APPLICATION ON NOTIFICATION – CROWN DEVELOPMENT

Applicant:	Origin Energy Power Limited
Development Number:	010/V007/18
Nature of Development:	Increase the electricity generation capacity of the Quarantine Power Station by 160–180 MW, through the installation of three new aero-derivative gas turbine generators and a substation.
Type of development:	Public Infrastructure
Zone / Policy Area:	Public Purposes (Quarantine Station)
Subject Land:	Quarantine Power Station - Grand Trunkway, Torrens Island. Allotment 112 in DP 59977 (CT 5907/399) and Allotment 302 in DP 90964 (CT 6154/53).
Contact Officer:	Lee Webb
Phone Number:	(08) 7109 7066
Start Date:	Wednesday 21 February 2018
Close Date:	Thursday 15 March 2018
During the notification period, hard copies of the application documentation can be viewed at the Department of Planning, Transport and Infrastructure, Level 5, 50 Flinders Street, Adelaide during normal business hours. Application documentation may also be viewed during normal business hours at the Port Adelaide Enfield Council office.	

Written representations must be received by the close date (indicated above) and can either be posted, hand-delivered, faxed or emailed to the State Commission Assessment Panel (SCAP). A representation form is provided as part of this pdf document.

Any representations received after the close date will not be considered.

Postal Address:
The Secretary
State Commission Assessment Panel
GPO Box 1815
ADELAIDE SA 5001

Street Address:
Development Division
Department of Planning, Transport and Infrastructure
Level 5, 50 Flinders Street
ADELAIDE

Email Address: scapadmin@sa.gov.au
Fax Number: (08) 8303 0753

Government of South Australia

Department of Planning, Transport and Infrastructure

DEVELOPMENT ACT 1993

NOTICE OF APPLICATION FOR CONSENT TO DEVELOPMENT

SECTION 49 – PUBLIC INFRASTRUCTURE

Notice is hereby given that an application has been made by **Origin Energy Power Limited** for the **'Quarantine Power Station Expansion Project'** (Development Application Number: **010/V007/18**). The proposal is to increase the electricity generation capacity of the Quarantine Power Station by 160–180 MW, through the installation of three new aero-derivative gas turbine generators (and associated electric generators and 30 metre high exhaust stacks). The application also includes an electricity substation adjacent the generators, underground 275kV cables to connect the facility to the Torrens Island Power Station substation, connection to the SeaGas pipeline, water storage tanks (potable and demineralised water), site access and temporary laydown areas for construction purposes. Two potential sites for the generators are proposed – a preferred site to the north of the power station and an alternative site to the south of the power station. Four regulated trees would also need to be removed during construction.

The land is situated at the **Quarantine Power Station – Grand Trunkway, Torrens Island** and applies to the land parcels - Allotment 112 in Deposited Plan 59977 (CT 5907/399) and Allotment 302 in Deposited Plan 90964 (CT 6154/53).

The subject land is located within the Public Purposes (Quarantine Station) Zone of the Land Not Within a Council Area (Metropolitan) Development Plan (consolidated 5 May 2016).

The application may be examined during normal office hours at the office of the State Commission Assessment Panel, Level 5, 50 Flinders Street and at the office of Port Adelaide Enfield Council, 163 St Vincent Street, Port Adelaide. Application documentation may also be viewed on the SCAP website at: http://www.saplanningcommission.sa.gov.au/scap/public_notices.

Any person or body who desires to do so may make representations concerning the application by notice in writing delivered to the Secretary, State Commission Assessment Panel (GPO Box 1815, Adelaide SA 5001), not later than **15 March 2018.**

Each person or body making a representation should state the reason for the representation and whether that person or body wishes to be given the opportunity to appear before the Panel to further explain the representation.

Representations may be made available for public inspection. Please indicate in writing if you object to your representations being made available in this way.

Should you wish to discuss the application and the public notification procedure please contact **Lee Webb** on **(08) 7109 7066** or lee.webb@sa.gov.au

Alison Gill
SECRETARY
STATE COMMISSION ASSESSMENT PANEL
www.saplanningcommission.sa.gov.au/scap

PN2496

PN2496
24x2 (63mm)
Adelaide Advertiser
Portside Messenger
Wed 21 February 2018

DEVELOPMENT ACT, 1993
S49/S49A – CROWN DEVELOPMENT
REPRESENTATION ON APPLICATION

Applicant:	Origin Energy Power Limited
Development Number:	010/V007/18
Nature of Development:	To increase the electricity generation capacity of the Quarantine Power Station by 160–180 MW, through the installation of three new aero-derivative gas turbine generators (and associated electric generators and 30 metre high exhaust stacks). The application also includes an electricity substation adjacent the generators.
Zone / Policy Area:	Public Purposes (Quarantine Station)
Subject Land:	Quarantine Power Station - Grand Trunkway, Torrens Island. Allotment 112 in Deposited Plan 59977 (CT 5907/399) and Allotment 302 in Deposited Plan 90964 (CT 6154/53).
Contact Officer:	Lee Webb
Phone Number:	(08) 7109 7066
Close Date:	Thursday 15 March 2018

My name:_____

My phone number: _____

PRIMARY METHOD(s) OF CONTACT: Email address: _____

Postal address:_____

_____Postcode_____

You may be contacted via your nominated PRIMARY METHOD(s) OF CONTACT if you indicate below that you wish to be heard by the State Commission Assessment Panel in support of your submission.

My interests are:
[ ] owner of local property
[ ] occupier of local property
[ ] a representative of a company/other organisation affected by the proposal
[ ] a private citizen

The address of the property affected is .....Postcode.....

The specific aspects of the application to which I make comment on are: .....

.....

.....

.....

.....

.....

.....

I
[ ] wish to be heard in support of my submission
[ ] do not wish to be heard in support of my submission
(Please tick one)

by
[ ] appearing personally
[ ] being represented by the following person : .....
(Cross out whichever does not apply)

Date: ..... Signature: .....

Return Address: The Secretary, State Commission Assessment Panel, GPO Box 1815, Adelaide, SA 5001 or scapadmin@sa.gov.au

SECTION 49 & 49A – CROWN DEVELOPMENT
DEVELOPMENT APPLICATION FORM

PLEASE USE BLOCK LETTERS

FOR OFFICE USE

COUNCIL: LNWCA (Metropolitan)

APPLICANT: Origin Power Pty Ltd

ADDRESS: L45 Australia Sq 264-278 George Street, Sydney

CROWN AGENCY: Department Premier & Cabinet

DEVELOPMENT No: _____

PREVIOUS DEVELOPMENT No: _____

DATE RECEIVED: / /

CONTACT PERSON FOR FURTHER INFORMATION

Name: Bill Truscott

Telephone: _____ [work] 0467 713 481 [Ah]

Fax: _____ [work] _____ [Ah]

Email: bill.truscott@originenergy.com.au

☐ Complying	Decision: _____
☐ Merit	Type: _____
☐ Public Notification	Finalised: / /
☐ Referrals	

NOTE TO APPLICANTS:

(1) All sections of this form must be completed. The site of the development must be accurately identified and the nature of the proposal adequately described. If the expected development cost of this Section 49 or Section 49A application exceeds $100,000 (excl. fit-out) or the development involves the division of land (with the creation of additional allotments) it will be subject to those fees as outlined in Item 1 of Schedule 6 of the *Development Regulations 2008*. Proposals over $4 million (excl. fit-out) will be subject to public notification and advertising fees.
(2) Three copies of the application should also be provided.

	Decision required	Fees	Receipt No	Date
Planning:				
Land Division:				
Additional:				
Minister's Approval				

EXISTING USE: Power Generation

DESCRIPTION OF PROPOSED DEVELOPMENT: Expansion of Quarantine Power Station for an additional number of units for a nominal 160-180MW

LOCATION OF PROPOSED DEVELOPMENT:

House No: _____ Lot No: ____ Street: Grand Trunkway Town/Suburb: Torrens Island

Section No [full/part] _____ Hundred: Port Adelaide Volume: 5907 Folio: 399

Section No [full/part] _____ Hundred: Port Adelaide Volume: 6154 Folio: 53

LAND DIVISION:

Site Area [m^2] _____ Reserve Area [m^2] _____ No of existing allotments _____

Number of additional allotments [excluding road and reserve]: _____ Lease: YES ☐ NO ☐

DEVELOPMENT COST [do not include any fit-out costs]: $ 121 million

POWERLINE SETBACKS: Pursuant to Schedule 5 (2a)(1) of the *Development Regulations 2008*, if this application is for a building it will be forwarded to the Office of the Technical Regulator for comment unless the applicant provides a declaration to confirm that the building meets the required setback distances from existing powerlines. The declaration form and further information on electricity infrastructure and clearance distances can be downloaded from the DPLG website (www.dac.sa.gov.au).

I acknowledge that copies of this application and supporting documentation may be provided to interested persons in accordance with the *Development Act 1993*.

SIGNATURE: _____ Dated: 22 / 01 / 2018

Quarantine Power Station Expansion Project

Origin Energy Power Limited (Origin)

Section 49 Development Application

IW169200-200-NP-RPT | 2

17 January 2018

OEEM100822-15

Quarantine Power Station Expansion Project

Project No:	IW169200
Document Title:	Section 49 Development Application
Document No.:	IW169200-200-NP-RPT
Revision:	2
Date:	17 January 2018
Client Name:	Origin Energy Power Limited (Origin)
Client No:	OEEM100822-15
Project Manager:	Kelly Briton-Jones
Author:	Kelly Briton-Jones, Lara Daddow

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Document history and status

Revision	Date	Description	By	Review	Approved
A	9/12/2017	Draft Development Application for internal review	K Briton-Jones	L Daddow	K Briton-Jones
0	13/12/2017	Draft Development Application for Origin review	K Briton-Jones	L Daddow	K Briton-Jones
1	12/1/2018	Final Draft Development Application for Origin review	K Briton-Jones, A Horan	L Daddow	L Daddow
2	17/1/2018	Final Development Application for Issue	K Briton-Jones	L Daddow	L Daddow

Contents

Appendix L. Relevant Development Plan Policy

List of Tables

List of Figures

List of Plates

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide a supporting document for the Development Application of the expansion of the Quarantine Power Station on Torrens Island, South Australia in accordance with the scope of services set out in the contract between Jacobs and Origin Energy Power Limited (Origin). That scope of services, as described in this report, was developed with Origin.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by Origin and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from Origin (if any) and/or information available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

The advice provided in this report does not constitute an interpretation of the law or provision of legal advice. The advice and report has been developed by environmental planners, environmental scientists, cultural heritage consultants and structural engineers, based solely on professional experience and interpretation of the environmental and technical legislative requirements. Relevant environmental and planning legislation to the best of our knowledge has been included.

This report has been prepared on behalf of, and for the exclusive use of, Origin, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and Origin. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

Executive Summary

Origin Energy (Origin) proposes to expand the existing Quarantine Power Station (QPS) and network connection infrastructure on Torrens Island. Under this project, the Quarantine Power Station Expansion (QPSX) a nominal 160-180 megawatts (MW) of latest technology flexible generating capacity will be installed at QPS. The proposed development is designed to meet the need for responsive and efficient open cycle gas generation and to support the supply variability resulting from high levels of renewable power within the South Australian market. Gas will be supplied to the QPS via the existing SeaGas pipeline via a new let-down station.

Origin is one of Australia's leading integrated energy companies that explores, produces, transports and sells energy to power millions of Australian homes and businesses every day. Origin plays an integral role in shaping Australia's energy future.

Origin is committed to ensuring affordable, reliable and sustainable electricity supply to its customers. The QPSX project will provide a significant step to improve security of the South Australian electricity network, and reliability of supply to South Australian customers. Furthermore, QPSX will be designed to have the flexibility needed to support the needs of a changing market-space in South Australia, support the high levels of predicted renewable energy penetration in South Australia, and to enhance grid stability.

Two options for siting of the generators are under consideration – the preferred site is directly to the north of QPS and the alternate site is south of QPS. The northern option is currently considered more feasible as it is proposed on land owned by Origin and is closer to the existing QPS infrastructure. The southern option is currently constrained by land ownership however is closer to the existing transmission lines which allows more efficient and less costly connection to the high voltage electricity network.

Torrens Island is Origin's preferred site for expansion of its South Australian generation fleet due to existing electrical and gas infrastructure, as well as proximity to the State's main load centre and existing Origin operations.

The proposed QPSX northern option is north of the existing QPS on Origin owned land (herein referred to as the northern option). The proposed northern option location is formally described as allotment 112, Certificate of Title – Volume 5907 Folio 399 in the area named Torrens Island Hundred of Port Adelaide.

The proposed southern option is formally described as allotment 302, Certificate of Title – Volume 6154 Folio 53 in the area named Torrens Island Hundred of Port Adelaide (herein referred to as the southern option). Should this site become available, Origin may prefer to develop the alternative southern option. An application for land access to allotment 302 was lodged with the Department of Planning Transport and Infrastructure (DPTI) on the 14 August 2017.

The current development design incorporates the following indicative key elements:

- Three new gas turbine (GT) and generator structures (gas turbine packages) at either the northern or southern site option, incorporating:
  - Three aero-derivative[1] GTs;
  - Three associated electric generators;
  - Three associated exhaust stacks 30m high aligned with the gas turbines;
- A transmission substation adjacent to the generators consisting of up to three 80MVA 275kV step up transformers and connection equipment;

[1] Aero-derivative gas turbines are named such as they are derived from the engines that power jet airliners. These engines are light and flexible and, as such, are well suited to fast flexible operation and can be turned on an off, and ramped up and down very quickly.

- Associated underground 275kV cables that generally following the existing access road, from Australian Gas Light Company's (AGL) Torrens Island Power Station (TIPS) to QPS connecting QPSX into the TIPS substation. The cable will either be direct burial or using a conduit depending on site assessments and construction methodologies prior to construction;
- Associated connection point for the gas pipeline into the existing SeaGas infrastructure to the west of the existing QPS;

  Water storage tanks for potable and demineralised water;
- Temporary laydown areas for construction; and
- Site access through existing access roads.

The indicative layout of the proposed development is presented in Appendix C. Both options will be using the same design elements, however these will be rotated to suit the final approved allotment and terrain.

Approval for the proposed development is sought under the *Development Act 1993* (Development Act) before construction can commence. Origin Energy Pty Ltd received Crown sponsorship from the Department of the Premier and Cabinet as provided for under Section 49(1)(a), of the *Development Act 1993* for its QPSX Project on Torrens Island (Appendix A).

The Section 49 process is appropriate for electricity infrastructure such as the proposed QPSX, as generation is provided for public usage and represents a service historically provided by the State.

Key Environmental Considerations

To support a Development Application for the QPSX Project, a range of environmental investigations have been undertaken. The key issues which have the potential to constrain the project are identified below and findings are summarised in the relevant section with the associated reports provided as appendices. Outcomes of the assessments to date provide confidence that environmental aspects will not be adversely impacted and prevent the project from proceeding.

Air Quality

An air quality assessment was conducted in accordance with the SA EPA's document: *Ambient air quality assessment* (SA EPA, 2016) to assess the air quality impacts on sensitive receivers as a result of the proposed QPSX Project northern option. The air quality assessment was based on conservative source data selections and assumptions and prepared in consultation with SA EPA's technical air quality staff.

The air quality model predictions show that the ground-level concentrations of NO_2 due to the QPSX (including a conservative estimate for ambient background concentration) comply with the air quality criteria across the model domain, which encompasses sensitive receiver locations. The air quality assessment demonstrated that QPSX Project is unlikely to adversely impact air quality at sensitive receptors in the vicinity. Air quality assessment for the southern option can be provided if requested.

Noise Impacts

An environmental noise assessment was conducted to understand the potential impact to sensitive receivers as a result of the proposed QPSX Project northern option. Based on the modelling of the sound power levels from the proposed infrastructure, noise impacts were assessed to be within the prescribed parameters of the EPA *Environment Protection (Noise) Policy 2007*. The noise assessment is provided in Section 5.4. Noise impact assessments for the southern option can be provided if requested.

Contaminated Sites

A preliminary contaminated land site investigation was conducted for the QPSX project area and surrounds. A number of potentially contaminating historical uses and disused structures are within and surrounding the QPSX Project area. Based on available information the PSI indicates there are likely to be no significant adverse on and off-site impacts to the beneficial uses of the land and groundwater related to the northern and southern generator site options. These sites have potentially low risk for the proposed end use and thus contamination is unlikely to restrict use of the land, however a soil and groundwater sampling investigation at the proposed northern generator site was recommended prior to construction commencing and appropriate environmental management measures will need to be implemented during construction. The recommendations are discussed further in Section 5.6.

Visual Amenity

A qualitative landscape character assessment was undertaken in a rigorous manner consistent with best practice, as prescribed by the *Guidelines for Landscape and Visual Impact Assessment* (Third Edition). The assessment determined that there will be no visual impact to the sensitive receiver in the locality based on the northern option, while the southern option may have a slight adverse impact as a result of the proposed expansion. A description of the landscape character is provided in Section 5.1.

Historical Heritage

The broader locality has historical ties with the Torrens Island Quarantine Station Complex, including the Jetty, Cemetery and Mortuary. This site adjacent QPS is a State Heritage Place in the South Australian Heritage Register, however the Quarantine Station Complex and other heritage listed structures are not to be disturbed for QPSX. A review of the impact on the heritage values of Torrens Island was undertaken based on the siting options included in the Development Application and a summary of this assessment is provided in Section 5.9.

A number of non-Aboriginal structures are present within the QPSX area to the south and north. If the northern option is progressed a number of historical water tanks may require removal. If the southern option is progressed, three buildings previously used for animal quarantine may be disturbed. None of these sites are heritage listed. During consultation with DEWNR it was considered that a photographic log of these structures would assist in recording their heritage contribution to the area. Origin engaged Jacobs to undertake a structural integrity assessment of the structures present in the southern area of the proposed QPSX Project.

Cultural Heritage

A desktop heritage assessment of the QPSX Project area was completed to determine the presence of non-Aboriginal and Aboriginal archaeological material within the boundary of the northern option, southern option and transmission line. In November 2017 Origin and Jacobs attended a Kaurna Nation Cultural Heritage Association (KNCHA) Community Forum for the QPSX. Site surveys will be undertaken with KNCHA in January 2018 to identify any archaeological sites within the QPSX Project area. Origin is working with KNCHA to ensure appropriate management measures are in place to manage cultural heritage in the QPS area and for the QPSX Project.

Flora and Fauna

An assessment of ecological values at the QPSX Project was undertaken to determine the presence of species of conservation significance (i.e. species protected under Commonwealth or State legislation). No Matters of National Environmental Significance were identified within the QPSX Project area that would be impacted by the project. A number of regulated trees were identified within the QPSX Project northern option that may require removal under the *Development Act 1993*. Terrestrial vegetation on Torrens Island is exempt from the provisions of the *Native Vegetation Act 1991* as it falls outside of the defined area of metropolitan Adelaide where the act applies, therefore no approval to clear native vegetation under the act is required. The ecological assessment is discussed further in Section 5.2.

1. Introduction

Origin (the applicant) is seeking to expand the existing QPS and network connection infrastructure on Torrens Island. Origin is one of Australia's leading integrated energy companies that explores, produces, transports and sells energy to power millions of Australian homes and businesses every day. Origin plays an integral role in shaping Australia's energy future.

Origin is committed to ensuring affordable, reliable and sustainable electricity supply to its customers. The QPSX project will provide a significant step to improve security of the South Australian electricity network, and reliability of supply to South Australian customers. Furthermore, QPSX will be designed to have the flexibility needed to support the needs of a changing market-space in South Australia, support the high levels of predicted renewable energy penetration in South Australia, and to enhance grid stability.

The proposed development; QPSX is designed to meet the need for responsive and efficient open cycle gas generation in the South Australian Market required due to the high levels of renewable energy penetration in this State. Origin is proposing to expand its QPS to install a nominal 160 – 180MW of gas powered generators on vacant land adjacent to the QPS site on Torrens Island as depicted in Appendix C. Origin is currently planning to have this new facility available for generation in the market by the summer of 2019/2020.

The existing Origin Quarantine Power Station consists of four Alstom GT10B gas turbines and one GE 9E gas turbine each operating primarily on natural gas and with a combined capacity to generate up to 224MW of electricity. As part of a separate project, Origin is planning to replace the four GT10B gas turbines over the next three to four years with the latest aero-derivative turbines as part of routine maintenance works (with the first of these currently scheduled to be replaced in September 2018).

The location of the QPSX Project in relation to Adelaide, is shown in Figure 1-1. The QPSX Project is located within the area of the Land Not Within A Council Area (LNWCA) (Metropolitan) and including the underground transmission line is situated within three zones; the Public Purpose (Quarantine Station) Zone, the Metropolitan Open Space System (MOSS) (Conservation) Zone and the Public Purpose (Power Station) Zone of the LNWCA (Metropolitan) Development Plan (the Development Plan) (refer Figure 1-2).

This Development Application has been prepared by Jacobs on behalf of Origin for Development Approval for the QPSX at allotment 112, CT 5907, 399 (the QPSX Project northern option). As discussed in the executive summary, this Development Application includes the alternative QPSX Project southern option located on allotment 302, CT 6154, 53 (QPSX Project southern option). Should the land become available, Origin will then seek to amend the Development Application accordingly. Only one site will be developed. Approval is sought for the proposed development on either site subject to land availability and detailed design. For the purposes of this Development Application, assessments have been completed to ensure adequate assessments of both options.

The QPSX Project will support the South Australian Government's focus on supporting infrastructure projects that improve the security of the South Australian electricity network, as well as on encouraging development and initiatives which create economic growth and jobs. Strong industry and community engagement for new developments, particularly gas energy and energy security developments, are enabled through the Government's policies and strategies such as:

- *The South Australian Energy Plan – delivering more generating capacity, more gas supplies and more job opportunities for South Australians;*
- *The South Australian Strategic Plan; and*
- *The Strategic Infrastructure Plan for SA – provision of a reliable and affordable supply of energy.*

This report has been prepared to support the Development Application for the proposed QPSX Project and includes:

- A summary of the statutory requirements applicable to this Development Application and the alignment of the QPSX with State strategic objectives (Section 2);
- An overview of the QPSX Project area and Project locality (Section 3);
- A detailed description of the proposed development (Section 4);
- A summary of the environmental impact assessment studies and the anticipated environmental impacts of the project (Section 5);
- An assessment of the proposed development against the relevant principles of the Land Not Within A Council (Metropolitan) Development Plan (Section 6);
- Environmental management measures during construction and operation (Section 7);
- Endorsement of the QPSX as 'public infrastructure' by the Department of State Development for assessment under Section 49 of the *Development Act 1993* (Appendix A);
- Certificate of Title of both the northern and southern option allotments (Appendix B);
- Site plan (Appendix C);
- Endorsement from the Office of Technical Regulator (Appendix C);
- Appendices, providing the outcomes of technical investigations used to inform the preparation of this Development Application; and
- Relevant Land Not Within A Council Area (LNWCA) (Metropolitan) Development Plan Policy (Appendix L).

Figure 1-1 Location of QPSX Project Area

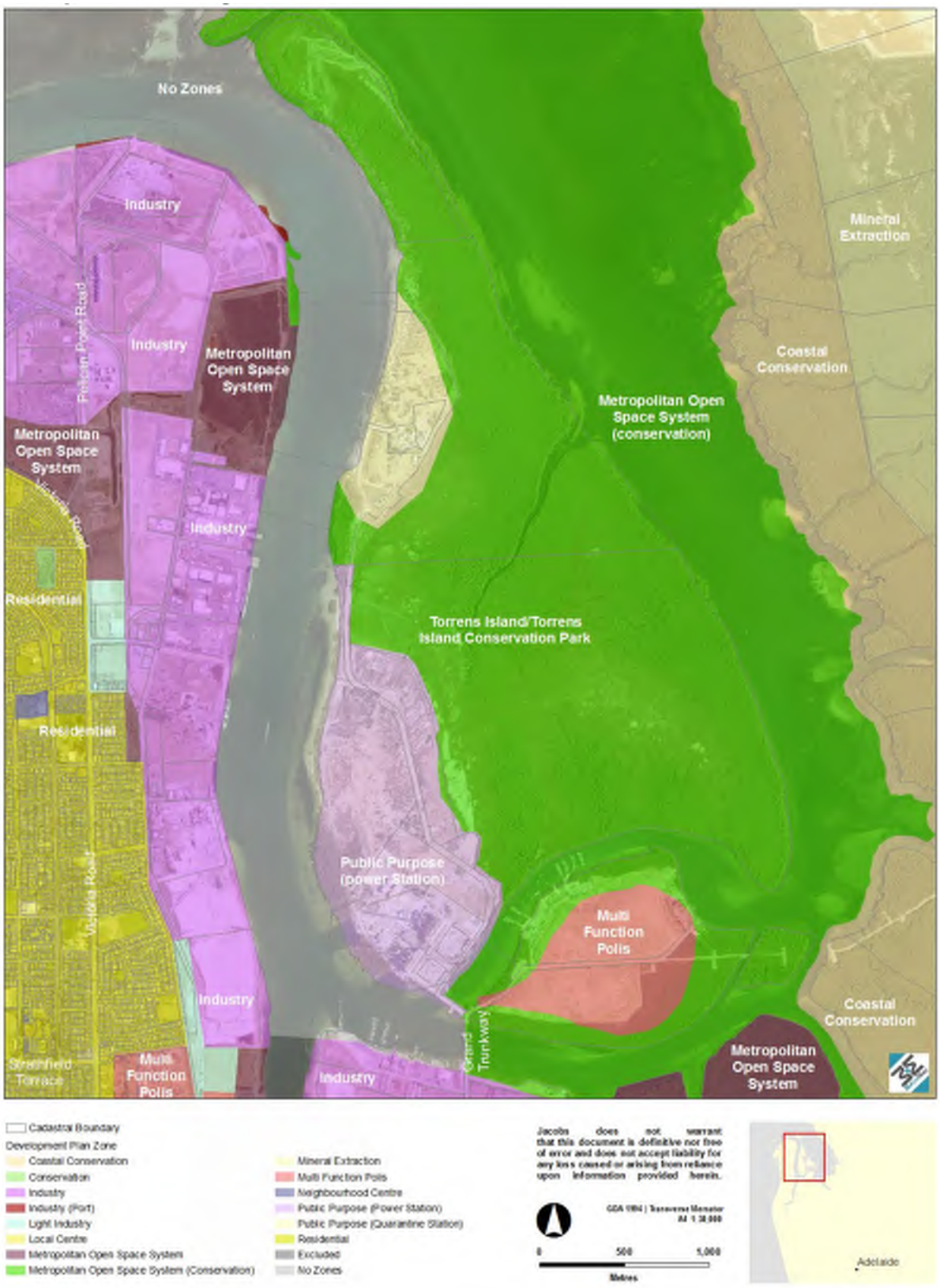

Figure 1-2 Development Plan Zoning

2. Statutory Requirements

This section identifies the key approval requirements for construction and operation of the QPSX. It also considers the strategic alignment of the QPSX with relevant National and State policy objectives.

2.1 Approval Process

This Development Application is submitted pursuant to Section 49 of the *Development Act 1993* with the endorsement of the Department of State Development (refer to Appendix A for DSD endorsement letter). The Section 49 process is appropriate for electricity infrastructure such as the proposed expansion of the existing QPSX, as generation is provided for public usage and represents a service historically provided by the State.

Under Section 49, public infrastructure incorporates *'… infrastructure, equipment, structures, works and other facilities used in or connection with the supply of… electricity…'*.

The Act defines infrastructure for the purposes of electricity generation as 'electricity infrastructure, in accordance with the definition provided in Section 4 of the *Electricity Act 1996'*. The establishment of QPSX at the QPSX Project area represents the development of **Electricity Infrastructure** whereby:

> ***Electricity Act 1996, Section 4, Electricity Infrastructure*** *means—*
>
> *a) electricity generating plant; and*
>
> *b) powerlines; and*
>
> *c) substations for converting, transforming or controlling electricity; and*
>
> *d) equipment for metering, monitoring or controlling electricity; and*
>
> *e) any wires, equipment or other things (including tunnels and cavities) used for, or in connection with, the generation, transmission, distribution or supply of electricity; and*
>
> *f) anything declared by regulation to form part of electricity infrastructure,*
>
> *but does not include anything declared by regulation not to form part of electricity infrastructure;*

The proposal fits the criteria of "public infrastructure" under Section 49 of the *Development Act 1993* for the following reasons:

- The proposal represents the establishment of public electricity infrastructure;
- The QPSX Project will add a nominal160 – 180 MW of new, flexible, gas fired generation to the existing QPS facility with the ability to rapidly respond to, and meet electricity requirements and stabilise supply variability conditions expected to arise with high levels of renewable penetration;
- The QPSX Project will be connected to the National Electricity Grid via 275kV connection; and
- Investment Attraction South Australia (IASA) – Minerals and Energy whom are currently providing case management support facilitated an introduction to the Planning unit within the Department of Planning, Transport and Infrastructure which verbally is supportive of this request under section 49 of the *Development Act 1993*, as Crown sponsored public infrastructure.

The Section 49 process is considered the appropriate approval process for the development as the QPSX is 'electricity generating plant' and 'substations for converting, transforming or controlling electricity'. The electricity generated from QPSX will be provided for public usage and represents a service historically provided by the State.

The Minister (or delegate) is the relevant authority for applications submitted pursuant to Section 49. The State Planning Commission (formerly Development Assessment Commission) supports this process through assessment of the application and a report to the Minister. The Minister (or delegate) may, after receiving a report from the State Planning Commission, approve or refuse the development.

It is noted that the State Government's State Energy Plan requires electricity generation Development Applications be accompanied by a certificate from the Office of Technical Regulator (OTR) certifying that the proposed generation plant complies with the requirements of the OTR in relation to the security and stability of the State's power system, in order to gain development approval. The certificate from the OTR has been included as Appendix E.

2.1.1 Development Plan Zoning

The proposed QPSX Project (in terms of both generation and transmission) is entirely located within the Land Not Within a Council Area (LNWCA) (Metropolitan) Development Plan, consolidated 5 May 2016. The QPSX footprint for the proposed expansion straddles a number of zones within the Development Plan (as depicted in Figure 1-2):

- The Public Purpose (Quarantine Station) Zone to the northern most point of the proposed project areas.
- The Metropolitan Open Space System (MOSS) (Conservation) Zone from the north to the south.
- The Public Purpose (Power Station) Zone to the south of Torrens Island.

An assessment of the QPSX against the relevant objectives and principles of development control of the Development Plan is provided in Section 6.

2.1.2 Public Notification

The proposed development has an estimated cost of construction of $121 million. Accordingly, public notification for a period of 15 business days is required pursuant to subsection 49(7(d)) of the Act as the cost of the proposed development is greater than $4 million.

2.1.3 Statutory Referrals

In accordance with Section 49 of the Act, and Schedule 8 of the Development Regulations 2008 (the Regulations), the following statutory referrals will be required:

- **Environment Protection Authority** – the QPSX is an activity of environmental significance (fuel burning) and therefore requires referral to the EPA.
- **Coastal Protection Board** – The QPSX is development near the coast and therefore a referral is required.
- **City of Port Adelaide Enfield** – in accordance with Regulation 38(4) the Council boundary is within 1km of the Development Site and therefore a referral to the Council is required.
- **State Planning Commission (formerly Development Assessment Commission)** – QPSX is proposed within the LNWCA and a referral is required. Under Section 49 and 49A of the Act, SPC (formerly DAC) is required to assess Crown Development and Public and Electricity Infrastructure applications, and prepare a report to the Minister for Planning who is responsible for making the final decision.
- **Commissioner of Highways (DPTI) –** the QPSX may temporarily change the nature of the movement of traffic in the surrounding locality of the Project area. There will be one access point from arterial roads during the construction period to facilitate the delivery of project components.

The statutory referrals will be facilitated by the State Planning Commission following lodgement of this Development Application.

2.2 Additional Approvals

A number of additional approvals under other legislation will be required prior to the construction and operation of the QPSX, including:

- Terrestrial vegetation on Torrens Island is exempt from the provisions of the *Native Vegetation Act* as Torrens Island falls outside of the defined area of metropolitan Adelaide where the act applies. Therefore, no approval to clear native vegetation under the act is required.
- Approval to clear four Regulated Trees in accordance with the *Development Act*.
- Approval to connect QPSX to the Network in accordance with the National Electricity Rules, including approval by the Transmission Network Service Provider (TNSP) and the Australian Energy Market Operator (AEMO) that the new facility meets its Generator Performance Standard requirements and obligations.
- Approval to modify the existing gas connection in accordance with the National Gas Rules and approval by the supply gas pipeline organisation
- Written approval from the EPA for the modification of existing EPA licence for fuel burning.

Other approvals (e.g. heavy vehicle permits) may be required subject to the construction methodology of the construction contractor and will be obtained by the appointed contractor prior to the commencement of construction.

2.3 Strategic Alignment

The QPSX will provide various economic and energy security benefits to South Australia, which in turn support the attainment of a range of identified strategic priorities. The QPSX aligns with various strategic policies, at a State level.

The State envisaged priorities are identified within the following strategic documents:

- SA's Our Energy Plan – to source, generate and control more of South's Australia's power supply in South Australia.
- State Strategic Infrastructure Plan – the overarching state framework for the planning and delivery of infrastructure by all government and private sector infrastructure providers.
- SA Strategic Plan – the overarching strategic plan, providing a blueprint for the development of the State.
- SA's Ten Economic Priorities – the top economic focus areas identified as growth areas within the State.

The QPSX is considered a project of public infrastructure with significant public benefit as outlined below:

Table 2.1 Proposal alignment to State Strategic Priorities

Document	Objective / Target	Project Alignment
SA Energy Plan	*Goal: Create more electricity generation to increase competition and put downward pressure on prices.*	Adding an extra nominal 160MW – 180MW of latest technology flexible generation to the State in close proximity to the major load centre, the project will enhance energy security in South Australia. The ability of this new facility to respond quickly to price spikes will result in lower average market spot prices, placing downward pressure on prices for customers in SA. In addition, extending the 275kV network to Quarantine Power Station will increase network

Document	Objective / Target	Project Alignment
		security significantly and will provide further future options for expansion (beyond the QPSX project).
SA Infrastructure Plan	*Objective 1: Growing Prosperity; Investment - Match or exceed Australia's ratio of business investment as a percentage of the economy within 10 years. (T1.6)*	Investment of an estimated $121 million in the planning, design, procurement and construction, of the project. Operation and maintenance of the asset will give rise to an annual cost of circa $4.5M – $5.0M.
SA Infrastructure Plan	*Objective 1: Strategic infrastructure - Increase investment in strategic areas of infrastructure, such as transport, ports and energy to support and achieve the targets in South Australia's Strategic Plan. (T1.16)*	Investment of an estimated $121 million into strategic areas of energy to support the SA Strategic Plan.
SA Strategic Plan	*Target 38: Business investment* Exceed Australia's ratio of business investment as a percentage of the economy by 2014 and maintain thereafter	Investment of an estimated $121 million in SA. Opportunities for local contractors / suppliers during construction phase and ongoing maintenance.
SA Strategic Plan	*Target 47: Jobs* Increase employment by 2% each year from 2010 to 2016	Job creation and opportunities for local contractors / suppliers during construction phase and ongoing maintenance. The construction workforce is estimated to have an average of 50 people over the 12-month construction period for both the generator and transmission components of the project. During operations, one full-time staff is expected to be employed at site in addition to a number of part-time and contract staff for maintenance requirements. During major overhauls there will be a number of contractors required for shorter periods.
SA Strategic Plan	*Target 49: Unemployment* Maintain equal or lower than the Australian average through to 2020	Job creation and opportunities for local contractors / suppliers during construction phase and ongoing maintenance. As above.

3. Subject Site and Project Locality

Origin Energy currently own and operate the QPS located to the north of Torrens Island with a generation capacity of 224 MW. The existing QPS site consists of substation, control room, office, associated car parking and five gas turbine generators consisting of:

- QPS Units 1-4 (96 MW total) commissioned in 2002.
- QPS Unit 5 (128 MW) commissioned in 2009.

The QPSX Project area is located on Torrens Island within the Port Adelaide area. However, the land is zoned within the geographical boundaries of Land Not Within a Council Area (Metropolitan) Development Plan. Access to QPS is via an AGL controlled boom gate adjacent to the main TIPS and is therefore largely inaccessible to the public. The QPS site is approximately 4 km from the boom gate via the island's established road network, namely Grand Trunkway.

The QPSX Project area is adjacent to the Torrens Island Quarantine Station Complex; a State Heritage listed number of structures including Jetty, Cemetery & Mortuary. Within the vicinity of QPSX Project are a number of other structures of heritage value in relation to the Quarantine Station, including holding bays for live animals and veterinary clinic and kennel buildings all part of the 1909 Animal Quarantine Station.

Torrens Island is located approximately 15 km north-west of the Adelaide CBD, South Australia. Torrens Island is joined to the mainland by the Grand Trunkway Bridge over the North Arm Creek and connected to Garden Island by a causeway.

Figure 3-1 illustrates the regional context of Torrens Island which is surrounded by various geographical features including the Gulf of St Vincent to the north, the Port Adelaide River to the west and south including Inner Harbor and Outer Harbor, Barker Inlet to the east and south and Garden Island to the lower south-east. The Port River is also home to the Adelaide Dolphin Sanctuary an area of importance for the Port River dolphins, native bird and fish habitat. Most of the eastern side of the island is a Conservation Park and is adjacent to the Port River Estuary and Barker Inlet, also important breeding habitat and migratory areas.

Land uses in the surrounding Torrens Island locality include: the Barker Inlet Wetlands of National Significance and Dry Creek Salt Fields (operations ceased) to the south-east, Dry Creek Landfill, bulk grain storage and export facilities, cement production facilities, bulk fuel storage facilities, Port Adelaide Rowing Club and Port Adelaide Sailing Club all to the south with Residential areas further west and south beyond the industrial areas.

The Port River is a busy shipping channel with multi-berth users along the Inner and Outer Harbor of Port Adelaide. The Port Adelaide Enfield Council is to the west and south of the Port River and the Salisbury Council is to the north-eastern mainland side of the Adelaide coastline, adjacent Torrens and Garden Island.

Existing electrical infrastructure in the vicinity of the proposed QPSX are depicted on Figure 3-2. Transmission assets on Torrens Island include a series of 66kV lines connecting the QPS, ElectraNet distribution substation and Osborne Power Station to the Torrens Island substation as shown in Figure 3-2. There is a 275kV connecting feeder from Pelican Point Power Station to Torrens Island substation. AGL TIPS (A and B), along with a number of other major transmission nodes, are also connected to the Torrens Island 275kV substation.

Table 3-1 Details of QPSX Project Area

Feature	Description
Formal description:	Existing QPS: Allotment 305, Certificate of Title – Volume 6132 Folio 766 in the area named Torrens Island, Hundred of Port Adelaide. QPSX Project northern option: Allotment 112, Certificate of Title – Volume 5907, Folio 399 in the area named Torrens Island, Hundred of Port Adelaide. QPSX Project southern option: Allotment 302, Certificate of Title – Volume 6154, Folio 53 in the area named Torrens Island, Hundred of Port Adelaide. Land ownership relating to the entire QPSX Project area including the transmission cable route is shown on Figure 3-3.
Ownership details:	The QPSX Project northern option land is currently owned by Origin. Origin lodged an application for land access with DPTI to locate QPSX on the southern option, allotment 302. The timeframe for this process is uncertain and as such, this Development Application is proceeding with allotment 112 in the event allotment 302 is not available. A copy of both of the Certificate of Title's are presented in Appendix B.
Site area:	The QPSX Project northern option is irregular in shape with a coastal frontage of approximately 33 m. The QPSX Project northern and southern option is provided access to via Grand Trunkway. The QPSX Project area is situated in largely cleared, low lying areas containing a mixture of exotic grasses and amenity plantings of native trees and shrubs. The wider location is supported by mangroves, low shrubland and sand dune vegetation, largely disturbed by unformed internal vehicle tracks.
Existing land uses and infrastructure on the subject site:	The QPSX Project is currently used for the Origin Quarantine Power Station, surrounded by numerous electrical infrastructure as shown in Plate 3-4. Historically the site has been used for quarantine purposes for people and animals although these facilities ceased to be used in 1995 (Habitable Places 2014: 15). The surrounding Quarantine Station complex continues to be used for research, education and tourism purposes.
Surrounding land uses:	The QPSX Project is bound by: The Metropolitan Open Space System Conservation Area (MOSS) to the east. The historic Quarantine Station to the north. Port River to the west and the AGL TIPS approximately 2.4 km to the south. As depicted in Figure 3-1the locality surrounding the QPSX Project is characterised by industrial and electrical activity in a largely flat to low-lying landscape.
Sensitive receptors:	During the supporting environmental assessments, two locations were identified as sensitive receptors to the QPSX. One location considered to be a sensitive receptor was identified during the Landscape Character Visual Impact Assessment, as the Mutton Cove Conservation Park Lookout is located approximately 800m west of the QPSX Project area and depicted on Figure 5-1. The environmental noise report and air quality impact assessment both identified the second sensitive receptor location to the residential area 2km west of Torrens Island over the Port River and beyond industrial areas of Osborne, Port Adelaide.
Local road network:	The main access road currently used, and proposed to continue to be used is Grand Trunkway. Site access during construction will be via two access points as shown on Figure 3-4.
Vegetation:	The vegetation communities identified within the construction footprint confirmed presence of

Feature	Description
	samphire mud flats, Chenopod low open shrubland and Acacia tall shrubland communities in the southern portion of the underground transmission cable. As discussed in Section 5.2 these areas have been highly disturbed by past vegetation clearance, earthworks and invasion of exotic grass and herbs and are considered to be in moderate to poor condition and provide limited habitat for wildlife including threatened species.

Figure 3-1 QPS Surrounding Land Uses

Figure 3-2 Existing Torrens Island Electricity Infrastructure

Figure 3-3 Torrens Island Land Ownership

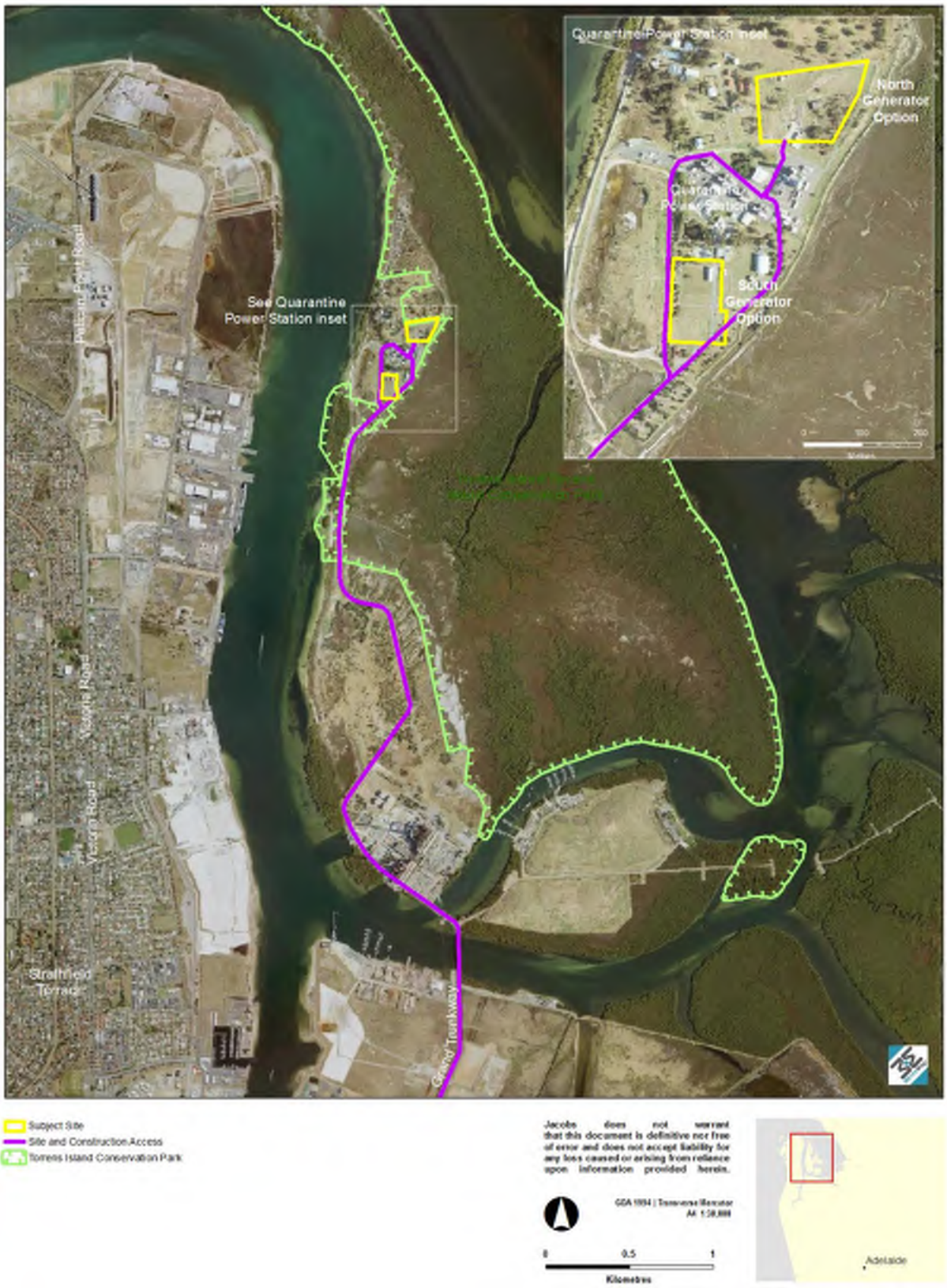

Figure 3-4 Site Access and Local Road Routes

Plate 3-1 QPSX Project area (northern option) looking south

Plate 3-2 QPSX Project area (southern option) entrance looking north

Plate 3-3 access road to QPS with adjacent 66kV transmission, looking north

Plate 3-4 Surrounding Land Uses (AGL TIPS), looking west

Plate 3-5 Surrounding Land Uses (AGL TIPS), looking south-west

Plate 3-6 Surrounding Land Uses (ASC) looking west

4. Description of Development

An additional (nominal) 160-180MW of latest technology flexible generating capacity will be installed as part of the QPSX Project. The proposed development is designed to meet the need for responsive and efficient open cycle gas generation and to support supply variability resulting from high levels of renewable power within the South Australian market. Connection to the transmission network will be via an underground 275kV transmission cable. A fully functioning gas powered generation facility with appropriate control system and associated auxiliaries, including connection to all interfaces at relevant terminal points is proposed. The QPSX Project key details are listed below in Table 4-1.

Table 4-1 QPSX key project details

Plant characteristic	Parameter
Power Output	160MW – 180MW
Start & Ramp-up / Load Flexibility	Fast start and/or load flexibility required. Unit(s) must be able to respond to changing market conditions and support SA network stability.
Fuel	Gas
Operating Mode	QPSX is expected to operate as a peaking generator in the South Australian market and will strengthen the stability of the network.
Network Connecting Voltage	275kV
Financial Investment Decision	April 2018
Practical Completion Date	December 2019 (indicative)
Design Life	QPSX is expected to have a minimum operating life of 25 years.

4.1 Proposed Layout and Key Components

4.1.1 Summary components

The proposed development incorporates the following elements:

- New gas turbine (GT) and generator structures (gas turbine packages) at either the northern or southern site option, incorporating:
  - Three aero-derivative GT's;
  - Three associated electric generators;
  - Three associated exhaust stacks 30m high.
- A transmission substation adjacent to the generators consisting of up to three 80MVA 275kV step up transformers and connection equipment.
- Associated underground 275kV cables that will generally follow the existing access road from the TIPS. The cable will either be direct burial or using a conduit depending on site assessments prior to construction. The 275kV underground cable will enter across the eastern boundary of the QPSX Project area (northern option), just north of the existing QPS Unit 5 (refer Figure 4-1). For the alternate southern option, the 275kV underground cable will enter across the southern boundary of the allotment (refer Figure 4-2).

- A gas pipeline and connection point into the existing SeaGas infrastructure to the west of QPS. The pipeline will remain in the existing QPS area and align with other existing pipelines where possible however the pipeline will be constructed in its own culvert and veer away from the existing pipe into the proposed QPSX site for both northern and southern options.
- The current design is for a 1 ML potable water tank, 15kL /hr demineralization plant and a 250 kL demineralisation tank. The demineralisation facility will have a water reject rate of approximately 20% that may require a 250kL reject tank if the current tank proves insufficient. No fundamental change to the method of reject water disposal (existing evaporative ponds) due to the high end peaking operation and scarce evaporative cooling and sprint operation, however, if this is not the case, QPSX may require transportation of reject water from site to an appropriate disposal location. The final design of the water system will be optimised over the coming months, and some minor adjustments to the numbers above may result.
- Bunding for the gas turbine package and transformer units to secure against contaminant spills.
- The gas turbine packages and step up transformers will be roughly in the middle of the QPSX Project area layout.
- Additional control rooms for each GT.

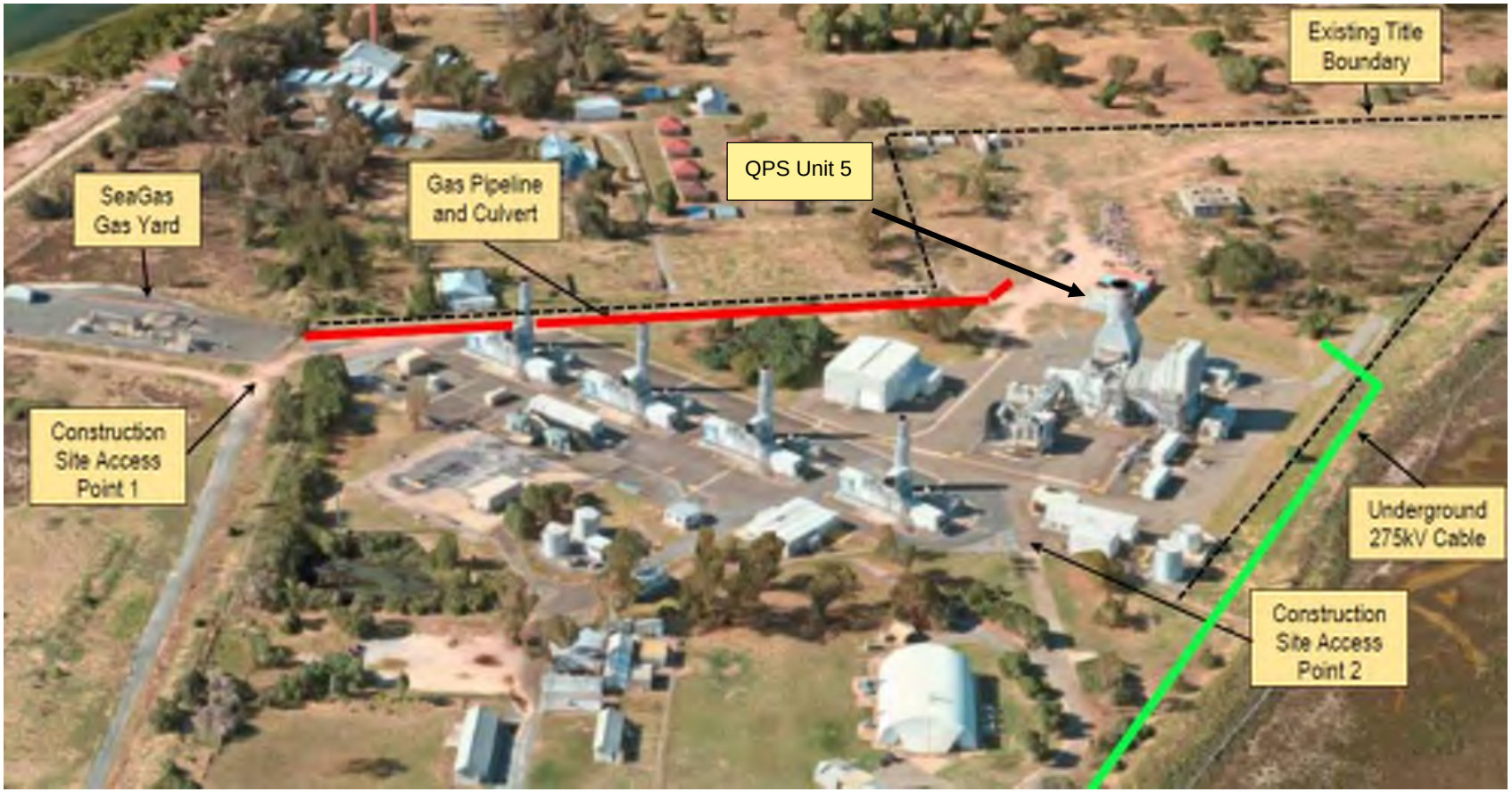

Figure 4-1 Existing QPS Site Layout and proposed cable and site access point for northern option

Figure 4-2 Existing QPS Site Layout and proposed cable and site access point for southern option

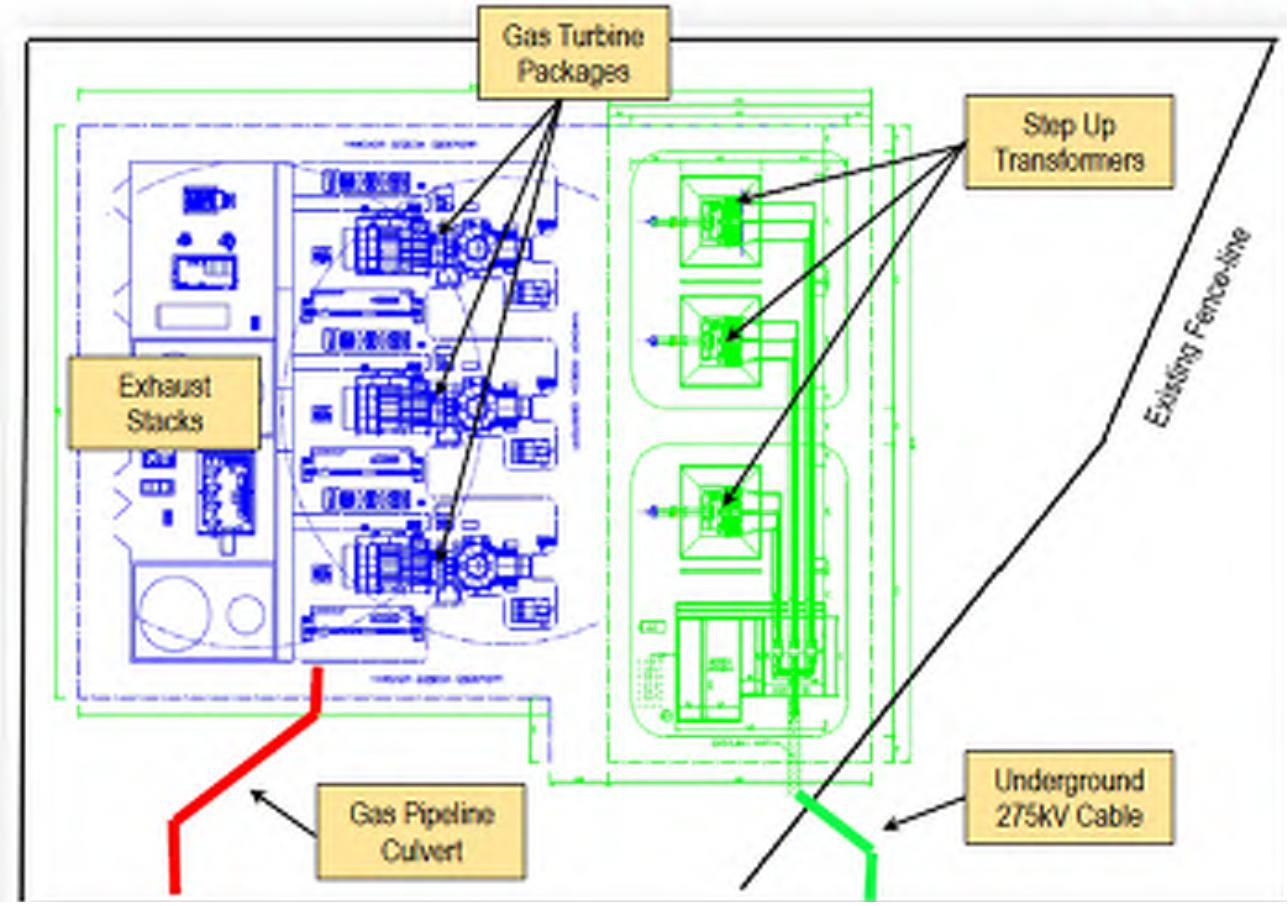

Figure 4-3 Indicative gas turbine and transformers detailed layout

4.1.2 Gas Turbine and Generator Package

Origin intends to achieve the increase output at QPS by installing three latest technology aero-derivative gas turbines (GT) at the power station. The current preferred GT model for this project is the General Electric LM6000, however, Origin is maintaining options to utilise similar technology from alternative providers. The current preferred machines provide a maximum of 57MW per unit at 15 degrees C, however this could increase as further efficiencies are realised. The following diagram (refer Figure 4-4) illustrates the general layout of the GT and Generator Package.

While the proposed package may change, the approximate dimensions of this package is 15 metres high (at the roof of the Filter Housing), 15m wide and 20m long. Should another package be used the dimensions will be similar. The diagram does not show the exhaust stack, that is 30m tall and is axially aligned with the turbine end of the package. The package also includes Air Intake and Filter Housing, Gas Turbine Housing and an Electric Generator as depicted Figure 4-4.

Figure 4-4 Gas turbine and generator package layout

4.1.3 Transmission substation

A transmission substation will be located at the generator end of the package, and will consist of three 275kV transformers and associated connection equipment. The 275kV network will be extended from TIPS on the southern end of Torrens Island, to QPS to provide connection for the new facility. This will be achieved via an underground cable that generally follows the existing access road into the QPS.

4.1.4 Gas pipeline

Gas will be supplied to the asset via the existing SeaGas pipeline via a let-down station most likely located on the existing SeaGas easement. As the new facility will require demineralised water, a demineralised plant will be constructed and sufficient tankage will be included so that the new asset can operate unconstrained.

4.2 Construction Phase

The following provides a very high level schedule for the construction phase of the QPSX Project:

- The target date for a financial investment decision by Origin is April 2018.
- This will be followed by a 13 to 14 month procurement period (driven by the GT Packages).
- QPSX construction will commence some months prior to the delivery of the packages to site (Mobilisation, Civil Works, etc).
- Commissioning is targeted for the back end of 2019, allowing the facility to be ready for summer of 2019/2020.

The main components of the construction program include:

- Civil works
- Establishment of the GT and transmission packages
- Infrastructure connection
- Commissioning of the power station and 275kV cable.

Table 4-2 Preliminary Construction Works Schedule

Construction Phase	Timeframe
Detailed design works	Jan 2018 to Jun 2018
Site civil works	Feb 2019 to May 2019
Delivery of equipment	Long Lead Items June 2019
Installation	Jun 2019 to Nov 2019
Commissioning & Testing	Nov 2019 to Dec 2019

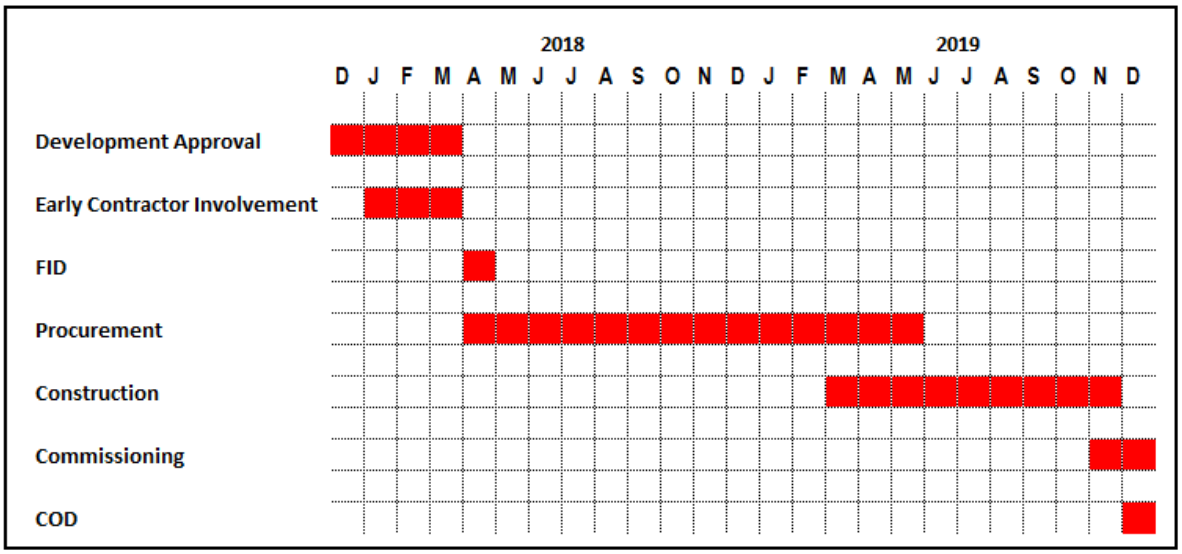

Figure 4-5 Indicative QPSX Project Schedule

Origin in conjunction with the Transmission Network Provider (TSP) may construct the cable and connection at an earlier stage as timing for procurement of the cable is shorter. This will spread the construction workforce over a longer period reducing the peak traffic numbers.

4.2.1 Construction Workforce

The average number of construction workers employed during the 12 months of 2019 (site facility and underground cable) is approximately 50 to 70.

4.2.2 Temporary Construction Facilities

Temporary facilities will be established during construction to provide basic amenities for construction workers and temporary laydown and storage areas for construction materials. The requirements for temporary facilities will be determined by the construction contractor, however are anticipated to include:

- Site office
- Temporary toilet facilities
- Laydown areas
- Temporary car parking (informal).

Due to the size of the QPSX Project area and available land, all temporary construction facilities will be accommodated within the QPSX Project area.

4.2.3 Traffic and Transport

A summary indicating the estimated number of vehicle movements expected during construction of the QPSX is provided in Table 4-3. It is important to note that dependent on the construction methodology of the contractor, traffic volumes may vary from these predicted estimates. The only public road which can be used to access the QPSX is Grand Trunkway which turns into the Garden Island Causeway. The access roads proposed to be used during construction are depicted in Figure 3-4.

Table 4-3 Construction Traffic Estimate

Date	Light Vehicles (/day)	Heavy Vehicles (/day)
Apr 18	1	0
May 18	3	1
Jun 18	0	0
Jul 18	0	0
Aug 18	0	0
Sep 18	0	0
Oct 18	0	0
Nov 18	10	1
Dec 18	40	9
Jan 19	60	9
Feb 19	60	3
Mar 19	90	1
Apr 19	110	2
May 19	110	1
Jun 19	90	1
Jul 19	90	1
Aug 19	60	1
Sep 19	30	1
Oct 19	30	1
Nov 19	20	0
Dec 19	0	0

Note that the number represents the vehicles travelling to the QPSX Project, therefore the total number of trips generated (in/out of the QPSX Project) will be double what is shown in the table. In addition, cable laying may be accelerated to late 2018 spreading the traffic load, as stated earlier.

Light vehicles

Light vehicles will be used to transport workers to the site. The light vehicle volumes have been based on approximate construction personnel factored from similar projects. Due to the location of the site and limited other transport options it is assumed that each worker will have a single vehicle.

Heavy vehicles

For this assessment heavy vehicles have been assumed to be vehicle exceeding 4.5 tonnes Gross Vehicle Mass. The heavy vehicle and oversized vehicles numbers are based on the number of components being delivered to the site across the assumed construction schedule.

The heavy vehicles and overmass vehicles which are proposed to access the site will do so outside of the peak access period for TIPS.

The Grand Trunkway route to the site access is currently a PBS Level 2A route gazetted for the following vehicles. Any larger vehicles will need to obtain appropriate permits, particularly for access across the causeway.

- 26m B Double (Higher Mass Limit)
- 23m Low Loader.

Oversized / overmass vehicles

Oversized and overmass (OSOM) vehicles will be used to carry some specialised components of the QPSX Project. It is assumed that contractors that use the OSOM vehicles will consult with and obtain relevant permits from the National Heavy Vehicle Regulator (NHVR) prior to the commencement of transport of these items and will provide any escort (if required) in accordance with legal and DPTI requirements.

4.2.4 Waste Management

Construction waste management procedures will be implemented via a Construction Environment Management Plan (CEMP). Specific measures to be incorporated will include:

- Construction waste will be separated into different streams to facilitate recycling with waste removed from the site by a licensed contractor as appropriate.
- Liquid waste (including hydrocarbons, paints and solvents) will be stored in sealed drums or containers in a bunded area before removal from the site by an EPA licensed contractor for recycling, where possible, or disposal to a licensed facility.
- During construction, temporary ablution facilities will be serviced by pump-out tanker trucks, used with off-site disposal by a licensed contractor.

4.3 Operation Phase

4.3.1 Operational Workforce

Once completed, the new facility at site will require one additional FTE at site for operations and intermittent part-time and contract staff for ongoing maintenance and operation. No further changes to current operations are proposed.

4.3.2 Stormwater Management

Following construction of access roads, generator foundations, laydown area, and hardstands, surface water runoff volume from the site will increase due to an increase in the area of sealed surfaces.

Current stormwater runoff pathways and infiltration/evaporation locations will be maintained where possible. The infiltration/evaporation capacity of these locations will be assessed through the detailed design stage. Runoff from roofs and hardstands would be directed to these locations, with local onsite stormwater water sensitive urban design measures (including detention / retention measures) included in the design if found to be necessary for managing increased stormwater runoff volumes.

