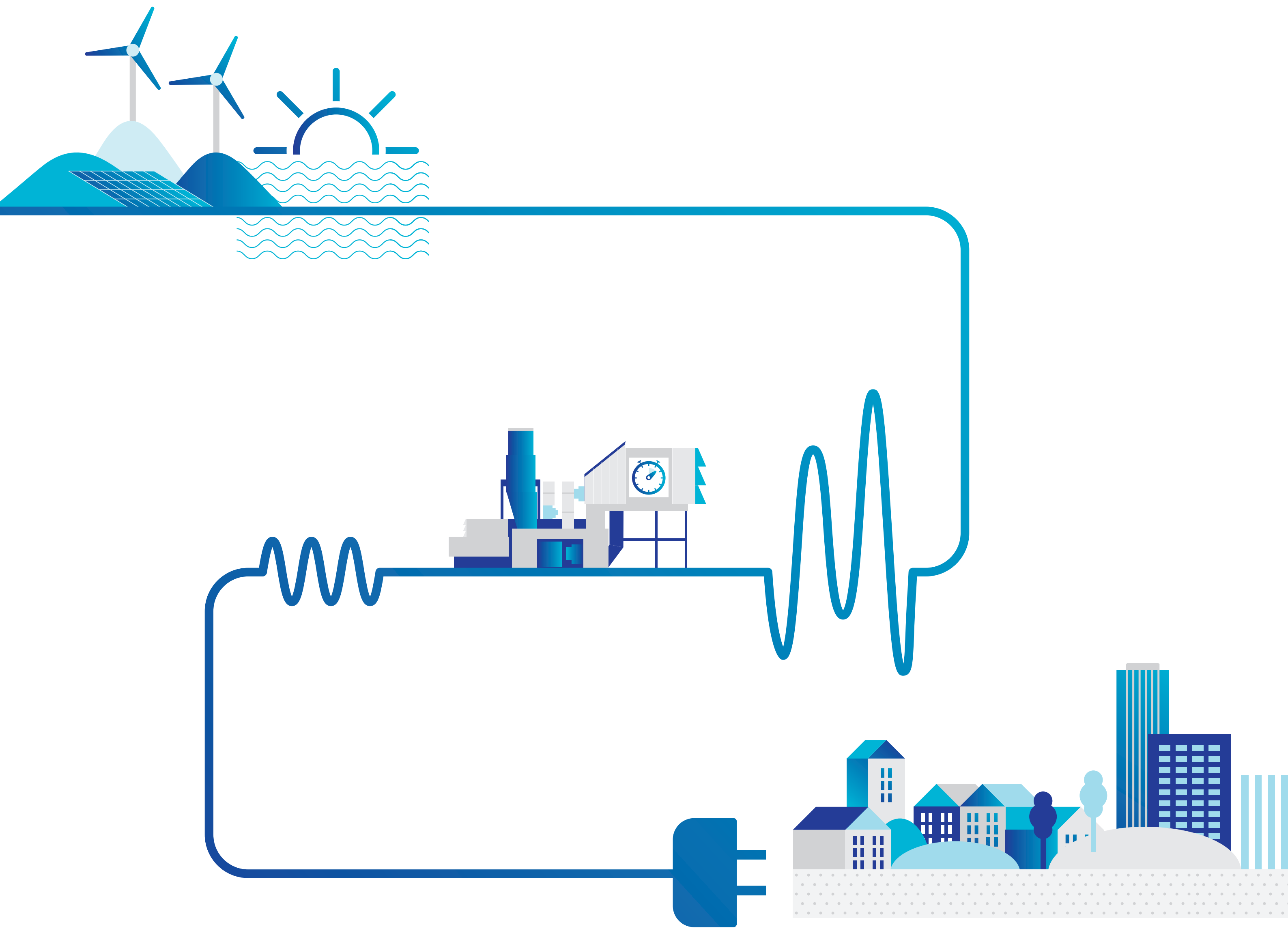
Newcastle Power Station Project

Environmental Impact Statement

November 2019



Certification

Preparation and submission of Environmental Impact Statement under Division 5.2 of the *Environmental Planning and Assessment Act 1979*

Environmental Impact Statement prepared by:

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Qualifications	B.EnvSci, M.EBM
Address	Aurecon Australasia Pty Ltd Level 5, 116 Military Road Neutral Bay NSW 2089
In respect of	Newcastle Power Station Project

Project application	Newcastle Power Station Project
Applicant address	L24, 200 George Street Sydney NSW 2000
Applicant name	Mr Andrew Carman Manager, Newcastle Power Station

	Gas power station	Transmission lines	Gas pipeline
Proposed development footprint	1940 Pacific Highway, Tomago, NSW Lot 3 DP1043561	Lot 3 of DP 1043561, Lot 4 of DP 1043561, Old Punt Road corridor Part Lot 202 of DP 1173564	Lot 3 of DP 1043561, Lot 4 of DP 1043561, Part Lot 1203 of DP 1229590, Part Lot 1202 of DP 1229590, Part Lot 1201 of DP 1229590, Old Punt Road corridor, Part Lot 202 of DP 1173564

Environmental Assessment	An Environmental Impact Statement for the proposed development has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the Newcastle Power Station Project issued on 18 February 2018 and the supplementary SEARs issued on 15 August 2019.
Certification	Peter Fawcett of Aurecon Australasia Pty Ltd certifies that I prepared the Environmental Impact Statement for the Newcastle Power Station. I certify that to the best of my knowledge this Environmental Impact Statement contains relevant information that is neither false nor misleading.

