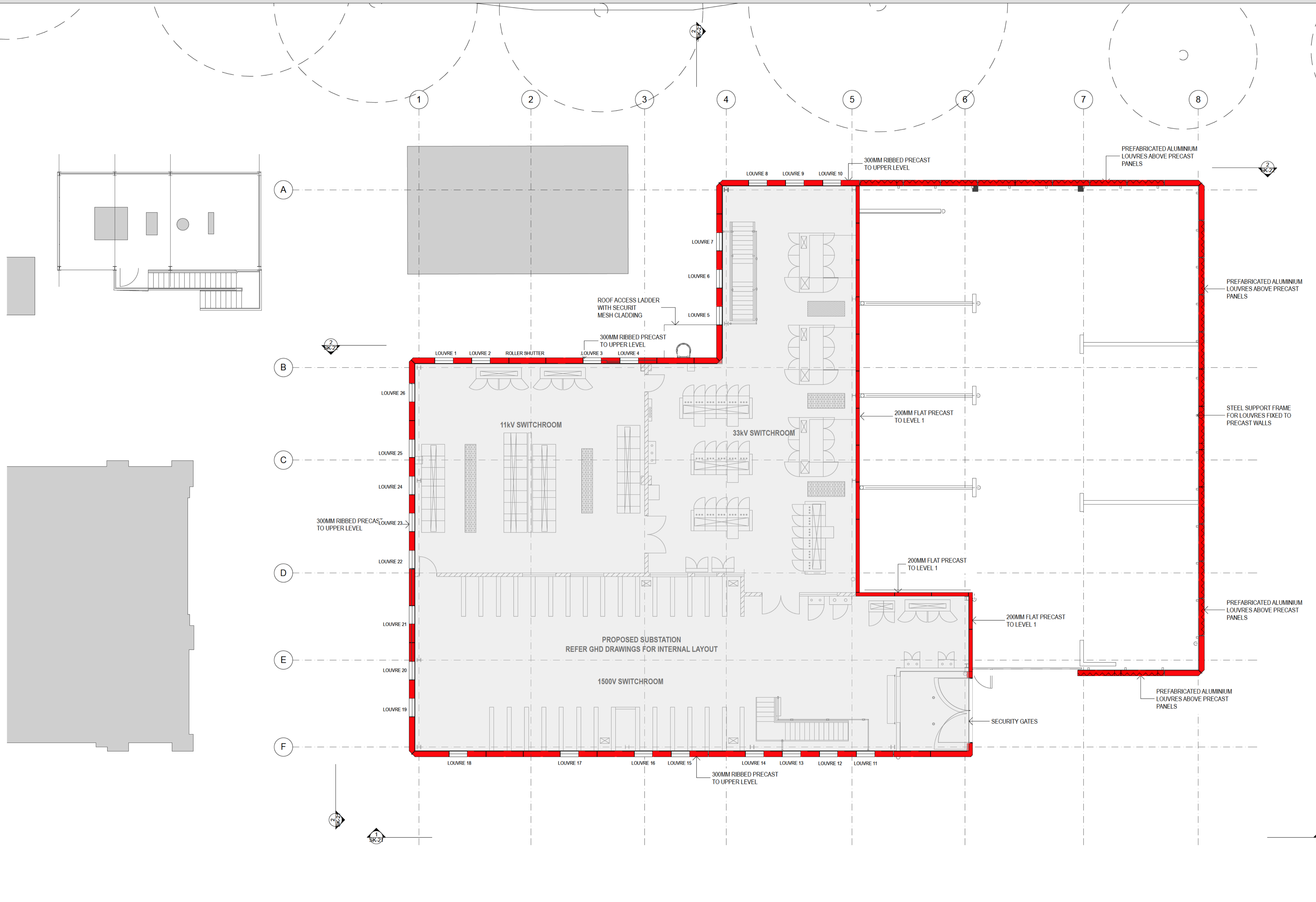
Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. External dimensions increase by 100mm – affected dimensions indicated in **RED**. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.



DATE	REV	NOTES	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT:	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD Phone: 02 9239 7439 Email: stephen.pusepjak@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	GROUND FLOOR PLAN	TF KN
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET							15019	ARCHITECTS	SKETCH DESIGN	CHECKED
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											1:100	02
											DRAWING NO	
											SK-11	

**DESCRIPTION:**

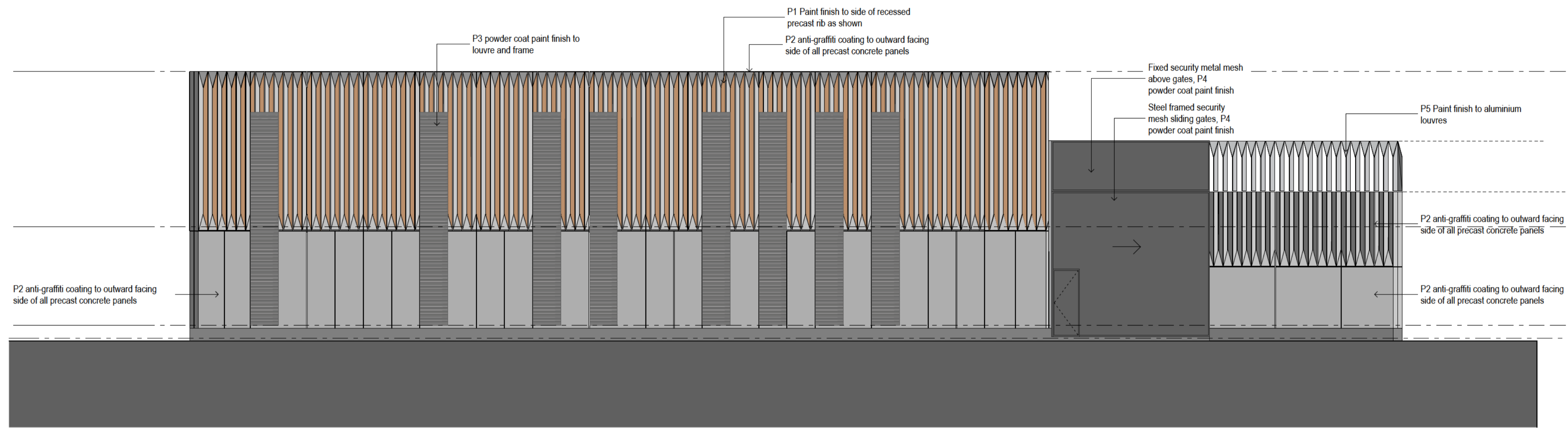
Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. External dimensions increase by 100mm – affected dimensions indicated in **RED**. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.



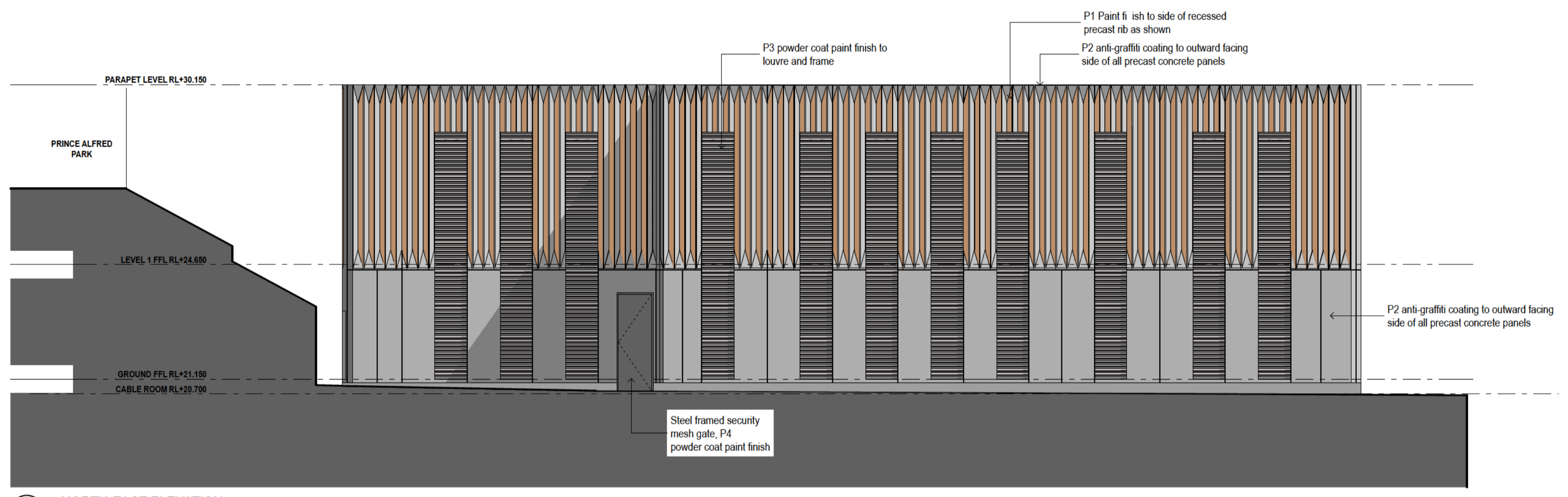
DATE	REV	NOTES	NOTES:	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT:	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW	Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD Phone: 02 9238 7439 Email: stephen.puseerjak@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	LEVEL 1 PLAN	TF KN
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET								15019	ARCHITECTS	SCALE	CHECKED
												:100	TG
												PHASE	REVISION
												SKETCH DESIGN	02
												DRAWING NO	
												SK-12	

**DESCRIPTION:**

Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. External dimensions increase by 100mm – affected dimensions indicated in **RED**. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.



1 NORTH-WEST ELEVATION  
1:100



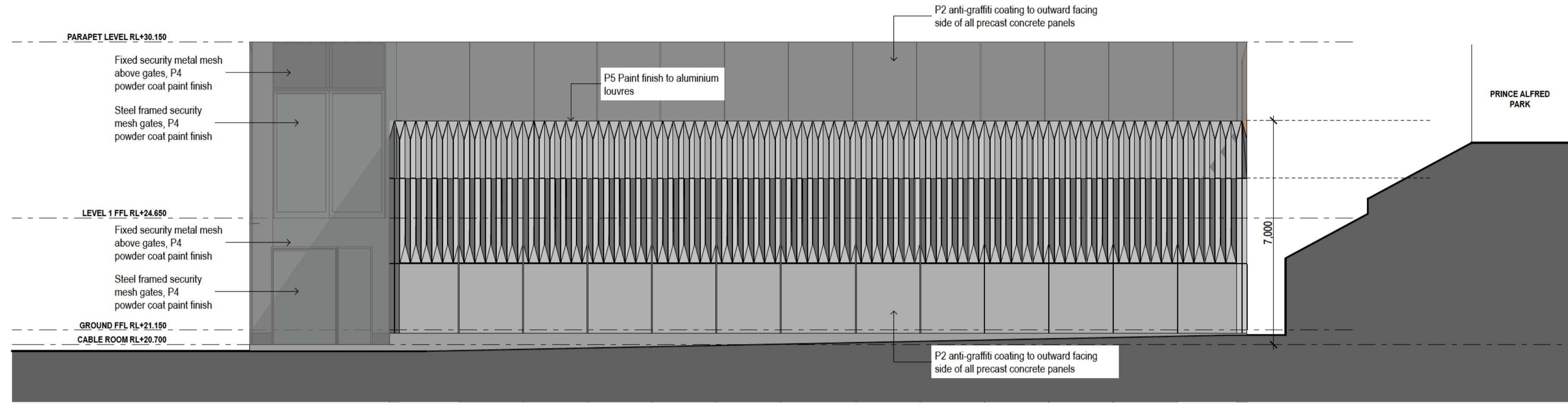
2 NORTH-EAST ELEVATION  
1:100

DATE	REV	NOTES	<p><b>NOTES:</b> Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.</p>	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	<p>PROJECT: <b>CHALMERS STREET SUBSTATION</b></p>	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD		15019	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tjg.com.au WEB: www.tjg.com.au	ELEVATIONS 1
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET							Phone: 02 9238 7438 Email: stephen.puseerjak@ghd.com		SCALES	CHECKED	
											:100	TG	
											PHASE	DRAWING NO	REVISION
											SKETCH DESIGN	SK-21	02

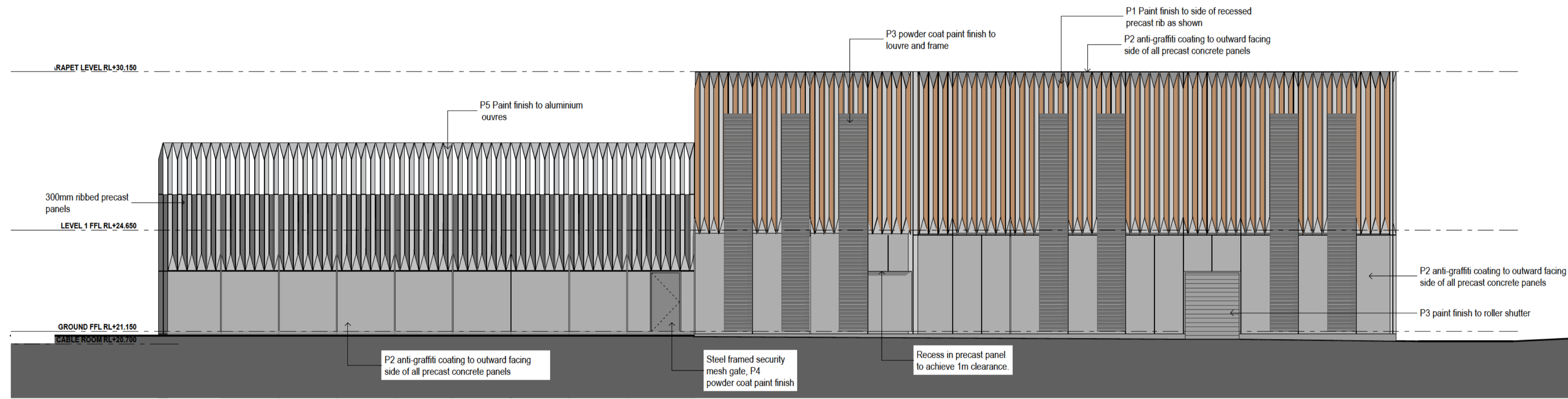


**DESCRIPTION:**

Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. External dimensions increase by 100mm – affected dimensions indicated in RED. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.



1 SOUTH-WEST ELEVATION  
1:100



2 SOUTH-EAST ELEVATION  
1:100

DATE	REV	NOTES	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT:	ARCHITECT	DRAWING TITLE	DRAWN BY
06/07/2015	01	ISSUED FOR CLIENT REVIEW	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD Phone: 02 9238 7439 Email: stephen.puseerak@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tazg.com.au WEB: www.tazg.com.au	ELEVATIONS 2	TF KN
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET									SKETCH DESIGN	CHECKED
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											DRAWING NO	
											SK-22	

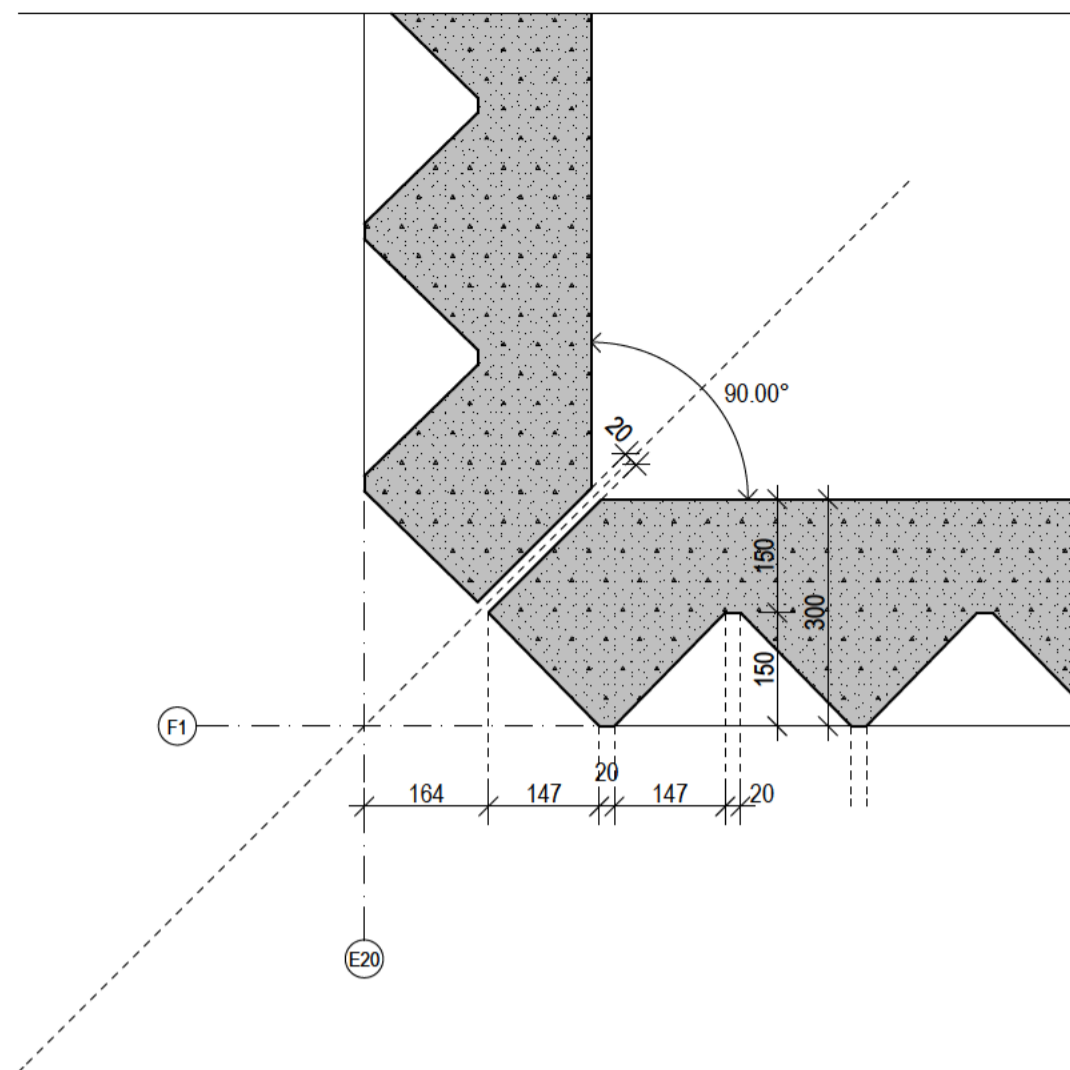
**DESCRIPTION:**

Overall precast wall thickness is 300mm, to match Lee Street Substation. Overall internal dimensions remain unchanged from GHD plans. Externa dimensions increase by 100mm – affected dimensions indicated in RED. Louvre area to match GHD's ventilation requirements. 2000mm precast module width with 1000mm louvre module width.

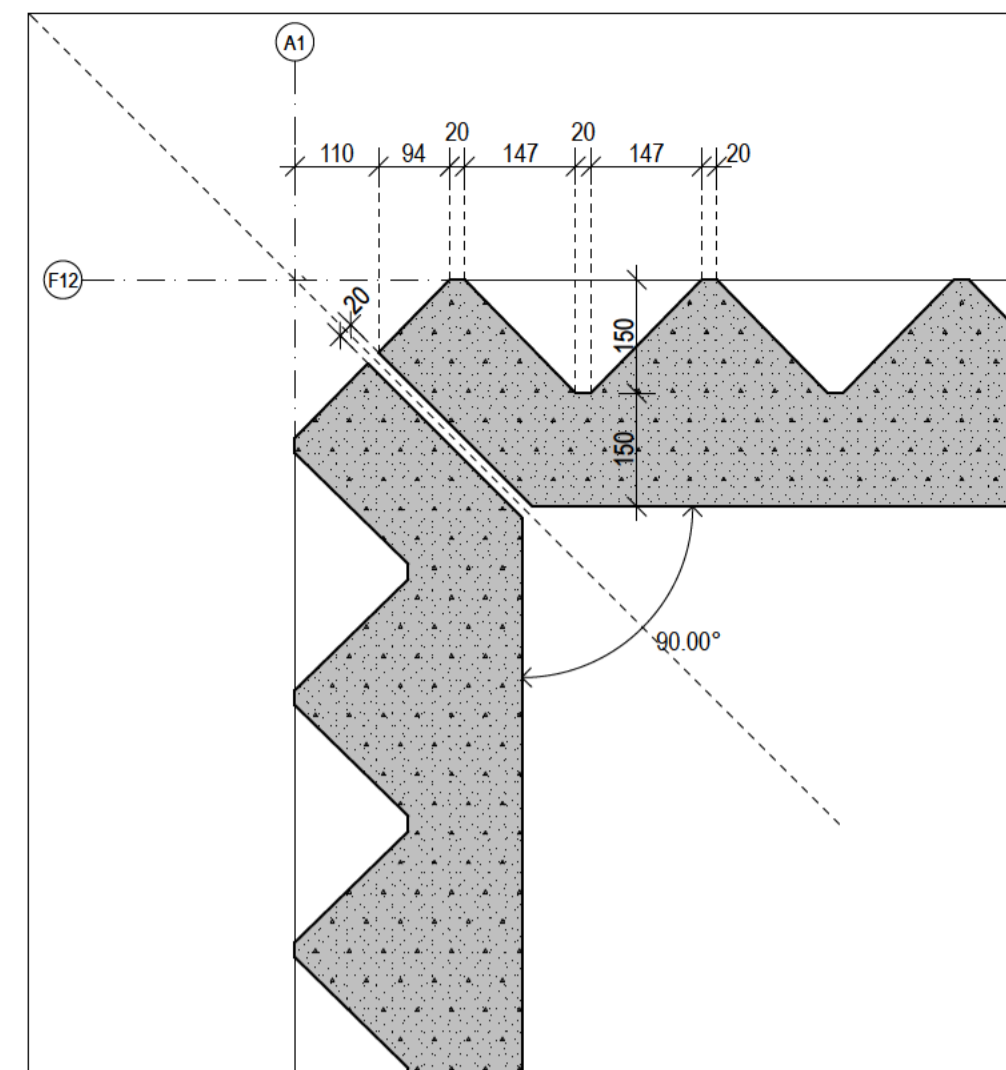


1 OVERALL NORTH ELEVATION  
1:200

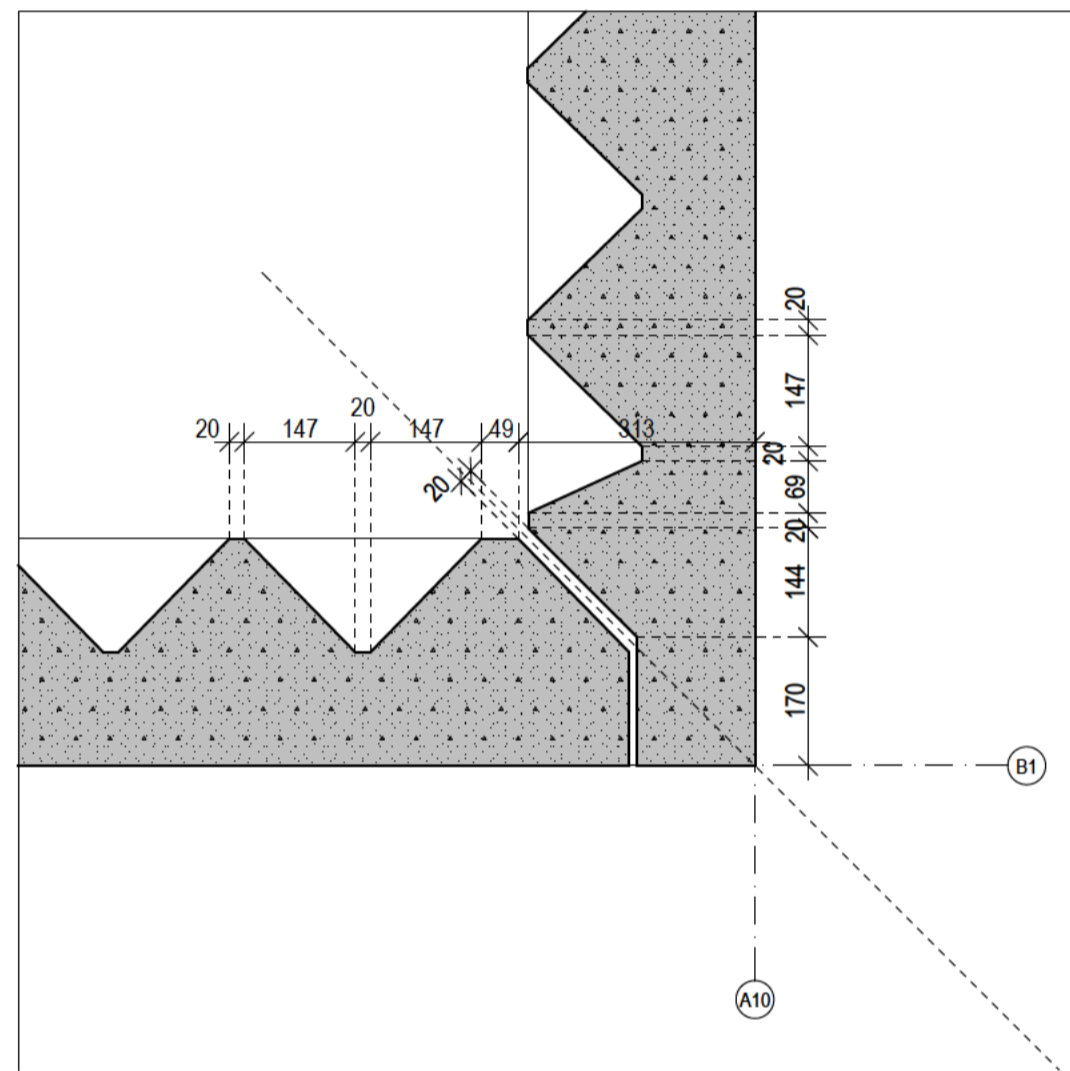
DATE	REV	NOTES :	NOTES: Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT: GHD Phone: 02 9239 7439 Email: stephen.puseerjak@ghd.com	PROJECT : CHALMERS STREET SUBSTATION 15019	ARCHITECT TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE 02 9215 4900 FAX 02 9215 4901 EMAIL tim@tzg.com.au WEB www.tzg.com.au	DRAWING TITLE E/N North Elevation Overall	DRAWN BY TF KN	
06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER				SCALES :100	CHECKED TG	
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET										PHASE SKETCH DESIGN	DRAWING NO SK-23	REVISION 02