Runoff from locations with the potential to pollute surface water such as fuel and chemical storages will either be roofed (and so will not interact with rainfall), or would be bunded to prevent release of potentially contaminated water. Stormwater collected in bunded areas would be treated via oily water separators or sediment traps as appropriate prior to collection by licensed waste transport operators on an as needs basis.

5. Environmental Assessment

The following section summarises the outcomes of environmental investigations undertaken to determine the feasibility of the QPSX including existing site conditions relevant environmental impacts. This section is followed by an assessment of the QPSX alignment with the LNWCA (Metropolitan) Development Plan, followed by an environmental management section which describes how identified impacts will be managed.

5.1 Visual amenity

A qualitative landscape character and visual impact assessment (LCVIA) was undertaken to assess the likely effect of the QPSX on landscape and visual amenity, consistent with best practice, as prescribed by *the Guidelines for Landscape and Visual Impact Assessment* (Third Edition). The LCVIA considered the sensitivity of the landscape to change by undertaking the following exercises:

- Determine the character of the contextual landscape, vegetation and topography using 'baseline' guiding definitions upon which judgments about the potential effects of the proposed development could be made. Landscape character definitions ranged from having high scenic quality, moderate scenic quality, low scenic quality to no scenic quality. The landscape characterisation process also categorised the landscapes ability to absorb a development within the visual amenity of the area as either high, medium, low or negligible.
- Identify sensitive receptors to the proposal; areas of high visual impact, residential areas.
- Assess the impact of the development by considering the degree of likely visual impacts from waypoints and sensitive receptors within the contextual landscape and determine management strategies to mitigate visual impacts (if possible).

The LCVIA took into account the existing view across Torrens Island skyline including transmission towers, Australian Submarine Corporation (ASC), disused power station exhaust stacks and the existing QPS with the Adelaide Hills forming the background.

5.1.1 Existing Environment

The site visit was undertaken on 6 December 2017 at four pre-determined publically accessible waypoints within the wider locality as shown in Figure 5-1. The LCVIA described the existing environment as initially appearing predominantly flat, while in reality the Torrens Island and adjacent Garden Island environs being a more complex 'sensory' landscape. Encompassing native samphire, wide mudflats, tidal creeks and estuarine plantings amongst the Port Adelaide River, the LCVIA described the landscape as tranquil, set against the panorama of the Adelaide Hills.

In the broader landscape the QPSX Project area and visual impact of the built form and infrastructure of the existing Quarantine Power Station is largely inconsequential with the surrounding locality supporting chimney stacks, the east – west 'procession' of incongruous transmission towers, substantial buildings of the nearby ASC and distant views to the south of the imposing chimney stacks of the TIPS.

The LCVIA categorised the landscape character as one of a moderate scenic quality and has a low to moderate sensitivity to change.

5.1.2 Sensitive Receptors

Of the waypoints where possible sensitive receptors would potentially be visually impacted, four locations were identified with one considered to be a sensitive receptor; Mutton Cove Conservation Park Lookout (refer Plate 5-1 and Figure 5-1).

Plate 5-1 Sensitive Receptor; Mutton Cove

5.1.3 Impact Assessment

The assessment was based on the following assumptions subject to detailed design at a later stage:

- No details have been provided on the likely construction material therefore it has been assumed that all infrastructure elements will comprise of painted galvanised steel.
- No new transmission towers are planned to be erected to facilitate the distribution of generated power via the transmission network.

During the construction phase, the change to visual amenity will occur as a result of earthworks, the presence of construction equipment of and an overall increase in the number of people and vehicles accessing the site. The changing visual environment and activity during construction will be temporary, therefore is not considered in detail in the visual impact assessment.

The LCVIA determined that for the proposed QPSX Project northern option there will be no predicted visual impact at the sensitive receptor location whereby '*views of the facility will be precluded by the expanse of existing canopies of mature trees that traverse the site in a north south direction to the direct west of the chosen location. The proposed 30 m chimney stack is likely to protrude above the trees canopies but be indiscernible with the expansive panorama'*.

Whereas for the southern site option the LCVIA determined that there would be no change to slightly adverse predicted visual impact at the sensitive receptor location due to the proposed elements; '…*30 m high chimney*

stack will be absorbed into the back drop horizon of the Adelaide hills. The proposed generators and transformers will sit below the horizon and, assuming that the material finish is comparable, will appear as an extension of the existing station infrastructure. The east – west axis of telecommunications tower and foreground of large warehouses remain the prominent visual elements within the panorama'.

Therefore, no mitigation measures are proposed. The detailed assessment of the visual impact, including photomontage illustration overlaid with the proposed QPSX is provided in Appendix E.

Figure 5-1 Landscape character visual impact assessment waypoints

5.2 Flora and Fauna

An assessment of ecological values at the QPSX Project area was undertaken to determine the presence of species of conservation significance (i.e. species protected under Commonwealth or State Legislation). The following tasks were undertaken with the ecological assessment report provided in Appendix F:

- Review of EPBC Act Protected Matters database and high level assessment of likelihood of occurrence for listed and threatened flora and fauna species and threatened ecological communities (TECs).
- Review of Biological Database of South Australia (BDBSA) search extract within a 5 km radius of the QPSX Project area for threatened flora, fauna and ecological community results.
- Review of DEWNR NatureMaps online database to identify any ecologically significant features that may occur at the site or surrounds.
- Surveyed the site on 27 November 2017 in order to map and describe native and exotic vegetation communities present or adjacent to the proposed infrastructure and construction footprint and conduct a high level assessment of their composition, condition and habitat value.
- Summarised the outcomes of the desktop reviews and site visit.
- Prepared a high level vegetation map of the study area.
- Collated the findings into an Ecological Assessment Report including provision of further information about approval requirements if vegetation clearance is required.

The ecological assessment was built on the results of a previous survey of the broader project area undertaken by Jacobs in April 2017 prepared for Origin for the purposes of the proposed QPSX. The ecological assessment takes into account both the underground transmission alignment and options for the northern and southern generators.

The areas surveyed are depicted in Figure 5-2 and Figure 5-3 and include; the proposed underground transmission alignment with a 20m buffer on either side, including the existing road corridor, the nominated sites for the location of proposed generators (northern and southern options) and three potential temporary laydown areas.

Figure 5-2 Ecology Assessment Study Area

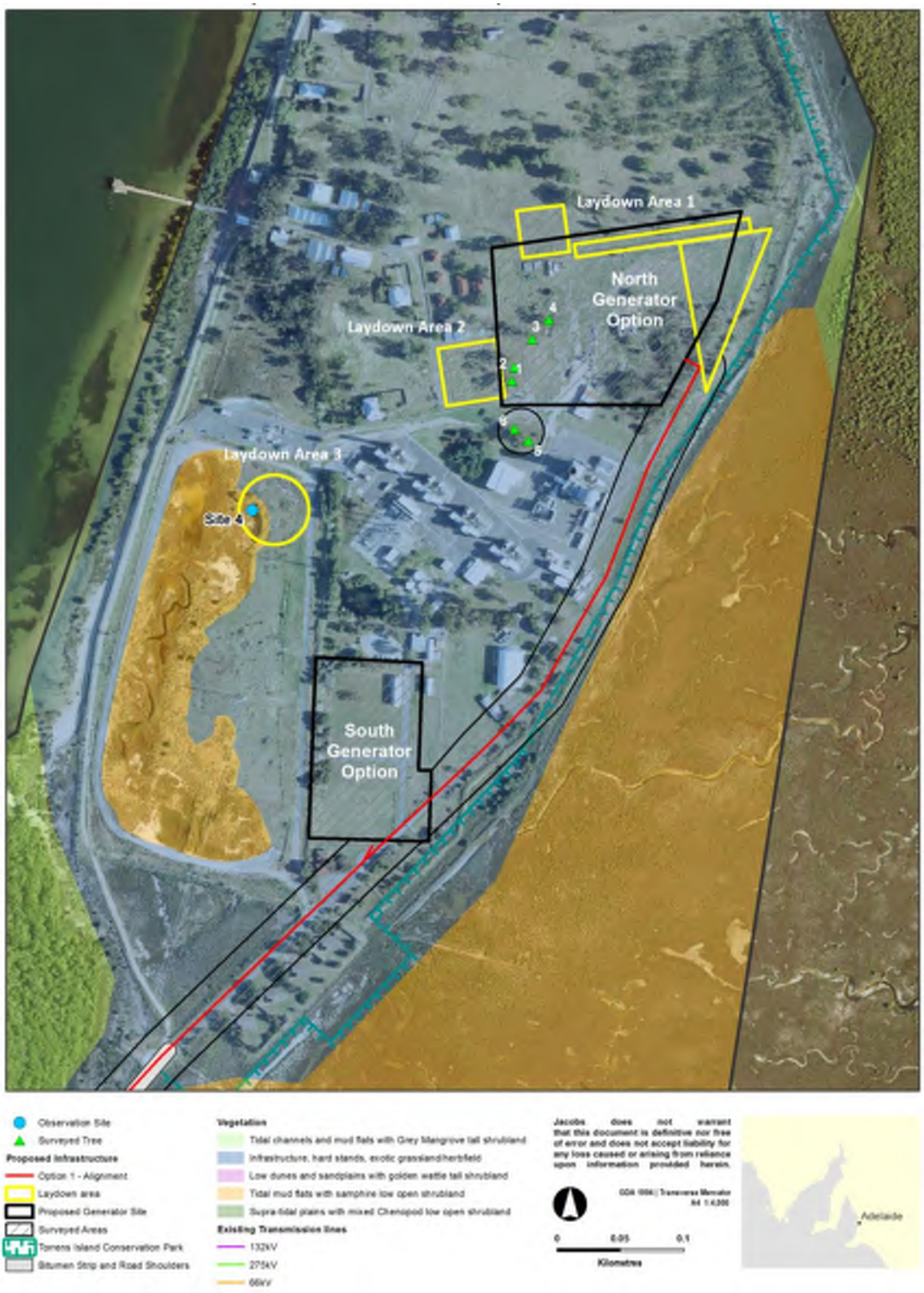

Figure 5-3 Generator Site and Laydown Areas Study Area

5.2.1 Existing Environment

Proposed underground transmission alignment

The desktop study and field survey identified the proposed transmission line alignment is largely cleared of native vegetation, however did confirm the presence of samphire mud flats which represent important habitat for a range of threatened and migratory species listed under the EPBC and National Parks and Wildlife Acts adjacent the proposed alignment. Historical clearance was associated with salt harvesting and installation of towers for existing overhead power lines and associated access tracks.

The samphire mud flats adjacent to the proposed underground transmission line alignment conform with the criteria for the Vulnerable Threatened Ecological Community (TEC): Subtropical and Temperate Coastal Saltmarsh. While the proposed installation of the transmission line will result in the clearance of up to 3.2 ha of native vegetation the proposed QPSX Project will not result in clearance of the Samphire TEC.

No threatened flora species were recorded during the survey of the proposed transmission line alignment. The nearest population of the Nationally Vulnerable *Tecticornia flabelliformis* (Bead Glasswort) lies approximately 400 m from the proposed construction footprint and it is considered that this EPBC and NPWA listed species will not be impacted by the proposed works.

The condition of the native vegetation present within the survey varied from poor in the sand dune / sand plain community through to moderate to good condition in the samphire and Chenopod low open shrubland and Grey Mangrove tall shrubland communities. Vegetation communities are presented in Figure 5-2. Sand dune and sandplain areas were characterised by low species richness, widespread weed infestations and exotic grass and herb species dominant in the understorey.

The Chenopod shrubland areas were characterised by scattered declared weed infestation with low disturbance levels. Disturbance levels were assessed as moderate in the samphire low open shrubland areas with areas of vegetation clearance for access tracks, powerline tower pads and salt evaporation ponds.

The Grey Mangrove tidal channels were assessed to be in good condition with low disturbance levels and mangrove populations in mixed-age stands with widespread recruitment.

It is noted that the proposed Transmission Line alignment traverses the western side of the survey area through native vegetation in poorer condition, characterised by higher disturbance levels.

Three weed species declared under the NRM Act were recorded during the survey, with details contained within Appendix F.

The proposed methodology for the installation of the buried transmission line has not been finalised however for the purposes of assessing potential environmental impacts the potential construction footprint has been defined as a 26 m wide corridor comprised of a 10m wide strip west of Grand Trunkway plus a 16m wide strip comprised of the road's bitumen strip (4m) and road shoulders (each 6m wide). The potential construction footprint avoids disturbance to better quality vegetation including samphire and mangrove communities, located to the east of the road.

Three remnant and one derived or regrowth native vegetation communities are present within northern portion of the transmission line survey area while the southern portion traverses cleared land dominated by introduced grasses and agricultural weed species.

Generator and laydown site options

The QPSX Project northern and southern options and associated laydown areas were assessed as depicted in Figure 5-3.

QPSX Project Northern Option

The northern generator site option covers an area of approximately two hectares and is comprised of cleared land with existing infrastructure. The site is dominated by slashed grass areas, exotic amenity plantings and patchy regrowth of common native species and does not provide important habitat for wildlife.

Laydown areas associated with the northern option predominantly comprise slashed grass areas, exotic amenity plantings and do not provide important habitat for wildlife.

Four Regulated Trees are located within the laydown and generators areas proposed for the northern generator site. Details of the criteria for regulated tree assessment as per the provisions of the *Development Act* are provided in the ecological assessment report (Appendix F) and will therefore require approval for removal or heavy pruning under the *Development Act 1993*.

QPSX Project Southern Option

The southern generator site option covers an area of approximately 1.1 hectares (ha) and predominantly comprises slashed grass areas, exotic amenity plantings and does not provide important habitat for wildlife. A small area of native vegetation is found in the western portion of laydown areas proposed for the southern option (referred to in Ecology Assessment as Laydown 3).

5.2.2 Impact Assessment

Proposed clearance of native vegetation has been minimised by positioning of the underground transmission line immediately adjacent to the Grand Trunkway road on the western side in cleared land in areas where existing disturbance levels are high, subject to final design of the alignment.

It is considered that potential impacts to flora and fauna associated with the installation of the transmission line, generator and laydown areas are localised and transient and are unlikely to result in significant impacts to nationally or state threatened flora and fauna or the TEC, hence an EPBC referral under the EPBC Act would not be required.

Native vegetation is present on portions of the proposed transmission line construction footprint and, subject to the final optimisation of the alignment, up to 3.2ha of native vegetation may be cleared and / or disturbed.

Terrestrial vegetation on Torrens Island is exempt from the provisions of the *Native Vegetation Act 1991* as it falls outside of the defined area of metropolitan Adelaide where the Act applies and no approval to clear native vegetation under the Act is required. Therefore, the NV Act does not apply to terrestrial native vegetation communities on Torrens Island (DEWNR, 2017) and clearance approval under the act is not required. Similarly, there is no requirement for the provision of an SEB (Significant Environmental Benefit).

Measures appropriate to minimise impacts to flora and fauna populations and habitat are outlined in the ecological assessment and include guidance for pre-construction and construction including fauna management, weed and erosion control. Further measures are also identified in Section 7.

Plate 5-2 Regulated Tree 3

5.3 Traffic

Construction of the QPSX will generate traffic volumes that have the potential to affect the local road network. Once operational, traffic movements are anticipated to be negligible, and not significantly alter traffic volumes from existing conditions. A Traffic Impact Assessment was prepared to identify traffic management measures and strategies proposed to address traffic safety and access issues inherent with using oversized vehicles and general daily construction and operational traffic. The Traffic Impact Assessment is attached as Appendix I.

The Traffic Impact Assessment was developed via desktop study to assess the additional traffic generated by the proposed QPSX on public roads. The internal access arrangement throughout Torrens Island is on private roads and part of an existing access agreement and therefore not considered as part of the impact assessment.

Existing Access Arrangement

Access to QPS is via an AGL controlled boom gate adjacent to the main TIPS as shown in Plate 5-3. The only public road which can be used to access the QPSX Project area is Grand Trunkway which turns into the Garden Island Causeway.

Plate 5-3 QPS Main Access Gate

The existing traffic numbers for the key DPTI[2] roads near the access gate are listed in Table 5-1. Both of these roads are two lane sealed road (single lane in each direction). Due to the current land use around the site it is expected that the traffic flow along these roads will have a high percentage of trips during peaks corresponding with the TIPS shift change over.

Existing operational and maintenance vehicles entering the QPS is approximately 6-9 per day including one delivery per day. Maintenance vehicles average approximately 100 vehicles per month. There are no known traffic issues with this section of the road network.

Table 5-1 Existing Traffic

Road	Total AADT[3] Estimate	Heavy Vehicles AADT
Grand Trunkway	3400	700 (20.5% of Total AADT)
Garden Island Causeway	1000	210 (21%)

Construction Traffic

An estimate of the construction traffic is provided in Table 4-3. Note that the number represents the vehicles travelling to the QPSX Project, therefore the total number of trips generated (in/out of the QPSX) will be double what is shown in the table.

Light Vehicles

Light vehicles will be used to transport workers to the site. The light vehicle volumes have been based on approximate construction personnel factored from similar projects. Due to the location of the site and limited other transport options it is assumed that each worker will have a single vehicle.

[2] Department of Planning, Transport and Infrastructure
[3] Annual Average Daily Traffic

Heavy Vehicles

For this assessment heavy vehicles have been assumed to be vehicles exceeding 4.5 tonnes Gross Vehicle Mass. The heavy vehicle and oversized vehicles numbers are based on the number of components being delivered to the site across the assumed construction schedule. The heavy vehicles and overmass vehicles which are proposed to access the site will do so outside of the peak access period for TIPS.

The Grand Trunkway route to the site access is currently a PBS Level 2A route gazetted for the following vehicles. Any larger vehicles will need to obtain appropriate permits, particularly for access across the causeway.

- 26m B Double (Higher Mass Limit)
- 23m Low Loader

Oversized / overmass vehicles

An estimated six oversized and overmass (OSOM) vehicles will be used to carry some specialised components for the QPSX Project. It is assumed that contractors that use the OSOM vehicles will consult with and obtain relevant permits from the National Heavy Vehicle Regulator (NHVR) prior to the commencement of transport of these items and will provide any escort (if required) in accordance with legal and DPTI requirements.

5.3.1 Impact Assessment

The desktop study identified no significant issues associated with public traffic conditions as a result of the construction of the proposed QPSX. With the existing internal road access arrangements to remain no traffic issues are anticipated on Torrens Island. It is noted that vehicle permits may be required for specific heavy vehicles and oversize / overmass vehicles.

As no increase in traffic is predicted after completion of construction and commissioning of the QPSX, the only impact associated with construction is summarised in Table 5-2 whereby the construction traffic will result in an estimated 6.7% increase in AADT on the Grand Trunkway and an estimated 22.8% increase in AADT on the Garden Island Causeway. Although the increased traffic on Garden Island is a notable increase it is temporary and will be managed through appropriate measures once the construction contractor is appointed and in accordance with requirements outlined in Section 7.

Table 5-2 Summary of Traffic Impact Associated with QPSX Construction

	Existing		Construction	
Road	**AADT**	**Heavy Vehicles**	**AADT**	**Heavy Vehicles**
Grand Trunkway	3400	700 (20.5%)	3628* (6.7% increase from existing)	708* (19.5%) (1.1% increase from existing)
Garden Island Causeway	1000	210 (21%)	1228* (22.8% increase from existing)	218* (17.8%) (3.8% increase from existing)

5.4 Noise

An environmental noise assessment was conducted by Sonus Pty Ltd on behalf of Origin for the proposed QPSX located at the northern (preferred) site. The results of the noise report are summarised here with the report included as Appendix H.

The Environmental Noise Assessment identified the existing acoustic environment, the EPP Noise measurement criteria and developed a noise predication model using the ConCAWE noise propagation model and SoundPLAN noise modelling software to assess the proposed QPSX ability to meet the EPP Noise criteria.

The noise impact assessment was undertaken to assess the noise impacts on sensitive receivers, with the closest residents located approximately 2 km to the west (beyond the Port Adelaide River) on Victoria Road, North Haven. While the proposed QPSX is located with the LNWCA Development Plan, the sensitive receivers are located with a Residential Zone of the Port Adelaide Enfield City Development Plan.

The assessment was conducted against the relevant criteria of the *South Australian Environment Protection Authority's Environment Protection (Noise) Policy 2007* (The Policy), which outlines goal noise levels (L_{eq}) to be achieved at the noise receivers (dwellings), based on the Development Plan locality in which the noise source (QPSX) and the noise receivers are located, the land use that these localities principally promote, and the ambient environment.

In addition, where the Development Plan locality in which the noise source and the noise receiver are separated by more than 100 m (with an intervening locality between), the goal noise levels of the Policy are based only on the principally promoted land use of the noise receiver. For the proposed site, the Port Adelaide River is considered to be an intervening locality separating the residences from the site.

Based on Development Plan localities and presence of an intervening locality (Port Adelaide River) greater than 100 m, the Policy defines the criteria based on the receiving (Residential) zone alone. The goal noise levels are as follows:

- an average noise level ($L_{eq,15min}$) of 47 dB(A) during the day (7am until 10pm); and,
- an average noise level ($L_{eq,15min}$) of 40 dB(A) during the night (10pm until 7am).

In addition to the above, when measuring or predicting noise levels for comparison with the goal noise levels of the Policy, adjustments are made for any dominant characteristic of tone, low frequency, modulation or impulsiveness. 5 dB(A) is added if one characteristic is present, 8 dB(A) is added for two characteristics and 10 dB(A) is added for three or four characteristics. To apply a penalty, the characteristic must be dominant when considered within the context of the existing acoustic environment at the noise receivers.

5.4.1 Existing Acoustic Environment

The existing acoustic environment was established by continuously monitoring between 9 and 16 November 2017 in a location adjacent to the closest residences on Victoria Road as shown in Figure 5-4. Background noise levels logged during this period indicate that noise in the area was intermittently influenced by traffic, meteorological conditions and industry and ranged from lower than 35 dB(A) to higher than 50 dB(A) (refer Figure 5-5).

Figure 5-4 Residential Monitoring Location (Source: Sonus)

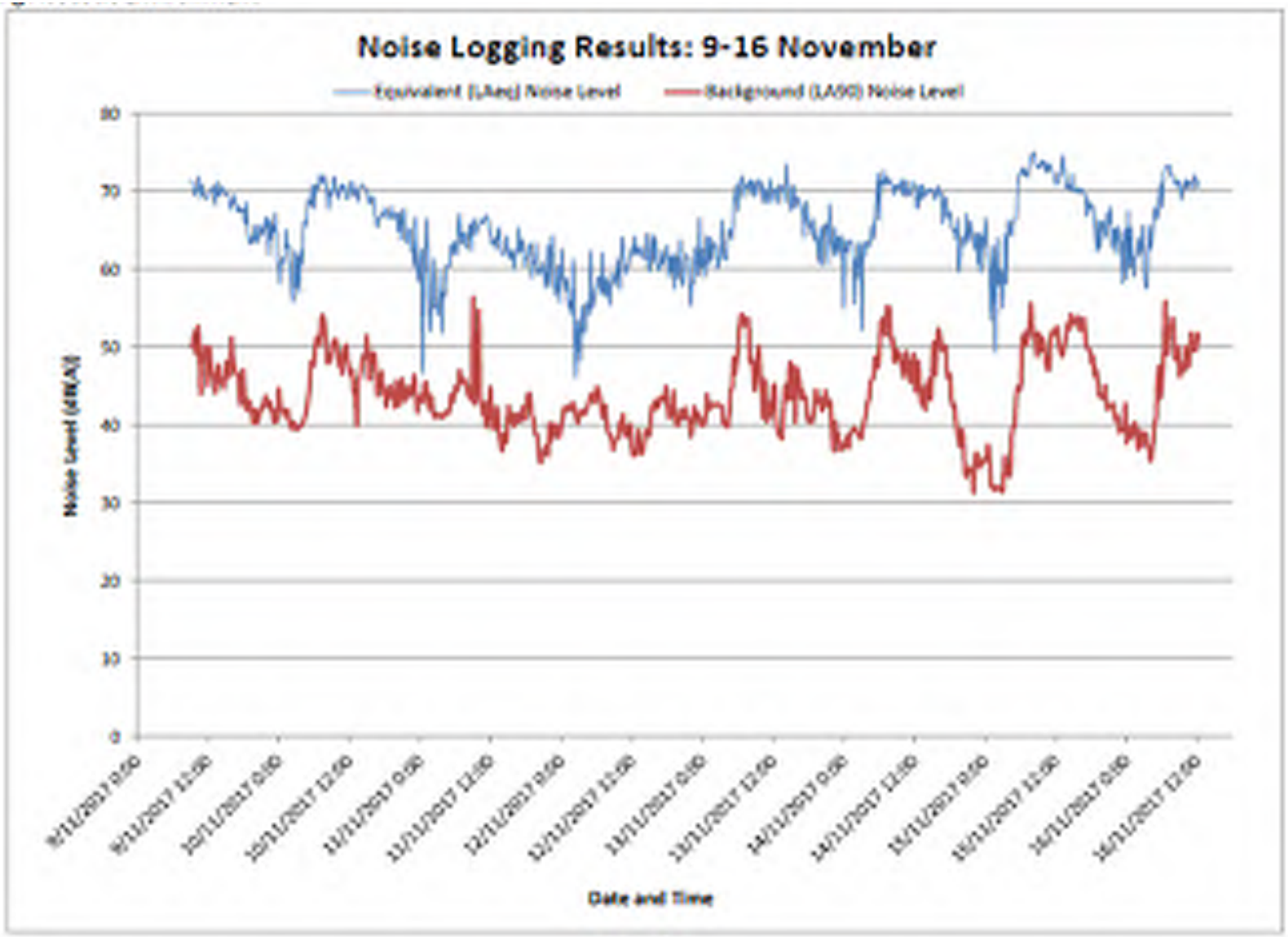

Figure 5-5 Existing Background Noise Levels (Source: Sonus)

5.4.2 Impact Assessment

The assessment was conducted based on worst case conditions likely to occur on a clear night with a light breeze from the QPSX to the residences. The assessment considered the combined noise from the proposed QPSX components with three gas turbines (specifications for LM6000 PF+) with noise levels depicted in Figure 5-6.

The noise data used for the environmental noise assessment is summarised in Table 5-3 below.

Table 5-3 Noise Data for each component of the QPSX (Source: Sonus)

Noise Source/Element	Sound power level, L_w, (dB re 1ρW)) in octave band centre frequencies									Overall Noise Level	
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	Total (dB)	Total (dB(A))
Simple Cycle Stack	139	133	124	109	107	104	99	94	96	140	113
Finfan Cooler	139	133	124	104	97	100	92	82	92	140	112
340 Brush Generator	59	107	106	103	98	96	90	84	78	111	101
Air Cool System	86	89	101	89	84	82	82	70	13	101	89
Gear Box	92	84	99	87	73	72	76	67	45	100	85
Water Injection Skid	82	31	26	77	95	91	90	81	74	98	96
Air Filter House	84	95	96	94	98	94	92	87	83	103	99
Turbine Combustion Inlet	53	111	92	81	80	79	77	78	85	111	89
Turbine Ventilation Inlet	123	109	92	85	81	79	79	79	68	123	89
Turbine Ventilation Outlet	108	95	92	77	75	75	73	73	79	109	83
Turbine Base	115	102	93	84	83	84	82	81	91	116	92
Turbine Enclosure	97	93	93	95	96	89	84	82	75	102	96

The three transformers have been assumed to have a rating of no greater than 80 MVA and the sound power level has been derived from the Australian/New Zealand Standard *AS/NZS60076.10:2009, Power transformers - Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD)* (summarised in Table 5-4).

Table 5-4 Noise Data for Transformers

Transformer Rating	SWL (dB(A)) for each Octave Band Centre Frequency							Total SWL (dB(A))
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
80 MVA	72	80	87	90	82	79	72	**93**

The noise level at the nearest residences (on the western side of Victoria Road) have been predicted for the continuous operation of the three proposed gas turbines for QPSX based on the sound power levels provided above and various heights of the different sources for the layout (detailed in Appendix C).

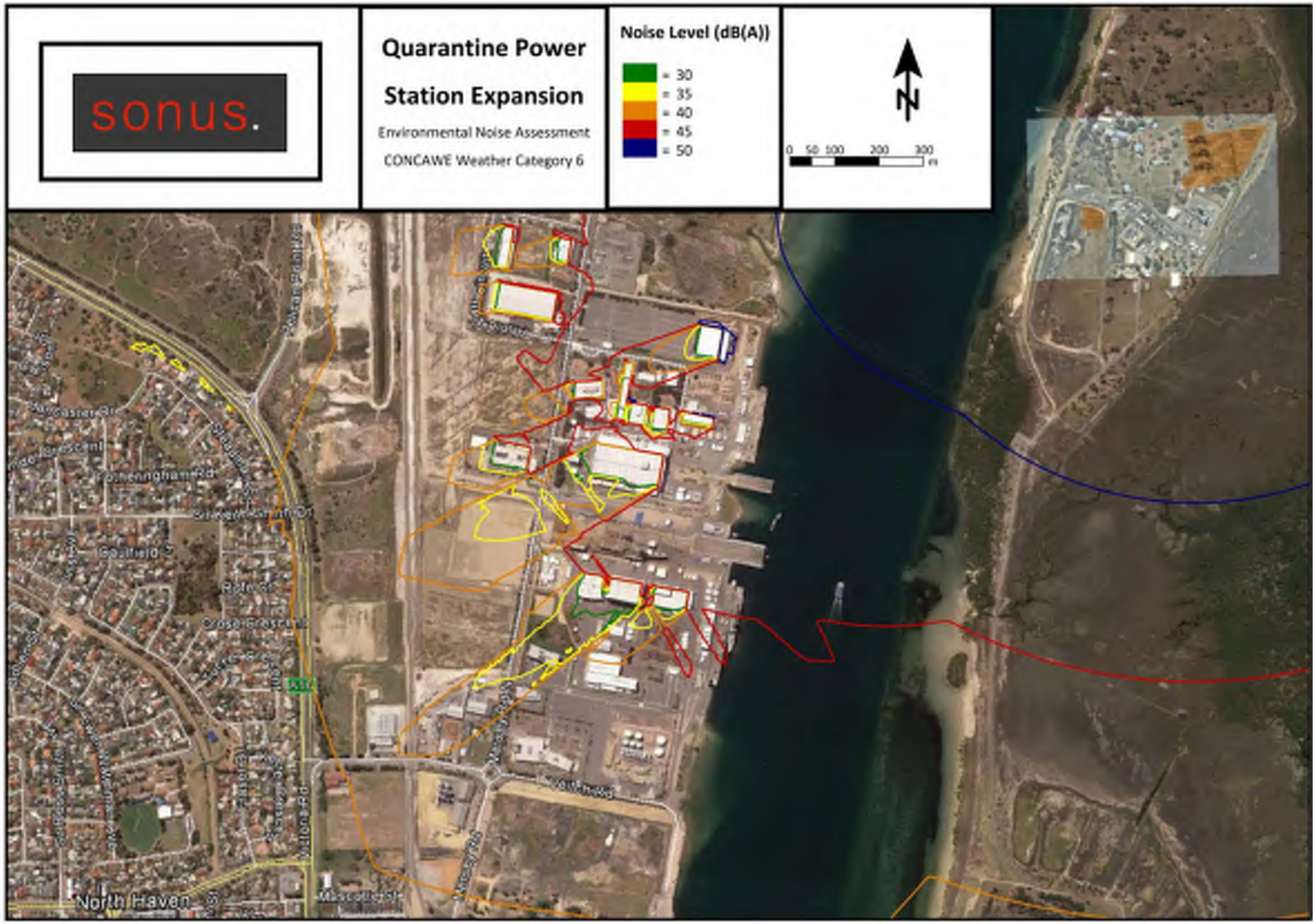

Figure 5-6 Predicted Noise Map (Source: Sonus)

The predictions indicate that the noise levels at the nearest residences will achieve the night time criterion of 40 dB(A) without any additional acoustic treatment above the level incorporated in the standard gas turbines proposed for QPSX. The equivalent (LAeq) noise level in the existing environment is rarely less than 50 dB(A). Given that a noise level of 40 dB(A) is predicted from the QPSX, noise characteristics such as tone, low frequency, modulation or impulsiveness will not be dominant in the context of the existing environment and therefore no penalties are applied to the predicted noise level.

In summarising the predicted impact as a result of the proposed equipment for the QPSX, the environmental noise report considered that the noise predictions will be within the EPP Noise Policy criteria.

5.5 Air Quality

An air quality assessment was conducted by Katestone Environmental Pty Ltd on behalf of Origin for the proposed QPSX located at the northern (preferred) site. The air quality assessment report is summarised here with the report included as Appendix G.

The air quality assessment was undertaken to assess the air quality impacts on sensitive receivers, with the closest residents located approximately 2km to the west (beyond the Port Adelaide River) on Victoria Road, North Haven.

The assessment was conducted in accordance with the SA EPA's document: *Ambient air quality assessment* (SA EPA, 2016) and in consultation with SA EPA's technical air quality staff. The maximum predicted emissions for the model domain (which encompasses sensitive receptor locations) were compared to the ambient air quality criteria (specified as maximum ground level concentration) stipulated in Schedule 2 of the Environment Protection (Air Quality) Policy 2016 (Air EPP).

The air quality assessment included:

- Description of site location and surrounding environment including identification of sensitive receptor locations.
- Description of existing air quality in the region derived from monitoring data recorded at the nearest SA EPA ambient air quality monitoring stations.
- Generation of a site specific meteorological data file using the TAPM and CALMET meteorological models (2009 was selected for the meteorological model simulation as a representative year based on discussions with the EPA).
- Selection of emission rates of NOx and stack characteristics based on a review of manufacturer's specifications, emission limits, and emissions information provided by Origin.
- Prediction of ground-level concentrations of NO_2 due to the QPSX project using the CALPUFF dispersion model, driven by the site-specific meteorological data generated by TAPM/CALMET. Predicted Ground-level concentrations were determined across a Cartesian grid of receptors, which includes the nearest sensitive receptors.
- Quantifying the potential cumulative effect of the QPSX project (i.e. the predicted ground-level concentrations of NO_2 due to the QPSX project plus existing sources of NO_2 have been assessed by comparison with the air quality criteria used in the assessment.

5.5.1 Existing Environment

The existing air quality in the region was established using the following existing data sources:

- National Pollutant Inventory (NPI) database for sources in the region.
- Ambient air quality monitoring data recorded by the SA EPA's monitoring network.

The air quality assessment identified a variety of industries operating in the Torrens Island and Port Adelaide area. A search of the National Pollutant Inventory for the 2015-2016 reporting year identified 11 other facilities within approximately 6 km with emissions of the same key pollutants as the QPSX. The most significant source of NO_x emissions is the AGL TIPS, located approximately 2.5km south of QPS, followed by the Adelaide Brighton Cement Plant, which is approximately 6km from QPS.

The nearest SA EPA monitoring stations to QPS measuring levels of nitrogen dioxide are at Le Fevre, Netley and Northfield. The Le Fevre site is located closest to QPS and overall, has recorded lower concentrations of NO_2 than the Netley and Northfield sites.

Table 5-5 presents the ambient background concentrations adopted in the assessment of cumulative levels of NO_x due to the QPSX Project plus existing sources.

Table 5-5 Ambient background concentrations selected for use in the air quality assessment

Pollutant	Averaging period	Ambient background concentration	Source
NO_x	1-hour	37.6	Maximum 90th percentile measurement from Le Fevre, Netley or Northfield between 2013 and 2016
	Annual	14.6	Maximum measurement from Le Fevre, Netley or Northfield between 2013 and 2016

5.5.2 Impact Assessment

The air quality assessment was conducted based on the following conservative source data selections and assumptions:

- Inclusion of a worst case modelling scenario which reflects the commissioning of the QPSX Project before replacement of the gas turbines on Units 1-4.
- Selection of emission rates and stack characteristics for the proposed units that are likely to result in worst-case air quality impacts for input into the dispersion model.
- Assumed ratio of 30% conversion of the oxides of nitrogen to nitrogen dioxide (considered conservative considering the short travel time of the plume to the maximum ground-level concentrations).
- Air emissions have been conservatively modelled as constantly emitting over 24 hours/day for the entire year where in reality the station will only run during peak demand.
- The results presented in the assessment report represent the maximum predicted ground level concentrations across the model domain rather than the predicted ground level concentrations at sensitive receiver locations.
- The predicted ground-level concentrations of nitrogen dioxide include a conservative estimate of the ambient background levels of nitrogen dioxide.

Model input parameters

The stack characteristics and emission rates used in the dispersion modelling are presented in Table 5-6.

Table 5-6 Stack characteristics and emission rates used in the dispersion modelling of QPSX

Parameter	Units	Unit 1 – 4 (existing)	Unit 5 (existing)	Units 6-8 (new)
Stack height[1]	m	18	25	30
Diameter[1]	m	2.6	5.7	3.2
Temperature	°C	526[2]	470[2]	495[3]
Exit velocity	m/s	25.0[4]	35[5]	36.3[3]
Actual flow rate	m^3/s	191.7[6]	1034[8]	302.9[9]
Normalised flow rate	Nm^3/s (0°C, dry, 15% O_2)	59[10]	390[11]	76.5[12]
Moisture content	%	6.5[13]	6.3[13]	Not provided
CO_2 concentration	%	3.4[13]	3.4[13]	Not provided
Oxygen concentration	%	14.9[12]	15.5[13]	Not provided
NOx (as NO_2)	mg/Nm^3 at 15% O2	70[7]	70[7]	51.3[3]
	g/s	4.13[14]	27.3[15]	3.9[16]

Table notes:

[1] Provided by Origin

[2] Minimum temperature measured in stack tests between 2007 and 2017

[3] Minimum value from information supplied by Origin for four modes of operation

[4] Conservative value, selected to be lower than the expected exit velocity provided by Origin of 36 m/s (which may apply to full load modes of operation only)

[5] Minimum velocity measured in stack tests between 2007 and 2017, less a 5% safety margin

[6] Calculated from provided exhaust flow rate (kg/s) and exhaust density (g/m^3) from exhaust composition breakdown

[7] Air Quality EPP emission limit

[8] Average of values calculated from stack test normalized flow rates and exhaust parameters between 2007 and 2017

[9] Calculated from stack diameter and exit velocity

[10] Calculated from provided exhaust flow rate (kg/s) and exhaust density (g/Nm^3) from exhaust composition breakdown

[11] Maximum measured during stack tests between 2007 and 2017

[12] Calculated from provided NO_x concentration and emission rate

[13] Average of values reported in stack tests between 2007 and 2017

[14] Calculated from 51 mg/Nm^3, exhaust flow rate provided by Origin, and exhaust composition by weight.

[15] Calculated from maximum flow rate from stack tests between 2007 and 2017 and assumed NO_x concentration

[16] Maximum value from information supplied by Origin for four modes of operation.

Meteorological parameters (wind speed and direction, atmospheric stability and mixing height) which influence the dispersion of air pollutants were derived from the TAPM and CALMET meteorological models for input into the dispersion model.

Figure 5-7 illustrates the annual wind speed distribution during 2009 at the QPSX site, as predicted by CALMET. The predominant wind directions are northeast and southwest, with the strongest winds being sea-breezes from the west. The CALMET predictions showed that wind directions vary considerably throughout the year. During summer, winds are predominantly from the south-west. Through autumn and into winter, winds are increasingly from the west and northeast.

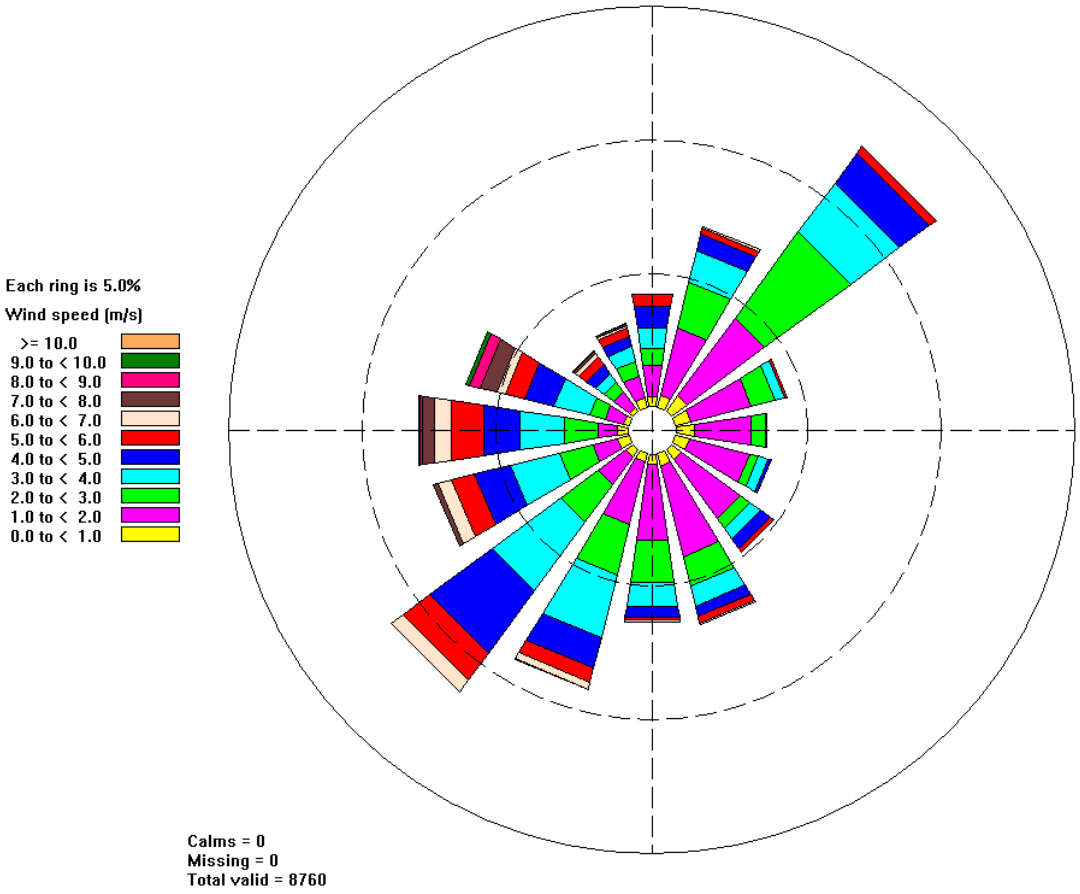

Figure 5-7 Annual distribution of winds at the project site (CALMET) (Source: Kate Stone)

Stability classification is a measure of the stability of the atmosphere. The stability classes range from A class, which represents very unstable atmospheric conditions that may typically occur on a sunny day to F class stability, which represents very stable atmospheric conditions that typically occur during light wind conditions at night.

Table 5-7 shows the overall percentage of stability classes at the project site. Class D stability occurs approximately 38% of the time due to moderate wind speeds generated by the site's proximity to the coastline and sea breezes. Class F stability occurs approximately 30% of the time and represents calm nights.

Table 5-7 Frequency of occurrence (%) of surface atmospheric stability at the project site under the Pasquil-Gifford stability classification scheme (as predicted by CALMET)

Pasquil-Gifford stability class	Classification	Frequency (%)
A	Extremely unstable	1%
B	Unstable	10%
C	Slightly unstable	14%
D	Neutral	38%
E	Slightly stable	7%

Pasquil-Gifford stability class	Classification	Frequency (%)
F	Stable	30%

The mixing height refers to the height above ground within which air pollutants released at or near ground can mix with ambient air. The data shows that the mixing height develops around 6am, increases to a peak at 1 to 3pm before descending rapidly until 6pm.

Dispersion Modelling Results

The predicted ground-level concentrations of NO_2 across the model domain due to the QPSX Project are presented in Appendix G. The maximum predicted ground-level concentration of NO_2 outside the QPSX site boundary are summarised in Table 5-8.

The results show that the ground-level concentrations of NO_2 due to the QPSX including a conservative estimate for ambient background concentration comply with the air quality criteria across the model domain.

The ground-level concentrations of NO_2 including a conservative ambient background concentration are predicted to be at most 34% of the air quality criteria. The air quality assessment considered the QPSX project is unlikely to adversely impact air quality at sensitive receptors in the vicinity.

Table 5-8 Maximum predicted ground-level concentrations of NO2 outside the QPSX site boundary (µg/m³)

Averaging period	Maximum predicted ground-level concentrations of NO_2 outside the QPSX site boundary (Scenario 1 – no upgrade to existing units)				Air quality criteria
	Project in Isolation	% of air quality criteria	Project plus background	% of air quality criteria	
1-hour average NO_2	48.3	19%	85.9	34%	**250 µg/m³**
Annual average NO_2	0.5	0.8%	15.1	24%	**60 µg/m³**

5.6 Soil and Site Contamination

A preliminary site investigation (PSI) was conducted for the QPSX Project in accordance with the *National Environment Protection Measure 1999* (NEPM, amended 2013), and comprised of the following activities:

- Collate and compile available background information relating to the site and its surrounds as a result of a site inspection conducted on 27 November 2017, review of historical land use, aerial photographs, assessment of geological and hydrogeological conditions, previously published reports and the South Australian EPA database.
- Determine the nature and extent of potential contamination and assess potential contaminated land risks.
- Address potential contaminated land issues related to the understanding of the site, its geological setting and the proposed land use development.
- To inform what further work may be required.

The findings of the PSI are presented in Appendix K and summarised below.

5.6.1 Existing Environment

The PSI identified historical developments that occurred on Torrens Island and in the vicinity of the QPSX Project area to establish potential site contamination risks. An active groundwater well is located on the existing QPS constructed in 1954, with nine other registered wells within 3 km of the QPSX Project area. Geology in the Torrens Island area was identified as poorly to well sorted bioclastic quartz-carbonate sands and loose to medium dense grey marine sediment and organic sand.

Historical aerial photography demonstrated the commencement of the Torrens Island A Station (AGL TIPS), constructed in 1967 followed by significant infrastructure development on the island from 1969, including the TIPS B station. QPS was commissioned later in 2002.

QPSX Northern Option

Site investigations were undertaken on the northern generator option. As stated earlier, the northern option is on Origin owned land. Soil stockpiles with organic matter, concrete pads, discussed water storage tank and disused hazardous materials shipping container were found as per Plate 5-4, Plate 5-5 and Plate 5-6.

Plate 5-4 Soil stockpile with organic matter

Plate 5-5 Concrete pads

Plate 5-6 Disused demineralised water storage tank and hazardous materials shipping container

QPSX Southern Option

The southern option was investigated however this area is largely cleared and vacant with the exception of the heritage structures discussed in Section 5.9. It is noted that this land is not owned by Origin.

QPSX Transmission Line Connection to TIPS

Two environmental protection orders were issued in 2010 and 2013 (AGL TIPS) in relation to groundwater contamination. Further details of the orders are contained within Appendix K.

5.6.2 Impact Assessment

A number of potentially contaminating historical uses and disused structures are within and surrounding the QPSX Project area including miscellaneous fill material stockpiles located in the vicinity of the northern option and the historic animal quarantine structures in the southern option.

Based on available information the PSI indicates there are likely to be no significant adverse on and off-site impacts to the beneficial uses of the land and groundwater related to the northern and southern generator site options. These sites have potentially low risk for the proposed end use and thus contamination is unlikely to restrict use of the land, however a soil and groundwater sampling investigation at the proposed northern generator site was recommended prior to construction commencing and appropriate environmental management measures will need to be implemented during construction.

The report also recommended that assessment of potential acid sulfate soil (PASS) is part of any future soil sampling plan as this had not been included in previous investigations. PASS is an item of concern within the QPSX Project area as the Torrens Island geology, ecology and location (within the vicinity of water) make it likely that PASS are within the QPSX area. This will need to be considered in the detailed design and construction methodology stage to ensure appropriate management measures are in place if PASS is exposed due to construction activities.

In the area adjacent to the AGL TIPS where the underground 275kV transmission cable proposes to connect into TIPS there is a high potential for adverse on and off-site impacts to land and groundwater, if not managed appropriately, as previous contamination issues have been previously identified within the vicinity of the power station, including Total Petroleum Hydrocarbons (TPH), chlorinated solvents, nitrate and phosphorus, which were reported by AGL to the South Australia EPA.

5.7 Surface Water

This section summarises potential risks to surface water and the coastal environment associated with the construction and operation of the proposed QPSX at both the northern and southern option locations broadly. A desktop assessment of the QPSX Project area was undertaken to assess the potential impacts of the proposed QPSX infrastructure with relation to surface water flows. This assessment was based on the following data:

- 0.1m resolution aerial imagery
- 0.3m resolution Digital Terrain Model (DTM) with 2 sigma accuracy of 0.17m
- Proposed QPSX infrastructure footprint.

5.7.1 Existing Environment

The Port River Inlet is to the west of the proposed QPSX on Torrens Island. Tidal Mangrove Mudflats are present to the north and east of the QPSX, which are protected areas within the Torrens Island Conservation Park. The QPSX Project area is generally flat with slight slope falling to the west. The existing Origin Quarantine Power Station site is protected by a levy maintained by Origin. The Department of Environment, Water and Natural Resources (DEWNR) (2017) describe Torrens Island as part of a low-lying coastal complex of tidal flats, dunes, swamps and sandy beaches. Soils are described as grey non-cracking plastic clays, grey duplex soils, whitish sands, grey calcareous loams and greyish calcareous sands.

The average annual rainfall on Torrens Island is 433mm.

Analysis of the DTM shows that:

- The QPSX Project area northern and southern options does not have a significant upstream catchment that could contribute to significant flows over the site.

- The QPSX Project area does not contain any watercourses.
- The existing levy has a crest level of 2.5m AHD.

Within the area protected by the levy, any additional runoff is expected to pool and evaporate, or infiltrate through the dunes into the groundwater table. Infiltration rates are likely to be significant in locations with high sand content, as occur across much of Torrens Island.

Identified risks and mitigation measures for the development are outlined in the following section.

5.7.2 Impact Assessment

During construction, vehicle movements would have the potential to disturb earth. Construction stockpiles may contain easily mobilised materials.

Rainfall runoff has the potential to mobilise disturbed earth, and materials stored in stockpiles, transporting these materials to the local low points from which the surface water runoff will evaporate or infiltrate, leading to deposition of mobilised material. The levy will prevent mobilised material from reaching the Port River Inlet.

The construction contractor would minimise land disturbance by ensuring:

- Site access roads and the lay-down area would incorporate existing tracks where possible.
- Vehicles would use only designated access roads.

Transport of materials in surface water runoff would be minimised through measures to be outlined in the site specific management procedures to be developed during the appointment of construction contractors. Mitigation measures for operational stormwater management, in addition to existing QPS site specific procedures are detailed further in Section 7.

5.7.3 Operational stormwater management

Operational stormwater management will continue in line with existing environmental management procedures and as detailed earlier in Section 4.3.2.

5.8 Coastal Hazards

5.8.1 Existing Environment

The Port Adelaide River inlet is a low energy coastal environment, presenting no wave risks to the proposed development. The maximum tidal range at Outer Harbour is 2.6m, resulting in high tides reaching approximately 1.3m AHD. Storm surge combined with king tides may result in water levels higher than 1.3m AHD on rare occasions.

The approximate high tide inundation extent is shown in Figure 5-8. This figure illustrates the benefit of the current levy, which has a crest level of 2.5m AHD in the vicinity of the proposed site. Figure 5-8 shows that there are low points to the east of the proposed generator locations which would naturally be inundated at high tide. These locations are currently protected from tides by the levy.

5.8.2 Impact Assessment

The natural site elevation at the proposed generator sites is:

- North generator option: between 2.1m – 2.8m AHD
- South generator option: between 1.5m – 2.1m AHD
- Along the site access road, the minimum elevation is 1.8m AHD.

The Development Plan does not prescribe a minimum site or floor level within the Public Purpose (Quarantine Station) Zone on Torrens Island. As the site is currently protected by an existing levy there are no wave or flooding risks to the development. However, the Development Plan requires that any development design allow for changes in sea level due to natural subsidence and probable climate change during the first 100 years of the development.

Scenarios developed by the CSIRO predict a possible sea level rise of 0.5 – 1m by the year 2100 (Rahmstorf et al. 2007; Domingues et al. 2008; Church et al. 2008). Should a worst-case scenario of 1m sea level rise occur, the proposed development may be at risk of flooding by overtopping the levy. While the seawall is currently sufficient to protect the site from coastal hazards, it will require maintenance and upgrade in line with sea level rise predictions through the life of the power station to mitigate potential future flooding risk.

Figure 5-8 QPSX Project area Elevation Data

5.9 Historical and Cultural Heritage

5.9.1 Cultural Heritage

At the time of submitting this Development Application, an Aboriginal cultural heritage desktop report had commenced in consultation with the KNCHA. The aim of the desktop assessment was to determine the presence of any Aboriginal archaeological sites or objects within the boundary of the Project area. The scope of work included:

- Undertake a review of available ethnographic and archaeological literature in relation to the Project area and greater Port Adelaide region.
- Identify whether or not Aboriginal sites, objects or remains are, or are likely to be, present in the Project area.
- Determine whether or not the Project activities are likely to harm Aboriginal sites, objects or remains (if present).

Aboriginal archaeological sites were identified during the desktop assessment. The majority of these are west, and within 500 m, of the Project area.

The review of the available archaeological and anthropological literature indicated that the likelihood of intangible Aboriginal cultural heritage in the QPSX Project area is high, particularly within the sand dunes along the western boundary of the QPSX Project area. No archaeological reports were available for this desktop assessment. It was therefore recommended that an archaeological site survey be undertaken of the Project area. Results of the site survey would inform management recommendations for the protection of any archaeological sites, objects or remains. A site survey was undertaken 17 and 18 January 2018. The results of the surveys will inform detailed design and construction methodologies.

5.9.2 Historical Heritage

The QPS is surrounded by a number of heritage structures of significance to the area, namely the Quarantine Station complex that was historically used for quarantine purposes for people and animals up until the 1980s and late 1990s, respectively. While no registered sites are contained within the QPSX Project area an historical assessment of the area and the potential impact of the QPSX on the heritage of these structures was completed. In addition, a structural integrity assessment was completed for three buildings in the vicinity of the southern option for QPSX in the event that these structures require removal. The associated impact assessment and structural integrity report are provided in Appendix J.

In completing the heritage impact assessment, a number of methods were utilised including a desktop assessment, site survey, structural integrity assessment and archival photographic recording (refer Appendix J).

5.9.3 Existing Environment

A significant portion of the QPSX Project area has been subject to land use activities associated with quarantine services, pastoralism, fencing, power station building infrastructure, equipment storage and vehicle tracks. Two areas identified as proposed laydown areas were inspected and are described below. Six structures, including three historical buildings, were inspected as part of the field survey.

The following heritage registers were searched on 27 November 2017 to determine whether any known historical heritage places were present within the Project area:

- South Australian Heritage Register (SAHR)
- National Trust Register

- CHL
- National Heritage List (NHL)
- World Heritage List
- RNE (non-statutory archive).

No registered historical heritage places are situated within the QPSX Project area.

The Torrens Island Quarantine Station Complex is listed on the SAHR (13931) and RNE (14866), and the Torrens Island Conservation park is listed on the RNE (6255). The Torrens Island Quarantine Station Complex is immediately west of the QPSX study area as shown in Figure 5-9.

The QPSX underground transmission alignment will follow the existing road from QPS to TIPS and for approximately 1.5km adjacent to the Torrens Island Conservation Park.

Six structures of varying heritage value (none registered) remain in the northern and southern options for the QPSX. Consultation with DEWNR was completed to ensure steps were implemented to record the structures of heritage importance, in the event that they require removal for the QPSX southern option. A photographic archival recording of the structures was considered an appropriate mechanism to contribute to heritage archives in the event that the structures are demolished.

QPSX Northern Option

One area, the site of a now demolished nurses' cottages, was assessed as having low archaeological potential. Three concrete water tanks located at the northern generator site appear to be in reasonable condition and associated with later period of the Quarantine Station construction from the 1970s.

QPSX Southern Option

The buildings previously used for animal quarantine located in southern generator site both showed signs of deterioration and housed pest bird species leaving generating significant amounts of faeces throughout. Results from the structural integrity inspection of animal quarantine buildings located in southern generator site recommend several requirements to upgrade the buildings to meet compliance with the Buildings Code of Australia (BCA) if they were to be relocated, requiring significant refurbishments to attain this. Further, added complications of asbestos contamination would add to the cost of relocation.

Advice from the heritage branch of DEWNR indicated that although the structures present in the southern area are not heritage listed they may be of heritage interest and are associated with the Torrens Island Quarantine Station (Michael Queale, pers. Comm, 19 July 2017). Structures present in the southern option are part of the 1909 Animal Quarantine Station relocation and represent the ongoing and diverse activities up until recent times, however are not essential to the understanding of the heritage values of the site.

Figure 5-9 Heritage Structures in the vicinity of the QPSX Project

5.9.4 Impact Assessment

The QPSX northern and southern generator options and temporary laydown area options were inspected for archaeological potential. The proposed laydown areas were vacant and cleared and some construction material remained no historic heritage was identified. The Historical Heritage Impact Assessment and Structural Integrity Assessment contain detailed descriptions of the buildings and structures in the QPSX area.

Historical Impact Summary

Structures in the vicinity of the northern and southern option are of historic interest due to the association of the Quarantine Station, however are not essential to the understanding of the heritage values of the site.

Given no disturbance is proposed to the heritage listed Quarantine Station Complex and the structures in the QPSX Project area are not listed, it is not considered imperative to relocate the buildings in order to retain the heritage importance of the area. Mitigation measures have been undertaken by way of an archival photographic log of the structures in the event that the southern or northern structures require removal. This photographic log is provided in Appendix J.

6. Development Plan Assessment

The following section identifies the provisions of the LNWCA (Metropolitan) Development Plan relevant to the assessment and alignment of the proposed development of the QPSX. The proposed QPSX is discussed in relation to the Council wide policy in the Development Plan, including policy relevant to the establishment of energy infrastructure, as well an assessment of the consistency of the QPSX with the associated zones that the QPSX is situated in. A copy of the relevant Development Plan policy is provided in Appendix L.

6.1 Visual

Development Plan Section	Objectives	Principles of Development Control
Metropolitan Adelaide Provisions		
Form of Development	1,2	1
Public Utilities	30	
Conservation	33, 34, 35, 36	41, 42, 43, 61, 62, 91
Metropolitan Open Space System (MOSS)	39	28, 32,
Appearance of Land and Buildings	43	
Council Wide Provisions		
Conservation		41, 42, 43
Appearance of Land and Buildings		45
Coastal Areas		47, 48, 49, 50, 52, 54, 56, 61, 62

QPSX Project Northern Option

As discussed in Section 5.1 the LCVIA determined that the proposed northern option will have no predicted visual impact at the sensitive receptor location (Mutton Cove Conservation Park) however during the construction phase there may be a change to visual amenity as a result of earthworks, this will be temporary.

QPSX Project Northern Option

The LCVIA also considered the proposed southern option and determined that post construction there would be no change to a slightly adverse impact at the sensitive receptor location.

QPSX Project – Visual Summary

The proposed infrastructure associated with QPSX will be located within built-up areas and as identified in the visual impact assessment will blend in with existing infrastructure such as power-line towers and exhaust stacks. The existing location is suitable for the proposed generator and switchyards given there is already screening with established trees and the appearance of the QPSX on the surrounding areas is anticipated to be low to negligible including from sensitive receptors in the local area such as Mutton Cove and other amenity areas such as Barker Inlet and Port River.

6.2 Flora and Fauna

Development Plan Section	Objectives	Principles of Development Control
Metropolitan Adelaide Provisions		

Development Plan Section	Objectives	Principles of Development Control
Public Utilities	30	
Conservation	33, 34, 35, 36	41, 42, 43
Metropolitan Open Space System (MOSS)	39	28, 32
Coastal Areas	45	48, 49
Council Wide Provisions		
Coastal Development	7, 9, 16	
Conservation		41, 42, 43
Appearance of Land and Buildings		45
Coastal Areas		47, 48, 49, 50, 52, 54, 56, 61, 62

QPSX Project Northern Option

The Ecological Assessment identified a number of regulated trees in the vicinity of the northern option that would require removal for the temporary laydown areas and proposed generator sites. Four regulated trees in total would require removal depending on the chosen temporary laydown location.

QPSX Project Southern Option

The Ecological Assessment considered a temporary laydown area and the proposed generator location for the southern option to be of a lower ecological value and did not include any regulated trees. This area is largely cleared and relatively flat compared to the northern project area.

QPSX Project – Flora and Fauna Summary

Ecological assessments of the area surrounding the QPSX Project identified areas of environmentally significant native vegetation, including TECs. The underground transmission alignment has been revised to achieve the most direct and least destructive route, including avoiding TECs. The 275kV transmission will mostly follow the existing access road and be buried, therefore reducing any impact on the Metropolitan Open Space System (MOSS).

QPSX siting and design seeks to minimise the effect of the development on natural coastal features such as sand dunes and wetlands and does not impact the conservation of land adjoining waters, scenic routes or the character of rivers and creeks.

6.3 Historical Built Heritage

Development Plan Section	Objectives	Principles of Development Control
Metropolitan Adelaide Provisions		
Conservation	33, 34 35, 36	
Council Wide Provisions		
Coastal Development	11, 12	
Conservation		41, 42, 43
Appearance of Land and Buildings		45
Coastal Areas		47, 48, 49, 50, 52, 54, 56, 61, 62

QPSX Project Northern Option

Structures of historical interest included disused circular and square concrete water tanks. These structures are not heritage listed and were not considered essential to the understanding of the heritage values of the Quarantine Station (Michael Queale, pers. Comm, 19 July 2017).

QPSX Project Southern Option

Buildings of historical interest in the southern option QPSX area may require re-location or removal. To support retention of their historical importance, historical assessments and photographic archival records have been undertaken. These records are provided in Appendix J and build upon earlier studies commissioned by the Department of Planning Transport and Infrastructure (Torrens Island Quarantine Station, Cultural Management Plan, Habitable Places 2014) in the event that the southern option becomes feasible and the structures require removal. While the structures are of heritage value, they are not heritage listed, however Origin have made efforts to expand records for the buildings preservation and in doing so endeavour to achieve Objective 34 for the preservation of buildings of historic and scientific interest.

6.4 Surface Water and Coastal Hazards

Development Plan Section	Objectives	Principles of Development Control
Metropolitan Adelaide Provisions		
Conservation	33, 34, 35, 36	
Coastal Areas	45	50, 52, 54, 56, 79, 80
Council Wide Provisions		
Coastal Development	7, 9, 16	
Coastal Areas		47, 48, 49, 50, 52, 54, 56,
Hazard Risk Minimisation		79, 80

The surface water and coastal hazards impacts were assessed broadly for both the north and south QPSX Project options.

Surface water and coastal hazards were assessed in terms of the potential for the QPSX to exacerbate soil erosion and flooding or impact the coastal environment. There is an existing levy with a crest of 2.5m protecting the QPS which will continue to be maintained by Origin as per existing arrangements. In addition, vegetation clearing proposed for the QPSX will not be undertaken in areas that may cause soil slip or deterioration in the quality of surface waters. The QPSX does not traverse any watercourses, however the increase in hard surfaces will generate more surface water flow. The increase in run-off will be managed by bunding of areas such as generator packages and water sensitive urban design such as oil-water separators where required during the detailed design phase. QPSX does not impact mangroves or wildlife habitat associated with the coastal environment and sets out to achieve minimal visual impact as a result of problems associated with erosion and flooding or deterioration of surface water quality.

6.5 Air Quality

There are no provisions of the LNWCA (Metropolitan) Development Plan relevant to the protection of air quality due to the development of the QPSX. However, an air quality assessment of the proposed development has been completed and is summarised in Section 5.5.

6.6 Noise

There are no provisions of the LNWCA (Metropolitan) Development Plan relevant to the impacts of noise pollution due to the development of the QPSX. However, a noise assessment of the proposed development has been completed and is summarised in Section 6.6.

6.7 Orderly and Economic Development

Development Plan Section	Objectives	Principles of Development Control
Metropolitan Adelaide Provisions		
Form of Development	30	1, 3
Public Utilities	30	
Conservation	33, 35	61, 62, 91
Metropolitan Open Space System (MOSS)		28, 32
Appearance of Land and Buildings	43	
Council Wide Provisions		
Coastal Development	7, 9, 16	91
Appearance of Land and Buildings	45	

QPSX Project Northern Option

The proposed northern option is the preferred option as it is closer to the existing QPS and therefore more efficient for access to services.

QPSX Project Southern Option

The southern option is also considered to be an orderly development in that it is adjacent to the existing power station and less costly to connect to the transmission network.

QPSX Project – Orderly Development Summary

The QPSX transmission line is considered to have minimal impact on the MOSS as the alignment will be buried adjacent to the existing road. Given the proposed QPSX is adjacent to the existing QPS, the location is considered suitable. The proposal is not considered to impair the amenity of the locality and is not out of character with the existing surrounding electrical infrastructure.

Further, the QPSX is an orderly development of the existing site as the QPSX proposes to infill vacant land adjacent to the existing power station.

6.8 Zoning

Development Plan Section	Objectives	Principles of Development Control
Public Purpose (Power Station) Zone	1, 2	1, 2
Public Purpose (Quarantine Station) Zone	1	5
MOSS Zone	3	2

The existing Origin QPS is adjacent to the heritage listed Quarantine Station and while the QPSX (both north and south options) is proposed adjacent the QPS, it is not anticipated to compromise the continued use of the Public Purpose (Quarantine Station) Zone for education, research or tourist development.

Origin intends to avoid impact the MOSS Zone for the transmission line by burying the cable alignment immediately adjacent to the existing road corridor, subject to detailed design.

The component of the QPSX that is sited within the Public Purpose (Power Station) Zone is the connection point for the 275kV transmission line. The Public Purpose (Power Station) Zone's objective envisages the continued operation of the TIPS consistent with sound environmental management. QPSX is considered to support this objective, and the principle of development control 1 and 2 that foresees development in this Zone for the generation and transmission of power.

7. Environmental Management

Origin is committed to conducting business in a way that causes no harm to the health and safety of its people and has no unforeseen impacts to the environment. Origin has a Health, Safety & Environment (HSE) Framework comprised of two directives (the HSE System Directive and HSE Risk Control Directive) aligned to Origin's HSE Policy. The HSE Risk Control Directive contains the minimum performance requirements for the following environmental aspects:

- Air, Energy and Greenhouse Management.
- Biodiversity and Biological.
- Hazardous Materials and Waste Management.
- Land Management and Disturbance.
- Noise and Amenity.
- Water Management.

This HSE framework is intended to ensure no unforeseen impacts to the environment and will be the overarching environmental framework used to support environmental management during the construction and operational phases of the QPSX.

During the detailed design phase and after appointment of the construction contractor, Origin will develop a Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP), which will be finalised to prior to the commencement of construction and operation. The CEMP and OEMP will establish objectives and targets to manage the significant environmental aspects of the QPSX.

The CEMP and OEMP for the proposed QPSX will also address compliance with regulatory requirements, environmental protection policies and relevant guidelines and codes of practice. The specific regulatory requirements for each environmental aspect will be identified in the CEMP and/or OEMP and incorporated, where appropriate, in the performance indicators utilised for monitoring environmental compliance.

Both the CEMP and OEMP will be implemented throughout the relevant phase of the QPSX, to ensure that potential environmental impacts are minimised.

7.1 Construction

Origin will develop environmental management strategies during the construction phase of the QPSX, which will be undertaken in accordance with the requirements of CEMP. The CEMP will outline environmental management measures to be implemented, timing of their implementation, and management and monitoring of the process and procedures.

A detailed CEMP will be developed prior to construction commencing to the satisfaction of the State Planning Commission. Development of a detailed CEMP at this stage (as part of the Development Application) is not practical as the detailed management measures will be defined when the construction contractor is engaged for the QPSX. The detailed CEMP will be based on, and further developed from, the following objectives and management measures.

The key objectives of the CEMP will include:

- Ensuring that works are carried out in accordance with statutory requirements, the conditions of approval for the QPSX, relevant guidelines and Origin environmental management systems and procedures.
- Ensuring that construction minimises the likelihood of impacts to the environment.

- Ensuring that construction manages the impact of works on neighbouring land uses and the Torrens Island Conservation Park.
- Ensuring that all contractors engaged in construction comply with the requirements of the CEMP; providing clear procedures for management of environmental impacts including corrective actions.
- Identifying management responsibilities and reporting requirements to demonstrate compliance with the CEMP.

The CEMP will serve as a working document to be used and updated throughout construction of QPSX.

Through the preparation of this Development Application and associated environmental investigations, a range of measures have been identified for incorporation into the CEMP. These measures are summarised in Table 7-1 below.

Table 7-1 CEMP Management Measures

Aspect	Construction Environmental Management Measures
Noise	• Construction activity resulting in noise will not occur at night- time, on Sundays or public holidays. • Equipment will be shut off or throttled down whenever it is not in actual use. • Noise reduction devices such as mufflers will be fitted and will operate effectively (where required). • Equipment will be serviced regularly and equipment in need of repair will not be used.
Air Quality	• Access roads to be constructed of compacted gravel or similar and kept in good condition. • Use of water trucks or chemical wettings agents where appropriate on unpaved roads or exposed areas. • Vehicle speed limits will be managed to minimise wheel- generated dust. • Equipment will be serviced regularly and equipment in need of repair will not be used.
Waste Management	• Construction waste will be separated into different streams to facilitate recycling and will be removed from the site by a licensed contractor. • Liquid waste (including hydrocarbons, paints and solvents) will be stored in sealed drums or containers in a bunded area before removal from the site by an EPA licensed contractor for recycling, where possible, or disposal to a licensed facility. • During construction, temporary ablution facilities will be serviced by pump-out tanker trucks, used with off-site disposal by a licensed contractor. • Manage additional surface water runoff so that no adverse effects from the water are evident such as erosion outside of the QPSX Project area.
Cultural Heritage	Incorporate stop-work procedures if a site or object of Aboriginal significance is identified during construction. • Stop works – stop all works in the vicinity of the site and no further disturbance of the site will be made. • Restrict access – access to the site will be restricted to protect the site. • Notify authorities – the Heritage Branch, Aboriginal Affairs and Reconciliation Division and / or the local Police (if suspected human remains have been discovered) will be notified of the finding. • Manage the site and access – determine the appropriate course of action in consultation with the relevant authorities and resume works when it is appropriate to do so.
Bushfire	Develop fire management procedures, including: • Emergency response procedures. • Consideration of construction schedule with regard to fire weather warnings (e.g. total fire ban or equivalent days). • Vegetation maintenance on site (i.e. maintaining vegetation clearances from electrical infrastructure). • Induction and training of on-site personnel. • Provision of firefighting equipment at the QPSX Project area.

Aspect	Construction Environmental Management Measures
Flora and Fauna	If required, an application will be made for the clearance of native vegetation in accordance with the *Native Vegetation Act 1991*. • Only approved areas of native vegetation will be cleared or disturbed. • Utilise procedures to restrict the spread of weed and pest species from the QPSX Project area. • Establishment of on-site landscaping utilising local endemic species (where required). • Minimise vegetation clearance and ensure that the clearance is managed strictly in accordance with approval requirements, including approval of Regulated Tree removal or pruning.
Soil	• PASS will be managed in accordance with regulatory requirements • Manage earthworks and site investigations in accordance with identified PASS risk assessment and management measures after sampling and construction methodology finalised. • Ensure contractors and aware of PASS risk and mitigation measures.
Traffic	• Engagement with DPTI regarding upcoming construction activities, delivery schedules and any temporary speed restrictions, and consultation with potentially affected stakeholders. • Development of a Traffic Management Plan for the construction period. • Restricting construction traffic movements during adverse or unsafe weather conditions. • Driving to the road conditions and adhering to safe operating speeds. • Providing way-finding signage where necessary to facilitate access along the proposed construction routes (if required). • Undertaking dust suppression activities (if required) to minimise dust emissions from construction traffic on unsealed roads. • Construction and maintenance of internal access roads in accordance with the CFS provisions. The CFS can be contacted on 1300 362 361.

7.2 Operational

The OEMP will be finalised during the construction period prior to the commencement of commissioning activities at the QPSX.

The key objectives of the OEMP will include:

- Ensuring that works are carried out in accordance with statutory requirements.
- Ensuring that operation minimise the likelihood of the impacts to the environment.
- Ensuring that operation of the QPSX manages the impact of works on neighbouring land uses.
- Ensuring that all employees are appropriately inducted on the OEMP requirements, providing clear procedures for management of environmental impacts including corrective actions.
- Identifying management responsibilities and reporting requirements to demonstrate compliance with the OEMP.

The OEMP will be developed prior to the commencement of operation and will serve as a working document to guide and direct the operation of the QPSX. Through the preparation of this Development Application and associated environmental investigations, a range of measures have been identified for incorporation into the OEMP. These measures are summarised in Table 7.2 as summarised below:

Table 7-2 OEMP Management Mitigation Measures

Aspect	Operation Environmental Management Mitigation Measures
Noise	• Equipment will be shut off or throttled down whenever it is not in actual use. • Noise reduction devices such as mufflers will be fitted and will operate effectively (where required). • Equipment will be serviced regularly and equipment in need of repair will not be used.
Waste Management	• Manage surface water so that existing uses, including environmental are protected. • Ensure that human health and safety is not adversely affected. • Implement measures to minimise waste generation, to maximise reuse and recycling, and to ensure safe and lawful disposal of all waste
Cultural Heritage	• Prevent unauthorised disturbance to Aboriginal or Non-Aboriginal heritage
Bushfire	Develop fire management procedures, including: • Emergency response procedures. • Vegetation maintenance on site (i.e. maintaining vegetation clearances from electrical infrastructure). • Provision of firefighting equipment at the QPSX Project area.
Flora and Fauna	• Undertake weed control and reporting of fauna incidents to Local Council for rescue or rehabilitation (where possible). • Maintain the quality of land and soils to protect ecological values. • Manage surface water so that existing uses, including environmental are protected.
Traffic	• Driving to the road conditions and adhering to safe operating speeds.
Site Decommissioning	• Maintain the quality of land and soils to protect ecological values. • Maintain representation, diversity, viability and ecological function of flora and fauna. • Rehabilitate the QPSX Project area to a standard suitable for future industrial use.

8. Conclusion

This Development Application has been prepared for the QPSX under Section 49(1)(a) of the *Development Act* which has been endorsed by the Department of Premier and Cabinet.

As described in this document, the QPSX aims to increase the production capacity of the existing QPS by an additional nominal 160-180MW of power. This in turn supports the South Australian energy infrastructure capability by providing responsive and efficient open cycle gas generation and stable supply to integrate with the supply variability of renewable power within the local market.

QPSX supports the strategic direction of the State, including the objectives of the South Australian Energy Plan and State Strategic Plan.

In assessing the merits of the proposal, the proposed QPSX satisfies the relevant objectives and principles of development control within the LNWCA (Metropolitan) Development Plan for the following reasons:

- QPSX is an appropriately located upgrade to the existing QPS facility.
- There are no significant environmental, social or heritage implications associated with the proposal.
- It represents expansion of energy infrastructure in a suitably located area as envisaged in the Development Plan.
- It is proposed to be located on largely cleared areas that avoids substantial areas of native vegetation.
- It is considered to have a low to slight visual impact on a single sensitive receptor identified at Mutton Cove.
- It is considered to be within the prescribed parameters for noise and air quality policies.
- The QPSX supports the strategic direction of the State, including the objectives of the South Australian Energy Plan and State Strategic Plan.

Having considered all of the relevant provisions of the Development Plan, the proposed development is considered to be not seriously at variance with the Development Plan.

On balance the proposed development accords with the relevant provisions contained within the LNWCA (Metropolitan) Development Plan Consolidated 5 May 2016 and warrants Development Approval.

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Appendix A. Section 49 Endorsement

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Origin Energy
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SOUTH MILTON QLD 4064

Dear Mr Rigby

QUARANTINE POWER STATION EXPANSION

I refer to your letter of 4 August 2017 regarding the request for support and specific endorsement pursuant to Section 49(2)(c) of the *Development Act 1993* for the proposed Quarantine Power Station Expansion Project on Torrens Island.

Given that the proposed works meet the definition of 'public infrastructure' as outlined in Section 49(1)(a) of *Development Act 1993,* and the project will provide additional back-up to the State's existing power generation supply, I am prepared to support and specifically endorse, pursuant to Section 49(2)(c) of the *Development Act 1993,* the works as detailed below:

- 160MW to 180MW gas plant with appropriate control systems.
- Fast start plant and/or load flexibility required.
- Consideration of dual fuel options to be provided.
- Connection to the existing 275kV network infrastructure.

It is understood that Origin Energy are considering three connection options for the Quarantine Power Station Expansion Project. A conceptual site layout of these works is detailed in Attachment 1 (Option 1 and Option 2a, 2b).

The Department of the Premier and Cabinet makes no representations or gives no warranties in relation to the outcome of the development application or time that it takes to secure a planning outcome for the project.

It is Origin Energy's responsibility to obtain all other statutory approvals, licences and permits from relevant authorities, manage community expectations and to fund the project. The State Government makes no commitment to purchase any product or service related to the project.

A development application must be lodged by Origin Energy at its cost with the Development Assessment Commission on or prior to 26 November 2018. If this is not achieved by that time, my support under Section 49(2)(c) of the *Development Act 1993* for the Quarantine Power Station Expansion project works will lapse.

Please contact Mr Peter Boulton, Investment Attraction South Australia, if you have any queries in relation to this advice or require further information. He can be contacted by phone on 8303 2342, by mobile on 0438 883 411 or via e-mail at peter.boulton@sa.gov.au.

Yours sincerely,

Dr Don Russell
CHIEF EXECUTIVE

Attachments:

- Option 1 from 4 August 2017 Origin letter (D17043447)
- Option 2 from 4 August 2017 Origin letter (D17043449)

Quarantine Power Station Expansion and Transmission Option 1 Infrastructure: Land Ownership

- Option 1 - Alignment
- Proposed Generator Site
- Aboriginal Heritage Site (not for public release)
- Aboriginal Heritage Area (not for public release)
- State Heritage Area
- Indicative Asbestos Burial Area
- EPBC Listed *Tecticornia flabelliformis* (Bead Glasswort)
- DEWNR Building Buffer (10m)
- Torrens Island Conservation Park
- Existing 275kV Transmission Line
- Existing 66kV Transmission Line
- SEA Gas Pipeline
- SEA Gas Pipeline Easement (indicative only)
- EPIC Gas Pipeline
- EPIC Gas Pipeline Easement (indicative only)

GDA 1994 | Transverse Mercator
A4 1:12,000

0 250 500
Metres

IW150900: Quarantine Power Station Expansion

JACOBS

Quarantine Power Station Expansion and Transmission Option 2 Infrastructure: Land Ownership

- Proposed Generator Infrastructure
- Option 2A - Alignment
- Option 2A - Substation
- Option 2B - Alignment
- Option 2B - Substation
- Aboriginal Heritage Site (not for public release)
- Aboriginal Heritage Area (not for public release)
- State Heritage Area
- Indicative Asbestos Burial Area
- Existing 275kV Transmission Line
- Existing 66kV Transmission Line
- SEA Gas Pipeline
- SEA Gas Pipeline Easement (indicative only)
- EPIC Gas Pipeline
- EPIC Gas Pipeline Easement (indicative only)
- EPBC Listed *Tecticornia flabelliformis* (Bead Glasswort)
- Torrens Island Conservation Park
- DEWNR Building Buffer (10m)

GDA 1994 | Transverse Mercator
A4 1:12,000

0 250 500
Metres

N Adelaide

IW150900: Quarantine Power Station Expansion

JACOBS

2/08/2017 12:37:46 PM kmcinerney F:\Projects\IW150900 Original\Spatial_Data\ArcGIS\Torrens Island Infrastructure_Option_2_Overview_20170724.mxd
Prepared by: HB
Checked by: LD/KB

Appendix B. Certificate of Title

REAL PROPERTY ACT, 1886
South Australia

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

REGISTRAR-GENERAL SOUTH AUSTRALIA

Certificate of Title - Volume 5907 Folio 399

Parent Title(s) CT 5885/650

Creating Dealing(s) T 9528575

Title Issued 25/11/2003 **Edition** 1 **Edition Issued** 25/11/2003

Estate Type

FEE SIMPLE

Registered Proprietor

ORIGIN ENERGY POWER LTD. (ACN: 008 289 398)
OF 1 KING WILLIAM STREET ADELAIDE SA 5000

Description of Land

ALLOTMENT 112 DEPOSITED PLAN 59977
IN THE AREA NAMED TORRENS ISLAND
HUNDRED OF PORT ADELAIDE

Easements

TOGETHER WITH THE EASEMENT(S) OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9031530)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9114323)

TOGETHER WITH RIGHT(S) OF WAY OVER THE LAND MARKED UU (RTC 9433645)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED EE (TG 9114321)

Schedule of Dealings

Dealing Number	Description
9528576	ENCUMBRANCE TO GENERATION LESSOR CORPORATION (SINGLE COPY ONLY)
11953763	CAVEAT BY GENERATION LESSOR CORPORATION

Notations

Dealings Affecting Title NIL

Priority Notices NIL

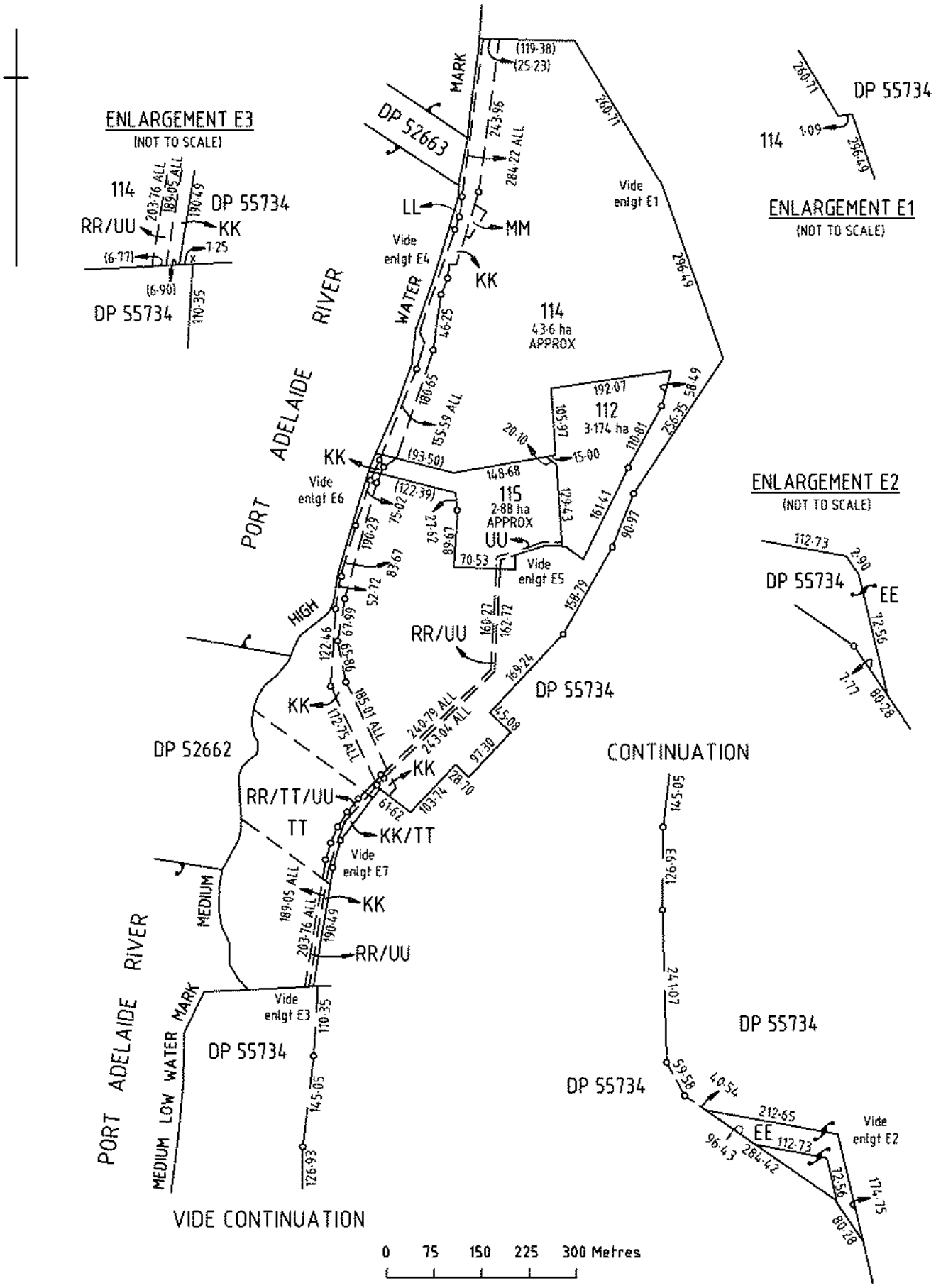
Notations on Plan NIL

Registrar-General's Notes

UNAPPROVED FX43708

Administrative Interests

CONFIRMED IN SA HERITAGE REGISTER 21/10/1993



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Date/Time	22/01/2018 12:12PM
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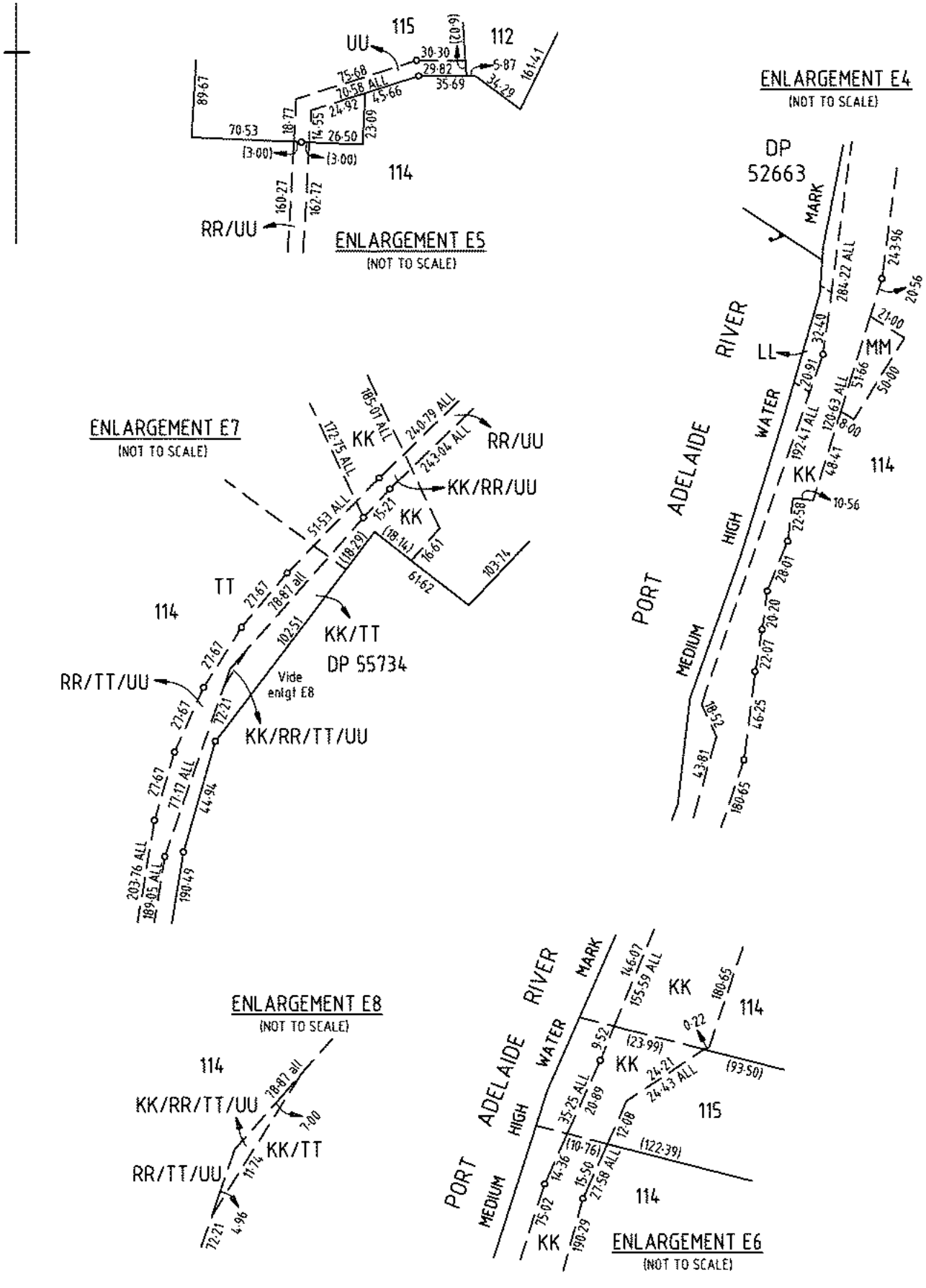
Order ID	20180122004818
Cost	$28.25



Government of South Australia
Department of Planning, Transport and Infrastructure

Product	Register Search (CT 6154/53)
Date/Time	24/07/2017 08:43AM
Customer Reference	IW150900
Order ID	20170724000742
Cost	$28.25

REAL PROPERTY ACT, 1886
South Australia

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

Certificate of Title - Volume 6154 Folio 53

Parent Title(s) CT 6132/765

Creating Dealing(s) TG 12250058

Title Issued 18/03/2015 **Edition** 1 **Edition Issued** 18/03/2015

Estate Type

FEE SIMPLE

Registered Proprietor

MINISTER FOR TRANSPORT AND INFRASTRUCTURE
OF ADELAIDE SA 5000

Description of Land

ALLOTMENT COMPRISING PIECES 302 AND 306 DEPOSITED PLAN 90964
IN THE AREA NAMED TORRENS ISLAND
HUNDRED OF PORT ADELAIDE

Easements

SUBJECT TO THE EASEMENT(S) AS PROVIDED FOR BY SECTION 9 OF THE NATURAL GAS AUTHORITY ACT 1967

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED KK ON DP 90964 TO THE NATURAL GAS AUTHORITY OF SOUTH AUSTRALIA (TG 6641578)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED MM ON DP 90964 (TG 8894092)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED TT ON DP 90964 (TG 8920535)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED A ON DP 90964 (TG 9802717)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED PP ON DP 90964 (TG 9858620)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED LL ON DP 90964 (TG 8894091)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED QQ ON DP 90964 (TG 10490935)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED D AND E ON DP 90964 TO DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000) (TG 11260482)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED AAA ON DP 90964 TO TRANSMISSION LESSOR CORPORATION OF 1 UNDIVIDED 2ND PART (SUBJECT TO LEASE 9061500) AND ELECTRANET PTY. LTD. OF 1 UNDIVIDED 2ND PART (TG 11630599)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED BBB.CCC.EEE AND HHH ON DP 90964 TO DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000) (TG 10024460)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED NN ON FP 59358 FOR THE TRANSMISSION OF TELECOMMUNICATION SIGNALS BY UNDERGROUND CABLE TO TRANSMISSION LESSOR CORPORATION OF 1 UNDIVIDED 2ND PART (SUBJECT TO LEASE 9061500) AND ELECTRANET PTY. LTD. OF 1 UNDIVIDED 2ND PART (TG 12250058)

SUBJECT TO RIGHT(S) OF WAY OVER THE LAND MARKED UU ON DP 90964 (RTC 9433645)

SUBJECT TO RIGHT(S) OF WAY OVER THE LAND MARKED T ON DP 90964 (RTC 12054788)

SUBJECT TO RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED RR ON DP 90964 (RTC 9153825)

SUBJECT TO RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED FFF ON DP 90964 (RTC 12054788)

SUBJECT TO RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED AA.FF AND GGG ON DP 90964 (RTC 12054788)

TOGETHER WITH THE EASEMENT(S) OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9031530)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9114323)

TOGETHER WITH RIGHT(S) OF WAY OVER PORTION OF PIECE 302 MARKED T ON DP 90964 APPURTENANT ONLY TO PIECE 306 (RTC 12054788)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER PORTION OF PIECE 302 MARKED AA ON DP 90964 APPURTENANT ONLY TO PIECE 306 (RTC 12054788)

TOGETHER WITH RIGHT(S) OF WAY OVER THE LAND MARKED DD ON DP 55734 (TG 9528574)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED EE ON DP 55734 (TG 9114321)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED G ON DP 90964 (RTC 12054788)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED GG ON DP 90964 APPURTENANT ONLY TO PIECE 306 (RTC 12054788)

Schedule of Dealings

NIL

Notations

Dealings Affecting Title NIL

Priority Notices NIL

Notations on Plan NIL

Registrar-General's Notes

PLAN FOR LEASE PURPOSES VIDE G251/2000
PLAN FOR LEASE PURPOSES VIDE G307/1999
APPROVED FILED PLAN FOR LEASE PURPOSES FX55252

Administrative Interests

CONFIRMED IN SA HERITAGE REGISTER 21/10/1993

Certificate of Title - Volume 6132 Folio 766

Parent Title(s) CT 6086/610, CT 6128/657

Creating Dealing(s) RTC 12054788

Title Issued 03/03/2014 **Edition** 1 **Edition Issued** 03/03/2014

Estate Type

FEE SIMPLE

Registered Proprietor

ORIGIN ENERGY POWER LTD. (ACN: 008 289 398)
OF 1 KING WILLIAM STREET ADELAIDE SA 5000

Description of Land

ALLOTMENT 305 DEPOSITED PLAN 90964
IN THE AREA NAMED TORRENS ISLAND
HUNDRED OF PORT ADELAIDE

Easements

SUBJECT TO THE EASEMENT(S) AS PROVIDED FOR BY SECTION 9 OF THE NATURAL GAS AUTHORITY ACT 1967

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED KK ON DP 90964 TO THE NATURAL GAS AUTHORITY OF SOUTH AUSTRALIA (TG 6641578)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED F ON DP 90964 TO DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000) (TG 10632456)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED H ON DP 90964 (TG 11286735)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED TTT ON DP 90964 TO DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000) (TG 11356863)

SUBJECT TO RIGHT(S) OF WAY OVER THE LAND MARKED UU ON DP 90964 (RTC 9433645)

SUBJECT TO RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED GG ON DP 90964 (RTC 12054788)

TOGETHER WITH THE EASEMENT(S) OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9031530)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9114323)

TOGETHER WITH RIGHT(S) OF WAY OVER THE LAND MARKED DD ON DP 55734 (TG 9470347)

TOGETHER WITH RIGHT(S) OF WAY OVER THE LAND MARKED T ON DP 90964 (RTC 12054788)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED G AND AA ON DP 90964 (RTC 12054788)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED EE ON DP 55734 (TG 9114321)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED RR ON DP 90964 (RTC 9153825)

Schedule of Dealings

Dealing Number	Description
9209686	ENCUMBRANCE TO GENERATION LESSOR CORPORATION
9211546	CAVEAT BY GENERATION LESSOR CORPORATION

Notations

Dealings Affecting Title NIL

Priority Notices NIL

Notations on Plan NIL

Registrar-General's Notes

PLAN FOR LEASE PURPOSES VIDE G251/2000
APPROVED FILED PLAN FOR LEASE PURPOSES FX55252
APPROVED FX45301

Administrative Interests

CONFIRMED IN SA HERITAGE REGISTER 21/10/1993

Appendix C. Proposed Development Indicative Layout

No	DATE	REVISION	DR	CHK	APP

DESIGNED
DRAWN
CHECKED
APPROVED
PROJECT No.
DATE

THIS DRAWING IS NOT TO BE REPRODUCED WITHOUT THE WRITTEN AUTHORITY OF ORIGIN ENERGY.

origin
G.P.O. BOX 148,
Brisbane, QLD, 4001
Ph.07 3858 0766 Fax.07 3367 1258
A.B.N. 93 008 289 398
www.originenergy.com.au

SCALE N.T.S.
SHEET SIZE A2
DRG.No.
REV.

SOUTH OPTION OVERVIEW

SCALE 1:1000

No	DATE	REVISION	DR	CHK	APP

THIS DRAWING IS NOT TO BE REPRODUCED WITHOUT THE WRITTEN AUTHORITY OF ORIGIN ENERGY.

DESIGNED		
DRAWN		
CHECKED		
APPROVED		
PROJECT No.		DATE

origin
G.P.O. BOX 148,
Brisbane, QLD, 4001
Ph.07 3858 0766 Fax.07 3367 1258
A.B.N. 93 008 289 398
www.originenergy.com.au

SCALE	N.T.S.
SHEET SIZE	A2
DRG.No.	
REV.	

Appendix D. Endorsement from the Office of Technical Regulator

Government of South Australia
Department of the Premier and Cabinet

Energy and Technical Regulation

Office of the Technical Regulator

Level 8, 11 Waymouth Street
Adelaide SA 5000

GPO Box 320
Adelaide SA 5001

Telephone: 08 8226 5500
Facsimile: 08 8226 5866

www.sa.gov.au/otr

Ref: 2017/01873.01 D18002816

10 January 2018

Michael Craig
Origin Energy Limited
Level 2, 339 Coronation Drive,
Brisbane QLD 4064
By email: michael.craig@originenergy.com.au

Dear Michael,

RE: CERTIFICATE FOR DEVELOPMENT OF THE QUARANTINE POWER STATION EXPANSION PROJECT

The development of the Quarantine Power Station Expansion Project on Torrens Island (QPSX) has been assessed by the Office of the Technical Regulator (OTR) under Section 37 of the Development Act 1993.

Regulation 70 of the *Development Regulations 2008* prescribes if the proposed development is for the purposes of the provision of electricity generating plant with a generating capacity of more than 5 MW that is to be connected to the State's power system – a certificate from the Technical Regulator is required, certifying that the proposed development complies with the requirements of the Technical Regulator in relation to the security and stability of the State's power system.

In making a decision on your application, our office has taken the following information into account:

- Origin Energy's letter 'Quarantine Power Station Expansion Project – Request for Office of the Technical Regulator evaluation and Approval Certificate', emailed by Michael Craig of Origin Energy to the OTR on 10 October 2017;
- A follow up phone conversation between Michael Craig and an OTR representative on 11 October 2017;
- A certificate issued for the project, emailed by the OTR to Origin Energy on 17 October 2017;
- A follow up meeting between Origin Energy and the OTR on 24 October 2017 to discuss changes to the project's application;

- A follow up phone conversation between Michael Craig and an OTR representative on 2 November 2017;
- Origin Energy's letter 'Quarantine Power Station Expansion Project – Updated Request for Office of the Technical Regulator Evaluation and Approval Certificate', emailed by Michael Craig to the OTR on 21 December 2017;
- A follow up phone conversation between Michael Craig and an OTR representative on 21 December 2017;
- Further supporting information to the application emailed by Michael Craig to the OTR on 22 December 2017.

After assessing the information provided, I advise that approval is granted for the proposed project.

Should you have any questions regarding this matter, please do not hesitate to call David Bosnakis on (08) 8226 5521.

Yours sincerely

Rob Faunt
TECHNICAL REGULATOR

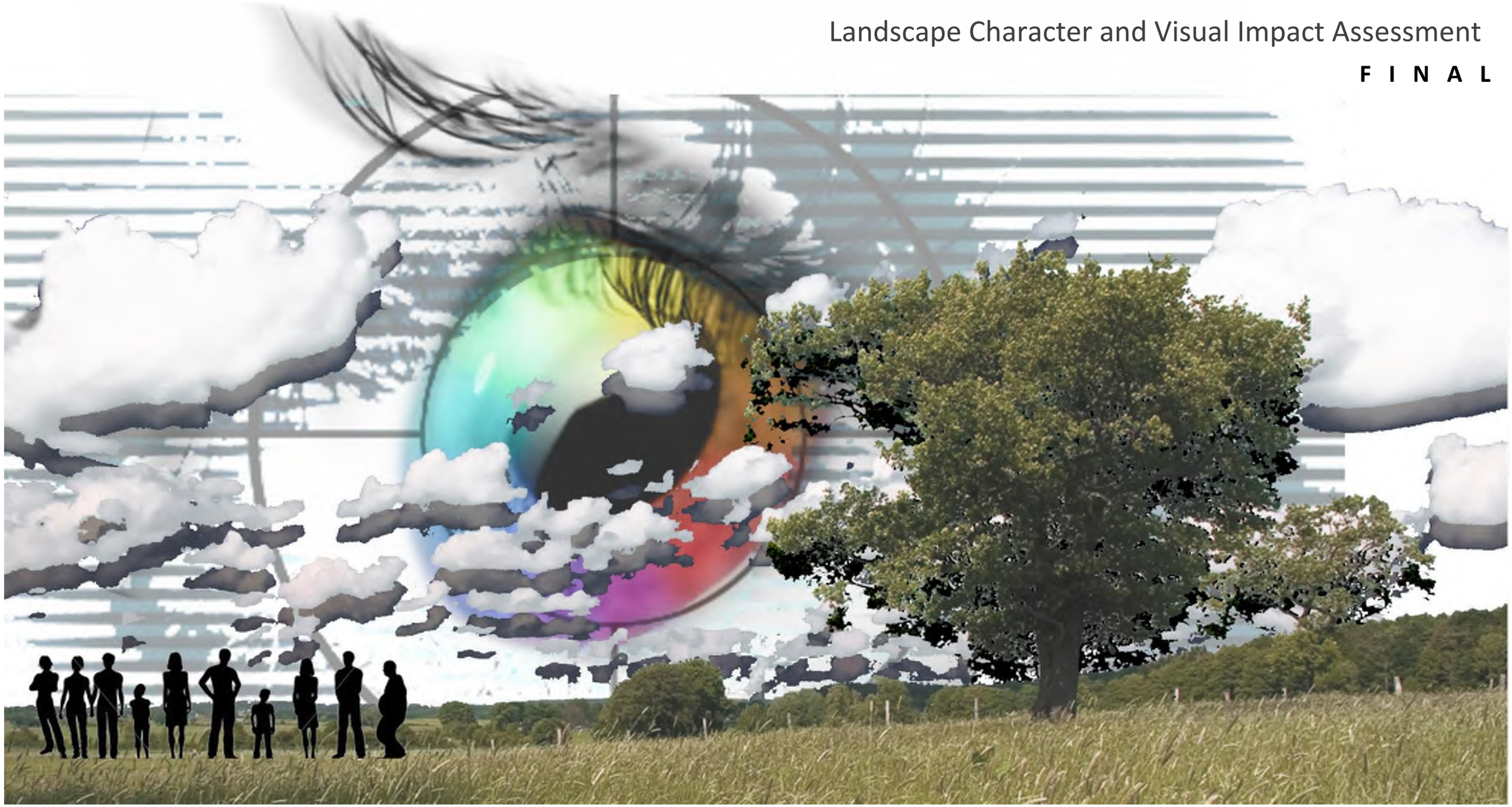
cc: Bill Truscott – Origin Energy
Greg Wilkinson – Origin Energy
Adam Earnshaw – Origin Energy
Marino Bolzon – DPC
Peter Boulton – IASA

Appendix E. Landscape Character and Visual Impact Assessment Statement

Quarantine Power Station Expansion Project, Torrens Island SA

Landscape Character and Visual Impact Assessment

F I N A L



Hemisphere Design (Aust) Pty Ltd

Contents

1. Introduction

This assessment has been prepared to support a Development Application for the Quarantine Power Station Expansion Project, Torrens Island SA.

Origin is proposing to expand its Quarantine Power Station to install a nominal 160 – 180 MW of gas powered generators on vacant land adjacent to the current site. Two options for siting of the generators are under consideration – the preferred site is directly to the north of the existing facility whilst the alternate site is to the south of the existing facility.

The northern option is currently considered more feasible as it is closer to the existing transmission lines which allow more efficient and less costly connection to the high voltage electricity network. Connection to the transmission network will be via a 275 kV transmission line. A number of connection options are currently being considered, the preferred option being a connection largely serviced by an underground transmission line from the proposed facility to the chosen connection point.

This assessment has considered two options for the potential location of expansion infrastructure which will comprise of three generators, three transformers, water treatment, cooling and switchyard infrastructure and chimney stack approximately 30m in height.

The following assumptions have been made which will be subject to further detail design at a later stage;

- All infrastructure elements will comprise of painted galvanised steel
- No new transmission towers will be erected to facilitate the distribution of generated power via the transmission network

The degree of likely visual impact that will arise from the proposed development options was determined based on an exercise which;

- visited four pre-determined publically accessible waypoints within the wider contextual landscape
- identified one ‘Sensitive Receptor’ for further consideration of the likely visual impact of the proposed development options
- determined the character of the existing contextual landscape
- qualitatively assessed the likely visual impact of the proposed development options within the contextual landscape from the identified ‘Sensitive Receptor’

2. Assessment Methodology

2.1 Site Visit and Photography

A site visit was undertaken on the 6th of December 2017.

On each visit, photographs were taken at selected viewpoints to underpin the landscape character and visual impact assessment. Photographs have been taken using a Nikon 35mm Single Lens Reflex (SLR) camera with an approximate lens setting of 43mm.

Photo: Mutton Cove Conservation Park Lookout. View east to existing Quarantine Power Station.

2.2 Evaluation of the Existing Landscape Character

A qualitative landscape character assessment has been undertaken in a rigorous manner consistent with best practice, as prescribed by *the Guidelines for Landscape and Visual Impact Assessment* (Third Edition).

2.2.1 Landscape Assessment

Landscape assessment, in contrast to visual assessment, deals with the fabric, character and quality of the countryside. The landscape fabric consists of the elements that make up the landscape, such as landform, land-use and cultural influences. The way these elements fit together in terms of proportion, pattern, scale, etc., gives rise to a particular landscape character. Changes to the fabric and character of a particular landscape may affect the perceived value of that landscape, giving rise to changes in its quality.

The landscape character assessment has encompassed both the wider contextual landscape and the locality, which is visually more difficult to define and within which the proposed development is located.

Photo: Snowdens Beach - Waypoint 04. One of four waypoints visited.

This characterisation process establishes a 'baseline' upon which judgments about the potential effects of the proposed development can be made. I apply the following guiding definitions to determine my assessments:

High scenic quality: Areas and localities which exhibit an exceptionally strong positive character with valued features which combine to give an experience of unity, richness and harmony. Within this definition 'exceptional' could apply where an area is also deemed to be worthy of a legislative designation, e.g. a National Park.

Moderate scenic quality: Areas which exhibit a strong positive character with valued features with evidence of a visually acceptable level of alteration/degradation/erosion resulting in a location of more mixed character.

Low scenic quality: Areas with a generally positive character with fewer valued features with evidence of a visually acceptable level of alteration/degradation/erosion resulting in a location of more mixed character.

No scenic quality: Areas with a little or no positive character with few or no valued features with evidence of a visually unacceptable level of alteration/degradation/erosion resulting in a highly modified location of little character

Further, the characterisation process defines the landscape 'sensitivity to change' of both the wider contextual landscape and the locality. This is categorised as either high, medium, low or negligible, where for example, a landscape that displays a high 'sensitivity to change' would not be able to absorb a development of this nature without irreparable consequences and impacts on the inherent character and visual amenity.

2.2.2 Landscape Character of the Locality

Whilst appearing predominantly flat, Torrens Island and the adjacent Garden Island environs is a more complex 'sensory' landscape than first appears.

It is a 'tranquil' contextual landscape where the expanse of native samphire and estuarine plantings and sinuous meandering of the Port River, set against the panorama of the Adelaide hills evokes, reflections of a past culture and their 'sense of place' association with the landscape.

It is a planar landscape which invites the eye of the observer to wander in a reflective fashion across the wide mudflats and tidal creeks. From the occasional vantage point the eye of the observer captures the curious and makes note of the 'incidental'. These observations include, for example the frequent flight of native wildfowl, drifts of native trees on the higher elevations of the distant hills silhouetting the horizon and glimpsed views of the occasional pleasure boat cruising on the Port River.

In a landscape that is 'monumental' in scale the visual impact of the built form and infrastructure of the existing Quarantine Power Station is largely inconsequential, the presence of the operational chimney stacks and the disused Quarantine Station chimney stack are merely noted in passing by the casual eye as it traces over the wider landscape before ultimately being drawn to the breathtaking hills face horizon.

Within this visual landscape the pleasing vista is marred by the east – west 'procession' of incongruous transmission towers, substantial buildings of the nearby Adelaide Submarine Corporation (ASC) and distant views to the south of the imposing chimney stacks of the Torrens Island Power Station.

It is my opinion that the landscape character of one of a **moderate scenic quality** and has **a low to moderate sensitivity** to change.

Photo: Australia Submarine Corporation (ASC) building.

2.3 Likely Visual Impact of the Proposed Development

Of the four waypoints visited the evaluation has identified:

(i) One location considered to be 'Sensitive Receptor' - Mutton Cove Conservation Park Lookout

A location from where it is considered the proposed development is likely to be partially visible.

(ii) One location from which partial views of varying magnitude only are likely.

This location is representative of many similar locations from which other similar views could be obtained. However, they are considered of low or no sensitivity due to their remoteness as a location, e.g. an unsealed private access road where the number of affected viewers would be negligible.

(iii) Two public locations from which views will be concealed by distance and through a combination of both landform and vegetation screening.

My assessment of the likely visual impact of the proposal has been confined to the Mutton Cove Conservation Park Lookout 'Sensitive Receptor'.

(Refer HD_U006 _AD01 _ Sheet 1)

With each assessment, reference is made to the description of the relevant prevailing landscape character unit.

For the single 'Sensitive Receptor' the likely visual impact of the proposed development is described considering factors which may include:

- The visual qualities of the view and the duration and angle of the view in relation to the main activity of the viewer;
- The distance of the viewpoint from the proposed development;
- The extent of the area over which the changes would be visible and the scale of the change in the view (loss or addition of features, changes in composition, proportion of view affected);
- The degree of contrast in form, scale, mass, line, height, colour and texture introduced into the view by the proposed development;
- The duration and nature of the effect (temporary, permanent, intermittent);
- The numbers and types of viewers affected.

Photo: Meyer Reserve- Waypoint 3. One of four waypoints visited.

LEGEND

- Waypoint
- Sensitive receptor

0 1.0km

N

TITLE	LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT			
PROJECT	QUARANTINE POWER STATION EXPANSION PROJECT, TORRENS ISLAND SA			
DWG NO HD_U006_AD01	SCALE -	SHEET NO 1	REVISION -	
DRAWN SW	CHECKED SRH	DATE 12/17		

Hemisphere Design (Aust) Pty Ltd
PO BOX 858 MITCHAM CENTRE,
TORRENS PARK SA 5062
P 08 8277 7640 F 08 8277 7641
E admin@hemispheredesign.com.au
ACN 114 503 936

2.4 Construction Phase

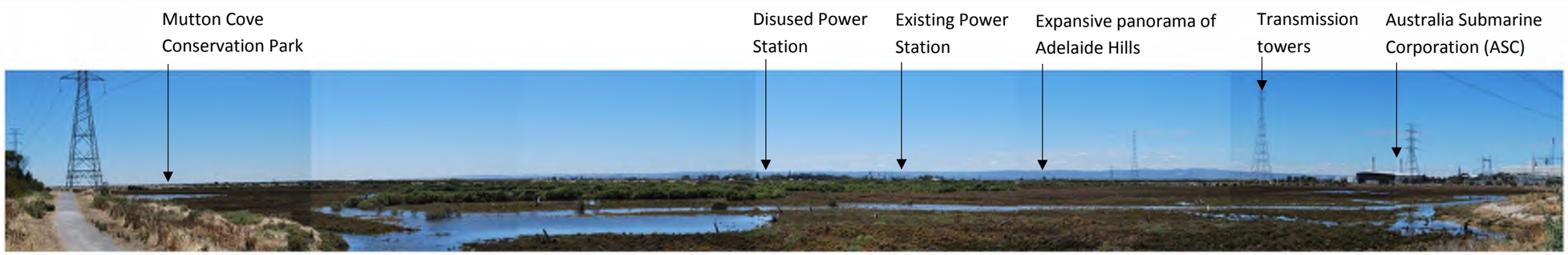
During the construction phase, the change to visual amenity will occur as a result of earthworks, the presence of construction equipment of and an overall increase in the number of people and vehicles accessing the site. The changing visual environment and activity during construction will be temporary, therefore is not considered in detail in the visual impact assessment.

2.5 Likely Visual Impact at the Identified 'Sensitive Receptors'

The following criteria were applied to describe the likely visual impact of the proposed development at the 'Sensitive Receptor':

Substantial adverse impact	where the scheme would cause a significant deterioration in the existing view
Moderate adverse impact	where the scheme would cause a noticeable deterioration in the existing view
Slight adverse impact	where the scheme would cause a barely perceptible deterioration in the existing view
Slight beneficial impact	where the scheme would cause a barely perceptible improvement in the existing view
Moderate beneficial impact	where the scheme would cause a noticeable improvement in the existing view
Substantial beneficial impact	where the scheme would cause a significant improvement in the existing view
No change	No discernible deterioration or improvement in the existing view

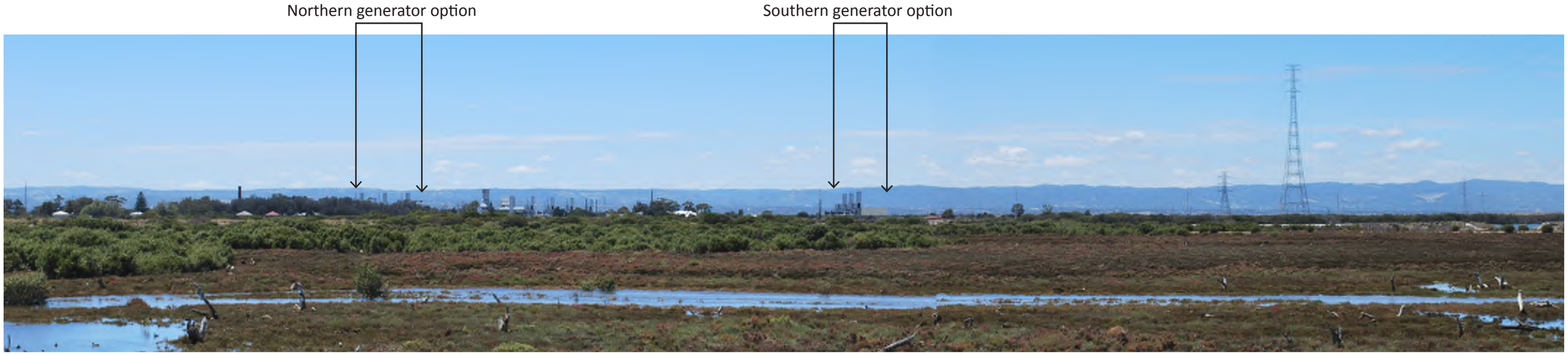
Photo: Mutton Cove Reserve

Landscape and Visual Impact Assessment: Sensitive Receptor SR #01	
	
Location	Mutton Cove Conservation Park Lookout, Mersey Road, Lefevre Peninsula, SA. This view would also be typical of other nearby roadside locations along Mersey Road and likely views from an elevated vantage point on a pleasure boat on the Port River to the east.
View direction	Panorama - north east to south east
Landscape and setting	A landscape of **low to moderate scenic quality** comprising of fore and mid - ground views across an estuarine landscape to an expansive panorama of the Adelaide hills face which defines the horizon. A mainly planar landscape where the eye of the observer traces over the 'tranquil' landscape - visual interest is defined by the undulating forms of the benign native vegetation of mainly samphire and the sinuous meanderings of the Port River. The existing Quarantine Station facilities sit below the horizon, the built form is inconsequential within such an expansive vista and visually ameliorated by the expanse of tree canopies across the current site. The panorama is dominated by the obtrusive 'angular' form of the existing transmission towers juxtaposed against the skyline.
Distance from Project Site(s)	1.4 km
Visual exposure at receptor	**Negligible – for the northern option site** Views of the facility will be precluded by the expanse of existing canopies of mature trees that traverse the site in a north south direction to the direct west of the chosen location. The proposed 30 m chimney stack is likely to protrude above the trees canopies but be indiscernible with the expansive panorama. **Low – for the southern option site** Whilst the proposed 30 m high chimney stack will be a new vertical element within the panorama, it does not puncture the skyline and (as per the existing chimney stacks) will be absorbed into the back drop horizon of the Adelaide hills. The proposed generators and transformers will sit below the horizon and, assuming that the material finish is comparable, will appear as an extension of the existing

	station infrastructure. Therefore, the visual impact within the expansive vista will be largely inconsequential. The east – west axis of telecommunications tower and foreground of large warehouses remain the prominent visual elements within the panorama. The procession of transmission towers is particularly incongruous and visually dominant.
Predicted visual impact	**Northern Option – No Change** **Southern Option – No Change to Slightly Adverse Impact**
Mitigation	None required

Existing view

Proposed view



*Illustrative only. Subject to detail design

Photomontage for Sensitive Receptor SR01

Location: Mutton Cove Lookout

View Panorama - north east to south east

Date: December 2017

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3. Summary and recommendations

It is my opinion that within a locality and character unit of **Moderate Scenic Quality** the visual impact that is likely to be experienced by the introduction of the expansion project at either one of the two locations under consideration will be;

- Northern Option – **No Change**
- Southern Option – **No Change to Slightly Adverse Impact**

Photo: Mersey Road. View south east to existing Quarantine Power Station.

About the author

Stuart Heseltine, Registered Landscape Architect, Principal Hemisphere Design.

Stuart is acknowledged as one of South Australia's leading practitioners in the area of landscape character and visual impact assessment. In considering each visual impact assessment exercise Stuart undertakes a qualitative landscape character assessment consistent with best practice as prescribed by the Guidelines for Landscape and Visual Impact Assessment (third edition), the Landscape Institute (UK) and Institute of Environmental Management and Assessment (NSW) 2013.

Stuart has successfully applied this methodology to major projects across South Australia and Victoria which includes main road, high street and highway projects, the Adelaide Desalination Plant EIA, the Roseworthy Development Feasibility Study, the Palmer, Allendale and Barn Hill Windfarm Developments, numerous infrastructure developments undertaken by Electranet SA and visual assessment exercises pertaining to Development Applications lodged in a numerous Adelaide metropolitan and regional council areas.

Stuart's particular expertise in undertaking visual assessments is highly sought after for the provision of expert evidence for the Environment, Resources and Development Court (SA).

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Appendix F. Ecological Assessment

Quarantine Power Station Expansion and Network Connection

Origin Energy

Ecological Assessment

IW169200-600-NP-RPT-0001 | 1

8 January 2018

QPSX

Quarantine Power Station Expansion and Network Connection

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Rev 0	8/12/17	Draft Report for Internal Review	R. Barratt	Z. Bull	K Briton-Jones
Rev 1	8/01/18	Final Report	R. Barratt	Z. Bull	K Briton-Jones

Contents

List of Tables

List of Figures

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs was to provide details regarding environmental constraints associated with the Quarantine Power Station Expansion and Network Connection proposed for Torrens Island, South Australia, in accordance with the scope of services set out in the contract between Jacobs and the client, Origin Energy.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and / or from other sources (e.g. DEWNR). Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Origin Energy, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and Origin Energy. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

Origin Energy (Origin) is proposing options for the expansion of Quarantine Power Station (QPS) and network connection infrastructure on Torrens Island. The proposed development is designed to meet the need for responsive and efficient open cycle gas generation in the South Australian market. This chapter provides information on the ecological values present within and adjacent to the proposed project area and also includes an assessment of potential impacts on terrestrial flora and fauna populations that may arise during the construction and operation of the proposed infrastructure. An assessment of potential impacts on MNES (Matters of National Environmental Significance) under the Commonwealth *Environment Protection and Biodiversity and Conservation Act 1999* (EPBC Act) has also been provided together with suggested measures to minimise potential environmental impacts.

Jacobs has undertaken the following tasks:

- Desktop Study including:
    - Review of EPBC Act Protected Matters database search results (project site plus 5 km buffer) and an assessment of the likelihood of occurrence for listed and threatened flora and fauna species and threatened ecological communities (TECs).
    - Review of the Biological Database of South Australia (BDBSA) search extract within 5 km of the site for threatened flora, fauna and ecological community results.
- Field survey to map and describe native and exotic vegetation present on or adjacent to the proposed infrastructure and construction footprint.
- Collation of findings into an Ecological Assessment Report.

This report builds on the results of a previous survey of the broader project area undertaken by Jacobs in April 2017 and the Preliminary Ecological Report (Jacobs, 2017) prepared for Origin.

The purpose of this report is to support a Development Application and Native Vegetation Application (if required) and to inform the design process (e.g. location of infrastructure and construction sites). The report also provides a description and maps of vegetation, assessment of habitat value and discussion of the potential vegetation clearance with respect to approval required under:

- NV Act and *Native Vegetation Act Regulations 2017*
- EPBC Act

2. Relevant Legislation

The proposed development will predominantly occur on cleared land, however clearance of up to 3.2 hectares of native vegetation will be required. Clearance of native vegetation in South Australia is generally addressed through the provisions of the South Australian *Native Vegetation Act 1991* (NV Act), however in the Adelaide metropolitan area, the act only applies to vegetation within a defined boundary. Clearance of vegetation on Torrens Island is not subject to the provisions of the NV Act. Potential impacts on nationally threatened species, threatened ecosystems or other MNES are dealt with by the EPBC Act. The relevant provisions and their application to the proposed development are described below.

2.1 Commonwealth Legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as MNES. Under the environmental provisions of the EPBC Act, actions that are likely to have a significant impact on a matter of National Environmental Significance are identified as 'controlled actions' and cannot be undertaken without referral to the Department of the Environment and Energy (DotEE) for consideration and approval under the EPBC Act.

The nine matters of national environmental significance identified in the EPBC Act are:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Threatened species and ecological communities
- Migratory species as listed under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining) and
- A water resource, in relation to coal seam gas development and large coal mining development.

If an action has the potential to have a significant impact on a MNES, the proposed action is referred to the Department of the Environment and Energy to determine the requirement for formal assessment and approval under the EPBC Act.

A preliminary assessment of the potential for this development to significantly impact on MNES is provided in Section 5 below.

2.2 South Australian Legislation

2.2.1 Native Vegetation Act 1991 (SA) (NV Act)

The NV Act controls the clearance of indigenous remnant vegetation and provides incentives and assistance to landholders in relation to the preservation and enhancement of native vegetation.

Whilst remnant native vegetation is present within the project footprint and is represented in DEWNR vegetation mapping (Naturemaps 2017), vegetation on Torrens Island is exempt from the provisions of the NV Act (DEWNR, 2017) because it falls outside the boundary defined by the Native Vegetation Council, of where the act applies (DEWNR, 2015).

2.2.2 National Parks and Wildlife Act (SA) (NPW Act)

The *National Parks and Wildlife Act 1972* (NPW Act) allows for the protection of habitat and wildlife through the establishment of parks and reserves (both on land and in State waters) and provides for the use of wildlife through a system of permits allowing certain actions, i.e. keeping, selling, trading, harvesting, farming, hunting and the destruction of native species.

The NPW Act assigns flora and fauna species to state conservation categories (i.e. threatened species); Endangered (Schedule 7), Vulnerable (Schedule 8), and Rare (Schedule 9). Potential impacts on NPW species are included in this ecological assessment report.

Torrens Island Conservation Park which adjoins the project area to the east, is also administered under the provisions of the act.

2.2.3 Natural Resources Management Act 2004 (NRM Act)

The *Natural Resources Management Act 2004* (NRM Act) is to assist in the achievement of ecologically sustainable development in the State by establishing an integrated scheme to promote the use and management of natural resources that recognises and protects the intrinsic values of natural resources. The NRM Act combines critical elements of the now repealed *Animal and Plant Control* (Agricultural Protection and Other Purposes) *Act 1986*, the *Soil Conservation and Land Care Act 1989* and the *Water Resources Act 1997*.

It further legislates for designated control requirements for a series of 'Declared' plants (as specific to each region or statewide), which effectively:

- Bans the sale of Declared weeds
- Controls the movement of Declared weeds
- Requires landowners / managers to destroy or control infestations of Declared weeds
- Requires further notification of authorities when an infestation is detected.

The Torrens Island site is located within the Adelaide and Mount Lofty Ranges Natural Resource Management (AML NRM) Region and the AML NRM Board is responsible for weed declarations and the designation of priority weed species for the region.

2.2.4 Development Act 1993

An Act to provide for planning and regulate development in the State; to regulate the use and management of land and buildings, and the design and construction of buildings; to make provision for the maintenance and conservation of land and buildings where appropriate; and for other purposes. The Act also covers Regulated Trees which are trees growing in the Adelaide metropolitan area with a trunk circumference of 2.0 m or more measured at a point 1.0 m above natural ground level. In the case of trees with multiple trunks, Regulated Trees are those with trunks having a total circumference of 2.0 m or greater and an average circumference of 625 mm (measured at 1.0 m).

Six trees located on or adjacent to proposed infrastructure or laydown areas were assessed as potential Regulated Trees and the results are provided in Section 4.

2.2.5 Environment Protection Act 1993 (EP Act)

The *Environment Protection Act 1993* (EP Act) provides for the protection of the environment and defines the Environment Protection Authority's (EPA) functions and powers. The Act promotes ecologically sustainable development and the use of precautionary principles to minimise environmental harm. It requires polluters to bear an appropriate share of the costs and responsibilities of protecting the environment from their activities.

3. Methods

3.1 Survey Area

The survey area includes:

- the proposed transmission line alignment plus a 20 m buffer on either side
- the nominated sites for the two options for the location of generators (North and South option)
- 3 potential laydown areas

The project area is delineated as the study area in Figure 3.1 below.

3.2 Desktop Methodology

Jacobs have undertaken a desktop study of the proposed project area including the following:

- Review of EPBC Act Protected Matters database search results and high level assessment of likelihood of occurrence for listed and threatened flora and fauna species and Threatened Ecological Communities.
- Review of Biological Database of South Australia (BDBSA) search extract within a 5 km radius of the site for threatened flora, fauna and ecological community results.
- Review of DEWNR NatureMaps online database to identify any ecologically significant features that may occur at the site or surrounds.

3.3 Field Survey Methodology

A Jacobs' ecologists undertook a high level environmental survey of the proposed site via vehicle and foot traverse on 27 November 2017 in order to:

- Describe and map native vegetation communities present within the study area, including existing disturbance levels and condition
- Identify any threatened species / ecological communities present, or important wildlife habitat
- Identify any environmental management issues which will require further consideration, including declared weed species

An assessment of the likelihood of each threatened fauna species occurring was undertaken using criteria outlined in Table 3-1. A likelihood of occurrence rating was assigned to each threatened species identified in the Protected Matters Search and BDBSA database searches. The rating ('Highly Likely', 'Likely', 'Possible' and 'Unlikely') takes the following criteria into consideration:

- Date of the most recent record (taking into consideration the date of the last surveys conducted in the area), records older than 20 years are not considered relevant…;
- Proximity of the records (distance to the project area);
- Landscape location of the records, vegetation remnancy and vegetation type of the record location (taking into consideration the landscape and vegetation type of the project area, with higher likelihood assigned to species that were found in similar locations/condition/vegetation associations); and
- Knowledge of the species habitat preferences, causes of its decline, and local population trends (e.g. use of field guide and data base references listed in Section 8).

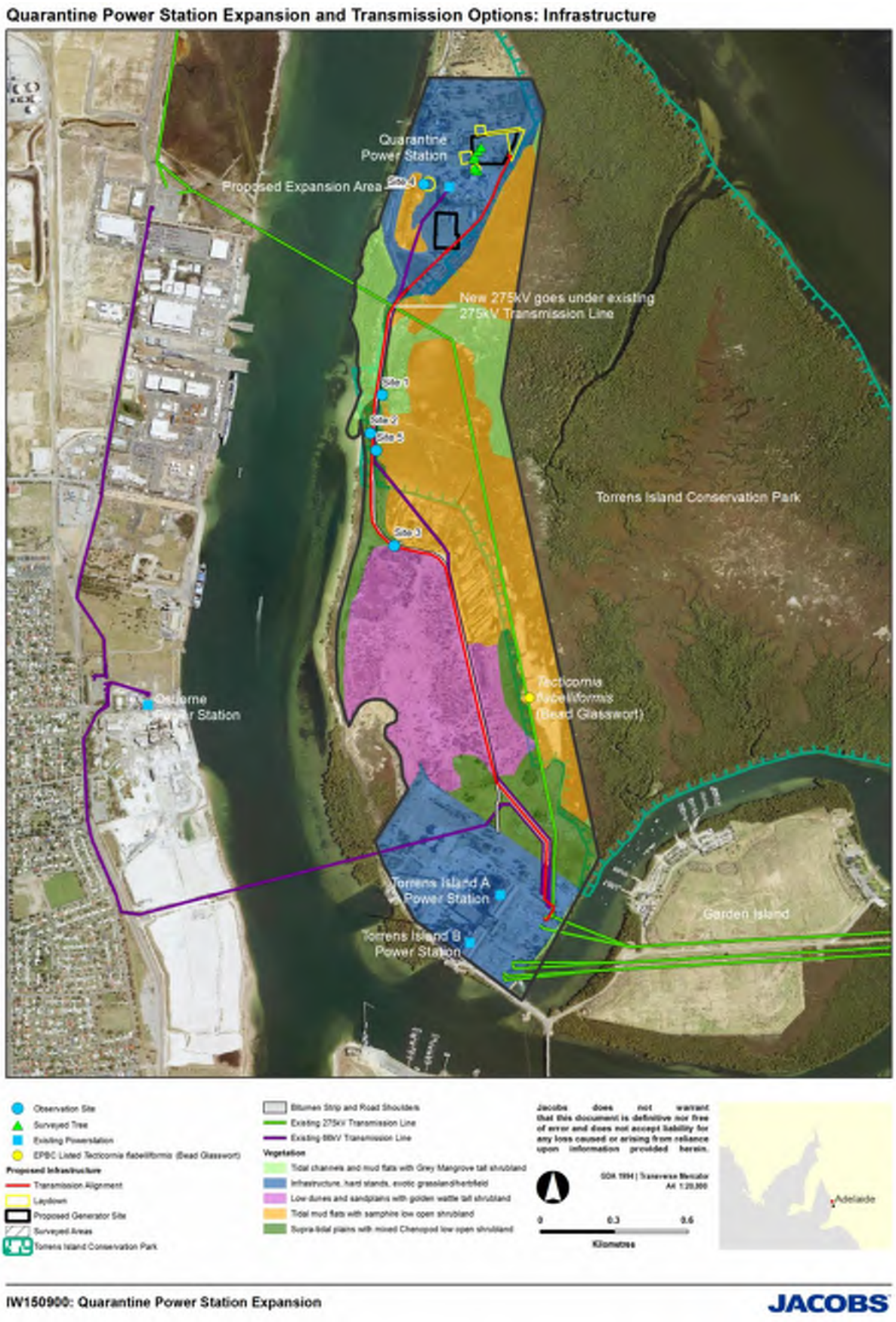

Figure 3-1 Quarantine Power Station: Ecology Assessment Study Area

Table 3-1 Likelihood of occurrence criteria.