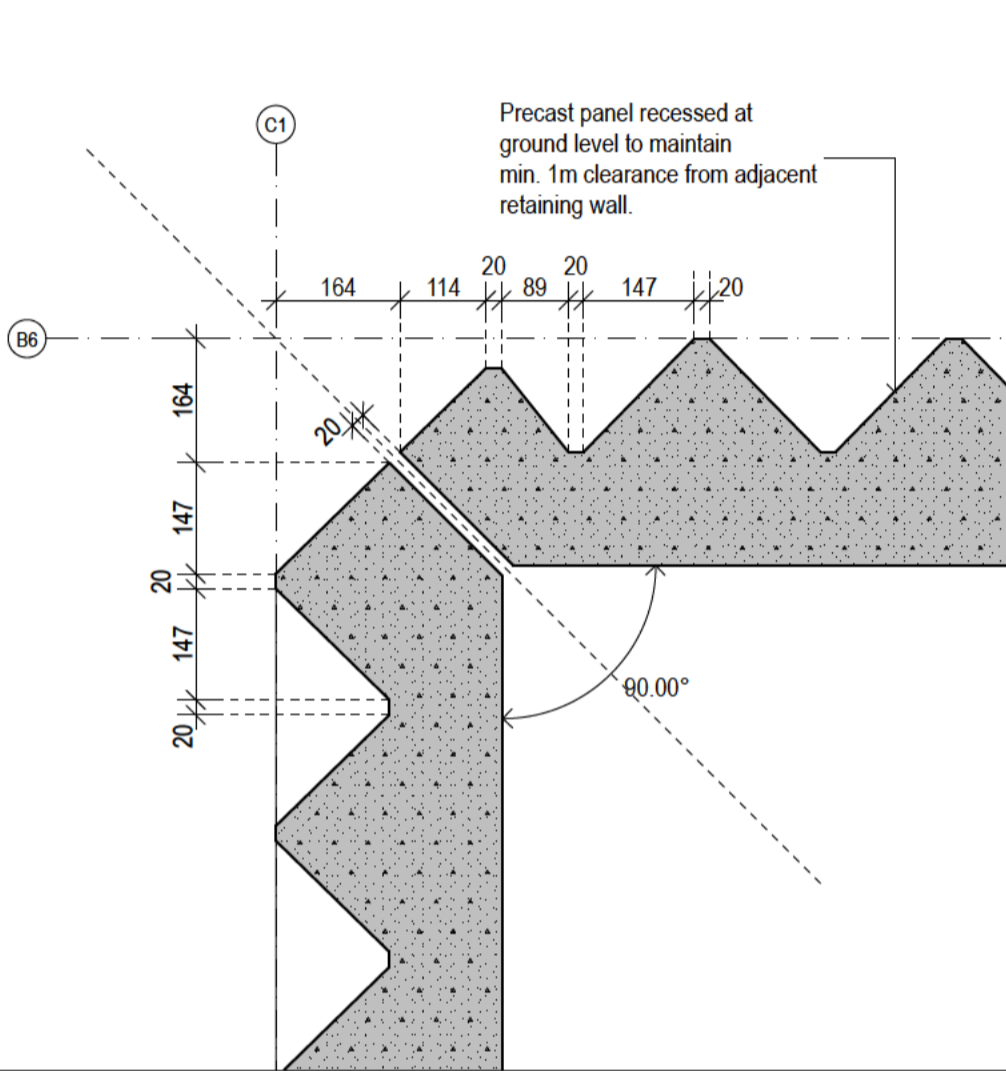
PLAN DETAIL 1  
1:10



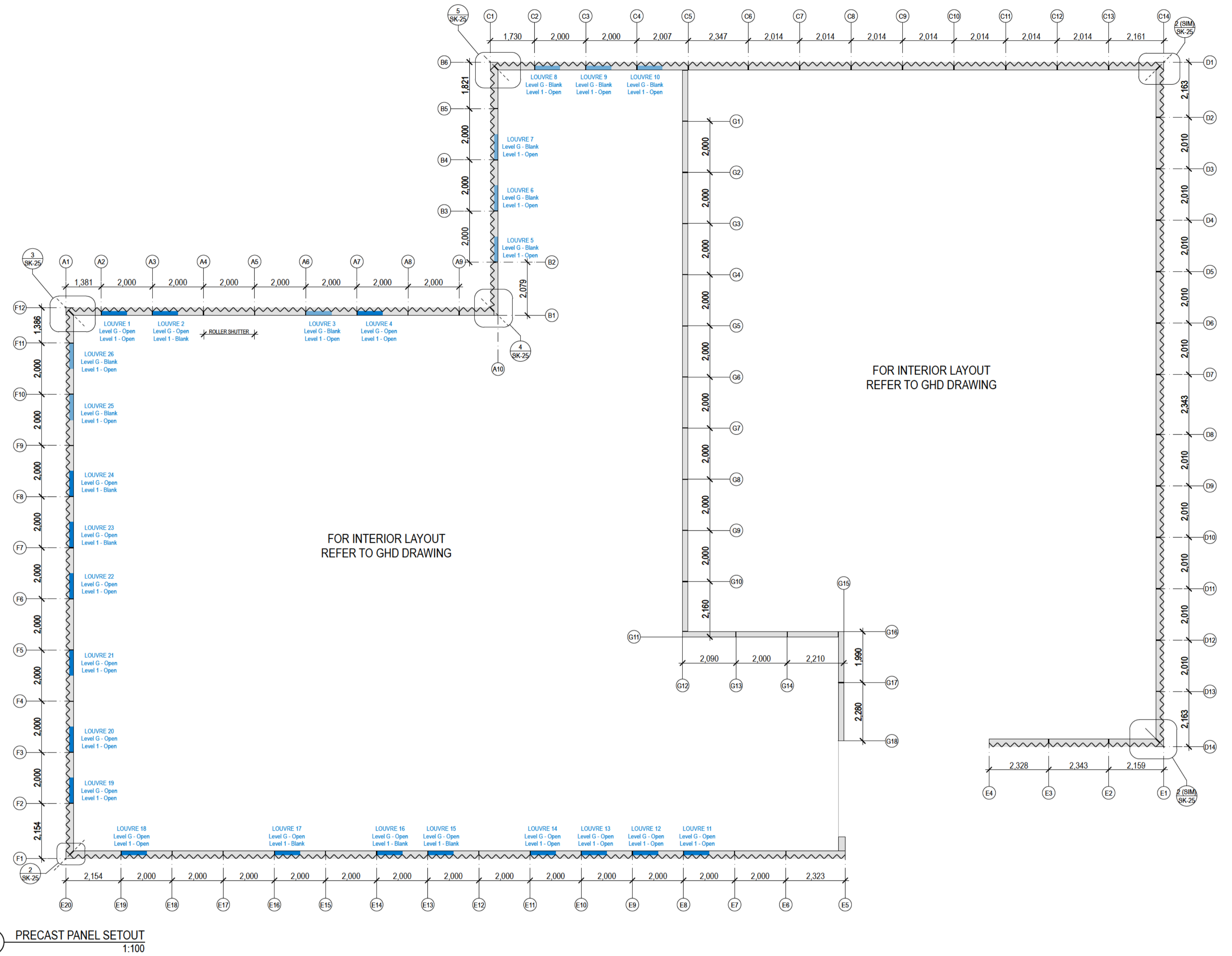
PLAN DETAIL 2  
1:10



PLAN DETAIL 3  
1:10



PLAN DETAIL 4  
1:10

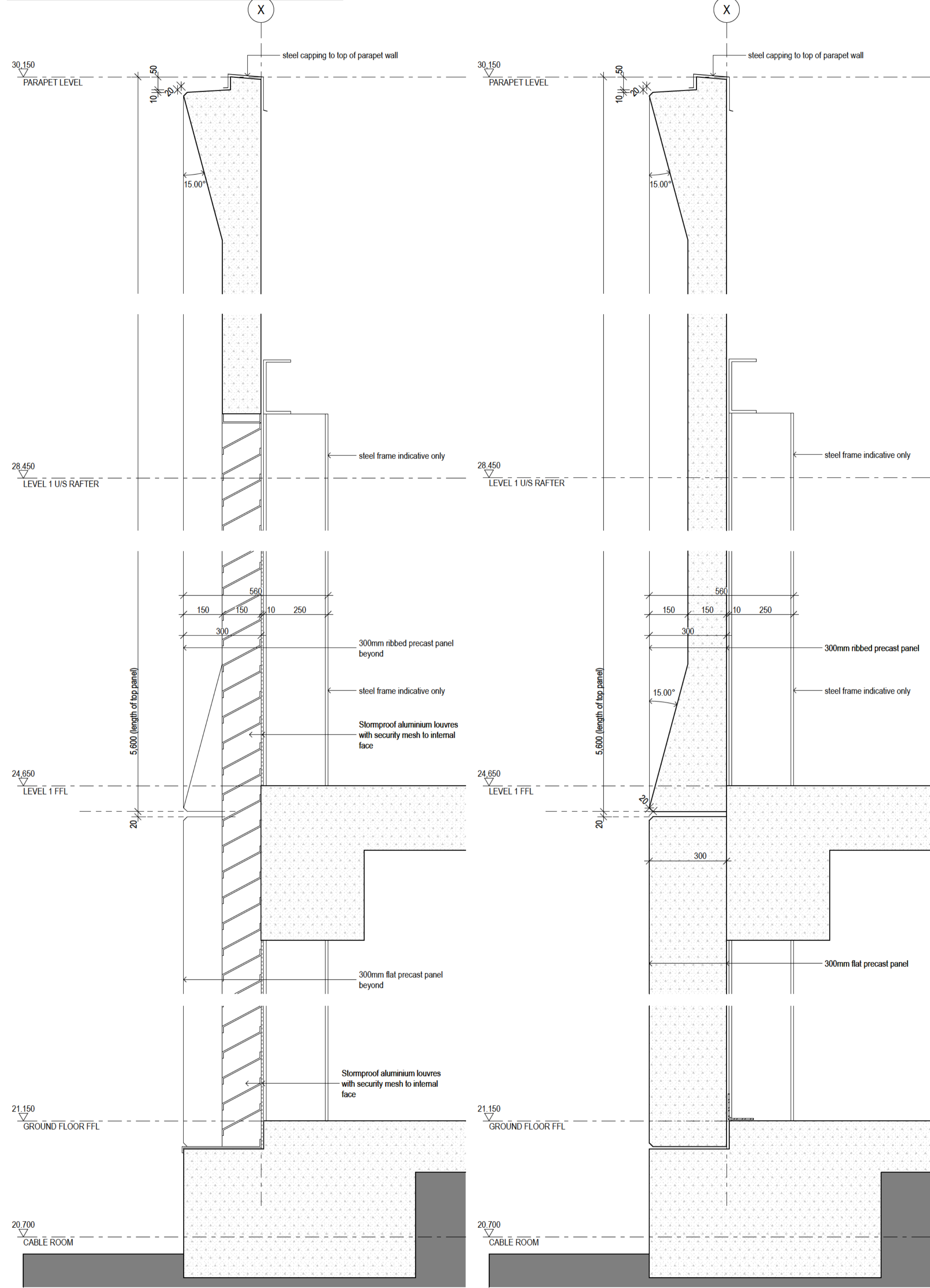


PRECAST PANEL SETOUT  
1:100

FOR INTERIOR LAYOUT  
REFER TO GHD DRAWING

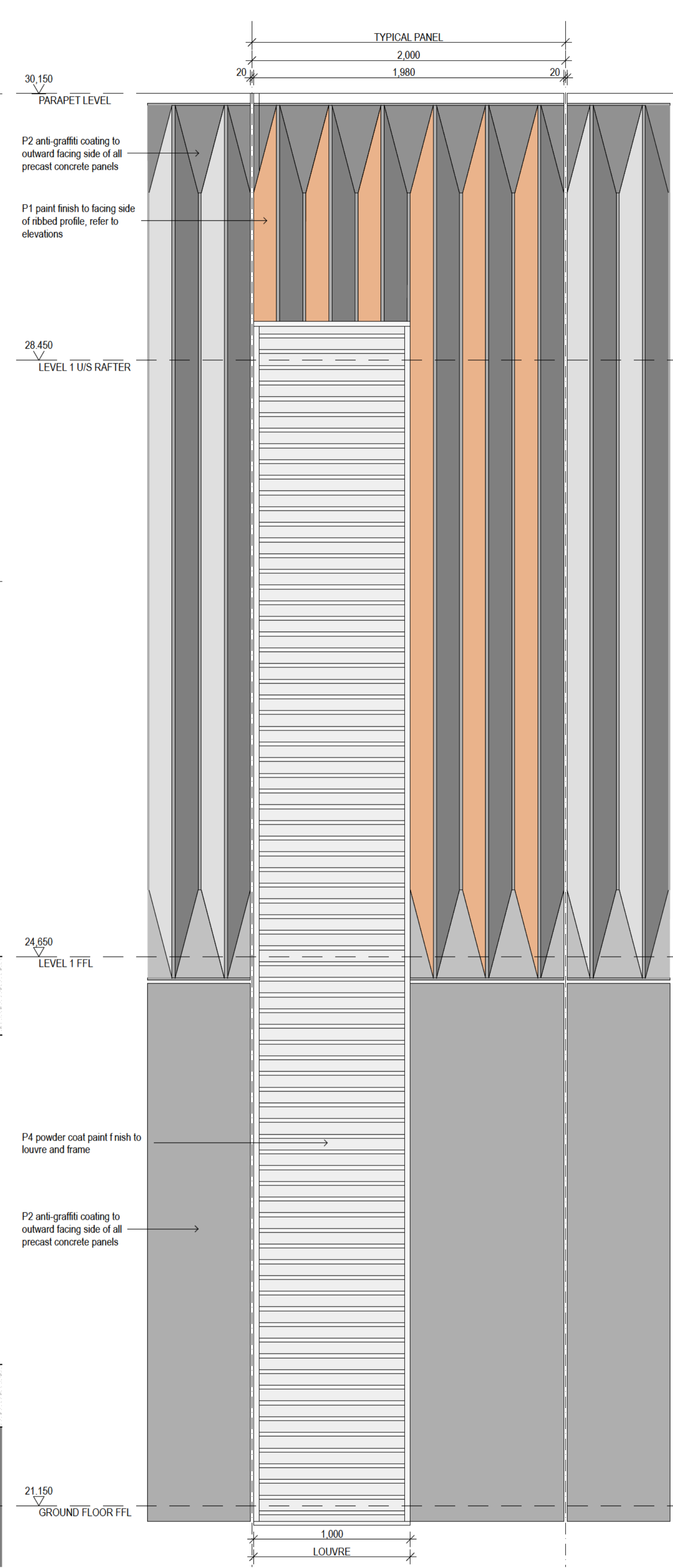
FOR INTERIOR LAYOUT  
REFER TO GHD DRAWING

DATE	REV	NOTES	NOTES:	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT:	ARCHITECT	DRAWING TITLE	DRAWN BY	
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												PHASE	DRAWING NO	REVISION
												SKETCH DESIGN	SK-25	01

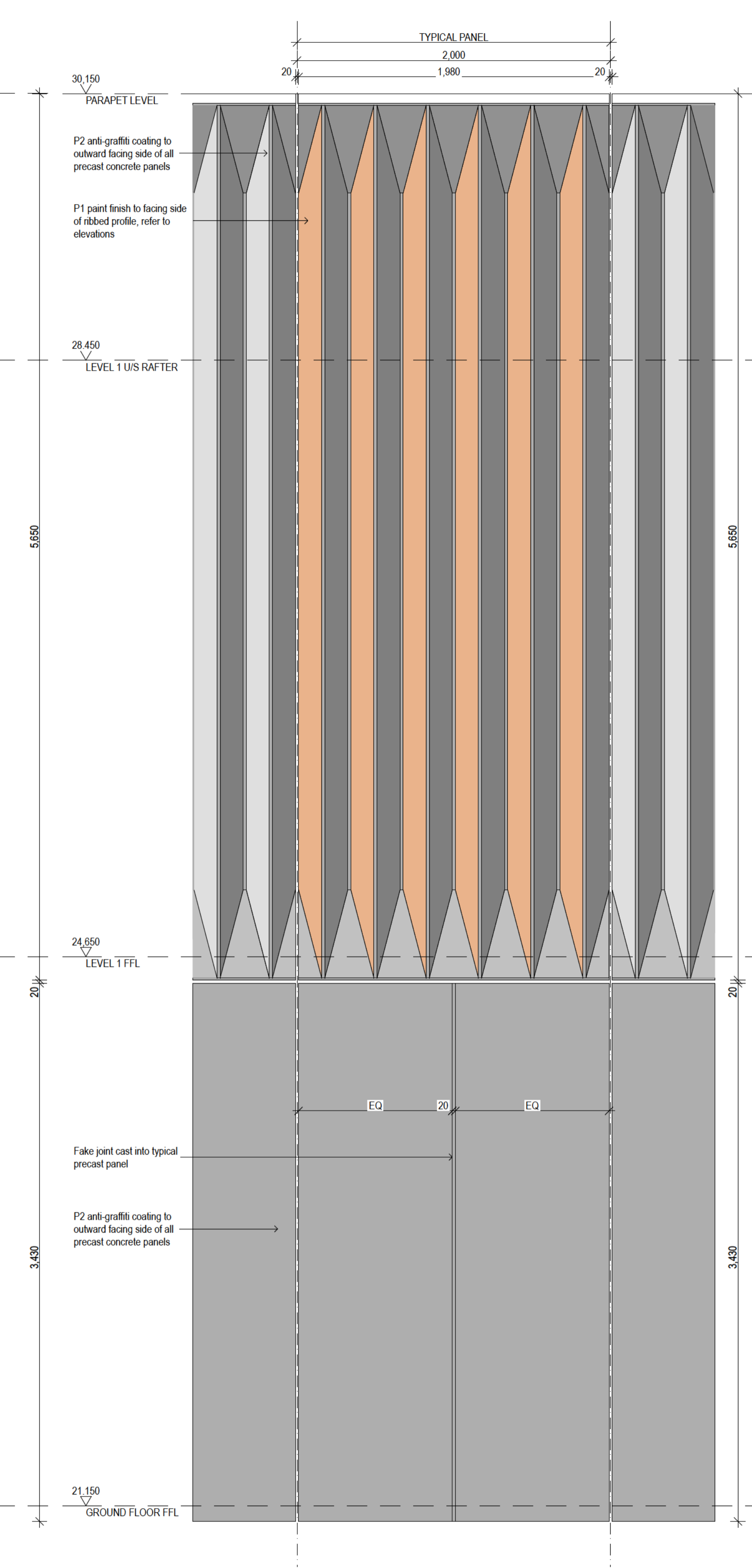


4 FACADE SECTION - through louvres  
1:10

3 FACADE SECTION - through precast  
1:10



2 PRECAST PANEL ELEVATION LOUVRED  
1:20



1 PRECAST PANEL ELEVATION TYPICAL  
1:20

DATE	REV	NOTES
17/07/2015	01	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET

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ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER

CLIENT:  
GHD  
Phone: 02 9239 7439  
Email: stephen.puseerak@ghd.com

PROJECT:  
CHALMERS STREET  
SUBSTATION

ARCHITECT  
TONKIN ZULAIKHA GREER ARCHITECTS  
117 Reservoir Street  
ABN: 4600272349  
PHONE: 02 9215 4900  
FAX: 02 9215 4901  
EMAIL: tim@tzig.com.au  
WEB: www.tzig.com.au

DRAWING TITLE  
FACADE DETAILS 1

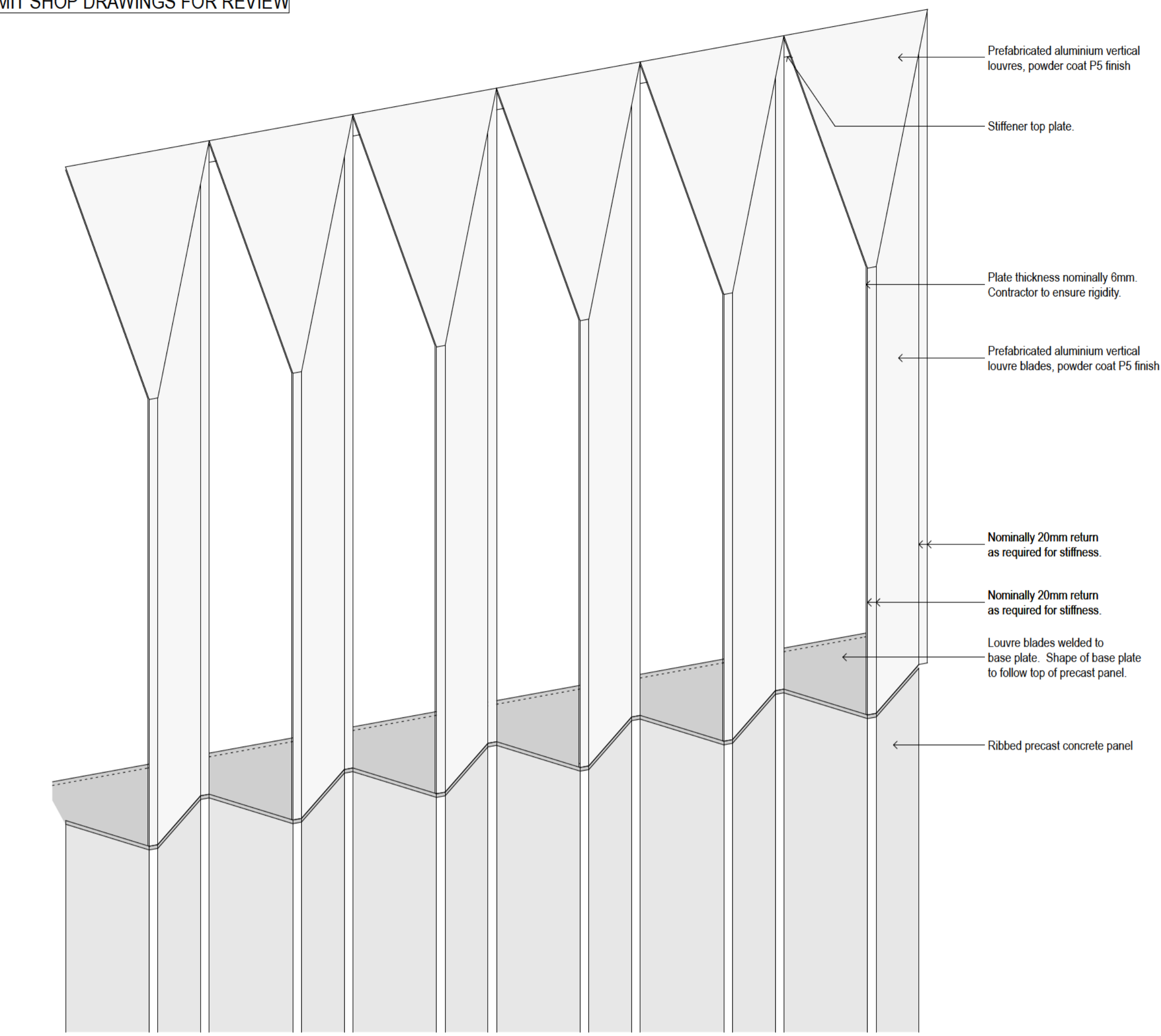
SCALES :20, 1:10

PHASE SKETCH DESIGN

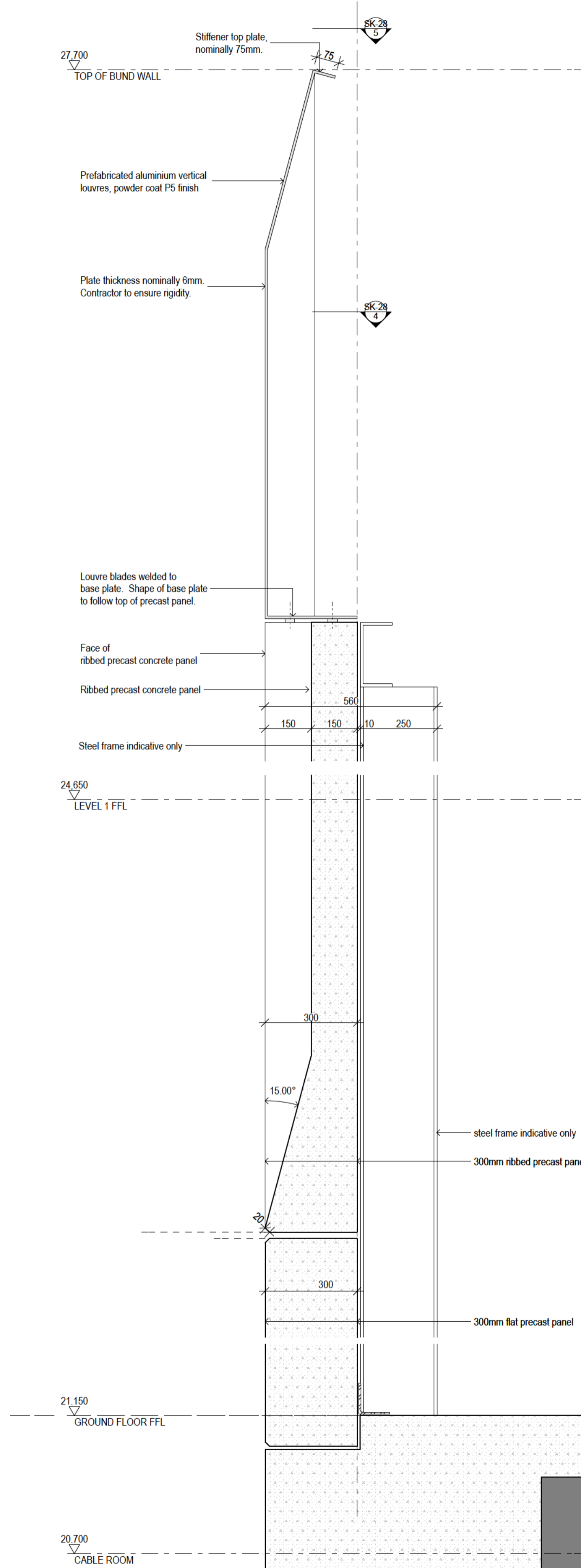
DRAWING NO SK-27

REVISION

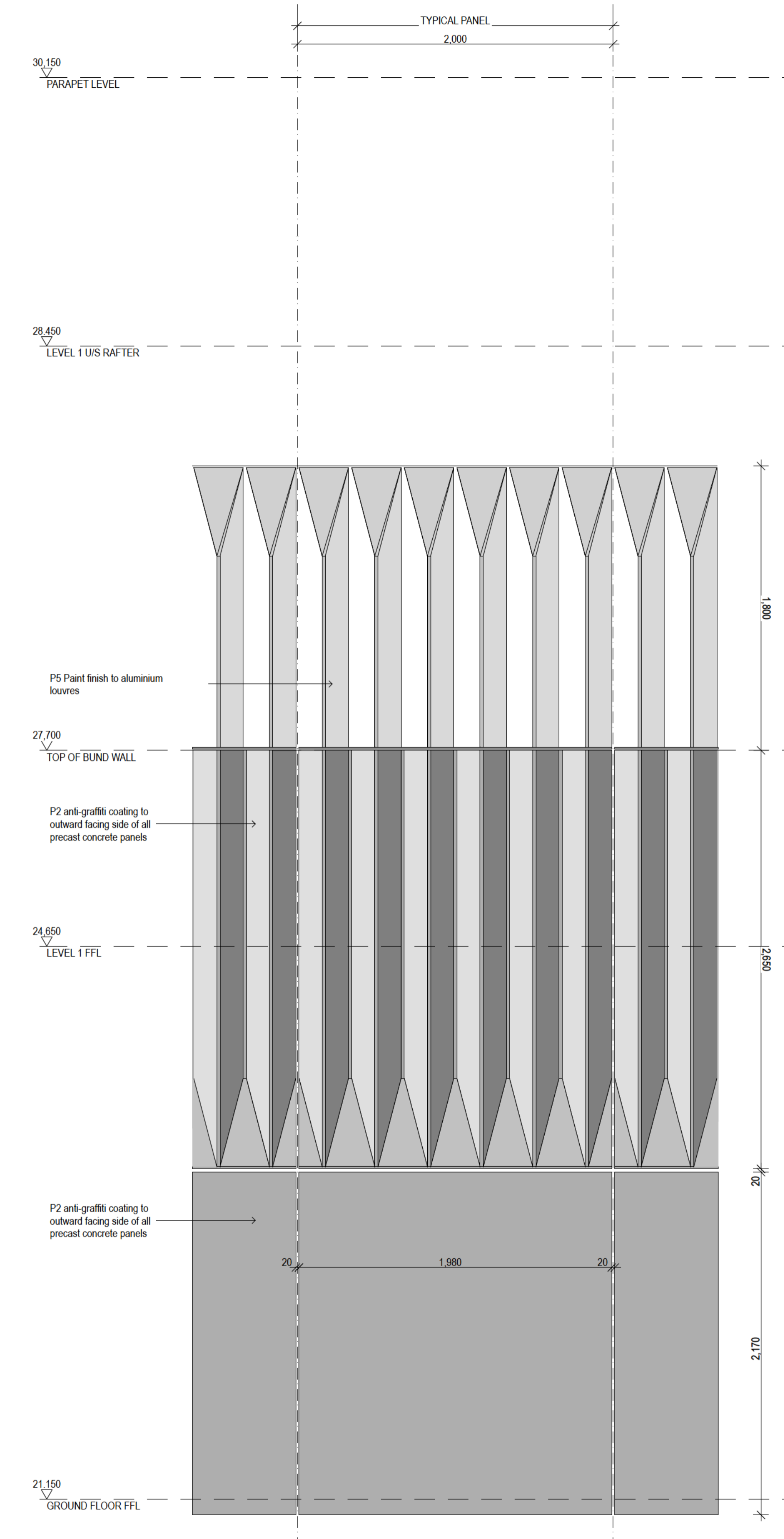
DRAWN BY TF KN  
CHECKED TG  
REVISION 01



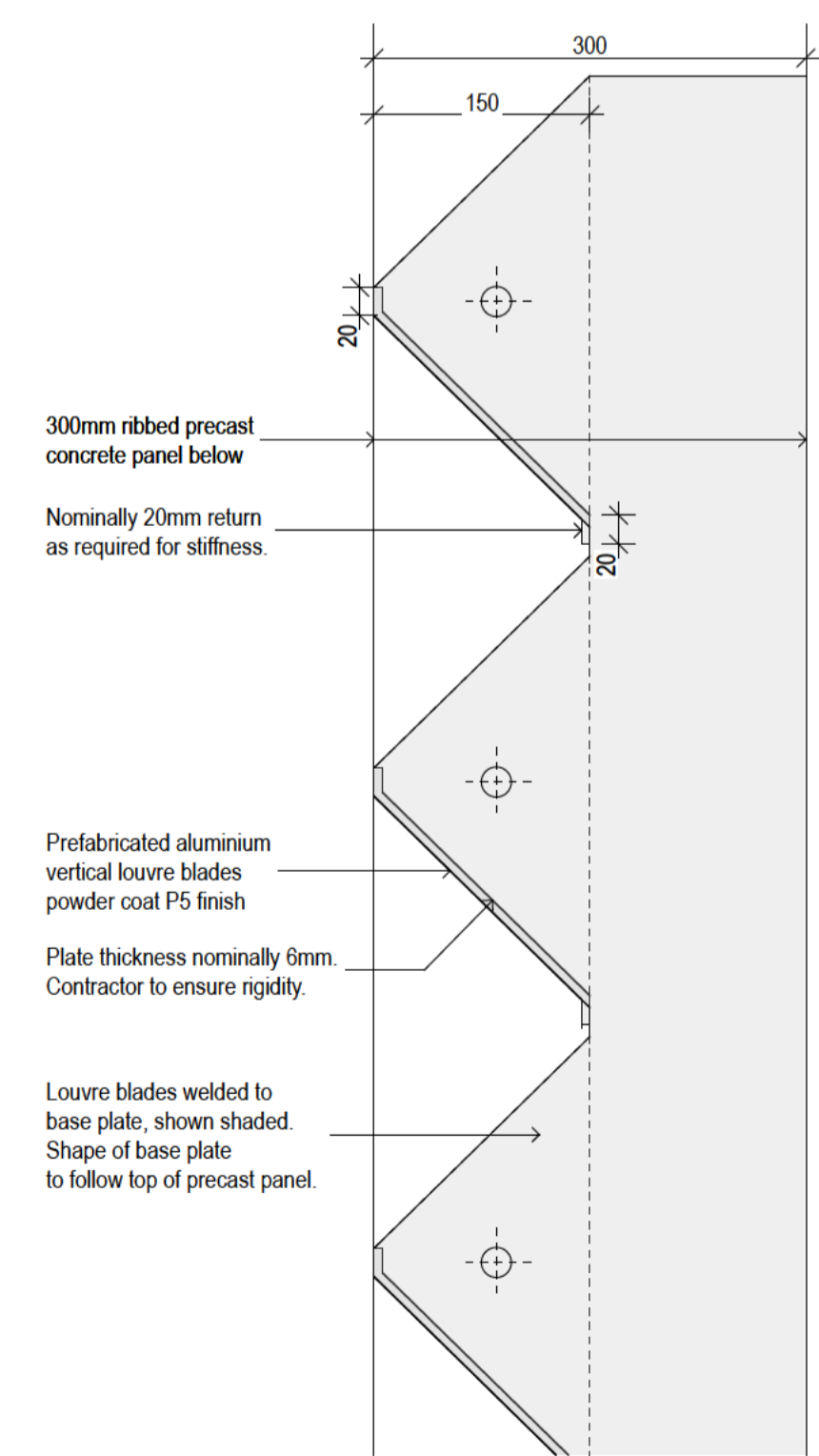
3 ALUMINIUM LOUVRE AXONOMETRIC 1:10



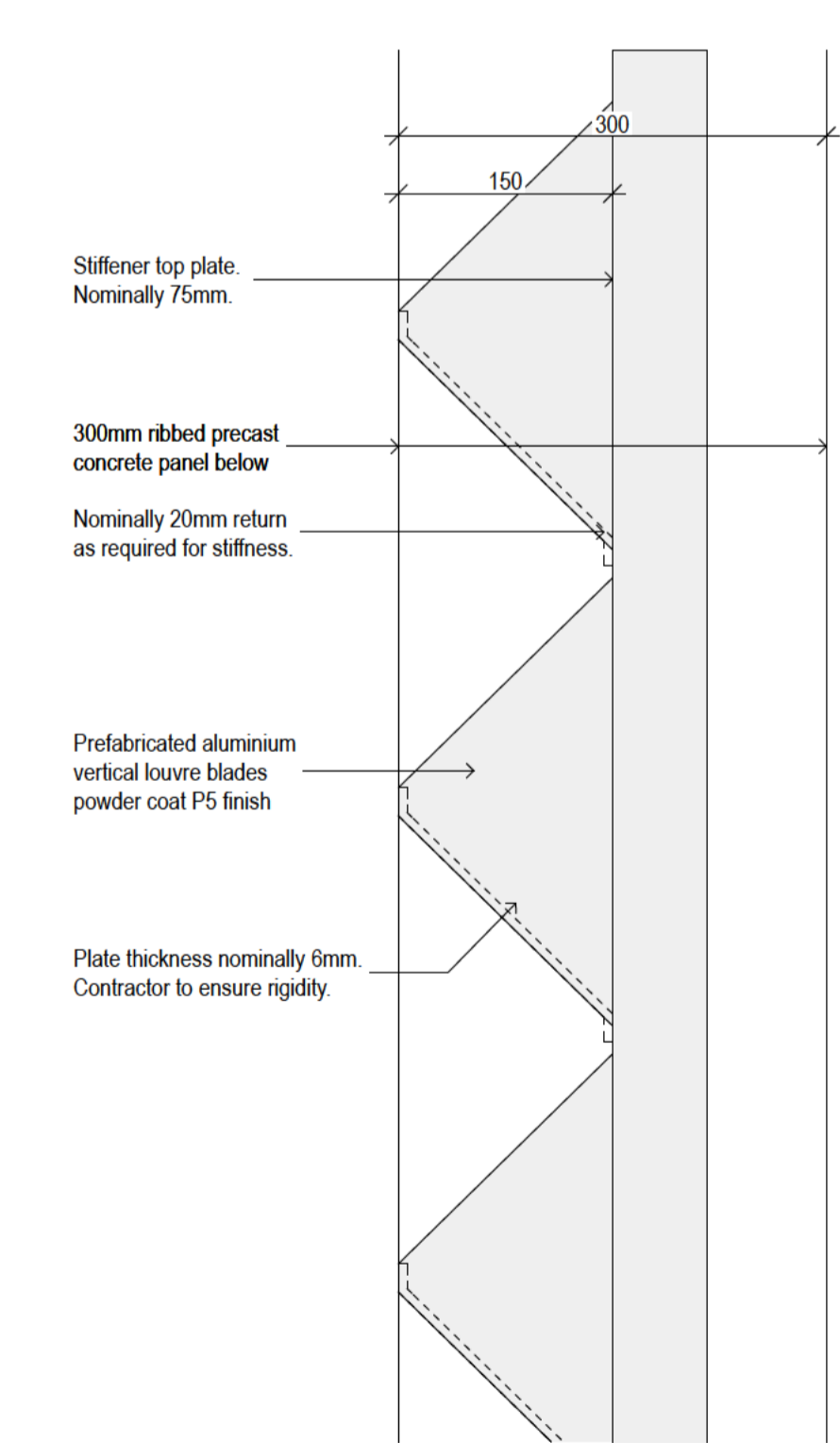
2 FACADE SECTION BUND WALL 1:10



1 PRECAST PANEL ELEVATION -BUND WALL 1:20



4 ALUMINIUM LOUVRE PLAN DET. 1 1:5



5 ALUMINIUM LOUVRE PLAN DET. 2 1:5

DATE 17/07/2015	REV 01	NOTES ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET	CONTRACTOR ESD	CIVIL ENGINEER STRUCTURAL ENGINEER	ELECTRICAL ENGINEER HYDRAULIC ENGINEER	MECHANICAL ENGINEER FIRE ENGINEERING	PCA TOWN PLANNER	CLIENT: GHD 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tbg.com.au WEB: www.tbg.com.au	PROJECT: CHALMERS STREET SUBSTATION	ARCHITECT TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tbg.com.au WEB: www.tbg.com.au	DRAWING TITLE FACADE DETAILS 2	DRAWN BY TF KN	
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											REVISION 01		

**FINISHES SCHEDULE**

- CO2** Precast Concrete Panel, Class 2C, Tone 2, Special Class Concrete with colour control
- P1** Dulux Weathermax Paint, gloss finish, colour: Dulux 'Ambit'
- P2** Anti-Graffiti coating, lower precast panel, clear finish
- P3** Powder coat paint finish, colour: Dulux ' Malay Grey'
- P4** Powder coat paint finish, colour: Dulux ' Raku'
- P5** Powder coat paint finish, colour to match colour of Precast Concrete Panel

**NOTE**

Contractor to submit samples of all colour selections for approval prior to construction.