Likelihood category	Criteria
Unlikely	No BDBSA records despite survey effort considered adequate, or No BDBSA records and survey effort is considered not adequate, and no suitable habitat is known to occur in the area, or No BDBSA records and survey effort is not considered adequate, and no suitable is known to occur in the area, and species of similar habitat needs have no records either.
Possible	No BDBSA records, survey effort is considered not adequate, suitable habitat does occur (or isn't known if it does occur) and species of similar habitat needs have been recorded in the area, or BDBSA records within the last 40 years, and the area is not largely intact, or BDBSA records in the last 10 years, the species does not have highly specific needs, and habitat is largely intact.
Likely	BDBSA records in the last 10 years, the species does not have highly specific habitat needs and the habitat is largely intact, or BDBSA records in the last 10 years, the species does have highly specific habitat needs and these needs occur in the area, or PMST search results indicate habitat "known" for area.
Highly likely	BDBSA records in the last 10 years, the species does not have highly specific needs, and the habitat is largely intact or PMST search results indicate species "known" for area.

4. Desktop Study and Field Survey Results

4.1 Regional Context

The Interim Biogeographical Regionalisation of Australia (IBRA) identifies geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information (REF). The bioregions are further refined into subregions and environmental associations. The survey area lies within the St Vincent subregion of the Eyre Yorke bioregion and is part of the Parham environmental association.

Three remnant and one derived or regrowth native vegetation communities are present within northern portion of the transmission line survey area while the southern portion traverses cleared land dominated by introduced grasses and agricultural weed species. A small area of native vegetation is found in the western portion of Laydown Area 3. The native vegetation communities have been delineated in Figure 3.1 and are described below.

4.1.1 Tidal channels with Grey Mangrove open shrubland / tall shrubland

This vegetation community comprises tidal channels lined with *Avicennia marina var australasica* (Grey Mangrove) open shrubland to tall shrubland over *Tecticornia arbuscula* (Shrubby Samphire) low shrubland which are associated with a narrow tidal channel that traverses the northern portion of the survey area. This community ranges from tall shrubland lining the deeper channel west of the main access road through to open shrubland in the newly colonized shallow channels traversed by the proposed transmission alignment (Plate 4-1 and Plate 4-2).

Plate 4-1 *Avicennia marina var australasica* (Grey Mangrove) tall shrubland adjacent to the main road channel crossing

Plate 4-2 *Avicennia marina var australasica* (Grey Mangrove) shrubland (background) with *Tecticornia arbuscula* (Shrubby Glasswort) low shrubland (foreground)

4.1.2 Tidal mud-flats with mixed samphire low open shrubland

This vegetation community is defined by intertidal saline plains and seasonally inundated brackish plains with *Sarcocornia quinqueflora* (Bearded Glasswort), *Tecticornia arbuscula* (Shrubby Glasswort) and *S. blackiana* (Thick-headed Glasswort) low open shrubland. The density of Samphire ranges from dense stands in the northern and eastern portions of the survey area to a sparse cover in large almost bare areas in the central portion (Plate 4-3).

A population of the Nationally Vulnerable *Tecticornia flabelliformis* (Bead Glasswort) was recorded in the previous survey (Jacobs, 2017) within this community in open saline mud flats approximately 400 m east of the proposed transmission line alignment. This species is discussed further in Section 5 below.

Plate 4-3 Tidal mud flats with mixed samphire low open shrubland (centre)

4.1.3 Supra-tidal plains with mixed chenopod low open shrubland

This vegetation community occupies the transitional zone between the sand dunes and the tidal mud flats and is characterised by a mix of Chenopod shrubs including *Atriplex stipitata* (Bitter Saltbush), *A. paludosa* (Marsh Saltbush), *S. blackiana* (Thick-headed Glasswort), *Lawrencia squamata* (Thorny Lawrencia) and *Maireana oppositifolia* (Salt Bluebush) in an open-shrubland formation (Plate 4-4). Ground storey species include *Carpobrotus rossii* (Native Pigface) and *Sporobolus virginicus* (Salt Couch).

Plate 4-4 Supra tidal plains with Bitter Saltbush and mixed Chenopod low open shrubland

4.1.4 Low sand dunes and sand plains with Golden Wattle tall open shrubland

This vegetation community comprises low coastal sand dunes and sand plains and occurs in the south of the southern portion of the survey area supporting *Acacia pycnantha* (Golden Wattle) tall open shrubland with a sparse mid-storey including *Dodonaea viscosa ssp angustissima* (Narrow-leaved Hopbush) (Plate 4-5**)**. Native low shrubs include *Rhagodia candolleana ssp. candolleana* (Seaberry Saltbush) and *Enchylaena tomentosa* (Ruby Saltbush) with scattered patches of *Dianella brevicaulis* (Short-stem Flax lily) and *Rytidosperma setacea* (Bristly Wallaby Grass).

This community is considered to be a derived community of colonising native and exotic species now dominant in areas formerly cleared for cropping and grazing.

Plate 4-5 Low sand dunes and sand plains with Golden Wattle tall open shrubland with exotic grass understorey

4.1.5 Cleared areas with exotic grasses and herbs and scattered amenity plantings

Cleared areas in the southern and northern portions of the study area adjacent to the Torrens Island and Quarantine and AGL Power Stations respectively, support exotic grasses and herbs including Couch grass (*Cynodon dactylon*), Hare's Tail Grass (*Lagurus ovatus*) and Sea Spurge (*Euphorbia paralias*) (Plate 4-6). Scattered regrowth of native species including *Ficinia nodosa* (Knobby Club-rush) and *Carpobrotus rossii* (Native Pigface) are also present. Scattered amenity plantings of *Eucalyptus camaldulensis* (River Red Gum) and *E. cladocalyx* (Sugar Gum) are found adjacent to both the Quarantine and AGL power stations.

Plate 4-6 Cleared areas (foreground) with exotic grasses and herbs

4.2 Generator Site Options

Two generator site options were assessed during the field survey and these are depicted on Figure 4-1(below) and described below.

4.2.1 Northern Site Option

The northern generator site option covers an area of approximately two hectares and is comprised of cleared land with existing infrastructure. Vegetation is in the western portion is dominated by exotic grasses including Couch grass (*Cynodon dactylon*) and Hare's Tail Grass (*Lagurus ovatus*) with the exotic perennial mat plant Galena (*Galena secunda*) also common (Plate 4-7). Patchy regrowth of *Acacia pycnantha* (Golden Wattle) together with several amenity tree species including *Casuarina glauca* (Swamp She-oak) is present in the south east of the area (Plate 4-8).

A Regulated Tree (Tree 3) is located near the western boundary of the site and two established trees are located to the south of the northern generator site (Trees 5 and 6), Tree 5 also being a Regulated Tree (see Section 4.3 and 4.4 below for Regulated Tree criteria and Appendix B for photographs).

The site is dominated by slashed grass areas, exotic amenity plantings and patchy regrowth of common native species and does not provide important habitat for wildlife.

Figure 4-1 Generator Site and Laydown Area site options: Vegetation

Plate 4-7 Northern Generator site option: north east portion with exotic grasses and herbs

Plate 4-8 Northern Generator site option: Amenity plantings and sucker regrowth of *Casuarina glauca* (Swamp She-oak)

Plate 4-9 View of Regulated Tree (Tree 3) in western portion of Northern Generator site

4.2.2 Southern Generator Site Option

The southern generator site option covers an area of approximately 1.1 hectares and is comprised of slashed grass with several amenity tree and shrub plantings along the western and north western boundary and a single smaller Eucalypt amenity tree surrounded by lawn area in the north (Plate 4-10).

The site is dominated by slashed grass areas, exotic amenity plantings and does not provide important habitat for wildlife.

Plate 4-10 Southern Generator site option: Slashed grass areas dominate the proposed site.

4.3 Laydown Areas

Three potential laydown areas were assessed during the field survey and these are depicted on Figure 4.1 and described below.

4.3.1 Laydown Area 1

This area adjoins the northern and eastern boundary of the Northern Generator site option and is largely comprised of cleared slashed exotic grass and herb species with scattered amenity plantings and patchy regrowth of native species along the northern and eastern boundary (Figure 4-1).

The site is dominated by slashed grass areas, exotic amenity plantings and does not provide important habitat for wildlife.

4.3.2 Laydown Area 2

The site adjoins the south west corner of the Northern Generator site option and is comprised cleared slashed exotic grass and herb species with scattered amenity plantings (Plate 4-11).

Two Regulated Trees (Trees 1 and 2 are located near the eastern boundary (see Section 4.4 below)).

Plate 4-11 View of eastern portion of Laydown Area 2 with cleared land and two Regulated Trees (back left)

4.3.3 Laydown Area 3

This site is located in the north eastern portion of the Race Course paddock and is characterised by cleared land in the north and eastern portion with the eastern portion comprised of a shallow depression supporting low open shrubland including samphire and low shrubs including *A. paludosa* (Marsh Saltbush), *S. blackiana* (Thick-headed Glasswort) and *Billardiera nitrariacea* (Nitre Bush) and a small stand of *Melaleuca halmaturorum* (Swamp Paperbark) (Plate 4-12).

The Chenopod low open shrubland and Swamp Paperbark vegetation is dominated by exotic grasses and herbs in the ground storey, has high disturbance levels and has been assessed to be in moderate to poor condition providing limited habitat for wildlife. The area is no longer subject to tidal flows and therefore does not meet the Subtropical and Temperate Coastal Saltmarsh Threatened Ecological Community (TEC) criteria (See Section 5 below).

Plate 4-12 View of Laydown Area 3 with patchy cover of Chenopod low open shrubland

4.4 Regulated Trees

As discussed in Section 2, six large trees located on or adjacent to proposed northern infrastructure and laydown sites were assessed against the criteria for Regulated Trees as stipulated in the provisions of the *Development Act*. Four trees meet the Regulated Tree criteria and removal or heavy pruning of these trees will require approval under the provisions of the *Development Act*. The location of the trees is depicted on Figure 4-1 and photos are presented in Appendix B. Table 4-1 below presents the results of the assessment against the Regulated Tree criteria.

Table 4-1 Regulated Tree Assessment

Tree Number	Scientific Name	Common Name	Coordinates	Circumference (m)	Regulated Tree
1	*Eucalyptus cladocalyx*	Sugar Gum	54 H 273337 6148731	4.0 (650mm ave diameter)	Yes
2	*Eucalyptus camaldulensis*	River Red Gum	54 H 273339 6148742	2.5	Yes
3	*Eucalyptus cladocalyx*	Sugar Gum	54 H 273353 6148764	3.0	Yes
4	*Eucalyptus leucoxylon*	Blue Gum	54 H 273366 6148779	5.7 (330 mm ave diameter)	No
5	*Eucalyptus leucoxylon*	Blue Gum	54 H 273339 6148693	4.1 (650 mm diameter)	Yes
6	*Eucalyptus leucoxylon*	Blue Gum	54 H 273327 6148713	2.0 (325 mm diameter)	No

4.5 Disturbance

4.5.1 Vegetation Clearance

Native vegetation has been cleared from a large proportion of the transmission line survey area including clearance for the main north south road (Grand Trunkway) which lies east of the proposed alignment. The *Acacia pycnantha* open woodland / tall shrubland present in the southern portions of the survey area is a derived community that has regrown following broad scale clearance for pasture and cropping undertaken in previous years. Clearance of mixed samphire low open shrubland associated with salt harvesting has occurred adjacent to the main north-south road in the central portion of the survey area and for the installation of towers to support the existing overhead power lines and for the construction of access tracks from the towers to the main road.

4.5.2 Weeds

Three weed species declared under the NRM Act were recorded during the field survey together with numerous introduced agricultural weed species. African boxthorn (*Lycium ferocissimum*), a Weed of National Significance (WONS) was recorded as scattered small infestations on both generator site and laydown area options and in the low sand dune and sand plain community and as scattered plants in the supra-tidal plains in the central portion of the survey area. Declared weed species recorded during the field survey are listed in Table 4-2 below.

Table 4-2 Declared Weeds recorded on the proposed project site

Scientific Name	Common Name	Occurrence[1]	Declared Status Adelaide and Mt. Lofty Ranges[2]
Asparagus asparagoides	Bridal Creeper	1	C
*Lycium ferocissimum**	African Boxthorn	2	WONS,C
Oleo europaea	Olive	2	C

* = Weed of National Significance (WONS)

[1] 1= scattered plants, 2 = scattered small infestations

[2] C = Control required in part of the State, S = Banned for sale (SA Natural Resources Management Act 2004)

4.5.3 Condition

The condition of the native vegetation present within the survey varied from poor in the sand dune / sand plain community through to moderate to good condition in the samphire and Chenopod low open shrubland and Grey Mangrove tall shrubland communities.

Sand dune and sandplain areas were characterised by low species richness, widespread weed infestations and exotic grass and herb species dominant in the understorey.

The Chenopod shrubland areas were characterised by scattered declared weed infestation with low disturbance levels. Disturbance levels were assessed as moderate in the samphire low open shrubland areas with areas of vegetation clearance for access tracks, powerline tower pads and salt evaporation ponds.

The Grey Mangrove tidal channels were assessed to be in good condition with low disturbance levels and mangrove populations in mixed-age stands with widespread recruitment.

It is noted that the proposed Transmission Line alignment traverses the western side of the survey area through native vegetation in poorer condition, characterised by higher disturbance levels.

5. Environmental Assessment

5.1 EPBC Threatened Species and Protected Matters

The EPBC Act Protected Matters database was interrogated via the online Protected Matters Search Tool for the project area plus a 1 km buffer. Results are provided in Appendix A. The results include a large number of marine and coastal species that require open water marine or beach habitats due to the relative proximity of the survey area to Gulf St. Vincent. No suitable habitat for these species is present within the survey area and as such these species are not considered likely to be present within the project area and will therefore not be impacted directly or indirectly (with mitigation measures) by the proposed development. Open water or beach marine and coastal species are therefore not considered further by this report. Table 5-1 below lists threatened flora and fauna species identified in the protected matters search (excluding open water or beach marine and coastal species) and provides a high level assessment of the likelihood of their presence on the proposed site.

5.1.1 EPBC Listed Flora and Fauna and Threatened Ecological Communities

The EPBC PMST results suggested a range of EPBC Act listed flora and fauna species as potentially present within the project area (search results are attached as Appendix A). Table 5-1 below provides an assessment of the likelihood of the presence of these listed species or habitat suitable for them, on or adjacent to the Project area. As mentioned above open water marine and beach coastal species have been excluded (e.g., Whales and other Cetaceans, Oceanic birds such as Albatrosses, Petrels and Prions, Fish, Sharks, Marine Turtles, Seals and Sea-lions).

Table 5-1 Likelihood of EPBC PMST listed ecological communities, flora and fauna species at the project site

Species	Common Name	EPBC Act[1]	SA NPW Act[2]	Likelihood of occurrence	Justification of likelihood of occurrence[3]
Threatened Ecological Communities (TECs)					
Subtropical and Temperate Coastal Saltmarsh		VU	-	Present in area surveyed	Present on the margins of northern portion of the transmission line alignment. Note EPBC referral is not required for Vulnerable TECs (DoTE 2013)
Birds					
Acanthiza iredalei ssp rosinae	Slender-billed Thornbill	VU	V	Likely	Preferred foraging and nesting low open shrubland and mangrove tall shrubland habitat present on the margins of northern portion of the transmission line alignment and the western portion of Race Course laydown area. Numerous BDBSA records within 5 km including 2014 record in mangroves adjacent to the proposed trans line alignment.
Actitis hypoleucos	Common Sand-piper	MT	R	Likely	Foraging tidal mud flats present on northern portion of tans line survey area. Several BDBSA records within 5 km.
Arenaria interpres	Ruddy Turnstone	MW	R	Unlikely	Recorded within 5 km, however no preferred beach habitat present.
Apus pacificus	Fork-tailed Swift	MM	-	Possible	Possible as overfly visitor. No historic BDBSA records, but wide ranging aerial species. No suitable habitat at site.
Botaurus poiciloptilus	Australasian Bittern	E	V	Likely	Mangrove channels provide suitable habitat. BDBSA records include Torrens Island CP. Records within 20

Species	Common Name	EPBC Act[1]	SA NPW Act[2]	Likelihood of occurrence	Justification of likelihood of occurrence[3]
					years, no records since 2006.
Calidris acuminata	Sharp-tailed Sandpiper	MW	-	Likely	Preferred tidal mud flat habitat present. Many BDBSA records within 5 km including several from Torrens Is C.P. Records within 20 years. No records after 2006.
Calidris alba	Sanderling	MW	R	Unlikely	No preferred beach habitat BDBSA records are for St Kilda beach area.
Calidris canutus	Red Knot	EN, MW	R	Likely	Preferred tidal mud flat habitat present. 4 BDBSA records within 5 km including 1 from Torrens Is C.P. Records within 20 years. No records since 2002.
Calidris ferruginea	Curlew Sandpiper	CE, MW	-	Likely	Preferred tidal mud flat habitat present. Many BDBSA records within 5 km including several from Torrens Is C.P. Records within 20 years. No records since 2002.
Calidris ruficollis	Red-necked Stint	MM		Likely	Preferred tidal mud flat habitat present. Many BDBSA records within 5 km. Records within 20 years. No records since 2006.
Calidris subminuta	Long-toed Stint	MM	R	Unlikely	Preferred tidal mud flat habitat present. No BDBSA records within 5 km.
Calidris tenuirostris	Great Knot	CE	R	Possible	Foraging tidal mud flats present, however few BDBSA records within 20 years and none since 2002 within 5 km.
Charadrius bicinctus	Double-banded Plover	MM	-	Unlikely	Preferred tidal mud flat habitat present. Few BDBSA records for beach habitats and none since 1999.
Charadrius leschenaultii	Greater Sand Plover	VU, MM	R	Unlikely	No preferred beach habitat Single undated BDBSA record for beach habitat.
Charadrius mongolus	Lesser Sand Plover	EN, MM	R	Unlikely	Preferred tidal mudflat foraging habitat present. 2 BDBSA records. None since 1999.
Charadrius veredus	Oriental Plover	MM		Unlikely	Prefers inland areas but will forage on tidal mud flats (present in survey area). No BDBSA records within 5km.
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	MM	R	Unlikely	No preferred sedge wetlands present. Few records and none since 2001.
Gallinago megala	Swinhoe's Snipe	MM		Unlikely	No preferred sedge wetlands present. No BDBSA records.
Gallinago stenura	Pin-tailed Snipe	MM		Unlikely	No preferred sedge wetlands present. No BDBSA records.
Tringa (formerly Heteroscelus) brevipes	Grey-tailed Tattler	MM	R	Unlikely	Preferred tidal mudflat foraging habitat No BDBSA records within 5km.
Limosa falcinellus	Broad-billed	MM		Unlikely	Preferred tidal mudflat foraging habitat No BDBSA

Species	Common Name	EPBC Act[1]	SA NPW Act[2]	Likelihood of occurrence	Justification of likelihood of occurrence[3]
	Sandpiper				records within 5km.
Limosa lapponica baueri	Bar-tailed Godwit (baueri)	VU, MM	R	Possible	Preferred foraging tidal mud flats present and BDBSA records within 5 km. Records within 20 years. None since 2005. Note sub-species not listed.
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	CR, MM	-	Possible	Preferred foraging tidal mud flats present and BDBSA records within 5 km. None since 2005. Note sub-species not listed
Limosa limosa	Black-tailed Godwit	MM	R	Possible	Preferred foraging tidal mud flats present and BDBSA records within 5 km. Records within 20 years. None since 2005.
Motacilla cinerea	Grey Wagtail	MT	-	Unlikely	Small area of preferred mangrove tall shrubland habitat. No BDBSA records within 5 km.
Motacilla flava	Yellow Wagtail	MT	-	Unlikely	Small area of preferred mangrove tall shrubland habitat. No BDBSA records within 5 km.
Myiagra cyanoleuca	Satin Flycatcher	MT	E	Unlikely	Small area of preferred mangrove tall shrubland habitat. No BDBSA records within 5 km.
Neophema chrysogaster	Orange-bellied Parrot	CE, MT	E	Unlikely	Foraging habitat (samphire) low shrubland present. No records within 5 km. No recent records within 100km
Numenius madagascariensis	Eastern Curlew	CE, MM	V	Likely	Preferred foraging tidal mud flats present. Records within 5 km including Torrens Island CP. Records within 20 years. None since 2006.
Numenius minutus	Little Curlew	MM		Likely	Preferred foraging tidal mud flats present. Records within 5 km including Torrens Island CP. Records within 20 years. None since 2006
Numenius phaeopus	Whimbrel	MM	R	Likely	Preferred foraging tidal mud flats present. Records within 5 km including Torrens Island CP. Records within 20 years. None since 2006.
Pandion haliaetus	Osprey	MW	E	Unlikely	Limited open water foraging habitat or woodland nesting habitat. 2 BDBSA records and none since 2000.
Pedionomus torquatus	Plains-wanderer	CR^	E	Unlikely	No suitable ephemeral grassland / herbfield habitat present. No BDBSA records within 5 km.
Pezoporus occidentalis	Night Parrot	EN	E	Not present	Species recently considered extinct in SA however potential record from samphire habitat in NE SA (Kalamurina Station). No recent BDBSA records within 500 km.
Phalaropus lobatus	Red-necked Phalarope	MM		Possible	Preferred foraging tidal mud flats present. Several records within 5 km. Records within 20 years. None since 2001
Philomachus pugnax	Ruff	MM		Possible	Preferred foraging tidal mud flats present. Several records within 5 km. Records within 20 years. None since 2001
Pluvialis fulva	Pacific Golden Plover	MM		Possible	Preferred foraging tidal mud flats present. Records within 5 km including Torrens Island CP. Records within

Species	Common Name	EPBC Act[1]	SA NPW Act[2]	Likelihood of occurrence	Justification of likelihood of occurrence[3]
					20 years. None since 2001.
Pluvialis squatarola	Grey Plover	MM		Possible	Preferred foraging tidal mud flats present. Records within 5km. Records within 20 years. None since 2005
Rostratula australis	Australian Painted-snipe	EN	-	Unlikely	No preferred freshwater wetland present. Few BDBSA records.
Sternula nereis nereis	Fairy Tern	VU	E	Possible	Possible overflight species. Records within 5 km. PMST suggested breeding occurred in the area. Breeds on sandy beaches and sandy spits. No suitable breeding habitat present within survey area.
Tringa glareola	Wood Sandpiper	MM		Likely	Preferred foraging tidal mud flats present. Records within 5 km including Torrens Island CP. Records within 20 years. None since 2006
Tringa nebularia	Common Greenshank	MW	-	Likely	Preferred foraging tidal mud flats present. Records within 5 km including Torrens Island CP. Records within 20 years. None since 2006
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank	MM	-	Likely	Preferred foraging tidal mud flats present. Records within 5 km. Records within 20 years. None since 2006.
Xenus cinereus	Terek Sandpiper	MM		Likely	Preferred foraging tidal mud flats present. Records within 5 km including Torrens Island CP. Records within 20 years. None since 2005.
Mammals					
Neophoca cinerea	Australian Sea-lion	VU	V	Unlikely	Little open water habitat. Few local records within 5 m have been from beach habitats.
Plants					
Tecticornia flabelliformis	Bead Glasswort	VU	V	Unlikely	Recorded during previous survey (Jacobs, 2017) approx. 400 m east of trans alignment. Not detected during targeted survey of proposed transmission line alignment

[1] Commonwealth *Environment Protection and Biodiversity Conservation Act1999* Status: Critically Endangered (CE), Endangered (EN), Vulnerable (VU), Migratory Wetland (MW), Migratory Marine (MM), Migratory Terrestrial (MT), Extinct (EX).

[2] South Australian *National Parks and Wildlife Act 1972* (NPWA) Status: Endangered (E); Vulnerable (V); Rare (R);

^ Status change, previously vulnerable

[3] Records refer to BDBSA records and suitable habitat based on field observation, and fauna / flora habitat textbooks

5.1.2 Threatened Ecological Communities

Subtropical and Temperate Coastal Saltmarsh, listed as a Threatened Ecological Community (vulnerable) under the EPBC Act is represented in the tidal mud flats with mixed samphire low shrubland found in the northern portions of the survey area. Under the EPBC Act, Vulnerable Threatened Ecological Communities are not afforded specific protection (DotE 2013).

5.1.3 Threatened Fauna

The survey area provides habitat for a large number of threatened fauna species. In particular, the tidal mud flats in the eastern portion provide foraging habitat for a range of threatened and migratory shore birds with 26 species designated as *Possible*, *Likley* or *Present* in the species likelihood of presence assessment based on habitat quality, BDBSA records and PMST search results.

The samphire low open shrubland on the tidal mud flats and the mixed Chenopod low open shrubland community on the adjacent supra-tidal plains, and to a lesser extent, the Grey Mangrove tidal channels, provide foraging and nesting habitat for the Slender-billed Thornbill listed as vulnerable under the EPBC and NPW Acts. This species has been recorded recently (2014) in Torrens Island Conservation Park and has also been designated as likely to be present within the survey area.

The proposed transmission line construction footprint traverses highly modified vegetation west of the main north south road (Grand Trunkway) and avoids disturbance to higher quality vegetation on the eastern side of the road resulting in minimal potential impact to threatened fauna habitat and populations.

5.1.4 Threatened Flora

A population of the threatened plant species *Tecticornia flabelliformis* (Bead Glasswort) listed as Vulnerable (EPBC and NPWA) was recorded during the April 2017 survey in open saline mud flats approximately 400 m east of the proposed transmission line alignment (refer Figure 3-1). The samphire communities adjacent to the proposed alignment are more elevated and not considered suitable for Bead Glasswort and no populations were detected in the current survey area. The location of the population is shown on Figure 3-1 above and pictured in Plate 5-1 below.

No other threatened flora or fauna species nor threatened vegetation communities were recorded during the field survey of the project area.

Plate 5-1 *Tecticornia flabelliformis* (Bead Glasswort) recorded on the eastern margin of the survey area

5.2 Potential Environmental Impacts

5.2.1 Construction Footprint

The proposed methodology for the installation of the buried transmission line has not been finalised however for the purposes of assessing potential environmental impacts the potential construction footprint has been defined as a 26 m wide corridor comprised of a 10 m wide strip west of the north-south road plus a 16 m wide strip comprised of the road's bitumen strip (4 m) and road shoulders (each 6 m wide). The potential construction footprint avoids disturbance to better quality vegetation including samphire and mangrove communities, located to the east of the road.

For the purposed of this report, the construction footprint of the generator and laydown area options is assumed to be the surveyed areas as shown in Figure 4-1.

5.2.2 Vegetation Clearance

The installation of the transmission line will require the clearance of up to 3.1 ha of native vegetation. Table 5-2 below provides an estimate of vegetation clearance required for each vegetation community based on the current alignment. The majority of vegetation clearance will take place in Chenopod low open shrubland and *Acacia pycnantha* tall shrubland communities in the southern portion of the proposed transmission alignment. These areas have been highly disturbed by past vegetation clearance, earthworks and invasion of exotic grass and herbs and are considered to be in moderate to poor condition and provide limited habitat for wildlife including threatened species.

The installation of Laydown Area 3 will require the clearance of approximately 0.1 ha of highly disturbed Samphire and Chenopod low open shrubland vegetation on the western margin of the site.

Table 5-2 Vegetation Communities: Preliminary estimates of vegetation clearance

Option	Vegetation Community / Area of clearance (ha)				
	Samphire low open shrubland	Chenopod low open shrubland	Golden Wattle tall open shrubland	Grey Mangrove tall shrubland	**Total**
Transmission Line	0	1.85	1.0	0.27	**3.12**
Laydown Area 3	0.1	0	0	0	**0.07**

5.2.3 Threatened Flora and Fauna and Threatened Ecosystems (TEC)

Whilst Samphire low open shrubland representative of the TEC is present within the survey area, to the east of the Grand Trunkway, the proposed alignment and construction footprint avoids traversing through this community and no clearance of the TEC is anticipated.

The installation of the proposed transmission line will result in the clearance of Chenopod low open shrubland (1.85 ha) and an area of Grey Mangrove tall shrubland (0.27 ha). Whilst these communities may provide foraging habitat for a range of EPBC and NPWA listed species, the proposed areas of clearance represent a small proportion of the available habitat on the site and in surrounding areas and have been assessed to be in moderate to poor condition. It is considered that with appropriate mitigation measures, impacts will be localised and minor in nature and not result in significant impact to populations of State or Commonwealth threatened species or the TEC.

No threatened flora species were recorded during the survey of the proposed transmission line alignment. The nearest population of the Nationally Vulnerable *Tecticornia flabelliformis* (Bead Glasswort) lies approximately 400 m from the proposed construction footprint (refer Figure 3-1) and it is considered that this EPBC and NPWA listed species will not be impacted by the proposed works.

6. Application of the Native Vegetation Act 1991

6.1 Approval to Clear Native Vegetation

Native vegetation is present on portions of the proposed transmission line construction footprint and, subject to the final optimisation of the alignment, up to 3.2 ha of native vegetation may be cleared and / or disturbed. The NV Act does not apply to terrestrial native vegetation communities on Torrens Island (DEWNR, 2017) and clearance approval under the act is not required. Similarly, there is no requirement for the provision of an SEB (Significant Environmental Benefit).

7. Summary and Recommendations

This ecological assessment provided information on the flora and fauna assemblages present or likely to be present within the construction footprint and adjacent areas for the transmission line and generator and laydown area site options proposed for this project. The principal findings of this report are:

- The desktop study and field survey confirmed the presence of samphire mud flats which represent important habitat for a range of threatened and migratory species listed under the EPBC and NPW Acts.
- The Samphire mud flats adjacent to the proposed transmission line alignment conform with the criteria for the Vulnerable Threatened Ecological Community (TEC): Subtropical and Temperate Coastal Saltmarsh.
- The proposed installation of the transmission line will result in the clearance of up to 3.2 ha of native vegetation however will not result in clearance of the Samphire TEC.
- Clearance of native vegetation has been minimised by positioning of the transmission line immediately adjacent to the north south road in cleared land in areas where existing disturbance levels are high.
- It is considered that potential impacts to flora and fauna associated with the installation of the transmission line and generator and laydown areas are localised and transient and are unlikely to result in significant impacts to nationally or state threatened flora and fauna or the TEC, hence an EPBC referral under the EPBC Act would not be required.
- Terrestrial vegetation on Torrens Island is exempt from the provisions of the *Native Vegetation Act* as it falls outside of the defined area of metropolitan Adelaide where the act applies and no approval to clear native vegetation under the act is required.
- Four trees meeting the Regulated Tree criteria will require Development Approval for their removal.

7.1 Recommended Measures:

The following measures to minimise impacts to flora and fauna populations and habitat include:

Pre-Construction

- Accurately and clearly mark out the limits of the work zone particularly in areas of higher value vegetation such as mangrove, samphire and Chenopod shrub communities.

Construction - Training

- Conduct environmental awareness training for all site personnel.

Construction – Vegetation Clearance (including fauna management)

- Avoid vegetation disturbance beyond the limits of the work zone.
- Regular inspections should be undertaken to ensure all retained vegetation is clearly marked and that appropriate flagging is in place.
- Conduct staged removal of large trees and provide time and space for fauna to leave the work area.
- Engage an experienced and licensed wildlife carer and /or ecologist to be present on site during tree and shrub removal / clearance (open woodland vegetation community) to capture and relocate fauna that may be encountered.
- Remove habitat as carefully as possible to avoid injury to any fauna still remaining in vegetation. Use equipment that would allow large trees to be lowered to the ground with minimal impact (e.g. claw extension on an excavator).

Construction – Weed Management

- Ensure that any machinery arriving on site be inspected for any foreign soil or plant matter/weed material and be washed down before entering the work site.
- Weeds should be controlled within the work area according to the requirements of the Natural Resource Management Act (2004).
- All declared weeds which are cleared as part of the project must be disposed of appropriately.

Construction – Erosion Control

- Ensure surface water flows are not impeded during construction and post construction by locating infrastructure in areas not subject to tidal flows wherever possible. Where infrastructure is located in areas subject to tidal flows minimising windrows along tracks and trenched area and providing culverts or similar under any raised access tracks in samphire and mangrove areas.
- Provide sediment and erosion controls to manage exposed soil surfaces and/or stockpiles and prevent sediment discharge into retained vegetation and drainage lines particularly in the vicinity of mangrove and samphire communities
- Ensure that any excess soil is not placed in adjacent vegetation and remains within the proposed clearance footprint.
- Re-profile top soil following transmission line installation and re-instate removed vegetation as “brush matting”.

It is considered that the disturbed areas of the construction footprint will revegetate naturally without further intervention.

8. References and Bibliography

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Appendix A. EPBC PMST Results

Australian Government

Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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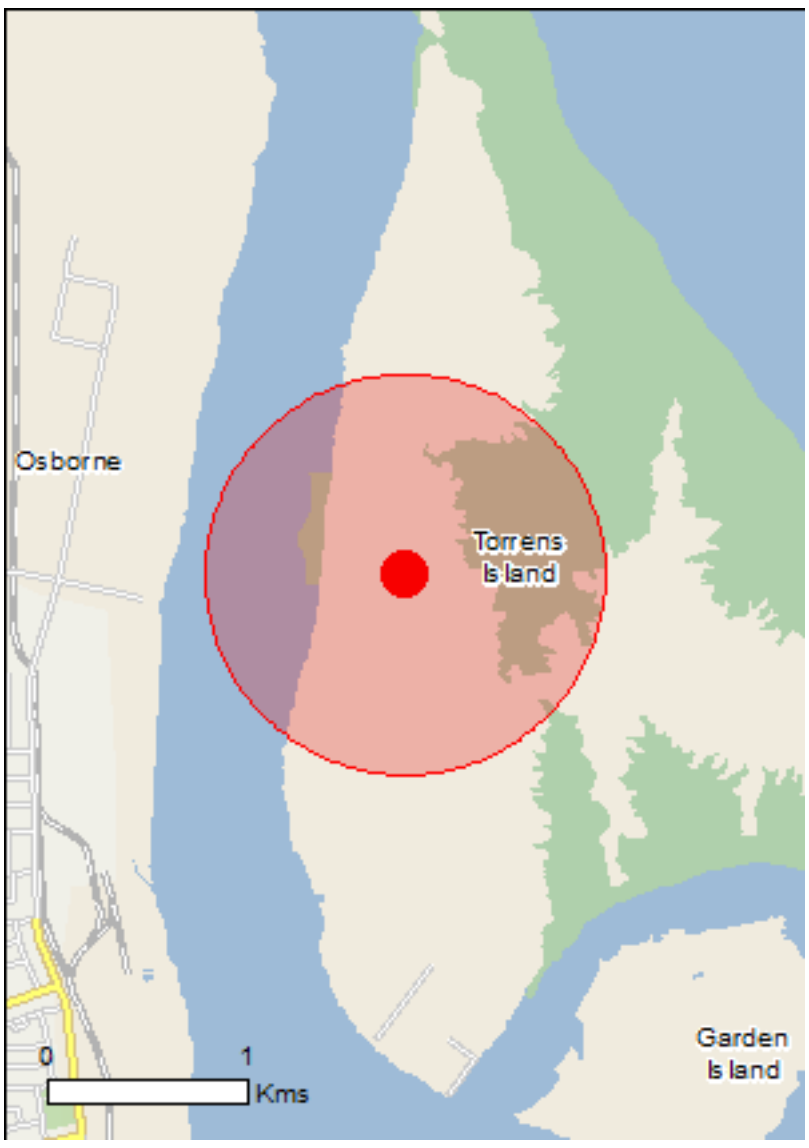

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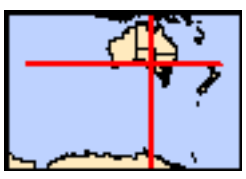

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	35
Listed Migratory Species:	56

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	92
Whales and Other Cetaceans:	8
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	35
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Acanthiza iredalei rosinae Slender-billed Thornbill (Gulf St Vincent) [67080]	Vulnerable	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
		to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Extinct within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Mammals		
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Neophoca cinerea		
Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
Tecticornia flabelliformis		
Bead Glasswort [82664]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca		
Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Sterna albifrons		
Little Tern [813]		Species or species habitat may occur within area
Thalassarche cauta		
Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Calidris subminuta Long-toed Stint [861]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Foraging, feeding or related behaviour known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Foraging, feeding or related behaviour known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Foraging, feeding or related behaviour known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Tringa glareola Wood Sandpiper [829]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Calidris subminuta Long-toed Stint [861]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Foraging, feeding or related behaviour known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour known to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Foraging, feeding or related behaviour known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Foraging, feeding or related behaviour known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Foraging, feeding or related behaviour known to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Tringa glareola Wood Sandpiper [829]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area
Fish		

Name	Threatened	Type of Presence
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Vanacampus vercoi Verco's Pipefish [66286]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Torrens Island	SA

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Barker Inlet & St Kilda	SA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.7898 138.5216

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B. Regulated Tree Photographs

Tree 1 *Eucalyptus cladocalyx* (front left) and Tree 2 *E. camaldulensis* (back centre)

Tree 3 *Eucalyptus cladocalyx* (Regulated Tree)

Tree 4 *E. leucoxylon* (back right) (Not Regulated Tree)

Tree 5 *E. leucoxylon* (Regulated Tree)

Tree 6 *E. leucoxylon* (Not Regulated Tree)

Appendix G. Air Quality Impact Assessment

Air Quality Assessment of Quarantine Power Station, Torrens Island

Prepared for:

Origin Energy Power Pty Ltd

January 2018

Final

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Contents

Tables

Figures

Contour Plates

Glossary

Term	Definition
µg/m^3	micrograms per cubic metre
°C	degrees Celsius
km	kilometre
MW	Megawatt
m	metre
m/s	metres per second
m^2	square metres
m^3	cubic metres
m^3/s	cubic metres per second
Nomenclature	**Definition**
CO	carbon monoxide
CO_2	carbon dioxide
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
SO_2	sulfur dioxide
Abbreviations	**Definition**
Air Quality EPP	*Environment Protection (Air Quality) Policy 2016*
QPS	Quarantine Power Station
SA EPA	South Australia Environment Protection Authority
TAPM	The Air Pollution Model

EXECUTIVE SUMMARY

Katestone Environmental Pty Ltd (Katestone) was commissioned by Origin Energy Power Pty Ltd (Origin) to complete an Air Quality Assessment of the Quarantine Power Station on Torrens Island, Adelaide. The assessment is to support a Development Application for the Quarantine Power Station Expansion (QPSX project) considering the following changes to the power station:

- The staged replacement of gas turbine within Units 1-4 over the next three to four years
- The proposed expansion of the power station with the addition of up to three new units (nominal capacity of 160 – 180 MW).

The Air Quality Assessment has used a dispersion modelling approach. A site-specific meteorological data file has been generated using the TAPM and CALMET meteorological models. The meteorological modelling has accounted for local terrain and land use features of the surrounding region.

Emission rates and stack characteristics have been determined from the manufacturer's specifications, emission limits, and emissions information provided by Origin. Emission rates and stack characteristics of the proposed units have been selected to provide a worst-case estimate of the potential impact of the expanded power station on air quality. Dispersion modelling scenarios have also been selected to reflect the possible timings of the proposed expansion project and the upgrade of the gas turbines on existing Units 1-4, which may occur before or after the installation of the three additional units.

The CALPUFF dispersion model has been used to predict ground-level concentrations of nitrogen dioxide due to the proposed operations of the Quarantine Power Station, including the replacement of the existing gas turbines on Units 1- 4 and the addition of three new generating units.

The Air Quality Assessment has shown that ground-level concentrations of nitrogen dioxide due to the project ***comply*** with the air quality criteria at all locations across the model domain outside the Quarantine Power Station site boundary. The predicted ground-level concentrations of nitrogen dioxide have included a conservative estimate of the ambient background levels of nitrogen dioxide. The maximum cumulative concentrations were predicted to be, at most, 34% of the air quality criteria.

1. INTRODUCTION

Katestone Environmental Pty Ltd (Katestone) was commissioned by Origin Energy Power Pty Ltd (Origin) to complete an Air Quality Assessment of the Quarantine Power Station on Torrens Island, Adelaide.

Origin currently operates the Quarantine Power Station (QPS), which supplies power to the South Australian market during periods of peak demand. The existing power station consists of four Alstom GT10B gas turbines (Units 1-4) and one GE 9E gas turbine (Unit 5) each operating primarily on natural gas and with a combined capacity to generate up to 224 megawatts (MW) of electricity. Origin proposes to replace the gas turbines on Units 1-4 over the next three to four years as part of routine maintenance and to expand the power station's generating capacity by a nominal 160 to 180 MW using up to three new gas turbines. This air quality assessment is to support Origin's application for the proposed expansion to the power station (QPSX project).

The timing of the replacement of the gas turbines on Units 1-4 and the QPSX project are uncertain. The air quality assessment has accounted for this uncertainty by considering two dispersion modelling scenarios relative to each other, that are conservative, as they reflect the possible commissioning of QPSX project both before and after the replacement of the gas turbines on Units 1-4.

This assessment has addressed the following scope of works:

- Describe the relevant regulatory requirements including relevant air pollutants and maximum concentration criteria relevant to the QPSX project.
- Describe the neighbouring land use, potential sensitive receptors and existing ambient air quality levels in the vicinity of the QPSX project.
- Develop a site-specific meteorological data file for the site, and describe the meteorological patterns relevant to dispersion of emissions from the QPSX project.
- Estimate worst-case emissions of NO_2 from the QPSX project based on a review of manufacturer's specifications, emission limits, and emissions information provided by Origin.
- Conduct dispersion modelling to predict ground-level concentrations of NO_2 due to the proposed changes and expansion.
- Assess the results of the dispersion modelling against the relevant maximum concentration criteria with the addition of a representative ambient background concentration.

2. THE PROJECT

Origin operates QPS, which supplies power to the South Australian market during periods of peak demand. The existing power station consists of four Alstom GT10B gas turbines (Units 1-4) and one GE 9E gas turbine (Unit 5) each operating primarily on natural gas and with a combined capacity to generate up to 224 megawatts (MW) of electricity. Origin plans to replace the gas turbines on Units 1-4 over the next three to four years with the latest aero-derivative turbines as part of routine maintenance works (with the first of these currently scheduled to be replaced in September 2018).

The primary aim of this air quality assessment is to support Origin's application for the QPSX project. The air quality assessment considers all potential operation scenarios of QPS during the roll-out of the project. The assessment considers the potential for cumulative air quality impacts as follows:

- Scenario 1:
    - Existing Units 1-4
    - Unit 5 running on natural gas
    - Units 6-8 (QPSX project)
- Scenario 2:
    - Upgraded Units 1-4
    - Unit 5 running on natural gas
    - Units 6-8 (QPSX project)

The QPSX project involves the expansion of the existing power station with the installation of three aero-derivative gas turbines that will increase the output of the station by 160 to 180 MW. The turbines for the QPSX project are designed to respond quickly and efficiently to market requirements. Origin plans to have this new facility available for generation in the market by the summer of 2019/2020.

The QPSX project will be located within the area of the 'Land Not Within a Council Area (LNWCA) (Metropolitan)' on vacant land within the existing Origin owned QPS site which is located on lot 112 Volume 5907 Folio 399 and Lot 305 Volume 6132 Folio 766". Origin has identified a second location for the QPSX project that may be more suited to the development; however, the second site is currently constrained by land ownership. Should this alternative site become available, Origin may choose to vary the application to include the alternative site.

The location of the Quarantine Power Station on Torrens Island is shown in Figure 1.

Figure 1 **Quarantine Power Stations and surrounds**

3. AIR QUALITY ASSESSMENT METHODOLOGY

3.1 Overview

The assessment is based on a dispersion modelling study incorporating source characteristics and operational activity data with meteorology that is representative of the site and surrounding region. The assessment has been prepared in accordance with the SA EPA's document: *Ambient air quality assessment* (SA EPA, 2016), regulatory requirements (Section 4) and best practice approaches. The proposed assessment methodology was developed with agreement from EPA personnel prior to the assessment being conducted.

The site location and surrounding environment has been described in Section 5 in terms of:

- Land-use
- Terrain features
- Sensitive receptor locations.

The existing air quality in the region has been described in Section 5 based on:

- National Pollutant Inventory (NPI) database for sources in the region
- Ambient air quality monitoring data recorded by the SA EPA's monitoring network.

The local meteorology at the site, including wind speed, direction, atmospheric stability and mixing height, have been described using site-specific data generated by the TAPM and CALMET meteorological models (Section 6).

The assessment has focused on nitrogen dioxide (NO_2) as this is the key pollutant emitted to the atmosphere from gas turbines. Other pollutants that may be emitted in very small quantities include carbon monoxide, particulate matter, volatile organic compounds (VOCs) and sulfur dioxide. These have not been explicitly assessed, as they are typically emitted in trace amounts. NO_2 is a suitable indicator of the overall risk to air quality posed by the QPSX project.

Emission rates of NOx and stack characteristics have been selected to provide a worst-case representation of the potential impact of the QPSX project and have been based on a review of manufacturer's specifications, emission limits, and emissions information provided by Origin (Section 7).

Predicted ground-level concentrations of NO_2 due to the QPSX project have been predicted using the CALPUFF dispersion model, driven by the site-specific meteorological data generated by TAPM/CALMET. Ground-level concentrations have been determined across a Cartesian grid of receptors (Section 8).

The potential cumulative impact of the QPSX project plus other existing sources of NO_2 in the vicinity has been estimated using conservative background concentrations derived from monitoring data recorded at the nearest SA EPA ambient air quality monitoring stations. The predicted ground-level concentrations of NO_2 due to the QPSX project plus existing sources of NO_2 have been assessed by comparison with the legislated maximum concentration criteria. (Section 8).

3.2 Meteorology

The prognostic model TAPM (developed by the Commonwealth Scientific and Industrial Research Organisation [CSIRO], version 4.0.5) and the diagnostic meteorological model CALMET (developed by EarthTec, version 6.5.0) were used to generate the three-dimensional meteorological dataset for the region. Following discussions with the EPA, 2009 was selected for the meteorological model simulation as a representative year. The TAPM generated dataset was evaluated by comparison with monitoring data from the SA EPA's Le Fevre site. This evaluation is presented in Appendix A.

The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the innermost nest. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

The three-dimensional wind field produced by TAPM/CALMET was then used to create a meteorological file suitable for us with the CALPUFF dispersion model.

Details of the model configuration and evaluation are presented in Appendix A.

3.3 Emission Rates

Emission rates for the gas turbines 1-4 that are proposed to be replaced and the three proposed additional gas turbines have been selected based on a review of emissions data supplied by Origin and the emission limits in the Air Quality EPP. Emission rates for Unit 5 have been selected based on a review of stack testing reports from 2007 – 2017 and the emission limits in the Air Quality EPP. Where possible, the combination of emission parameters likely to result in worst-case air quality impacts have been selected for each unit.

3.4 Dispersion Modelling

The air quality impact assessment was conducted in accordance with recognised techniques for dispersion modelling. Air dispersion modelling was conducted using the CSIRO air dispersion model TAPM and the meteorological field was further refined using the CALMET meteorological model. CALPUFF was used to predict ground-level concentrations of nitrogen dioxide across the model domain due to the QPSX project.

CALPUFF is an advanced non-steady-state air quality modelling system. Twelve months of modelled meteorological data was used as input for the dispersion model in order to include all weather conditions likely to be experienced in the region during a typical year. The modelling has been used to predict maximum ground-level concentrations of air pollutants across a Cartesian grid and at the locations of the nearest sensitive receptors.

Source characteristics and pollutant emission rates were incorporated into a dispersion modelling study. This was conducted using a standard and regulated model developed by EarthTec, the CALPUFF model (version 7.21). Emission sources were configured in CALPUFF. Source characteristics have been summarised in Section 7. Air emissions have been conservatively modelled as constantly emitting over 24 hours/day for the entire year.

Technical details of the configuration of the CALPUFF model are presented in Appendix A.

3.5 Methods for the conversion of NOx to NO_2

Nitric oxide (NO) that is emitted by power stations can undergo chemical transformation in the atmosphere to form NO_2. NO_2 is more toxic than NO and therefore it is important to quantify the transformation of NO to NO_2 in the atmosphere. Measurements around power stations in Central Queensland show, under worst possible cases, a conversion of 25-40% of the nitric oxide to nitrogen dioxide occurs within the first 10 kilometres of plume travel. During days with elevated background levels of hydrocarbons (generally originating from bush-fires, hazard reduction burning or other similar activities), the resulting conversion is usually below 50% in the first 30 kilometres of plume travel (Bofinger et al 1986). For this air dispersion modelling assessment, a ratio of 30% conversion of the oxides of nitrogen to nitrogen dioxide has been assumed, which is very conservative considering the short travel time of the plume to the maximum ground-level concentrations.

3.6 Cumulative Impacts

To determine the potential impact of the QPSX project in conjunction with existing emission sources of NO_2, an estimate of the background level of NO_2 has been made using data recorded by the SA EPA's ambient air quality monitoring network. As discussed in Section 5.3.2, data from the three nearest monitoring sites at Le Fevre, Netley and Northfield has been analysed and conservative background values selected.

4. LEGISLATIVE FRAMEWORK FOR AIR QUALITY

In SA, environmental protection from the effects of emissions to air are managed by a range of policies and guidelines, with the foundation provided by the *Environment Protection Act 1993*. Section 25 of the *Environmental Protection Act 1993* imposes a general environmental duty on all persons undertaking an activity that pollutes or might pollute the environment, requiring them to take all reasonable and practicable measures to prevent or minimise any resulting environmental harm. The Environment Protection (Air Quality) Policy 2016 (Air EPP) provides specific requirements for air quality regulation and management across the state, including maximum ground-level concentrations of air pollutants and stack emission limits.

Schedule 4 of the Air Quality EPP specifies limits to emissions to air of pollutants produced on premises emitted through a chimney, flue or vent. Emission limits of relevance to the Quarantine Power Station are reproduced in Table 1.

Table 1 Stack emission limits (Schedule 4 of the Air Quality EPP)

Pollutant	Activity	Maximum pollutant level
Oxides of nitrogen	Gas turbines for power generation of 10MW or greater – for gaseous fuels	70 mg/m³ referenced to 15% by volume of oxygen
Table note: * All volumes (m^3) are expressed as volume of dry gas at 0°C and 101.3 kPa.		

Schedule 2 of the Air Quality EPP specifies ambient air quality criteria specified as maximum ground level concentrations that are to occur at sensitive receptor locations. To demonstrate that no adverse effects will occur at ground level due to emissions from a proposed or existing facility, proponents are required to use atmospheric dispersion modelling techniques to predict the maximum ground-level concentrations which will result. Proponents are required to show that these maximum concentrations are less than the ground level concentrations specified in Schedule 2 of the Air Quality EPP at all sensitive receptor locations, and at all times. The specified maximum ground level concentrations are based on protecting public health and amenity, or other environmental factors. Ground level concentration limits of relevance to the Quarantine Power Station are reproduced in Table 2.

The assessment has also been conducted with reference to the SA EPA's guidance document *Ambient air quality assessment* (2016) and in consultation with SA EPA's technical air quality staff.

Origin operates QPS under the Environmental Authorisation (EA) Licence No. 13697.

Table 2 Air quality criteria used in the assessment (Schedule 2 of the Air Quality EPP)

Pollutant	Classification	Averaging time	Maximum concentration	
			µg/m³	ppm
Nitrogen dioxide	Toxicity	1-hour	250	0.12
		Annual	60	0.03

5. EXISTING ENVIRONMENT

5.1 Local terrain and land use

QPS is located on Torrens Island, approximately 15 km to the north of Adelaide CBD. The land surrounding the plant on Torrens Island is mainly low lying and coastal. The terrain at QPS and across the surrounding area is relatively flat, with the plant site at an elevation of approximately 5m above sea level.

Land use on the adjacent outer harbour to the east of the site along with the areas immediately south of Torrens Island is a mix of residential and industrial. Torrens Island is bordered to the east by the mangrove areas of the Barker Inlet. The greater Adelaide region is also a mix of residential and industrial land uses.

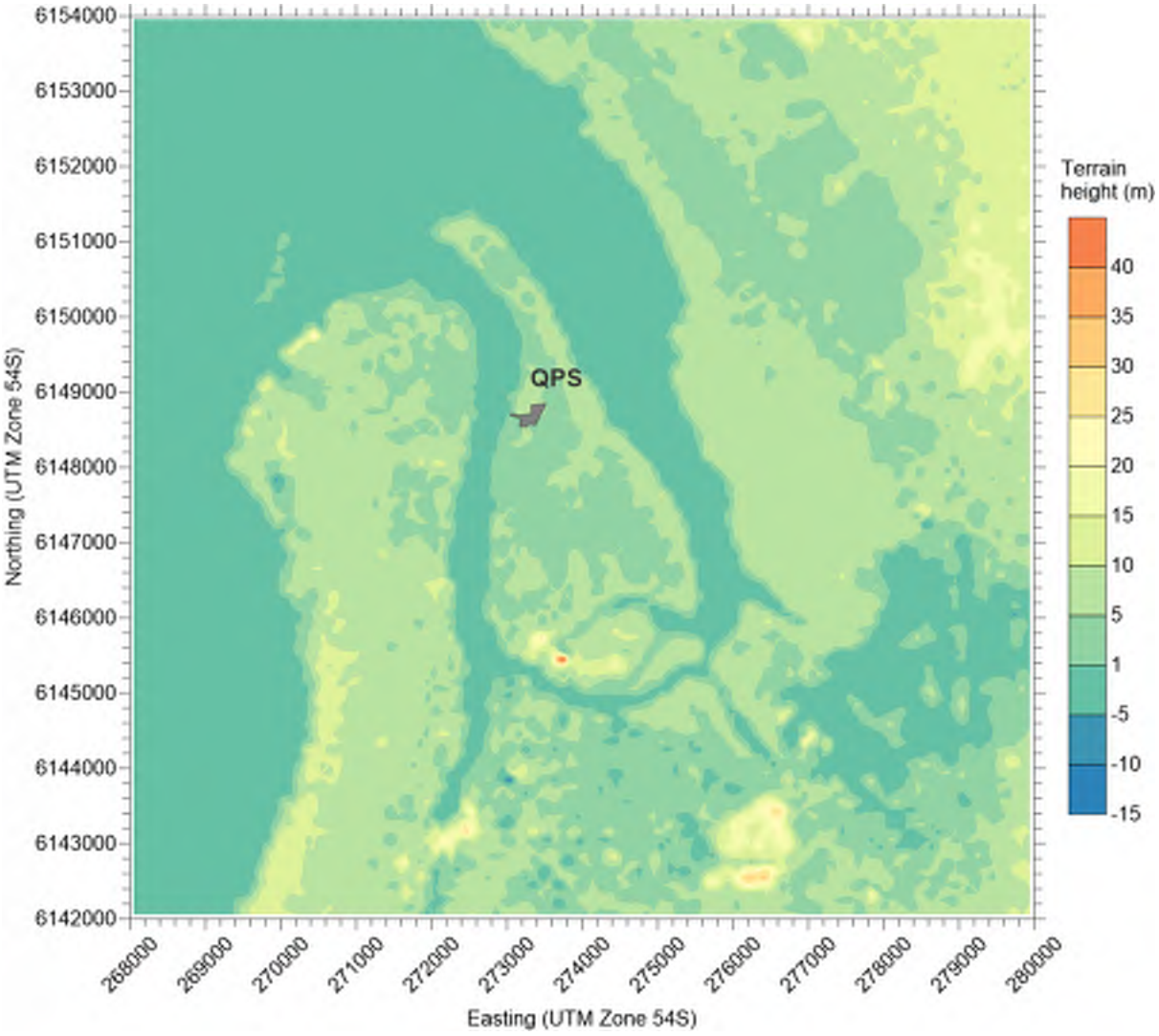

Figure 2 Terrain elevation (m)

5.2 Sensitive receptors

The nearest sensitive receptors to QPS are located over 2km west of the site. Ground level concentrations of air pollutants have been assessed across a Cartesian grid that encompasses all sensitive receptors in the local area.

5.3 Existing air quality

5.3.1 Existing sources of emissions

There are a variety of industries operating in the Torrens Island and Port Adelaide area. A search of the National Pollutant Inventory for the 2015-2016 reporting year identified 11 other facilities with emissions of the same key pollutants as QPS. A summary of these industries, and the reported emissions of NO_x, CO and PM_{10} is presented in Table 3. The most significant source of NO_x emissions is the AGL Torrens Island Power Station, located approximately 3km south of the QPS site, followed by the Birkenhead Cement Plant, which is approximately 6km from QPS.

Table 3 Emissions inventory of NO_x, CO and particulates for facilities within 6km of the QPS, as reported to the NPI for the 2015-2016 reporting year

Facility	Location	Industry	Distance and direction from the QPSX project	Emission rate (kg/year)		
				NO_x	CO	PM_{10}
Quarantine Power Station	Torrens Island	Electricity generation using natural gas	-	73,135	11,141	4,778
Quarantine Meter Station	Torrens Island	Natural gas metering station	-	232	195	17
Pelican Point Power Station	Outer Harbor	Electricity generation	1.9 NW	105,122	17,061	6,689
Pelican Point Meter Station	Outer Harbor	Natural gas metering station	1.9 NW	1,345	1,134	100
OSBORNE COGENERATION PLANT	Osborne	Electricity and steam production	2.4 SW	326,473	13,701	412
Flinders Adelaide Container Terminal	Outer Harbor	Container freight slipping	2.8 NW	6,695	4,108	684
Torrens Island Meter Station	Outer Harbor	Natural gas metering station	2.8 S	28,588	24,088	2,118
AGL TORRENS ISLAND POWER STATION	Torrens Island	Electricity supply – generating using natural gas & fuel oil	3.1 S	3,115,936	323,921	107,941
Malt Port Adelaide	Port Adelaide	Malting barley for the manufacture of malt	5.5 S	4,476	7,588	6,362
Viva Energy Birkenhead Bitumen Plant	Peterhead	Bitumen storage and distribution	5.8 SSW	1,215	1,015	90
Bolivar Wastewater Treatment Plant	Bolivar	Treatment of wastewater	5.9 NE	38,501	5,440	1,674
Birkenhead Plant	Birkenhead	Cement manufacturing	6.2 SSW	2,966,640	611,083	121,734

5.3.2 Existing ambient air quality

The EPA carries out air quality monitoring of criteria air pollutants for the Air NEPM at various locations in Adelaide, including Le Fevre Primary, Netley, Northfield, Kensington, Elizabeth and Christies Beach. The nearest monitoring stations to the QPS measuring levels of nitrogen dioxide are at Le Fevre, Netley and Northfield. The Le Fevre site is located closest to QPS and overall, has recorded lower concentrations of NO_2 than the Netley and Northfield sites.

Table 4 Ambient concentrations of NO_2 recorded at the nearest EPA monitoring stations

Monitoring site	Year	1-hour average NO_2 ($\mu g/m^3$)[1]			Annual average NO_2 ($\mu g/m^3$)[1]
		Maximum	90th percentile	70th percentile	
Le Fevre	2013	70.2	24.1	11.6	10.0
	2014	60.8	24.4	11.9	9.5
	2015	67.7	24.4	11.3	9.6
	2016	63.9	20.7	9.4	7.3
Netley	2013	77.7	34.5	15.4	12.1
	2014	86.2	37.6	18.5	14.6
	2015	88.4	35.7	16.9	13.5
	2016	73.3	32.0	13.2	12.1
Northfield	2013	67.7	27.0	11.9	10.6
	2014	76.2	27.9	13.5	11.8
	2015	69.6	30.1	15.0	13.1
	2016	73.3	26.3	11.3	10.4
Air NEPM standard		**250**			**60**

Table note:
[1] Based on conversion from parts per million (ppm) to $\mu g/m^3$ at 25°C and 1atm.

Table 5 presents the ambient background concentrations that have been selected for use in the assessment to determine cumulative levels of NO_x due to the QPSX project plus existing sources.

Table 5 Ambient background concentrations selected for use in the assessment

Pollutant	Averaging period	Ambient background concentration	Source
NO_x	1-hour	37.6	Maximum 90th percentile measurement from Le Fevre, Netley or Northfield between 2013 and 2016
	Annual	14.6	Maximum measurement from Le Fevre, Netley or Northfield between 2013 and 2016

6. METEOROLOGY

The following sections describe the meteorology of the region surrounding the project, focusing on parameters that are important for dispersion of air pollutants, based on data generated by the TAPM/CALMET models.

6.1 Wind speed and wind direction

Wind speed and wind direction are important meteorological parameters that will influence the dispersion of air pollutants. Figure 3 illustrates the annual wind speed distribution during 2009 at the QPSX project site, as predicted by CALMET. The predominant wind directions are northeast and southwest, with the strongest winds being sea-breezes from the west.

The wind directions vary considerably throughout the year (Figure 4). During summer, winds are predominantly from the south-west. Through autumn and into winter, winds are increasingly from the west and northeast. Winds during spring occur primarily from the northeast, southwest and west. During winter, 34% of all strong winds (>5m/s) occur, with a further 30% of strong winds occurring during spring, primarily from the west during these seasons.

Figure 5 illustrates the diurnal distribution of winds. The most prominent feature is the south-westerly sea-breeze occurring in the afternoon (midday – 6pm). Winds are strongest during the day (6am – 6pm).