**C02**

TILT-UP PRECAST CONCRETE PANEL  
STANDARD NOT LESSER THAN CLASS 2C, TONE 2

Type of finish: Design metal formwork and construct to provide off-form surfaces of a standard not lower than class 2 as described in AS 3610 Formwork for concrete Special Class Concrete  
Colour control: Tone 2, AS 3610, for 90% of readings  
Colour tone range may be between tone 1 and 5 for 10% maximum of finish

Location: precast concrete panels



**P1**

PAINT TYPE 1 - Dulux Weathermax Paint, gloss finish, colour: Dulux 'Ambit' Code: P10E8

Location: Feature access to precast concrete ribs on upper level precast panel



**P3**

PAINT TYPE 3 - Powder coat paint finish, colour: Dulux ' Malay Grey' Code: PG2C6

Location: External storm proof louvres and external door leaves



**P4**

PAINT TYPE 4 - Powder coat paint finish, colour: Dulux ' Raku' Code: PG2C7

Location: External door frames and security mesh gates



**P5**

PAINT TYPE 5 - Powder coat paint finish, colour to match precast concrete panel colour

Location: Aluminium louvres above transformer yard Bund walls

DATE	REV	NOTES :	NOTES:	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT :	ARCHITECT	DRAWING TITLE	DRAWN BY		
17/07/2015	01	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET	Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD Phone: 02 9239 7439 Email: stephen.puseerak@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE 02 9215 4900 FAX 02 9215 4901 EMAIL tim@tzg.com.au WEB www.tzg.com.au	FINISHES SCHEDULE	TF KN		
												CHECKED	TG		
												SCALES	:1	DRAWING NO	REVISION
												PHASE	SKETCH DESIGN	SK-29	01



ALUMINIUM LOUVRES TO TOP OF BUND WALL

300MM RIBBED PRECAST TO BUND WALLS

STEEL FRAMED SECURITY MESH GATE

200MM FLAT PRECAST TO SUBSTATION WALLS

ALUMINIUM LOUVRES TO TOP OF BUND WALL

300MM RIBBED PRECAST TO SUBSTATION WALLS

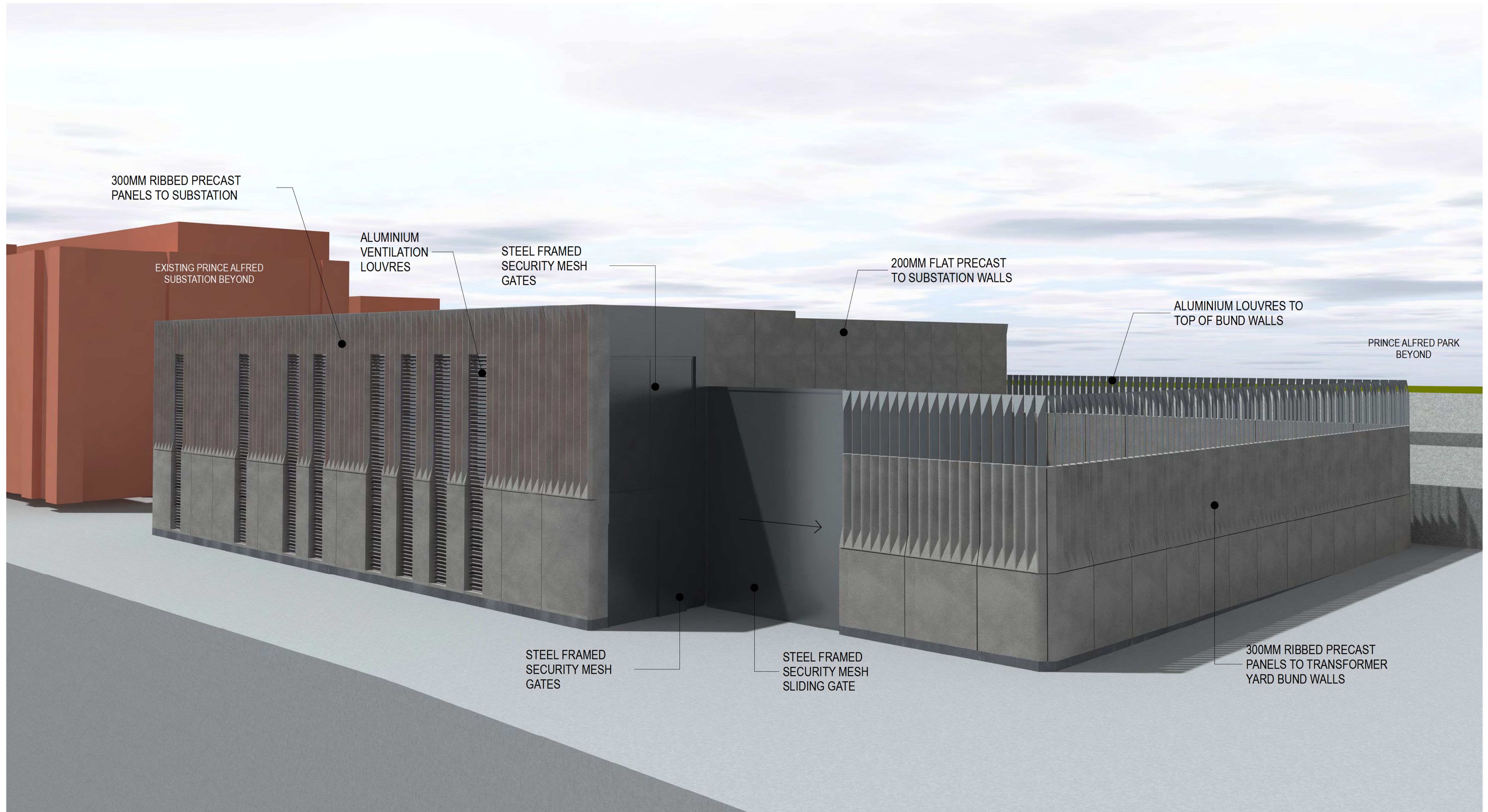
ALUMINIUM VENTILATION LOUVRES

EXISTING PRINCE ALFRED SUBSTATION BEYOND

PRINCE ALFRED PARK

VIEW FROM PRINCE ALFRED PARK

DATE	REV	NOTES :	NOTES: Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT: GHD Phone: 02 9239 7439 Email: stephen.puseerak@ghd.com	PROJECT: CHALMERS STREET SUBSTATION	ARCHITECT TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	DRAWING TITLE 3D VIEW 1	DRAWN BY TF KN
06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER		15019	ARCHITECTS tonkin zulaikha greer	SCALES	CHECKED TG
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET										PHASE SKETCH DESIGN	REVISION 02
											DRAWING NO SK-31		



VIEW FROM THE RAILWAY TRACKS

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06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER		15019	ARCHITECTS tonkin zulaikha greer	SCALES	CHECKED TG
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET										PHASE SKETCH DESIGN	REVISION 02
											DRAWING NO SK-32		





1 VIEW FROM RAILWAY TRACKS

DATE	REV	NOTES :	NOTES: Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd, and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT: GHD Phone: 02 9238 7439 Email: stephen.pusey@ghd.com	PROJECT: CHALMERS STREET SUBSTATION	ARCHITECT TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE: 02 9215 4900 FAX: 02 9215 4901 EMAIL: tim@tzg.com.au WEB: www.tzg.com.au	DRAWING TITLE 3D VIEW 3	DRAWN BY TF KN
06/07/2015	01	ISSUED FOR CLIENT REVIEW		ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER		15019	ARCHITECTS tonkin zulaikha greer	SCALES	CHECKED TG
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET										PHASE SKETCH DESIGN	REVISION 02
											DRAWING NO SK-33		



1 VIEW FROM NORTH

DATE	REV	NOTES :	NOTES:	CONTRACTOR	CIVIL ENGINEER	ELECTRICAL ENGINEER	MECHANICAL ENGINEER	PCA	CLIENT:	PROJECT :	ARCHITECT	DRAWING TITLE	DRAWN BY	
06/07/2015	01	ISSUED FOR CLIENT REVIEW	Do not scale off drawings. Use figured dimensions only. Report any discrepancies to the architect. These designs, plans, specifications and the copyright therein are the property of Tonkin Zulaikha Greer Architects Pty Ltd. and must not be reproduced or copied wholly or in part without written permission of Tonkin Zulaikha Greer Architects Pty Ltd.	ESD	STRUCTURAL ENGINEER	HYDRAULIC ENGINEER	FIRE ENGINEERING	TOWN PLANNER	GHD Phone: 02 9239 7439 Email: stephen.pusenjak@ghd.com	CHALMERS STREET SUBSTATION	TONKIN ZULAIKHA GREER ARCHITECTS 117 Reservoir Street ABN: 4600272349 PHONE 02 9215 4900 FAX 02 9215 4901 EMAIL tim@tzg.com.au WEB www.tzg.com.au	3D VIEW 1 - VIEW FROM NORTH	TF KN	
17/07/2015	02	ISSUED TO GHD FOR INCLUSION IN FINAL DRAWING SET								15019	ARCHITECTS tonkin zulaikha greer	SCALES	CHECKED	
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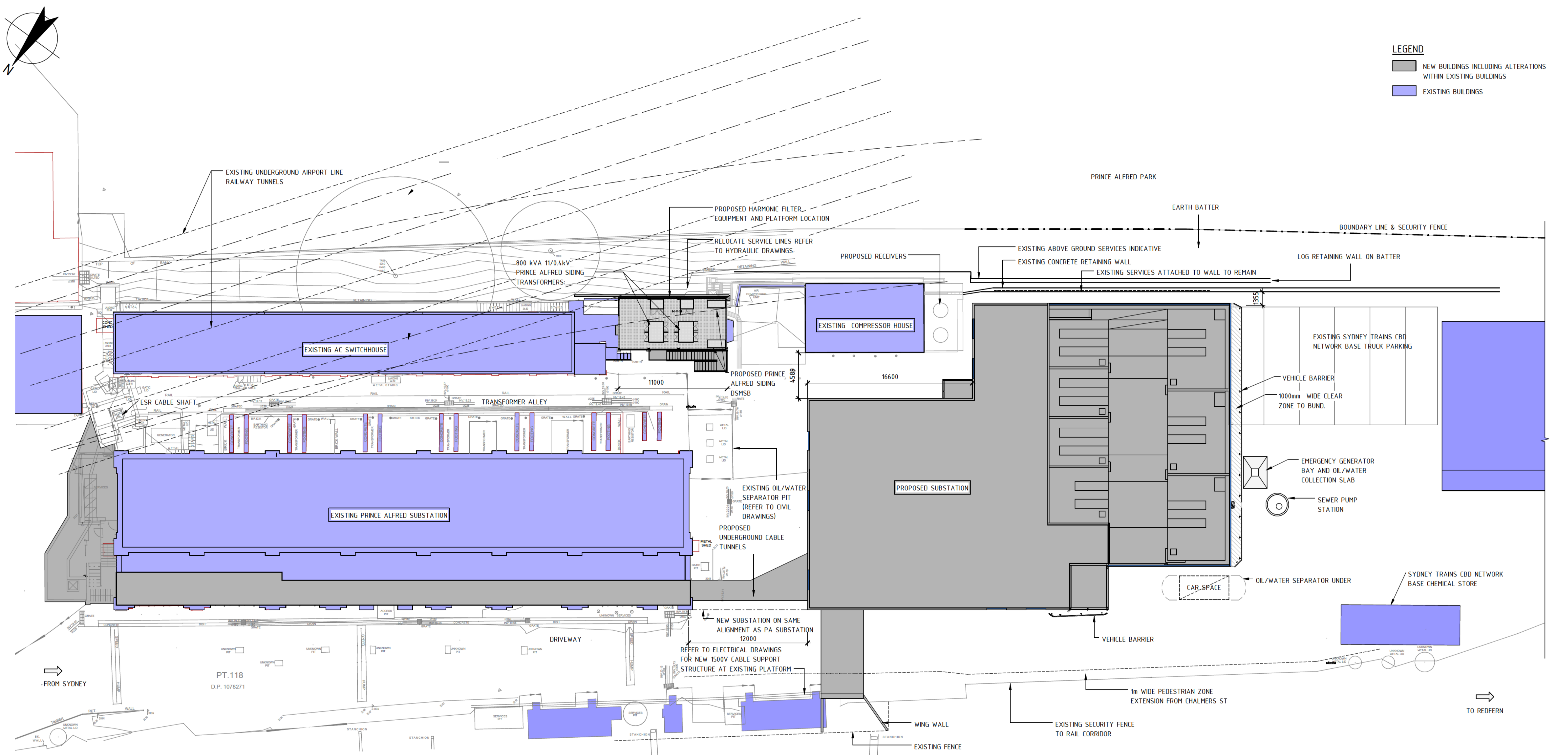
1 VIEW FROM RAIL CORRIDOR

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VIEW FROM PRINCE ALFRED PARK

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**LEGEND**  
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 [Blue Box] EXISTING BUILDINGS

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 Sydney NSW 2000 Australia  
 T 61 2 9239 7100 F 61 2 9239 7199  
 E gpr@ghd.com W www.ghd.com

DRAWN	A. WANG	01.04.15
DESIGNED	E. BULLO	01.04.15
DRG CHECK	H. PAPADIMITRIOU	01.04.15
DESIGN CHECK	A. MILLER	01.04.15
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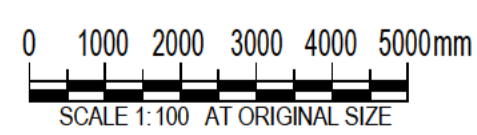
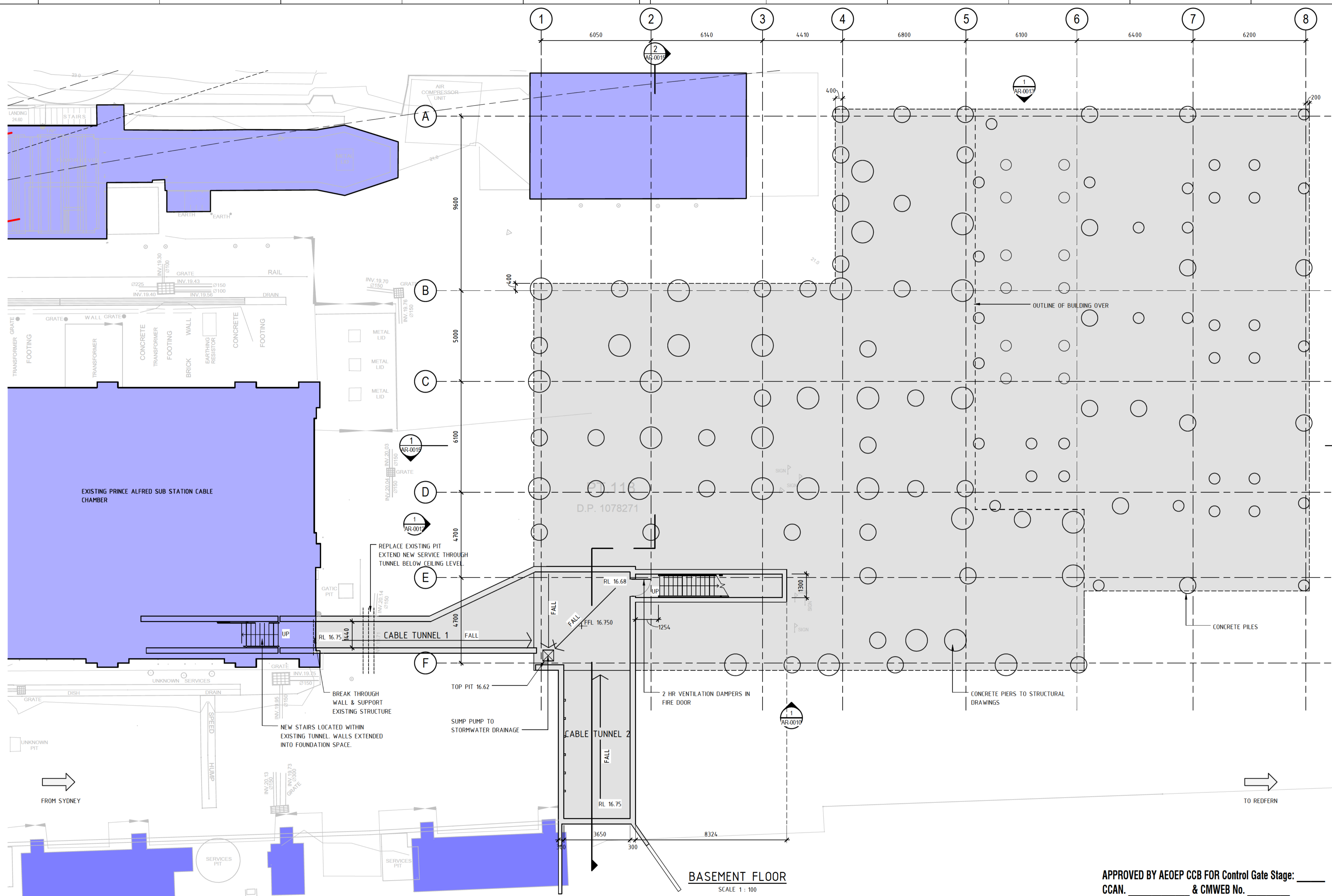
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**CHALMERS STREET**  
 AIRPORT LINE 0.352 km  
 SUBSTATIONS - POWER SUPPLY UPGRADE  
 SITE PLAN

FILE No.	21-22993	1	OF	1
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DRG No.	2656-2650-CSSS-AR-0002	C	EDMS No.	CV0561930

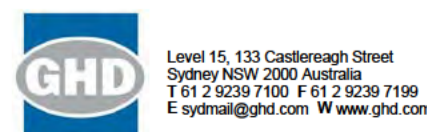


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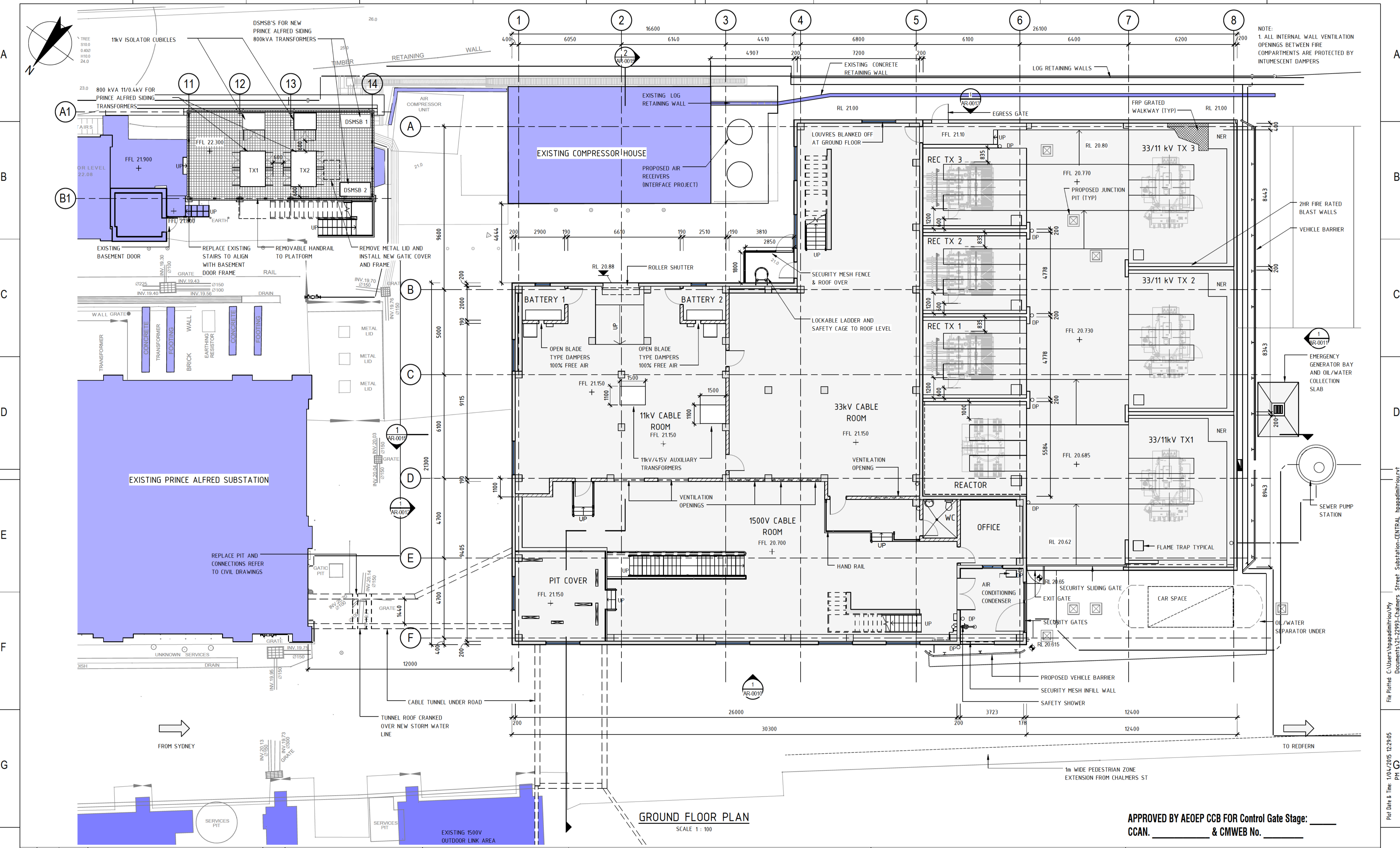
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**CHALMERS STREET**  
AIRPORT LINE 0.352 km  
**SUBSTATIONS - POWER SUPPLY UPGRADE**  
**BASEMENT FLOOR**  
PLAN

FILE No.	21-22993	1	OF	1
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**CHALMERS STREET**  
AIRPORT LINE 0.352 km  
**SUBSTATIONS - POWER SUPPLY UPGRADE**  
**GROUND FLOOR PLAN**

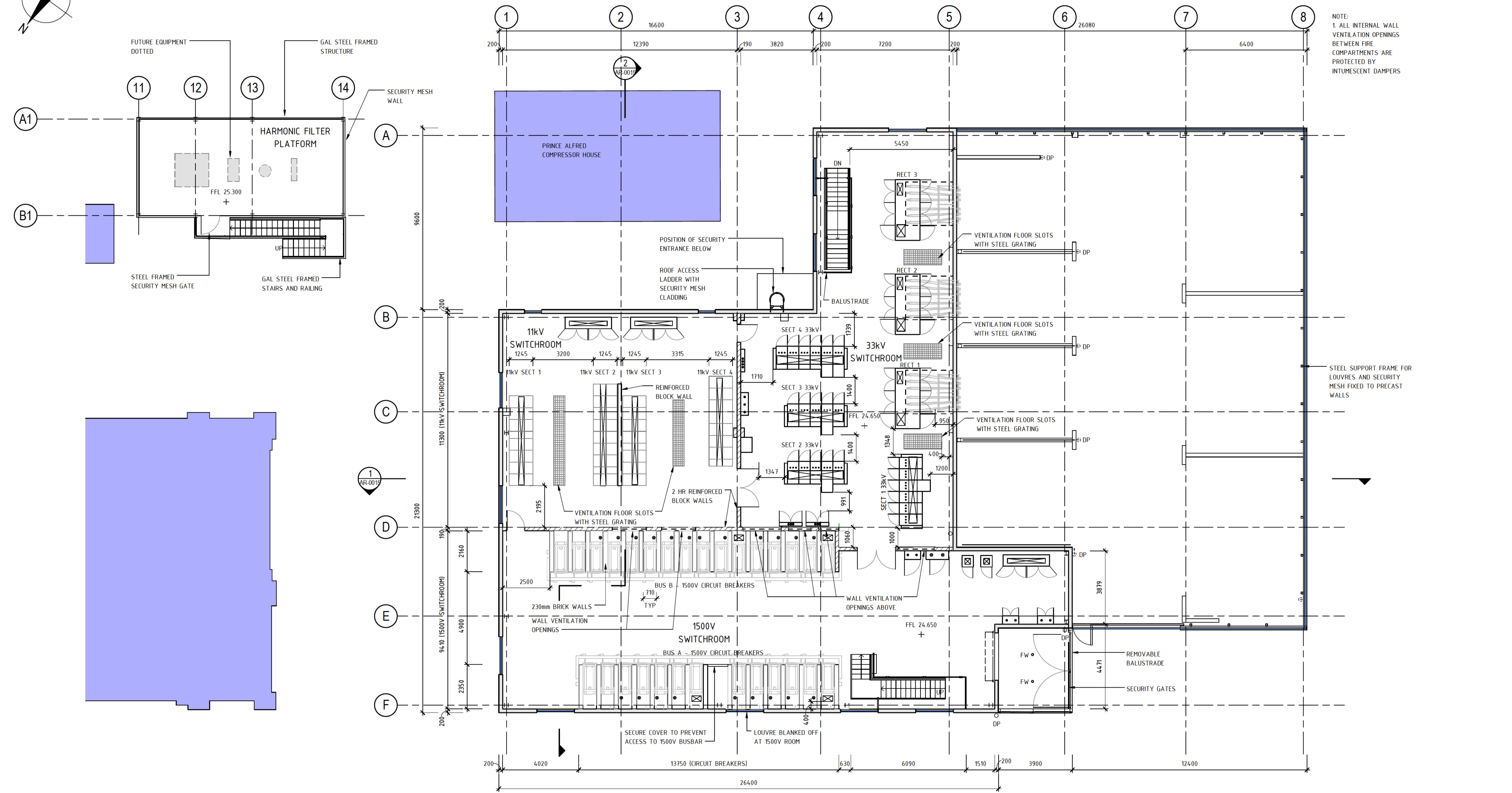
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**LEVEL 1 FLOOR PLAN**  
SCALE 1 : 100

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<b>CHALMERS STREET</b>		AIRPORT LINE 0.352 km	
<b>SUBSTATIONS - POWER SUPPLY UPGRADE</b>			
<b>LEVEL 1 FLOOR PLAN</b>			
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# Appendix D – Noise and vibration assessment



Transport for New South Wales  
Power Supply Upgrade Program  
Chalmers Street Substation  
Noise and Vibration Assessment

July 2015



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The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

# Executive summary

Transport for NSW proposes to replace the existing Sydney Trains Prince Alfred Substation with two new substations; Lee Street Substation and Chalmers Street Substation. This report details the Chalmers Street Substation noise and vibration impact assessment.

Background noise monitoring results were sourced from *Sydney to Burwood Compressor House Detailed Design Project* (GHD, November 2012) and used to calculate operational and construction noise criteria for the proposal.

Construction activities during recommended standard construction hours are predicted to exceed the noise affected construction noise management level at sensitive receivers. Reasonable and feasible construction noise and vibration mitigation measures have been recommended, which would minimise noise impacts at potentially affected receivers.

Some construction activities may be required to be undertaken outside of scheduled construction hours. These would be limited to scheduled track possession periods and involve activities such as connection to the overhead wiring equipment, installation of certain electrical equipment and delivery of oversized equipment. These activities are not expected to cause adverse impacts at sensitive receivers. It is recommended that noise monitoring should be conducted at the start of these works to determine compliance with out of hour work noise management levels and sleep disturbance criteria.

Construction traffic noise is not expected to cause adverse impacts as it would not be significant when compared with the daily existing vehicle numbers in the central business district. Therefore no construction traffic noise impacts are anticipated at sensitive receivers.

Construction traffic noise is not expected to cause adverse impacts as it would not be significant when compared with the daily existing vehicle numbers in the central business district. Therefore no construction traffic noise impacts are anticipated at sensitive receivers.

There is potential for some human comfort vibration impacts at sensitive receivers when ground compaction is within 50 m. The human comfort vibration impacts would be short-term in nature and where possible scheduled during standard construction hours. Sensitive receivers and land uses within the safe working distance buffers would be informed of the nature of the work, duration and contact details as part of the proposal communications strategy.

The building damage vibration criterion for heritage buildings is much more stringent. There is the potential that these heritage structures could exceed the building damage criteria during vibration intensive activities, particularly any percussive activities. Reasonable and feasible construction vibration mitigation measures for heritage structures have been recommended in Section 6.

Operational noise from the proposal is predicted to comply with the INP at the surrounding sensitive receivers during general operations. Operational noise from DCCB tripping is expected to exceed the sleep disturbance screening test. However, due to the infrequency of DCCB tripping events per year, sleep disturbance adverse impacts are not expected.

Vehicle movements associated with site operations will be infrequent and are not expected to cause noise impacts in an urban area. Therefore no operational traffic noise impacts are anticipated at sensitive receivers.

The proposal should be acceptable from an acoustic perspective assuming the recommended mitigation measures are implemented.

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# Glossary and abbreviations

Term	Description
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dB(A)	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
EPA	Environment Protection Authority
Groundborne vibration	Groundborne vibration is vibration transmitted from source to receiver via the medium of the ground.
ICNG	<i>Interim Construction Noise Guideline</i> (DECC, 2009).
INP	<i>Industrial Noise Policy</i> (EPA, 2000).
L <sub>A90(period)</sub>	The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured. This is considered to represent the background noise e.g. L <sub>A90(15 min)</sub> .
L <sub>Aeq(period)</sub>	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
Mitigation	Reduction in severity.
Noise sensitive receiver	An area or place potentially affected by noise which includes: <ul style="list-style-type: none"> <li>• a residential dwelling.</li> <li>• an educational institution, library, childcare centre or kindergarten.</li> <li>• a hospital, surgery or other medical institution.</li> <li>• an active (e.g. sports field, golf course) or passive (e.g. national park) recreational area.</li> <li>• commercial or industrial premises.</li> <li>• a place of worship.</li> </ul>
OEH	Office of Environment and Heritage
Peak particle velocity	Peak particle velocity is the maximum vector sum of three orthogonal time-synchronized velocity components regardless of whether these component maxima occurred simultaneously.
Rating Background Level	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. This is the level used for assessment purposes.
RNP	<i>Road Noise Policy</i> (DECCW, 2011).
Tonality	Noise containing a prominent frequency or frequencies characterised by definite pitch.
V <sub>rms</sub>	The vibration velocity presented as a root mean square value.



Term	Description
Vibration	<p>The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference.</p> <p>Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).</p>
Vibration Dose Value	<p>Vibration Dose Value (VDV) - As defined in BS6472 – 1992, VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.</p>

# 1. Introduction

## 1.1 Purpose of this report

Transport for NSW (TfNSW) proposes to replace the existing Sydney Trains Prince Alfred Substation with two new substations; Lee Street Substation (subject to a separate assessment) and Chalmers Street Substation (subject to this assessment and referred to as the proposal).

GHD Pty Ltd (GHD) has been engaged by TfNSW to undertake a noise and vibration assessment for the proposal which forms part of review of environmental factors (REF). For the purpose of these works, TfNSW is the proponent and the determining authority under Part 5 of the *Environmental Planning and Assessment Act 1979 (EP&A Act)*.

Background noise monitoring data has been sourced from *Sydney to Burwood Compressor House Detailed Design Project* (GHD, November 2012) and is considered representative of the ambient environment surrounding the site.

The noise and vibration impact assessment has been undertaken with consideration to the following guidelines:

- *Industrial Noise Policy* (EPA, 2000)
- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009)
- *Assessing Vibration: a Technical Guideline* (DEC, 2006)
- *Road Noise Policy* (DECCW, 2011)
- *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013).

This report details the Chalmers Street Substation noise and vibration impact assessment.

## 1.2 Proposal background

As part of testing the feasibility of upgrading Prince Alfred Substation, Sydney Trains engaged GHD in 2010 to undertake a significant study involving BCA and AS 2067 compliance issues; together with the preparation of a REF and Statement of Heritage Impact. These reports addressed the potential impacts of upgrading the existing substation with respect to ventilation, fire resistance, access and egress and ancillary work. The outcome of these reports included the identification of significant building (civil) and mechanical work which would be required along with the electrical work in a major operational substation.

The decision was made to establish two new substations, Lee Street and Chalmers Street.

## 1.3 The proposal

The proposal (Chalmers Street Substation) will be located within Sydney Trains Prince Alfred sidings parallel to Chalmers Street. The new substation would be positioned adjacent to the existing Prince Alfred Substation and Sydney Central Compressor Room. The substation would be partially located on land which is occupied by an existing maintenance building and a Sydney Trains fibre optic hub. The site location is shown in Figure 1.

Details of the substation are provided in the REF.

## 1.4 Scope of this assessment

The scope of this noise and vibration assessment is based on the scope or work reviewed and approved by TfNSW and is shown in Table 1-1 along with the location in the report where each item has been addressed.

**Table 1-1 Scope of assessment**

Scope	Addressed in report section
Assessing existing background noise levels by:	
Sourcing long term noise monitoring data from <i>Sydney to Burwood Compressor House Detailed Design Project</i> (GHD, November 2012) report	2.2
Assessing construction noise and vibration impacts in accordance with the <i>Interim Construction Noise Guideline</i> (DECC, 2009), <i>Construction Noise Strategy</i> (TfNSW, 2012) and <i>Assessing Vibration: a Technical Guideline</i> (DEC, 2006), including:	
Providing a description of construction including a review of the construction methodology with regards to staging of work and durations to determine construction scenarios.	4.1
Identifying noise goals during construction.	3.4.1
Construction noise modelling to predict the impacts from the Chalmers Street substation for each construction scenario at sensitive receivers.	4.2.1
Assessing the potential impacts of construction by comparing the predicted noise levels for each stage of work against the construction noise management levels.	4.2.2 4.2.3 4.2.4
Assessing construction traffic noise.	4.3
Assessing construction vibration.	4.4
Providing options for reasonable and feasible construction noise and vibration management measures if required in accordance with the <i>Construction Noise Strategy</i> (TfNSW, 2012).	6.1
Assessing operational noise impacts in accordance with the <i>Industrial Noise Policy</i> (EPA, 2000), including:	
Modelling noise levels from the Chalmers Street substation to predict the impacts at the sensitive receivers.	5.1
A description of the noise modelling methodology.	5.1.3
A description of the operational noise criteria including screening sleep disturbance criteria.	3.4.2
Assessing the potential impacts by comparing the predicted noise levels to the operation noise criteria.	5.2

Scope	Addressed in report section
Assessing sleep disturbance impacts during the night –time period. The sleep disturbance assessment will consider guidance provided in the <i>Road Noise Policy</i> (DECCW, 2011) Section 5.4 and the <i>Industrial Noise Policy</i> (EPA, 2000) Application Notes.	5.2
Assessing traffic noise from maintenance activities associated with the facility with consideration to the <i>Road Noise Policy</i> (DECCW, 2011).	5.3
Discussing recommended noise mitigation to meet the noise criteria and provide options for reasonable and feasible operation noise management measures if required.	6.1.1

## 2. Existing environment

### 2.1 Sensitive receivers and land uses

Noise and vibration sensitive receivers are defined based on the type of occupancy and the activities performed in the land use. Sensitive noise and vibration receivers could include both existing and proposed:

- residences
- educational institutes
- hospitals and medical facilities
- places of worship
- passive and active recreational areas such as parks, sporting fields, golf courses. Note that these recreational areas are only considered sensitive when they are in use or occupied
- commercial or industrial premises.

The sensitive receivers and land uses in close proximity (150 metres) to the Chalmers Street substation are identified in Table 2-1 and shown in Figure 1.

**Table 2-1 Sensitive receivers and land uses**

Receiver type	Receiver ID	Receiver Address
Residential and hotel accommodation	R1	100-114 Chalmers St (Ground to fourth floor)
	R2	116-118 Chalmers St (First and second floor)
	R3	120-124 Chalmers St (Ground to second floor)
	R4	126-140 Chalmers St (First to fifth floor)
Educational institutes, museums, court houses, theatres, places of worship, recreational areas	R5	Prince Alfred Park
	R6	Prince Alfred Park swimming pool
	R7	Presbyterian Church, 142-144 Chalmers St
	R8	Tom Mann Theatre, 126-140 Chalmers St (Ground floor)
Commercial	R9	Reprise Media Australia, 100 Chalmers St (Ground floor)
	R10	Australian Online Solutions, 94-98 Chalmers St
	R11	Ground floor commercial premises along 116-140 Chalmers St
	R12	Railway Institute, 101 Chalmers Street

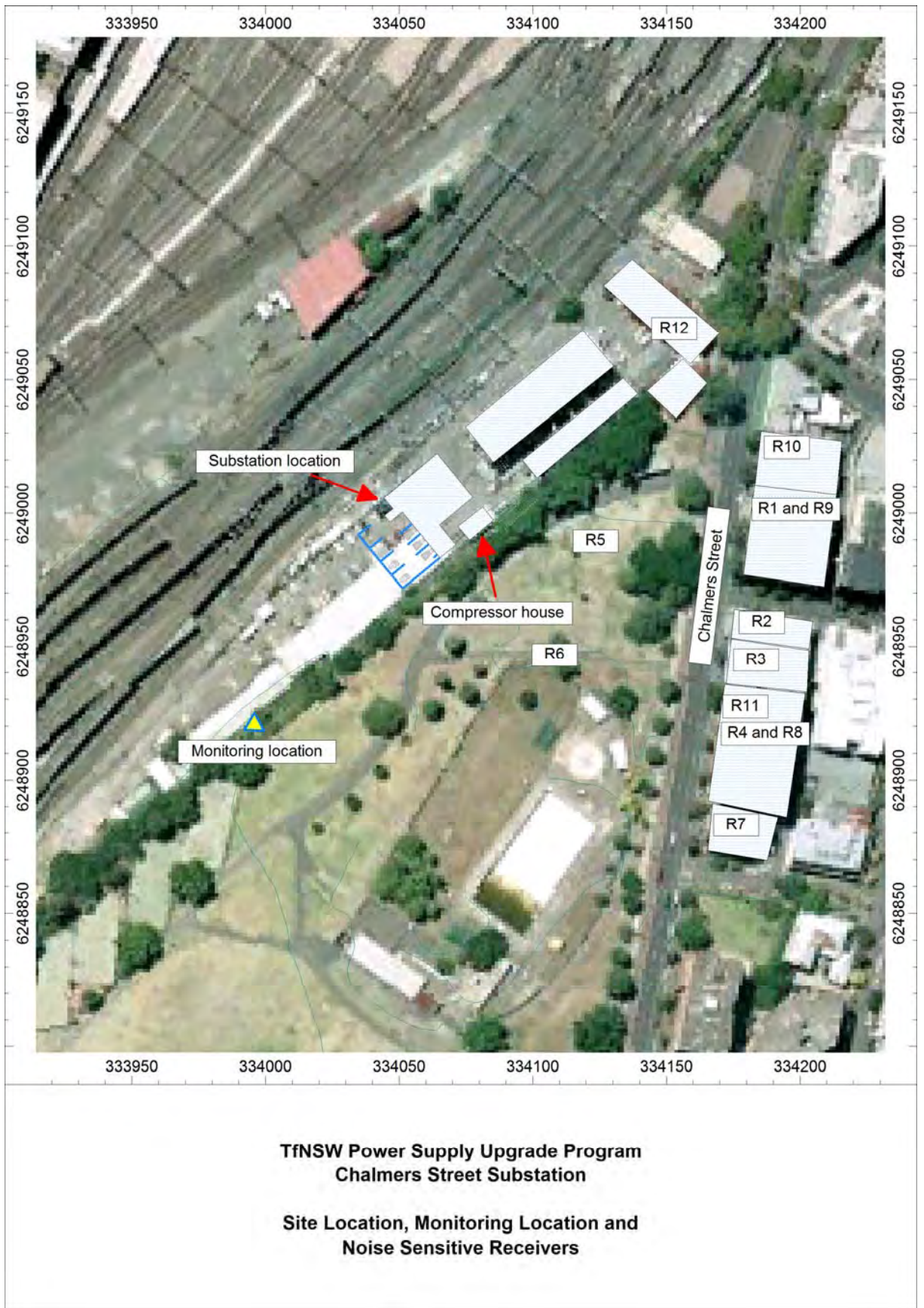


Figure 1 Proposed site location, monitoring location and sensitive receiver locations

## 2.2 Background noise monitoring results

Background noise monitoring data was obtained from the *Sydney to Burwood Compressor House Detailed Design Project* (GHD, November 2012) undertaken in April 2012 and considered representative of the background noise environment. The background monitoring location is shown in Figure 1.

The ambient noise levels were of a typical urban noise environment. A summary of the calculated rating background level (RBL)  $L_{A90(\text{period})}$  and  $L_{Aeq(\text{period})}$  noise monitoring results are shown in Table 2-2.

**Table 2-2 Summary of noise monitoring results; dB(A)**

Date	Rating background level 90 <sup>th</sup> percentile $L_{A90(15\text{min})}$			Ambient noise levels, $L_{Aeq(\text{period})}$		
	Day	Evening	Night	Day	Evening	Night
24/04/2012	51	49	45	58	57	52
25/04/2012	50	50	45	56	55	54
26/04/2012	48	47	44	56	55	53
27/04/2012	48	48	45	56	55	53
28/04/2012	49	48	46	56	54	53
29/04/2012	47	47	44	55	53	52
30/04/2012	48	47	44	56	55	53
01/05/2012	50	-	-	57	-	-
<b>RBL / Average</b>	<b>48</b>	<b>48</b>	<b>45</b>	<b>56</b>	<b>55</b>	<b>53</b>

Note: (-) indicates insufficient data measurements or filtered data

## 3. Compliance criteria

The noise and vibration compliance criteria during operation and construction are presented in the following section. A summary of the noise criteria relevant to this proposal are summarised in Section 3.4.

### 3.1 Construction noise criteria

#### 3.1.1 Construction noise management levels

The ICNG guideline recommends standard hours for construction activities as Monday to Friday: 7 am to 6 pm, Saturday: 8 am to 1 pm and no work on Sundays or public holidays. The ICNG acknowledges that the following activities have justification to be undertaken outside the recommended standard construction hours assuming that all reasonable and feasible mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses:

- the delivery of oversized plant or structures that police or other authorities determine to require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- work where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours
- work which maintains noise levels at receivers to below the noise management levels outside of the recommended standard construction hours.

Table 3-1 and Table 3-2 detail the ICNG construction noise management levels at sensitive land uses and residences, respectively.

**Table 3-1 Construction noise management levels at sensitive land uses**

Land use	Management level, $L_{Aeq(15min)}$ (when in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Industrial premises	External noise level 75 dB(A)
Offices and retail outlets	External noise level 70 dB(A)



**Table 3-2 Construction noise management levels at residences**

Time of day	Management level $L_{Aeq(15min)}$	How to apply
<p><b>Recommended standard hours:</b></p> <ul style="list-style-type: none"> <li>Monday to Friday 7 am to 6 pm</li> <li>Saturday 8 am to 1 pm</li> <li>No work on Sundays or public holidays</li> </ul>	<p>Noise affected</p> <p>Rating background level plus 10 dB(A)</p>	<p>The noise affected level represents the point above which there may be some community reaction to noise.</p> <p>Where the predicted or measured <math>L_{Aeq(15min)}</math> is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.</p>
	<p>Highly noise Affected</p> <p>75 dB(A)</p>	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:</p> <ul style="list-style-type: none"> <li>times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences)</li> <li>if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li> </ul>
<p><b>Outside recommended standard hours</b></p>	<p>Noise affected</p> <p>Rating background level plus 5 dB(A)</p>	<p>A strong justification would typically be required for work outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.</p>

### 3.1.2 Sleep disturbance criteria during construction

The ICNG states that where construction works are planned to extend over more than two consecutive nights, the analysis should include maximum noise levels and the extent and number of times the maximum exceeds the rating background levels.

The *Industrial Noise Policy* (EPA, 2000) application notes regarding sleep disturbance recommend that where the  $L_{A1(1min)}$  or  $L_{A(max)}$  exceeds the  $L_{A90(15min)}$  by more than 15 dB(A) outside the bedroom window, a more detailed analysis is required.

The ICNG also refers to the *Environmental Criteria for Road Traffic Noise* (EPA, 1999) for more guidance on sleep disturbance from maximum noise level events. This guideline has since been superseded by the *Road Noise Policy* (DECCW, 2011). Both guidelines provide a discussion on research into the effects of maximum noise events on sleep disturbance. The results of this research is aimed at limiting the level of sleep disturbance due to environmental noise and concludes that the  $L_{Amax}$  or  $L_{A1(1min)}$  level of any noise should not exceed the ambient  $L_{A90(15min)}$  noise level by more than 15 dB(A). This guideline takes into account the emergence of noise events, but does not directly limit the number of such events or their highest level, which are also found to affect sleep disturbance.

The *Road Noise Policy* (DECCW, 2011) provides further guidance, which indicates that:

- maximum internal noise levels below 50–55 dB(A) are unlikely to cause awakening reactions
- one or two noise events per night with maximum internal noise levels of 65–70 dB(A) are not likely to significantly affect health and wellbeing.

For this assessment the background level plus 15 dB(A) has been used as a screening level assessment of sleep disturbance which is consistent with the *Industrial Noise Policy* (EPA, 2000) application notes and the *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013).

### 3.1.3 Construction traffic noise criteria

The *Road Noise Policy* (DECCW, 2011) provides traffic noise target levels for residential receivers in the vicinity of existing roads (Table 3-3). These levels are applied to construction work to identify potential construction traffic impacts and the potential for reasonable and feasible mitigation measures.

The application notes<sup>1</sup> for the *Road Noise Policy* (DECCW, 2011) state that “for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.”

If road traffic noise increases from the construction work is within 2 dB(A) of current levels then the objectives of the *Road Noise Policy* (DECCW, 2011) are met and no specific mitigation measures are required.

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<sup>1</sup><http://www.environment.nsw.gov.au/noise/roadnoiseappnotes.htm> 12 December 2012

**Table 3-3 Construction traffic noise criteria,  $L_{Aeq(Period)}$ , dB(A)**

Type of Development	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 $L_{Aeq(15hr)}$	55 $L_{Aeq(9hr)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{Aeq(1hr)}$	50 $L_{Aeq(1hr)}$
School classrooms	Internal noise level 40 $L_{Aeq(1hr)}$ dB(A) (When in use)	-
Places of worship	Internal noise level 40 $L_{Aeq(1hr)}$ dB(A) (when in use)	Internal noise level 40 $L_{Aeq(1hr)}$ dB(A) (when in use)
Open space (active use)	External noise level 60 $L_{Aeq(15hr)}$ dB(A) (when in use)	-
Open space (passive use)	External noise level 55 $L_{Aeq(15hr)}$ dB(A) (when in use)	-

## 3.2 Construction vibration criteria

### 3.2.1 Human comfort

Vibration has been assessed based on the criteria in *Assessing Vibration: a technical guideline* (DEC February 2006). *British Standard (BS) 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* is recognised by the guideline as the preferred standard for assessing the ‘human comfort criteria’.

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3-4 for sensitive receivers.

Whilst the assessment of response to vibration in *BS 6472-1:1992* is based on vibration dose value and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of a peak value, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in *BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration*, as shown below in Table 3-5.

**Table 3-4 Human comfort intermittent vibration limits (BS 6472-1992)**

Receiver type	Period <sup>1</sup>	Intermittent vibration dose value (m/s <sup>1.75</sup> )	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26
Educational institutes	When in use	0.4	0.8

Note 1: Day is between 7 am and 10 pm and night is between 10 pm and 7 am

**Table 3-5 Guidance on effects of vibration levels for human comfort (BS 5228.2 – 2009)**

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

### 3.2.2 Structural damage

Currently, there is no Australian Standard that sets criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures* (refer to Table 3-6).

**Table 3-6 Guideline values for short term vibration on structures**

Type of structure	Guideline values for velocity, (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz <sup>1</sup>
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10

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

### 3.3 Operational noise criteria

The *Industrial Noise Policy* (EPA, 2000) provides guidance on the assessment of operational noise impacts. The guidelines include both intrusive and amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the total noise level from all sources near a receiver. The *Industrial Noise Policy* (EPA, 2000) also provides guidance on sleep disturbance impacts.

The *Industrial Noise Policy* (EPA, 2000) noise criteria are planning levels and are not mandatory limits required by legislation however the noise criteria will assist the determining authority to assess operational noise impacts. Where noise criteria are predicted to be exceeded, feasible and reasonable noise mitigation strategies should be considered. Feasible and reasonable noise mitigation measures should consider the economic, social and environmental costs and benefits of the development against the noise impacts.

The intrusive noise criteria controls the relative audibility of operational noise compared to the background level at residential receivers. The amenity criteria limits the total level of extraneous noise for all receiver types. Both sets of criteria are calculated and, in the case of continuous noise sources, the lower of the two in each time period normally apply. For noise sources with intermittent characteristics both noise criteria should be assessed independently.

#### 3.3.1 Intrusive criteria

The intrusive criteria are determined by a 5 dB(A) addition to the measured (or adopted) background level with a minimum of 35 dB(A). The *Industrial Noise Policy* (EPA, 2000) recommends that the intrusive noise criteria for the evening period should not exceed the daytime period and the night-time period should not exceed the evening period. The intrusive noise criteria are only applicable to residential receivers.

#### 3.3.2 Amenity criteria

The amenity criteria are determined based on the overall acoustic characteristics of the receiver area, the receiver type and the existing level of industrial noise.

Residential receiver areas are characterised into 'urban', 'suburban', 'rural' or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic.

Amenity criteria are also provided for other sensitive land uses such as schools, hospitals, places of worship and recreational areas.

The amenity criteria aim to limit continual increases in noise levels from industrial noise sources and apply to all industrial noise sources at the receiver location, rather than just the noise source from the proposed development. To prevent cumulative noise level increases above the amenity criteria, the *Industrial Noise Policy* (EPA, 2000) provides adjustments to the amenity criteria to set a target level for the proposed development. The applicable adjustment is scaled as per *Industrial Noise Policy* (EPA, 2000) Table 2.2 and is based on the existing level of industrial noise at the receiver location. The *Industrial Noise Policy* (EPA, 2000) amenity criteria are provided in Table 3-5.

**Table 3-7 Industrial Noise Policy (EPA, 2000) amenity criteria**

Type of receiver	Noise amenity area	Time of day	Recommended $L_{Aeq(period)}$ noise level	
			Acceptable	Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban / industrial interface	Day	65	70
		Evening	55	60
		Night	50	55
School classroom	All	When in use (highest 1 hour period)	35 (internal)	40 (internal)
Hospital ward	All	When in use (highest 1 hour period)	35 (internal) 50 (external)	40 (internal) 55 (external)
Place of worship	All	When in use	40 (internal)	45 (internal)
Passive recreation	All	When in use	50	55
Active recreation	All	When in use	55	60
Commercial	All	When in use	65	70
Industrial	All	When in use	70	75

### 3.3.3 Meteorological conditions

Noise propagation can be enhanced by wind conditions and temperature inversions. The *Industrial Noise Policy* (EPA, 2000) states:

*“Where inversion conditions are predicted for at least 30% (or approximately 2 nights per week) of the total night time in winter, then inversion effects are considered to be significant and should be taken into account in the noise assessment.*

*Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source-to-receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 per cent of the time or more in any assessment period (day, evening, night) in any season.”*

Therefore noise enhancing meteorological conditions should be included in the assessment unless it can be shown that they do not occur for 30% of the time during any seasonal period.

### 3.3.4 Modifying factor adjustments

The *Industrial Noise Policy* (EPA, 2000) requires that modifying factor adjustments are added to the measured or predicted noise levels if the noise sources contain tonal, low frequency, intermittent or impulsive characteristics, which have the potential to increase annoyance. The modifying factor adjustments are summarised in Table 3-8.

**Table 3-8 Industrial Noise Policy (EPA, 2000) modifying factor adjustments**

Factor	Assessment/measurement	When to apply	Correction <sup>1,2</sup>
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: <ul style="list-style-type: none"> <li>• 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz</li> <li>• 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive</li> <li>• 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.</li> </ul>	5 dB(A) <sup>2</sup>
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more.	5 dB(A) <sup>2</sup>
Intermittent noise	Subjectively assessed	When the night-time noise level drops to that of the background noise level with a noticeable change in noise level of at least 5 dB(A).	5 dB(A)
Impulsive noise	A-weighted fast response and impulse response	If the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.	Apply the difference in measured noise levels as the correction up to a maximum of 5 dB(A)

Note 1: Where two or more modifying factors are present the maximum correction is limited to 10 dB(A).

Note 2: Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.

### 3.3.5 Sleep disturbance during operation

The *Industrial Noise Policy* (EPA, 2000) application notes and the *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013) recommend that where the  $L_{A1(1min)}$  or  $L_{A(max)}$  exceeds the  $L_{A90(15min)}$  by more than 15 dB(A) outside the bedroom window, a more detailed analysis is required.

The *Road Noise Policy* (DECCW, 2011) provides further guidance, which indicates that:

- maximum internal noise levels below 50–55 dB(A) are unlikely to cause awakening reactions
- one or two noise events per night with maximum internal noise levels of 65–70 dB(A) are not likely to significantly affect health and wellbeing.

### 3.3.6 Operational traffic noise

Operational traffic noise impacts from the proposal are not anticipated however the traffic noise criteria presented in Section 3.1.3 for construction traffic noise would be relevant for the project.

## 3.4 Proposal specific criteria

### 3.4.1 Construction noise

The construction noise criteria for the proposed construction activities during recommended standard hours and outside of the recommended standard hours are provided in Table 3-9 for each sensitive receiver and are based on Table 3-1, Table 3-2 and the *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013) guidance on sleep disturbance.



**Table 3-9 Proposal specific construction noise criteria, dB(A)**

Receiver	Construction noise management level, $L_{Aeq}(15min)$					Sleep disturbance screening test $L_{Amax}$ (external)
	During standard recommended hours		Outside of standard recommended hours			
	7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday, no work on Sunday or public holidays		Day 7 am to 8 am and 1 pm to 6 pm Saturday, 8 am to 6 pm Sunday & Public Holidays	Evening 6 pm to 10 pm Monday to Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays
	Noise affected	Highly noise affected				
R1: 100-114 Chalmers St (Ground to fourth floor)	58	75	53	53	50	60
R2: 116-118 Chalmers St (First and second floor)	58	75	53	53	50	60
R3: 120-124 Chalmers St (Ground to second floor)	58	75	53	53	50	60
R4: 126-140 Chalmers St (First to fifth floor)	58	75	53	53	50	60
R5: Prince Alfred Park	60	-	-	-	-	-
R6: Prince Alfred Park swimming pool	65	-	-	-	-	-
R7: Presbyterian Church, 142-144 Chalmers St	45 internal (55 external)	-	-	-	-	-
R8: Tom Mann Theatre, 126-140 Chalmers St (Ground floor)	25-30 internal (40 external)	-	-	-	-	-
R9: Reprise Media Australia, 100 Chalmers St	70	-	-	-	-	-

Receiver	Construction noise management level, $L_{Aeq}(15min)$					Sleep disturbance screening test $L_{Amax}$ (external)
	During standard recommended hours		Outside of standard recommended hours			
	7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday, no work on Sunday or public holidays		Day 7 am to 8 am and 1 pm to 6 pm Saturday, 8 am to 6 pm Sunday & Public Holidays	Evening 6 pm to 10 pm Monday to Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays
	Noise affected	Highly noise affected				
(Ground floor)						
R10: Australian Online Solutions, 94-98 Chalmers St	70	-	-	-	-	-
R11: Ground floor commercial premises along 116-140 Chalmers St	70	-	-	-	-	-
R12: Railway Institute, 101 Chalmers St (Ground Floor)	70	-	-	-	-	-

### 3.4.2 Operational noise

The operational noise criteria at the residential receivers surrounding the substation site are provided in Table 3-10 and are based on criteria discussed in Section 3.3.

**Table 3-10 Proposal specific operational noise criteria**

Receiver	Time period	Amenity criteria (acceptable noise level) <sup>1,2</sup> $L_{Aeq(period)}$	RBL, $L_{Aeq(15min)}$	Intrusive criteria, $L_{Aeq(15min)}$	Proposal specific noise criteria (external)	Sleep disturbance screening test (external)
Residential receivers (R1 to R4)	Day	60	48	53	53 $L_{Aeq(15min)}$	-
	Evening	50	48	53	50 $L_{Aeq(evening)}$	-
	Night	45	45	50	45 $L_{Aeq(night)}$	60 $L_{Amax}$
Passive recreational area (R5)	When in use	55	-	-	55 $L_{Aeq(period)}$	-
Active recreational area (R6)	When in use	60	-	-	60 $L_{Aeq(period)}$	-
Place of worship (internal, R7)	When in use	40 (internal)	-	-	50 $L_{Aeq(period)}$ <sup>3</sup>	-
Theatre (internal, R8)	When in use	25-30 (internal)	-	-	40 $L_{Aeq(period)}$ <sup>3</sup>	-
Commercial premises (R9 to R12)	When in use	65	-	-	65 $L_{Aeq(period)}$	-

Note 1: With consideration to the *Industrial Noise Policy* (EPA, 2000) 'noise amenity area' classification, the residential receivers surrounding the Chalmers Street substation have been classified as 'urban'.

Note 2: Attended observations during the site visit noted that there were no significant industrial noise sources in the area therefore no adjustments have been applied for the proposal.

Note 3: A 10 dB(A) noise reduction is assumed from outside to inside the building for the theatre and place of worship

## 4. Assessment of construction noise and vibration impacts

### 4.1 Construction methodology

#### 4.1.1 Construction timing and scheduling

It is anticipated that the majority of work for the proposal would be undertaken during the recommended standard working hours adopted as follows:

- Monday to Friday: 7 am to 6 pm.
- Saturday: 8 am to 1 pm.
- Sundays and Public Holidays: no work.

However, there is potential that some work could be undertaken outside of the standard working hours. This would be limited to scheduled track possession periods and involve activities such as connection to the overhead wiring system, installation of certain electrical equipment and delivery of oversized equipment.

It is anticipated that construction would take approximately 28 months. The main civil construction activities would be completed within 16 months, the fit out of the proposed substation would take six months and six months for commissioning works. Construction of the new substation is anticipated to commence in late 2016 with early works starting from early to mid-2016.

#### 4.1.2 Construction process

The general construction process can be broken into three main categories. These categories are:

- site establishment:
  - establishment of the construction compound
  - installation of safety fencing around the proposal site
- compaction and earth work
- substation construction work.

### 4.2 Construction noise impacts

#### 4.2.1 Modelling methodology

For each construction scenario, the potential noise impacts on the surrounding sensitive receivers have been predicted. At present detailed construction equipment to be used on the proposal is unknown as it would be dependent on the construction contractor and detailed construction methodology. However the noise generating equipment anticipated to be used for each construction scenario is detailed in Table 4-1 with the corresponding sound power level. Noise levels have been obtained from *Construction Noise Strategy* (TfNSW, 2012) and *AS2436 – 2010 Guide to noise and vibration control on construction, demolition and maintenance sites*. Other equipment may be used, however it is anticipated that they would produce similar noise emissions.

Noise modelling was undertaken using Computer Aided Noise Abatement (CadnaA). CadnaA is a computer program for the calculation, assessment and prognosis of noise exposure. CadnaA

calculates environmental noise propagation according to *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'*.

The following noise modelling assumptions were made:

- surrounding land was modelled assuming a hard reflective surface with a ground absorption coefficient of 0
- the noise model was used to predict noise levels during typical worst case 15 minute period of operation where the noisiest item of equipment is running at full power.
- atmospheric absorption was based on an average temperature of 10 °C and an average humidity of 70%.
- atmospheric propagation conditions were modelled with favourable wind conditions for noise propagation (downwind conditions) or equivalently a well-developed moderate ground based temperature inversions.

The magnitude of off-site noise impact will be dependent upon a number of factors:

- the intensity of activities
- the location of activities
- the type of equipment used
- the background noise levels
- intervening terrain and structures
- the prevailing weather conditions.

During any given period, the equipment would operate at maximum sound power levels for only brief stages. At other times, the equipment may produce lower sound levels while carrying out activities not requiring full power or when not in use. It is highly unlikely that all equipment would be operating at their maximum sound power levels at any one time and certain types of equipment would be used for only brief periods during the work.

**Table 4-1 Equipment noise levels, dB(A)**

Construction category	Equipment	Sound power level
Site establishment works	Bulldozer	108
	Dump truck	108
	Small Machinery (e.g. Jackhammer, Concrete saw)	118
	Excavator	105
Compaction and earth work	Compactor	113
	Excavator	105
	Dump truck	108
Substation construction work	Mobile crane	104
	Concrete truck	108
	Piling	110
	Road truck	107
	Small Machinery (e.g. Jackhammer, Concrete saw)	118

#### 4.2.2 Predicted construction noise levels

The predicted noise levels at the ground and first floors of sensitive receivers are detailed in Table 4-2 with receivers exceeding the relevant noise management levels being identified. Results in bold indicate exceedances to the noise affected management levels while results in bold red indicate exceedances to the highly noise affected management levels. Exceedances from the construction noise management levels are provided in brackets with positive values indicating potential adverse impacts. Receivers on levels above the first floor would experience noise levels less than or similar to the first floor predicted noise levels.

**Table 4-2 Predicted construction noise levels, dB(A)**

Receiver	Standard hours criteria	Site establishment work		Earth work		Construction work	
		Ground floor	First floor	Ground floor	First floor	Ground floor	First floor
R1: 100-114 Chalmers St (Ground to fourth floor)	58	<b>59 (+1)</b>	<b>61 (+3)</b>	57 (-1)	58 (0)	<b>59 (+1)</b>	<b>61 (+3)</b>
R2: 116-118 Chalmers St (First and second floor)	58	-	<b>59 (+1)</b>	-	57 (-1)	-	<b>59 (+1)</b>
R3: 120-124 Chalmers St (Ground to second floor)	58	54 (-4)	58 (0)	52 (-6)	56 (-2)	54 (-4)	58 (0)
R4: 126-140 Chalmers St (First to fifth floor)	58	-	57 (-1)	-	55 (-3)	-	56 (-2)
R5: Prince Alfred Park	60	<b>71 (+11)</b>	-	<b>69 (+9)</b>	-	<b>71 (+11)</b>	-
R6: Prince Alfred Park swimming pool	65	62 (-3)	-	60 (-5)	-	62 (-3)	-
R7: Presbyterian Church, 142-144 Chalmers St	55	52 (-3)	-	50 (-5)	-	51 (-4)	-
R8: Tom Mann Theatre, 126-140 Chalmers St (Ground floor)	45	<b>53 (+8)</b>	-	<b>51 (+6)</b>	-	<b>53 (+8)</b>	-
R9: Reprise Media Australia, 100 Chalmers St (Ground floor)	70	59 (-11)	-	57 (-13)	-	59 (-11)	-
R10: Australian Online Solutions, 94-98 Chalmers St	70	62 (-8)	63 (-7)	58 (-12)	59 (-11)	60 (-10)	62 (-8)
R11: Ground floor commercial premises along 116-140 Chalmers St	70	53 (-17)	-	52 (-18)	-	53 (-17)	-
R12: Railway Institute, 101 Chalmers St	70	64 (-6)	67 (-3)	56 (-14)	58 (-12)	64 (-6)	67 (-3)

Note 1: Results in **bold** indicate exceedances to noise affected construction noise management levels.

Note 2: Results in **bold red** indicate exceedances to highly noise affected construction noise management levels.

#### 4.2.3 Discussion of predicted construction noise levels

Noise levels generated due to construction activities are predicted to exceed noise affected noise management levels at residential receivers R1 (1 to 3 dB(A)) and R2 (1 dB(A)) during site establishment and construction work. Highly noise affected noise management levels are not expected to be exceeded at any sensitive receivers

Noise affected noise management levels are also expected to be exceeded at the following sensitive receivers:

- Prince Alfred Park
- Tom Mann Theatre.

It is recommended that the *Construction Noise Strategy* (TfNSW, 2012) standard noise mitigation measures detailed in section 6 be implemented where feasible and reasonable and all potentially impacted residents should be informed of the nature of the work, expected noise levels, duration of work and a method of contact.

During recommended standard construction hours the *Construction Noise Strategy* (TfNSW, 2012) additional mitigation measures provided in section 6 require letter box drops and compliance monitoring for the residential receivers identified above.

#### 4.2.4 Out of hours works and sleep disturbance

Some construction activities may be required to be undertaken outside of scheduled construction hours such as scheduled track possession periods and involve activities such as connection to the overhead wiring equipment, installation of certain electrical equipment and delivery of oversized equipment.

These activities are not expected to cause adverse impacts at sensitive receivers. If out of hours work is required, contractor would obtain approval from Transport for NSW, prior to works being undertaken. All out of hour work and activities outside the recommended standard hours are to be undertaken with additional mitigation measures in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012)..

### 4.3 Construction traffic noise impacts

The application notes for the *Road Noise Policy* (DECCW, 2011) state that 'for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.' This is also considered to be applicable for construction noise therefore if road traffic noise increases from construction is within 2 dB(A) of current levels then the objectives on the *Road Noise Policy* (DECCW, 2011) are achieved.

A significant increase in traffic volumes would be needed in order to increase road traffic noise by 2 dB(A) (a doubling in traffic corresponds to an approximate 3 dB(A) increase). It is estimated that up to 10 heavy vehicles and 10 light vehicles would be required on-site daily. 40 vehicle movements daily would not be significant when compared with the daily existing vehicle numbers in the central business district.

It is recommended that a traffic management plan be prepared by the contractor which detail specific routes that construction traffic and local traffic would follow throughout the construction phase and where feasible and reasonable, avoid the use of local roads.



## 4.4 Construction vibration

Typical vibration generating activities during the construction of the proposal will include:

- during site establishment works, bulldozers and excavators
- during concrete removal and ground compaction, compactor and concrete hand tools
- during substation construction, bored piling works.