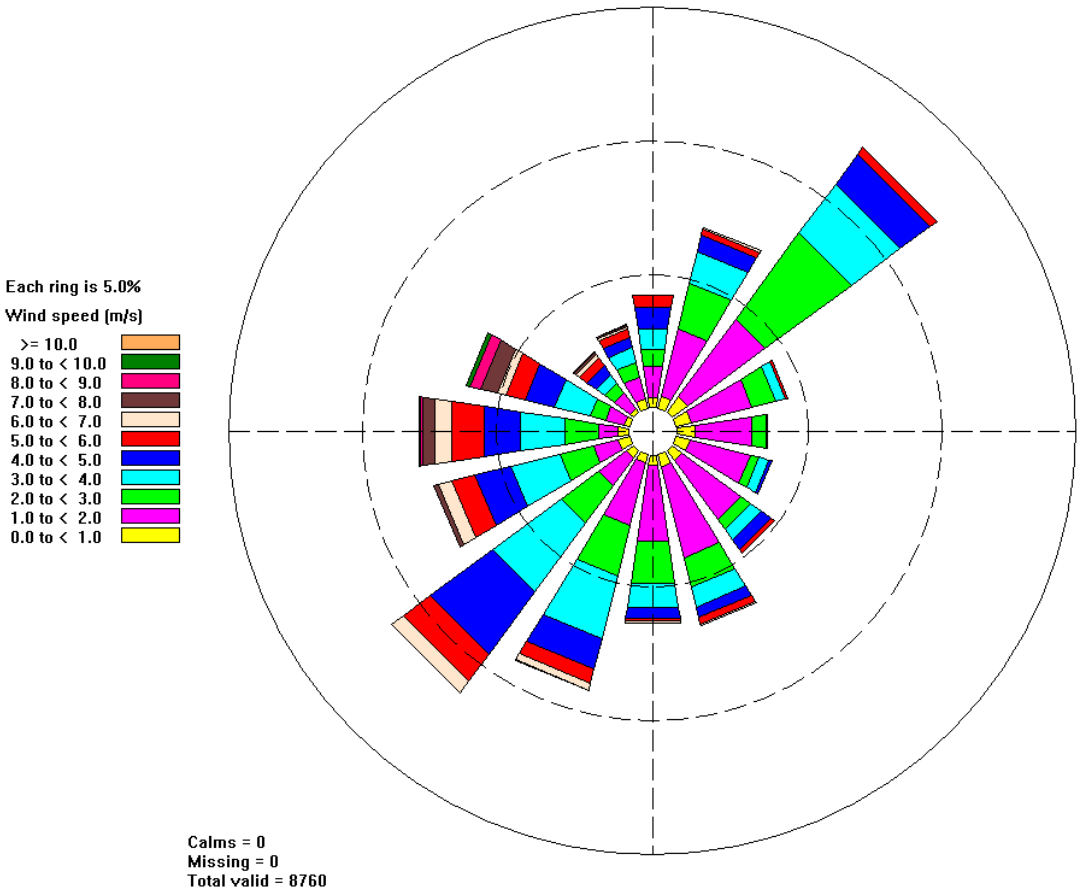

Figure 3 Annual distribution of winds at the project site (CALMET)

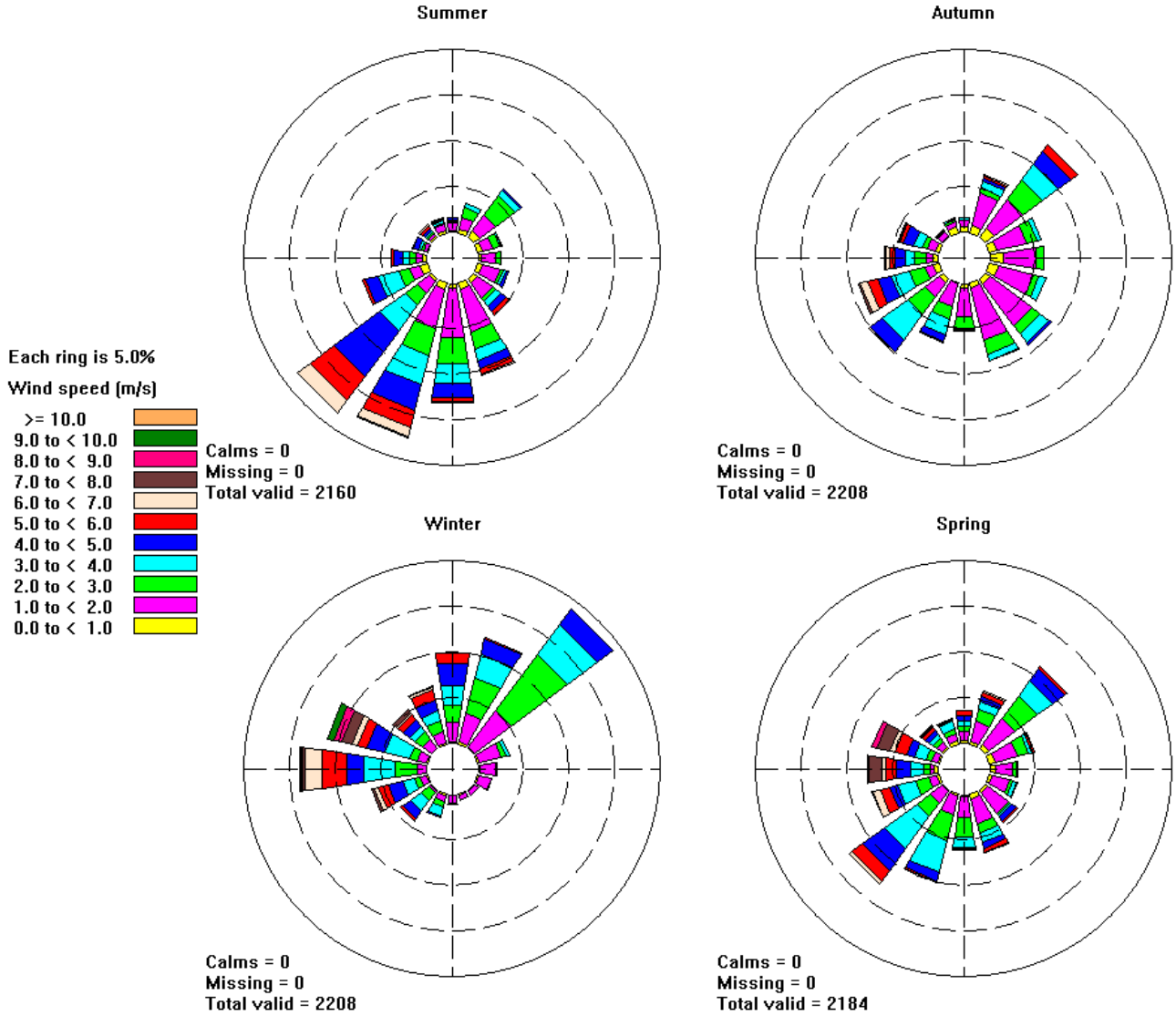

Figure 4 **Seasonal distribution of winds at the project site (CALMET)**

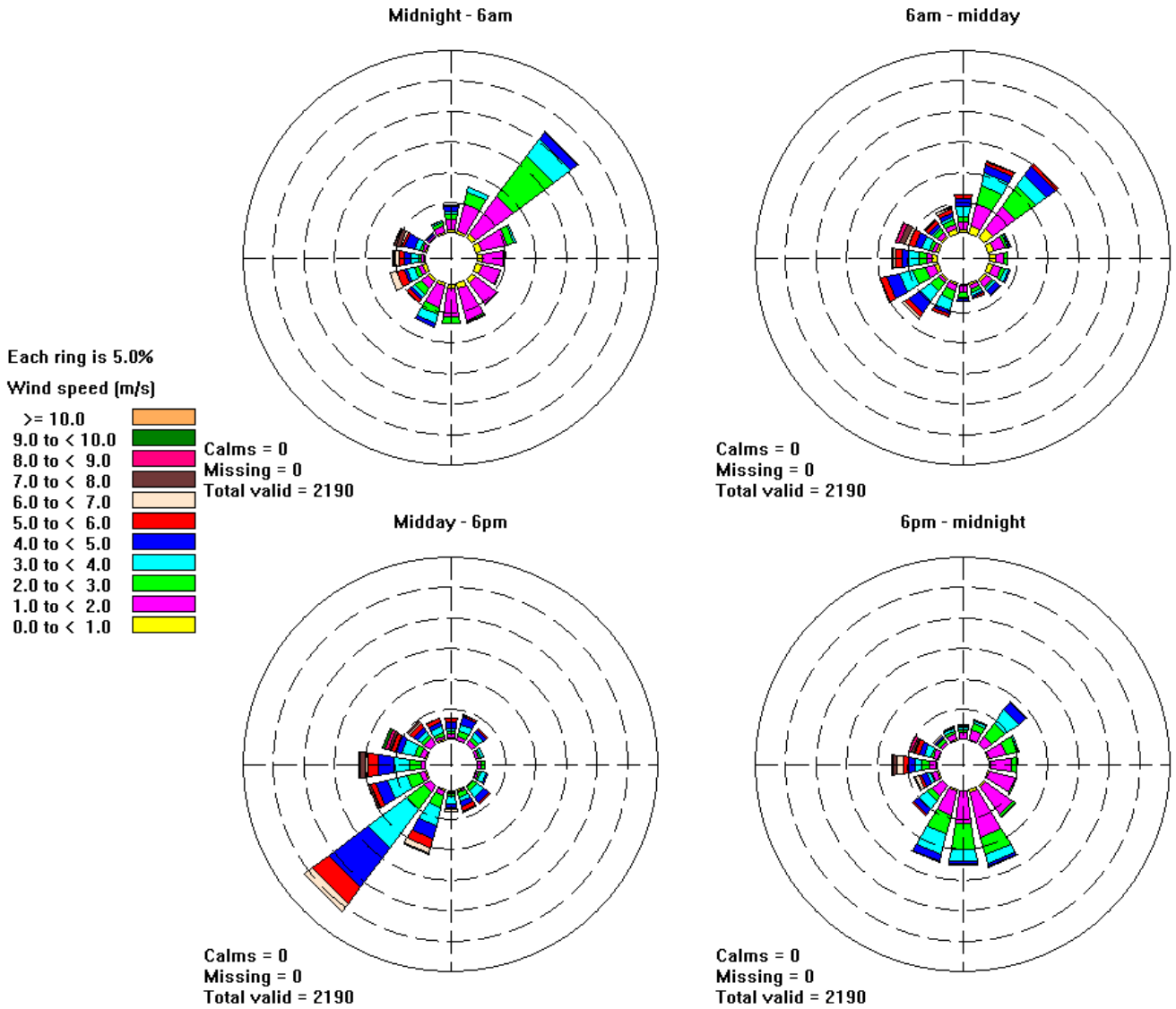

Figure 5 **Diurnal distribution of winds at the project site (CALMET)**

6.2 Atmospheric Stability

Stability classification is a measure of the stability of the atmosphere and can be determined from wind measurements and other atmospheric observations. The stability classes range from A class, which represents very unstable atmospheric conditions that may typically occur on a sunny day to F class stability, which represents very stable atmospheric conditions that typically occur during light wind conditions at night. Unstable conditions (Classes A to C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground. This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion processes for the most frequently occurring Class D conditions are dominated by mechanical turbulence generated as the wind passes over irregularities in the local surface. During the night, the atmospheric conditions are generally stable (often classes E and F).

Table 6 shows the overall percentage of stability classes at the project site, and Figure 6 illustrates the diurnal distribution of stability classes. Class D stability occurs approximately 38% of the time due to moderate wind speeds generated by the site's proximity to the coastline and sea breezes. Class F stability occurs approximately 30% of the time and represents calm nights.

Table 6 Frequency of occurrence (%) of surface atmospheric stability at the project site under the Pasquil-Gifford stability classification scheme (as predicted by CALMET)

Pasquil-Gifford stability class	Classification	Frequency (%)
A	Extremely unstable	1%
B	Unstable	10%
C	Slightly unstable	14%
D	Neutral	38%
E	Slightly stable	7%
F	Stable	30%

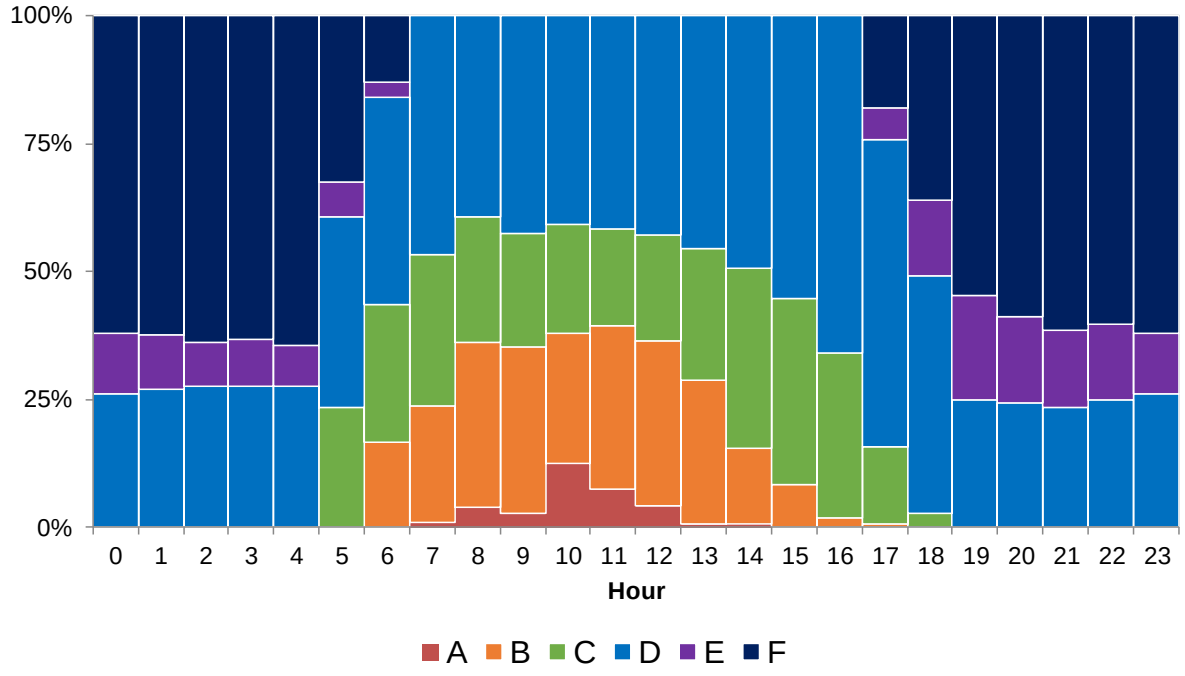

Figure 6 Diurnal distribution of stability classes at the project site

6.3 Mixing height

The mixing height refers to the height above ground within which air pollutants released at or near ground can mix with ambient air. During stable atmospheric conditions, the mixing height is often quite low and dispersion is limited to within this layer. During the day, solar radiation heats the air at the ground level and causes the mixing height to rise. The air above the mixing height during the day is generally cooler. The growth of the mixing height is dependent on how well the air can mix with the cooler upper level air and therefore depends on meteorological factors such as the intensity of solar radiation and wind speed. During strong wind speeds, the air will be well mixed, resulting in a high mixing height.

Mixing height information at the QPSX project site is presented in Figure 7. The data shows that the mixing height develops around 6 am, increases to a peak at 1 to 3 pm before descending rapidly until 6pm.

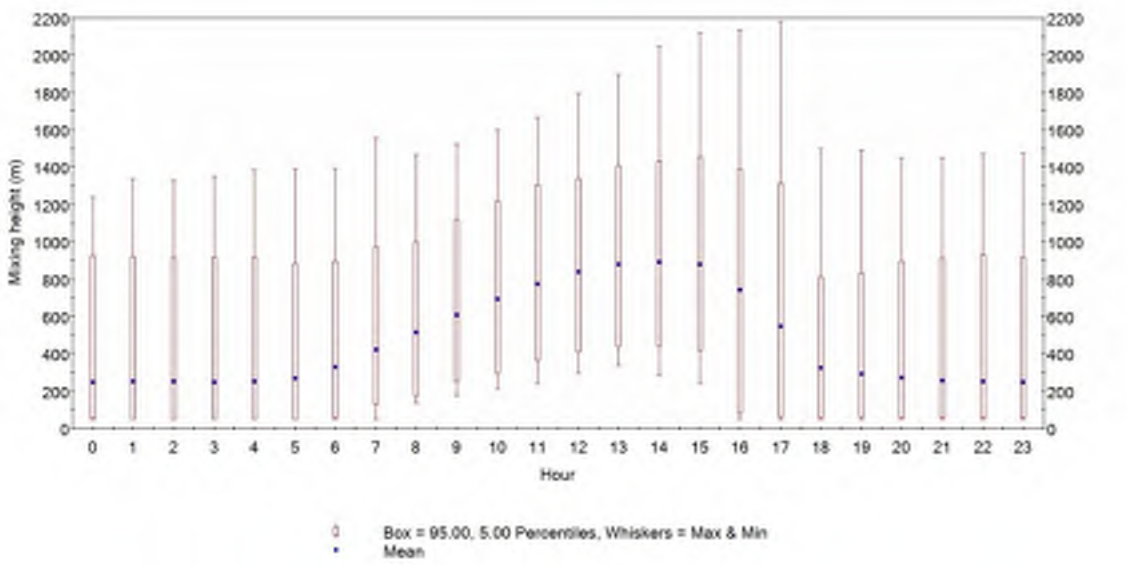

Figure 7 Diurnal profile of modelled mixing height at the project site (CALMET)

7. EMISSIONS TO THE ATMOSPHERE

For this assessment, the following information has been utilised to select emission rates and stack characteristics for dispersion modelling:

- Emission limits specified in the Air Quality EPP
- Manufacturer's specifications or performance guarantees
- Historical stack testing data.

Table 7 presents the stack characteristics and emission rates selected for dispersion modelling. Historical stack testing data for Units 1-5 is presented in Appendix B for reference.

Table 7 Scenario 1 and 2 - stack characteristics and emission rates used in the dispersion modelling of the QPSX project

Parameter	Units	Units 1 – 4 (existing)	Units 1 – 4 (upgraded)	Unit 5 (existing)	Units 6-8 (new)
Stack height[1]	m	18	18	25	30
Diameter[1]	m	2.6	2.6	5.7	3.2
Temperature	°C	526[2]	519.8[1]	470[2]	495[3]
Exit velocity	m/s	25.0[4]	25.0[4]	35[5]	36.3[3]
Actual flow rate	m^3/s	191.7[6]	191.7[6]	1034[8]	302.9[9]
Normalised flow rate	Nm^3/s (0°C, dry, 15% O_2)	59[10]	65.7[10]	390[11]	76.5[12]
Moisture content	%	6.5[13]	4.7[1]	6.3[13]	Not provided
CO_2 concentration	%	3.4[13]	5.1[1]	3.4[13]	Not provided
Oxygen concentration	%	14.9[12]	15.3[1]	15.5[13]	Not provided
NOx (as NO_2)	mg/Nm^3 at 15% O2	70[7]	51[1]	70[7]	51.3[3]
	g/s	4.13[14]	3.35[14]	27.3[15]	3.9[16]

Table notes:
[1] Provided by Origin
[2] Minimum temperature measured in stack tests between 2007 and 2017
[3] Minimum value from information supplied by Origin for four modes of operation
[4] Conservative value, selected to be lower than the expected exit velocity provided by Origin of 36 m/s (which may apply to full load modes of operation only)
[5] Minimum velocity measured in stack tests between 2007 and 2017, less a 5% safety margin
[6] Calculated from provided exhaust flow rate (kg/s) and exhaust density (g/m^3) from exhaust composition breakdown
[7] Air Quality EPP emission limit
[8] Average of values calculated from stack test normalized flow rates and exhaust parameters between 2007 and 2017
[9] Calculated from stack diameter and exit velocity
[10] Calculated from provided exhaust flow rate (kg/s) and exhaust density (g/Nm^3) from exhaust composition breakdown
[11] Maximum measured during stack tests between 2007 and 2017
[12] Calculated from provided NO_x concentration and emission rate
[13] Average of values reported in stack tests between 2007 and 2017
[14] Calculated from 51 mg/Nm^3, exhaust flow rate provided by Origin, and exhaust composition by weight.
[15] Calculated from maximum flow rate from stack tests between 2007 and 2017 and assumed NO_x concentration
[16] Maximum value from information supplied by Origin for four modes of operation.

8. RESULTS

This section presents the results of the dispersion modelling assessment of NO_2 emissions from the QPSX project. The predicted ground-level concentrations of NO_2 across the model domain due to the QPSX project are presented in Plates 1 to 4. The maximum predicted ground-level concentration of NO_2 outside the QPSX project site boundary are summarised in Table 8 and Table 9 for scenarios 1 and 2.

The results show that:

- The ground-level concentrations of NO_2 due to the QPSX project including an ambient background concentration ***comply*** with the air quality criteria across the model domain.
- The ground-level concentrations of NO_2 including a conservative ambient background concentration are predicted to be at most 34% of the air quality criteria.
- Ground-level concentrations of NO_2 due to QPSX project are predicted to be marginally lower after the upgrade of Units 1-4.
- The QPSX project is unlikely to adversely impact air quality at sensitive receptors in the vicinity.

Table 8 Scenario 1 - Maximum predicted ground-level concentrations of NO_2 outside the QPSX project site boundary (µg/m^3)

Averaging period	Maximum predicted ground-level concentrations of NO_2 outside the QPSX project site boundary				Air quality criteria
	Project in Isolation	% of air quality criteria	Project plus background	% of air quality criteria	
1-hour average NO_2	48.3	19%	85.9	34%	**250 µg/m^3**
Annual average NO_2	0.5	0.8%	15.1	24%	**60 µg/m^3**

Table 9 Scenario 2 - Maximum predicted ground-level concentrations of NO_2 outside the QPSX project site boundary (µg/m^3)

Averaging period	Maximum predicted ground-level concentrations of NO_2 outside the QPSX project site boundary				Air quality criteria
	Project in Isolation	% of air quality criteria	Project plus background	% of air quality criteria	
1-hour average NO_2	42.6	17%	80.2	32%	**250 µg/m^3**
Annual average NO_2	0.5	0.7%	15.1	24%	**60 µg/m^3**

9. LIMITATIONS

This study necessarily relies on the accuracy of a number of data sets including, but not limited to:

- Meteorological information;
- Calculation of emission rates; and
- Characterisation of ambient NO_2 levels.

Where uncertainty exists in important properties of the QPSX project, the assessment has erred on the side of caution and conservative inputs have been selected.

Some uncertainty exists in the selection of emissions data from the provided information. It is possible that the characteristics do not cover all operating scenarios (e.g. lower loads). Parameters have been selected to provide a conservative estimate of emission characteristics where possible.

Some uncertainty exists in the selection of emissions data from stack test reports for Unit 5. Whilst the worst-case parameters have been selected, it is possible that the stack tests do not reflect all possible modes of operation of Unit 5 and may therefore not reflect the potential worst-case operating scenario for this unit. However, the use of the Air Quality EPP emission limit of 70 mg/Nm^3 to calculate emissions from this unit helps to mitigate this uncertainty, as measured concentrations have typically been less than half this value.

Alternative methods exist for estimating the concentration of NO_2 generated by the conversion of NO_x as the plume disperses. However, due to the magnitude of the predicted ground-level concentrations in the assessment, the use of a more detailed method than a 30% conversion is unlikely to impact the outcome of the assessment.

The assessment has considered emissions of nitrogen dioxide only. Nitrogen dioxide is considered to be the key indicator for air quality impacts from the power station, with emissions of carbon monoxide, particulates and other air pollutants typically being relatively small in comparison. This has been demonstrated by previous dispersion modelling of proposed expansion options for the facility (Katestone, 2012) in which predicted ground-level concentrations of NO_2 were found to be approximately 20-40% of the maximum concentration criteria, and all other pollutants, including CO, were found to be less than 3% of their respective maximum concentration criteria.

It is also important to note that numerical models are based on an approximation of governing equations and will inherently be associated with some degree of uncertainty. The more complex the physical model, the greater the number of physical processes that must be included.

There will be physical processes that are not explicitly accounted for in the model and, in general, these approximations tend to lead to an over prediction of air pollutant levels.

Overall, whilst there are a number of limitations and assumptions associated with this study, given the magnitude of the predicted ground-level concentrations of NO_2 (which are at most, 30% of the air quality criteria with the inclusion of a conservative ambient background) these features are unlikely to impact the outcome of the assessment.

10. CONCLUSIONS

Katestone Environmental Pty Ltd (Katestone) was commissioned by Origin Energy Power Pty Ltd (Origin) to complete an Air Quality Assessment of the Quarantine Power Station on Torrens Island, Adelaide. The assessment is to support a Development Application for the Quarantine Power Station Expansion (QPSX project) considering the following changes to the power station:

- The staged replacement of gas turbine within Units 1-4 over the next three to four years
- The proposed expansion of the power station with the addition of up to three new units (nominal capacity of 160 – 180 MW).

The Air Quality Assessment has used a dispersion modelling approach. A site-specific meteorological data file has been generated using the TAPM and CALMET meteorological models. The meteorological modelling has accounted for local terrain and land use features of the surrounding region.

Emission rates and stack characteristics have been determined from the manufacturer's specifications, emission limits, and emissions information provided by Origin. Emission rates and stack characteristics of the proposed units have been selected to provide a worst-case estimate of the potential impact of the expanded power station on air quality. Dispersion modelling scenarios have also been selected to reflect the possible timings of the proposed expansion project and the upgrade of the gas turbines on existing Units 1-4, which may occur before or after the installation of the three additional units.

The CALPUFF dispersion model has been used to predict ground-level concentrations of nitrogen dioxide due to the proposed operations of the Quarantine Power Station, including the replacement of the existing gas turbines on Units 1-4 and the addition of three new generating units.

The Air Quality Assessment has shown that ground-level concentrations of nitrogen dioxide due to the QPSX project ***comply*** with the air quality criteria at all locations across the model domain outside the Quarantine Power Station site boundary. The predicted ground-level concentrations of nitrogen dioxide have included a conservative estimate of the ambient background levels of nitrogen dioxide. The maximum cumulative concentrations were predicted to be, at most, 34% of the air quality criteria.

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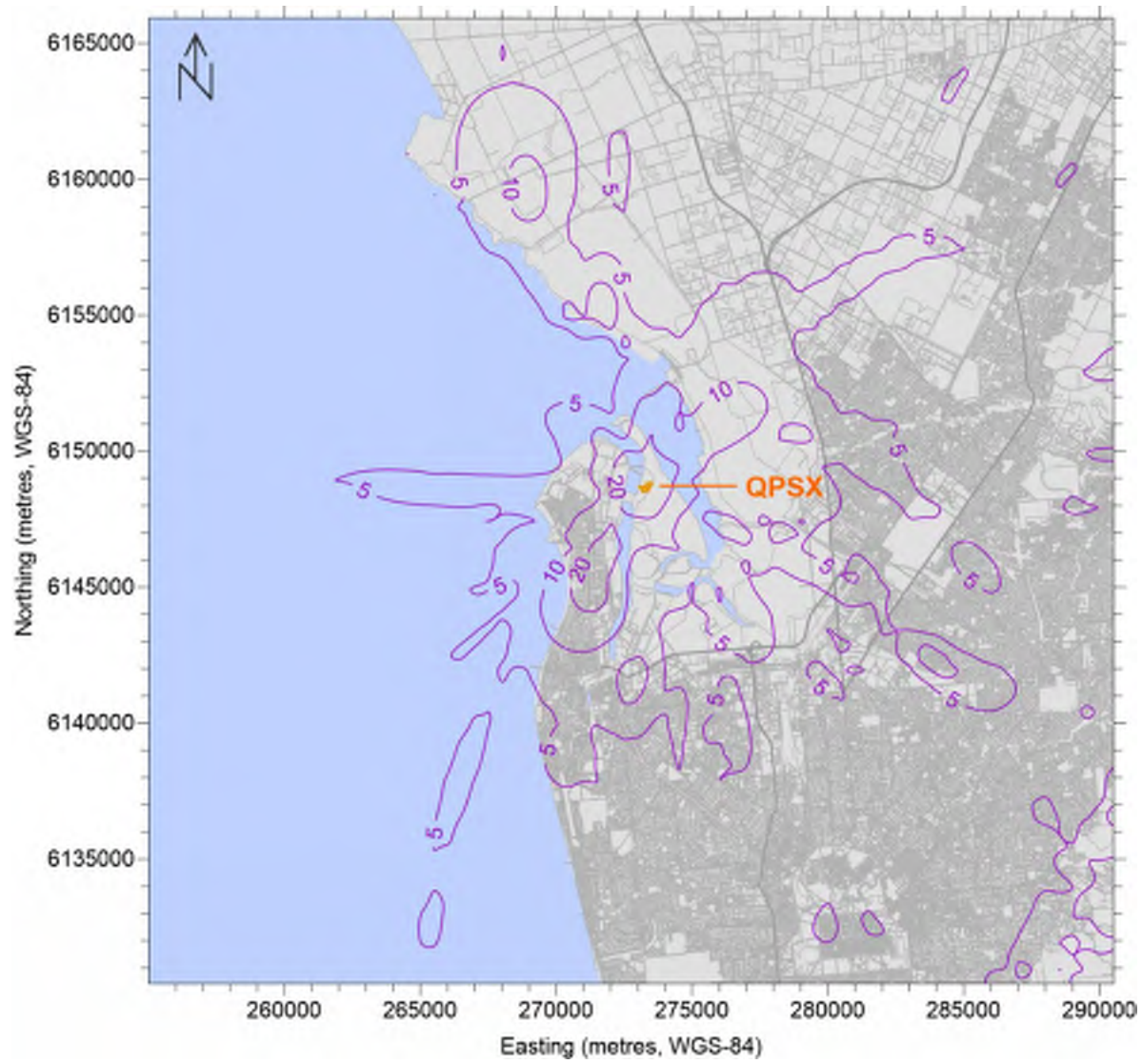

Plate 1 **Scenario 1 - Maximum 1-hour average ground-level concentration of NO_2 due to the existing Units 1-4, Unit 5 and the QPSX project in isolation**

Location: Torrens Island, SA	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Maximum contour	**Maximum concentration criteria:** 250 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

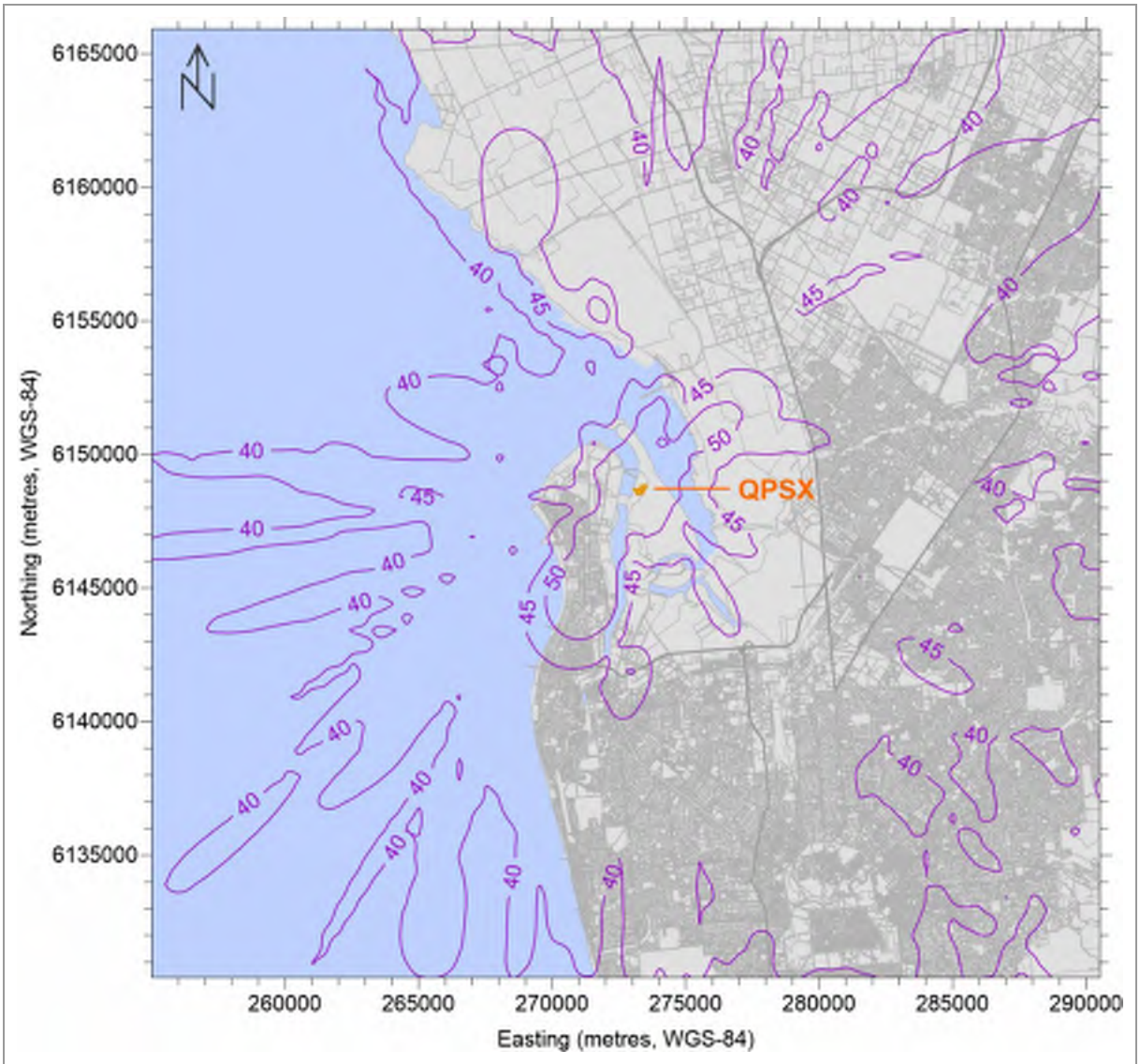

Plate 2 **Scenario 1 - Maximum 1-hour average ground-level concentration of NO_2 due to the existing Units 1-4, Unit 5 and the QPSX project plus an ambient background concentration of 37.6 µg/m³**

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-hour	CALPUFF	µg/m³
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Maximum contour	250 µg/m³	Tania Haigh	December 2017

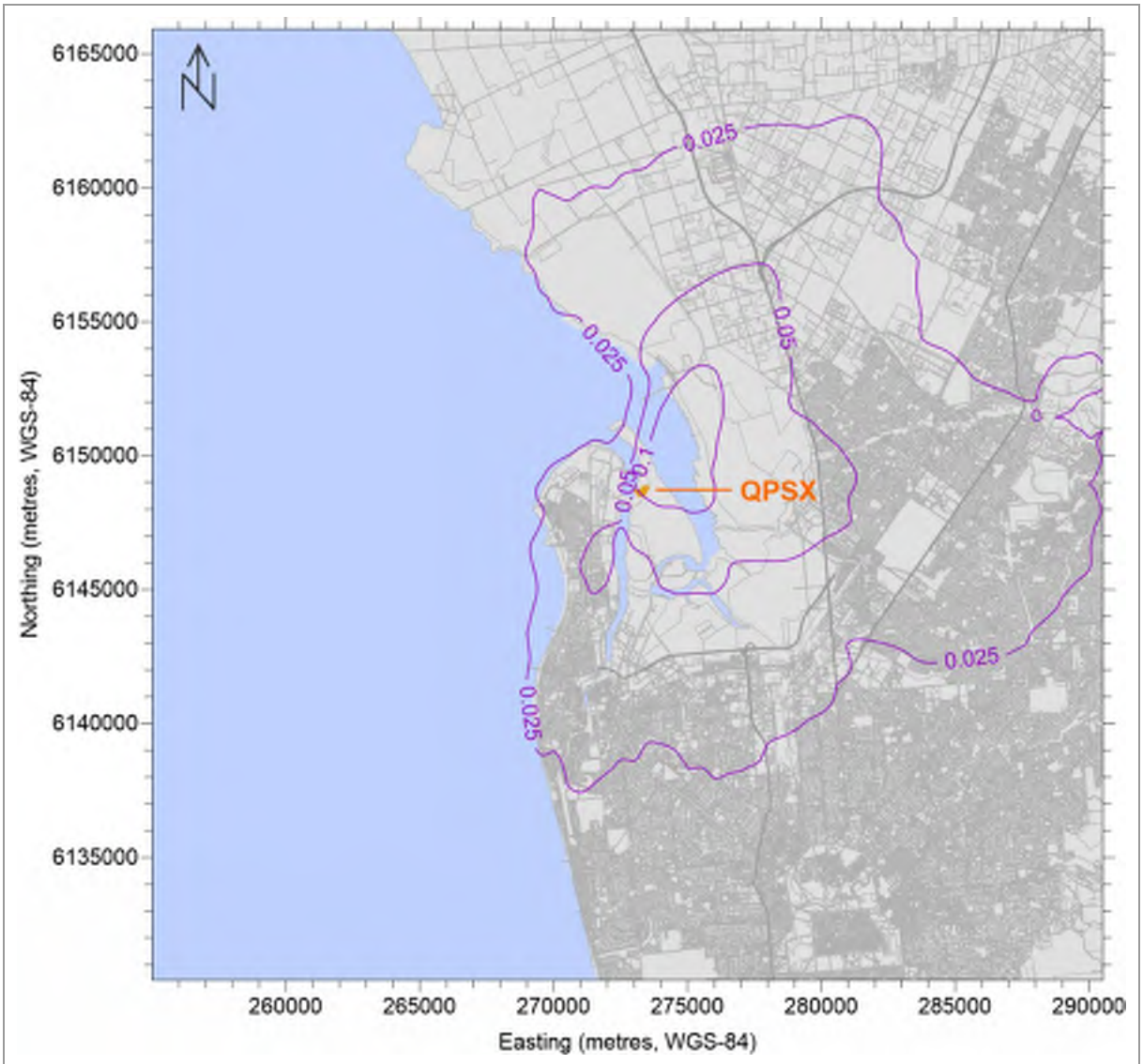

Plate 3 **Scenario 1 - Annual average ground-level concentration of NO_2 due to the existing Units 1-4, Unit 5 and the QPSX project in isolation**

Location: Torrens Island, SA	**Averaging period:** 1-year	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Average contour	**Maximum concentration criteria:** 60 µg/m^3	**Prepared by:** Tania Haigh	**Date:** December 2017

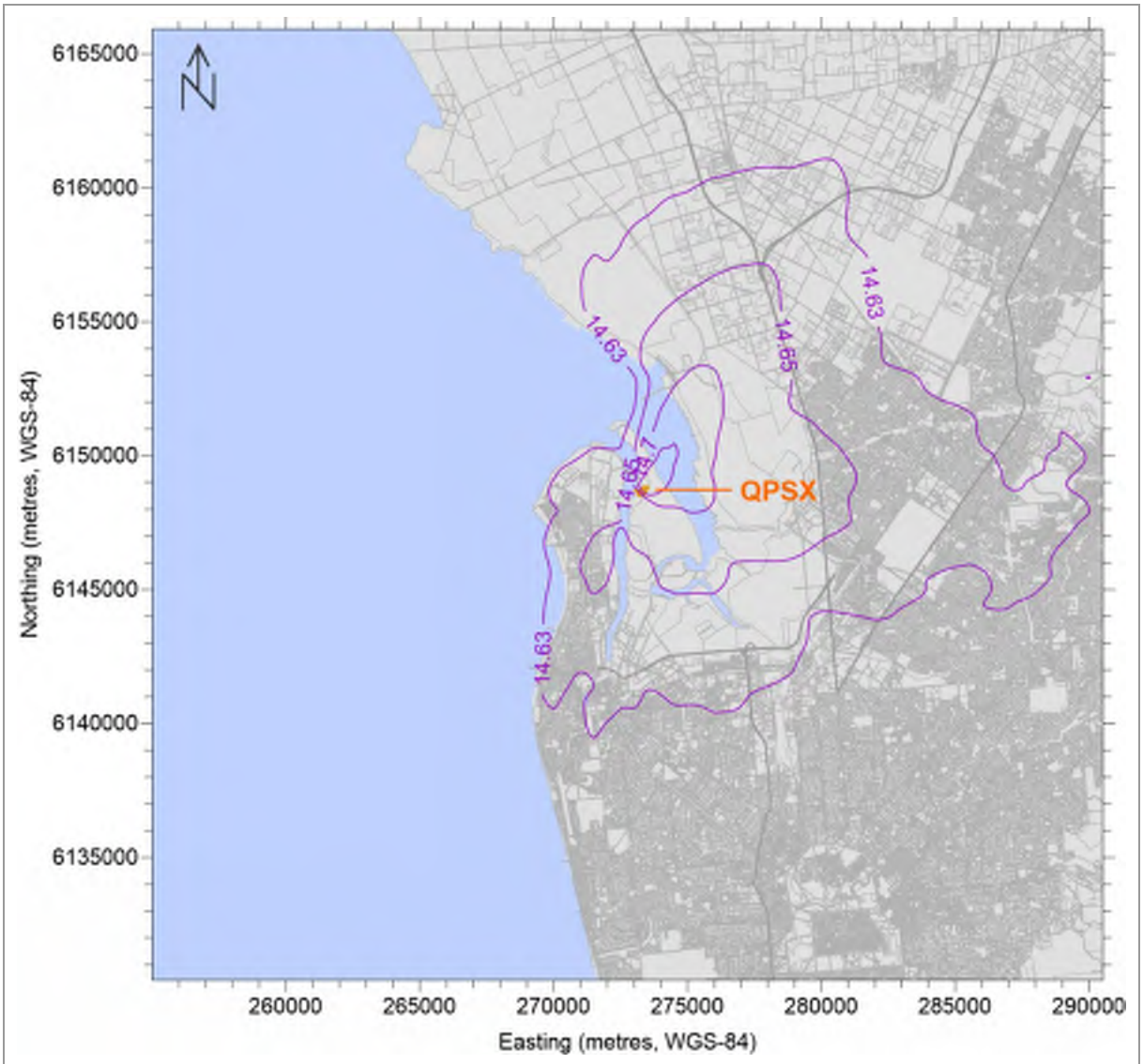

Plate 4 **Scenario 1 - Annual average ground-level concentration of NO_2 due to the existing Units 1-4, Unit 5 and the QPSX project plus an ambient background concentration of 14.6 µg/m³**

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-year	CALPUFF	µg/m³
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Average contour	60 µg/m³	Tania Haigh	December 2017

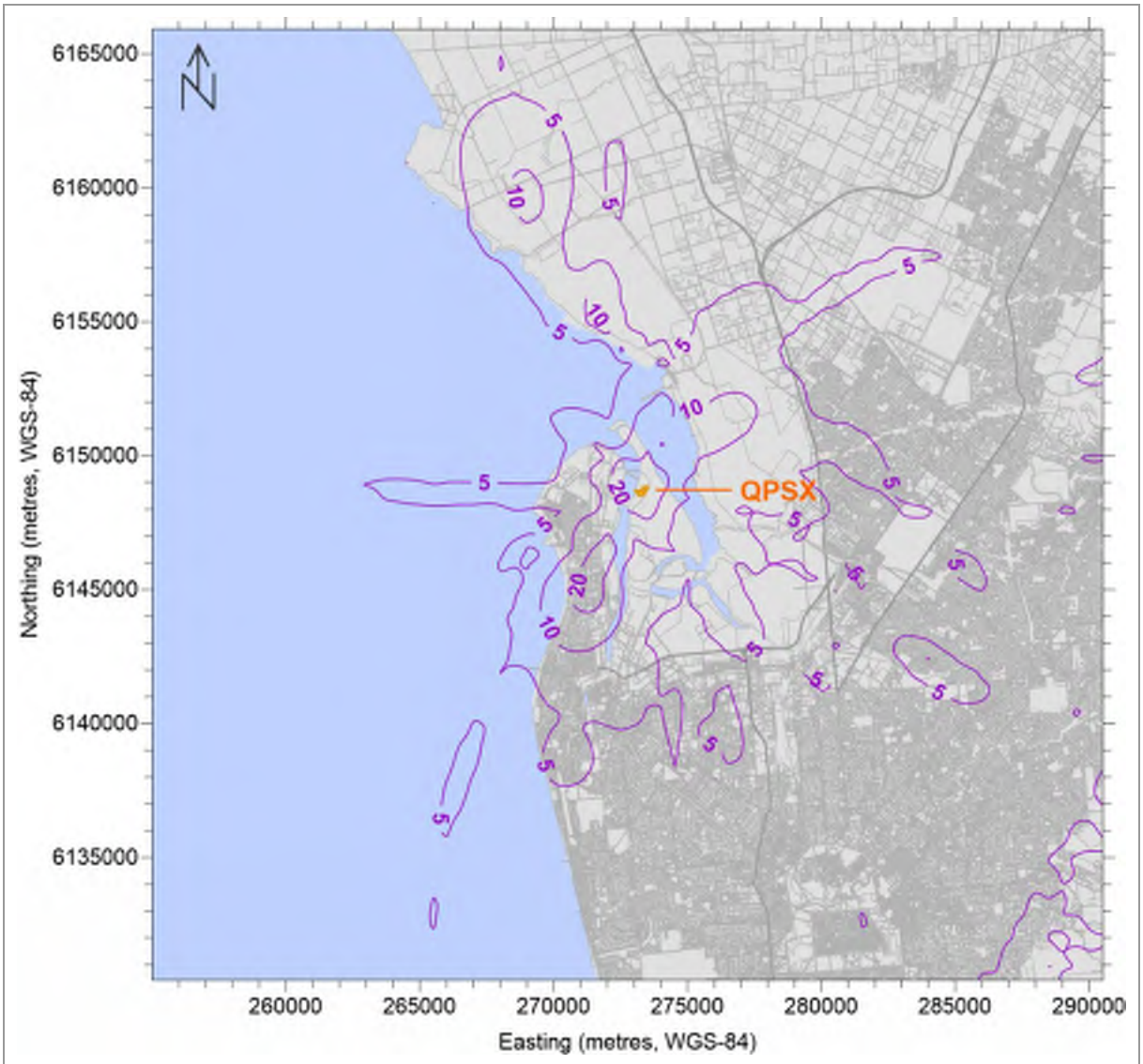

Plate 5 **Scenario 2 - Maximum 1-hour average ground-level concentration of NO_2 due to the upgraded Units 1-4, Unit 5 and the QPSX project in isolation**

Location: Torrens Island, SA	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Maximum contour	**Maximum concentration criteria:** 250 µg/m^3	**Prepared by:** Tania Haigh	**Date:** December 2017

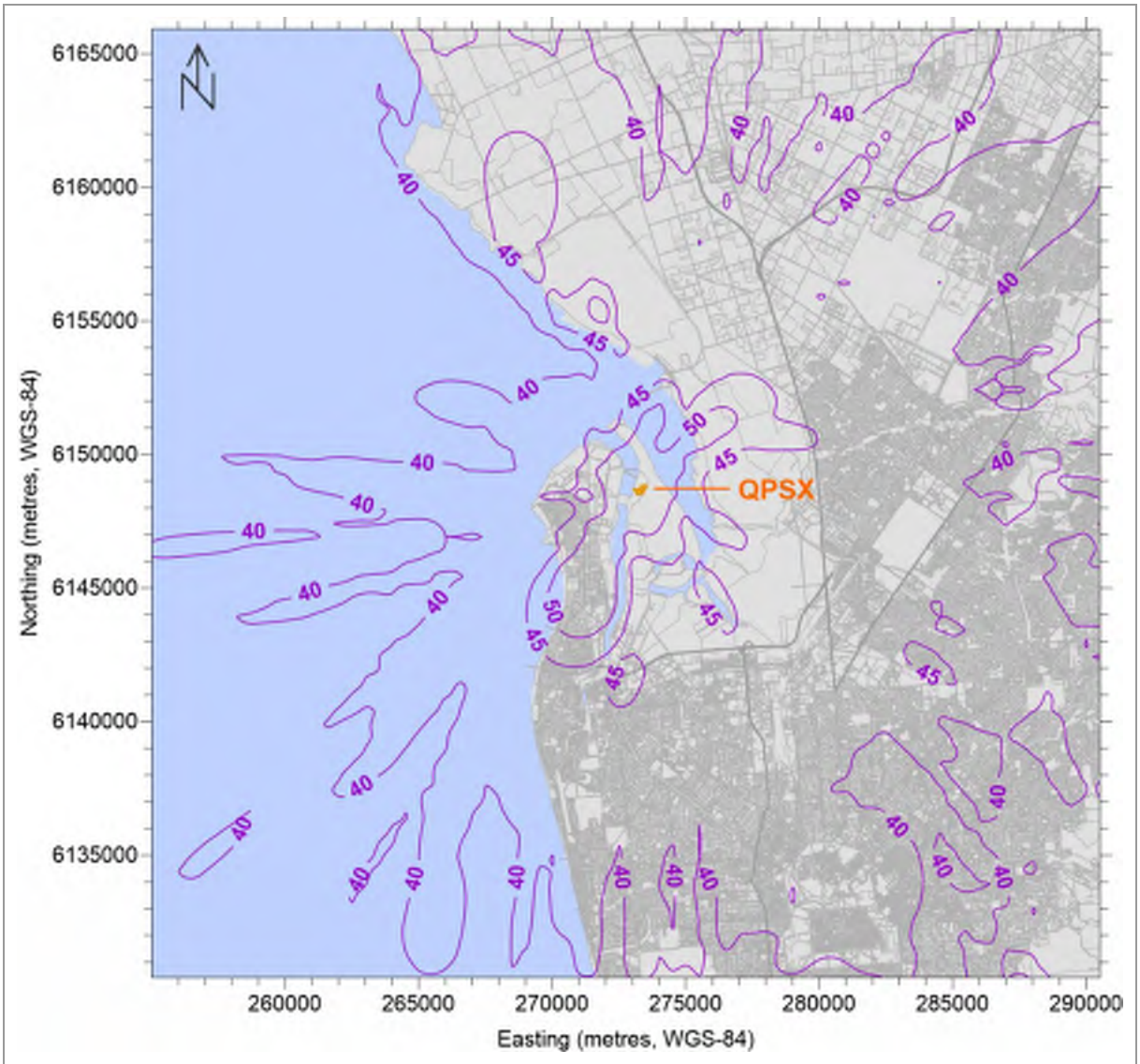

Plate 6 **Scenario 2 - Maximum 1-hour average ground-level concentration of NO_2 due to the upgraded Units 1-4, Unit 5 and the QPSX project plus an ambient background concentration of 37.6 µg/m³**

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-hour	CALPUFF	µg/m³
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Maximum contour	250 µg/m³	Tania Haigh	December 2017

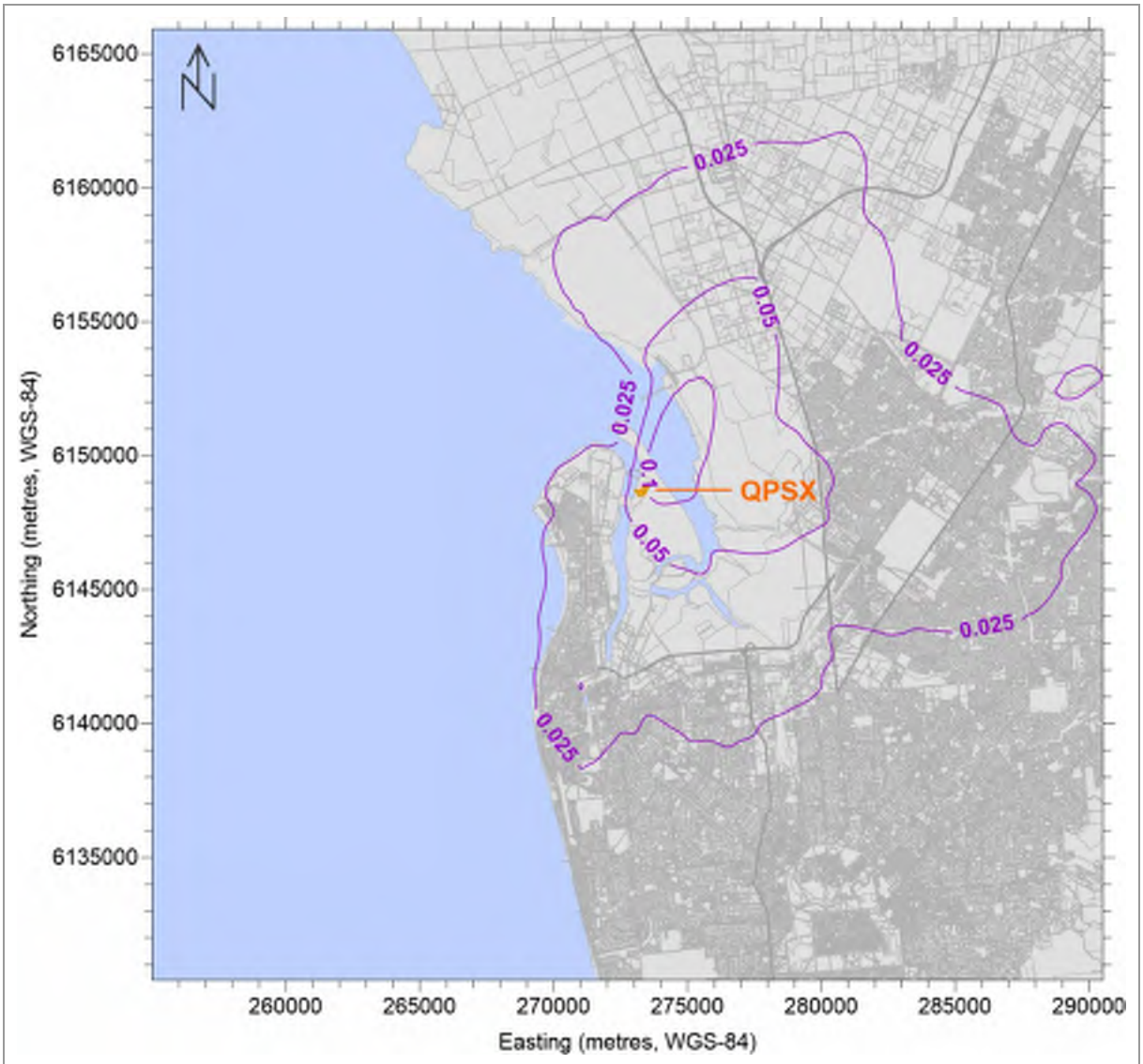

Plate 7 **Scenario 2 - Annual average ground-level concentration of NO_2 due to the upgraded Units 1-4, Unit 5 and the QPSX project in isolation**

Location: Torrens Island, SA	**Averaging period:** 1-year	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Average contour	**Maximum concentration criteria:** 60 µg/m^3	**Prepared by:** Tania Haigh	**Date:** December 2017

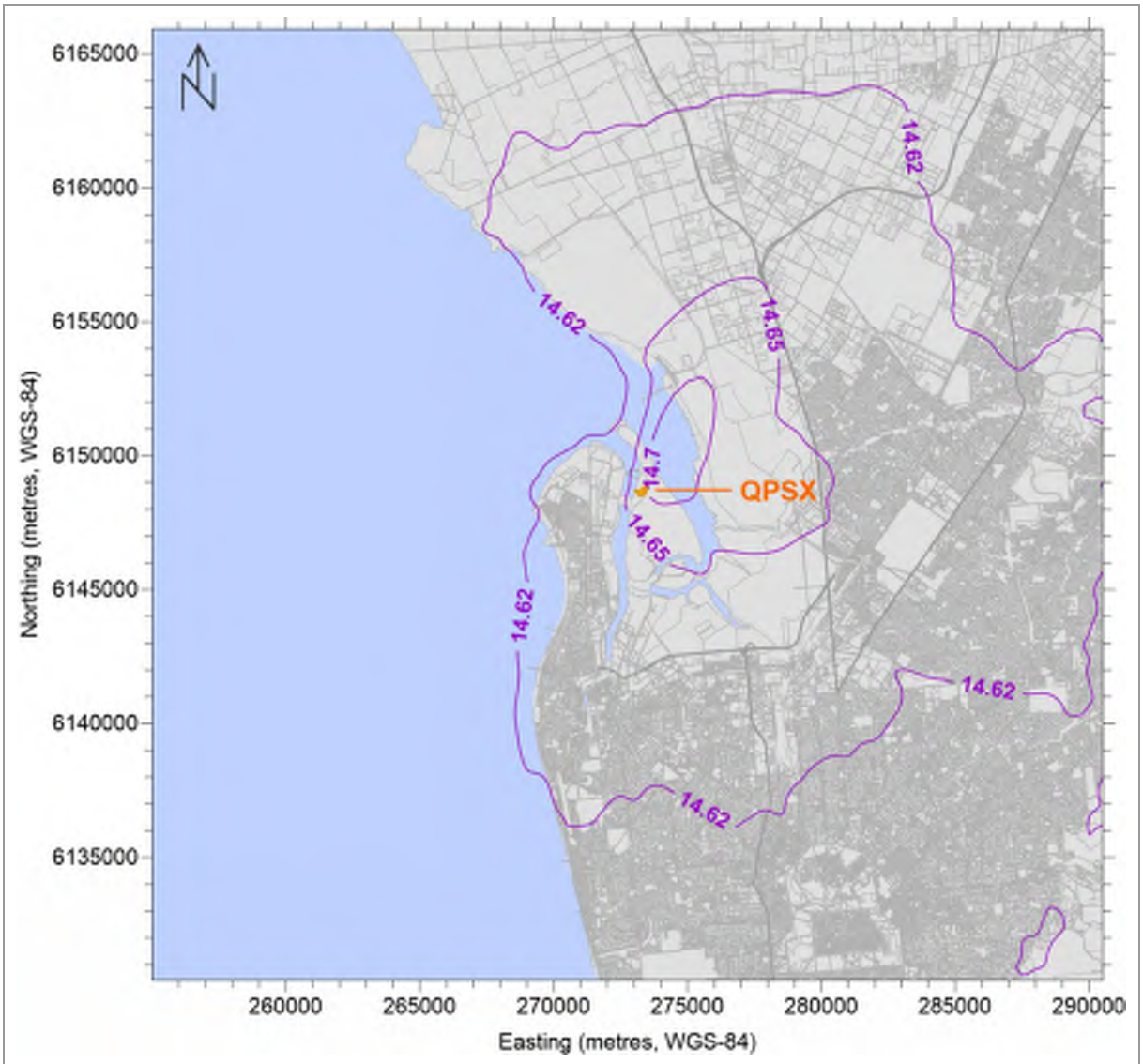

Plate 8 **Scenario 2 - Annual average ground-level concentration of NO_2 due to the upgraded Units 1-4, Unit 5 and the QPSX project plus an ambient background concentration of 14.6 µg/m³**

Location: Torrens Island, SA	**Averaging period:** 1-year	**Data source:** CALPUFF	**Units:** µg/m³
Type: Average contour	**Maximum concentration criteria:** 60 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

APPENDIX A METEOROLOGICAL AND DISPERSION MODELLING METHODOLOGY

A1 METEOROLOGY

A1.1 TAPM meteorology

The meteorological model TAPM has been validated by the CSIRO, Katestone Environmental and others for many locations in Australia, in southeast Asia and in North America (CSIRO, 2008). Katestone has used the TAPM model throughout Australia as well as in parts of America, Bangladesh, New Caledonia and Vietnam. This model has performed well for simulating regional winds patterns. TAPM has proven to be a useful model for simulating meteorology in locations where monitoring data is unavailable.

TAPM is a prognostic meteorological model which predicts the flows important to regional and local scale meteorology, such as sea breezes and terrain-induced flows from the larger-scale meteorology provided by the synoptic analyses. TAPM solves the fundamental fluid dynamics equations to predict meteorology at a mesoscale (20 km to 200 km) and at a local scale (down to a few hundred metres [m]). TAPM includes parameterisations for cloud/rain micro-physical processes, urban/vegetation canopy and soil, and radiative fluxes.

TAPM requires synoptic meteorological information for the region. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data were supplied on a grid resolution of approximately 75 km, and at elevations of 100 m to 5 km above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

The year 2009 was used for meteorological modelling, based on advice from EPA.

TAPM was configured as follows:

- Modelling period for one year from 1 January to 2009 December 2009;
- 40 x 40 grid point domain with an outer grid of 30 km and nesting grids of 10 km, 3 km and 1 km;
- 25 vertical levels;
- Grid centred near the QPSX project site (latitude –34° 47.0', longitude 138° 31.0');
- Geoscience Australia 9 second DEM terrain data;
- Land cover data based on TAPM's default landuse database and edits based on a comparison against aerial imagery;
- Default options selected for advanced meteorological inputs; and
- No data assimilation.

A1.2 Comparison of TAPM output with observational data

The model validation in the following sections compares observational meteorological data from the SA EPA's ambient monitoring site at Le Fevre with data derived from running TAPM.

Table A1 presents statistical comparisons of TAPM output (wind speed and temperature) to meteorological data recorded at the automatic weather station located at the exploration camp for the CCMP. Figure A1 shows probability density functions that graphically compare statistical distributions of meteorological parameters between the TAPM output and observational data. The TAPM output was extracted from the closest inner grid point to the location of the automatic weather station.

The following statistical measures of model accuracy are presented in the tables.

The mean bias, which is the mean model prediction minus the mean observed value. Values of the mean bias close to zero show good prediction accuracy.

The root mean square error (RMSE), which is the standard deviation of the differences between predicted values and observed values. The RMSE is non-negative and values of the RMSE close to zero show good prediction accuracy. The RMSE is given by:

$$\mathrm{RMSE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}$$

where N is the number of observations, P_i are the hourly model predictions and O_i are the hourly observations

The index of agreement (IOA), which takes a value between 0 and 1, with 1 indicating perfect agreement between predictions and observations. The IOA is calculated following a method described in Willmott (1982), using the equation

$$\mathrm{IOA} = 1 - \frac{\sum_{i=1}^{N}(P_i - O_i)^2}{\sum_{i=1}^{N}(|P_i - O_{mean}| + |O_i - O_{mean}|)^2}$$

where N is the number of observations, P_i are the hourly model predictions, O_i are the hourly observations and O_{mean} is the observed observation mean.

The predicted wind speeds are within the benchmarks for performance and are therefore representative of the area. There temperature bias is larger than the benchmark, however, the index of agreement is within the benchmark range, and the mean and range of predicted temperatures is similar to the observed temperatures. The probability density functions illustrate reasonable agreement between predicted and observed meteorological data.

Table A1 A comparison of the observed meteorological data with the first-level TAPM output

Statistic	"Good" value	Wind speed			Temperature		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Mean	-	-	3.2	2.9	-	17.7	16.9
Standard deviation	-	-	1.8	1.7	-	6.1	5.8
Minimum	-	-	0.0	0.0	-	3.2	5.0

Statistic	"Good" value	Wind speed			Temperature		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Maximum	-	-	10.5	9.8	-	43.5	40.3
Bias	0	<±0.5 m/s	0.3		<±0.5 °C	0.8	
Root mean square error (RMSE)	Close to 0	<2 m/s	1.1		-	2.0	
Index of agreement	Close to 1	>0.6	0.89		≥0.8	0.97	

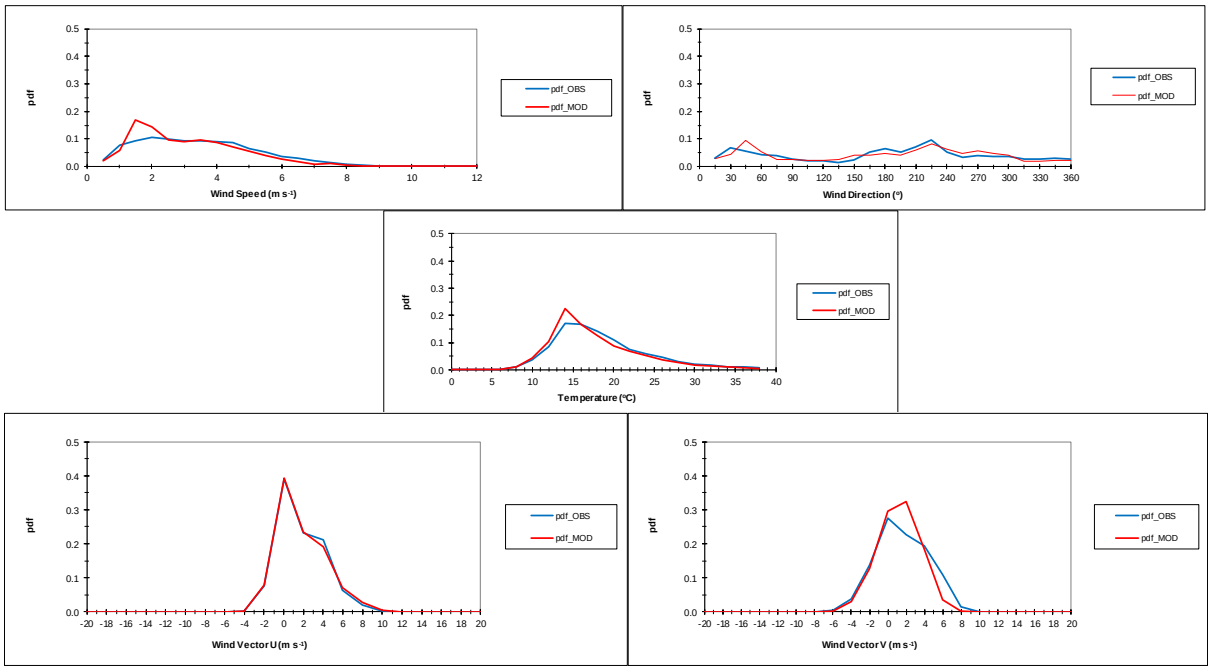

Figure A1 **Probability density functions (pdfs) comparing observational data (blue) with TAPM data (red) at the SA EPA Le Fevre monitoring station**

A1.3 CALMET meteorological modelling

CALMET is an advanced non-steady-state diagnostic 3D meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data as data assimilation from multiple sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET (version 6.5.0) was used to simulate meteorological conditions in the region. The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the 3km grid. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

CALMET was set up with twelve vertical levels with heights at 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600, 4600 metres at each grid point.

All default options and factors were selected except where noted below.

Key features of CALMET used to generate the wind fields are as follows:

- 72 x 72 grid point domain with a spacing of 0.5 km
- 365 days (1 January 2009 to 31 December 2009)
- No observations mode, with prognostic wind fields generated by TAPM input as MM5/3D.dat at surface and upper air for "initial guess" field
- No extrapolation of surface wind observations
- Maximum search radius in averaging process set to 4 grid cells
- Terrain radius of influence set at 2 km
- No data assimilation.

A2 CALPUFF DISPERSION MODELLING

CALPUFF simulates the dispersion of air pollutants to predict ground-level concentration and deposition rates across a network of receptors spaced at regular intervals, and at identified discrete locations. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the 3D meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal.

CALPUFF takes into account the geophysical features of the study area that affects dispersion of pollutants and ground-level concentrations of those pollutants in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long-range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 72 by 72 grids at 0.5 km spacing, equivalent to the domain defined in CALMET

- 365 days modelled (1 January 2013 to 31 December 2013)
- Gridded 3D hourly-varying meteorological conditions generated by CALMET
- Partial plume path adjustment for terrain modelled
- No chemical transformation or deposition
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables
- Stack tip downwash, transitional plume rise and PDF used for dispersion under convective conditions.

All other options set to default.

Source coordinates are presented in Table A2.

Table A2 Source coordinates used in the dispersion modelling

Unit	Easting (metres, WGS-84)	Northing (metres, WGS-84)
Unit 1	273245	6148679
Unit 2	273275	6148654
Unit 3	273304	6148629
Unit 4	273336	6148604
Unit 5	273391	6148663
Unit 6	273410	6148812
Unit 7	273415	6148787
Unit 8	273419	6148762

APPENDIX B STACK TEST DATA

B1 NO_X CONCENTRATIONS AND EMISSION RATES

Figure B1 presents the measured NO_x concentrations for each unit, as reported in stack test reports from 2007. With the exception of 2007, all test results have complied with the Air EPP emission limit of 70 mg/Nm^3 (15% O_2). Calculated NO_x emission rates from Units 1-4 (presented in Figure B2) have average around 2-3 g/s, again with the exception of higher results in 2007. NO_x emissions from GT5 have ranged up to 6 g/s until 2017, when over 10 g/s was calculated.