Table 4-3 outlines typical vibration levels for these plant activities sourced from the Roads and Maritime Services *Environmental Noise Management Manual* (RTA, 2001) and GHD's internal measurement database.

**Table 4-3 Typical vibration levels – construction equipment**

Item	Peak particle velocity at 10 m (mm/s)
7 tonne compactor	7
Jackhammer	0.5
Excavator	2.1
Piling (bored)	0.8
Dozer	3

Potential vibration impacts would be limited to the construction period.

### 4.4.1 Assessment of impacts

Energy from equipment is transmitted into the ground and transformed into vibration, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- the efficiency of the energy transfer mechanism of the equipment (i.e impulsive; reciprocating, rolling or rotating equipment)
- the frequency content
- the impact medium stiffness
- the type of wave (surface or body)
- the ground type and topography.

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data.

Safe working buffer distances to comply with the human comfort and structural damage criteria were calculated and are presented in Table 4-4.

**Table 4-4 Vibration buffer distances (m)**

Activity	Human comfort	Structural damage	
		Heritage building/structure	Standard dwellings
7 tonne compactor	50 m	20 m	13 m
Jackhammer <sup>1</sup>	Avoid contact with structure	2 m (nominal)	1 m (nominal)
Excavator	18 m	8 m	5 m
Piling (bored) <sup>1</sup>	-	4 m (nominal)	2 m (nominal)
Dozer	25 m	10 m	6 m

Note 1: These distances have been sourced from the *Construction Noise Strategy* (TfNSW, 2012)

There is potential for some human comfort impacts at sensitive receivers when ground compaction is within 50 metres. Piling activities would be required, and any potential impacts would be temporary and short-term in nature and where possible scheduled during standard construction hours. Sensitive receivers and land uses within the safe working distance buffers would be informed of the nature of the work, duration and contact details as part of the proposal communications strategy.

With consideration to the building damage criteria for typical commercial buildings, the expected magnitude of ground vibrations should not be sufficient to cause damage to buildings within 13 metres of the work. As there are no commercial buildings within 13 metres of the work, building damage due to vibration is not expected.

The building damage vibration criterion for heritage buildings is much more stringent. A list of identified heritage structures immediately adjacent to the work is shown in Table 4-5. There is potential that these heritage structures could exceed the building damage criteria during vibration intensive activities, particularly any percussive activities. Reasonable and feasible construction vibration mitigation measures for heritage structures have been recommended in Section 6.

**Table 4-5 Heritage structures immediately adjacent to the works**

Heritage building	Distance to proposal
Sydney terminal and yards	Closest building (existing Prince Alfred Substation) 5 m from the proposed substation

Vibration generating activities associated with the site compound and laydown areas would be considered minimal on the surrounding residential buildings and other sensitive structures. Yet there is a possibility that construction activities within these areas, that include vibratory activities, could adversely impact on nearby residential buildings and other sensitive structures. Therefore it is recommended that the mitigation measures detailed in section 6 **Error! Reference source not found.** be implemented to ensure all impacts associated with vibration generating activities are below the criteria limits.

# 5. Assessment of operational noise impacts

## 5.1 Noise modelling methodology

Acoustic modelling was undertaken using Computer Aided Noise Abatement (CadnaA) v4.3 to predict the effects of industrial noise generated by the proposed substation. CadnaA v4.3 noise modelling software was used to predict the operational noise in accordance with the *ISO 9613-2*, 'Acoustics – Attenuation of sound during propagation outdoors' algorithm. Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations. The algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.

### 5.1.1 Noise sources

Based on information provided at the time of the assessment, it is understood the primary sources of noise emission will include:

- 2 5.35MVA Rectifier Transformer (and 1 standby rectifier transformer)
- 2 5MW Rectifier (and 1 standby rectifier)
- 4 6.25MVA Power Transformer (3 will be operational at the start of the substation)
- direct current circuit breaker (DCCB).

DCCB tripping is an extremely infrequent event with approximately 3 openings within a substation per year if the openings were uniformly spread across all DCCB's.

Similarly, any emergency alarms are considered one-off events and not included in this assessment.

The noise source levels of operational noise equipment are detailed in Table 5-1. These noise levels are within the range of values provided by Sydney Trains in the *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013)

**Table 5-1 Equipment noise source information**

Equipment	Noise level	Source of data
Rectifier	L <sub>Aeq</sub> 60 dB(A) Internal sound pressure level	Measurement data from GHD Erskineville traction substation site visit
Transformer: 5.35 MVA	L <sub>Aeq</sub> 79 dB(A) Sound power level	Based on CadnaA transformer noise equations. Confirmed by measurements undertaken on 10 February 2010 at the Erskineville traction substation.
Transformer: 6.25 MVA	L <sub>Aeq</sub> 82 dB(A) Sound power level	
DCCB	L <sub>Amax</sub> 113 dB(A) Internal sound pressure level	Measurement data from the Waverton traction substation noise assessment

As rectifier and transformer noise levels fluctuate with loading, worst-case noise levels have been used for assessment purposes even though it is unlikely that the transformers will be under maximum load during the night time period.

Past measurements indicate that low frequency characteristics (in the 20 Hz to 250 Hz range) are typically present in transformers. Therefore, a plus 5 dB(A) factor adjustment has been applied to the transformer noise emission levels.

### 5.1.2 Substation building construction

Building components, with their modelled insertion loss (IL) or reduction index ( $R_w$ ) are as follows:

- 200 mm precast concrete walls,  $R_w$  55
- metal roof  $R_w$  45
- solid core access doors,  $R_w$  30
- louvre screens, 7 dB(A) insertion loss
- office window,  $R_w$  15.

### 5.1.3 Noise modelling

The following noise modelling assumptions were made:

- surrounding land was modelled assuming a hard reflective surface with a ground absorption coefficient of 0
- the noise model was used to predict noise levels during worst case (peak loading) substation operations
- atmospheric absorption was based on an average temperature of 10 °C and an average humidity of 70%
- atmospheric propagation conditions were modelled with favourable wind conditions for noise propagation (downwind conditions) or equivalently a well-developed moderate ground based temperature inversions.

The following modelling cases were run:

- Case 1: Rectifier and transformers operating for assessment against the  $L_{Aeq(night)}$  amenity noise criteria
- Case 2: Substation DCCB tripping for assessment against the external sleep disturbance criteria of  $L_{Amax}$  70 dB(A).

Results were assessed at the ground floor (1.5 m) and first floor (4.5 m). Receivers on levels above the first floor would experience noise levels less than or similar to the first floor predicted noise levels.

## 5.2 Operational Noise Results

The worst case noise levels at sensitive residential receivers surrounding the site are shown in Figure 2 to Figure 5 for case 1 and case 2, respectively. The predicted noise levels with a comparison against the noise criteria are provided in Table 5-2 and Table 5-3. Exceedances from the  $L_{Aeq(night)}$  (Table 5-2) and sleep disturbance criteria (Table 5-3) are provided in brackets with positive values indicating potential adverse impacts.

**Table 5-2 Predicted operational noise levels during normal operations, dB(A)**

Receiver	Operational criteria , $L_{Aeq(night)}$	Predicted noise levels, $L_{Aeq(night)}$	
		Receiver height	
		1.5 m	4.5 m
R1: 100-114 Chalmers St (Ground to fourth floor)	45	34 (-11)	35 (-10)
R2: 116-118 Chalmers St (First and second floor)	45	32 (-13)	34 (-11)
R3: 120-124 Chalmers St (Ground to second floor)	45	31 (-14)	33 (-12)
R4: 126-140 Chalmers St (First to fifth floor)	45	30 (-15)	31 (-14)
R5: Prince Alfred Park	55	43 (-12)	45 (-10)
R6: Prince Alfred Park swimming pool	60	37 (-23)	39 (-21)
R7: Presbyterian Church, 142-144 Chalmers St	50	28 (-22)	29 (-21)
R8: Tom Mann Theatre, 126- 140 Chalmers St (Ground floor)	40	30 (-10)	31 (-9)
R9: Reprise Media Australia, 100 Chalmers St (Ground floor)	65	34 (-31)	35 (-30)
R10: Australian Online Solutions, 94-98 Chalmers St	65	34 (-31)	35 (-30)
R11: Ground floor commercial premises along 116-140 Chalmers St	65	31 (-34)	32 (-33)
R12: Railway Institute, 101 Chalmers St	65	40 (-25)	40 (-25)

**Table 5-3 Predicted operational noise levels during DCCB tripping, dB(A)**

Receiver	Sleep disturbance criteria. $L_{Amax}$	Predicted noise levels (dB(A))	
		Receiver height	
		1.5 m	4.5 m
R1: 100-114 Chalmers St (Ground to fourth floor)	60	64 (+4)	66 (+6)
R2: 116-118 Chalmers St (First and second floor)	60	63 (+3)	65 (+5)
R3: 120-124 Chalmers St (Ground to second floor)	60	62 (+2)	64 (+4)
R4: 126-140 Chalmers St (First to fifth floor)	60	60 (0)	62 (+2)

Based on supplied information and modelling assumptions the predicted noise levels indicate the following:

- For Case 1, with transformers and rectifiers operating at full load, the operational noise criteria are not predicted to be exceeded at any sensitive receiver
- For Case 2, with DCCB tripping, the sleep disturbance criteria are predicted to be exceeded at all residential receivers. However, DCCB tripping is an extremely infrequent event with approximately 3 openings within a substation per year. With the development of additional substations the risk of DCCB tripping is further reduced. Therefore due to the infrequency of events, DCCB tripping is not anticipated to adversely impact surrounding residences.

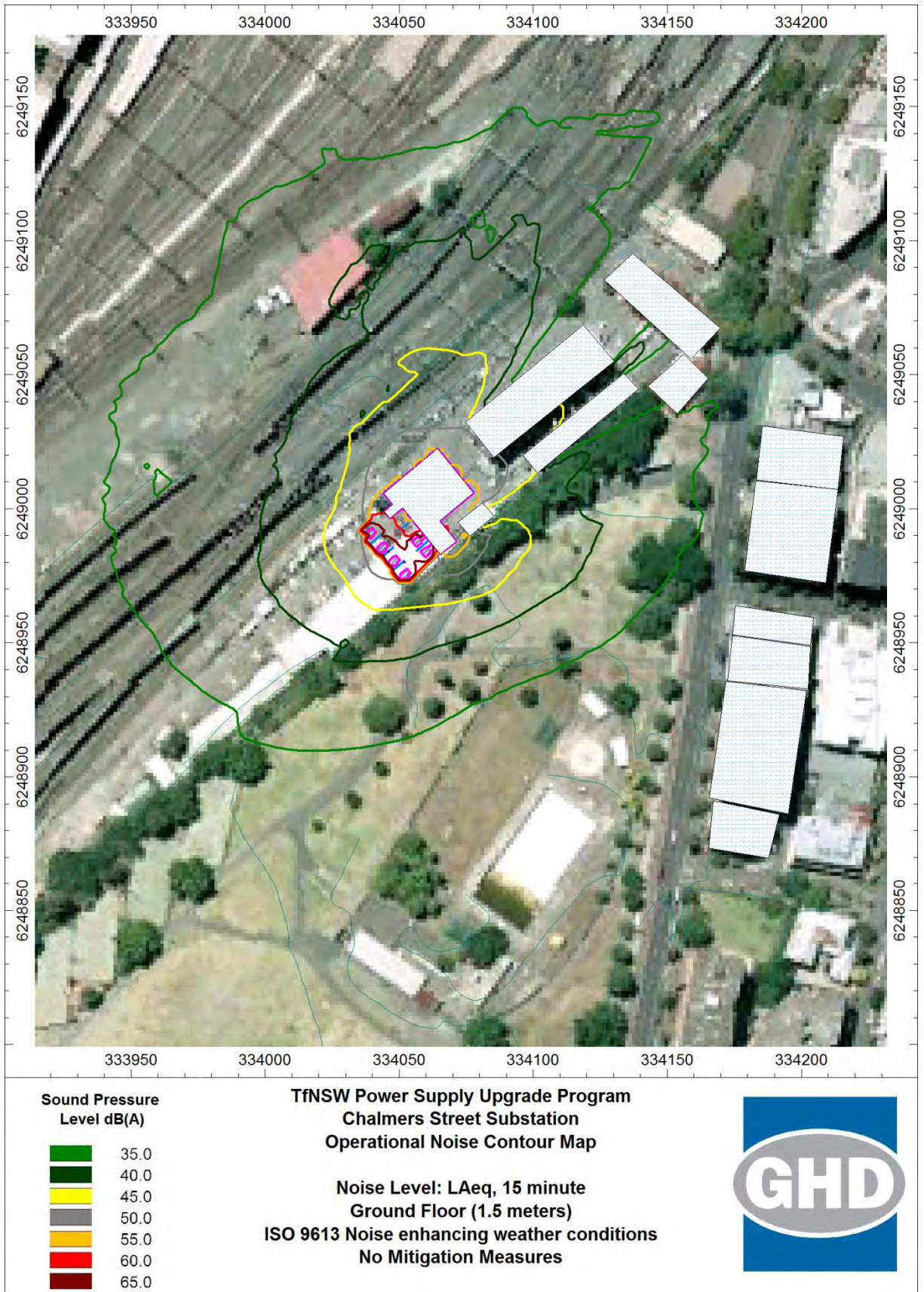


Figure 2 Case 1: Predicted  $L_{Aeq(night)}$  noise levels, dB(A) at a receiver height of 1.5 m

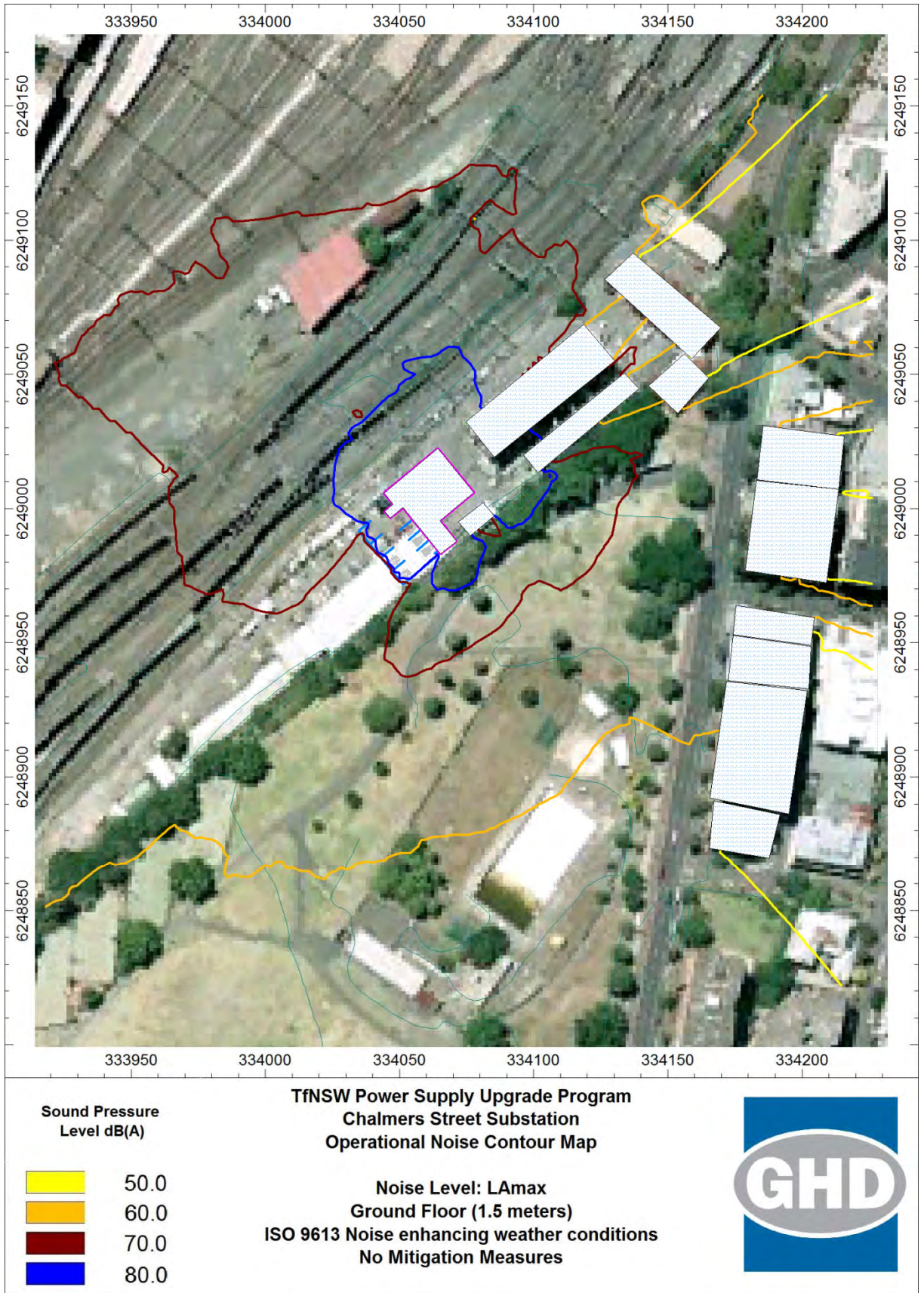


Figure 3 Case 2: Predicted L<sub>max</sub> noise levels, dB(A) at a receiver height of 1.5 m



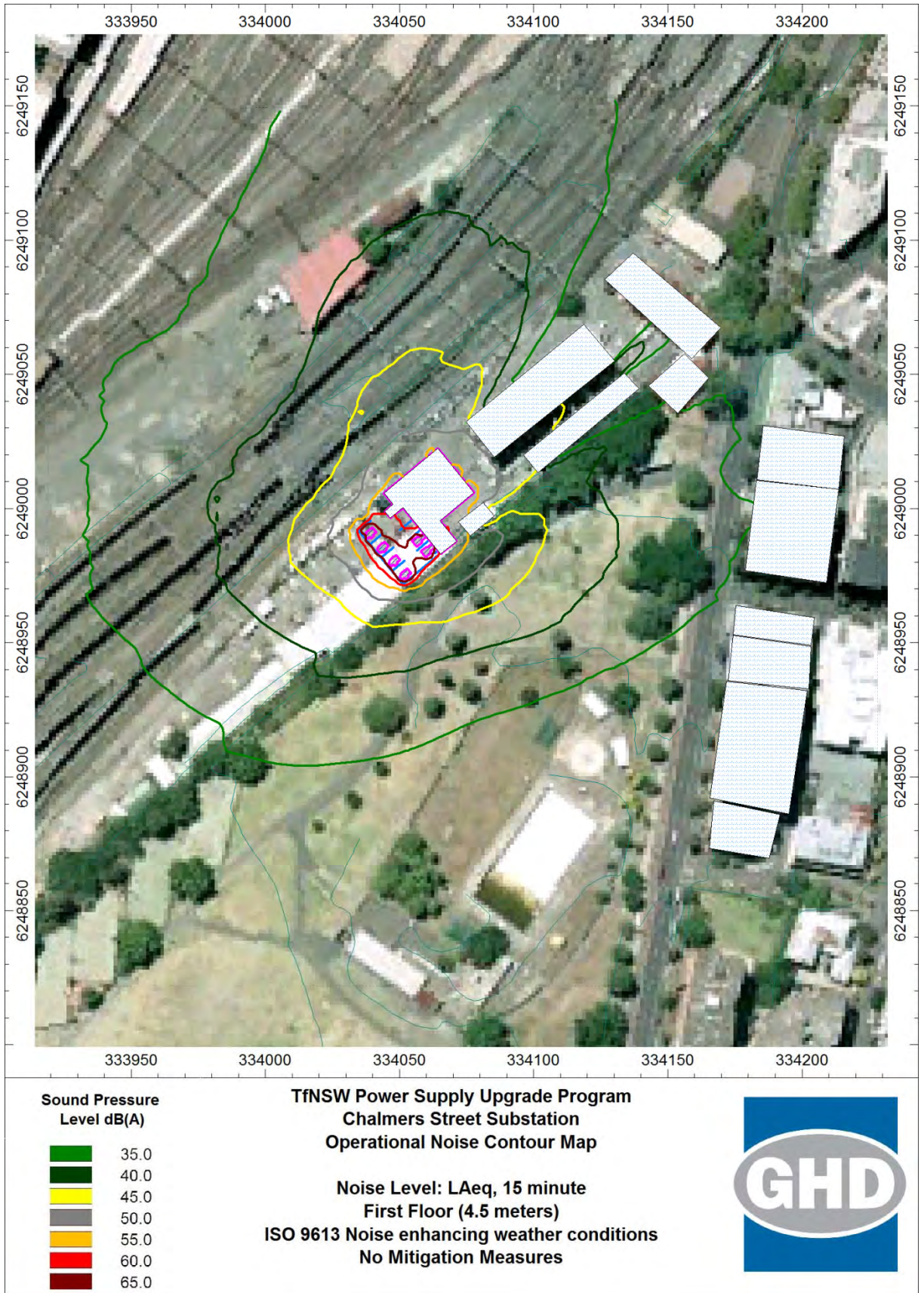


Figure 4 Case 1: Predicted  $L_{Aeq(night)}$  noise levels, dB(A) at a receiver height of 4.5 m

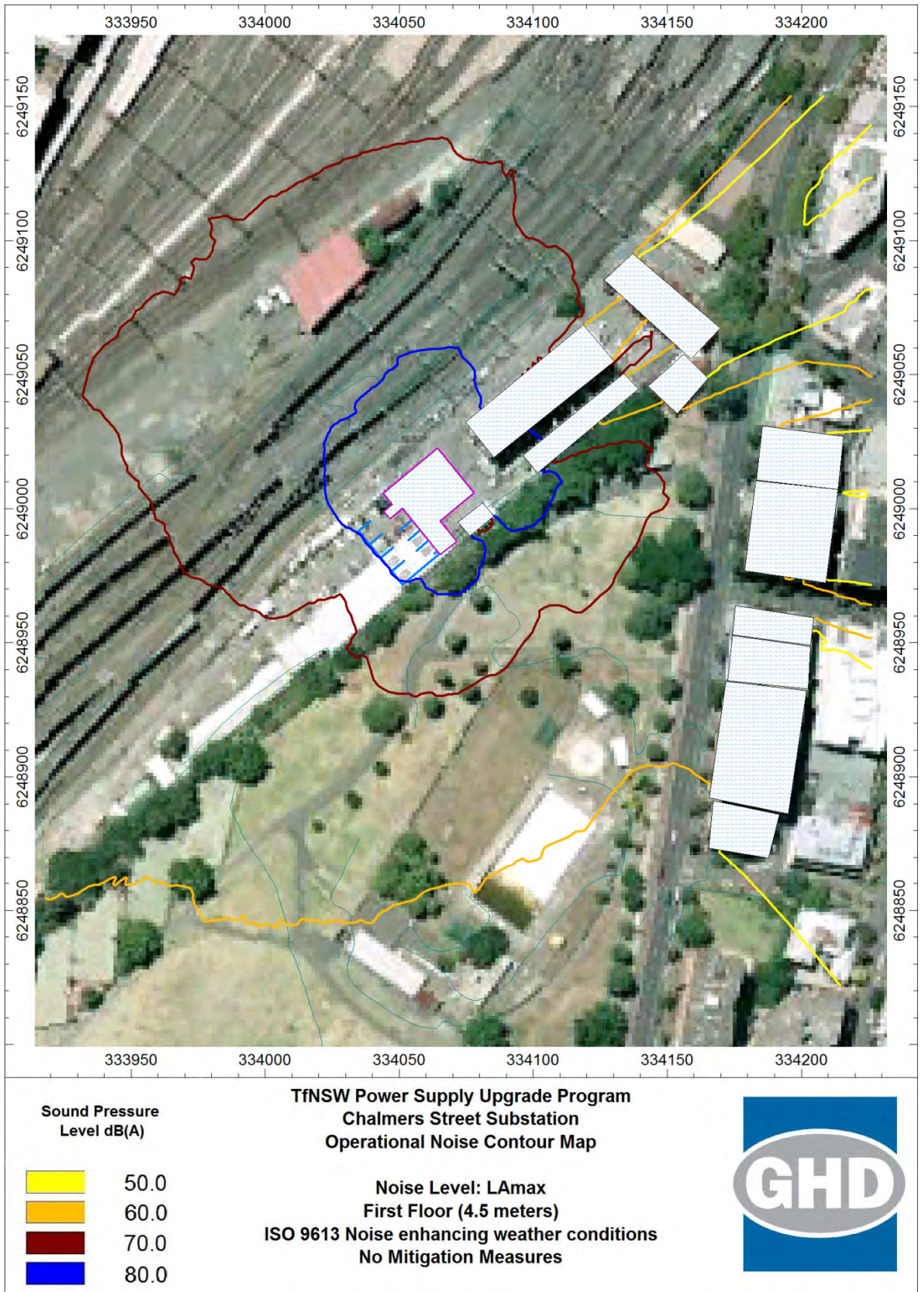


Figure 5 Case 2: Predicted  $L_{Amax}$  noise levels, dB(A) at a receiver height of 4.5 m

### 5.3 Operational traffic noise

Staff will occasionally access the site out of normal business hours to perform maintenance works. Vehicle movements associated with servicing and maintenance will be infrequent and are not expected to cause noise impacts in an urban area. Therefore no operational traffic noise impacts are anticipated at sensitive receivers.

## 6. Mitigation measures

### 6.1 Construction noise and vibration

As discussed in the construction noise impact assessment, there is the potential that construction activities could cause adverse impact on surrounding sensitive receivers. In practice, all reasonable and feasible measures would be implemented to minimise noise emissions from the construction activities. A Noise and Vibration Management Plan would be prepared and implemented for the proposal including the mitigation measures in the following sections.

The mitigation measure provided are in accordance with the Construction Noise Strategy (TfNSW, 2012) and the Interim Construction Noise Guideline (DECC, 2009).

#### 6.1.1 Standard mitigation measures

The noise and vibration mitigation measures detailed in Table 6-1 would be implemented to reduce the impact on the surrounding receivers and sensitive land uses.

**Table 6-1 Standard mitigation measures for construction noise and vibration**

Action required	Details
Management measures	
Implement community consultation measures	<ul style="list-style-type: none"> <li>• periodic notification (letterbox drop or equivalent)</li> <li>• website</li> <li>• project info-line</li> <li>• construction response line</li> <li>• email distribution list</li> <li>• community based forums (if required by approval conditions)</li> </ul>
Site inductions	<p>All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:</p> <ul style="list-style-type: none"> <li>• all relevant project specific and standard noise and vibration mitigation measures</li> <li>• relevant licence and approval conditions</li> <li>• permissible hours of work</li> <li>• any limitations on high noise generating activities</li> <li>• location of nearest sensitive receivers</li> <li>• construction employee parking areas</li> <li>• designated loading/ unloading areas and procedures</li> <li>• construction traffic routes</li> <li>• site opening/closing times (including deliveries)</li> <li>• environmental incident procedures.</li> </ul>
Behavioural practices	<p>No unnecessary shouting or loud stereos/radios on site.</p> <p>No dropping of materials from height, throwing of metal items and slamming of doors.</p>
Monitoring	Noise monitoring should be conducted at the commencement of out of hours works.
Attended vibration measurement	Vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent building damage to heritage sites.

Action required	Details
<b>Source controls</b>	
Construction hours and scheduling	Where reasonable and feasible, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period	If highly noise affected impacts are predicted high noise and vibration generating activities may only be scheduled between the following hours, unless inaudible at nearby residential properties and/or other noise sensitive receivers: (a) 8 am to 12 noon, Monday to Saturday (b) 2 pm to 5 pm Monday to Friday. An example of these activities includes jack hammering/rock breaking, concrete cutting/grinding, compacting/vibratory rolling and impact piling.
Equipment selection	Use quieter and less vibration emitting construction methods where reasonable and feasible.
Maximum noise levels	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria listed in Table 2 of the <i>Construction Noise Strategy</i> .
Use and siting of plant	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.
Plan worksites and activities to minimise noise and vibration	Plan traffic flow, parking and loading/ unloading areas to minimise reversing movements within the site.
Non-tonal reversing alarms	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Minimise disturbance arising from delivery of goods to construction sites	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
<b>Path controls</b>	
Shield stationary noise sources such as pumps, compressors, fans etc.	Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained.
Shield sensitive receivers from noisy activities	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when siting plant.

### 6.1.2 Additional noise mitigation measures

Due to the highly variable nature of the activities and the potential of work needing to be undertaken outside the standard construction hours, the proposal's noise management levels are likely to be exceeded at times. Consultation and cooperation with the neighbours of the site will assist in minimising uncertainty, misconceptions and adverse reactions to noise.

In circumstances where the noise levels are predicted to exceed acceptable levels after implementation of the general work practices, the relevant additional mitigation measures detailed in Table 6-2 should be considered.

Based on the predicted noise levels, additional mitigation measures detailed in Table 6-2 are likely to be required for works during standard construction hours. The additional mitigation

measures during recommended standard construction hours are limited to letter box drops and compliance noise monitoring.

**Table 6-2 Additional mitigation measures**

Criteria		L <sub>Aeq(15 min)</sub> noise level above rating background level			
		0 to 10 dBA	10 to 20 dBA	20 to 30 dBA	>30 dBA
Time period		Noticeable	Clearly audible	Moderately intrusive	Highly intrusive
Standard	Weekday (7am– 6pm)	-	-	LB, M	LB, M
	Saturday (8am – 1pm)				
Evening	Weekday (6pm–10pm)	-	LB	M, LB	M, IB, LB, PC, SN
	Saturday (1pm – 10pm)				
	Sunday (8am – 6pm)				
Night	Weekday (10pm–7am)	LB	M, LB	M, IB, LB, PC, SN	AA, M, IB, LB, PC, SN
	Saturday (10pm – 8am)				
	Sunday (6pm – 7am)				

**Monitoring (M):** Compliance noise monitoring

**Individual Briefings (IB):** Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the proposal.

**Letter box drops (LB):** Letter box drops or media advertisements.

**Phone Calls (PC):** Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs.

**Specific Notifications (SN):** Specific notifications are letterboxed or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications.

**Alternative accommodation (AA)**

Source: *Construction Noise Strategy (Rail Projects)*, (TfNSW, 2012)

## 6.2 Construction vibration

There is the potential that vibration in the vicinity heritage structures (Sydney terminal and yards) could exceed the building damage criteria. It is recommended that the contractor should undertake the following mitigation measures:

- A dilapidation survey for all heritage buildings within 20 m of vibration intensive compaction equipment.
- Compliance vibration monitoring during operation of any vibration intensive construction equipment to ensure compliance with the building damage criteria for heritage buildings.
- Prepare a Noise and Vibration Management Plan detailing construction vibration management measures including:
  - A trigger alarm system to notify site personnel when vibration limits have been exceeded

- Reducing force or load to prevent exceedences
- Providing alternative equipment or methodologies where feasible and reasonable to minimise vibration impacts.

### 6.3 Operational noise

The predicted operational noise levels are expected to comply with the proposal specific criteria at all sensitive receivers. Therefore, specific operational mitigation measures are not required at the Chalmers Street substation. However, general noise management mitigation measures include:

- Ensuring that transformers, rectifiers and other electrical equipment on site are well maintained and operating according to specifications. If noise levels are significantly higher than those modelled as part of this assessment, the use of mufflers or other acoustic treatment methods should be investigated.
- Scheduling maintenance operations during the day time period to minimise potential for adverse impacts at sensitive receivers.
- Investigating and addressing noise complaints.
- Conducting post construction operational noise monitoring to assess compliance against operational noise criteria and undertake remedial measures to achieve compliance if required.

## 7. Conclusions

Construction activities during recommended standard construction hours are predicted to exceed the noise affected construction noise management level at sensitive receivers. Reasonable and feasible construction noise and vibration mitigation measures have been recommended, which would minimise noise impacts at potentially affected receivers.

Some construction activities may be required to be undertaken outside of scheduled construction hours. These would be limited to scheduled track possession periods and involve activities such as connection to the overhead wiring equipment, installation of certain electrical equipment and delivery of oversized equipment. These activities are not expected to cause adverse impacts at sensitive receivers. It is recommended that noise monitoring should be conducted at the start of these works to determine compliance with out of hour work noise management levels and sleep disturbance criteria.

Construction traffic noise is not expected to cause adverse impacts as it would not be significant when compared with the daily existing vehicle numbers in the central business district. Therefore no construction traffic noise impacts are anticipated at sensitive receivers.

There is potential for some human comfort vibration impacts at sensitive receivers when ground compaction is within 50 m. The human comfort vibration impacts would be short-term in nature and where possible scheduled during standard construction hours. Sensitive receivers and land uses within the safe working distance buffers would be informed of the nature of the work, duration and contact details as part of the proposal communications strategy.

The building damage vibration criterion for heritage buildings is much more stringent. There is the potential that these heritage structures could exceed the building damage criteria during vibration intensive activities, particularly any percussive activities. Reasonable and feasible construction vibration mitigation measures for heritage structures have been recommended in Section 6.

Operational noise from the proposal is predicted to comply with the INP at the surrounding sensitive receivers during general operations. Operational noise from DCCB tripping is expected to exceed the sleep disturbance screening test. However, due to the infrequency of DCCB tripping events per year, sleep disturbance adverse impacts are not expected.

Vehicle movements associated with site operations will be infrequent and are not expected to cause noise impacts in an urban area. Therefore no operational traffic noise impacts are anticipated at sensitive receivers.

The proposal should be acceptable from an acoustic perspective assuming the recommended mitigation measures are implemented.



## 8. References

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*Guide to noise and vibration control on construction, demolition and maintenance sites, AS 2436 - 2010*, Australian Standards, 2010

*Industrial Noise Policy*, Environmental Protection Authority, January 2000

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*Structural Vibration Part 3: Effects of vibration on structures, DIN 4150-3 -1999*, German Standards, 1999

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133 Castlereagh St Sydney NSW 2000

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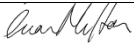
T: +61 2 9239 7100 F: +61 2 9239 7199 E: sydmail@ghd.com.au

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		Name	Signature	Name	Signature	Date
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1	M Weston	E Milton		F. Palermo		07/04/15
2	M Weston	E Milton		F. Palermo		24/07/15

# Appendix E – Ecology desktop assessment results

## Threatened ecological communities

Community	TSC Act	EPBC Act	Habitat Association	Details of record	Presence in study area
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	EEC		Occurs on the Cumberland Plain with the most extensive stands in Castlereagh and Holsworthy areas. Smaller remnants in Kemps Creek area and eastern section of the Cumberland Plain. Ranges from open forest to low woodland. Dense shrubby understorey over sparse ground layer of grasses and herbs.	Recorded within 10km (OEH 2012a)	No native vegetation communities present.
Cumberland Plain Woodland in the Sydney Basin Bioregion	EEC		Grassy woodland/forest endemic to the hills and plains of the Cumberland Plain.	Recorded within 10km (OEH 2012a)	No native vegetation communities present.
Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion	EEC	EEC	Remaining stands totalling approximately 146 hectares have been recorded from the local government areas of Botany, Randwick, Waverley, and Manly. Occurs on disjunct patches of nutrient poor aeolian (wind blown) dune sand. The community possesses soil seed bank and has been observed to regenerate naturally on cleared sand where the soil profile remains intact (OEH 2012).	Recorded within 10km (OEH 2012a) Predicted to occur within 10km (DSEWPaC 2012a)	No native vegetation communities present.
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	EEC	-	Occurs in coastal areas subject to periodic flooding with standing fresh water for at least part of the year. Typically on silts, muds or humic loams below 20 m elevation in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes.	Recorded within 10km (OEH 2012a)	No native vegetation communities present.
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions; Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	EEC	CEEC	Occurs along the NSW coast, usually within 2 km of the ocean on a variety of substrates. Variable structure and composition, typically with closed canopy. Generally rainforest species with vines a major component.	Recorded within 10km (OEH 2012a) Predicted to occur within 10km (DSEWPaC 2012a)	No native vegetation communities present.
Moist Shale Woodland in the Sydney Basin Bioregion	EEC	CEEC	Occurs on clay soils from Wianamatta Shale in the southern half of the Cumberland Plain, and is intermediate between Cumberland Plain Woodland and Western Sydney Dry Rainforest. Similar to Cumberland Plain Woodland but with more mesic shrub understorey.	Recorded within 10km (OEH 2012a) Predicted to occur within 10km (DotE 2013a)	No native vegetation communities present.
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	EEC	-	Occurs on flats, drainage lines and river terraces of coastal floodplains where flooding is periodic and soils generally rich in silt, lack deep humic layers and have little or no saline (salt) influence. Characterised by a tall open canopy layer of eucalypts with variable species composition.	Recorded within 10km (OEH 2012a)	No native vegetation communities present.

Community	TSC Act	EPBC Act	Habitat Association	Details of record	Presence in study area
Swamp Oak Floodplain forest of the NSW North Coast, Sydney basin and South East Corner Bioregions	EEC	-	Typically occurs below 20m asl on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes on coastal floodplains of NSW. Associated with grey-black clay-loams and sandy loams, saline or sub-saline groundwater. Structure variable from open forests to scrubs or reedlands with scattered trees. Canopy dominated by <i>Casuarina glauca</i> .	Recorded within 10km (OEH 2012a)	No native vegetation communities present.
Swamp Sclerophyll forest on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	EEC	-	Usually occurs below 20m asl (sometimes up to 50m). Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Characterised by open to dense tree layer of eucalypts and paperbarks.	Recorded within 10km (OEH 2012a)	No native vegetation communities present.
Sydney Turpentine-Ironbark Forest	EEC	CEEC	Occurs on the Cumberland Plain , with most remnants in Baulkham Hills, Hawkesbury, Hornsby, Ku-ring-gai, Parramatta, Ryde, Sutherland and Wollondilly LGAs. Open forest with a sparse shrub stratum.	Recorded within 10km (OEH 2012a) Predicted to occur within 10km (DotE 2013a)	No native vegetation communities present.

## Threatened flora

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Acacia prominens</i>	Gosford Wattle	EP (Hurstville and Kogarah)	-	Occurs at a few sites along the railway line at Penshurst, at Carss Bush Park, Carss Park and there is an unconfirmed siting at Oatley Park, Oatley. Grows in open situations on clayey or sandy soils. Habitats mostly cleared and occurs as isolated or small groups of trees.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.
<i>Acacia pubescens</i>	Downy Wattle	V	V	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravely, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Acacia terminalis</i> <i>subsp. terminalis</i>	Sunshine Wattle	E	E	Occurs in near-coastal areas from northern shores of Sydney Harbour south to the northern and western shores of Botany Bay. Occurs on sandy soil on creek banks, hillslopes of in shallow soil in rock crevices and sandstone platforms on cliffs. Grows in scrub and open eucalypt woodland or forest.	Recorded within 10km (OEH 2013a) Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable vegetation or geomorphology present.
<i>Allocasuarina portuensis</i>	Nielsen Park She-oak	E	E	Restricted to within Nielsen Park (part of Sydney Harbour NP) in Woollahra. Cultivars have been planted throughout Sydney Harbour NP e.g. Gap Bluff, Hermit Point and Vaucluse House. Originally found on a sandstone shelf approximately 20 m above the harbour, on shallow sandy soils in tall closed woodland. Has been planted in a variety of habitats.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Callistemon linearifolius</i>	Netted Bottlebrush	V	-	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. In Sydney, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.
<i>Chamaesyce psammogeton</i>	Sand Spurge	E	-	Sparse populations along the coast from south of Jervis Bay to Queensland. Grows on fore-dunes and exposed headlands, often with <i>Spinifex sericeous</i> .	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgeland, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with <i>Cryptostylis subulata</i> and the <i>Cryptostylis erecta</i> . Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable vegetation or geomorphology present.
<i>Darwinia biflora</i>		V	V	Known from north and north-western Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai LGAs. Grows on the edges of weathered shale-capped ridges, at the intergrade with Hawkesbury Sandstone. Occurs in woodland, open forest and scrub/heath. Associated overstorey species include Eucalyptus haemastoma, Corymbia gummifera and/or E. squamosa.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Dillwynia tenuifolia</i>	Dillwynia tenuifolia, Kemps Creek	EP		Bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area. This population occurs on a small outlier of the Berkshire Park Soil Landscape; the site supports a transition from Castlereagh	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Diuris arenaria</i>	Sand Doubletail	E	-	Known from Tomaree Peninsula near Newcastle, in three locations. Inhabits coastal heath and dry grassy eucalypt forest on sandy flats on clay soil.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>		V	-	Occurs from Gosford in the north, Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Grows in a range of sclerophyll forest, scrubs and swamps, most of which have a strong shale soil influence.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	V	Occurs from Raymond Terrace to Waterfall, with populations known from Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai and the Royal NP. Occurs in exposed situations on sandstone plateaus, ridges and slopes near the coast, often on the boundary of tall coastal heaths or low open woodland. It grows in shallow sandy soils overlying Hawkesbury sandstone.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Eucalyptus scoparia</i>		E	V	Occurs mostly in Queensland with only three known occurrences in NSW near Tenterfield. In NSW it is found on well-drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Lasiopetalum joyceae</i>		V	V	Occurs on Hornsby Plateau between Berrilee and Duffys Forest, south of the Hawkesbury. Grows on lateritic to shaley ridgetops, in heath on sandstone.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Meleleuca biconvexa</i>	Biconvex Paperbark	V	V	Scattered, disjunct populations in coastal areas from Jervis Bay to Port Macquarie, with most populations in the Gosford-Wyong areas. Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Predicted to occur within 10km (DSEWPac 2012a)	Nil. No suitable vegetation or geomorphology present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Occurs from Nowra- St Albans and west to the Blue Mountains, with most records in Ku-ring-gai / Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath- open forest, often in sandstone ridgetop woodland communities.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.
<i>Pelargonium sp. Striatellum</i> (G.W.Carr 10345)	Omeo Stork's-bill	E	E	Omeo Storks-bill <i>Pelargonium</i> sp. (G.W. Carr 10345), syn. <i>P. striatellum</i> , is a tufted perennial forb known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Predicted to occur within 10km (DSEWPaC 2012a)	Nil. Outside known distribution.
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	Confined to area between North Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable vegetation or geomorphology present.
<i>Pimelea spicata</i>	Spiked Rice Flower	E	E	In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).	Predicted to occur within 10km (DSEWPaC 2012a)	Nil. Outside known distribution.



Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Pomaderris prunifolia</i>		EP (Parramatta, Auburn, Strathfield and Bankstown LGAs)	-	Known from only 3 sites within population range: at Rydalmere, within Rookwood Cemetery and at The Crest of Bankstown. At Rydalmere occurs along a road reserve near a creek, among grass species on sandstone. At Rookwood Cemetery occurs in small gully of degraded Cooks River / Castlereagh Ironbark Forest on shale soils.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Prostanthera junonis</i>	Somersby Mintbush	E	E	Restricted to nine populations within the Somersby Plateau in Gosford/Wyong LGAs. Grows on gently undulating country on Hawkesbury Sandstone. Inhabits open forest, low woodland and open scrub, in disturbed and undisturbed sites. Predominately found in low woodland dominated by <i>E. haemastoma</i> and associated ecotone areas (NSW NPWS 2000).	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Prostanthera marifolia</i>	Seaforth Mintbush	CE	Ex	Only known from a 2 x 2 km area in Seaforth, N Sydney. Associated with the endangered Duffys Forest ecological community. Grows on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Predicted to occur within 10km (DSEWPaC 2012a)	Nil. Outside known distribution.
<i>Pterostylis sp. Botany Bay</i>	Botany Bay Bearded Orchid	E	E	Restricted to the Sydney region where it is known from a small number of sites within Botany Bay National Park on the Kurnell Peninsula. Occupies moist level sites on skeletal sandy soils derived from sandstone.  Associated vegetation is coastal heath. Occurs in small localised populations, usually in areas within the heath where the canopy allows filtered light to reach the ground.	3 record within 10km (OEH 2012a) Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable vegetation or geomorphology present.
<i>Senecio spathulatus</i>	Coast Groundsel	E		Coast Groundsel occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah). Grows on frontal dunes.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Streblus pendulinus</i>	Siah's backbone		E	Siah's Backbone occurs from Cape York Peninsula to Milton, south-east New South Wales (NSW), as well as Norfolk Island. Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest (ATRP 2010).	Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable vegetation or geomorphology present.
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	V	Occurs in narrow coastal strip from Bulahdelah to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Recorded within 10km (OEH 2013a) Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable vegetation or geomorphology present.
<i>Tetradlea glandulosa</i>		V	V	Restricted to The Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong LGAs. Associated with shale-sandstone transition habitat (shale-cappings over sandstone). Occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils generally shallow, yellow, clayey/sandy loam, commonly with lateritic fragments. Vegetation varies from heath to open forest.	Recorded within 10km (OEH 2013a) Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable vegetation or geomorphology present.
<i>Thesium australe</i>	Austral Toadflax	V	V	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass ( <i>Themeda australis</i> ).	Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable vegetation or geomorphology present.
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	EP		Found in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. Typically occurs in damp, disturbed sites (with natural or human disturbance of various forms), typically amongst other herbs rather than in the open.	Recorded within 10km (OEH 2013a)	Nil. Outside known distribution.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Wilsonia backhousei</i>	Narrow-leaved Wilsonia	V	-	In NSW it is scattered along the coast with a northern limit of Wamberal, N of Sydney. Most extensive stands at Jervis Bay. Grows on the margins of saltmarshes and lakes.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.
<i>Zannichellia palustris</i>		E		Known from the Lower Hunter and Sydney Olympic Park. A submerged aquatic plant that grows in fresh or slightly saline water.	Recorded within 10km (OEH 2013a)	Nil. No suitable vegetation or geomorphology present.

### Threatened fauna

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<b>Birds</b>						
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Favours permanent freshwater wetlands with tall dense reedbeds particularly <i>Typha</i> spp. and <i>Eleocharis</i> spp., with adjacent shallow, open water for foraging.	Recorded within 10km, (OEH 2013) Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Rostratula australis</i>	Australian Painted Snipe	E	V, M	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Ninox connivens</i>	Barking Owl	V	-	Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage, or dense eucalypt canopy. Nests in hollows of large, old eucalypts. Territories range from 30 to 200 hectares.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Ixobrychus flavicollis</i>	Black Bittern	V	-	Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Falco subniger</i>	Black Falcon	V		The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. Occurs in plains, grasslands, foothills, timbered watercourses, wetland environs, crops, and occasionally over towns and cities.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Burhinus grallarius</i>	Bush Stone-curlew	E		Scattered distribution across NSW. The nearest known population to the site is in CHECK (DEC 2006). Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (DEC 2006).	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Nettapus coromandelianus</i>	Cotton Pygmy Goose	E		Although once found from north Queensland to the Hunter River in NSW, the Cotton Pygmy-Goose is now only a rare visitor to NSW. Uncommon in Queensland. Occurs in Freshwater lakes, lagoons, swamps and dams.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Callocephalon fimbriatum</i>	Gang-gang cockatoo	V	-	Spends summer in tall mountain forests and woodlands, usually heavily timbered and mature wet sclerophyll forests. Winters at lower altitudes in drier more open eucalypt forest and woodlands, particularly in coastal areas. Nests in summer in large tree hollows.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V		Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Hieraaetus morphnoides</i>	Little Eagle	V		Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Cacatua leadbeateri</i>	Major Mitchells Cockatoo	V	-	Occurs in arid and semi-arid NSW, regularly as far east as Bourke and Griffith and occasionally further east as vagrants. Inhabits a range of treed and treeless inland habitats within easy reach of water. Nests in tree hollows.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	CE	CE	Breeds in Tasmania and migrates in winter to SE South Australia and southern Victoria. There are occasional reports from NSW, including Maroubra. In winter, usually found within 3 km of the coast in saltmarsh and strandline/ foredune vegetation. May also occur on golf-courses and other grassy areas.	Recorded within 10km, (OEH 2013) Predicted to occur within 10km (DSEWPac 2012a)	Nil. No suitable habitat present.
<i>Ninox strenua</i>	Powerful Owl	V		Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Forages within open and closed woodlands as well as open areas.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Erythrorchis radiatus</i>	Red Goshawk	CE	V	Prefer woodlands and forests with a mosaic of vegetation types that are open enough for fast manoeuvring flight, avoiding very open or very dense habitats. In NSW inhabits mixed subtropical rainforest, Melaleuca swamp forest and open eucalypt forest along coastal rivers.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E	E	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought.	Recorded within 10km, (OEH 2013) Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Petroica boodang</i>	Scarlet Robin	V	-	Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Circus assimilis</i>	Spotted Harrier	V		Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km <sup>2</sup> .	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Ptilinopus superbis</i>	Superb Fruit Dove	V		Inhabits rainforest and closed forests, may also forage in eucalypt or acacia woodland with fruit-bearing trees. Nests 5-30 m above ground in rainforest/rainforest edge tree and shrub species. Part of the population migratory/nomadic.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	Occurs as a single population in the South-west Slopes and Riverina bioregions. Nest in hollow trees, in tall riparian River Red Gum communities (Riverina area) or open Box Gum woodland or isolated paddock trees (SW Slopes). Mainly forages in grassy box woodlands, up to 10km from breeding sites.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Lathamus discolor</i>	Swift Parrot	E	E	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. <i>Eucalyptus robusta</i> , <i>Corymbia maculata</i> and <i>C. gummifera</i> dominated coastal forests are important habitat in NSW.	Recorded within 10km, (OEH 2013) Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Epthianura albifrons</i>	White-fronted Chat	V, EP		This species is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Along the coast they are found in estuarine and marshy habitats with vegetation <1m tall, and in open grasslands and areas bordering wetlands.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<b>Mammals</b>						
<i>Petrogale pencillata</i>	Brush-tailed Rock-wallaby	E	V	Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V		Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas.	Recorded within 10km, (OEH 2013)	Unlikely. No suitable habitat in the subject site. May forage on occasion in the adjoining Prince Alfred Park, which would not be impacted by the proposal.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	Recorded within 10km, (OEH 2013) Predicted to occur within 10km (DotE 2013a)	Unlikely. No suitable habitat in the subject site. May forage on occasion in figs in the adjoining Prince Alfred Park, which would not be impacted by the proposal.
<i>Phascolarctos cinereus</i>	Koala	V	V	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Perameles nasuta</i>	Long-nosed Bandicoot population in inner western Sydney	EP	-	Occurs within Marrickville and Canada Bay LGAs, and may also occur in the Canterbury, Ashfield and Leichhardt LGAs. Shelter mostly under older houses and buildings, and forage in parkland and backyards.	Recorded within 10km, (OEH 2013)	Nil. Outside known distribution.
<i>Perameles nasuta</i>	Long-nosed Bandicoot population at North Head	EP	-	Restricted to North Head in the Manly LGA. Inhabits both heath and open lawns within the area, and individuals are occasionally observed in neighbouring gardens. Preferred foraging habitat is in areas with soft, moist soils, close to shelter (e.g. vegetation/buildings).	Recorded within 10km, (OEH 2013)	Nil. Outside known distribution.
<i>Potorous tridactylus</i>	Long-Nosed Potoroo	V	V	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy soil (Johnston 2008).	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.



Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Pseudomys novaehollandiae</i>	New Holland Mouse		V	Inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot	E	E	Inhabits scrubby vegetation, including heath, shrubland, and heathy forest and woodland. Often associated with well-drained soils and dry heathland communities, and prefers periodically burnt areas as this increases insect abundance.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Myotis macropus</i>	Southern Myotis	V		Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	Recorded within 10km, (OEH 2013) Predicted to occur within 10km (DSEWPaC 2012a)	Nil. No suitable habitat present.
<i>Petaurus australis</i>	Yellow-Bellied Glider	V	-	Inhabits a variety of forest types but prefers tall mature eucalypt forest with high rainfall and rich soils. Relies on large hollow-bearing trees for shelter and nesting, with family groups of 2-6 typically denning together. Mostly feeds on sap, nectar and honeydew.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<b>Reptiles</b>						
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V	-	Inhabits coastal heathlands, wet and dry sclerophyll forests, woodlands and mallee communities. Termite mounds are an important habitat feature: eggs are laid in the mounds in summer and incubate till spring, when the young dig themselves out.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<b>Frogs</b>						
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	Forage and live amongst deep, damp leaf litter in rainforest, moist eucalypt forest and nearby dry eucalypt forest. Breed in shallow, flowing rocky streams. Within Sydney Basin, confined to small populations in tall, wet forest in the Watagan Mountains north of the Hawkesbury and the lower Blue Mountains.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi ( <i>Typha</i> spp.) or spike rushes ( <i>Eleocharis</i> spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby.	Recorded within 10km, (OEH 2013) Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V	-	Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Details of record	Likelihood of occurrence
<i>Crinia tinnula</i>	Wallum Froglet	V		Found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They occur in sedgelands, wet heathlands, paperbark swamps and drainage lines within other vegetation communitiesBreeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches.	Recorded within 10km, (OEH 2013)	Nil. No suitable habitat present.
<b>Fish</b>						
<i>Prototroctes mairaena</i>	Australian Grayling -		V, M	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Epinephelus daemeli</i>	Black Rockcod, Black Cod, Saddled Rockcod		V	Occurs from southern Queensland through NSW to northern Victoria. Generally inhabits near-shore rocky and offshore coral reefs at depths down to 50m (DSEWPAC 2012a)	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.

## Terrestrial migratory species listed under the EPBC Act

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Recorded/predicted to occur within 10 km	Likelihood of occurrence
<b>Birds</b>						
<i>Rostratula australis</i>	Australian Painted Snipe	E	V, Migratory Wetlands	Refer to threatened biota table above.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	Migratory Terrestrial	This species of bird usually inhabits dense gullies of rainforest, sclerophyll forests and eucalypt woodlands along the coastal regions from Victoria to Cape York and is migratory over much of its range.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Ardea ibis</i>	Cattle Egret	-	Migratory Marine, Wetlands	This species occurs in grasslands, woodlands, wetlands and pasture areas often seen with cattle and other animals. It makes shallow platform nests in wetland areas in surrounding trees and shrubs.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Pandion haliaetus</i>	Eastern Osprey	V	M	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Nests are built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Apus pacificus</i>	Fork-tailed Swift	-	Migratory Marine	It is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. Mostly occur over inland plains but sometimes above foothills or in coastal areas, over cliffs and beaches and also over islands and sometimes well out to sea. They probably roost aerially, but are occasionally observed to land.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Ardea alba</i>	Great Egret	-	Migratory Marine, Wetlands	This species of wetland bird occurs in a variety of habitats including marshes, swamps, river margins, lake shorelines, flooded grasslands, sea-grass flats, mangrove swamps, coastal lagoons, and offshore coral reefs.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Gallinago hardwickii</i>	Latham's Snipe	-	Migratory Wetlands	This species of medium sized wading bird occurs in permanent and ephemeral wetlands up to 2000 m above sea-level, usually inhabiting open, freshwater wetlands with nearby low, dense vegetation such as swamps, flooded grasslands or heathlands, around bogs and other water bodies.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Habitat association	Recorded/predicted to occur within 10 km	Likelihood of occurrence
<i>Merops ornatus</i>	Rainbow Bee-eater	-	Migratory Terrestrial	Occurs in a variety of habitat but seems to prefer lightly timbered forests and woodlands, and various cleared or semi-cleared habitats, including farmland and areas of human habitation often located close to permanent water. Nests in enlarged chambers at the end of long burrow or tunnel excavated in flat or sloping ground, in the banks of rivers, creeks or dams, in roadside cuttings, in the walls of gravel pits or quarries, in mounds of gravel, or in cliff-faces.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Xanthomyza phrygia</i>	Regent Honeyeater	CE	E, Migratory Terrestrial	Refer to threatened biota table above.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	Migratory Terrestrial	This species is a breeding migrant to southeast Australia during July to December, wintering in Papua New Guinea. It prefers wetter eucalypt forests, gullies, coastal scrub, watercourses, and rainforests where it feeds of insects. Occasional reports have this species utilising parks and gardens during migration.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	Migratory Terrestrial	Prefers heavily vegetated gullies in forests, tall woodlands and during migration, coastal forests, woodlands, mangroves, trees in open country, and even gardens.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	-	Migratory Terrestrial	Occurs along the coastline of Australia and also range inland over large rivers and wetlands, favouring forested coasts and forested margins of inland waterways. Nests are usually near water, in tall live or dead trees or on remote coastal cliffs.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	Migratory Terrestrial	It is known to inhabit a variety of habitats including forests, woodlands, farmlands, plains, lakes, costs and towns. Feeds on insects during flight, chiefly ahead of weather changes. In Australia, this species is nomadic, responding to local weather changes.	Predicted to occur within 10km (DotE 2013a)	Nil. No suitable habitat present.

# Appendix F – Electromagnetic energy assessment

12/8 Tilley Lane  
Frenchs Forest NSW 2086  
AUSTRALIA

Tel +61 2 9975 4555  
Fax +61 2 9876 2796

Report No. 131106-2

**Prediction and Assessment of  
Electromagnetic Fields for the Proposed  
Railway Electrical Substation at  
Chalmers Street**

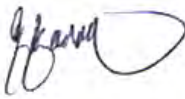
for

GHD

by

*Yu Ji*

PhD MSc (Elect) SMIEEE



Signed:

16 December 2013

*Geoffrey Garrett BE (Elect) Hons.*

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## APPLICABLE DOCUMENTS

- [1] AS/NZS 2344:2007 Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz.
- [2] ARPANSA Radiation Health Series (RHS) No. 30, Interim Guidelines on Limits of Exposure to 50/60 Hz Electric and magnetic Fields (1989).
- [3] RPS3 (Radiation Protection Standard 3), Maximum Exposure Levels to Radio-Frequency Fields – 3 kHz to 300 GHz (2002), National Health and Medical Research Council.
- [4] Guidelines for the Management of 50 Hz Magnetic Fields in Office Buildings Owned and Managed by the Queensland Department of Public Works.
- [5] AS/NZS CISPR 11: Industrial scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement.



## 1. INTRODUCTION

Transport for NSW has proposed a location at Chalmers Street near the Sydney Central Station for constructing a 33 kV AC to 1500V DC substation. The two storey building for accommodating the new substation will be built next to the existing Prince Alfred substation which will be decommissioned. The new steel framed building will consist of reinforced concrete footings and foundations, precast brick panels for the external walls, reinforced core-filled blockwork and a metal deck roof. Specific 33 kV and 11 kV feeders to the Prince Alfred substation will be relocated to connect to the Chalmers Street substation, which effectively replaces the Prince Alfred substation. Subsequently, an investigation on the impact of the electromagnetic effect on the surrounding community and on-site staff is required.

The location of the proposed Chalmers Street substation is shown in the aerial photograph of Figure 1, where marked in red. The new substation is bounded by Sydney Trains facilities to the south, the rail tracks to the west, the existing Prince Alfred substation to the north, and Prince Alfred Park to the east.

Power to the substation would be supplied via 33 kV underground cabling to the three transformer/rectifier pairs. Note that only two transformer / rectifier pairs will be in operation at any one time. Each set is comprised of a 5.35 MVA transformer (33 kV and 162 A at input) which produces a low voltage (3 phase star/delta supply of 600 V AC per phase at 5148 Amperes) fed to separate six phase rectifiers. The rectifier cabinet, which contains two three-phase bridge circuits with 1 diode in each bridge arm, then produces a DC output of 1500 Volts. A common reactor (a 0.5 mH inductor), smooths the 1500V DC rectifier output, which is to be connected to the railway catenary and track via underground cabling. The 1500V DC feeder cables are reticulated via a dedicated new tunnel underground, until emerging to existing 1500V switches located at the trackside. Four sets of existing 1500V Link Switches will be reused.

Figure 2 contains the substation floor plan showing the details of the electrical layout cabling, switchgears, transformers and rectifier. On the ground floor level, outside the substation, three 33/11 kV 6.25 MVA power transformers and three 5.35 MVA rectifier transformers will be located in a bunded yard. The three 5 MW rectifiers will be located on the first floor of the proposed substation. The 11 kV and 33 kV switchboards are each arranged in three sections, whereas the 1500V DC circuit breakers are arranged in two sections.

The electromagnetic fields that would be produced by the substation equipment and its configurations are considered in this report. Both power frequency and radio frequency fields can pose potential risk to human health, and interference risk to the operation of electrical equipment and appliances, if not appropriately managed. Unintentional transmission (or emission) of radio frequency fields can potentially interfere with radio and TV broadcast reception and radio communications equipment, resulting in degradation of reception quality.

## 2. OBJECTIVE

This report predicts the electromagnetic fields expected to be generated by the substation, and identifies potential constraints the electromagnetic fields may pose on the design of the substation, or impact these fields may have on the nearby residents or the wider community. This report assesses the health risks to human occupants within the vicinity of the substation due to electromagnetic exposure and effects on radio and TV broadcast reception and radio communications equipment that may be used in the area.

## 3. APPLICABLE STANDARDS

The following Australian standards are applicable:

- RHS 30 (Radiation Health Series 30), *Interim Guidelines on Limits of Exposure to 50/60 Hz Electric & Magnetic Fields* (1989), National Health and Medical Research Council
- RPS 3 (Radiation Protection Series No.3), *Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz* (2002), ARPANSA
- AS/NZS 2344: 1997 and Amdt 1: 2006 *Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz*

Tables 1a & 1b below, list the standards and limits for low frequency (50Hz) magnetic fields and radio frequency fields applicable to both human exposure and radiocommunications including broadcast radio and TV.

**Table 1a Human Exposure Limits - Magnetic Fields and Electric Fields**

Exposure Type	Applicable Standard	Magnetic Field	Electric Field
Occupational 50 Hz exposure (whole working day)	RHS 30	500 $\mu$ T	10 kV/m
General Public 50 Hz exposure (up to 24hrs per day)	RHS 30	100 $\mu$ T	5,000 V/m
Occupational RF exposure at 1 MHz (whole working day)	RPS 3	1.63 A/m	614 V/m
General Public RF exposure at 1 MHz (up to 24hrs per day)	RPS 3	0.729 A/m	86.8 V/m

**Table 1b Interference Limits – Radiocommunications**

Interference Type	Applicable Standard	Magnetic Field	Electric Field
Radiocommunications (overhead power lines)	AS/NZS 2344	0.84 $\mu$ A/m <sup>(1,2)</sup>	0.316 mV/m <sup>(1,2)</sup>

- Notes:
1. Limit in the frequency range of 0.15 MHz to 1.7 MHz
  2. Limit for urban areas.

Other than these standards, in Queensland Government owned or managed buildings, the managed limit of human exposure in “occupied areas” (4 hours or more per day on average) is 5  $\mu$ T (refer [4]).

## 4. ANALYSIS

### 4.1 Main Equipment in the Proposed Chalmers Street Substation

The main design elements for the proposed substation at Chalmers Street, Central, are listed below:

1. 1500V DC Switchgear, including 27-off 1500 V DC circuit breakers
2. 33 kV and 11kV AC Switchgear, including 14-off 33 kV circuit breakers and 30-off 11 kV circuit breakers
3. Three 5 MW 1500V DC Rectifiers
4. Three 5.3 MVA 33 kV/600V Rectifier Transformers
5. Smoothing Reactor
6. HV/LV Cables
7. Three 6.25 MVA 33/11 kV power transformer
8. Future 11 kV AC Harmonic Filter (to be installed in a separate enclosure approximately 10 metres away from the proposed substation building)

### 4.2 Sources of EMF

The main sources of EMF considered within the substation include:

- High Voltage (HV) power cabling
- Low Voltage (LV) power cabling
- HV to LV power transformers
- Rectifiers
- Reactors
- Low voltage switchboards
- High voltage switchboards
- AC busbars and cabling
- DC busbars and cabling

### 4.3 Electromagnetic Field Behaviour

The power-frequency electromagnetic fields (EMF) produced by the substation predominantly comprise of magnetic fields at a frequency of 50 Hz. Electric fields are also present but their influence is far less and can be negligible.

At distances close to the EMF source, such as High Voltage (HV) and Low Voltage (LV) cabling, the magnetic field generally decreases proportionally to the inverse square of the distance away from the source, that is:

$$B \propto I \times d / r^2 \quad \text{where: } B = \text{magnetic field (Tesla)}$$

$I = \text{load current (Amperes)}$   
 $d = \text{separation distance between cable conductors (metres)}$   
 $r = \text{separation distance from the EMF source to the observer (metres)}$

At distances that are large compared to the source, the magnetic field reduces proportionally to the inverse cube of the distance.

With radio frequencies (frequencies above the audible range) the radiated fields comprise both electric and magnetic field components. At the higher frequencies the electric component can be considered representative of both the electric and magnetic fields. The electric field generally decreases proportionally to the inverse of the distance away from the source:

$$E \propto I \times A \times f / r \quad \text{where: } E = \text{electric field (Volts/metre)}$$

$I = \text{excitation current (Amps)}$   
 $A = \text{area of radiator (m}^2\text{)}$   
 $f = \text{frequency (Hz)}$

The source of these fields is the switching or commutation of the rectifiers, which convert the alternating current supply to pulsating Direct Current (DC).

The rectifier is a six phase unit with the following harmonic frequencies:

$$f_n = 6 \times 50 \times n \\ = 300 n$$

where:  $f_n$  is the harmonic frequency (Hz)  
 $n$  is the harmonic number

The amplitude of these harmonics decreases rapidly with increasing frequency and may be approximated as follows:

$$E \propto ((\sin x) / x)^2$$

where:  $x$  is the angular frequency of the impulse  $\pi/t_d$  (radians)  
 $t_d$  is the impulse width

#### 4.4 Predicted EMF Field Strengths

##### 4.4.1 Assumptions

The electromagnetic fields produced, varies depending on the amount of power that is being consumed by the substation. In determining this power consumption, the following has been assumed:

- A maximum of two transformer / rectifier pairs are operating at any time as the third transformer and rectifier set is a backup (reserve) should one of the three fail.
- The maximum LV power supplied to the rectifiers is the rated output power of one of the transformers (5148 amps at 600 volts ac).
- The maximum output of the rectifiers is their rated DC output (3393 amps at 1500 volts)
- All the above equipment is operating at their rated (maximum) output
- All installed equipment in the substation complies with CISPR 11 or equivalent.