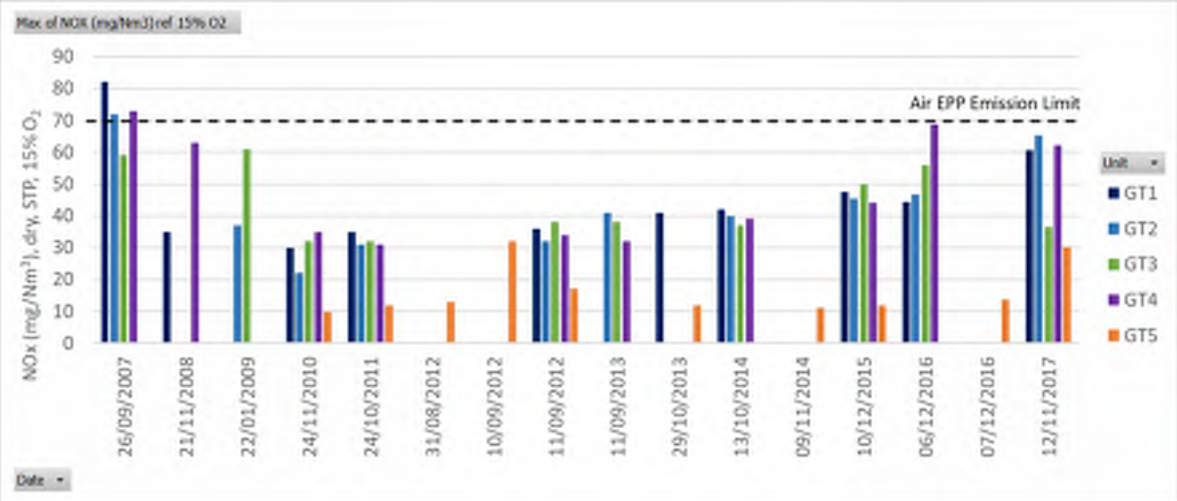

Figure B1 **NO_x concentrations as reported in annual stack test monitoring reports (mg/Nm^3, 15% O_2)**

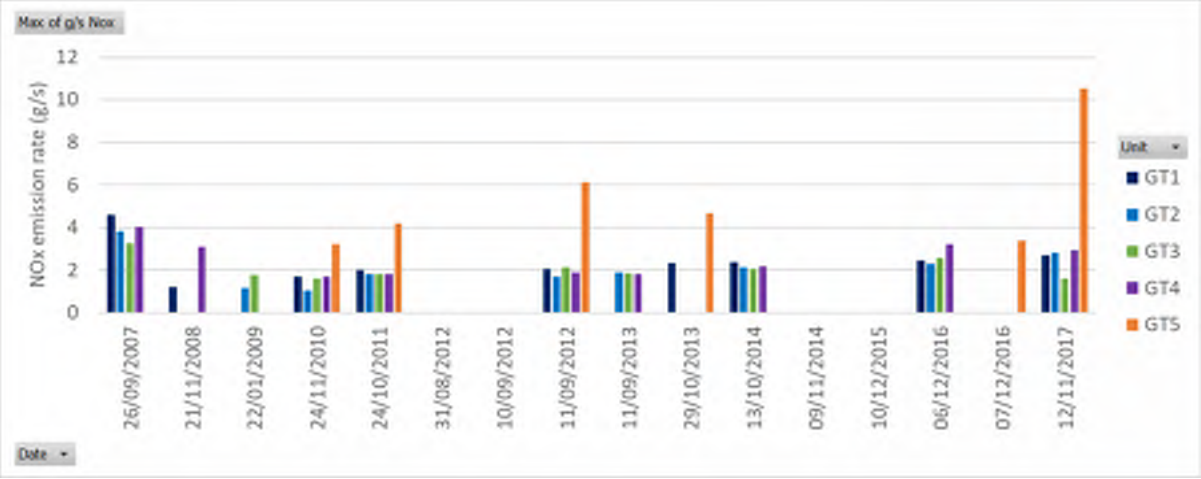

Figure B2 **NO_x emission rates calculated from annual stack test monitoring reports (g/s)**

Figure B3 presents exhaust temperatures measured for each unit since 2007. Exhaust temperatures for Units 1-5 have remained consistent, ranging from 520 °C to approximately 550 °C. Exhaust temperature for Unit 5 have exhibited a wide range, with measurements from approximately 470 °C to 550 °C.

Figure B4 presents exit velocities reported for each unit since 2007. Exit velocities for Units 1-4 have ranged from 26 m/s to 34 m/s, while exit velocities for Unit 5 have ranged from 37 m/s to 46 m/s.

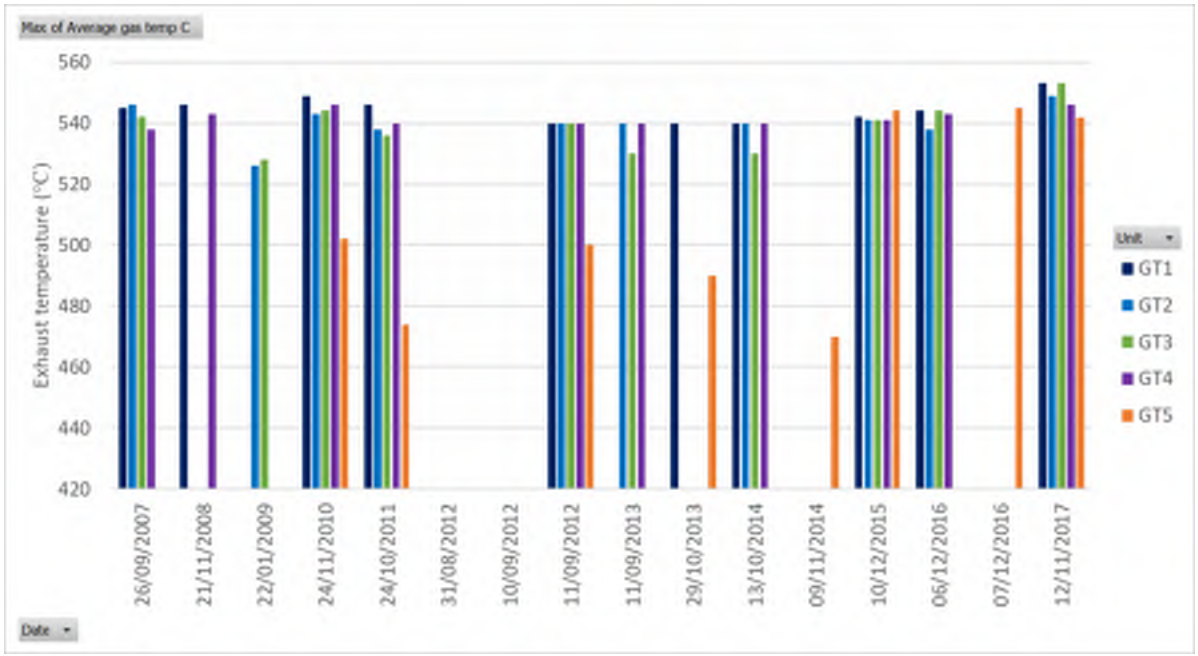

Figure B3 Exhaust temperatures as reported in annual stack test monitoring reports (°C)

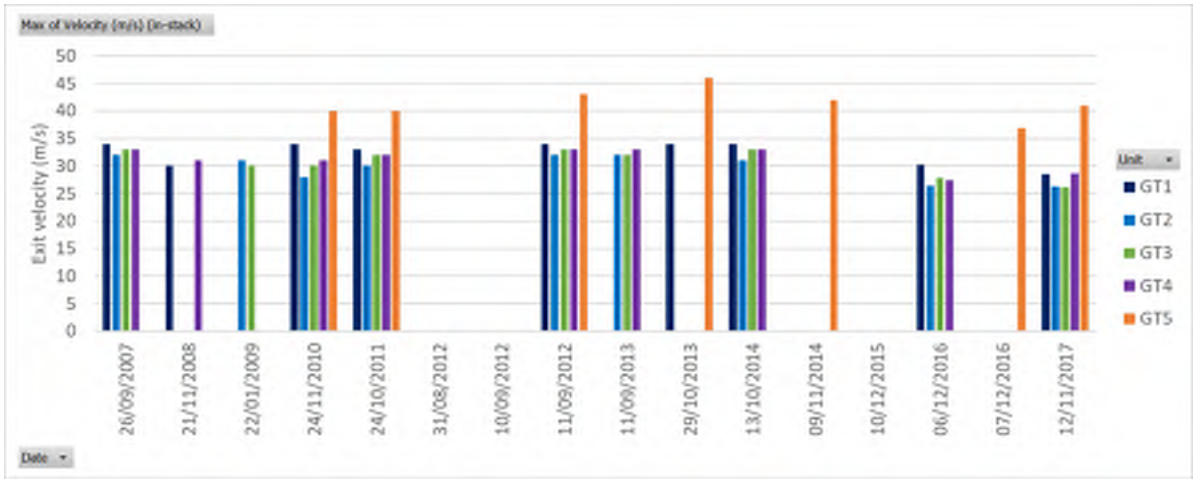

Figure B4 Exit velocity as reported in annual stack test monitoring reports (m/s)

Figure B5 presents the normalised flow rates for each unit as reported in annual stack test monitoring reports since 2007. For Units 1-4, these have ranged from 43 to 57 Nm^3/s (15% O_2). For GT5, these have ranged from 47 to 59 Nm^3/s (15% O_2). The highest flow rates for Units 1-4 and Unit 5, have been used to calculate the worst-case emission rate (g/s) of NO_x from the Unit, along with the assumed NO_x concentration.

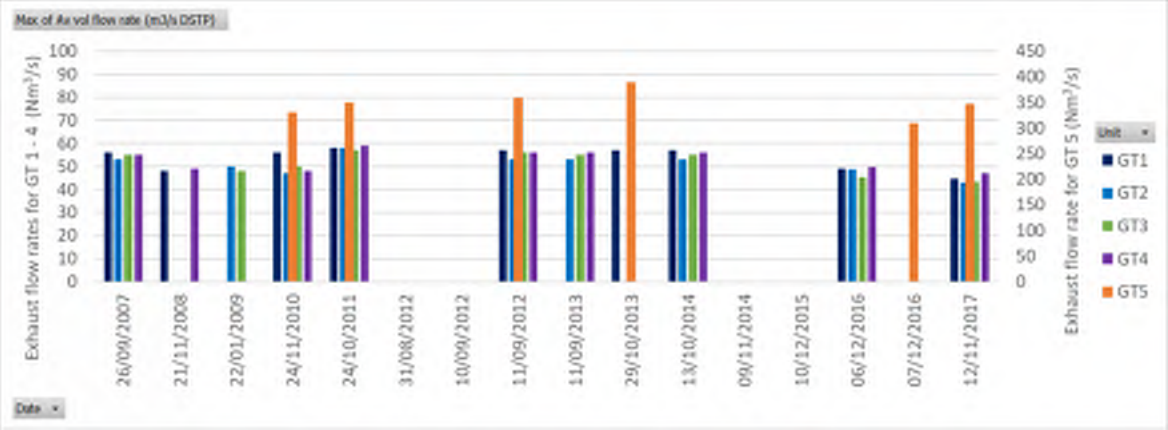

Figure B5 Flow rates as reported in annual stack test monitoring reports (Nm^3/s, 15% O_2)

Appendix H. Environmental Noise Assessment

Quarantine Power Station Expansion

Environmental Noise Assessment

S3797C6

January 2018

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Document Title	Quarantine Power Station Expansion – Environmental Noise Assessment
Document Number	S3797C4
Date	December 2017
Author	Chris Turnbull, MAAS
Reviewer	Jason Turner, MAAS

TABLE OF CONTENTS

GLOSSARY

A-weighting	Frequency adjustment applied to measured noise levels to replicate the frequency response of the human ear.
CONCAWE	The oil companies' international study group for conservation of clean air and water - Europe, The propagation of noise from petrochemical complexes to neighbouring communities (May 1981).
Day	The period between 7am and 10pm.
dB	Un-weighted (or linear) noise or sound power level in decibels.
dB(A)	A-weighted noise or sound power level in decibels.
Equivalent noise level	Energy averaged noise level.
L_{eq}	Equivalent noise level
Night	The period between 10pm and 7am.
Sound power level	A measure of the total sound energy emitted from a source of noise.
Weather category 6	Weather category which is most conducive for the propagation of noise, resulting in highest predicted noise levels when using CONCAWE.
Worst-case	Meteorological conditions resulting in the highest noise level at residences.

1 INTRODUCTION

Sonus has conducted an environmental noise assessment of the proposed expansion of the Quarantine Power Station (QPS) located on Torrens Island.

The proposed expansion to the QPS comprises three gas turbine generators and associated transformers. The layout for the QPS expansion is provided in Appendix A. The closest residences to the QPS are located approximately 2km to the west (on the opposite side of the Port Adelaide River) on Victoria Road, North Haven. Appendix B provides the location of the closest residences with respect to the proposed QPS expansion.

This report assesses the operational noise from the proposed QPS expansion against the relevant criteria of the *Environment Protection (Noise) Policy 2007*

2 EXISTING ACOUSTIC ENVIRONMENT

To provide a measure of the existing acoustic environment at the closest residences to the QPS, noise levels were continuously monitored on Victoria Road at a location adjacent to the closest residences (shown in Appendix B), between 9 and 16 November 2017.

A graph of the noise levels logged during this period is presented as Appendix C. The noise monitoring results indicate that the noise in the area is intermittently influenced by traffic, meteorological conditions and industry, with periods where the background (L_{A90}) noise was higher than 50 dB(A) but other periods where the noise was less than 35 dB(A). The graph also includes the measured equivalent (L_{Aeq}) noise levels.

3 CRITERIA

The proposed QPS expansion is located within a Public Purpose Zone of Land Not Within a Council Area Development Plan, while the nearest residences are located on the western side of Victoria Road, North Haven, within a Residential Zone of Port Adelaide Enfield City Development Plan.

To provide an objective assessment of the noise from the operation of the proposed QPS expansion, reference is made to the *South Australian Environment Protection Authority's Environment Protection (Noise) Policy 2007* (the Policy). The Policy provides objective criteria for the assessment of environmental noise

which are based on the World Health Organisation Guidelines to prevent annoyance, sleep disturbance and unreasonable interference on the amenity of an area.

The Policy establishes goal noise levels (L_{eq}) to be achieved at the noise receivers (dwellings), based on the Development Plan locality in which the noise source (QPS) and the noise receivers are located, the land use that these localities principally promote, and the ambient environment.

Where the Development Plan locality in which the noise source and the noise receiver are separated by more than 100m (with an intervening locality between), the goal noise levels of the Policy are based only on the principally promoted land use of the noise receiver. For the proposed site, the Port Adelaide River is considered to be an intervening locality separating the residences from the site.

Based on Development Plan localities and presence of an intervening locality (Port Adelaide River) greater than 100m, the Policy defines the criteria based on the receiving (Residential) zone alone. The goal noise levels are as follows:

- an equivalent noise level ($L_{eq,15min}$) of 47 dB(A) during the day (7am until 10pm); and,
- an equivalent noise level ($L_{eq,15min}$) of 40 dB(A) during the night (10pm until 7am).

In addition to the above, when measuring or predicting noise levels for comparison with the goal noise levels of the Policy, adjustments are made for any dominant characteristic of tone, low frequency, modulation or impulsiveness. 5 dB(A) is added if one characteristic is present, 8 dB(A) is added for two characteristics and 10 dB(A) is added for three or four characteristics. To apply a penalty, the characteristic must be dominant when considered within the context of the existing acoustic environment at the noise receivers.

4 ASSESSMENT

4.1 Noise Prediction Model

Noise predictions have been made using the CONCAWE[1] noise propagation model and SoundPLAN noise modelling software. The sound propagation model considers the following influences:

- sound power levels and locations of noise sources (including heights);
- separation distances between noise sources and receivers;
- topography of the area;
- influence of the ground;
- air absorption; and,
- meteorological conditions.

The CONCAWE system divides meteorological conditions into six separate "weather categories", depending on wind speed, wind direction, time of day and level of cloud cover. Weather Category 1 provides the weather conditions associated with the "lowest" propagation of noise, whilst Weather Category 6 provides "worst-case" (i.e. highest noise level) conditions. Weather Category 4 provides "neutral" weather conditions for noise propagation (that is, conditions which do not account for the effects of temperature inversion or wind on propagation).

The assessment has been conducted based on worst-case (Weather Category 6) conditions. Such conditions are most likely to occur on a clear night with a light breeze from the QPS to the residences.

4.2 Noise Sources

This assessment has considered the combined noise from three representative gas turbines and associated equipment.

The noise data used for the environmental noise assessment is summarised in Table 1 below.

[1] CONCAWE - The oil companies' international study group for conservation of clean air and water – Europe, 'The propagation of noise from petrochemical complexes to neighbouring communities', May 1981.

Table 1: Noise data for each component of the QPS expansion

Noise Source/Element	Sound power level, L_w, (dB re 1pW)) in octave band centre frequencies									Overall Noise Level	
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	Total (dB)	Total (dB(A))
Simple Cycle Stack	139	133	124	109	107	104	99	94	96	140	113
Finfan Cooler	139	133	124	104	97	100	92	82	92	140	112
340 Brush Generator	59	107	106	103	98	96	90	84	78	111	101
Air Cool System	86	89	101	89	84	82	82	70	13	101	89
Gear Box	92	84	99	87	73	72	76	67	45	100	85
Water Injection Skid	82	31	26	77	95	91	90	81	74	98	96
Air Filter House	84	95	96	94	98	94	92	87	83	103	99
Turbine Combustion Inlet	53	111	92	81	80	79	77	78	85	111	89
Turbine Ventilation Inlet	123	109	92	85	81	79	79	79	68	123	89
Turbine Ventilation Outlet	108	95	92	77	75	75	73	73	79	109	83
Turbine Base	115	102	93	84	83	84	82	81	91	116	92
Turbine Enclosure	97	93	93	95	96	89	84	82	75	102	96

The three transformers have been assumed to have a rating of no greater than 80 MVA and the sound power level has been derived from the Australian/New Zealand Standard *AS/NZS60076.10:2009, Power transformers - Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD)* (summarised in Table 2).

Table 2: Noise data for transformers

Transformer Rating	SWL (dB(A)) for each Octave Band Centre Frequency							Total SWL (dB(A))
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
80 MVA	72	80	87	90	82	79	72	**93**

4.3 Predicted Noise Level

The noise level at the nearest residences (on the western side of Victoria Road) have been predicted for the continuous operation of the three proposed gas turbines at the QPS based on the sound power levels provided above and various heights of the different sources for the layout (detailed in Appendix A).

The predictions indicate that the noise levels at the nearest residences will achieve the night time criterion of 40 dB(A) without any additional acoustic treatment above the level incorporated in the standard representative gas turbine.

The predicted noise levels are shown graphically on an aerial overlay of the site and the closest residences in Appendix D.

The equivalent (L_{Aeq}) noise level in the existing environment is rarely less than 50 dB(A). Given that a noise level of no more than 40 dB(A) is predicted from the QPS expansion, noise characteristics such as tone, low frequency, modulation or impulsiveness will not be dominant in the context of the existing environment and therefore no penalties are applied to the predicted noise level.

5 CONCLUSION

An environmental noise assessment has been made of the proposed extension to the Quarantine Power Station.

The assessment considers noise at the closest residences from the combined operation of three representative gas turbines and associated equipment, with sound power levels as provided in this report.

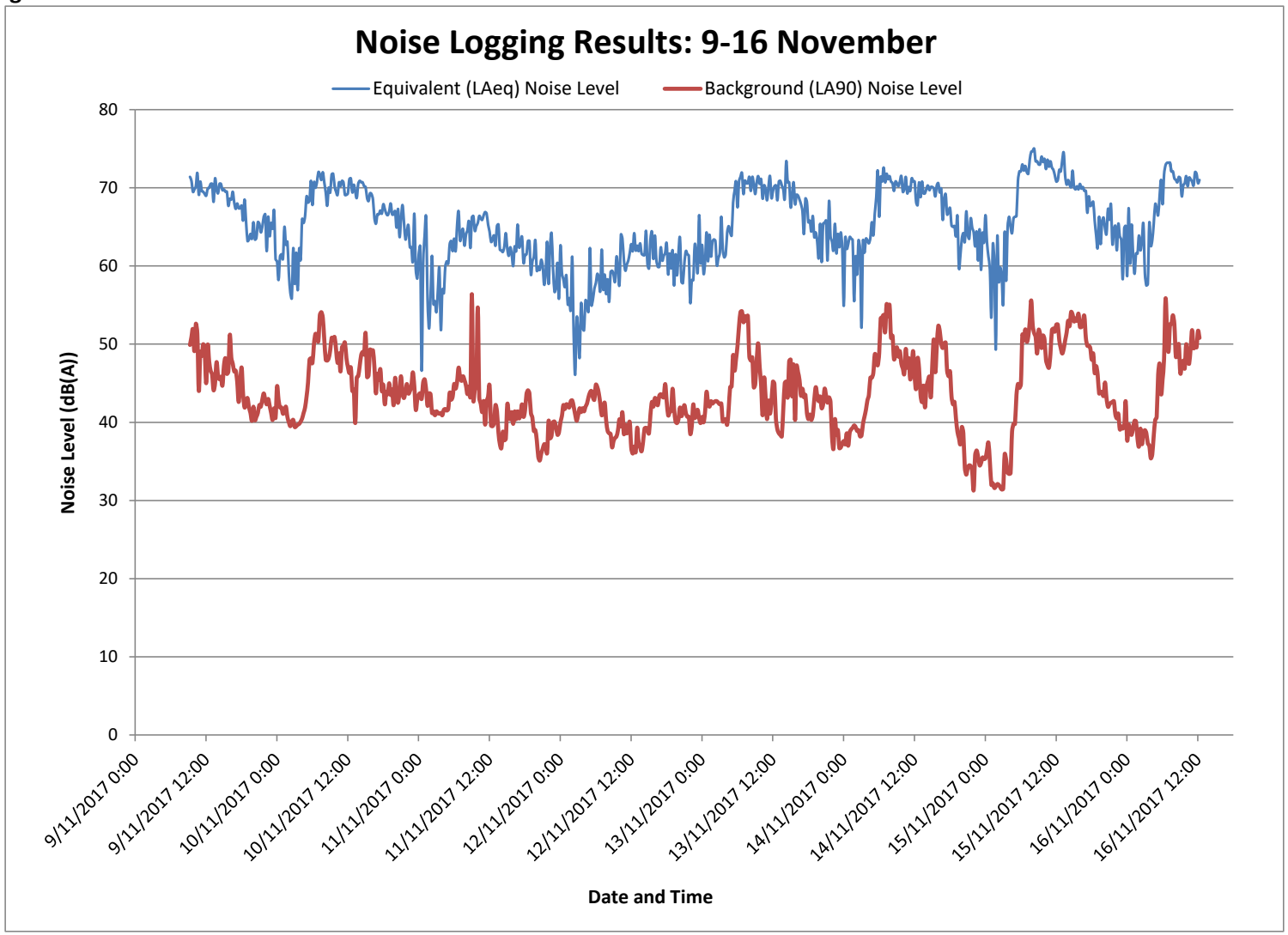
Noise predictions have been compared against criteria developed in accordance with the *Environment Protection (Noise) Policy 2007*.

Based on the predictions, the requirements of the *Environment Protection (Noise) Policy 2007* will be achieved with the proposed equipment.

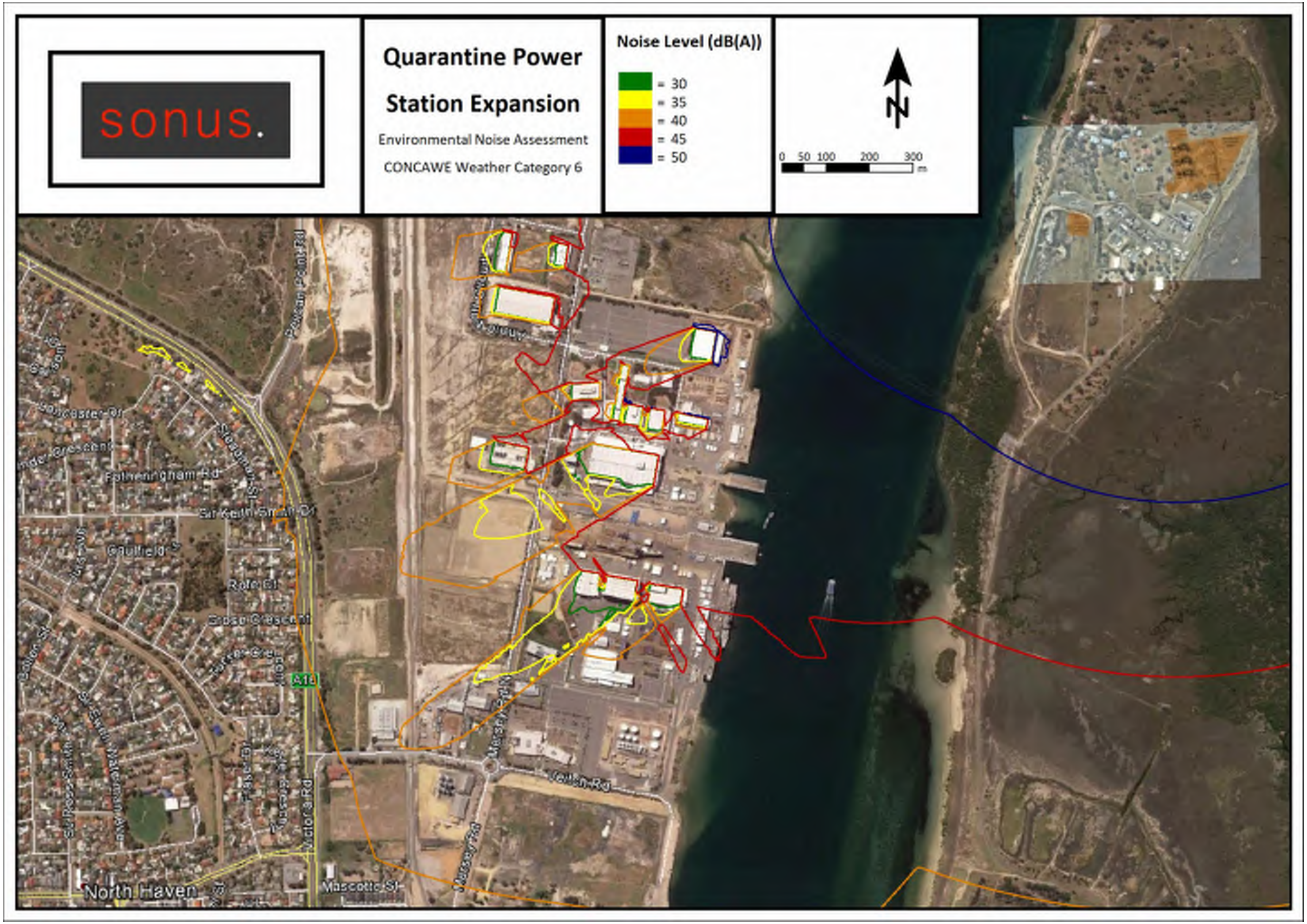
APPENDIX A: Proposed layout of the QPS Extension

APPENDIX B: Location of Residences & Noise Logging Location

APPENDIX C: Existing Acoustic Environment



APPENDIX D: Grid Noise Map


sonus.
Quarantine Power
Station Expansion
Environmental Noise Assessment
CONCAWE Weather Category 6
Noise Level (dB(A))
= 30
= 35
= 40
= 45
= 50
N
0 50 100 200 300
m
Lancaster Dr
Fotheringham Rd
Sir Keith Smith Dr
Caulfield
Rafo Ct
Pelican Point Rd
A16
Victoria Rd
Mascotte St
North Haven
Mersey Rd N
Veitch Rd
Jersey Rd

Appendix I. Traffic Impact Assessment

Quarantine Power Station Expansion

Origin Energy Power Limited (Origin)

Traffic Impact Assessment

IW169200-500-CT-RPT-0001 | 2

17 January 2018

OEEM100822-15

Quarantine Power Station Expansion Development

Project No:	IW169200
Document Title:	Traffic Impact Assessment
Document No.:	IW169200-500-CT-RPT-0001
Revision:	2
Date:	17 January 2018
Client Name:	Origin Energy Power Limited (Origin)
Client No:	OEEM100822-15
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Revision	Date	Description	By	Review	Approved
0	11/12/2017	Draft for Origin review	J Haigh	M Heintze	K Briton-Jones
1	10/01/2018	Final Report for Issue	K Briton-Jones	J Haigh	J Haigh
2	17/01/2018	Final Report updated for Client Issue	J Haigh	K Briton-Jones	K Briton-Jones

Contents

List of Figures

List of Tables

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide a supporting document for the Development Application of the expansion of the Quarantine Power Station on Torrens Island, South Australia in accordance with the scope of services set out in the contract between Jacobs and Origin Energy Power Limited (Origin). That scope of services, as described in this report, was developed with Origin.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by Origin and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from Origin (if any) and/or information available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

The advice provided in this report does not constitute an interpretation of the law or provision of legal advice. The advice and report has been developed by environmental planners and civil/traffic engineers, based solely on professional experience and interpretation of the environmental and technical legislative requirements. Relevant environmental and planning legislation to the best of our knowledge has been included.

This report has been prepared on behalf of, and for the exclusive use of, Origin, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and Origin. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 Background

Origin Energy (Origin) is seeking to expand the Quarantine Power Station (QPS) and network connection infrastructure on Torrens Island. The proposed development, Quarantine Power Station Expansion (QPSX), is designed to meet the need for responsive and efficient open cycle gas generation in the South Australian Market.

Origin Energy currently own and operate the QPS located to the north of Torrens Island with a generation capacity of 224 MW. Origin is proposing to expand its QPS to install a nominal 160 – 180 MW of gas powered generators on vacant land adjacent to the QPS site on Torrens Island. Two options for siting of the generators are under consideration – the preferred site is directly to the north of the existing facility on land owned by Origin and the alternate site is south of QPS on land owned by the South Australian Government and is depicted on Figure 1-1.

1.2 Scope of work

This document contains a traffic impact assessment for the additional traffic generated by this development on public roads.

The internal access arrangement through the Torrens Island site is on private roads and is part of an existing access agreement. The impact of the proposed underground trenching for the underground transmission cable is unknown while the construction methodology has not yet been determined. The impact on the internal road network is outside the scope of this assessment.

1.3 References

The following have been used in the development of this assessment:

- DPTI traffic volumes (accessed on 30 November 2017). https://dpti.sa.gov.au/traffic_volumes
- Construction traffic volumes estimated by Origin.
- Online approved heavy vehicle route map (RAVnet) (accessed on 30 November 2017). https://www.dpti.sa.gov.au/ravnet

Figure 1-1 QPSX Project Overview and Land Ownership

2. Existing conditions

2.1 Access arrangement

Torrens Island is located approximately 15 km north-west of the Adelaide CBD, South Australia. Torrens Island is joined to the mainland by the Grand Trunkway Bridge over the North Arm Creek and connected to Garden Island by a causeway. The subject site is located on Torrens Island within the Port Adelaide area. However, the land is zoned within the geographical boundaries of Land Not Within a Council Area (Metropolitan) Development Plan.

Access to QPS is via an AGL controlled boom gate adjacent to the main Torrens Island Power Station (TIPS). See Figure 2-1. The QPS site is approximately 4km from the boom gate via the island's established road network.

Figure 2-1: Main access gate

The site is located on Torrens Island and the access route with Torrens Island is on private roads with existing agreements in place. The only public road which can be used to access the site is Grand Trunkway which turns into the Garden Island Causeway. This arrangement is shown in Figure 2-2.

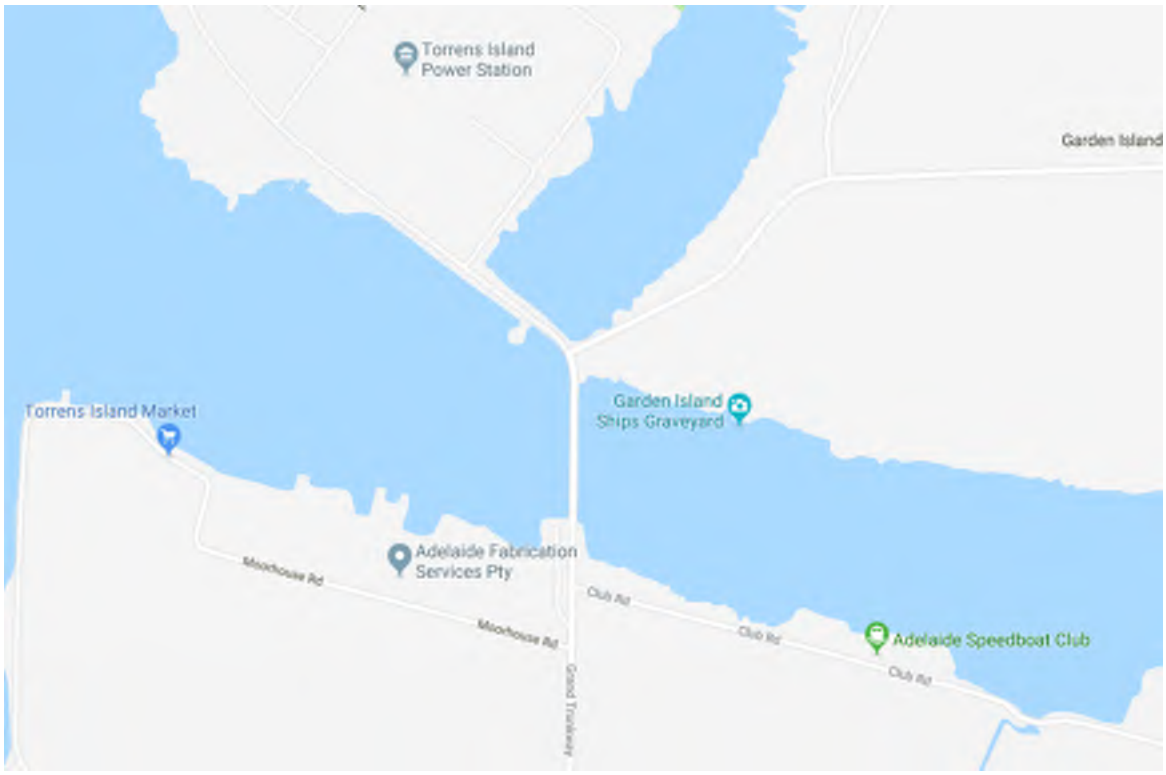

Figure 2-2: Access road arrangement (Google)

2.2 Existing traffic

2.2.1 Public roads

The existing traffic numbers for the key DPTI[1] roads near the access are listed in Table 2.1. Both of these roads are two lane sealed road (single lane in each direction). Due to the current land use around the site it is expected that the traffic flow along these roads will have a high percentage of trips during peaks corresponding with the Torrens Island Power Station shift change over.

Table 2.1: Existing Traffic

Road	AADT[2]	Heavy Vehicles
Grand Trunkway	3400	700 (20.5%)
Garden Island Causeway	1000	210 (21%)

There are no known traffic issues with this section of the road network.

2.2.2 Operational / Maintenance traffic

It is understood that the current operational and maintenance activities currently average approximately 290 vehicles per month. This includes an average of 9 site team vehicles and is averaged across the year.

[1] Department of Planning, Transport and Infrastructure
[2] Annual Average Daily Traffic

3. Proposed expansion

3.1 Proposed access arrangement

For the proposed upgrade it is proposed that the existing access via Grand Trunkway will still be used to access Torrens Island. The existing internal road network is proposed as the easement for which the underground transmission line which will connect into the AGL Torrens Island Power Station to the south and into the QPSX to the north.

3.2 Construction traffic

An estimate of the construction traffic is provided in Table 3.1.

Table 3.1: Construction Traffic Estimate

Date	Light Vehicles (/day)	Heavy Vehicles (/day)
Apr 18	1	0
May 18	3	1
Jun 18	0	0
Jul 18	0	0
Aug 18	0	0
Sep 18	0	0
Oct 18	0	0
Nov 18	10	1
Dec 18	40	9
Jan 19	60	9
Feb 19	60	3
Mar 19	90	1
Apr 19	110	2
May 19	110	1
Jun 19	90	1
Jul 19	90	1
Aug 19	60	1
Sep 19	30	1
Oct 19	30	1
Nov 19	20	0
Dec 19	0	0

Notes:

The number represents the vehicles travelling to the subject site, therefore the total number of trips generated (in/out of the subject site) will be double what is shown in the table.

A total of six oversized / overmass vehicles are expected for the construction phase of the project.

3.2.1 Light vehicles

Light vehicles will be used to transport workers to the site. The light vehicle volumes have been based on approximate construction personnel factored from similar projects. Due to the location of the site and limited other transport options it is assumed that each worker will have a single vehicle.

3.2.2 Heavy vehicles

For this assessment heavy vehicles have been assumed to be vehicle exceeding 4.5 tonnes Gross Vehicle Mass. The heavy vehicle and oversized vehicles numbers are based on the number of components being delivered to the site across the assumed construction schedule.

The heavy vehicles and overmass vehicles which are proposed to access the site will do so outside of the peak access period for TIPS.

The Grand Trunkway route to the site access is currently a PBS Level 2A route gazetted for the following vehicles. Any larger vehicles will need to obtain appropriate permits, particularly for access across the causeway.

- 26m B Double (Higher Mass Limit)
- 23m Low Loader

3.2.3 Oversized / overmass vehicles

Oversized and overmass (OSOM) vehicles will be used to carry some specialised components of the QPSX. It is assumed that contractors that use the OSOM vehicles will consult with and obtain relevant permits from the National Heavy Vehicle Regulator (NHVR) prior to the commencement of transport of these items and will provide any escort (if required) in accordance with legal and DPTI requirements.

3.3 Operational traffic

There will be one additional ongoing operational / maintenance personnel on site as a result of this expansion. This is not expected to impact the existing traffic.

4. Summary

Based on the relatively low volume of existing traffic the proposed additional construction traffic on the adjacent public road network is not considered an issue for the QPSX.

Table 4.1: Summary of traffic impact by the QPS Expansion

	Existing		Construction	
Road	**AADT**	**Heavy Vehicles**	**AADT**	**Heavy Vehicles**
Grand Trunkway	3400	700 (20.5%)	3628* (6.7% increase from existing)	708* (19.5%) (1.1% increase from existing)
Garden Island Causeway	1000	210 (21%)	1228* (22.8% increase from existing)	218* (17.8%) (3.8% increase from existing)

* Assumed max construction traffic generation, based on assumptions in Section 3.2. Higher construction traffic generation occurring over 5 months of a 21-month construction program. Less than half of peak traffic generation for remainder of construction period.

The existing access arrangements for the internal road network are assumed to remain and there are no major issues identified based on a desktop study of these roads.

It is noted that vehicle permits may be required for specific heavy vehicles and oversize / overmass vehicles.

Appendix J. Heritage Reports

QPSX Development Application Supporting Document

Origin Energy Power Limited

Historical (Built) Heritage - Structural Assessment

IW169200-SU-RP-0001 | 1

15 January, 2018

Project No:	IW169200
Document Title:	Historical (Built) Heritage - Structural Assessment
Document No.:	IW169200-SU-RP-0001
Revision:	1
Date:	15 January 2018
Client Name:	Origin Energy Power Limited
Client No:	Client Reference
Project Manager:	Kelly Briton-Jones
Author:	Keegan Steele
File Name:	J:\IE\Projects\06_Central West\IW169200\21 Deliverables\Structural\IW169200-SU-RP-0001.docx

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Revision	Date	Description	By	Review	Approved
0	11/12/17	Preliminary Inspection Report For Origin Review	KS	LE	KB
1	15/01/18	Final Inspection Report	KS	KB	KB

Contents

List of Figures

1. Introduction

Origin Energy Power Limited (Origin) has appointed Jacobs Australia Pty Ltd to aid in the preparation of a Development Application under the Development Act 1993, Crown Development and Public Infrastructure Section 49 process for Quarantine Power Station Expansion and Network Connection Development (QPSX). The Origin site is located on Torrens Island, approximately 25km North-West of the Adelaide CBD in South Australia.

The Project is currently in the concept design stage, however, proposes to upgrade Origin's existing 224 MW Torrens Island power station with an additional 160-180 MW of generation capacity. The scope of work includes construction of the generators and underground transmission cables connected to existing power station and transmission infrastructure located at the southern end of Torrens Island.

It is currently intended that these new units will be located on existing Origin land, to the north of the existing facility which is the preferred option (northern option). Origin have located a site for a second option (southern) that maybe more suited to the development, however the site is currently constrained by land ownership. Should this site become available, Origin may seek to amend the application to suit the alternative option.

A number of structures with heritage values are within the footprint of the southern option of QPSX and were required to be inspected to determine the feasibility of relocation. This report covers the inspection of three buildings, each being assessed for possible removal, relocation and structural integrity. The locality of these buildings can be seen in Figure 1.1 and situated at the entrance to the Origin Quarantine Power Station (QPS).

Figure 1.1: Locality of buildings

2. Background

The three buildings inspected on the Torrens Island Origin site were originally used as part of the 1909 relocated animal quarantine stations. The purpose of each of the buildings is listed below for reference;

Building 1 – “Store and Mans room”, part of the relocated 1909 Animal Quarantine Station.

Building 2 – “Loose Boxes for Cattle” Shed, part of the relocated 1909 Animal Quarantine Station.

Building 3 – “Loose Boxes for Horses”, part of the relocated 1909 Animal Quarantine Station.

Each of the buildings are similar in construction materials, with a timber frame and weather board cladding. Buildings 2 and 3 were used as holding bays for live animals, as such have a basic fit out. Building 1 was originally used as a veterinary clinic and has had a complete fit out with internal wall cladding and a ceiling in place. Since construction, building 1 has been modified to include a blockwork building that facilitates kennels.

3. Site Inspection

The site inspection was performed on the 23rd of November 2017.

Inspections were non-destructive in nature and conducted on foot. No platforms of scaffolds were required for inspection.

Weather during the inspection was mild, with light rainfall recorded on the day.

The inspection report focuses on the following building elements;

1. Timber frame.
2. External weather board cladding.
3. Roofing.
4. Building fit out.

The following sections provide a record of key observations for each primary element. The photos provided are examples and do not display details of each individual element. The following photos are expected to provide context, information and discussion points in combination with the recommendation section of this report.

3.1 Building 1 – Store and Mans room

Building 1 was originally used as a veterinary clinic. Other buildings have since been attached to the original structure, including a block work building comprised of kennels, refer to Figure 3.1. The structure has a chimney built in place that separates the cladding as shown in Figure 3.2.

The building contains significant amounts of asbestos cladding with the majority of wall panels marked with asbestos warning labels.

3.1.1 Timber Frame

Due to the building fit out as a veterinary clinic, the frame of this structure was not visible throughout the majority of the structure. However, due to external weatherboard cladding deteriorating and/or missing, certain areas of the timber frame are visible. There is evidence to indicate that the frame has begun deteriorating due to the exposure to weathering. This deterioration of the timber frame has caused some section loss and rot of the material. Refer to Figure 3.3.

3.1.2 External Weatherboard Cladding

Building 1 shows significant degradation of the weatherboard cladding. Many sections have begun rotting and deteriorating. From inspection there is substantial peeling of the paint surface, exposing the material to the weather. This exposure to the environment over time has turned the material brittle. Though the deterioration of the cladding currently presents no structural integrity problems, it has exposed the internal timber framing at a number of locations as discussed in the above section. Examples of the weatherboard condition can be seen in Figure 3.3 and Figure 3.4.

3.1.3 Roofing

The roof structure for the Veterinary Clinic also contains a ceiling lining (likely to be asbestos similar to the wall lining) due to the intended nature of the building. Internal inspection of the roof framing was not possible on the day. However, an external inspection of the roof sheeting indicated signs of corrosion similar to the other two structures inspected.

3.1.4 Building Fit Out

Building 1 has been used as a veterinary clinic, for this reason the building has been fitted out with an internal wall and ceiling lining. On inspection, each section of the wall lining internally and also to some external cladded areas were marked with asbestos warning labels. Refer to Figure 3.6 and Figure 3.7.

3.1.5 Photos

Figure 3.1: Blockwork Structure Attached to Building 1

Figure 3.2: Brick Chimney in Building 1

Figure 3.3: Exposed Timber Frame and Missing Cladding

Figure 3.4: Example of Deteriorated Weatherboard

Figure 3.5: General Photo of Weatherboard Condition

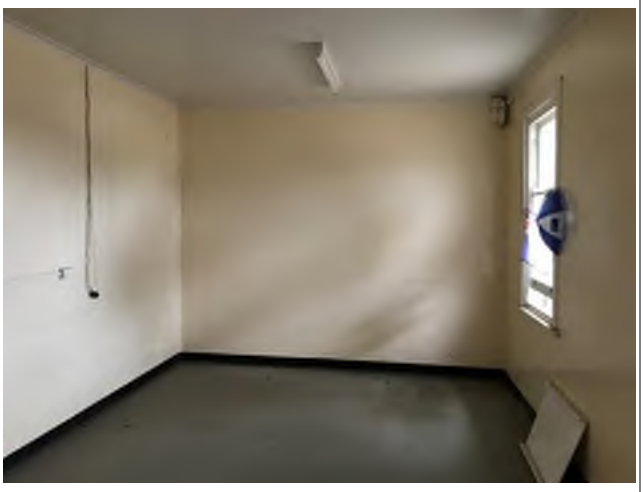

Figure 3.6: Building 1 Internal Fit Out

Figure 3.7: Asbestos Warning Labels

3.2 Building 2 – Loose Boxes for Cattle Shed

Building 2 was previously used to store cattle with a cattle chute still in place beside the structure, refer to Figure 3.8.

3.2.1 Timber Frame

The timber frame of the structure was visible internally and the frame showed no signs of structural deterioration from this view, refer to Figure 3.9. However, similar to buildings 1 and 2, the degradation of the weatherboard wall cladding has exposed the outside face of the timber frame in certain sections. This exposure has caused some section loss and the timber has turned brittle at these sections.

3.2.2 External Weatherboard Cladding

Similar to building 1, the weatherboard cladding has deteriorated and peeling paint has exposed the timber material to weathering. This has caused sections of the weatherboard to break apart from the structure and become significantly brittle, leaving sections of the frame subject to the environment. Refer to Figure 3.10.

3.2.3 Roofing

The roof sheeting on building 2 shows notable signs of corrosion as seen in Figure 3.11. The timber framing for the roof however appears to be in good condition showing no obvious signs of section loss.

3.2.4 Building Fit Out

Building 2 has been used as a storage shed for cattle in the past, as such the structure comprises of a basic fit out. The internal structure contains timber plank walls and an exposed ceiling space. The entry doors into each bay of the structure comprise of two large panels that swing out, each being supported with two steel brackets. Refer to Figure 3.13.

The timber walls show some signs of exposure to the weather, causing decolouring. However, panels were still in good condition from an internal visual inspection. Refer to Figure 3.12.

Since the building has been left open to the environment, pigeons have inhabited the area. Significant amounts of pigeon? faeces are present throughout the building.

The large swing out door panels show signs of corrosion around the steel encasement. The latches have undergone significant corrosion, causing the mechanisms to seize. The two brackets per panel have also undergone corrosion and have fatigued due to age. As such, many of the brackets have broken off due to the significant weight of the doorway panels. On inspection, some doorway panels were opened with extreme difficulty and were not able to be placed back into the original position due to the deformation of the brackets under the self-weight of the panels.

3.2.5 Photos

Figure 3.8: Cattle Chute

Figure 3.9: Timber Frame of Building 2

Figure 3.10: Weatherboard Cladding of Building 2

Figure 3.11: Internal View of Roofing

Figure 3.12: Staining on Internal Timber Planks

Figure 3.13: Damaged/Missing Doorway Brackets

3.3 Building 3 – Loose Boxes for Horses

3.3.1 Timber Frame

The missing weatherboard cladding has exposed the timber frame of building 3 at various locations. Due to this exposure to weathering, the timber frame has undergone significant section loss. The majority of concern is along the back wall of building 3, where there is approximately 30-50% section loss of certain wall stud sections in the frame. Refer to Figure 3.14.

3.3.2 External Weatherboard Cladding

Building 3 shows extensive weather damage to the external weatherboard cladding. As seen in Figure 3.15, paint has completely stripped off the weatherboard and panels have since rotted and deteriorated. Sections of cladding have been removed or are missing, therefore exposing the timber wall framing to the weather.

3.3.3 Roofing

Building 3 shows a significant amount of corrosion in the steel roof sheeting as seen in Figure 3.17. The gutter attached to the roof has had significant corrosion throughout as can be seen in Figure 3.18. The timber roof framing shows no obvious signs of deterioration internally within the building. However, sections of the frame that protrude out of the structure and are exposed to the weather show significant signs of weathering and deterioration as seen in Figure 3.16.

3.3.4 Building Fit Out

Similar to building 2, the latches for the doorway panels have corroded and seized. On inspection some would not open, and others were opened with great difficulty. The hinges on all panels began deforming under the self-weight of the door panels due to corrosion and metal fatiguing from age. Due to the deformation of the hinges, some panels would not return to the original closed position. The steel trim around the doorway panels was also found to have high levels of corrosion at certain locations, an example of this is shown in Figure 3.19.

3.3.5 Photos

Figure 3.14: Deterioration of Timber Frame

Figure 3.15: Severe Degradation of Weatherboard Cladding

Figure 3.16: Deterioration of Roofing Frame

Figure 3.17: Corrosion of Roof Sheeting

Figure 3.18: Holes Forming in Gutters from Corrosion

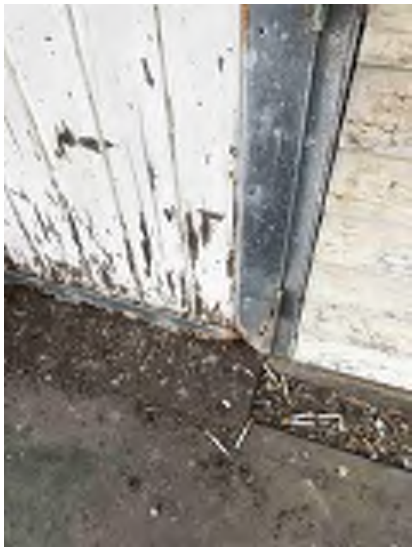

Figure 3.19: Corrosion around Doorway Panels

4. Recommendations

4.1 Building 1 – Store and Mans room

Jacobs recommend that if the structure were to be removed from site and reinstated at another location, the following would need to be completed as a part of the requirements for compliance with the Buildings Code of Australia:

1. The existing timber frame will need to be replaced with a new hard wood timber frame, such that structural integrity of the structure can be confirmed and original appearance is maintained.

2. All weatherboard cladding will need to be restored or replaced in order to protect the frame of the structure from weathering. The majority of the weatherboard will likely need replacing due to the age, and removal of these boards is likely to result in the boards cracking or breaking.

3. Due to the significant health hazards posed by asbestos materials, the structure will need to be safely dismembered and all asbestos removed in accordance to relevant Australian Standards.

4. A new chimney will need to be constructed at the new location to replicate the original chimney that is currently in place.

5. At the location that the blockwork building interacts with the weatherboard cladding structure, the structure entrance will need to be sealed.

6. All gutters and roof sheeting requires replacement as current materials have experienced moderate levels of corrosion. The severity of this corrosion has been increased due to close proximity to salt water.

7. New foundations will need to be designed and constructed for the desired new location.

Overall the current condition of the structure does not meet current BCA standards and will require significant works and refurbishments to attain this. Due to the significant works required in moving and repairing the structure, and considering the added complications of asbestos contamination the process is unlikely to be economically feasible, however this would depend heavily on the historical value of the structure.

4.2 Building 2 – Loose Boxes for Cattle Shed

Jacobs recommend that if the structure were to be removed from site and reinstated at another location, the following would need to be completed as a part of the requirements for compliance with the Buildings Code of Australia:

1. The existing timber frame will need to be replaced with a new hard wood timber frame, such that structural integrity of the structure can be confirmed and original appearance is maintained.

2. All weatherboard cladding will need to be restored or replaced in order to protect the frame of the structure from weathering. The majority of the weatherboard will likely need replacing due to the age, and removal of these boards is likely to result in the boards cracking or breaking.

3. All gutters and roof sheeting requires replacement as current materials have experienced high levels of corrosion, the severity of which has been increased due to close proximity to salt water.

4. New foundations will need to be designed and constructed for the desired new location.

5. The doorway panels leading into the holding bays pose serious safety concerns due to the aged and corroded brackets. These brackets would need to be replaced and the latches on the panels require replacing.

6. As the structure has been left open for an extended period of time, the pigeon faeces has built up to unhygienic levels. This will need to be thoroughly cleaned before disassembly of the structure in order to avoid safety concerns around bacteria build up potentially causing illness, infections or spread of diseases.

Overall the current condition of the structure does not meet current BCA standards and will require significant works and refurbishments to attain this. Due to the significant works required in moving and repairing the structure, the process is unlikely to be economically feasible, however this would depend heavily on the historical value of the structure.

4.3 Building 3 – Loose Boxes for Horses

Jacobs recommend that if the structure were to be removed from site and reinstated at another location, the following would need to be completed as a part of the requirements for compliance with the Buildings Code of Australia:

1. The existing timber frame will need to be replaced with a new hard wood timber frame, such that structural integrity of the structure can be confirmed and original appearance is maintained.

2. All weatherboard cladding will need to be restored or replaced in order to protect the frame of the structure from weathering. The majority of the weatherboard will likely need replacing due to the age, and removal of these boards is likely to result in the boards cracking or breaking.

3. All gutters and roof sheeting requires replacement as current materials have experienced high levels of corrosion, the severity of which has been increased due to close proximity to salt water.

4. New foundations will need to be designed for the desired location.

5. The doorway panels leading into the holding bays pose serious safety concerns due to the aged and corroded brackets. These brackets would need to be replaced and the latches on the panels require replacing.

6. As the structure has been left open for an extended period of time, the pigeon faeces has built up to unhygienic levels. This will need to be thoroughly cleaned before disassembly of the structure in order to avoid safety concerns around bacteria build up potentially causing illness, infections or spread of diseases.

Overall the current condition of the structure does not meet current BCA standards and will require significant works and refurbishments to attain this. Due to the significant works required in moving and repairing the structure, the process is unlikely to be economically feasible, however this would depend heavily on the historical value of the structure.

Quarantine Power Station Expansion

Origin Energy

Historical Heritage Impact Assessment

IW169200 | 1

11 January 2018

Quarantine Power Station Expansion

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1	10/1/2018	Final document	Kelly Briton-Jones	15/1/2018	15/1/2018

Contents

List of figures

List of tables

Abbreviations

AGL	Australian Gas Light Company
BCA	Building Code of Australia
CHL	Commonwealth Heritage List
CMP	Conservation Management Plan
DA	Development Application
DEWNR	Department of Environment, Water and Natural Resources
HP Act	*Heritage Places Act* 1993
Jacobs	Jacobs Group (Australia) Pty Ltd
kV	Kilovolt
NHL	National Heritage List
North Option	Option for the generator north of the current Quarantine Power Station
Origin	Origin Energy
RNE	Register of the National Estate
SA	South Australia
SAHR	South Australian Heritage Register
South Option	Option for the generator south of the current Quarantine Power Station
the Council	The South Australian Heritage Council
the Project	The Quarantine Power Station Expansion project
TIQS	Torrens Island Quarantine Station
QPSX	Quarantine Power Station Expansion

Executive Summary

Introduction

Jacobs Group (Australia) Pty Ltd (Jacobs) has been engaged by Origin Energy (Origin) to undertake historical heritage impact assessment of a proposed Quarantine Power Station Expansion (QPSX) project (the Project).

The Project is currently in the concept design stage, however, Origin proposes to expand the existing 224 MW Torrens Island power station with an additional 160-180 MW of generation capacity. The scope of work includes construction of the power station including turbines, generators and underground transmission cables transmission infrastructure located at the southern end of Torrens Island.

It is currently intended that these new units will be located on existing Origin land on allotment 305, to the north of the existing facility which is the preferred option (North Option) (Figure 1.1). Origin have located a site for a second option (South Option) that maybe more suited to the development, however the site is currently constrained by land ownership (Figure 1.1). Should this site become available, Origin may choose to vary the application to suit the alternative option.

Torrens Island is located approximately 15 km north-west of Adelaide, South Australia. The island is within the Port Adelaide area, east of Le Fevre's Peninsular, and bounded by Lipson Reach of the Port River (officially known as the Port Adelaide River) to the west, Barker Inlet to the north and east, and The North Arm to the south. The Grand Trunkway Bridge over the North Arm Creek joins the island to the mainland via a causeway connected to Garden Island. The Project area is located on Torrens Island within the Port Adelaide area, however the land is zoned within the geographical boundaries of Land Not Within a Council Area (Metropolitan) Development Plan. The Project area is shown in Figure 1.1.

This historical heritage impact assessment identifies the historical heritage places within and immediately adjacent to the Project area, assesses the potential impact on the heritage places from the proposed activities, and develops measures to manage the impacts. The historical heritage assessment will inform the Development Application (DA) for the proposed works.

Desktop assessment

A register search for historical heritage places within the Project area was undertaken on 27 November 2017. No historical heritage places are listed within the Project area. The Torrens Island Quarantine Station Complex is listed on the South Australian Heritage Register (SAHR 13931) and the Register of the National Estate (RNE 14866). The Torrens Island Quarantine Station Complex is immediately west of the North Option of the Project area (Figure 3.4).

A Torrens Island Quarantine Station (TIQS) Conservation Management Plan (CMP) was developed by Habitable Places Architects (2014) and provides a comprehensive summary of the history and assessment of the structural elements of the Quarantine Station. The CMP summarised a number of previous studies of the Quarantine Station, including heritage assessments, conservation management plans, and historical investigations. Buildings and structures within the Project area were not assessed as part of the CMP.

Results of site survey

A site survey was undertaken by Andrew Wilkinson (Project Archaeologist, Jacobs) and Dr Karen Murphy (Technical Leader - Historical Heritage, Jacobs) on 12 December 2017. A significant portion of the Project area has been subject to land use activities associated with quarantine services, pastoralism, fencing, power station building infrastructure, equipment storage and vehicle tracks. Six structures were inspected as part of the site survey. These structures, while associated with the original Quarantine Station operation, were assessed as having historical interest with only a minor contribution to the overall significance of the Quarantine Station. One area, in the western portion of the North Option, the site of now demolished nurses' cottages associated with the Quarantine Station, was assessed as having low archaeological potential due to the level of demolition, clean up and subsequent ground disturbance from development.

Impact assessment

The proposed works include the construction and installation of a new gas turbine generator and ancillary equipment with the North Option within the boundaries of the existing Origin Power Station, and the South Option, south of the existing Origin Power Station, on Department for Planning, Transport and Infrastructure (DPTI) owned land. Works will include connection to the existing gas pipeline network west of the existing Power Station and the installation of an underground transmission line connecting the new generator to the existing transmission grid at the Australian Gas Light Company (AGL) Power Station to the south. Works will include trenching and ground disturbance for the installation and associated construction laydown areas.

North Option

Development within the North Option would have minor adverse visual impact on the setting of the State Heritage place, however this would be little more than that of the current generators as the existing Power Station (Michael Queale, Pers. comm, 19 July 2017).

South Option

Visual impacts on the heritage significance of the Quarantine Station overall would be minor as development within the southern option would result in negligible visual impact on the State Heritage place as it is immediately south of the existing Power Station and is separated from the State Heritage place by the current turbines and infrastructure.

The three buildings located in the South Option area (Structures 1, 2 and 3) are of historical interest, but they have only a minor contribution to the overall significance of the Quarantine Station. The structural assessment of Structures 1,2 and 3, undertaken by Jacobs (Steele 2017), indicates that the current condition of each structure does not meet current Building Code of Australia (BCA) standards and would require significant works and refurbishments to meet the standard including the replacement of substantial portions of original fabric. Due to the significant works required in moving and repairing the structure, the process is unlikely to be economically feasible (Steele 2017).

Mitigation measures

Archival photographic recording

As the relocation of Structures 1, 2 and 3 in the South Option is unlikely to be feasible due to their condition, a photographic archival record of the structures was recommended prior to their demolition. While Structures 4, 5 and 6 within the North Option are of limited heritage significance, they may also be subject to photographic recording prior to demolition.

Discovery of archaeological artefacts

In the event of the discovery or location of an archaeological artefact of heritage significance, excavation or disturbance work must cease at the place where the relevant object has been discovered and the State Heritage Council must be notified within five business days. No other activities or disturbance can occur in the area until the Council has provided a permit or other authorisation to continue.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs Group (Australia) Pty Ltd (Jacobs) is to undertake a historical heritage assessment for Origin Energy (Origin) in accordance with the scope of services set out in the contract between Jacobs and Origin. That scope of services, as described in this report, was developed with Origin.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by Origin and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from Origin (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of Origin, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and Origin. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 Project background

Jacobs Group (Australia) Pty Ltd (Jacobs) has been engaged by Origin Energy (Origin) to undertake a historical heritage impact assessment of the proposed Quarantine Power Station Expansion (QPSX) project (the Project).

The Project is currently in the concept design stage, however, Origin proposes to expand the existing 224 MW Torrens Island power station with an additional 160-180 MW of generation capacity. The scope of work includes construction of the power station including turbines, generators and underground transmission cables transmission infrastructure located at the southern end of Torrens Island.

It is currently intended that these new units will be located on existing Origin land on allotment 35, to the north of the existing facility which is the preferred option (North Option) (Figure 1.1). Origin have located a site for a second option (South Option) that maybe more suited to the development, however the site is currently constrained by land ownership (Figure 1.1). Should this site become available, Origin may choose to vary the application to suit the alternative option.

1.2 Project location

Torrens Island is located approximately 15 km north-west of Adelaide, South Australia. The island is within the Port Adelaide area, east of Le Fevre's Peninsular, and bounded by Lipson Reach of the Port River (officially known as the Port Adelaide River) to the west, Barker Inlet to the north and east, and The North Arm to the south. The Grand Trunkway Bridge over the North Arm Creek joins the island to the mainland via a causeway connected to Garden Island. The Project area is located on Torrens Island within the Port Adelaide area, however the land is zoned within the geographical boundaries of Land Not Within a Council Area (Metropolitan) Development Plan. The Project area is shown in Figure 1.1.

1.3 Aims and scope of the assessment

This historical heritage impact assessment identifies the historical heritage places within and immediately adjacent to the Project area, assesses the potential impact on the heritage places from the proposed activities, and develops measures to address the impact. The historical heritage impact assessment will inform the Development Application (DA).

1.4 Authorship

This report has been prepared by Andrew Wilkinson (Project Archaeologist, Jacobs). Mapping was prepared by Chris Johnson (Spatial Consultant, Jacobs). A quality review was undertaken by Dr Karen Murphy (Technical Leader - Historical Heritage, Jacobs). All photographs were taken by Andrew Wilkinson unless otherwise acknowledged.

Figure 1.1 : Location of the Project area

2. Legislative context

2.1 State legislation

2.1.1 Heritage Places Act 1993

The *Heritage Places Act* 1993 (the HP Act) provides a number of mechanisms by which items and places of heritage significance to South Australia may be protected. The HP Act is designed to 'recognise the importance of South Australia's heritage places and related objects in understanding the course of the State's history, including its natural history'. It protects State Heritage Places and Areas, and places of geological, palaeontological, speleological and archaeological significance. The HP Act is administered by the South Australian Heritage Council (Council) and the Department of Environment, Water and Natural Resources (DEWNR).

South Australian Heritage Register

The South Australian Heritage Register (SAHR) is a list of places of heritage significance to South Australia. The register may include such places as:

- a place or object of heritage significance
- any local heritage place, local heritage zone or local heritage policy area designated by a Development Plan
- any State Heritage Area

To make changes, alterations or to develop State Heritage Places development approval must be obtained under the *Development Act* 1993 from the relevant planning authority (usually the local council). The *Development Act* 1993 requires all development applications affecting State Heritage Places and State Heritage Areas to be referred to the Minister responsible for the HP Act for advice on potential impact of the development on the heritage significance of the place.

Archaeological places or objects

Section 27 of the HP Act provides protection for archaeological artefacts even if not registered as a State Heritage Place. In particular, a person must not excavate or disturb any land knowing that the excavation or disturbance will result in an archaeological artefact of heritage significance being discovered, exposed, moved, damaged or destroyed without a permit from the Council. Therefore, there may be a need to assess whether there is archaeological potential before works in order to not be in breach of the HP Act. Under section 29 of the HP Act a permit may be granted by the Council to allow operations to be carried out on such land, provided certain conditions are met.

Discovery of archaeological artefacts

Under section 27(2) of the HP Act, any person not acting under the authority of a permit, who is aware or believes that they may have discovered or located an archaeological artefact of heritage significance, must cease to excavate or disturb the place where the relevant object has been discovered and notify the Council within five business days. No other activities or disturbance can occur in the area until the Council has provided a permit or other authorisation to continue.

Stop orders

If a person is of the opinion that a place has sufficient heritage significance to justify its preservation the Council may issue a Stop Order under section 30 of the HP Act in order to protect the place and allow further evaluation of the heritage significance. The Council may make an order requiring a person to stop any work or activity, or prohibiting a person from starting any work or activity, that may destroy or reduce the heritage significance of that place.

2.2 Commonwealth legislation

2.2.1 *Environment Protection and Biodiversity Conservation Act* 1999

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) includes 'national heritage' as a Matter of National Environmental Significance and protects listed places to the fullest extent under the Constitution. It also establishes the National Heritage List (NHL) and the Commonwealth Heritage List (CHL).

The following is a description of each of the heritage lists and the protection afforded places listed on them.

2.2.1.1 Commonwealth Heritage List

The CHL is established under the EPBC Act. The CHL is a list of properties owned by the Commonwealth that have been assessed as having significant heritage value. Any proposed actions on CHL places must be assessed for their impact on the heritage values of the place in accordance with *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies (Significant Impact Guidelines 1.2).* The guidelines require the proponent to undertake a self-assessment process to decide whether or not the action is likely to have a significant impact on the environment, including the heritage value of places. If an action is likely to have a significant impact an EPBC Act referral must be prepared and submitted to the Minister for approval.

2.2.1.2 National Heritage List

The NHL is a list of places with outstanding heritage value to Australia, including places overseas. Any proposed actions on NHL places must be assessed for their impact on the heritage values of the place in accordance with *Matters of National Environmental Significance (Significant Impact Guidelines 1.1).* The guidelines require the proponent to undertake a self-assessment process to decide whether or not the action is likely to have a significant impact on a matter of National Environmental Significance, including the national heritage value of places. If an action is likely to have a significant impact an EPBC Act referral must be prepared and submitted to the Minister for approval.

2.2.1.3 Register of the National Estate

The Register of the National Estate (RNE) was formerly compiled as a record of Australia's natural, cultural and Aboriginal heritage places worth keeping for the future. The RNE was frozen on 19 February 2007, which means that no new places have been added or removed since that time. From February 2012 all references to the RNE were removed from the EPBC Act. The RNE is maintained on a non-statutory basis as a publicly available archive.

3. Background to the assessment

3.1 Historical context

3.1.1 Settlement and development of Torrens Island

The Aboriginal inhabitants of the Adelaide Plains area that includes the Torrens Island Project area were the Kaurna people. The Port River and estuarine areas around Torrens Island were important sources of food for the Kaurna people and the general area was known by the Kaurna as Yerta-bulti, meaning Land of Dance (Garth Agius, Pers. comm, 13 December 2017). The area of what was to become Port Adelaide was first sighted by Captain Collet Barker in 1831, however it wasn't until 1836 that the Port River was navigated by Colonel William Light and was proclaimed suitable for a port to service the new settlement, which was to be established further inland. Port Adelaide was proclaimed a legal port by Governor Hindmarsh in 1837 (City of Port Adelaide Enfield 2015) and the island was named after Colonel Robert Torrens, chair of the South Australian Colonisation Commission (Wohltmann 2016).