*Note - The substation would normally operate at levels much lower than the rated output. Typically, the highest power would be delivered when multiple trains are in this section of Sydney Yard supplied by the Chalmers Street Substation.*

Having considered the scenarios of maximum power consumption, the predicted (calculated) electromagnetic field values are actually the maximum values expected under normal load conditions (that is the maximum achievable loading, disregarding all fault conditions).

##### 4.4.2 Power Frequency Electromagnetic Fields

The power-frequency magnetic fields from the substation are predominantly emitted from the 600V cabling between the transformer and the rectifier due to the high amount of current consumption. There are 8-off cables per phase per winding and in total 48 AC low voltage cables from the rectifier transformer to the rectifier. These cables connected from the transformers' palm will rise vertically about 3 meters and then change to horizontal in a curving arc with an about 4.4 meter horizontal path before penetrating through the substation building wall. The current in these cable conductors and the distance separating them influences the magnitude of the magnetic field produced. The maximum and average separation distances between adjacent cables are estimated as 315 mm at the rectifier side and 200 mm at transformer side, respectively. The maximum magnetic field strength, for when the substation is under maximum loading, has been calculated at ten different locations in and around the proposed substation as shown in Figures 2 and 3, and the predicted fields listed in Table 2.

At the first floor of the substation building, outside of the rectifier cabinet (location 8 in Figure 3) which is about 0.625 m away from the 600V cabling between the transformer and the rectifier, the predicted power frequency magnetic field exceeds the ARPANSA RHS 30 limit of 100 microtesla, applicable to the General Public. The field level would drop to 100 microtesla at a distance of 0.92 metre from the cabinet or 1.53 metres from the 600V cabling (location 10 in Figure 3).

If a smaller separation distance between the 600V cables, of say 30 mm could have been arranged by bundling cables together, the magnetic field could have been reduced by 90% from the maximum separation of 315 mm. This reduction is possible because of the relationship that, the closer the cables are kept together, the greater the field cancellation. However, since it may be impractical to reduce the separation distance, due to a number of reasons such as stress on palm terminals, and alterations to penetrations in the blast-resistant wall between the rectifier and transformer units, there are other possible measures that can be applied for ensuring safety. Such measures could include cautioning or preventing access in close proximity to the 600V cabling, and/or reduction of the magnetic fields by installation of shielding.

Outside the eastern side of the new substation, at the existing concrete retaining wall (refer location 6 of Figure 2), which forms a boundary between the railway facility and the Prince Alfred Park, the field strength is estimated to be 4.7 microtesla ( $\mu\text{T}$ ). This is the strongest power frequency magnetic field outside of the substation. At the substation office on the ground floor (location 2 of Figure 2), a distance of approximately 7.5 metres from the main source within the substation, the field strength is estimated to be 1.61  $\mu\text{T}$ .

The calculations noted in the above paragraph and in Table 2, are maximum field values based on the substation being loaded at maximum rated capacity. However, in practice the fields will normally be significantly lower, as during normal and peak operating hours the substation would more likely be loaded closer to 30% and 60% of rated capacity on average, respectively.

The 33 kV incoming cabling and 11 kV cabling within the substation will also be a source of power frequency magnetic fields, but due to its lower maximum current and shielding arrangements, the associated magnetic fields are expected to be negligible compared to the 600V cabling between the rectifier transformers and rectifiers.

#### 4.4.3 Radio Frequency EMF Strengths

The switching transients of the rectifiers dominate the radio frequency field radiated from the substation, and a larger transient occurs when each diode is turned 'off', the maximum rate of decay,  $di/dt$  of the forward current in each diode of the rectifier, is 50 A/ $\mu\text{S}$  or for two diodes in parallel 100 A/ $\mu\text{S}$  (two diodes are paralleled for each phase of the six phase rectifier).

The energy contained in the transient (pulse) is low and not of sufficient magnitude to constitute a hazard even directly alongside the rectifiers, however the radiated radio frequency (RF) field could potentially interfere with radiocommunications. For the purposes of this report, the interference to medium frequency broadcast, which is evaluated as the emissions of the transient at these frequencies, is much greater than for short wave radio and TV. Harmonics are produced at the repetition frequency (300 Hz) at an amplitude proportional to  $1/n$  where  $n$  is the harmonic number.

The predicted electric field levels at different distances from the 600V cabling in the substation ranging from 5 m to 60 m are listed in Table 3. Preliminary calculations suggested that the field strength from 500 kHz to 1.7 MHz (3,333<sup>rd</sup> harmonic at 999.9 kHz) would be more than 0.317 mV/m (the AS/NZS 2344 interference limit as shown in Table 1b) at distances away of 41 m, 24m, and 11 m, when the substation is loaded at 100%, 60%, and 30% respectively. Note that the 30% loading is expected to be more representative during normal hours.

In this prediction, we considered that there is at least 6 dB RF attenuation of the substation walls and a blast resistant wall for the banded yard accommodating the transformers. The actual attenuation could be greater in practice, depending on details such as use of metal building materials, the method of construction, shielding of equipment, etc...

As all 33 kV switchboards are metal clad, RF emissions from busbars and bushings during a switching event, will be limited and of little concern

## 4.5 Analysis of EMF Predictions

### 4.5.1 Impact on health

The strongest power-frequency magnetic field in a public area is predicted at the existing concrete retaining wall (refer location 6 of Figure 2), which forms a boundary between the eastern side of the substation and Prince Alfred Park. However the field here does not exceed the permissible exposure limit of 100 microtesla for the General Public and 500 microtesla for Occupational Personnel, as set down in RHS 30 by the National Health and Medical Research Council (see Table 1a). The magnetic field drops off rapidly as the separation distance is increased and is no more than 5  $\mu$ T at the boundary of the substation. The power-frequency electric fields within the substation are also well within the applicable limit.

However, as magnetic fields within the Substation, particularly the areas next to the rectifiers and 600V cabling, can be very high, access should be restricted, along with precautions and procedures to prevent health risks, and warning wearers of life supporting medical devices (eg. pacemakers, Implantable Cardioverter Defibrillators, etc.), of the interference risks. The Substations, Switch Rooms and Service Tunnel should only be accessed by appropriately qualified electrical maintenance and service personnel deemed to be classified Occupational Persons as defined by RHS 30. It is predicted that, inside the substation building, within 1.53 m and 0.58 m of the 600V cabling between the transformer and the rectifier, the predicted power frequency magnetic field will exceed 100 microtesla for the General Public and 500 microtesla for Occupational Personnel, respectively.

The RF fields predicted are well below the human exposure requirements being much less than 2 V/m at more than 6 m away from the substation even when considered as a broadband signal.

### 4.5.2 Impact on Radiocommunications and Broadcasting

Without accounting for shielding inherent within the substation, when the substation is fully loaded, the RF electric fields within 41 m of the substation would not exceed the applicable limit for urban broadcast reception of 0.316 mV/m applicable from 0.15 MHz to 1.7 MHz. Within a 41m distance from the substation, radio reception will be impacted, especially for AM reception and HF frequency bands, though the later would generally be less of a concern, as is typically used by amateur radio operators.

## 5. CONCLUSIONS & RECOMMENDATIONS

### 5.1 Health & Safety

1. Outside the substation building, there should be no concern of risk to the health and safety of the general public or the on-site staff, due to the power-frequency or RF electromagnetic field emissions from the substation, as the predicted fields are well below the exposure limits set down by the ARPANSA RHS 30 and RPS 3 guidelines.
2. Within the substation building, as the power frequency magnetic field level nearby the 600V AC cabling is expected to exceed the ARPANSA RHS 30 limit of 100  $\mu$ T, it is recommended that safety measures be implemented, as described in point 3 below.
3. It is recommended that all twelve 7.4 m long 600V AC cables, connecting between the transformer and rectifier, be bundled as close as possible together in trefoil formation, so as to reduce both the power frequency and RF electromagnetic field levels. However, since it may be impractical to bundle the cables together, due to a number of reasons such as stress on palm terminals, and alterations to penetrations in the blast-resistant wall between the rectifier and transformer units, there are other possible measures that can be applied for ensuring safety, as described in point 4.

4. An exclusion zone could be established around the 600V cabling, which could consist of precautionary signage warning of high magnetic fields, and provision of boundary signage and/or fencing, located at least 1.8 m away from the cabling. Installation of magnetic shielding is another option that can be considered, for instance if there are limitations allocating the space required for an exclusion zone, though this type of shielding should be avoided where possible as it is generally expensive.
5. The Precautionary Principle can be applied where there is a possible or potential risk of concern, which can be mitigated at reasonable cost. If the office is to be occupied for 4 hours or more per day on average, then reduction of long-term magnetic field exposure within the office could be considered. As, bundling the 600V cabling together, may be impractical, as described in point 3 above, there are other mitigation measures that can be applied for reducing exposure. These measures include relocating the office further away from the rectifiers. Alternatively, the magnetic fields could be reduced in the office by installation of shielding, though this option should be avoided where possible as it would likely be costly.

## **5.2 Interference**

6. Except within a 41 m radius, the operation of the proposed substation is not expected to produce RF electric fields that would significantly add to the ambient levels within the Medium Frequency (MF) band (500 kHz to 3 MHz) and so should not affect reception of AM radio broadcasts. However, to mitigate the potential interference impact within the 41 m radius, it is recommended that RF shielding be installed around the 600V cabling including replacing the current cabling with shielded cabling. The detail of the shielding, would need to be designed, though could minimally consist in the form of a metal framed and/or mesh cage-like structure, which would allow access for equipment maintenance purposes and should not impact on ventilation.
7. As the RF electric field emissions within the range 30 MHz to 1 GHz, will largely be impacted by small dimensions and factors of the installed electrical substation (eg. conductor lengths affecting radiation efficiencies, self resonance of the circuit affecting the frequencies emitted, etc...) it is not practical to predict these emissions from the proposed substation. However, these emissions are not likely to significantly add to the existing ambient environment, so would unlikely risk interference to the main types of communications services such as FM radio & TV broadcasts.

## **5.3 Survey**

8. After installation of the substation, it is recommended that an electromagnetic survey be conducted, to assess the final electromagnetic environment, to ensure electromagnetic compliance and compatibility.

## 6. APPENDIX

**Table 2. Predicted Power Frequency Magnetic Fields at the Chalmers Street Substation**

Position No. and description in relation to 600V cabling in the proposed substation (refer Figures 2 and 3 for locations)	Separation distance from the nearest 600 V cabling (m)	Maximum Magnetic Field (μT, rms) (1) (2)
1, directly underneath the 1st floorslab, below rectifiers and 600V cabling	2.80	26.71
2, at office on ground floor	7.5	1.61
3, at western stairs on ground floor	15	0.24
4, at northern stairs on ground floor	17	0.18
5, at eastern stairs on ground floor	7	2.67
6, at existing eastern retainment concrete wall on ground floor	5	4.66
7, at western stairs on first floor	15	0.24
8, outside of rectifier cabinet on first floor	0.625	441.15
9, at eastern stairs on first floor	3.5	15.82
10, at 1.53m away from 600V cabling on first floor	1.53	100.52

**Note:** 1. Maximum Magnetic field predicted under maximum loading of the substation.  
2. Maximum Magnetic field predictions are at 1m AFL unless described otherwise.

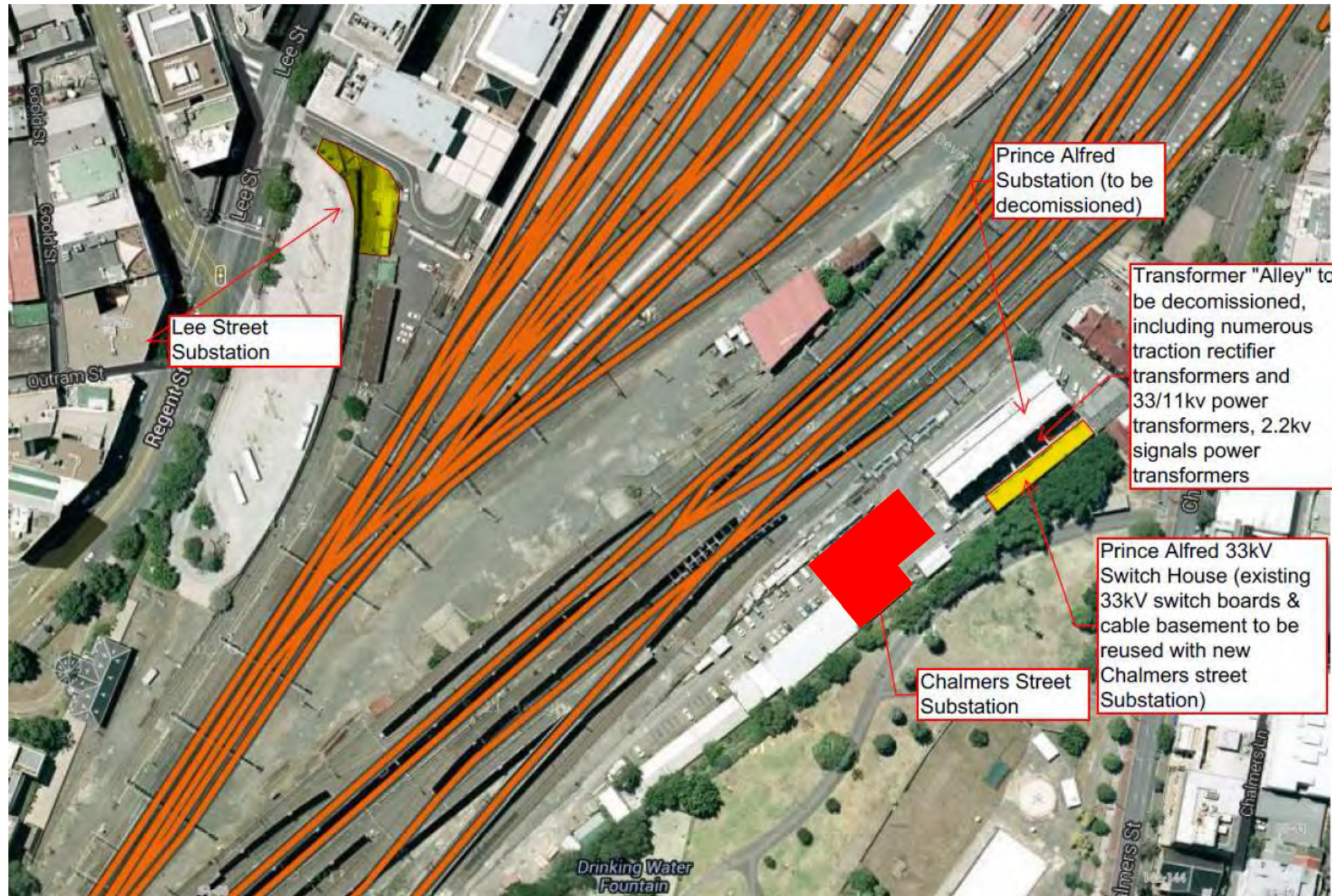
**Table 3. Predicted 500 kHz to 1.7 MHz RF Electric Fields at Prince Alfred Park**

Separation distance from 600 V cabling (m)	Distance in Prince Alfred Park from the existing eastern retainment concrete wall (m)	Electric Field at 100% Load (mV/m)	Electric Field at 60% Load <sup>(1)</sup> (mV/m)	Electric Field at 30% Load <sup>(1)</sup> (mV/m)
5	0	2.183	1.310	0.655
11	6	1.077	0.646	0.323
24	19	0.528	0.317	0.158
41	36	0.319	0.191	0.096
60	55	0.221	0.133	0.066

**Note:** 1. A 30 % or 60% loading could approximately be indicative of normal hour or peak hour loading, respectively.  
2. It is assumed that there is 6 dB attenuation from the substation external walls which consists of precast brick panels supported on steel frame and 190mm thick reinforced blockwork for the bunded yard.

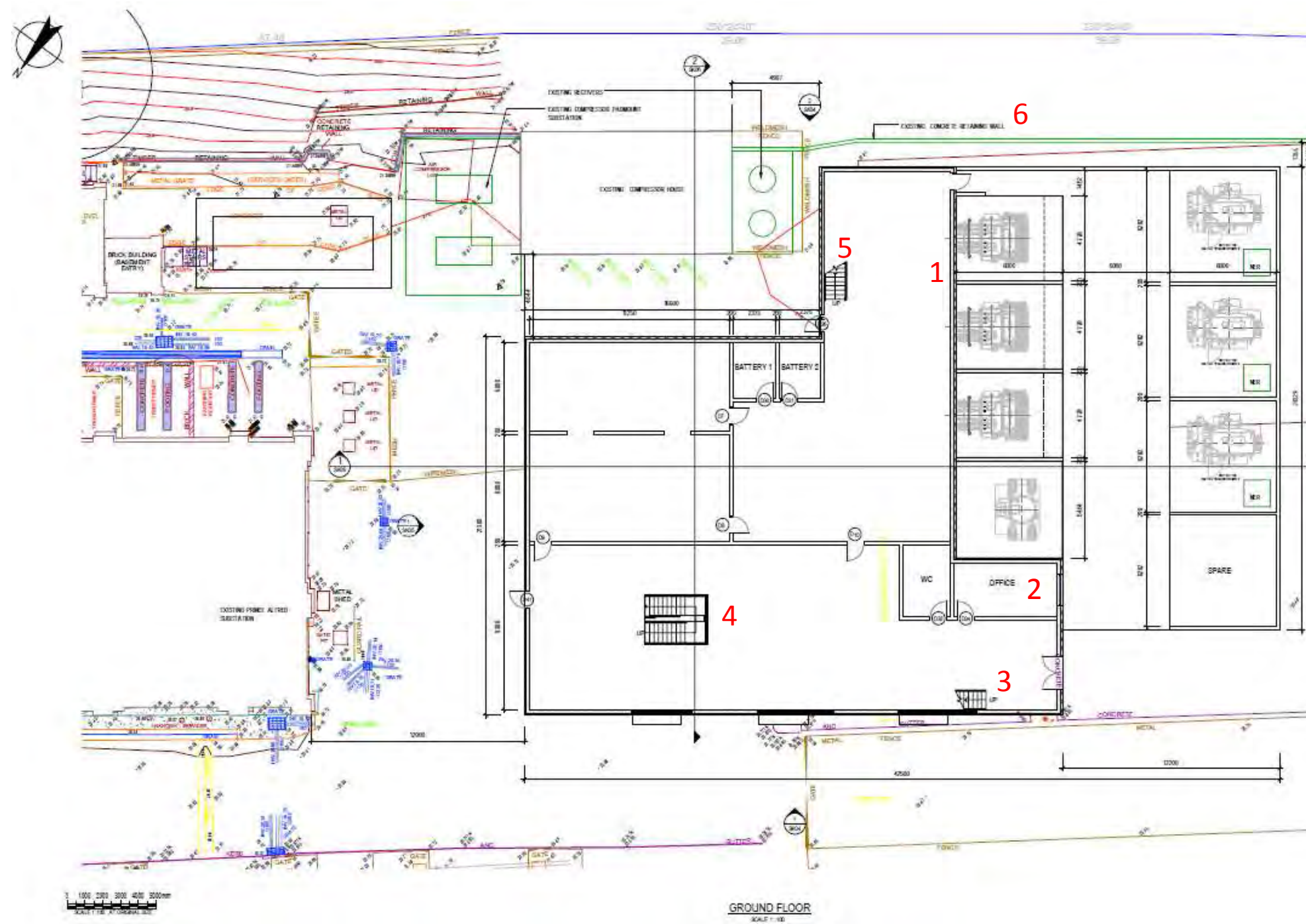


Figure 1. Location of the New Chalmers Street Substation



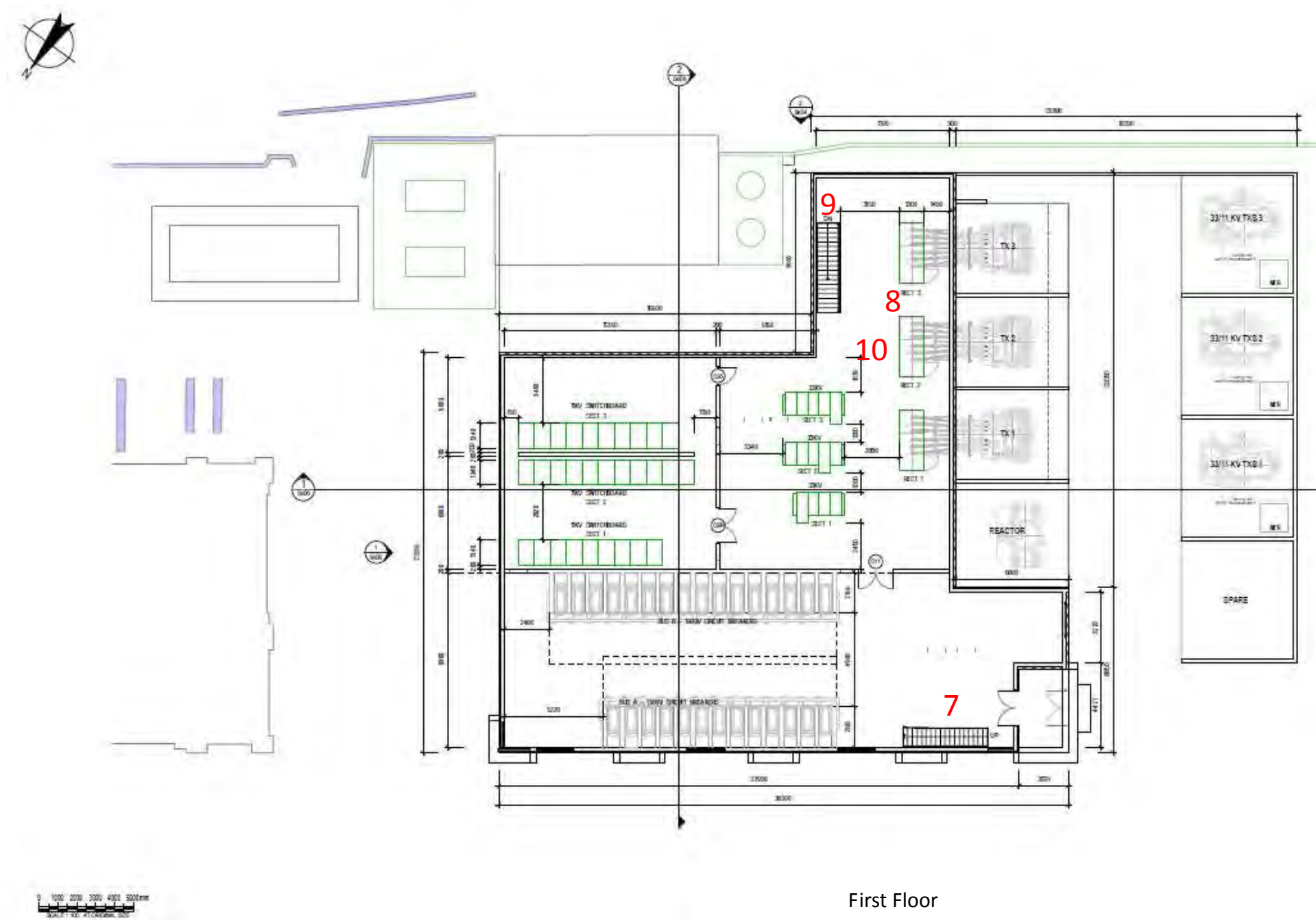
- Note:**
1. Chalmers Street Substation is shown where highlighted in red.
  2. This figure has been altered and scanned for illustration only, and is not to scale.

Figure 2. Locations for EMF Predictions in the new Chalmers Street Substation – Ground Floor



Note: 1. This figure has been altered and scanned for illustration only, and is not to scale.

Figure 3. Locations for EMF Predictions in the New Chalmers Street Substation – First Floor



Note: 1. This figure has been altered and scanned for illustration only, and is not to scale.

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133 Castlereagh St Sydney NSW 2000

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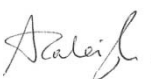

T: +61 2 9239 7100 F: +61 2 9239 7199 E: sydmail@ghd.com.au

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	Ben James	Amanda Raleigh		Steve Pusenjak		03/08/15

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## Appendix 2: Conditions of Approval



# Conditions of Approval

## Chalmers Street Substation

### Abbreviations

<b>CEMP</b>	Construction environmental management plan
<b>CLP</b>	Community liaison plan
<b>EIA</b>	Environmental impact assessment
<b>EPA</b>	NSW Environment Protection Authority
<b>EP&amp;A Act</b>	<i>Environmental Planning and Assessment Act 1979</i>
<b>EPL</b>	Environment protection licence issued by the EPA under the <i>Protection of the Environment Operations Act 1997</i>
<b>EMR</b>	Environmental management representative
<b>ISO</b>	International Standards Organisation
<b>OEH</b>	NSW Office of Environment and Heritage
<b>OOHWP</b>	Out of hours work protocol
<b>PMEM</b>	Principal Manager Environment Management, TfNSW (or nominated delegate)
<b>REF</b>	Review of environmental factors
<b>TfNSW</b>	Transport for NSW

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## Definitions

<b>construction</b>	Includes all work in respect of the Project, other than survey, acquisitions, fencing, investigative drilling or excavation, building/road dilapidation surveys, or other activities determined by the EMR to have minimal environmental impact such as minor access roads, minor adjustments to services/utilities, establishing temporary construction compounds (in accordance with this approval), or minor clearing (except where threatened species, populations or ecological communities would be affected).
<b>contamination</b>	The presence in, on or under land of a substance at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment.
<b>designated works</b>	Tunnelling, blasting, piling, excavation, bulk fill or any vibratory impact works (including jack hammering and compaction) for construction.
<b>emergency work</b>	Includes works to avoid loss of life, damage to external property, utilities and infrastructure, prevent immediate harm to the environment, contamination of land or damage to a heritage (indigenous or non-indigenous) item.
<b>environmental impact assessment</b>	The documents listed in Condition 1 of this approval.
<b>environmental management representative</b>	An independent environmental representative appointed to the Project or a delegate nominated by Transport for NSW.
<b>noise sensitive receiver</b>	In addition to residential dwellings, noise sensitive receivers include, but are not limited to, hotels, entertainment venues, pre-schools and day care facilities, educational institutions (e.g. schools, TAFE colleges), health care facilities (e.g. nursing homes, hospitals), recording studios, places of worship/religious facilities (e.g. churches), and other noise sensitive receivers identified in the environmental impact assessment.
<b>reasonable and feasible</b>	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
<b>the Project</b>	The construction and operation of the Chalmers Street Substation project as described in the environmental impact assessment.
<b>the Proponent</b>	A person or body proposing to carry out an activity under Part 5 of the EP&A Act. In the case of the Project, TfNSW.

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## Conditions of approval

No	Condition									
	<b>General</b>									
1.	<p><b>Terms of approval</b></p> <p>The Project shall be carried out generally in accordance with the environmental impact assessment (EIA) for this Project, which comprises the following documents:</p> <table border="1"> <thead> <tr> <th>DOCUMENT</th> <th>AUTHOR</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>Chalmers Street Substation Project – Review of Environmental Factors</td> <td>GHD</td> <td>August 2015</td> </tr> <tr> <td>Chalmers Street Substation Project – Determination Report</td> <td>TfNSW</td> <td>December 2015</td> </tr> </tbody> </table> <p>In the event of an inconsistency between these conditions and the EIA, these conditions will prevail to the extent of the inconsistency.</p>	DOCUMENT	AUTHOR	DATE	Chalmers Street Substation Project – Review of Environmental Factors	GHD	August 2015	Chalmers Street Substation Project – Determination Report	TfNSW	December 2015
DOCUMENT	AUTHOR	DATE								
Chalmers Street Substation Project – Review of Environmental Factors	GHD	August 2015								
Chalmers Street Substation Project – Determination Report	TfNSW	December 2015								
2.	<p><b>Project modifications</b></p> <p>Any modification to the project as approved in the EIA would be subject to further assessment. This assessment would need to demonstrate that any environmental impacts resulting from the modifications have been minimised. The assessment shall be subject to approval under delegated authority by TfNSW. The Proponent shall comply with any additional requirements from the assessment of the project modification.</p>									
3.	<p><b>Statutory requirements</b></p> <p>These conditions do not relieve the Proponent of the obligation to obtain all other licences, permits, approvals and land owner consents from all relevant authorities and land owners as required under any other legislation for the Project. The Proponent shall comply with the terms and conditions of such licences, permits, approvals and permissions.</p>									
	<b>Communications</b>									
4.	<p><b>Community liaison plan</b></p> <p>The Proponent shall develop and implement a community liaison plan (CLP) to engage with government agencies, relevant councils, landowners, community members and other relevant stakeholders (such as utility and service providers, bus companies and businesses) where required. The CLP shall comply with the obligations of these conditions and should include, but not necessarily be limited to:</p> <ol style="list-style-type: none"> <li>details of the protocols and procedures for disseminating information and liaising with the community and other key stakeholders about construction activities (including timing and staging) and any associated impacts during the construction period</li> <li>stakeholder and issues identification and analysis</li> <li>procedures for dealing with complaints or disputes and response requirements, including advertising the 24 hour construction response line number</li> <li>details (including a program) of training for all employees, contractors and sub-contractors on the requirements of the CLP.</li> </ol> <p>Sub-plans to the CLP will be developed as required. These sub-plans will detail site-specific consultation and communication requirements for construction works that impact residents, other stakeholders and businesses. They will also identify further mitigation measures and processes to reduce construction impacts.</p>									

No	Condition
	<p>The CLP shall be prepared to the satisfaction of the Director Community Engagement prior to the commencement of construction and implemented, reviewed and revised as appropriate during construction of the Project.</p>
<p><b>5.</b></p>	<p><b>Community notification and liaison</b></p> <p>The local community shall be advised of any activities related to the Project with the potential to impact upon them.</p> <p>Prior to any site activities commencing and throughout the Project duration, the community is to be notified of works to be undertaken, the estimated hours of construction and details of how further information can be obtained (i.e. contact telephone number/email, website, newsletters etc.) including the 24 hour construction response line number.</p> <p>Construction-specific impacts including information on traffic changes, access changes, detours, services disruptions, public transport changes, high noise generating work activities and work required outside the nominated working hours shall be advised to the local community at least seven (7) days prior to such works being undertaken or other period as agreed to by the Director Community Engagement or as required by Environment Protection Authority (EPA) (where an environment protection licence (EPL) is in effect).</p>
<p><b>6.</b></p>	<p><b>Website</b></p> <p>The Proponent shall provide electronic information (or details of where hard copies of this information may be accessed by members of the public) related to the Project, on dedicated pages within its existing website, including:</p> <ul style="list-style-type: none"> <li>(a) a copy of the documents referred to under Condition 1 of this approval</li> <li>(b) a list of environmental management reports that are publicly available</li> <li>(c) 24 hour contact telephone number for information and complaints.</li> </ul> <p>All documents must be compliant with the Web Content Accessibility Guidelines 2.0.</p>
<p><b>7.</b></p>	<p><b>Complaints management</b></p> <p>The Proponent shall set up a 24 hour construction response line number.</p> <p>Details of all complaints received during construction are to be recorded on a complaints register. A verbal response to phone enquiries on what action is proposed to be undertaken is to be provided to the complainant within two (2) hours during all times construction is being undertaken and within 24 hours during non-construction times (unless the complainant agrees otherwise). A verbal response to written complaints (email/letter) should be provided within 48 hours of receipt of the communication. A detailed written response is to be provided to the complainant within seven (7) calendar days for verbal and/or written complaints.</p> <p>Information on all complaints received during the previous 24 hours shall be forwarded to the environmental management representative (EMR) each working day.</p>
	<p><b>Environmental management</b></p>
<p><b>8.</b></p>	<p><b>Construction environmental management plan</b></p> <p>The Proponent shall prepare a construction environmental management plan (CEMP) prior to commencement of construction which addresses the following matters, as a minimum:</p> <ul style="list-style-type: none"> <li>(a) traffic and pedestrian management (in consultation with the relevant roads authority)</li> <li>(b) noise and vibration management</li> <li>(c) water and soil management</li> <li>(d) air quality management (including dust suppression)</li> <li>(e) indigenous and non-indigenous heritage management</li> <li>(f) flora and fauna management</li> </ul>

No	Condition
	<p>(g) storage and use of hazardous materials            (h) contaminated land management (including acid sulphate soils)            (i) weed management            (j) waste management            (k) sustainability            (l) environmental incident reporting and management procedures            (m) non-compliance and corrective/preventative action procedures</p> <p>The CEMP shall:</p> <ol style="list-style-type: none"> <li>i. comply with the Conditions of Approval, conditions of any licences, permits or other approvals issued by government authorities for the Project, all relevant legislation and regulations, and accepted best practice management</li> <li>ii. comply with the relevant requirements of <i>Guideline for Preparation of Environmental Management Plans</i> (Department Infrastructure, Planning and Natural Resources, 2004)</li> <li>iii. include an Environmental Policy.</li> </ol> <p>The Proponent shall:</p> <ol style="list-style-type: none"> <li>1. consult with government agencies and relevant service/utility providers as part of the preparation of the CEMP</li> <li>2. submit a copy of the ECM to the EMR for review. The EMR is to be given a minimum period of 7 days to review and endorse the ECM.</li> <li>3. submit a copy of the CEMP to the PMEM (or nominated delegate) for approval at least 14 days prior to commencement of construction (or such time as is otherwise agreed to by the PMEM)</li> <li>4. review and update the CEMP at regular intervals, and in response to any actions identified as part of the EMR's audit of the document</li> <li>5. ensure updates to the CEMP are made within 7 days of the completion of the review or receipt of actions identified by any EMR audit of the document, and be submitted to the EMR for approval.</li> </ol> <p>The CEMP must be approved by the PMEM prior to the commencement of construction work associated with the Project.</p>
9.	<b>Not Used</b>
	<b>Hours of work</b>
10.	<p><b>Standard construction hours</b></p> <p>Construction activities shall be restricted to the hours of 7:00 am to 6:00 pm (Monday to Friday); 8:00 am to 1:00 pm (Saturday) and at no time on Sundays and public holidays except for the following works which are permitted outside these standard hours:</p> <ol style="list-style-type: none"> <li>(a) any works which do not cause noise emissions to be more than 5dBA higher than the rating background level at any nearby residential property and/or other noise sensitive receivers</li> <li>(b) out of hours work identified and assessed in the EIA or the approved out of hours work protocol (OOHWP)</li> <li>(c) the delivery of plant, equipment and materials which is required outside these hours as requested by police or other authorities for safety reasons and with suitable notification to the community as agreed by the PMEM</li> <li>(d) emergency work to avoid the loss of lives, property and/or to prevent environmental harm</li> <li>(e) any other work as agreed by the PMEM (or nominated delegate) and considered essential to the Project, or as approved by EPA (where an EPL is in effect).</li> </ol>

No	Condition
11.	<p><b>High noise generating activities</b></p> <p>Rock breaking or hammering, jack hammering, pile driving, vibratory rolling, cutting of pavement, concrete or steel and any other activities which result in impulsive or tonal noise generation shall not be undertaken for more than 3 hours, without a minimum 1 hour respite period unless otherwise agreed to by the PMEM (or nominated delegate), or as approved by EPA (where relevant to the issuing of an EPL), unless inaudible at nearby residential properties and/or other noise sensitive receivers.</p>
	<p><b>Noise and vibration</b></p>
12.	<p><b>Construction noise and vibration</b></p> <p>Construction noise and vibration mitigation measures shall be implemented through the CEMP, in accordance with TfNSW's <i>Construction Noise Strategy</i> and the EPA <i>Interim Construction Noise Guideline</i> (July 2009). The mitigation measures shall include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> <li>(a) details of construction activities and an indicative schedule for construction works</li> <li>(b) identification of construction activities that have the potential to generate noise and/or vibration impacts on surrounding land uses, particularly sensitive noise receivers</li> <li>(c) detail what reasonable and feasible actions and measures shall be implemented to minimise noise impacts (including those identified in the environmental impact assessment)</li> <li>(d) procedures for notifying sensitive receivers of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints</li> <li>(e) an out of hours work protocol (OOHWP) for the assessment, management and approval of works outside the standard construction hours identified in Condition 10 of this approval, including a risk assessment process which deems the out of hours activities to be of low, medium or high environmental risk, is to be developed. All out of hours works are subject to approval by the EMR and/or PMEM (or nominated delegate) or as approved by EPA (where relevant to the issuing of an EPL). The OOHWP should be consistent with the TfNSW <i>Construction Noise Strategy</i></li> <li>(f) a description of how the effectiveness of actions and measures shall be monitored during the proposed works, identification of the frequency of monitoring, the locations at which monitoring shall take place, recording and reporting of monitoring results and if any exceedance is detected, the manner in which any non-compliance shall be rectified.</li> </ul>
13.	<p><b>Vibration criteria</b></p> <p>Vibration (other than from blasting) resulting from construction and received at any structure outside of the Project shall be limited to:</p> <ul style="list-style-type: none"> <li>(a) for structural damage vibration - German Standard DIN 4150:Part 3 – 1999: <i>Structural Vibration in Buildings: Effects on Structures</i></li> <li>(b) for human exposure to vibration – the acceptable vibration values set out in the <i>Environmental Noise Management Assessing Vibration: A Technical Guideline</i> (DEC 2006).</li> </ul> <p>These limits apply unless otherwise approved by the PMEM through the CEMP.</p>
14.	<p><b>Non-tonal reversing beepers</b></p> <p>Non-tonal reversing beepers (or an equivalent mechanism) shall be fitted and used on all construction vehicles and mobile plant regularly used on site (i.e. greater than one day) and for any out of hours work.</p>
15.	<p><b>Noise impact on educational facilities</b></p> <p>Potentially affected pre-schools, schools, universities and any other affected permanent educational institutions shall be consulted in relation to noise mitigation measures to identify any noise sensitive periods (e.g. exam periods). As much as reasonably practicable noise intensive construction works in the vicinity of affected educational buildings are to be minimised.</p>
16.	<p><b>Piling</b></p> <p>Wherever practical, piling activities shall be completed using non-percussive piles. If percussive</p>

No	Condition
	piles are proposed to be used, approval of the PMEM shall be obtained prior to commencement of piling activities.
	<b>Contamination and hazardous materials</b>
17.	<p><b>Unidentified contamination (other than asbestos)</b></p> <p>If previously unidentified contamination (excluding asbestos) is discovered during construction, work in the affected area must cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of any contamination. The level of reporting must be appropriate for the identified contamination in accordance with relevant EPA guidelines, including the <i>Guidelines for Consultants Reporting on Contaminated Sites</i>.</p> <p>The Proponent shall:</p> <ul style="list-style-type: none"> <li>(a) submit a copy of any contamination report to the EMR for review. The EMR is to be given a minimum period of 7 days to review and provide any comments to the Proponent in relation to the report</li> <li>(b) submit a copy of the report to the PMEM for consideration upon completion of the EMR review period. The PMEM shall determine whether consultation with the relevant council and/or EPA is required prior to continuation of construction works within the affected area.</li> </ul> <p><i>Note: In circumstances where both previously unidentified asbestos contamination and other contamination are discovered within a common area, nothing in these conditions shall prevent the preparation of a single investigation report to satisfy the requirements of both Condition 17 and Condition 18.</i></p>
18.	<p><b>Asbestos management</b></p> <p>If previously unidentified asbestos contamination is discovered during construction, work in the affected area must cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of the asbestos contamination. The level of reporting must be appropriate for the identified contamination in accordance with relevant EPA and WorkCover guidelines and include the proposed methodology for the remediation of the asbestos contamination. Remediation activities must not take place until receipt of the investigation report.</p> <p>Works may only recommence upon receipt of a validation report from a suitably qualified contamination specialist that the remediation activities have been undertaken in accordance with the investigation report and remediation methodology.</p> <p><i>Note: In circumstances where both previously unidentified asbestos contamination and other contamination are discovered within a common area, nothing in these conditions shall prevent the preparation of a single investigation report to satisfy the requirements of both Condition 17 and Condition 18.</i></p>
19.	<p><b>Storage and use of hazardous materials</b></p> <p>Construction hazard and risk issues associated with the use and storage of hazardous materials shall be addressed through risk management measures, which shall be developed by the construction contractor prior to construction as part of the overall CEMP, in accordance with relevant EPA guidelines, TfNSW <i>Chemical Storage and Spill Response Guideline</i> and Australian and ISO standards. These measures shall include:</p> <ul style="list-style-type: none"> <li>(a) the storage of hazardous materials, and refuelling/maintenance of construction plant and equipment to be undertaken in clearly marked designated areas that are designed to contain spills and leaks</li> <li>(b) spill kits, appropriate for the type and volume of hazardous materials stored or in use, to be readily available and accessible to construction workers. Kits to be kept at hazardous materials storage locations, in site compounds and on specific construction vehicles. Where a spill to a watercourse is identified as a risk, spill kits to be kept in close proximity to potential discharge points in support of preventative controls</li> <li>(c) all hazardous materials spills and leaks to be reported to site managers and actions to be immediately taken to remedy spills and leaks</li> <li>(d) training in the use of spill kits to be given to all personnel involved in the storage, distribution</li> </ul>

No	Condition
	or use of hazardous materials.
	<b>Erosion and sediment control</b>
20.	<p><b>Erosion and sediment control</b></p> <p>Soil and water management measures shall be prepared as part of the CEMP for the mitigation of water quality impacts during construction of the Project. The management measures shall be prepared in accordance with <i>Managing Urban Stormwater; Soils and Construction 4<sup>th</sup> Edition</i> (Landcom, 2004).</p>
	<b>General</b>
21.	<p><b>Pre-construction environmental compliance matrix</b></p> <p>A pre-construction environmental compliance matrix (PECM) for the Project (or such stages of the Project as agreed to by the Environmental Management Representative (EMR)) shall be prepared detailing compliance with all relevant conditions and mitigation measures prior to commencement of construction. The PECM shall also include details of approvals, licences and permits required to be obtained under any other legislation for the Project.</p> <p>The Proponent shall:</p> <ul style="list-style-type: none"> <li>(a) submit a copy of the PECM to the EMR for review. The EMR are to be given a minimum period of 7 days to review and provide any comments to the Proponent in relation to the PECM</li> <li>(b) upon completion of the EMR review period, submit a copy of the PECM to the PMEM for approval, at least 14 days (or within such time as otherwise agreed to by the PMEM) prior to commencement of construction of the Project.</li> </ul>
22.	<p><b>Construction environmental compliance report</b></p> <p>The Proponent shall prepare a construction environmental compliance report (CECR) which addresses the following matters:</p> <ul style="list-style-type: none"> <li>(a) compliance with the construction environmental management plan (CEMP) and these conditions</li> <li>(b) compliance with the <i>Sustainable Design Guidelines Version 3.0</i> compliance checklist</li> <li>(c) compliance with any approvals or licences issued by relevant authorities for construction of the Project</li> <li>(d) implementation and effectiveness of environmental controls (the assessment of effectiveness should be based on a comparison of actual impacts against performance criteria identified in the CEMP)</li> <li>(e) environmental monitoring results, presented as a results summary and analysis</li> <li>(f) details of the percentage of waste diverted from landfill and the percentage of spoil beneficially reused</li> <li>(g) number and details of any complaints, including summary of main areas of complaint, actions taken, responses given and intended strategies to reduce recurring complaints (subject to privacy protection)</li> <li>(h) details of any review and amendments to the CEMP resulting from construction during the reporting period</li> <li>(i) any other matter as requested by the PMEM.</li> </ul> <p>The Proponent shall:</p> <ol style="list-style-type: none"> <li>1. submit a copy of the CECR to the EMR for review. The EMR is to be given a minimum period of 7 days to review and provide any comments to the Proponent in relation to the CECR</li> <li>2. submit a copy of the CECR to the PMEM (or nominated delegate) for approval upon completion of the EMR review period.</li> </ol> <p>The first CECR shall report on the first six months of construction and be submitted within six</p>

No	Condition
	weeks of expiry of that period (or at any other time interval agreed to by the PMEM). CECRs shall be submitted no later than six months after the date of submission of the preceding CECR (or at other such periods as requested by the PMEM) for the duration of construction.
23.	<p><b>Pre-operation compliance report</b></p> <p>A pre-operation compliance report (POCR) for the Project shall be prepared, prior to commencement of operation of the Project. The POCR shall detail compliance with all conditions of approval, licences and permits required to be obtained under any other legislation for the project.</p> <p>The Proponent shall:</p> <p>(a) submit a copy of the POCR to the EMR for review. The EMR is to be given a minimum period of 7 days to review and provide any comments to the Proponent in relation to the POCR.</p> <p>(b) upon completion of the EMR review period submit a copy of the POCR to the PMEM (or nominated delegate) for approval. The POCR is to be provided to the PMEM at least one month prior to the scheduled operation of the Project (or such time as otherwise agreed to by the PMEM).</p>
	<b>Environmental management</b>
24.	<p><b>Environmental controls map</b></p> <p>The Proponent shall prepare an environmental controls map (ECM) in accordance with TfNSW's <i>Guide to Preparing ECMs</i> prior to the commencement of construction for implementation for the duration of construction. The ECM is to be endorsed by the EMR and may be prepared in stages as set out in the CEMP.</p> <p>The Proponent shall submit a copy of the ECM to the EMR for review and endorsement. The EMR is to be given a minimum period of 7 days to review and endorse the ECM. Following receipt of the EMR's endorsement, the ECM shall be submitted to the PMEM (or nominated delegate) for approval, at least 14 days prior to commencement of construction (or such time as is otherwise agreed to by the PMEM).</p> <p>The ECM shall be prepared as a map – suitably enlarged (e.g. A3 size or larger) for mounting on the wall of a site office and included in site inductions, supported by relevant written information.</p> <p>Updates to the ECM shall be made within 7 days of the completion of the review or receipt of actions identified by any EMR audit of the document, and be submitted to the EMR for approval.</p>
	<b>Flora and fauna</b>
25.	<p><b>Replanting program</b></p> <p>All cleared vegetation shall be offset in accordance with TfNSW's <i>Vegetation Offset Guide</i>. All vegetation planted on-site is to consist of locally endemic native species, unless otherwise agreed by the PMEM, following consultation with the relevant council, where relevant, and/or the owner of the land upon which the vegetation is to be planted. All vegetation planted on-site shall be maintained for a minimum period of 12 months, unless otherwise agreed by the PMEM.</p>
26.	<p><b>Removal of trees or vegetation</b></p> <p>Separate approval, in accordance with TfNSW's <i>Application for Removal or Trimming of Vegetation</i>, is required for the trimming, cutting, pruning or removal of trees or vegetation where the impact has not already been identified in the EIA for the Project. The trimming, cutting, pruning or removal of trees or vegetation shall be undertaken in accordance with the conditions of that approval.</p>
	<b>Heritage management</b>
27.	<p><b>Protection of State heritage items</b></p> <p>Design and construction of the Project within the curtilage of Sydney Terminal and Central Railway Stations Group (referred to as the Central Station site/group) must be undertaken in accordance with the conditions of the approval granted under Section 60 of the <i>NSW Heritage Act 1977</i> (No:2015/S60/115) and recommendations made in the Statement of Heritage Impact (Tonkin Zulaikha Greer, August 2015).</p>



No	Condition
	In the event of any inconsistency between the Conditions of the Section 60 approval and the Statement of Heritage Impact, the Section 60 approval will prevail to the extent of the inconsistency.
28.	<p><b>Heritage interpretation strategy</b></p> <p>Prior to the commencement of construction, a Heritage Interpretation Strategy is to be prepared in by a suitably qualified and experienced heritage professional accordance with Condition 12 of the Section 60 approval (No:2015/S60/115). The strategy is to be submitted to the PMEM for approval at least 14 days prior to the commencement of construction of the Project (or such time as is otherwise agreed to by the PMEM).</p>
29.	<p><b>Archival recording</b></p> <p>Archival recording of the Prince Alfred Substation sections/items impacted by construction, including those elements identified in Condition 10 of the Section 60 Approval (No:2015/S60/115) shall be undertaken in accordance with Heritage Division Guidelines prior to its removal.</p> <p>A copy of the archival recording shall be submitted to Heritage Branch of Office of Environment and Heritage and Sydney Trains Heritage Group so that a complete record of the original location of the items/sections of the Prince Alfred Substation impacted by construction is available for public access.</p>
30.	<p><b>Indigenous and non-Indigenous heritage</b></p> <p>If previously unidentified Indigenous or non-Indigenous heritage/archaeological items are uncovered during construction works, all works in the vicinity of the find shall cease and appropriate advice shall be sought from a suitably qualified heritage consultant (and in consultation with the OEH Heritage Branch where appropriate), and in accordance with the <a href="#">Unexpected Heritage Finds Guideline - 3TP-SD-115</a>. Works in the vicinity of the find shall not re-commence until clearance has been received from a suitably qualified and experienced heritage consultant.</p>
	<b>Property</b>
31.	<p><b>Property condition surveys</b></p> <p>Subject to landowner agreement, property condition surveys shall be completed prior to piling, excavation or bulk fill or any vibratory impact works including jack hammering and compaction (Designated Works) in the vicinity of the following buildings/structures:</p> <ul style="list-style-type: none"> <li>(a) all buildings/structures/roads within a plan distance of 50 metres from the edge of the Designated Works</li> <li>(b) all heritage listed buildings and other sensitive structures within 20 metres of construction involving vibration intensive compaction equipment.</li> </ul> <p>Property condition surveys need not be undertaken if a risk assessment indicates that selected buildings/structures/roads identified in (a) and (b) will not be affected as determined by a qualified geotechnical and construction engineering expert with appropriate registration on the National Professional Engineers Register prior to commencement of Designated Works.</p> <p>Selected potentially sensitive buildings and/or structures shall first be surveyed prior to the commencement of the Designated Works and again immediately upon completion of the Designated Works.</p> <p>All owners of assets to be surveyed, as defined above, are to be advised (at least 14 days prior to the first survey) of the scope and methodology of the survey, and the process for making a claim regarding property damage.</p> <p>A copy of the survey(s) shall be given to each affected owner. A register of all properties surveyed shall be maintained.</p> <p>Any damage to buildings, structures, lawns, trees, sheds, gardens, etc. as a result of construction activity direct and indirect (i.e. including vibration and groundwater changes) shall be rectified at no cost to the owner(s).</p>
32.	<p><b>Pre-construction sustainability report</b></p> <p>Prior to commencement of construction, a pre-construction sustainability report (PCSR) shall be</p>

No	Condition
	<p>prepared to the satisfaction of the PMS. The Report shall include the following minimum components:</p> <ul style="list-style-type: none"> <li>(a) a completed electronic checklist demonstrating compliance with the <i>Sustainable Design Guidelines Version 3.0</i></li> <li>(b) a statement outlining the Proponent's own corporate sustainability obligations, goals, targets, in house tools, etc</li> <li>(c) a section specifying any areas of innovation that will be explored and/or implemented on the Project during the course of the construction period.</li> </ul> <p>The Proponent shall submit a copy of the PCSR to the PMS for approval, at least 14 days prior to the commencement of construction (or within such time as otherwise agreed to by the PMS).</p>
<b>Traffic and Access</b>	
33.	<p><b>Traffic management plan</b></p> <p>The Proponent shall prepare a construction traffic management plan (TMP) as part of the CEMP which addresses, as a minimum, the following:</p> <ul style="list-style-type: none"> <li>(a) ensuring adequate road signage at construction work sites to inform motorists and pedestrians of the work site ahead to ensure that the risk of road accidents and disruption to surrounding land uses is minimised</li> <li>(b) maximising safety and accessibility for pedestrians and cyclists</li> <li>(c) ensuring adequate sight lines to allow for safe entry and exit from the site</li> <li>(d) ensuring access to railway stations, businesses, entertainment premises and residential properties (unless affected property owners have been consulted and appropriate alternative arrangements made)</li> <li>(e) managing impacts and changes to on and off street parking and requirements for any temporary replacement provision</li> <li>(f) parking locations for construction workers away from stations and busy residential areas and details of how this will be monitored for compliance</li> <li>(g) routes to be used by heavy construction-related vehicles to minimise impacts on sensitive land uses and businesses</li> <li>(h) details for relocating kiss-and-ride, taxi ranks and rail replacement bus stops if required, including appropriate signage to direct patrons, in consultation with the relevant bus operator. Particular provisions should also be considered for the accessibility impaired.</li> <li>(i) measures to manage traffic flows around the area affected by the Project, including as required regulatory and direction signposting, line marking and variable message signs and all other traffic control devices necessary for the implementation of the TMP.</li> </ul> <p>The Proponent shall consult with the relevant roads authority during preparation of the TMP, as required. The performance of all Project traffic arrangements must be monitored during construction.</p>
34.	<p><b>Road condition reports</b></p> <p>Prior to construction commencement (or as otherwise agreed with the PMEM), the Proponent shall prepare road condition surveys and reports on the condition of roads and footpaths potentially affected by construction. The roads and footpaths to be surveyed are to be agreed with TfNSW prior to commencement of the surveys. Any damage resulting from the construction of the Project, aside from that resulting from normal wear and tear, shall be repaired at the Proponent's expense.</p>
35.	<p><b>Road safety audit</b></p> <p>Prior to commencement of any construction works, a Road Safety Audit is to be undertaken for the construction and operation of the substation. . The Road Safety Audit is to be prepared by a suitably qualified and experienced traffic engineer, and is to include specific assessment of:</p> <ul style="list-style-type: none"> <li>(a) sight distances for vehicles exiting or entering the driveway entrance at the Chalmers Street and Devonshire Street intersection and mitigation measures proposed</li> <li>(b) assessment of the Chalmers Street and Devonshire Street intersection and mitigation</li> </ul>

No	Condition
	<p>measures proposed</p> <p>The Road Safety Audit is to be submitted for comment to TfNSW.</p>
	<p><b>Miscellaneous</b></p>
<p>36.</p>	<p><b>Graffiti and advertising</b></p> <p>Hoardings, site sheds, fencing, acoustic walls around the perimeter of the site, and any structures built as part of the Project are to be maintained free of graffiti and advertising not authorised by the Proponent during the construction period. Graffiti and unauthorised advertising will be removed or covered within the following timeframes:</p> <ul style="list-style-type: none"> <li>(a) offensive graffiti will be removed or concealed within 24 hours</li> <li>(b) highly visible (yet inoffensive) graffiti will be removed or concealed within a week</li> <li>(c) graffiti that is neither offensive or highly visible will be removed or concealed within a month</li> <li>(d) any unauthorised advertising material will be removed or concealed within 24 hours.</li> </ul>
<p>37.</p>	<p><b>Electromagnetic energy</b></p> <p>An electromagnetic study is to be conducted for the detailed design, to assess the final electromagnetic environment. If required, modifications are to be made to the substation design to ensure electromagnetic compliance and compatibility.</p> <p>During commissioning of the substation, an electromagnetic survey is to be conducted, to assess the final operational electromagnetic environment, to ensure compliance with the following Australian Standards:</p> <ul style="list-style-type: none"> <li>• RHS 30 (Radiation Health Series 30), <i>Interim Guidelines on Limits of Exposure to 50/60 Hz Electric &amp; Magnetic Fields</i> (1989), National Health and Medical Research Council</li> <li>• RPS 3 (Radiation Protection Series No.3), <i>Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz</i> (2002), ARPANSA</li> <li>• AS/NZS 2344: 1997 and Amdt 1: 2006 <i>Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz</i></li> </ul> <p>A survey report is to be submitted to TfNSW for comment prior to the completion of commissioning.</p>
<p>38.</p>	<p><b>Hazardous materials</b></p> <p>A hazardous materials management plan is to be prepared as part of the CEMP. The plan is to include the following measures.</p> <ul style="list-style-type: none"> <li>(a) The Hazardous Material Survey should be updated prior to works commencing to confirm presence and conditions of hazardous items.</li> <li>(b) The removal, handling and disposal of any asbestos waste is to be undertaken by an appropriately licensed contractor (an occupational hygienist who is also a licensed asbestos assessor), and in accordance with: <ul style="list-style-type: none"> <li>a. <i>Code of Practice for the Safe Removal of Asbestos 2005</i></li> <li>b. <i>Code of Practice for the Management and Control of Asbestos in Workplaces 2005.</i></li> </ul> </li> <li>(c) The occupational hygienist shall be responsible for conducting asbestos fibre air monitoring, visual clearance inspections and issuing clearance certificates after the completion of any removal works.</li> <li>(d) Work is to cease in the vicinity of any potential asbestos materials which have not been previously identified, and the material be analysed for the presence of asbestos. In the event the material is disturbed prior to work ceasing, the provisions of an Asbestos Removal Control Plan or similar is to be followed, including seeking advice from a suitably qualified and experienced professional.</li> <li>(e) Prior to commencement of any construction works, Lead paint stabilisation and Lead dust removal is to be carried out by a qualified hazardous material removal contractor for all relevant areas within the substation areas affected by construction or utilised for construction</li> </ul>

No	Condition
	<p>access.</p> <p>(f) All known and presumed occurrences of polychlorinated biphenyl's would be handled and disposed of in accordance with the procedure documented within <i>ANZECC Identification of PCB-containing Capacitors – An information booklet for electricians and electrical contractors 1997</i>. Removal would be undertaken by a suitable licenced hazardous material removal contractor and would be disposed of at an appropriately licenced facility.</p> <p>(g) In the event synthetic material fibres are found on site, they would be handled and disposed of in accordance with the <i>National Code of Practice for the Safe Use of Synthetic Mineral Fibres</i>.</p>

END OF CONDITIONS



## **Appendix 3: Chalmers Street Substation Power Supply Upgrade approval under Section 60 of the *Heritage Act* 1977**





3 Marist Place  
Parramatta NSW 2150

Locked Bag 5020  
Parramatta NSW 2124  
DX 8225 PARRAMATTA

Telephone: 61 2 9873 8500  
Facsimile: 61 2 9873 8599

[heritage@heritage.nsw.gov.au](mailto:heritage@heritage.nsw.gov.au)  
[www.heritage.nsw.gov.au](http://www.heritage.nsw.gov.au)

Our File No: SF15/11317  
Our Ref: DOC15/301968-2

Mr Ben Groth  
821 Pacific Highway  
Transport for NSW  
CHATSWOOD NSW 2056

Dear Mr Groth,

**RE: APPLICATION UNDER S60 OF THE NSW HERITAGE ACT 1977 – Chalmers Street Substation, Central Station, Sydney**

Proposal: Construct new substation within the Prince Alfred Sidings and carry out minor alterations and additions to Prince Alfred Substation.

S60 Application No: 2015/S60/115 received on 7 August 2015  
Information received with the s60 application: As per Condition No.1

Pursuant to section 63 of the NSW Heritage Act 1977, the Heritage Council informs Transport for NSW that approval is granted subject to the following conditions:

**APPROVED DEVELOPMENT**

- 1 **Development must be in accordance with:**
  - b) **Report entitled Statement of Heritage impact – Chalmers Street substation, prepared by Tonkin Zulaikha Greer, and dated August 2015.**
  - b) **Architectural drawings prepared by Tonkin Zulaikha Greer listed in the table 1.**
  - c) **Architectural drawings prepared by GHD listed in the table 2.**

Table 3: Tonkin Zulaikha Greer architectural drawings

Dwg. No.	Rev.	Title
SK01	02	Site Plan
SK11	02	Ground Floor Plan
SK12	02	Level 1 Plan
SK21	02	Elevations 1
SK22	02	Elevations 2
SK23	02	E/N North Elevation Overall



SK25	01	Façade Plan Setout and Detail Ground Floor
SK27	01	Façade Details 1
SK28	01	Façade Details 2
SK29	01	Finishes Schedule
SK31	02	3D View 1
SK32	02	3D View 2
SK33	02	3D View 3
SK35	02	3D View 1 – View From North
SK36	01	3D View 2 – View From Rail Corridor
SK37	01	3D View 3 – View From Park

Table 4: GHD architectural drawings

Dwg. No.	Rev.	Title
2656-2650-CSSR-AR-0002	C	Site Plan
2656-2650-CSSR-AR-0003	C	Basement Floor Plan
2656-2650-CSSR-AR-0004	C	Ground Floor Plan
2656-2650-CSSR-AR-0005	C	Level 1 Floor Plan

- c) Report entitled *Central Station Conservation Management Plan*, prepared by NSW Railcorp and Rapport Conservation Architects, dated June 2013

**EXCEPT AS AMENDED** by the conditions of this approval:

**SITE PROTECTION & WORKS**

- 2 Develop a Temporary Protection Plan for the site to ensure that the Prince Alfred Substation and Former Railway Institute Building are adequately protected during the works. Protection systems must ensure significant historic fabric is not damaged or removed, potential impacts due to vibration are minimised, and traffic is appropriately managed during the works.
- 3 Prepare a dilapidation survey of the area proposed for the temporary construction compound, the Prince Alfred Substation and Former Railway Institute Building before and after the works. Repair any damage and undertake necessary repairs and cleaning under the guidance of a nominated heritage consultant at the conclusion of the works.
- 4 Salvage ground floor windows removed from Prince Alfred Substation in suitable safe storage on site. Windows to be stored with provenance to allow for possible future reinstatement.
- 5 Allow for the monitoring and repair of any damage of significant items (including the Prince Alfred Substation and Former Railway Institute Building) as a result of construction of the substation as part of the Contract. This should include an allowance for a nominated heritage consultant to inspect and report before, during and after completion of the works.

#### **NOMINATED HERITAGE CONSULTANT**

- 6** The nominated heritage consultant shall monitor the works to ensure that no unapproved loss or removal of significant fabric or elements occurs.
- 7** All work shall be carried out by suitably qualified tradespeople with practical experience in conservation and restoration of similar heritage items. The nominated heritage consultant shall be consulted prior to the selection of appropriate tradespeople.

#### **ARCHAEOLOGY**

- 8** Manage archaeology in accordance with Unexpected Heritage Finds Guideline contained in TfNSW's Quality Management System. If any unanticipated archaeological deposits are identified during construction, work likely to impact on the deposit should cease immediately and the NSW Heritage Council and an archaeologist must be contacted. Where required, further archaeological work and/or consents would be obtained prior to works recommencing at the location.
- 9** Should any Aboriginal objects be uncovered by the work, excavation or disturbance of the area is to stop immediately and the Office of Environment & Heritage (Enviroline 131 555) is to be notified in accordance with Section 89A of the *National Parks and Wildlife Act 1974* (NPW Act). Aboriginal objects in NSW are protected under the NPW Act. Unless the objects are subject to a valid Aboriginal Heritage Impact Permit, work must not recommence until approval to do so has been provided by the Office of Environment & Heritage.

#### **ARCHIVAL RECORDING**

- 10** Prepare a photographic archival record before, during and after the works of areas affected by the work at the Prince Alfred Substation. This includes the electrical switches on the north east wall which are proposed to be removed, pump well doors, ground floor windows, north east and western corners of the building and either end of the basement cable tunnel.

#### **FUTURE USE**

- 11** Develop a long term adaptive reuse strategy for the Prince Alfred Substation building
- 12** Develop an Interpretation Strategy for the Prince Alfred Sidings precinct. Implementation should be coordinated with a site-wide Interpretation Strategy and may be best online or within Central Station itself due to the site's location and inaccessibility.

#### **DURATION OF APPROVAL**

- 13** This approval shall be void if the activity to which it refers is not physically commenced within five years after the date of the approval or

**within the period of consent specified in any relevant development consent granted under the *Environmental Planning and Assessment Act 1979*, whichever occurs first.**

The above conditions have been imposed to ensure compatibility of the proposed work with the existing heritage qualities of the item and to ensure consistency with the Environmental Planning and Assessment Act, 1979. Your attention is drawn to the right of appeal against these conditions.

It should be noted that an approval under the Heritage Act is additional to that which may be required from other Local Government and State Government Authorities. If you have any questions regarding the above matter please contact Mr Adrian Hohenzollern at the Heritage Division, Office of Environment and Heritage on 9873 8540 or [adrian.hohenzollern@environment.nsw.gov.au](mailto:adrian.hohenzollern@environment.nsw.gov.au).

Yours sincerely



**Christian Hampson**  
A/Director, Heritage Division  
Heritage Division  
Office of Environment and Heritage  
**AS DELEGATE OF THE HERITAGE COUNCIL OF NSW**  
11 October 2015

## Appendix 4: Environmental Impact Assessment

### CHALMERS STREET SUBSTATION PROJECT

#### APPROVAL

I, FIL CERONE, as delegate of the Secretary, Transport for NSW:

1. Have examined and considered the Proposed Activity in the Chalmers Street Substation Project Review of Environmental Factors and Chalmers Street Substation Project Determination Report in accordance with the provisions of section 111 of the *Environmental Planning and Assessment Act 1979*.
2. Determine on behalf of Transport for NSW (the Proponent) that the Proposed Activity may be carried out in accordance with the Conditions of Approval in this Determination Report, consistent with the proposal described in the Chalmers Street Substation Project Review of Environmental Factors as amended by this Determination Report.



Fil Cerone  
A/Technical Director, Planning and Environment Services  
Transport for NSW

Date: 30/11/15.