The settlement of Torrens Island began almost immediately following the establishment of the colony with a map from 1839 showing the southern portion of the island set aside for future port development (Figure 3.2). The port was eventually established further south of this planned location, and by 1846 the parcel of land was owned by John Ellis (Figure 3.3). Sometime after their arrival in the colony in 1847 Isaac and Elizabeth Yeo began dairy farming on Torrens island (Habitable Places Architects 2014: 17), becoming the islands first permanent resident (Wohltmann 2016). By the 1850s disease epidemics were becoming a major concern for South Australia and in 1854 the government began subdividing portions of land on the low sand dunes along the western shoreline towards the north of Torrens Island (Habitable Places Architects 2014: 17), west of the current Project area.

3.1.1.1 Quarantine Stations

Following an outbreak of smallpox on the *Taymouth Castle* in 1855, a quarantine camp comprising military tents was established on the southern beach of Torrens Island forcing Yeo to relocate his farm to five of the northern subdivided sections. Subdivided sections 869 and 870 of these northern portions were reserved for quarantine purposes. There are conflicting records of the precise location of the first quarantine station, indicating it may have been along the waterfront west of the current Project area, however court evidence of 1916 suggests the camp was more likely on the southern portion of the island where the 1855 camp was established (Bell 2012: 3), approximately three kilometres south of the current Project area. Ships arriving in South Australia were required to remain offshore at Semaphore with the passengers and ship's crew remaining aboard in quarantine until medically cleared of infectious diseases.

Although land-based quarantine control commenced with the 1855 camp, and the first permanent quarantine building was established on Torrens Island in 1857 (Habitable Places Architects 2014: 17), the offshore quarantine system remained in effect until the late 1870s. Quarantine concerns at this time prompted new regulations and the need for better quarantine services. The offshore quarantine hulks in use at the time were found to be unsuitable and interest returned to land-based quarantine facilities. Yeo was resettled a second time when the government acquired his land towards the north of the island in 1875 (Habitable Places Architects 2014: 17). The second quarantine station was constructed in 1879 with the erection of permanent buildings, including prefabricated houses imported from San Francisco (Bell 2012: 3). The only remaining building of the 1879 period is a timber cottage, now a museum, approximately 50 m from the proposed North Option (Figure 1.1 and Figure 3.5). A tramway was constructed on the island in 1886 and telephone services connected in 1898 (Habitable Places Architects 2014: 19).

The site of the original 1855 camp was used for animal quarantine from 1879, and in 1912 new animal facilities were constructed south of the human quarantine station following transfer of quarantine services to the Commonwealth Government in 1909 (Habitable Places Architects 2014: 25). The animal quarantine area is south of the Origin power station and within the current Project area (South Option) (Figure 1.1). As Australia developed and improved its quarantine processes and regulations over the following decades, further improvements were made to existing buildings, and new facilities added and others removed, to service the

quarantine station, with much of the federation era construction still visible today (Habitable Places Architects 2014: 25).

The devastation of the outbreak of Spanish Influenza at the end of World War One (WWI) caused global panic and hundreds of soldiers returning from service were quarantined on Torrens Island (Habitable Places Architects 2014: 19). In 1921 a Venereal Diseases Hospital was constructed on the site of the current Power Station. The building suffered fire damage in 1950 and was demolished in 1999. In 1993 the Torrens Island Quarantine Station (CT 4331/286 Sec 1029, 1030 &1031 Hd Port Adelaide) was listed on the State Heritage Register. Another period of construction of the quarantine station began in the 1960s with the removal, sale and destruction of many of the timber dwellings and the building of new animal quarantine facilities.

In 1980 the World Health Organisation declared the world-wide eradication of smallpox (WHO 2010). The facilities at Torrens Island were closed for human quarantine the same year. In 1989 an avian quarantine station was constructed on the island and animal quarantine services remained in operation until 1995 (Habitable Places Architects 2014: 15).

3.1.1.2 Internment Camps

On 5 August 1914 war with Germany was declared. Five days later the Australian government proclaimed all German subjects were to report to their nearest police station, and two days after that Austrian subjects were required to do the same (Monteath *et al.* 2014: 18). An intern camp opened on Torrens Island on 9 October 1914, which soon became known as the Torrens Island Concentration Camp (Monteath *et al.* 2014: 19) (Figure 3.1). Up to 400 men of German or Austro-Hungarian decent were held at Torrens Island.

The first camp on Torrens Island was established a short distance south of the quarantine station, west of the current Project area. In 1915 the camp was relocated to the southern point of the island where conditions were so poor the camp was considered the worst in Australia (Habitable Places Architects 2014: 29). The camp was closed on 17 August 1915 (Monteath *et al.* 2014: 90). Seventeen Japanese soldiers were held in quarantine on Torrens Island in 1942.

Figure 3.1 : Torrens Island Concentration Camp photographed by prisoner Paul Bubotski c1914, State Library of South Australia, Torrens Island Collection B12161.

3.1.1.3 Sand mining

Sand extraction for land fill, north of the southern-most (AGL) power station on Torrens Island, commenced in 1963. Between 1988 and 1990, 187,500 cubic metres of sand from Torrens Island had been relocated to Glenelg North Beach to address problems with sand erosion along the coast (Bell 2012: 9).

3.1.1.4 Sea wall

Torrens Island was susceptible to flooding due to its low lying aspect. In 1881 embankments were raised to protect the buildings and inhabitants. Repairs were made to the Sea Wall in 1950, however this proved insufficient and following a serious flood a new timber Sea Wall to raise the height was constructed ten years later. The current Sea Wall follows the alignment of the original timber Sea Wall, however no original fabric remains (Habitable Places Architects 2014: 93). Following the construction of the Moomba gas pipeline in 1969, a road was constructed behind the Sea Wall. The existing Sea Wall is currently maintained by Origin.

3.1.1.5 Power stations

Until 1963 South Australia was heavily reliant upon imported coal for power generation. Gas was found in the Cooper Basin in 1958 and construction of pipelines began to transport the gas to Adelaide. The causeway and bridge to Torrens Island were built in the early 1960s which facilitated construction of the first power station on the island, commissioned in 1966. Power generation on Torrens Island began in 1967 and was initially fuelled by oil, with gas connected to the power station in 1969. A second power station, built by Origin Energy, was constructed in 1999 in the eastern area of the old quarantine station site (Bell 2012: 9). A 66 kV overhead transmission line currently connects the Torren Island Power Station (AGL) to the Quarantine Power Station (Origin) which is in the northern portion of the Project area (Figure 1.1). In order to address the increased capacity the proposed underground transmission line will primarily follow the existing road alignment and a portion of the existing 66 kV transmission line between the two power stations.

3.1.1.6 Conservation park

In 1972 the northern and eastern intertidal mangroves and salt marshes were proclaimed a Conservation Park. This was extended in 2005 to include the remaining intertidal zone which covers much of the island apart from the ridge of sand dunes west of the Project proposed alignment (Figure 1.1). The Adelaide Dolphin Sanctuary, which comprises 118 square km and encompasses Torrens Island, was established in 2005 in order to protect a population of *Tursops aduncus* (Indo-Pacific bottlenose dolphin) (Department of Environment Water and Natural Resources 2014).

3.1.1.7 Continued Quarantine Station use

In 2009 a program of asbestos removal commenced at the Quarantine Station with the cladding replaced on buildings constructed from asbestos cement sheeting. Military and police exercises were held on the site in 2011, however activities ceased following reports of damage to the attendant's cottage (Habitable Places Architects 2014: 43). Management of the land came became the responsibility of the DPTI in 2013. Other site uses have included camping facilities for Scouts, the Youth Adventure Recreation Service and storage for the Department of Health mosquito eradication program (Habitable Places Architects 2014: 44). The South Australian Maritime Museum conducts regular tours of the Quarantine Station, and the Friends of Torrens Island facilitates community picnics and undertakes site maintenance on the Quarantine Station.

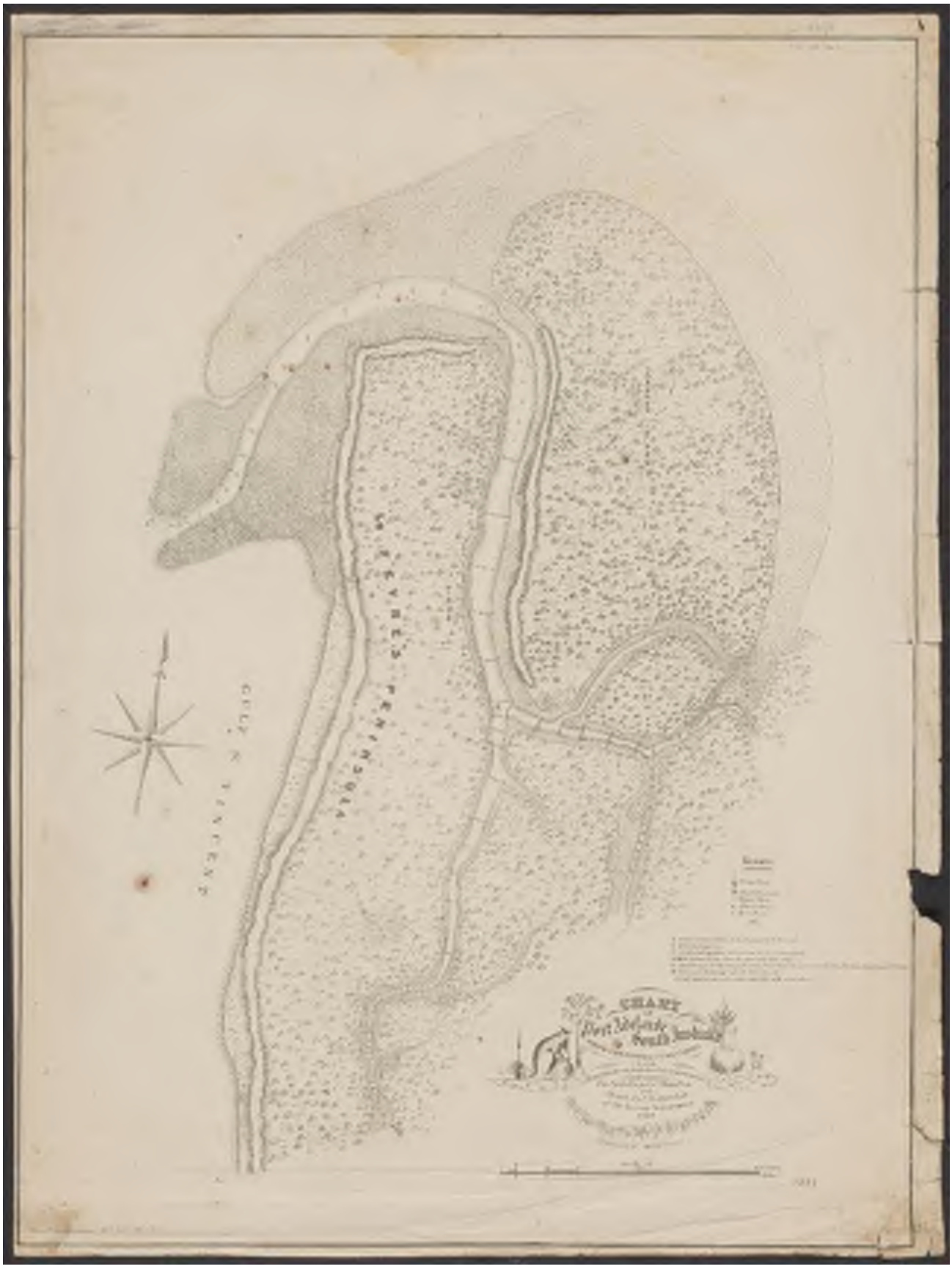

Figure 3.2 : Colonel Light's survey map of Torrens Island 18339, National Library of Australia 3584294.

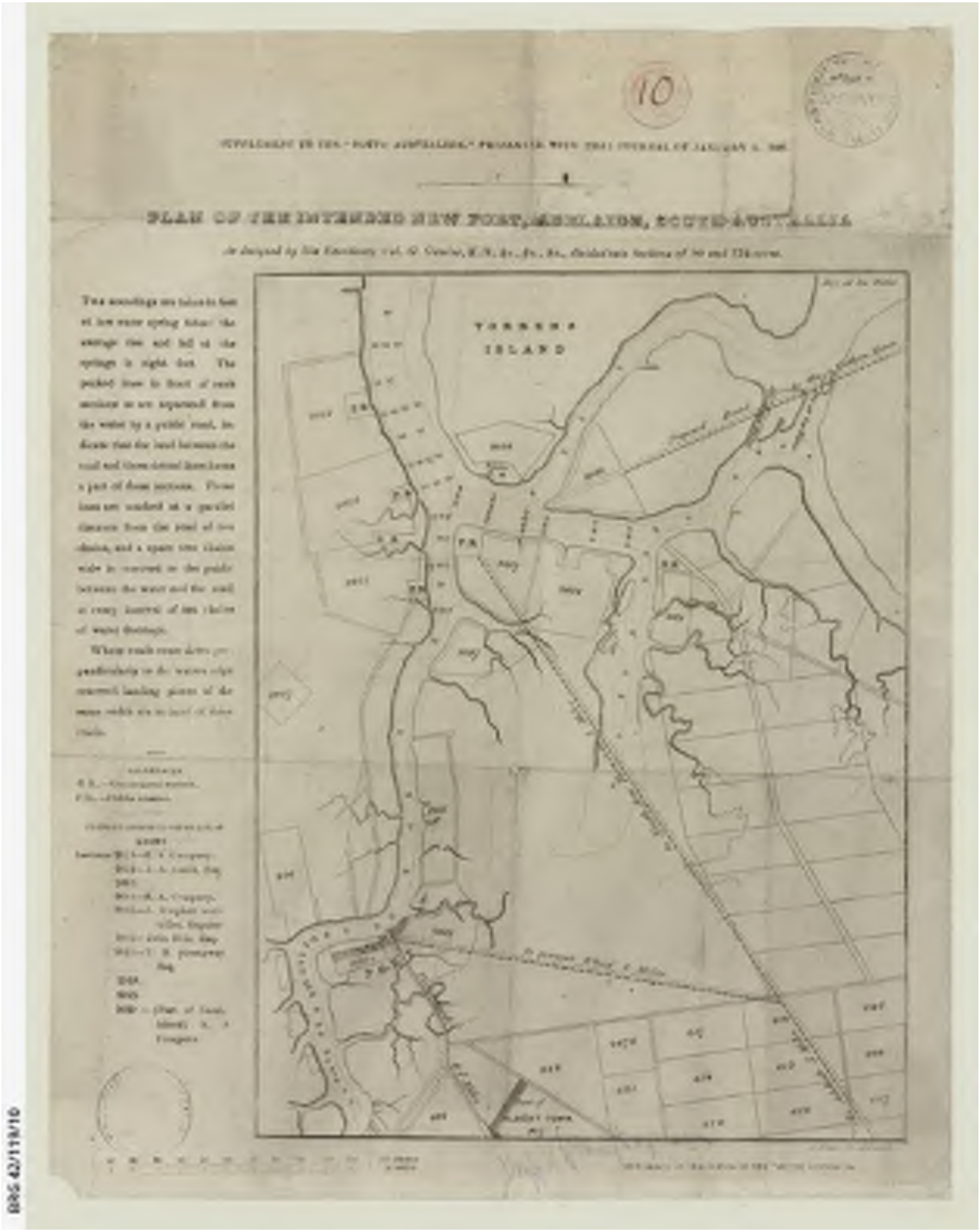

Figure 3.3 : 1846 map showing parcel of land (2016) on Torrens Island owned by John Ellis, State Library of South Australia BRG 42/119/10.

Figure 3.4 : Map of Quarantine Station historical heritage places

3.2 Heritage context

3.2.1 Register searches

The following heritage registers were searched on 27 November 2017 to determine whether any known historical heritage places were present within the Project area:

- South Australian Heritage Register (SAHR)
- National Trust Register
- CHL
- NHL
- World Heritage List
- RNE (non-statutory archive)

No registered historical heritage places are situated within the Project area.

The Torrens Island Quarantine Station Complex is listed on the SAHR (13931) and RNE (14866), and the Torrens Island Conservation park is listed on the RNE (6255). The Torrens Island Quarantine Station Complex is immediately west of the South Option of the current study area Figure 3.4.

3.2.2 Torrens Island Quarantine Station Conservation Management Plan

The Torrens Island Quarantine Station (TIQS) Conservation Management Plan (CMP) (Habitable Places Architects 2014) provides a comprehensive summary of the history and assessment of the structural elements of the Quarantine Station. The CMP summarised a number of previous studies of the Quarantine Station, including heritage assessments, conservation management plans, and historical investigations. The investigation undertaken to inform the CMP included a comparative analysis with other quarantine stations and an assessment of significance.

Nineteen structures were examined in the CMP. All structures investigated were within Lot 306, apart from the cemetery and well located in Lot 300 (Figure 3.5). It should be noted that Lot 301 is mislabelled in the CMP (Figure 3.5) and should be identified as Lot 300. Lots 300 and 306 are north and west, respectively, of the current study area (Figure 1.1).

A number of places and services were excluded from the 2014 CMP (Habitable Places Architects 2014: 5). Those excluded places located within the current Project area were:

- Animal quarantine uses and buildings (Lot 302).
- Internment camp sites (trotting track).

In addition, the CMP also did not include in the assessment:

- Detailed archaeological assessment and investigations.
- Indigenous cultural heritage.

The CMP identified the structures associated with the Quarantine Station (Figure 3.5) and the areas of historical archaeological potential at the site (Figure 3.6).

Figure 3.5 : Quarantine Station structures identified in the CMP (Habitable Places Architects 2014: 4). Note that the area identified as Lot 301 in the figure is Lot 300. Lot 301 is the portion of unidentified land east of Lot 306.

Figure 3.6 : Quarantine Station areas of archaeological potential (Habitable Places Architects 2014: 114)

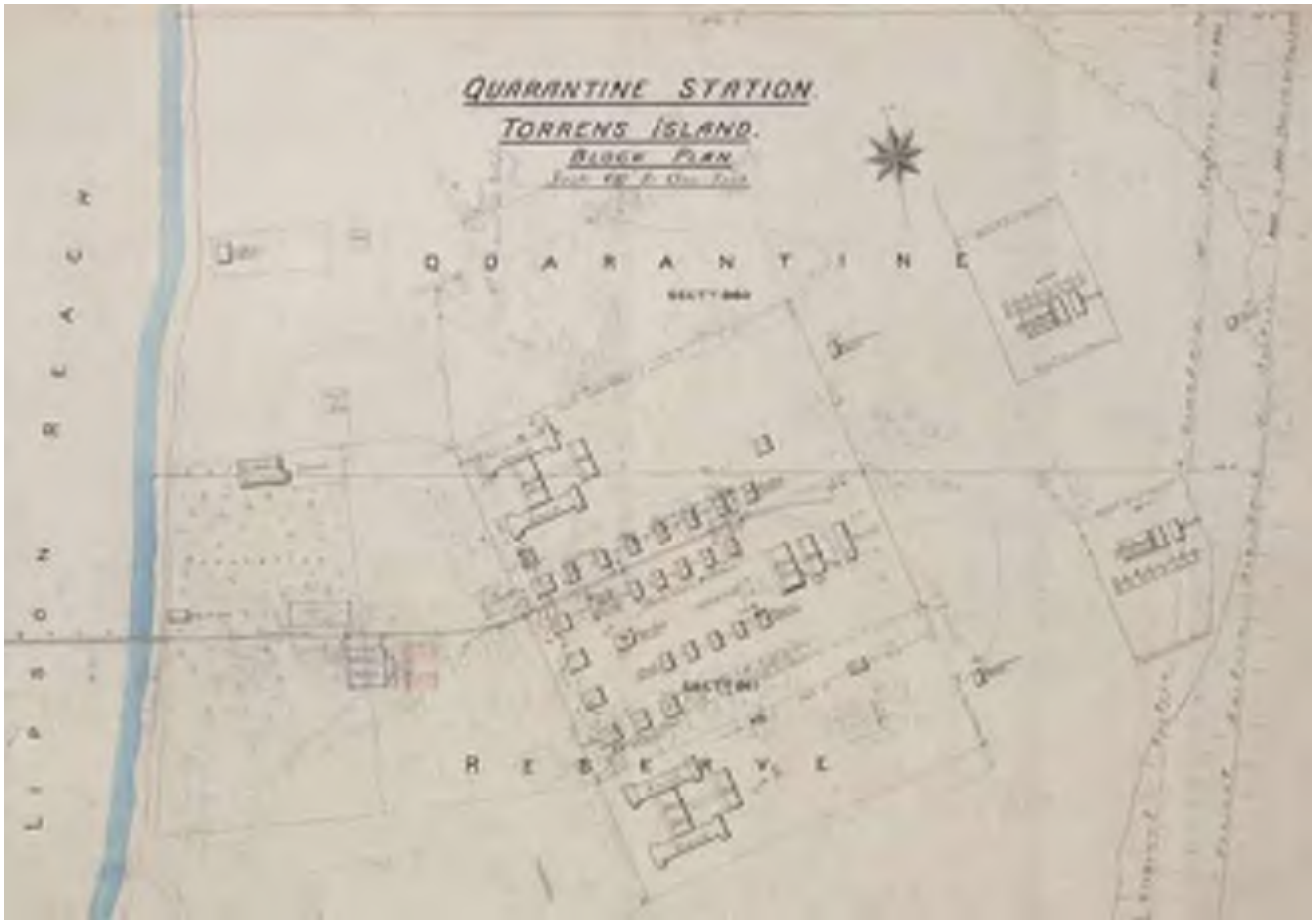

Figure 3.7 : Quarantine station plan from 1910 (NAA_folder_57_D9 1910 Block Plan, cited in Habitable Places Architects 2014: 84)

4. Historic heritage survey

4.1 Field survey

4.1.1 Methodology

A historical heritage field survey was undertaken on 12 December 2017 by Andrew Wilkinson (Project Archaeologist, Jacobs) and Dr Karen Murphy (Technical Leader - Historical Heritage, Jacobs). The survey was conducted on foot with the ground surface inspected for historical heritage with six structures inspected and recorded. The survey areas, and structures inspected, are shown in Figure 4.1, and also followed the road where the underground transmission cable is proposed as shown in Figure 1.1.

Two additional areas proposed as laydown areas outside the two options for the generators (Figure 4.1) were also inspected for historic heritage. The laydown areas outside the two options are highlighted in yellow (Figure 4.2), with one comprising the northeast portion of the trotting track west of South Option, and the second in the south east corner of the Quarantine Station within the State Heritage Place boundary, west of the North Option.

Information relating to the environmental and archaeological context of the current Project area including landscape features, structure location and ground disturbance within the Project area were recorded during the survey. Photographs were taken with a digital SLR camera.

Results of the structural integrity assessment (Jacobs, 2017) of the buildings one, two and three were also used to inform the structural state of the buildings and are summarised in Section 5.

4.1.2 Constraints

The majority of the Project area has been subject to a degree of ground disturbance, and is covered with low to medium height grass or low vegetation groundcover, which hindered visibility of the natural ground surface. No other constraints existed in the Project area.

The following types of land use were recorded across the Project area:

- Vegetation clearance, fencing and grazing
- General storage of industrial materials
- Ground levelling
- Power station and gas pipeline construction
- Seawall construction
- Demolition of buildings
- Road reserve

4.2 Survey results

A significant portion of the Project area has been subject to land use activities associated with quarantine services, pastoralism, fencing, power station building infrastructure, equipment storage and vehicle tracks. Two areas identified as proposed laydown areas were inspected and are described below. Six structures, including three historical buildings, were inspected as part of the field survey. One area, the site of now demolished nurses' cottages, was assessed as having low archaeological potential.

4.2.1 Proposed laydown areas

The northeast portion of the trotting track (D90964 Q302) (also known as the race track) comprised a shallow depression of salt and mudflat region. The area is bounded by a Sea Wall and access road along the west and south boundaries, and a levy along the east boundary which forms the west boundary of the South Option area (Figure 4.1). Bare ground surface was visible amongst low marsh shrubs with a pocket of medium height

vegetation near the west boundary of the proposed laydown area. Some modern construction material was found in this area, but no historic heritage was identified. As this is believed to be the site of the earlier internment camp there may be some archaeological potential.

The proposed laydown area in the south east corner of the Quarantine Station State Heritage Place boundary (D90964 Q306) (Figure 4.3) includes the remains of a bitumen road following along the east-west alignment of the fence line that marks the southern boundary of the Quarantine Station site. The grass was cut low with some ground surface visible over the site. A large depression is evident where the two large trees now stand (Figure 4.3). Fragmentary remains of building material comprising brick, tile and glass were found within the depression and the surrounding area. This may be the location of the now demolished single women's quarters (Figure 3.6 and Figure 3.7) and may hold archaeological potential. This proposed laydown area was used as the laydown area for the generator constructed in 2009 (Bill Truscott, pers. Comm, 2 January 2018)

4.2.2 Animal Quarantine Station Horse Stable (Structure 1)

The Animal Quarantine Station Horse Stable (Structure 1) (Figure 4.1) is within the parcel of land D90964 Q302 and is the larger of the three buildings (Structures 1-3) remaining of the animal quarantine area (Figure 4.4 and Figure 4.5). The building is part of the 1909 Commonwealth transfer and relocation of the animal quarantine station. It is possible that the building dates to the initial relocation or later 1912 construction phase. The building was used to house horses during quarantine services.

The building is a timber frame construction on a concrete foundation built to a standard design. The roof is an open gable type with corrugated steel sheeting. The building has wooden cladding exterior and interior walls with eaves that extend further out on the eastern side where stable doors provide access to the interior bays. The stable doors are galvanised metal frames with wooden panelling.

The building is showing signs of deterioration with deterioration of the timber frame, corrosion of the metal roof sheeting and gutters, and paint peeling from the outer surfaces due to exposure to the environment. Sections of the cladding have been removed. Pigeons have taken roost inside with significant amounts of bird faeces throughout.

4.2.3 Animal Quarantine Station Loose Boxes for Cattle Shed (Structure 2)

The Animal Quarantine Station Loose Boxes for Cattle Shed (Structure 2) (Figure 4.1) is within the parcel of land D90964 Q302 and east of Structure 1 (Figure 4.6). The building is part of the 1909 Commonwealth transfer and relocation of the animal quarantine station. It is possible that the building dates to the initial relocation or later 1912 construction phase. The building was used to house or service cattle during quarantine.

The building is a timber frame construction on a concrete foundation built to a standard design. The roof is an open gable type with corrugated steel sheeting. The building has wooden cladding exterior and interior walls with eaves that extend further out on the eastern side where stable doors provide access to the interior bays. The stable doors are galvanised metal frames with wooden panelling.

The building is showing signs of deterioration with corrosion of the metal roof sheeting and gutters, and paint peeling from the outer surfaces due to exposure to the environment. The timber frame appears to be in good condition. Sections of the cladding have been removed. The interior construction appears largely sound; however, pigeons have taken roost inside with significant amounts of bird faeces throughout.

4.2.4 Animal Quarantine Station Store and Mans room (Structure 3)

The Animal Quarantine Station Store and Mans room (Structure 3) (Figure 4.1) is within the parcel of land D90964 Q302 and north of Structure 2 (Figure 4.7). The building is part of the 1909 Commonwealth transfer and relocation of the animal quarantine station. It is possible that the building dates to the initial relocation or later 1912 construction phase. The building was originally used for veterinary services.

The building is a timber frame construction on a concrete foundation built to a standard design. The roof is an open gable type with corrugated steel sheeting. The building has wooden cladding exterior with exterior and

interior panel walls and ceiling. Some panels are labelled with Asbestos warning stickers. A brick chimney on the eastern side, and double doors on the western side are two additional features of this building. A later besser block addition extending from the southeast of the building comprises kennels (Figure 4.8).

The exterior of the building is showing signs of deterioration with some corrosion of the metal roof sheeting and gutters, and paint peeling from the outer surfaces due to exposure to the environment. Some of the removal of the exterior cladding indicates that the timber frame appears to be deteriorating. The interior appears largely sound.

4.2.5 Reinforced concrete circular water tank (Structure 4)

Structure 4 is near the eastern boundary of the North Option of the current Project area, and a few metres southeast of Structure 5 (Figure 4.1). The reinforced circular water tank (Figure 4.9) is installed in the ground and protrudes approximately 50 cm above the ground level. It is approximately 13 m in diameter and is approximately 130 cm in depth. Remnant pipes and fittings are still evident in the structure. The water tank appears to be of more recent construction and does not appear to feature in a 1966 map indicating construction details of a Push Button Fire Alarm (Habitable Places Architects 2014: 34). The structure is in good condition with little evidence of cracking or damage to the fabric.

It is likely the structure was built during the period of quarantine station development during the 1970s to provide the water needs of the Quarantine Station and therefore has association with the later phases of quarantine services on the island.

4.2.6 Reinforced concrete water tank (Structure 5)

Structure 5 is just east of the centre of the North Option of the current Project area, and a few metres northwest of Structure 4 (Figure 4.1). The reinforced concrete water tank (Figure 4.10) is a square enclosed construction with four access openings on top. It is approximately 14 m in length and extends above the ground surface for approximately 2 m in height. Remnant pipes and fittings associated with the structure are still evident. As with Structure 4 the water tank appears to be of more recent construction and does not appear to feature in the 1966 Push Button Fire Alarm system map (Habitable Places Architects 2014: 34). The structure is in good condition with little evidence of cracking or damage to the fabric.

It is likely the structure was built during the period of quarantine station development during the 1970s to provide the water needs of the Quarantine Station and therefore has association with the later phases of quarantine services on the island.

4.2.7 Square water tanks (Structure 6)

Two rectangular water tanks approximately 5.5 m by 6.5 m in size are located in the northwest portion of the North Option of the Project area (Figure 4.1). These two tanks are constructed of brick with a corrugated metal sheeting roof and gutter that collects water and feeds into the water tank. The structures extend above the ground surface for approximately 1 m in height and feature supporting buttresses (Figure 4.11). An elevated pipe connects the two tanks to one another.

These two structures are similar in size and construction details of two water tanks found in the Quarantine Station State Heritage Place boundary south of the remaining cottages, to the east of the current Project area (Figure 3.5). It is likely these were constructed at a similar time and serviced the buildings in the vicinity such as the nurses' quarters and recreation hall, which are now demolished (Figure 3.6).

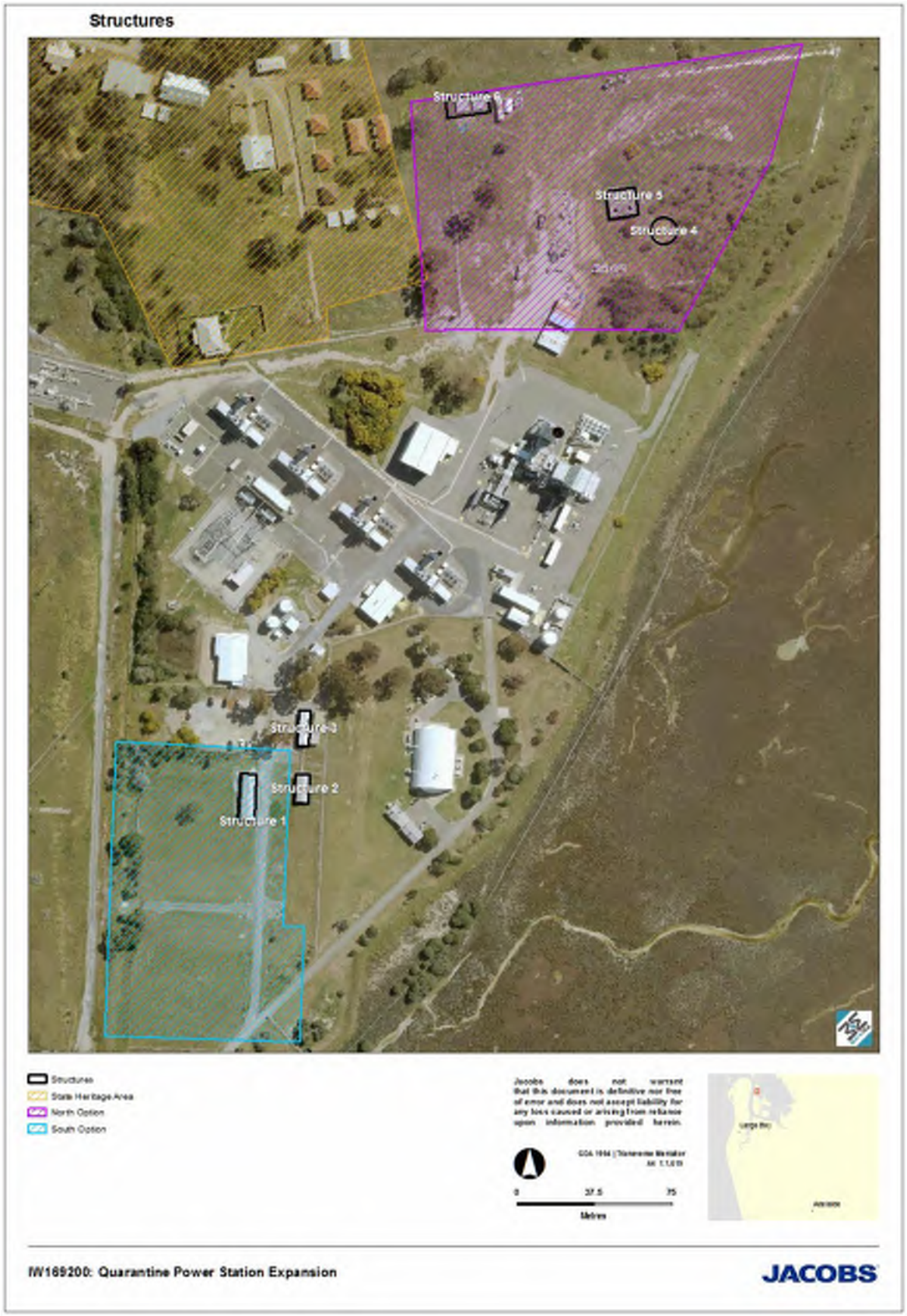

Figure 4.1 : Historic heritage survey areas and structure locations

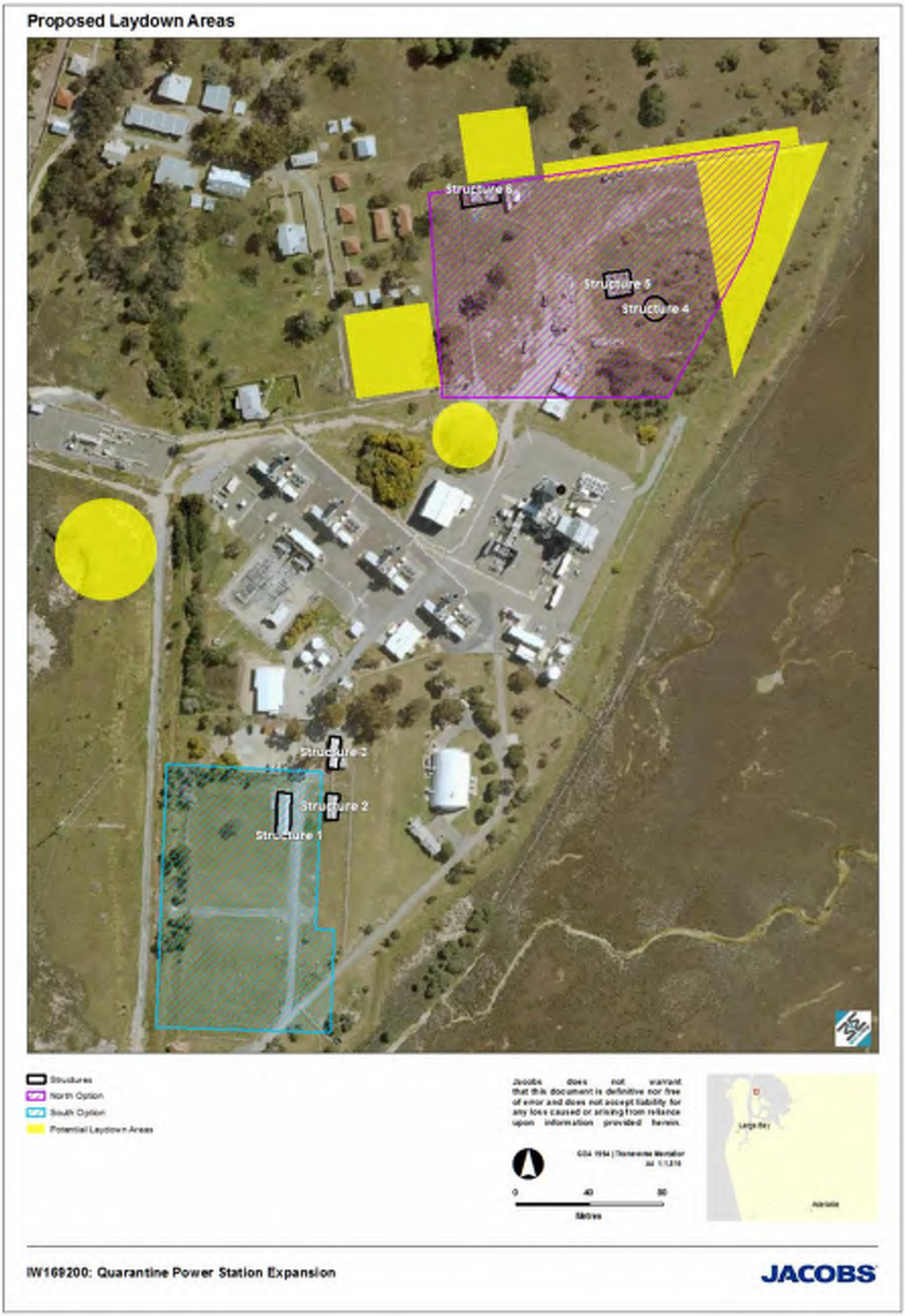

Figure 4.2 : Proposed laydown areas inspected for historic heritage

Figure 4.3 : View of proposed laydown area within the Quarantine Station State Heritage Place boundary, facing south.

Figure 4.4 : Overview of the three animal quarantine buildings (Structures 1, 2 and 3), facing north east.

Figure 4.5 : Animal Quarantine Station Horse Stable (Structure 1), facing north west.

Figure 4.6 : Animal Quarantine Station Cattle Shed (Structure 2), facing north west.

Figure 4.7 : Animal Quarantine Station Store and Mans room (Structure 3), facing south east.

Figure 4.8 : Animal Quarantine Station Store and Mans room (Structure 3) interior of Structure 3 kennels room, facing southeast.

Figure 4.9 : Reinforced concrete circular water tank (Structure 4), facing north.

Figure 4.10 : Reinforced concrete water tank (Structure 5), facing northeast.

Figure 4.11 : Brick water tanks (Structure 6), facing north east.

Figure 4.12 : Overview of the location of former nurses' cottages now demolished, facing west.

5. Structural assessment results

A structural assessment of Structures 1,2 and 3, within the South Option of the Project area, were undertaken by Jacobs on 23 November 2017. The buildings were assessed for possible removal, relocation and structural integrity (Steele 2017). Assessment of the structures within the North Option (Structures 4, 5 and 6) were not undertaken.

The results and recommendations below are taken from the Historical (Built) Heritage - Structural Assessment report (Steele 2017).

5.1.1 Structure 1 – Animal Quarantine Station Loose Boxes for Horses

Jacobs recommend that if the structure were to be removed from site and reinstated at another location, the following would need to be completed as a part of the requirements for compliance with the Buildings Code of Australia (BCA):

1. The existing timber frame will need to be replaced with a new hard wood timber frame, such that structural integrity of the structure can be confirmed and original appearance is maintained.

2. All weatherboard cladding will need to be restored or replaced in order to protect the frame of the structure from weathering. The majority of the weatherboard will likely need replacing due to the age, and removal of these boards is likely to result in the boards cracking or breaking.

3. All gutters and roof sheeting requires replacement as current materials have experienced high levels of corrosion, the severity of which has been increased due to close proximity to salt water.

4. New foundations will need to be designed for the desired location.

5. The doorway panels leading into the holding bays pose serious safety concerns due to the aged and corroded brackets. These brackets would need to be replaced and the latches on the panels require replacing.

6. As the structure has been left open for an extended period of time, the pigeon faeces has built up to unhygienic levels. This will need to be thoroughly cleaned before disassembly of the structure in order to avoid safety concerns around bacteria build up potentially causing illness, infections or spread of diseases.

Overall the current condition of the structure does not meet current BCA standards and will require significant works and refurbishments to attain this. Due to the significant works required in moving and repairing the structure, the process is unlikely to be economically feasible, however this would depend heavily on the historical value of the structure.

5.1.2 Structure 2 – Animal Quarantine Station Loose Boxes for Cattle Shed

Jacobs recommend that if the structure were to be removed from site and reinstated at another location, the following would need to be completed as a part of the requirements for compliance with the Buildings Code of Australia:

1. The existing timber frame will need to be replaced with a new hard wood timber frame, such that structural integrity of the structure can be confirmed and original appearance is maintained.

2. All weatherboard cladding will need to be restored or replaced in order to protect the frame of the structure from weathering. The majority of the weatherboard will likely need replacing due to the age, and removal of these boards is likely to result in the boards cracking or breaking.

3. All gutters and roof sheeting requires replacement as current materials have experienced high levels of corrosion, the severity of which has been increased due to close proximity to salt water.

4. New foundations will need to be designed and constructed for the desired new location.

5. The doorway panels leading into the holding bays pose serious safety concerns due to the aged and corroded brackets. These brackets would need to be replaced and the latches on the panels require replacing.

6. As the structure has been left open for an extended period of time, the pigeon faeces has built up to unhygienic levels. This will need to be thoroughly cleaned before disassembly of the structure in order to avoid safety concerns around bacteria build up potentially causing illness, infections or spread of diseases.

Overall the current condition of the structure does not meet current BCA standards and will require significant works and refurbishments to attain this. Due to the significant works required in moving and repairing the structure, the process is unlikely to be economically feasible, however this would depend heavily on the historical value of the structure.

5.1.3 Structure 3 – Animal Quarantine Station Store and Mans room

Jacobs recommend that if the structure were to be removed from site and reinstated at another location, the following would need to be completed as a part of the requirements for compliance with the Buildings Code of Australia:

1. The existing timber frame will need to be replaced with a new hard wood timber frame, such that structural integrity of the structure can be confirmed and original appearance is maintained.

2. All weatherboard cladding will need to be restored or replaced in order to protect the frame of the structure from weathering. The majority of the weatherboard will likely need replacing due to the age, and removal of these boards is likely to result in the boards cracking or breaking.

3. Due to the significant health hazards posed by asbestos materials, the structure will need to be safely dismembered and all asbestos removed in accordance to relevant Australian Standards.

4. A new chimney will need to be constructed at the new location to replicate the original chimney that is currently in place.

5. At the location that the blockwork building interacts with the weatherboard cladding structure, the structure entrance will need to be sealed.

6. All gutters and roof sheeting requires replacement as current materials have experienced moderate levels of corrosion. The severity of this corrosion has been increased due to close proximity to salt water.

7. New foundations will need to be designed and constructed for the desired new location.

Overall the current condition of the structure does not meet current BCA standards and will require significant works and refurbishments to attain this. Due to the significant works required in moving and repairing the structure, and considering the added complications of asbestos contamination the process is unlikely to be economically feasible, however this would depend heavily on the historical value of the structure.

6. Heritage significance

6.1 Significance assessment

The Quarantine Station was assessed for the CMP (Habitable Places Architects 2014) against the State Heritage Criteria outlined in the Act with guidance from the Burra Charter (Australia ICOMOS 2013).

The information in Table 6.1 is reproduced directly from the CMP (Habitable Places Architects 2014).

Table 6.1 : Assessment against the State Heritage Criteria (Habitable Places Architects 2014)

	Criterion	Description
Criterion A	It demonstrates important aspects of the evolution or pattern of the State's history.	The Torrens Island Quarantine Station is historically significant because it relates directly to the growth of South Australia as a separate colony. The layout, landscape and spatial elements of the quarantine station reinforce the social and medical philosophies underlying quarantine principles. It demonstrates the early adoption of the science of germ theory by the medical profession in South Australia, and the development of an integrated national quarantine system after Federation. The quarantine station and its siting at Torrens Island reflects its role in the maritime, medical and immigration history of the state. It highlights the final stage of a lengthy, arduous and risky journey for some of the 19th and 20th century South Australian immigrants. The quarantine station played a key maritime role by allowing quarantined ships whose crew and passengers had been transferred to Torrens Island, to be fumigated and granted pratique, minimising disruption to trade and cost to ship owners. Although it was a land based quarantine station, Torrens Island's primary role was maritime. The isolation provided by its island location was central to its quarantine function. The jetty provided an effective point of control for access to the station. The eventual closure of the station reflected the pattern of change from maritime immigration to mass air travel. The quarantine station is significant because changing community expectations of accommodation and workplace standards are reflected in the development of similar building types constructed at Torrens Island. The 1960s chalets, quarantine office and cyanide store contribute to the cultural significance by contrasting with the earlier buildings for the same uses, throwing changing standards into relief.
Criterion B	It has rare, uncommon or endangered qualities that are of cultural significance.	Torrens Island quarantine station is the only example of a site used for maritime quarantine in South Australia. It is the only place that can effectively tell the story of keeping infectious diseases from taking hold in the community. The village character of the station and its cultural landscape, set against a low coastal environment, and arranged around a tramway is uncommon. It derives from its unity of purpose and its development in three phases. It is distinct from the landscape character of other quarantine stations in Australia. The systematic selection of the isolated site, the provision of buffer zones, the separation between compounds of the 1879 station, and the later provision of an integrated sewerage system reflect aspects of the widely held miasma theory of the transmission of contagious disease. The principles underlying germ theory are reflected by the order and arrangement of the Commonwealth period quarantine processing buildings and the internal division of buildings into foul, disinfecting and clean zones. Such unity of purpose reflected across a whole site, in the design of all of the elements and in its operation, is rare.

	Criterion	Description
		The 1878 Timber Cottage is a rare surviving and exceptionally intact example of a prefabricated colonial building, in this case from the United States, that remains on the site where it was originally erected. The existence and integrity of the furnishings and finishes of the remaining cottage, artefacts that relate directly to its historical use, is particularly uncommon. These values are endangered by the current condition and vulnerability of the building and contents. Torrens Island artefacts, records and documents from the quarantine station's days of operation, that are held in national and state collections contribute to the interpretive potential of the site.
Criterion C	It may yield information that will contribute to an understanding of the State's history, including its natural history.	The Torrens Island Quarantine Station is architecturally and environmentally significant because it retains physical evidence of the human and animal quarantine practice as undertaken in South Australia since the 1870s. The extant buildings reflect the physical processes of disinfecting and quarantine of various periods, the early Commonwealth period of 1911-1921 providing the most intact physical evidence. Torrens Island contributes to the understanding of social, moral and community values and their changes over time. Attitudes of discrimination towards non-European contacts and patients are evident from the historical records. The Bathing Block and cottage layouts reflect class distinctions. Later the station played an important role in the mass post WW2 immigration that transformed Australian society and values. It was a memorable part of the immigration experience for many Australians. The Torrens Island quarantine station records the development of medical practices in controlling infectious diseases as related to the relevant Parliamentary Acts for Quarantine in South Australia and the Commonwealth. It formed an integral part of a national system of quarantine established under the Commonwealth Quarantine Service. The Adelaide medical profession, in particular Quarantine officers based in Semaphore and Port Adelaide, and the Central Board of Health, played a key role at Torrens Island. Torrens Island demonstrates the independent stance to quarantine taken by Australian States and later the Commonwealth, against pressure from Britain for a less stringent system. The role of Torrens Island as a non–maritime quarantine station and cemetery during the plaque outbreaks early in the 20th century has not previously been recognised, and is important.
Criterion D	It is an outstanding representative of a particular class of places of cultural significance	Not assessed or did not meet this criterion.
Criterion E	It demonstrates a high degree of creative, aesthetic or technical accomplishment or is an outstanding representative of particular construction techniques or design characteristics	Not assessed or did not meet this criterion.
Criterion F	It has strong cultural or spiritual associations for the community or a group within it	Not assessed or did not meet this criterion.
Criterion G	it has a special association with the life or work of a person or organisation or an event of historical importance.	Not assessed or did not meet this criterion.

A review of the 1986, 1988 and 2014 CMPs undertaken by Michael Queale of DEWNR for the South Option and North Option indicated that although Structures 1-6 are not heritage listed they are of heritage interest and are associated with the Torrens Island Quarantine Station (Michael Queale, pers. Comm, 19 July 2017). Structures 1-3 are part of the 1909 Animal Quarantine Station relocation and represent the ongoing and diverse activities up until recent times. Structures 4 and 5 are of historic interest due to the association of the Quarantine Station, however are not essential to the understanding of the heritage values of the site. The two water tanks comprising Structure 6 are of the same provenance and design of extant water tanks within the State Heritage place and are of associated value to the State heritage place (Michael Queale, pers. Comm, 19 July 2017).

6.2 Areas of archaeological potential

6.2.1 Archaeological potential South Option

There was no archaeological potential for the South Option identified in the CMP (Habitable Places Architects 2014).

During the field survey some fragments of 19th and 20th century ceramic material were located in the South Option area; however, the fragments were few and largely isolated. The source of this material and relationship to historical structures was unable to be determined and could have been brought into the area as construction fill. The archaeological potential of this area is assessed as being low.

6.2.2 Archaeological potential North Option

Assessment of the archaeological potential of the Quarantine Station were outside the scope of the CMP (Habitable Places Architects 2014: 115), however areas of archaeological potential were identified where buildings have been demolished in the Accommodation Compound and 1879 Isolation Wards precincts, as defined in the CMP. A portion of both precincts are within the North Option Project area and a number of these demolished buildings are within the boundary of the North Option (Figure 3.6).

Demolished buildings identified within the North Option Project area are:

- Nurses cottages
- Recreation hall
- Fumigation chamber
- Probationary ward
- Unidentified structures within the boundary of the proposed development.

During the field survey some fragments of 19th and 20th century ceramic material was located in the North Option area; however, the source of this material and relationship to historical structures was unable to be determined and could have been brought into the area as construction fill.

One area of archaeological potential was identified during the survey. The ground surface of the North Option appears to have been built up and levelled, possibly as part of the construction of the 2009 generator. A depression and tall vegetation near the west fence line of the North Option is in the location of the former nurses' cottages (Figure 4.12). While there is some potential of subsurface archaeological material to be present, it appears likely that the demolition of these buildings during the 1980s was thorough and has left few remains. Therefore, the archaeological potential of this area is assessed as low.

7. Impact assessment and mitigation measures

7.1 Description of proposed activities

The proposed works includes the construction and installation of three new gas turbine generators and ancillary equipment in the location of either the northern area or southern area of the existing Origin Quarantine Power Station. Works will include connection to the existing gas pipeline network west of the Power Station and the installation of a 275 kV underground transmission line connecting the new generator to the existing transmission grid at the AGL TIPS. Works will include trenching, ground disturbance for the installation and associated construction laydown areas.

7.2 Buildings and structures

North Option

Development within the North Option would have minor adverse visual impact on the setting of the State Heritage place, however this would be little more than that of the current generators at the existing Power Station (Michael Queale, Pers. comm, 19 July 2017).

South Option

Visual impacts on the heritage significance of the Quarantine Station overall would be minor as development within this option would result in negligible visual impact on the State Heritage place as it is immediately south of the existing Power Station and is separated from the State Heritage place by the current turbines and infrastructure.

The three buildings located in the vicinity of the proposed South Option (Structures 1, 2 and 3) are of historical interest, but they have only a minor contribution to the overall significance of the Quarantine Station. The structural assessment of Structures 1,2 and 3 undertaken by Jacobs (Steele 2017) indicated that the current condition of each structure does not meet current Building Code of Australia (BCA) standards and would require significant works and refurbishments to meet the standard, including the replacement of substantial portions of original fabric. Due to the significant works required in moving and repairing the structure, the process is unlikely to be economically feasible.

7.3 Archaeological potential

There is a low likelihood of archaeological potential within the vicinity of the South Option due to significant existing ground disturbance from construction and land use within the survey area. There is a low likelihood of archaeological potential within the vicinity of the North Option due to significant ground disturbance from the power station generator construction and ground clearance of rubble following building demolition. Therefore, there is no recommendation for either archaeological monitoring during construction works, or test or salvage excavation prior to construction works. However, if archaeological artefacts are discovered during works, the following measure would be implemented.

7.3.1 Discovery of archaeological artefacts

In the event of the discovery or location of an archaeological artefact of heritage significance, excavation or disturbance work must cease at the place where the relevant object has been discovered and the State Heritage Council must be notified within five business days. No other activities or disturbance can occur in the area until the Council has provided a permit or other authorisation to continue.

8. References

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Quarantine Power Station Expansion

Origin Energy

Torrens Island Quarantine Station: Animal Quarantine Area

Archival Photographic Record

IW169200 | 0

15 January 2018

Quarantine Power Station Expansion

Project No:	IW169200
Document Title:	Torrens Island Quarantine Station: Animal Quarantine Area
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Document history and status

Revision	Date	Description	By	Review	Approved
V1	12 January 2018	Technical review	Andrew Wilkinson	Karen Murphy	Karen Murphy
0	15 January 2018	Issue to Client	Andrew Wilkinson	Karen Murphy	Kelly Briton-Jones

Contents

List of figures

Abbreviations

DEWNR	Department of Environment, Water and Natural Resources
Jacobs	Jacobs Group (Australia) Pty Ltd
m	metres
North Option	Option for the generator north of the current Quarantine Power Station
Origin	Origin Energy
South Option	Option for the generator south of the current Quarantine Power Station
the Project	Quarantine Power Station Expansion project
TIQS	Torrens Island Quarantine Station
QPSX	Quarantine Power Station Expansion

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs Group (Australia) Pty Ltd (Jacobs) is to prepare an archival photographic record of three structures associated with the relocated 1909 Animal Quarantine Station, Torrens Island, for Origin Energy (Origin) in accordance with the scope of services set out in the contract between Jacobs and Origin Energy (Origin). That scope of services, as described in this report, was developed with Origin.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by Origin and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from Origin (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of Origin, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and Origin. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 Project background

Jacobs Group (Australia) Pty Ltd (Jacobs) was engaged by Origin Energy (Origin) to undertake a historical heritage impact assessment of the proposed Quarantine Power Station Expansion (QPSX) project (the Project). The Project is currently in the concept design stage, however, Origin proposes to expand the existing 224 MW Torrens Island power station with an additional 160-180 MW of generation capacity. The scope of work includes construction of the power station including turbines, generators and underground transmission cables transmission infrastructure located at the southern end of Torrens Island.

Jacobs assessed two options for the proposed location of the new generator (North Option and South Option) for the QPSX project. The assessment (Wilkinson 2018) identified six structures associated with the State heritage listed Torrens Island Quarantine Station (TIQS) that may be impacted as part of the QPSX project. In order to meet the management measures from that assessment, an archival photographic record has been prepared by Jacobs on behalf of Origin.

1.2 Project scope

The archival photographic record of the structures associated with the TIQS has been completed to meet the management measures of the previous historical heritage impact assessment (Wilkinson 2018). The assessment recommended the structures be recorded and documented for the development application for the QPSX project.

The archival photographic record will be submitted to the Department of Environment, Water and Natural Resources (DEWNR).

1.3 Location of site

Torrens Island is located approximately 15 km north-west of Adelaide, South Australia. Two power stations are located on the island with the northern most power station, the Quarantine Power Station, operated by Origin. Three historical structures are located within the Quarantine Power Station on Parcel D59977 A112 (Figure 2.1), within the North Option of the Project. Three historical structures of the relocated 1909 Animal Quarantine Station are located on Parcel D90964 Q302, south of the Quarantine Power Station (Figure 2.1), within the South Option of the Project. The Project area is shown in Figure 1.1.

1.4 Method

The following guidelines were used to prepare the archival photographic record of the historical structures:

- Photographic Recording for Heritage Places and Objects (Heritage Victoria 2006).

Additional guidance was also obtained from the following guidelines:

- Photographic Recording of Heritage Items Using Film or Digital Capture (Heritage Council of NSW 2006)
- How to Prepare Archival Records of Heritage Items (Heritage Council of NSW 1998)

The equipment used for the archival record comprised a Nikon D5100 16.2 megapixel digital SLR camera. Photographs were taken in RAW (NEF) and Large JPEG format, at 4928 px x 3264 px resolution. The RAW image files were also converted to TIFF files. Images, photographic logs and photographic plans were burned to DVD for archival storage and hard copy images and proof sheets form the archival record.

1.5 Authorship of report

The archival photographic recording was undertaken by Andrew Wilkinson (Project Archaeologist, Jacobs) on 12 December 2017. The report and photographic plans were prepared by Andrew Wilkinson. A technical review of the report was undertaken by Dr Karen Murphy (Technical Leader - Historical Heritage, Jacobs).

Figure 1.1 : Location of the Project area

2. Site description and history

2.1 History

The information in this section was taken from the *Historical Heritage Impact Assessment* (Wilkinson 2018).

2.1.1 Settlement and development of Torrens Island

The Aboriginal inhabitants of the Adelaide Plains area that includes the Torrens Island Project area were the Kaurna people. The Port River and estuarine areas around Torrens Island were important sources of food for the Kaurna people and the general area was known by the Kaurna as Yerta-bulti, meaning Land of Dance (Garth Agius, Pers. comm, 13 December 2017). The area of what was to become Port Adelaide was first sighted by Captain Collet Barker in 1831, however it wasn't until 1836 that the Port River was navigated by Colonel William Light and was proclaimed suitable for a port to service the new settlement, which was to be established further inland. Port Adelaide was proclaimed a legal port by Governor Hindmarsh in 1837 (City of Port Adelaide Enfield 2015) and the island was named after Colonel Robert Torrens, chair of the South Australian Colonisation Commission (Wohltmann 2016).

The settlement of Torrens Island began almost immediately following the establishment of the colony with a map from 1839 showing the southern portion of the island set aside for future port development. The port was eventually established further south of this planned location, and by 1846 the parcel of land was owned by John Ellis. Sometime after their arrival in the colony in 1847 Isaac and Elizabeth Yeo began dairy farming on Torrens island (Habitable Places Architects 2014: 17), becoming the islands first permanent resident (Wohltmann 2016). By the 1850s disease epidemics were becoming a major concern for South Australia and in 1854 the government began subdividing portions of land on the low sand dunes along the western shoreline towards the north of Torrens Island (Habitable Places Architects 2014: 17), west of the current Project area.

2.1.1.1 Quarantine Stations

Following an outbreak of smallpox on the *Taymouth Castle* in 1855, a quarantine camp comprising military tents was established on the southern beach of Torrens Island forcing Yeo to relocate his farm to five of the northern subdivided sections. Subdivided sections 869 and 870 of these northern portions were reserved for quarantine purposes. There are conflicting records of the precise location of the first quarantine station, indicating it may have been along the waterfront west of the current Project area, however court evidence of 1916 suggests the camp was more likely on the southern portion of the island where the 1855 camp was established (Bell 2012: 3), approximately three kilometres south of the current Project area. Ships arriving in South Australia were required to remain offshore at Semaphore with the passengers and ship's crew remaining aboard in quarantine until medically cleared of infectious diseases.

Although land-based quarantine control commenced with the 1855 camp, and the first permanent quarantine building was established on Torrens Island in 1857 (Habitable Places Architects 2014: 17), the offshore quarantine system remained in effect until the late 1870s. Quarantine concerns at this time prompted new regulations and the need for better quarantine services. The offshore quarantine hulks in use at the time were found to be unsuitable and interest returned to land-based quarantine facilities. Yeo was resettled a second time when the government acquired his land towards the north of the island in 1875 (Habitable Places Architects 2014: 17). The second quarantine station was constructed in 1879 with the erection of permanent buildings, including prefabricated houses imported from San Francisco (Bell 2012: 3). The only remaining building of the 1879 period is a timber cottage, now a museum, approximately 50 m from the proposed North Option generator site (Figure 1.1 and Figure 2.1). A tramway was constructed on the island in 1886 and telephone services connected in 1898 (Habitable Places Architects 2014: 19).

The site of the original 1855 camp was used for animal quarantine from 1879, and in 1912 new animal facilities were constructed south of the human quarantine station following transfer of quarantine services to the Commonwealth Government in 1909 (Habitable Places Architects 2014: 25). The animal quarantine area is south of the Origin power station and within the current Project area (South Option) (Figure 2.1). As Australia developed and improved its quarantine processes and regulations over the following decades, further

improvements were made to existing buildings, and new facilities added and others removed, to service the quarantine station, with much of the federation era construction still visible today (Habitable Places Architects 2014: 25).

The devastation of the outbreak of Spanish Influenza at the end of World War One (WWI) caused global panic and hundreds of soldiers returning from service were quarantined on Torrens Island (Habitable Places Architects 2014: 19). In 1921 a Venereal Diseases Hospital was constructed on the site of the current Power Station. The building suffered fire damage in 1950 and was demolished in 1999. In 1993 the Torrens Island Quarantine Station (CT 4331/286 Sec 1029, 1030 &1031 Hd Port Adelaide) was listed on the State Heritage Register. Another period of construction of the quarantine station began in the 1960s with the removal, sale and destruction of many of the timber dwellings and the building of new animal quarantine facilities.

In 1980 the World Health Organisation declared the world-wide eradication of smallpox (WHO 2010). The facilities at Torrens Island were closed for human quarantine the same year. In 1989 an avian quarantine station was constructed on the island and animal quarantine services remained in operation until 1995 (Habitable Places Architects 2014: 15).

2.2 Description of the sections potentially impacted by the QPSX project

2.2.1 South Option

During the field survey undertaken on 12 December 2017, three structures (Figure 2.1) were inspected in the property (D90964 Q302) south of the existing Quarantine Power Station (QPS). The area appears to have been subject to significant disturbance likely resulting with quarantine services, pastoralism and other activities. The ground surface was completely obscured by grass. Shrub vegetation were found along the levy forming the west boundary, and the fence forming the north boundary, or the South Option.

The following descriptions are taken from the *Historical Heritage Impact Assessment* (Wilkinson 2018).

2.2.1.1 Animal Quarantine Station Horse Stable (Structure 1)

The Animal Quarantine Station Horse Stable (Structure 1) (Figure 2.1) is within the parcel of land D90964 Q302 and is the larger of the three buildings (Structures 1-3) remaining of the animal quarantine area. The building is part of the 1909 Commonwealth transfer and relocation of the animal quarantine station. It is possible that the building dates to the initial relocation or later 1912 construction phase. The building was used to house horses during quarantine services.

The building is a timber frame construction on a concrete foundation built to a standard design. The roof is an open gable type with corrugated steel sheeting. The building has wooden cladding exterior and interior walls with eaves that extend further out on the eastern side where stable doors provide access to the interior bays. The stable doors are galvanised metal frames with wooden panelling.

The building is showing signs of deterioration with deterioration of the timber frame, corrosion of the metal roof sheeting and gutters, and paint peeling from the outer surfaces due to exposure to the environment. Sections of the cladding have been removed. Pigeons have taken roost inside with significant amounts of bird faeces throughout.

2.2.1.2 Animal Quarantine Station Loose Boxes for Cattle Shed (Structure 2)

The Animal Quarantine Station Loose Boxes for Cattle Shed (Structure 2) (Figure 2.1) is within the parcel of land D90964 Q302 and east of Structure 1. The building is part of the 1909 Commonwealth transfer and relocation of the animal quarantine station. It is possible that the building dates to the initial relocation or later 1912 construction phase. The building was used to house or service cattle during quarantine.

The building is a timber frame construction on a concrete foundation built to a standard design. The roof is an open gable type with corrugated steel sheeting. The building has wooden cladding exterior and interior walls

with eaves that extend further out on the eastern side where stable doors provide access to the interior bays. The stable doors are galvanised metal frames with wooden panelling.

The building is showing signs of deterioration with corrosion of the metal roof sheeting and gutters, and paint peeling from the outer surfaces due to exposure to the environment. The timber frame appears to be in good condition. Sections of the cladding have been removed. The interior construction appears largely sound; however, pigeons have taken roost inside with significant amounts of bird faeces throughout.

2.2.1.3 Animal Quarantine Station Store and Mans room (Structure 3)

The Animal Quarantine Station Store and Mans room (Structure 3) (Figure 2.1) is within the parcel of land D90964 Q302 and north of Structure 2. The building is part of the 1909 Commonwealth transfer and relocation of the animal quarantine station. It is possible that the building dates to the initial relocation or later 1912 construction phase. The building was originally used for veterinary services.

The building is a timber frame construction on a concrete foundation built to a standard design. The roof is an open gable type with corrugated steel sheeting. The building has wooden cladding exterior with exterior and interior panel walls and ceiling. Some panels are labelled with Asbestos warning stickers. A brick chimney on the eastern side, and double doors on the western side are two additional features of this building. A later besser block addition extending from the southeast of the building comprises kennels.

The exterior of the building is showing signs of deterioration with some corrosion of the metal roof sheeting and gutters, and paint peeling from the outer surfaces due to exposure to the environment. Some of the removal of the exterior cladding indicates that the timber frame appears to be deteriorating. The interior appears largely sound.

2.2.2 North Option

During the field survey undertaken on 12 December 2017, three structures (Figure 2.1) were inspected in the northern portion of the existing QPS property (D59977 A112). The area appears to have been built up with fill and levelled to a height above the elevation of the surrounding landscape. The majority of the ground surface was completely obscured by grass, apart from some areas set aside for storage where there was 100 per cent ground surface visibility. Trees and shrubs were found within the area along the west fence and around Structures 5 and 6.

The following descriptions are taken from the *Historical Heritage Impact Assessment* (Wilkinson 2018).

2.2.3 Reinforced concrete circular water tank (Structure 4)

Structure 4 is near the eastern boundary of the North Option of the current Project area, and a few metres southeast of Structure 5 (Figure 2.1). The reinforced circular water tank is installed in the ground and protrudes approximately 50 cm above the ground level. It is approximately 13 m in diameter and is approximately 130 cm in depth. Remnant pipes and fittings are still evident in the structure. The water tank appears to be of more recent construction and does not appear to feature in a 1966 map indicating construction details of a Push Button Fire Alarm (Habitable Places Architects 2014: 34). The structure is in good condition with little evidence of cracking or damage to the fabric.

It is likely the structure was built during the period of quarantine station development during the 1970s to provide the water needs of the Quarantine Station and therefore has association with the later phases of quarantine services on the island.

2.2.4 Reinforced concrete water tank (Structure 5)

Structure 5 is just east of the centre of the North Option of the current Project area, and a few metres northwest of Structure 4 (Figure 2.1). The reinforced concrete water tank is a square enclosed construction with four access openings on top. It is approximately 14 m in length and extends above the ground surface for approximately 2 m in height. Remnant pipes and fittings associated with the structure are still evident. As with

Structure 4 the water tank appears to be of more recent construction and does not appear to feature in the 1966 Push Button Fire Alarm system map (Habitable Places Architects 2014: 34). The structure is in good condition with little evidence of cracking or damage to the fabric.

It is likely the structure was built during the period of quarantine station development during the 1970s to provide the water needs of the Quarantine Station and therefore has association with the later phases of quarantine services on the island.

2.2.5 Square water tanks (Structure 6)

Two rectangular water tanks approximately 5.5 m by 6.5 m in size are located in the northwest portion of the North Option of the Project area (Figure 2.1). These two tanks are constructed of brick with a corrugated metal sheeting roof and gutter that collects water and feeds into the water tank. The structures extend above the ground surface for approximately 1 m in height and feature supporting buttresses. An elevated pipe connects the two tanks to one another.

These two structures are similar in size and construction details of two water tanks found in the Quarantine Station State Heritage Place boundary south of the remaining cottages, to the east of the current Project area. It is likely these were constructed at a similar time and serviced the buildings in the vicinity such as the nurses' quarters and recreation hall, which are now demolished.

Figure 2.1 : Location of Structures 1-6 and relationship with the Quarantine Power Station

3. Heritage significance

3.1 Significance assessment of TIQS

The TIQS was assessed for a Conservation Management Plan (CMP) (Habitable Places Architects 2014) against the State Heritage Criteria outlined in the Act with guidance from the Burra Charter (Australia ICOMOS 2013) (Table 3.1). The structures inspected during the historical heritage impact assessment (Wilkinson 2018) were not assessed in the CMP.

The information in Table 3.1 is reproduced directly from the CMP (Habitable Places Architects 2014).

Table 3.1 : Assessment against the State Heritage Criteria (Habitable Places Architects 2014)

	Criterion	Description
Criterion A	It demonstrates important aspects of the evolution or pattern of the State's history.	The Torrens Island Quarantine Station is historically significant because it relates directly to the growth of South Australia as a separate colony. The layout, landscape and spatial elements of the quarantine station reinforce the social and medical philosophies underlying quarantine principles. It demonstrates the early adoption of the science of germ theory by the medical profession in South Australia, and the development of an integrated national quarantine system after Federation. The quarantine station and its siting at Torrens Island reflects its role in the maritime, medical and immigration history of the state. It highlights the final stage of a lengthy, arduous and risky journey for some of the 19th and 20th century South Australian immigrants. The quarantine station played a key maritime role by allowing quarantined ships whose crew and passengers had been transferred to Torrens Island, to be fumigated and granted pratique, minimising disruption to trade and cost to ship owners. Although it was a land based quarantine station, Torrens Island's primary role was maritime. The isolation provided by its island location was central to its quarantine function. The jetty provided an effective point of control for access to the station. The eventual closure of the station reflected the pattern of change from maritime immigration to mass air travel. The quarantine station is significant because changing community expectations of accommodation and workplace standards are reflected in the development of similar building types constructed at Torrens Island. The 1960s chalets, quarantine office and cyanide store contribute to the cultural significance by contrasting with the earlier buildings for the same uses, throwing changing standards into relief.
Criterion B	It has rare, uncommon or endangered qualities that are of cultural significance.	Torrens Island quarantine station is the only example of a site used for maritime quarantine in South Australia. It is the only place that can effectively tell the story of keeping infectious diseases from taking hold in the community. The village character of the station and its cultural landscape, set against a low coastal environment, and arranged around a tramway is uncommon. It derives from its unity of purpose and its development in three phases. It is distinct from the landscape character of other quarantine stations in Australia. The systematic selection of the isolated site, the provision of buffer zones, the separation between compounds of the 1879 station, and the later provision of an integrated sewerage system reflect aspects of the widely held miasma theory of the transmission of contagious disease. The principles underlying germ theory are reflected by the order and arrangement of the Commonwealth period quarantine processing buildings and the internal division of buildings into foul, disinfecting and clean zones. Such unity of purpose reflected across a whole site, in the design of all of the elements and in its operation, is rare. The 1878 Timber Cottage is a rare surviving and exceptionally intact example of a prefabricated colonial building, in this case from the United States, that

	Criterion	Description
		remains on the site where it was originally erected. The existence and integrity of the furnishings and finishes of the remaining cottage, artefacts that relate directly to its historical use, is particularly uncommon. These values are endangered by the current condition and vulnerability of the building and contents. Torrens Island artefacts, records and documents from the quarantine station's days of operation, that are held in national and state collections contribute to the interpretive potential of the site.
Criterion C	It may yield information that will contribute to an understanding of the State's history, including its natural history.	The Torrens Island Quarantine Station is architecturally and environmentally significant because it retains physical evidence of the human and animal quarantine practice as undertaken in South Australia since the 1870s. The extant buildings reflect the physical processes of disinfecting and quarantine of various periods, the early Commonwealth period of 1911-1921 providing the most intact physical evidence. Torrens Island contributes to the understanding of social, moral and community values and their changes over time. Attitudes of discrimination towards non-European contacts and patients are evident from the historical records. The Bathing Block and cottage layouts reflect class distinctions. Later the station played an important role in the mass post WW2 immigration that transformed Australian society and values. It was a memorable part of the immigration experience for many Australians. The Torrens Island quarantine station records the development of medical practices in controlling infectious diseases as related to the relevant Parliamentary Acts for Quarantine in South Australia and the Commonwealth. It formed an integral part of a national system of quarantine established under the Commonwealth Quarantine Service. The Adelaide medical profession, in particular Quarantine officers based in Semaphore and Port Adelaide, and the Central Board of Health, played a key role at Torrens Island. Torrens Island demonstrates the independent stance to quarantine taken by Australian States and later the Commonwealth, against pressure from Britain for a less stringent system. The role of Torrens Island as a non–maritime quarantine station and cemetery during the plaque outbreaks early in the 20th century has not previously been recognised, and is important.
Criterion D	It is an outstanding representative of a particular class of places of cultural significance	Not assessed or did not meet this criterion.
Criterion E	It demonstrates a high degree of creative, aesthetic or technical accomplishment or is an outstanding representative of particular construction techniques or design characteristics	Not assessed or did not meet this criterion.
Criterion F	It has strong cultural or spiritual associations for the community or a group within it	Not assessed or did not meet this criterion.
Criterion G	it has a special association with the life or work of a person or organisation or an event of historical importance.	Not assessed or did not meet this criterion.

3.2 Significance of Structures 1-6

The following information has been taken from the *Historical Heritage Impact Assessment* (Wilkinson 2018).

A review of the 1986, 1988 and 2014 CMPs undertaken by Michael Queale of DEWNR for the South Option and North Option indicated that although Structures 1-6 are not heritage listed they are of heritage interest and are associated with the Torrens Island Quarantine Station (Michael Queale, pers. Comm, 19 July 2017).

Structures 1-3 are part of the 1909 Animal Quarantine Station relocation and represent the ongoing and diverse activities up until recent times. Structures 4 and 5 are of historic interest due to the association of the Quarantine Station, however are not essential to the understanding of the heritage values of the site. The two water tanks comprising Structure 6 are of the same provenance and design of extant water tanks within the State Heritage place and are of associated value to the State heritage place (Michael Queale, pers. Comm, 19 July 2017).

4. Photographic log sheets

Photo number	Structure	Direction	Description
0001	Structure 1,2 and 3	NE	Overview
0002	Structure 1,2 and 3	N	Overview
0003	Structure 1	E	West elevation
0004	Structure 1	NE	Southwest corner
0005	Structure 1	N	South elevation
0006	Structure 1	NW	Southeast corner
0007	Structure 1	W	East elevation
0008	Structure 1	S	North elevation
0009	Structure 1	SW	Northeast corner
0010	Structure 1	SE	Northwest corner
0011	Structure 1	E	Door on west side
0012	Structure 1	E	Door on west side
0013	Structure 1	E	Closed timber ‘louvre’ window (west elevation)
0014	Structure 1	E	Open timber ‘louvre’ window (west elevation)
0015	Structure 1	E	Interior west wall
0016	Structure 1	E	Interior west ceiling
0017	Structure 1	N	Interior feed basket
0018	Structure 1	W	East low level door (west elevation)
0019	Structure 1	W	Close up interior boarding and exterior cladding construction
0020	Structure 1	W	Close up interior boarding and exterior cladding construction
0021	Structure 1	N	Underside of eaves, fascia, guttering and downpipe Southwest corner
0022	Structure 1	N	Verandah awning joists on east side
0023	Structure 1	W	Stable doors, timber and galvanised iron frame (east elevation)
0024	Structure 1	W	Interior showing west wall
0025	Structure 1	S	Interior showing south wall
0026	Structure 1	S	North end gable louvre
0027	Structure 2	S	North elevation and cattle chutes to east
0028	Structure 2	SE	Cattle chutes and building overview
0029	Structure 2	E	West elevation
0030	Structure 2	NE	Southwest corner
0031	Structure 2	N	South elevation
0032	Structure 2	NW	Southeast corner showing cattle chutes
0033	Structure 2	W	Southern section of east elevation
0034	Structure 2	W	Northern section of east elevation
0035	Structure 2	SW	Northeast corner
0036	Structure 2	S	Brick paving and verandah joists on east side
0037	Structure 2	W	Interior west wall
0038	Structure 2	NW	Interior water tank and trusses
0039	Structure 2	W	Stable door example east side

Photo number	Structure	Direction	Description
0040	Structure 2	S	Close up of concrete slab
0041	Structure 3	E	West elevation
0042	Structure 3	NE	Southwest corner
0043	Structure 3	N	South elevation
0044	Structure 3	NW	Southeast corner with concrete block extension
0045	Structure 3	W	East elevation between two brick buildings/extension
0046	Structure 3	SE	Northwest corner
0047	Structure 3	S	North elevation
0048	Structure 3	S	North elevation showing the three structures
0049	Structure 3	SE	Northwest corner
0050	Structure 3	E	Sash window on west side
0051	Structure 3	E	Dog kennel sign on west side
0052	Structure 3	E	Timber double door and louver windows west elevation
0053	Structure 3	E	Underfloor joists on west side
0054	Structure 3	S	Fireplace interior
0055	Structure 3	SE	Kennels concrete block extension interior
0056	Structure 3	NW	Interior room 3
0057	Structure 3	NE	Looking into room 2
0058	Structure 3	NE	Interior room 1
0059	-	NW	TIQS laydown area
0060	6A	E	West elevation
0061	6A	SE	Northwest corner
0062	6A	NE	Southwest corner
0063	6A	N	South elevation
0064	6A	NW	Southeast corner
0065	6B	NE	Southwest corner
0066	6B	N	South elevation
0067	6B	NW	Southeast corner
0068	6B	W	East elevation
0069	6B	SW	Northeast corner
0070	6B	S	North elevation
0071	6A	SW	Northeast corner
0072	6A	S	North elevation
0073	6B	SE	Northwest corner
0074	6A	SE	Northwest corner
0075	5	E	West elevation
0076	5	NE	Southwest elevation
0077	5 and 6	NE	Overview
0078	5	N	South elevation
0079	5	NW	Southeast corner

Photo number	Structure	Direction	Description
0080	5	W	East elevation
0081	5	SW	Northeast elevation
0082	5	S	North elevation
0083	5	SE	Northwest elevation
0084	-	W	TIQS from near Structure 5
0085	6	NW	Context of Structure 6 with TIQS in background
0086	4	S	North elevation
0087	4	W	East elevation
0088	4	N	South elevation
0089	4	NE	Interior
0090	4	NW	Interior
0091	4	E	West elevation
0092	-	N	Area of earlier nurse's quarters
0093	-	S	Area of earlier nurse's quarters
0094	-	W	Area of earlier nurse's quarters

5. Photographic plans

The location of the structures within the South Option and North Option in relation to the Quarantine Power Station are shown in Figure 2.1.

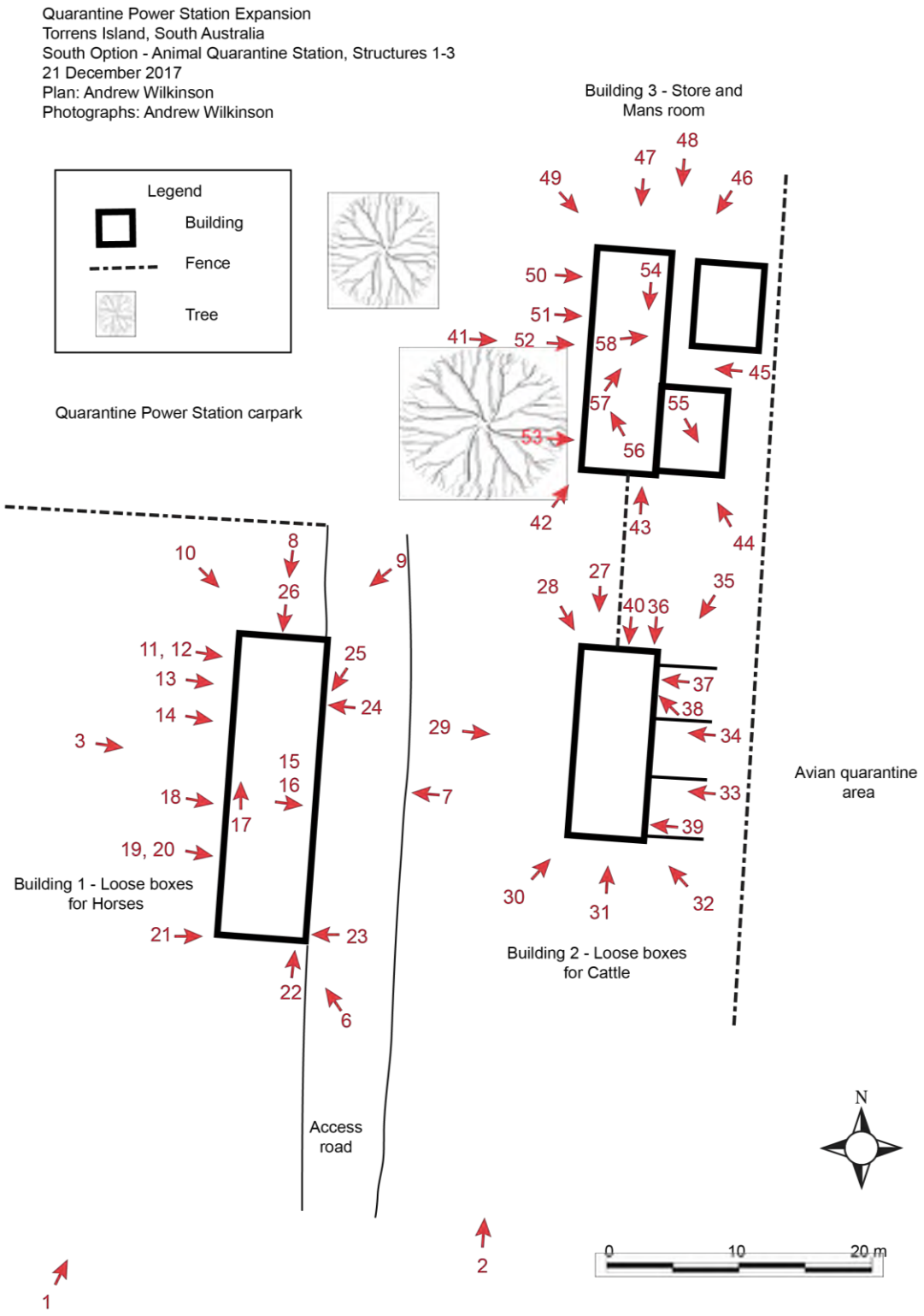


Figure 5.1 : South Option Structures 1-3, Torrens Island

Quarantine Power Station Expansion
Torrens Island, South Australia
North Option - Quarantine Station, Structures 4 and 5
9 January 2018
Plan: Andrew Wilkinson
Photographs: Andrew Wilkinson

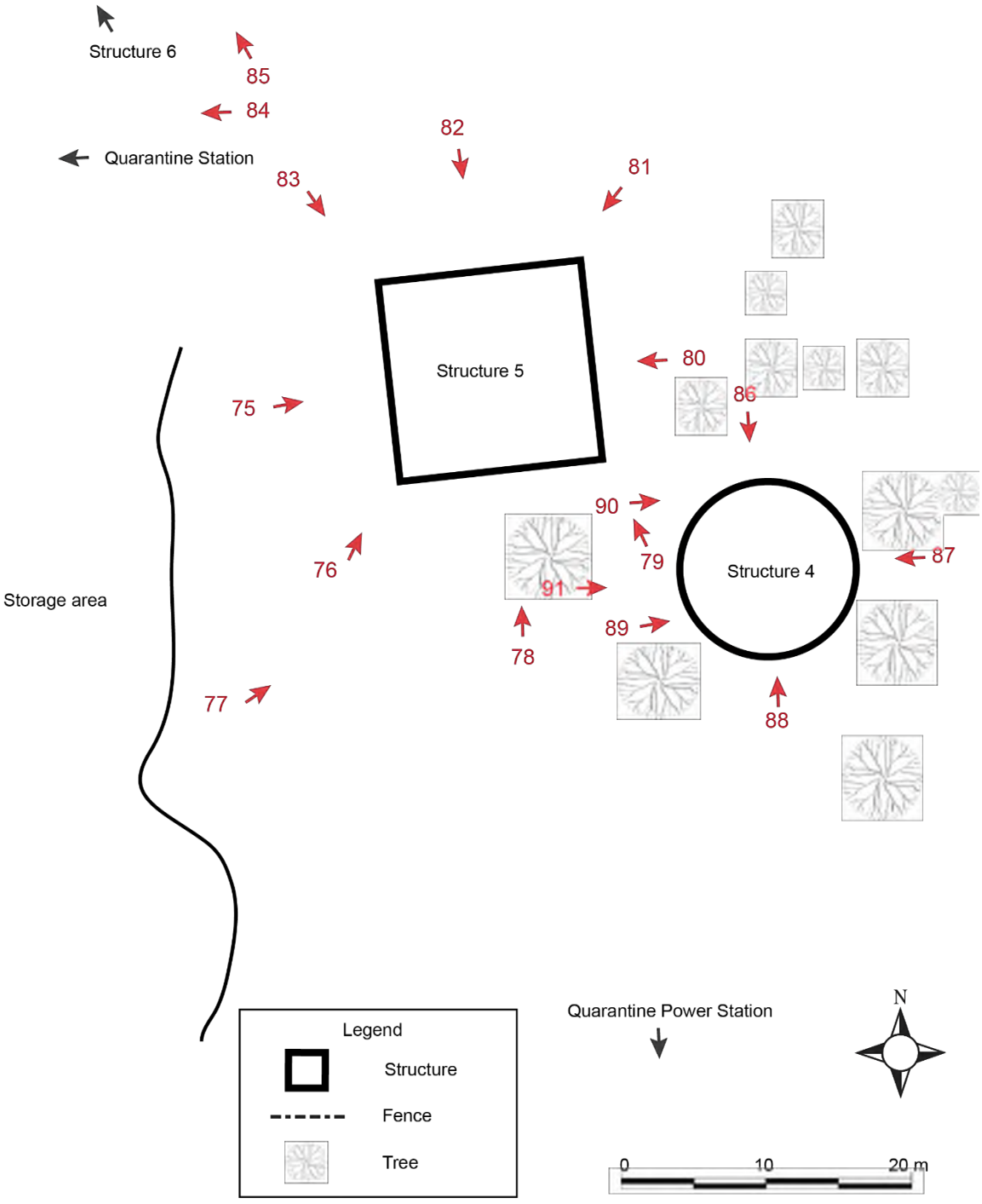


Figure 5.2 : North Option Structures 4 and 5, Torrens Island

Quarantine Power Station Expansion
Torrens Island, South Australia
North Option - Quarantine Station, Structure 6 (6A and 6B)
21 December 2017
Plan: Andrew Wilkinson
Photographs: Andrew Wilkinson

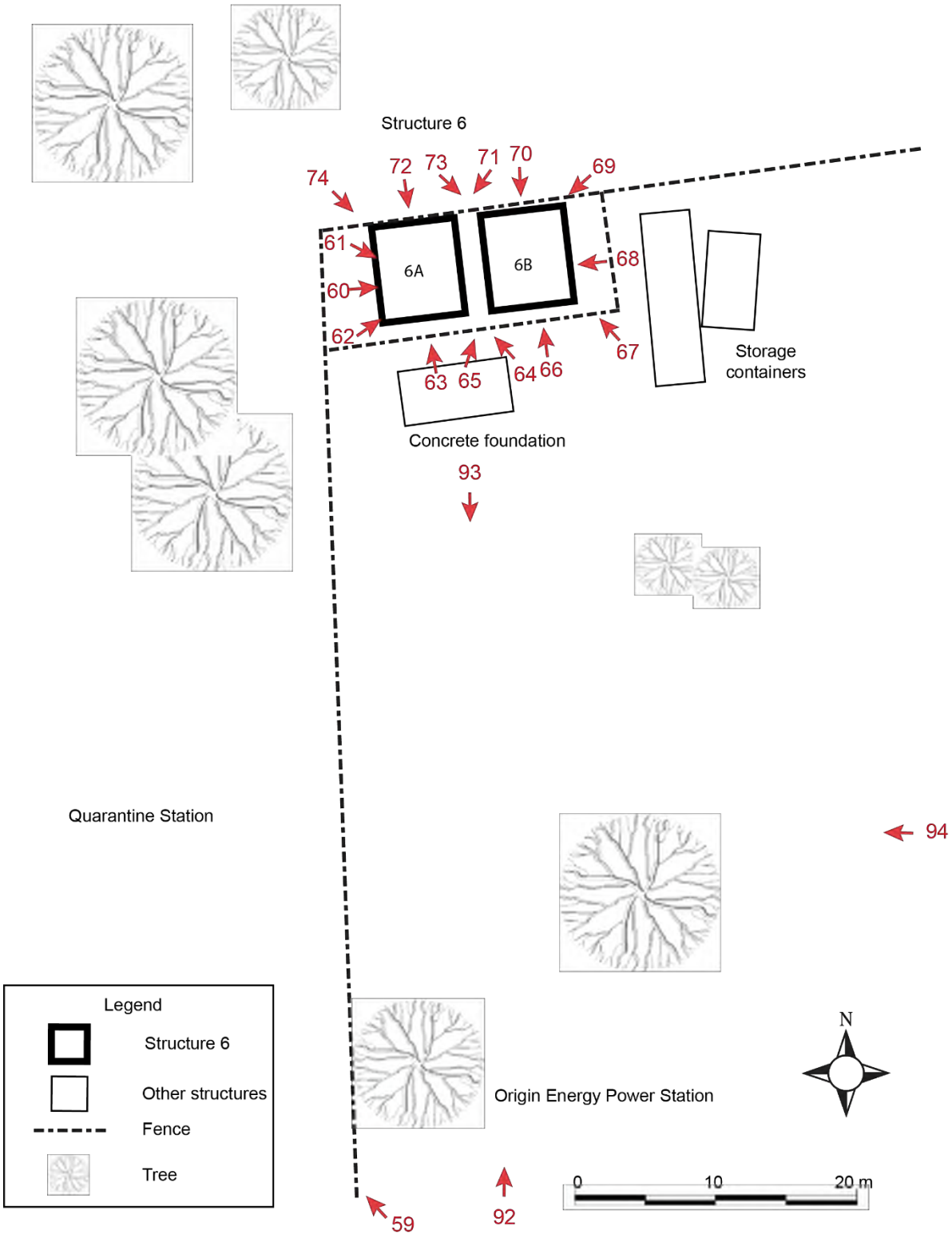
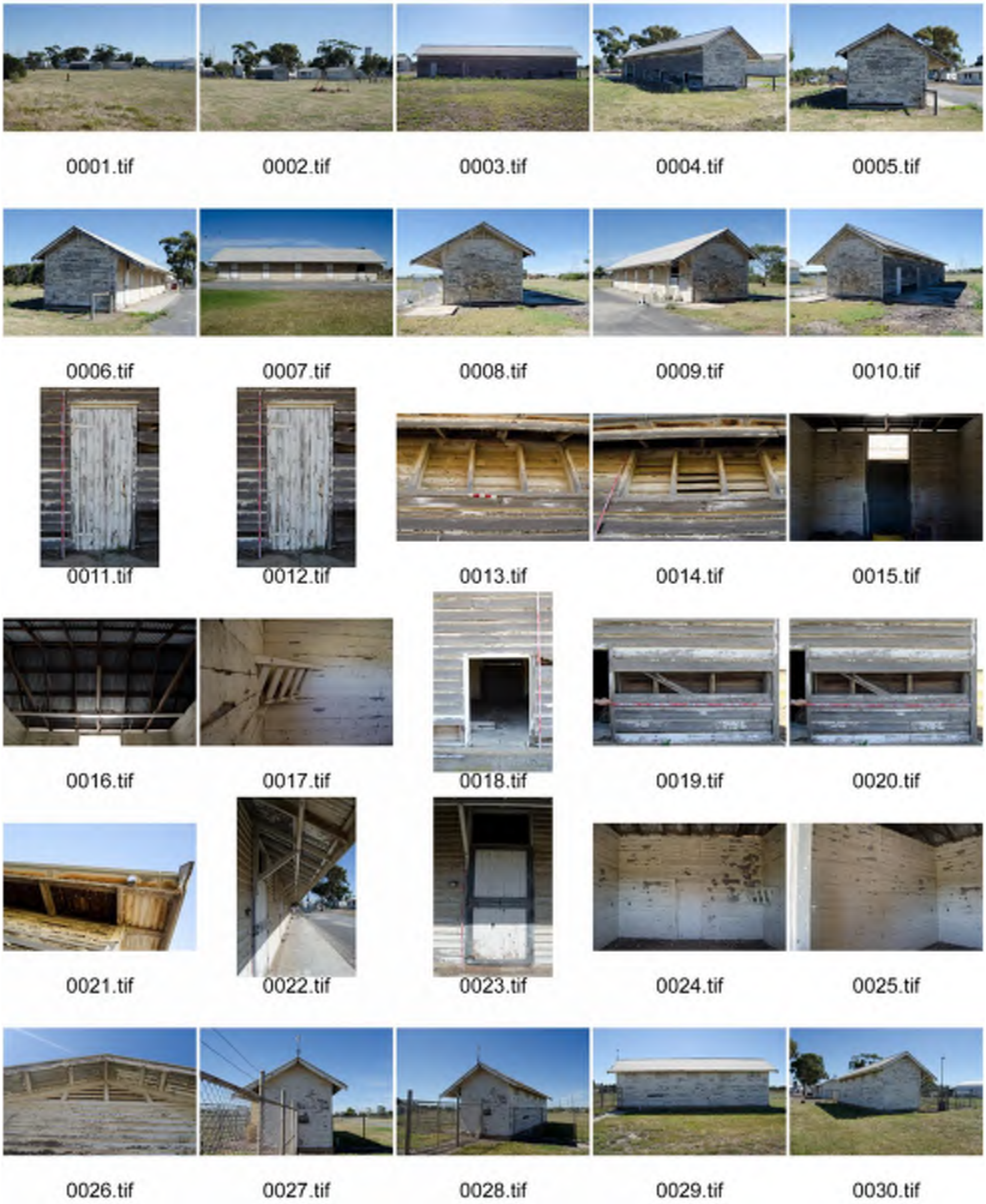


Figure 5.3 : North Option Structure 6 (6A and 6B), Torrens Island

6. Thumbnail Images

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Wohltmann, M. 2016 *A Future Unlived: A History of the Internment of German Enemy Aliens on Torrens Island in South Australia during 1914-1924*. Retrieved 27 November 2017 from http://torrensislandinternmentcamp.com.au/torrens_island01.html.

Appendix K. Preliminary Site Investigation Report

Quarantine Power Station Expansion (QPSX) Project

Origin Energy

Preliminary Site Investigation - Contaminated Land

IW169200-300-NP-RPT-0001 | 1

10 January 2018

Quarantine Power Station Expansion (QPSX) Project

Project No:	IW169200
Document Title:	Preliminary Site Investigation - Contaminated Land
Document No.:	IW169200-300-NP-RPT-0001
Revision:	1
Date:	10 January 2018
Client Name:	Origin Energy
Client No:	QPSX
Project Manager:	Kelly Briton-Jones
Author:	Jason White
File Name:	J:\IE\Projects\06_Central West\IW169200\21 Deliverables\Soil and Contamination

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Document history and status

Revision	Date	Description	By	Review	Approved
0	7/12/2017	Draft Document for Client Review	JW	DC	KBJ
1	10/1/2018	Final Document	KBJ	JW	KBJ

Contents

List of Tables

List of Figures

Executive Summary

Jacobs has prepared a preliminary assessment of the risk of soil and land contamination for Origin Energy's Quarantine Power Station Expansion and Network Connection Development (QPSX) project. The QPSX involves the expansion of Origin's existing 224 MW Torrens Island Quarantine Power Station (QPS) generation capacity. The preliminary assessment is based on the results of a Preliminary Site Investigation (PSI), undertaken by Jacobs, and consists of a high level review of geological, hydrogeological and land contamination information related to the site.

The available information indicates there are likely to be no significant adverse on and off-site impacts to the beneficial uses of the land and groundwater within the vicinity of the existing Quarantine Power Station (QPS). We have classified the QPS site as potentially low risk for the proposed end use and thus contamination is unlikely to restrict use of the land. There remain a number of uncertainties in making this general conclusion and further confirmatory sampling is recommended.

Within the vicinity of the TIPS at the southern end of the island, the available information indicates that there is high potential for adverse on and off-site impacts to the beneficial uses of the land and groundwater. Significant contamination issues have been previously identified within the vicinity of the power station, including Total Petroleum Hydrocarbons (TPH), chlorinated solvents, nitrate and phosphorus, which were reported by AGL to the South Australia EPA.

It is recommended that further soil and groundwater sampling investigation should be conducted in the vicinity of the QPS in the north, where the power generators are expected to be constructed, as well as the connection point of the transmission line into the Torrens Island Power Station. It is also recommended that assessment of potential acid sulfate soil (PASS) is part of any future soil sampling plan. PASS has not been included in previous site investigations, and the proximity of the project area to local waterbodies, coupled with the local geology of the site (predominantly organic matter and sand), warrants further investigation, particularly if excavation beneath the groundwater table on site is to occur.

Important note about your report

The purpose of this report and the associated services performed by Jacobs is to complete a preliminary site investigation for the Quarantine Power Station Expansion and Network Connection Development (QPSX) project, on behalf of Origin Energy. In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

1. Introduction

1.1 Project Description

Jacobs was engaged by Origin Energy to complete a preliminary contaminated land site investigation for the Quarantine Power Station Expansion and Network Connection Development (QPSX) project on Torrens Island in South Australia.

The QSPX Project is currently in the concept design stage, and it proposes to expand Origin's existing 224 MW facility with an additional 160-180 MW of generation capacity The scope of work includes construction of power generation facilities in the northern end of the existing QPS site and transmission lines connecting QPSX to the existing AGL Torrens Island Power Station (TIPS) and transmission infrastructure at the south end of the island. An illustration of the expansion is provided in **Appendix A**.

1.2 Project Objectives

In order to gain a preliminary understanding of the potential for contamination at the QPSX project area, a Preliminary Site Investigation (PSI) was undertaken by Jacobs, in accordance with the *National Environment Protection Measure 1999* (NEPM, amended 2013), comprising of the following activities:

- Collate and compile available background information relating to the site and its surrounds.
- Determine the nature and extent of contamination and assess potential contaminated land risks.
- Address potential contaminated land issues related to our understanding of the site, its geological setting and the proposed land use development.
- To inform what further work may be required.

The findings of the PSI are presented in this preliminary assessment for review.

1.3 Scope of Work

Works included the following:

- Inspection of the project area for visible evidence of potential contamination sources. The site inspection was conducted by Jacobs' ecologist, Rick Barratt, on 27 November 2017.
- Review of historical aerial photographs to gain an understanding of historical land use and development of the project area.
- Review of maps and previously published reports to assess local and regional geological and hydrogeological conditions.
- Review of South Australia EPA database of publically available records in regards to site contamination.
- Consolidation of the findings of all reviews and site inspections into the preparation of this report.

2. Site Description

The project area is almost 3 km^2 in area and is located approximately 15 km northwest of Adelaide, South Australia. The island is within the Port Adelaide area, east of Le Fevre's Peninsular, and bounded by Lipson Reach of the Port River (officially known as the Port Adelaide River) to the west, Barker Inlet to the north and east, and The North Arm to the south. The Grand Trunkway Bridge over the North Arm Creek joins the island to the mainland via a causeway connected to Garden Island. The Project area is illustrated in **Figure 2-1**.

Historically from around the mid-1800s, Torrens Island was mainly used for the quarantine of humans and animals. In the early 20th century, a permanent animal quarantine station was established in the northern end of the island, the structures of which are still on site today.

In the 1960s the causeway and bridge to Torrens Island were built which facilitated construction of the Torrens Island A Power Station, a 480 MW gas fired power generation facility, which was completed in 1967. The facility was expanded in the 1970s, with the completion of Torrens Island B Power Station, an 800 MW power generation facility.

Figure 2-1 – QPSX Project Area

3. Geological and Hydrogeological Conditions

3.1 Geology

The main geological formations under Torrens Island are listed in **Table 1** and illustrated in **Appendix B**.

Table 1 – Summary of Main Geological Formations beneath Torrens Island[1]

Unit	Geological Unit	Description
Qhcks	Semaphore Sand Formation	Poorly to well sorted bioclastic quartz-carbonate sands, ranging from 0 to 2 metres below ground level (mbgl).
Qhck	St. Kilda Formation	Loose to medium dense grey marine sediment and organic sand, ranging from 0 to 6 mbgl.

3.2 Hydrogeology

A review of the Government of South Australia's WaterConnect groundwater database indicated 10 active registered groundwater wells within 3 km of the project area. Their location within the vicinity of Torrens Island is illustrated in **Appendix C.** A summary of hydrogeological conditions surrounding Torrens Island is as follows:

- Standing water levels (SWL) in the registered wells ranged from between 0.9 and 3.4 mbgl in shallow wells (less than 6 mbgl) and 1.4 and 30.3 mbgl in deep wells (greater than 100 mbgl).
- Recorded Total Dissolved Solids (TDS) concentrations within the local groundwater ranged between 282 and 33,645 mg/L.
- A pH result of 8.3 was observed at borehole 6628-3356, on 7 April 2003, which is located in the middle of the proposed generator sites.

Table 2 – Summary of Groundwater Well Information

Bore #	Installation Date	Depth (mbgl)	SWL (mbgl)	TDS (mbgl)
6628-3356 (QPS)	22/04/1954	111.56	4.08	517
6528-254	7/02/1968	225.55	2.31	3620
6628-15205	6/12/1989	243	1.39	4031
6628-22421	28/10/2005	227	30.3	3827
6628-26555	13/04/2012	5	1.6	33645
6628-28725	3/11/2016	4.3	0.9	340
6628-28726	3/11/2016	4.1	1.2	282
6628-28727	3/11/2016	3.7	0.9	335
6628-28728	3/11/2016	3.3	0.9	485
6528-2866	28/04/2017	6	3.4	501

[1] Unit corresponds to map labels illustrated in **Appendix B**

4. Contaminated Land Risk Assessment

4.1 Site History Review

4.1.1 Historical Aerial Photography

Historical aerial photographs of Torrens Island were sourced from South Australia's Department of Environment, Water and Natural Resources. General observations of the project area and changes over time relevant to risk of potential land contamination are summarised in **Table 3**. Aerial photographs are provided in **Appendix D**.

Table 3 – Summary of Historical Aerial Photographs of Torrens Island

Photograph Date	Observations
23/01/1949	Buildings and structures of the former Torrens Island Quarantine Station, located towards the northern end of the island. Towards the south of the Quarantine Station is vacant land and the mangrove swamps of Barker Inlet. Some grazing paddocks are present immediately east of the Quarantine Station, and to the west is land covered by scattered shrubs. The southern end of the island is vacant, with sandy beaches along the Port Adelaide River in the east and scattered shrubs and mangroves towards the west.
09/01/1969	Majority of the surrounding area remained unchanged since the 1949 photograph, except for the following developments: • Additional structures built within the southern vicinity of the Quarantine Station towards the northern end of the island • Removal of shrub / vegetation at the southern end of the island and installation of a dirt path towards the middle of the island Not observed in the photo are the 4x 120 MW turbines for Torrens Island A Station, which were constructed by 1967.
19/03/1979	Significant development activity is observed to have occurred since the 1969 photograph, which includes the following: • Additional structures built within the southern vicinity of the Quarantine Station towards the northern end of the island • Completion and upgrade of the road connecting the northern and southern ends of the island • Construction of the TIPS B station at the southern end of the island
28/09/1989	Removal of shrubs / vegetation along the roadway in the middle of the island. No significant changes since the 1979 are observed.

4.1.2 Environmental Notifications and Protection Orders

Review of the South Australian EPA public database indicated there were no environment protection orders for areas located on Torrens Island. However, two Section 83A notices, under the *Environment Protection Act 1993*, have been issued in regards to groundwater contamination. Publicly available data in regards to the notices are summarised in **Table 4**, and further details are provided in **Section 4.2.3**.

Table 4 – Summary of Torrens Island 83A Notifications

Notification #	Date Issued	Address	Potentially Contaminating Activity
60281 - 01	11/06/2010	Lots 303 Torrens Island Road, TORRENS ISLAND SA 5015	Electrical substations; Electricity generation or power plants
61145 - 01	25/06/2013	Lots 10 & Piece 301 Torrens Island Road, TORRENS ISLAND SA 5960	Electricity generation or power plants

4.2 Previous Environmental Assessments and Site Inspections

Historical environmental studies for the Torrens Island have been completed for various assessments, however specific assessments related to the QPSX Project are detailed here.

4.2.1 Coffey Environments Asbestos Survey (March 2008)

An asbestos survey of the Torrens Island Animal Quarantine Station, in the northern end of the island, was conducted by Coffey Environments Pty. Ltd., on behalf of the Generation Lessor Corporation (Coffey, 2008). The findings of the survey were compiled into an asbestos materials register, with corresponding recommended actions and risk control strategies. The authors of the report determined that none of the identified materials posed and immediate risk to occupants at, if left undisturbed, except for one identified high risk situation requiring action at the time, located in Building 27 – 1924 Storeman's Hut.

4.2.2 AECOM Stage 1 Environmental Assessment (June 2010)

A Phase 1 ESA with a limited soil sampling program in the northern end of Torrens Island, was conducted by AECOM Australia Pty Ltd (AECOM), on behalf of Origin Power (AECOM, 2010). The assessment determined that no significant contamination issues were identified that would preclude the future intention of ongoing commercial/industrial land use at the northern end of Torrens Island. Arsenic concentrations, exceeding ecological protection guidelines, were recorded during the soil sampling program. The concentrations were noted to be below health investigation criteria for commercial/industrial land use.

No analysis to assess potential acid sulfate soil (PASS) was undertaken as part of the assessment, and the report recommended that PASS should be considered before undertaken future construction works on Torrens Island, particularly if soils are to be excavated from beneath the groundwater table. It also recommended further investigation into the characterisation of the contaminant status of stockpiled soil located in the southeast portion of the island, within the vicinity of the TIPS.

4.2.3 URS Environmental Site Assessments (July 2010 and December 2014)

An environmental site assessment was undertaken at TIPS by URS Australia Pty Ltd (URS), on behalf of AGL Torrens Island Pty Ltd (AGL) (URS, 2010). The ESA was conducted in support of AGL's notification of groundwater contamination, under Section 83A of the *Environment Protection Act 1993*, reference no. 60281-01. Elevated levels of chlorinated solvents and Total Petroleum Hydrocarbons (TPH), above guidelines for commercial waste at that time, were recorded. Further assessments were conducted by URS until December 2014, when it was determined that no contaminants of concern were detected (URS, 2015).

However, another Section 83A notification of groundwater contamination was issued by AGL to the SA EPA, for elevated concentrations of nitrate, nitrite, phosphate and fluoride identified in two monitoring wells, reference no. 61145-01. No evidence of remediation activities or assessments in regards to this notification were available in public records.

4.3 Site Inspection

A site inspection was undertaken by Jacobs' ecologist, Rick Barratt, on 27 November 2017. The objective of the site inspection was to identify items of interest in regards to land contamination. A summary of observations is provided in **Table 5** and in an aerial map depicting the locations of each observation provided in Figure 4-1.

Figure 4-1 – Site Contamination Observations

Table 5 – Summary of Site Inspection Observations

Observation	Description	Photos (Table 6)
Miscellaneous dumped waste	Various concrete slabs dumped on transmission line area of site	837
Soil Stockpiles	Various soil and gravel stockpiles	776, 791, 792
Infrastructure	Above ground disused hazardous chemical storage container, concrete pads, empty disused water storage tank and abandoned brick sheds.	777, 778, 779, 780, 796, 797

The photos referenced in **Table 5** are provided in **Table 6** and a map indicating their location within the QSPX project area is provided in **Appendix E.**

Table 6 – Site Investigation Photographs

Photo 776 – Soil stockpile with organic matter	Photo 777 – Concrete pads
	
Photo 778 – Unknown brick structures	**Photo 779 – Disused demineralised water storage tank and hazardous materials shipping container**
	

Photo 780 – Disused demineralised water storage tank	Photo 791 – Mixed gravel stockpile
	
Photo 792 – Soil stockpile with organic matter	**Photo 796 – Unknown concrete structure**
	
Photo 797 – Unknown concrete structure	**Photo 837 – Dumped concrete columns**
	

4.4 Summary of Potential Contaminants of Concern

Based on the findings of the PSI, identified activities with the potential of generating contaminants of concern within the project area and their corresponding likely locations are listed in **Table 7**, with reference to each site specific location depicted in Figure 4-1.

Table 7 – Summary of Contaminants of Concern

Activity	Description	Contaminants of Concern	Site Specific Locations[2]
Chemical Storage	Possible storage of chemicals, which may have been prone to leakage or spillage during handling of chemicals.	• Unknown	• Building structures and disused hazardous materials shipping contain (Photos 778, 796 and 797) • TIPS
Fill Material	Imported fill from unknown sources have been used in construction activities across the site.	• Total Petroleum Hydrocarbons (TPH) • Monocyclic Aromatic Hydrocarbons (MAHs) • Polycyclic Aromatic Hydrocarbons (PAHs) • Volatile Organic Compounds (VOCs) • Semi-volatile Organic Compounds (SVOCs) • Organochlorine pesticides (OCPs) • Organophosphorus pesticides (OPPs) • Asbestos containing material (ACM) • Heavy metals • Phenols	• Miscellaneous stockpiles (Photos 776, 791 and 792)
Animal Handling	History of housing domesticated mammals at the Quarantine Station on Torrens Island.	• Nutrients • Animal wastes • Pesticides • Carcasses • Pathogens	• Quarantine Station (north of QPS)
Waste Disposal	Dumping of various waste materials around the project area.	• Heavy metals • TPH, MAHs and PAHs • Phenols • ACM	• Dumped concrete columns (Photo 837)
Unused Infrastructure	Various derelict buildings, disused storage tank, shipping container and concrete pads across site.	• OCPs / OPPs • ACM	• Various derelict structures (Photos 778, 796 and 797) • Disused water storage tank (Photos 779 and 780)
Power Generation	TIPS facilities located at the southern end of the island	• Heavy metals • TPH, MAHs and PAHs • Phenols • VOCs and SVOCs	• TIPS

Please note that potential contaminants of concern should not be assumed to be limited to the site specific locations identified in **Table 7**.

[2] Photos are provided in Table 6 or where otherwise indicated.

5. Conclusions

The available information indicates there are probably no significant adverse impacts to the beneficial uses of the land and groundwater within the vicinity of the proposed QPSX Project area. We have classified the existing QPS site and surrounding QPSX Project area as potentially low risk for the proposed end use and thus contamination is unlikely to restrict use of the land. There remain a number of uncertainties in making this general conclusion and further confirmatory sampling is recommended in the proposed expansion footprint.

Within the vicinity of the TIPS at the southern end of the island, the available information indicates that there is high potential for adverse impacts to the beneficial uses of the land and groundwater. Significant contamination issues were identified within the vicinity of the TIPS, including Total Petroleum Hydrocarbons (TPH), chlorinated solvents, nitrate and phosphorus. These contaminants of concern have been previously detected by AGL in quantities that required a notification of contaminated groundwater in the past to the South Australia EPA.

It is recommended that further soil and groundwater sampling investigation should be conducted in the vicinity of the Quarantine Power Station in the north, where the power generators are expected to be constructed, as well as the connection point of the transmission line into the TIPS. It is also recommended that assessment of potential acid sulfate soil (PASS) is part of any future soil sampling plan. PASS has not been included in previous site investigations, and the proximity of the project area to local waterbodies, coupled with the local geology of the site (predominantly organic matter and sand), warrants further investigation, particularly if excavation beneath the groundwater table on site is to occur or construction activities result in the lowering of the water table within the project and surrounding areas.

6. References

AECOM Australia Pty Ltd, *Phase 1 Environmental Site Assessment and Limited Soil Sampling – Torrens Island*, June 2010.

Coffey Environments Pty Ltd, *Torrens Island Animal Quarantine Station – Asbestos Material Register*, March 2008.

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Government of South Australia, Department of Environment, Water and Natural Resources, *Water Connect*, https://www.waterconnect.sa.gov.au/Systems/GD/Pages/Default.aspx viewed December 2017.

URS Australia Pty Ltd, *Environmental Site Assessment, AGL Torrens Island Power Station*, July 2010.

National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure* – Amended, April 2013.

URS Australia Pty Ltd, *AGL Torrens Drain 16 Groundwater Monitoring Events – June and December 2014 – Final Report*, February 2015.

Appendix A. QPSX Project Diagram

Quarantine Power Station Expansion and Transmission Option 1 Infrastructure: Land Ownership

- Transmission Alignment
- Proposed Generator Site
- Aboriginal Heritage Site (not for public release)
- Aboriginal Heritage Area (not for public release)
- State Heritage Area
- Indicative Asbestos Burial Area
- EPBC Listed *Tecticornia flabelliformis* (Bead Glasswort)
- DEWNR Building Buffer (10m)
- Torrens Island Conservation Park
- Existing 275kV Transmission Line
- Existing 66kV Transmission Line
- SEA Gas Pipeline
- SEA Gas Pipeline Easement (indicative only)
- EPIC Gas Pipeline
- EPIC Gas Pipeline Easement (indicative only)

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0 250 500
Metres

IW150900: Quarantine Power Station Expansion

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Appendix B. Geological Survey of South Australia (1:100,000)

Geological Survey of South Australia 1:100,000 Mapsheet (Reduced to 1:30,000)

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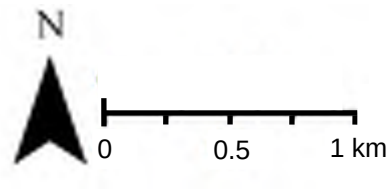

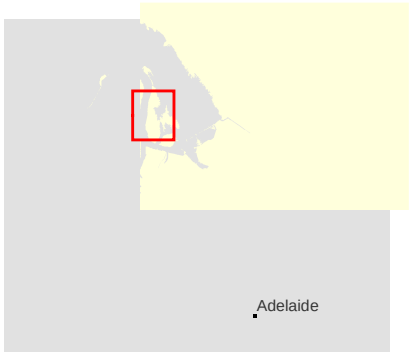

DATA SOURCE: Goverment of South Australia Resources Information Gateway (SARIG)

IW169200: Quarantine Power Station Extension (QPSX) Project

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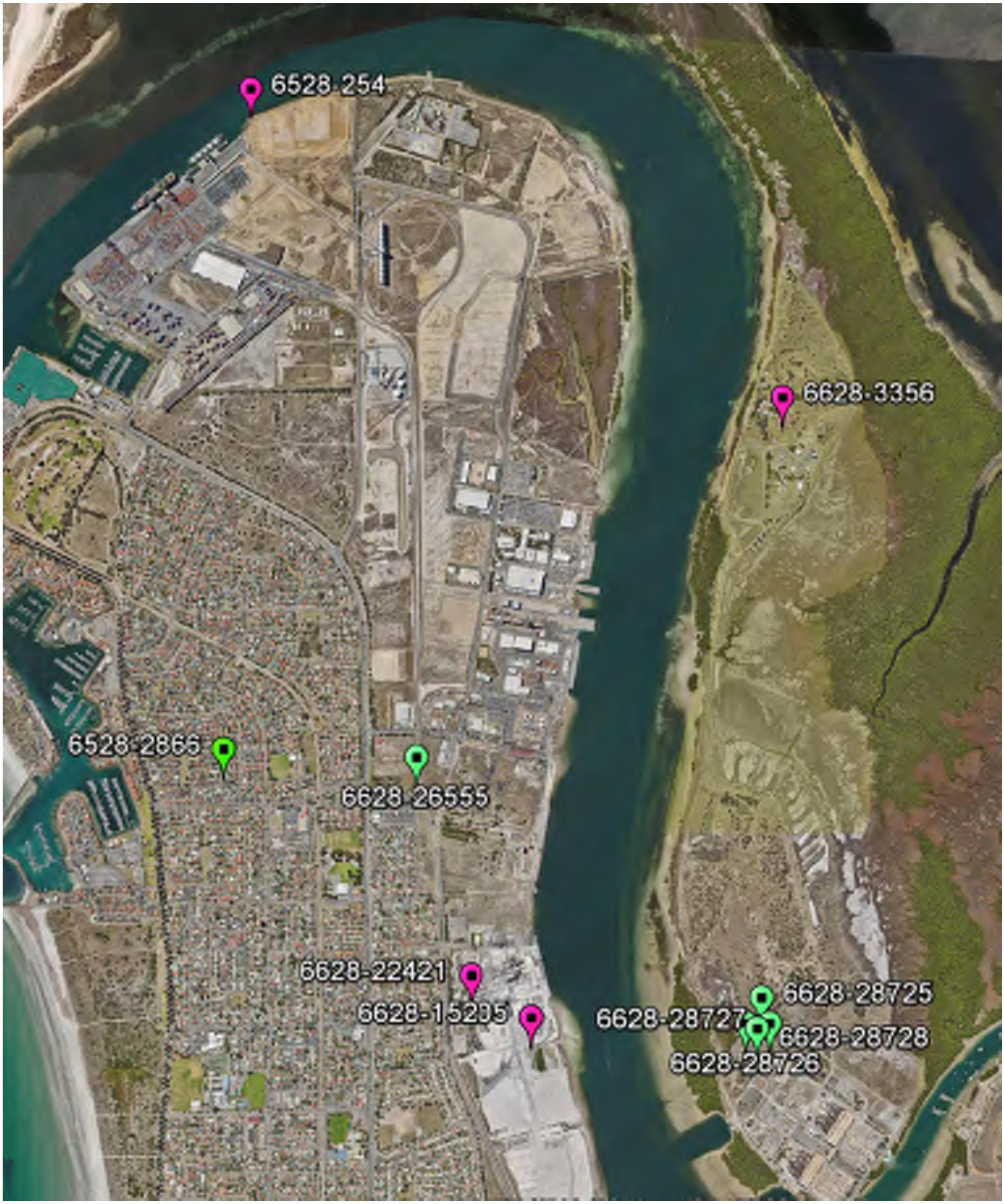
Appendix C. Groundwater Well Locations



Groundwater Well Locations

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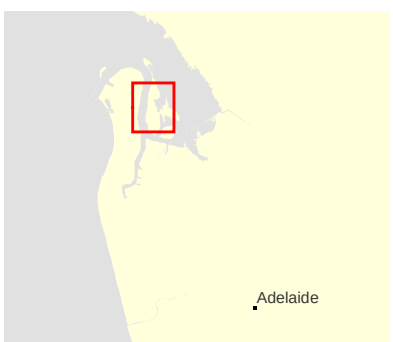

DATA SOURCE: Google Earth and Government of South Australia WaterConnect Resource

IW169200: Quarantine Power Station Extension (QPSX) Project

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Appendix D. Historical Aerial Photographs

Historical Aerial Photograph, Torrens Island - 23/01/1949

DATA SOURCES: Department of Environment, Water and Natural Resources, State of South Australia 2017, Jacobs 2017

IW169200: Quarantine Power Station Extension (QPSX) Project

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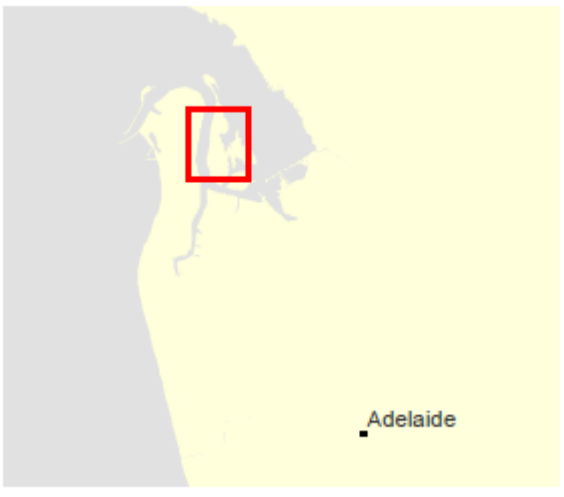
Historical Aerial Photograph, Torrens Island - 09/01/1969

Legend

Area of change since previous aerial photograph (Jan 1949)



DATA SOURCES: Department of Environment, Water and Natural Resources, State of South Australia 2017, Jacobs 2017

IW169200: Quarantine Power Station Extension (QPSX) Project

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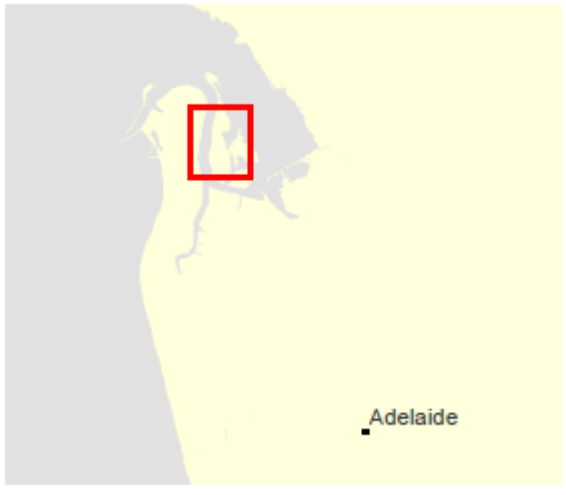
Historical Aerial Photograph, Torrens Island - 19/03/1979



Legend

Area of change since previous aerial photograph (Jan 1969)

DATA SOURCES: Department of Environment, Water and Natural Resources, State of South Australia 2017, Jacobs 2017

IW169200: Quarantine Power Station Extension (QPSX) Project

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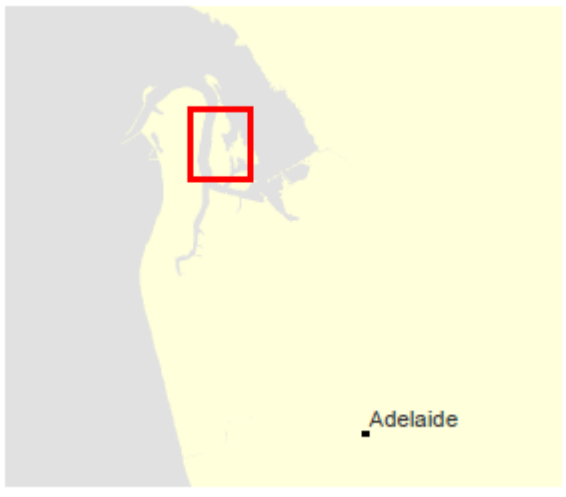
Historical Aerial Photograph, Torrens Island - 28/09/1989



Legend

Area of change since previous aerial photograph (Mar 1979)

DATA SOURCES: Department of Environment, Water and Natural Resources, State of South Australia 2017, Jacobs 2017

IW169200: Quarantine Power Station Extension (QPSX) Project

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Appendix E. Site Investigation Observation Points

Site Investigation Observation Points

Jacobs does not warrant that this document is definitive nor free of error and does not accept liability for any loss caused or arising from reliance upon information provided herein.

DATA SOURCE: Google Earth and Jacobs Group (Australia) Pty Ltd

IW169200: Quarantine Power Station Extension (QPSX) Project

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Appendix L. Relevant Development Plan Policy

Metropolitan Adelaide

OBJECTIVES

Form of Development

Objective 1: Orderly and economic development.

Objective 2: A proper distribution and segregation of living, working and recreational activities by the allocation of suitable areas of land for those purposes.

Public Utilities

Objective 30: Economy in the provision of public services.

Conservation

Objective 33: The conservation, preservation, or enhancement, of scenically attractive areas, including land adjoining water or scenic routes.

Objective 35: The retention of environmentally-significant areas of native vegetation.

Objective 36: The retention of native vegetation where clearance is likely to lead to problems of soil erosion, soil slip and soil salinization, flooding or a deterioration in the quality of surface waters.

Objective 37: The retention of native vegetation for amenity purposes, for livestock shade and shelter and for the movement of native wildlife.

Open Space

Objective 38: Adequate public parks and recreation areas conveniently located.

Metropolitan Open Space System (MOSS)

Objective 39: A clearly defined and linked Metropolitan Open Space System of public and privately owned land of an open or natural character in and around metropolitan Adelaide which will:

(a) provide a visual and scenic contrast to the built urban environment;

(b) separate different parts of the metropolitan area;

(c) assist in the conservation of natural or semi-natural habitats and sites of scientific or heritage interest and re-vegetation;

(d) provide corridors for movement of wildlife;

(e) accommodate a range of active recreation and sporting facilities of regional or State significance, including facilities which may be used for national and international events;

(f) accommodate a range of passive recreation and leisure areas; and

(g) provide for the integration of stormwater management in association with recreation, aquifer recharge and water quality management.

Objective 40: The use of private land within the Metropolitan Open Space System for low-scale uses such as non-intensive agriculture, rural living or low-impact tourist facilities where the emphasis is on retaining or developing the open, natural or rural character and buildings are located and designed in such a way as to blend into the open character of the area.

Appearance of Land and Buildings

Objective 43: The amenity of localities not impaired by the appearance of land, buildings and objects.

Coastal Areas

Objective 45: Preserve and manage the environmentally-important features of coastal areas, including mangroves, wetlands, dune areas, stands of native vegetation, wildlife habitats and estuarine areas.

Objective 48: Due recognition of and allowance for hazards to coastal development such as inundation by storm tides or combined storm tides and stormwater, coastal erosion and sand drift, including an allowance for changes in sea level due to natural subsidence and predicted climate change during the first 100 years of the development.

PRINCIPLES OF DEVELOPMENT CONTROL

1) Buildings and structures should not adversely affect by way of their height and location the long-term operational, safety and commercial aviation requirements of Adelaide International Airport and Parafield Airport.

2) Buildings and structures which penetrate the obstacle limitation surfaces (OLS) should be designed, marked or lit to ensure the safe operation of aircraft within the airspace around the Adelaide International Airport and Parafield Airport.

Metropolitan Open Space System (MOSS)

28) Development should preserve and enhance the character and amenity of land within the Metropolitan Open Space System.

32) Buildings and structures erected on land within the Metropolitan Open Space System should be designed, located and screened so as to be unobtrusive and not detract from the open natural or landscaped character of these areas.

COUNCIL WIDE

OBJECTIVES

The following objectives, and principles are additional to those for Metropolitan Adelaide.

Coastal Development

Objective 7: Development which does not interfere with environmentally important features of coastal areas, including mangroves, wetlands, dune areas, stands of native vegetation, wildlife habitats and estuarine areas.

Objective 9: Preserve areas of high landscape and amenity value including stands of vegetation, exposed cliffs, headlands, islands and hill tops, and areas which form an attractive background to urban and tourist developments.

Objective 16: Non-residential development of a type or size which does not require a coastal site located in appropriate zones away from the coast.

PRINCIPLES OF DEVELOPMENT CONTROL

Form of Development

1) Development should be orderly and economic.

3) Land used for the erection of buildings should be stable.

Conservation

41) Development should have the minimum effect on natural features, land adjoining water or scenic routes or scenically-attractive areas.

42) Natural vegetation should be preserved wherever possible and replanting should take place, wherever practicable.

43) The natural character of rivers and creeks should be preserved.

44) Development should not impair the character or nature of buildings or sites of architectural, historical or scientific interest or sites of natural beauty.

Appearance of Land and Buildings

45) The appearance of land, buildings, and objects should not impair the amenity of the locality in which they are situated.

Coastal Areas

Environmental Protection

48) Development should not be located in areas of delicate or environmentally sensitive coastal features such as sand dunes, wetlands or important remnants of native vegetation.

49) Development should not, nor be likely in the future to, adversely affect the ecology and stability of environmentally -sensitive coastal features.

50) Development should not be undertaken where it will create or aggravate coastal erosion, or where it will require coast protection works which cause or aggravate coastal erosion.

52) Development should be designed for solid or fluid wastes and stormwater run-off to be disposed of so that it will not cause pollution or other detrimental impacts on the marine and on-shore environment of coastal areas.

54) Development should preserve natural drainage systems and should not significantly increase or decrease the volume of water flowing to the sea. Where necessary it should incorporate stormwater management schemes including:

(a) onsite harvesting of water and land based disposal system;

(b) retention basins to facilitate settlement of pollutants and to regulate water flow; and

(c) infiltration.

56) Development should not cause deleterious effect on the quality or hydrology of groundwater.

58) Development should not preclude the natural geomorphological and ecological adjustment to changing climate, sea level or other conditions. For example landward migration of coastal wetlands should not be prevented by embankments. Development should be designed to allow for new areas to be colonised by mangroves and wetland species and for removal of existing embankments where practical.

Preservation of scenic, heritage, amenity and other values

61) Development within coastal areas should be designed and sited in sympathy with the natural and built character of its locality and be complementary in scale, height, bulk, materials and external colours to its surroundings.

62) Development which is proposed to be located outside of designated urban and tourist zones should be sited and designed so as not to adversely affect:

(a) the natural, rural or heritage character of the area;

(b) areas of high visual or scenic value;

(c) views from the coast, near-shore waters, public reserves, tourist routes and walking trails; or

(d) the amenity of public beaches by intruding into undeveloped areas.

63 Development within urban areas should maintain or improve the amenity of the locality by:

(a) preserving important views;

(b) not overshadowing the foreshore;

(c) incorporating and maintaining suitable landscaping; and

(d) enhancing or maintaining the recreational and open space character of the foreshore.

Hazard risk minimisation

79) Development should not occur on land where the risk of flooding is unacceptable having regard to personal and public safety and to property damage.

80) For the purposes of assessing coastal developments the standard sea-flood risk level for a development site is defined as the 100-year average return interval extreme sea level (tide, stormwater and associated wave effects combined), plus an allowance for land subsidence for 50 years at that site.

Development in appropriate locations

91) Development along the coast should be infill in existing developed areas or concentrated into appropriately chosen nodes and not be in a scattered or linear form.

MOSS (CONSERVATION) ZONE

OBJECTIVES

Objective 3: The continued provision of essential infrastructure to the power station and quarantine station on Torrens Island including road access, transmission lines and gas feed lines, but in a manner that will, in the long term, contribute to the conservation, rehabilitation and improvement of the zone.

PRINCIPLES OF DEVELOPMENT CONTROL

2) Development should not detrimentally affect the marine and estuarine biota and ecosystems and should contribute to the zone's rehabilitation and improvement.

PUBLIC PURPOSE (POWER STATION) ZONE

OBJECTIVES

Objective 1: A zone for the continued operation maintenance and essential development of the Torrens Island Power Station consistent with sound management and protection of the natural environment.

Objective 2: A zone for associated development relating to the production and utilization of energy, the utilization of waste products and education and research activities.

PRINCIPLES OF DEVELOPMENT CONTROL

1) Development in the Public Purpose (Power Station) Zone should be for the generation and transmission of power, maintenance and storage activities and associated activities involved in the production and utilization of energy, the utilization of waste products (namely cooling water), education and research.

2) Development involving the production of energy should be consolidated around the existing power station in the southern portion of the zone.

PUBLIC PURPOSE (QUARANTINE STATION) ZONE

OBJECTIVES

Objective 1: A zone for the continued operation and essential development of the Quarantine Station.

PRINCIPLES OF DEVELOPMENT CONTROL

5) Development should provide buffers and limit access to the adjoining MOSS (Conservation) Zone.