Signature:
Name: Peter Fawcett
Date: 11 November 2019

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Terms and abbreviations

Acronym	Description
ACHAR	Aboriginal Cultural Heritage Assessment Report
AEC	areas of environmental concern
AEMO	Australian Energy Market Operator
AGL	AGL Energy Limited
AHD	Australian height datum
AHIP	Aboriginal Heritage Impact Permit
AQIA	Air Quality Impact Assessment
AS	Australian Standards
ASS	acid sulphate soils
ASSMP	acid sulphate soils management plan
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BGL	below ground level
BoM	Bureau of Meteorology
CASA	Civil Aviation Safety Authority
CEMP	Construction Environment Management Plan
CEMS	Continuous Emission Monitoring Systems
CO_{2-e}	carbon dioxide equivalent
CoPC	chemicals of potential concern
CSSI	critical state significant infrastructure
CWG	community dialogue group
DoEE	Commonwealth Department of Environment and Energy
DPIE	Department of Planning, Industry and Environment
EDI	electro-deionisation
EMF	electric and magnetic fields
ENM	excavated natural material
EPA	Environmental Protection Authority
EP&A Act	*Environment Planning and Assessment Act 1979*

Acronym	Description
EPBC Act	*Commonwealth Environment Protection and Biodiversity Conservation Act 1999*
EPBC Regulations	Commonwealth Environment Protection and Biodiversity Regulations 2000
EPL	environment protection licence
FSF	Fire Safety Study
GAC	groundwater assessment criteria
GDE	groundwater dependent ecosystems
GHG	greenhouse gas
GHGA	Greenhouse Gas Assessment
GSS	Groundwater Specialist Study
GSWnp	general solid waste – non-putrescible
GSWp	general solid waste – putrescible
GWP	global warming potential
HDD	horizontal directional drilling
HPP	High Pressure Pipeline
HWC	Hunter Water Corporation
IBRA	Interim Biogeographic Regionalisation for Australia
JGN	Jemena Gas Networks
kV	kilovolt
LEP	Local Environment Plan
LGA	Local Government Area
LULUCF	land use, land-use change, and forestry
Mt	megaton
MW	megawatt
NCA	noise catchment area
NEM	National Electricity Market
NGER	National Greenhouse and Energy Reporting
NGSF	Newcastle Gas Storage Facility
NMES	Matters of National Environmental Significance
NML	noise management level
NPS	Newcastle Power Station
NSW	New South Wales
NVIA	Noise and Vibration Impact Assessment

Acronym	Description
OEH	Office of Environment and Heritage
OEMP	Operation Environmental Management Plan
PEA	Preliminary Environmental Assessment
PHA	Preliminary Hazard Analysis
POEO Act	*Protection of the Environment Operations Act 1997*
PRA	Plume Rise Assessment
RAAF	Royal Australian Air Force
Roads and Maritime	Roads and Maritime Services
SCR	Selective Catalytic Reduction
SEPP	State Environmental Planning Policy
SWHSS	Surface Water and Hydrology Specialist Study
TAC	Tomago Aluminium Company
TIA	Traffic Impact Assessment
WMS	Waste Management Strategy

Introduction

1 Introduction

1.1 Overview

AGL Energy Limited (AGL) proposes to construct a dual fuel power station, known as the Newcastle Power Station (NPS). The NPS, with gas pipelines, electricity transmission lines, site access and associated ancillary facilities would be built in Tomago in New South Wales (NSW). Together, the NPS, gas pipeline, electrical transmission lines and associated infrastructure form the Proposal. The location of the Proposal is shown in Figure 1.2.1.

The NPS would be a fast-start dual fuel peaking plant with a nominal capacity of 250 megawatt (MW), designed to provide firming capacity to the National Electricity Market (NEM). The NPS is intended to be operated as a peaking plant (base case); however, it will be designed for continuous operation to maximise operational flexibility (worst case). The power generation technology would consist of either reciprocating engines or of aero-derivative gas turbines. The NPS would only be operated continuously if requisite circumstances arise in the NEM. This impact assessment considers both the base case scenario and the worst case scenario.

The Proposal would consist of three key components and associated ancillary infrastructure (discussed in Chapter 2). The key components include:

- Power station: a dual fuel power station capable of operating on natural gas and/or liquid fuel (diesel)
- Gas pipelines: to store gas and to connect the NPS to existing gas supply sources (including the Jemena Gas Network (JGN) and AGL's Newcastle Gas Storage Facility (NGSF)) via AGL's existing pipeline PL42
- Electricity transmission lines: to transfer the electricity produced by the NPS to the national electricity network

Figure 1.2.2 shows the key components of the Proposal (the development footprint) and their general arrangement on the NPS site, however the design will continue to develop and be refined prior to construction. The power sector is exposed to rapidly changing technologies and AGL is seeking to use these processes to determine the most cost-effective technology best suited to the Proposal requirements, the local environment and relevant statutory requirements. As such, this EIS assesses potential construction and operational impacts of the Proposal using a maximum parameters' approach in accordance with the NSW *Draft Environmental Impact Assessment Guidance Series Preparing an Environmental Impact Statement* (DPE, 2017) to bring greater certainty to the assessment of the Proposal.

The Proposal has a capital investment value of approximately $400 million. Construction of the Proposal is planned to commence in 2021 and become operational by the end of 2022.

1.2 Proponent

AGL is an Australian publicly-listed company involved in the generation and retailing of electricity and gas for residential and commercial use. AGL generates energy from a range of sources including thermal power, natural gas, gas storage, coal seam gas, and from renewables including wind, hydroelectricity and solar. AGL is the largest ASX-listed investor in renewable energy and markets its natural gas, electricity and energy-related products and services to approximately 3.6 million customers.

While AGL Energy Limited is currently the proponent, the ultimate proponent may be a successor or assignee to AGL.

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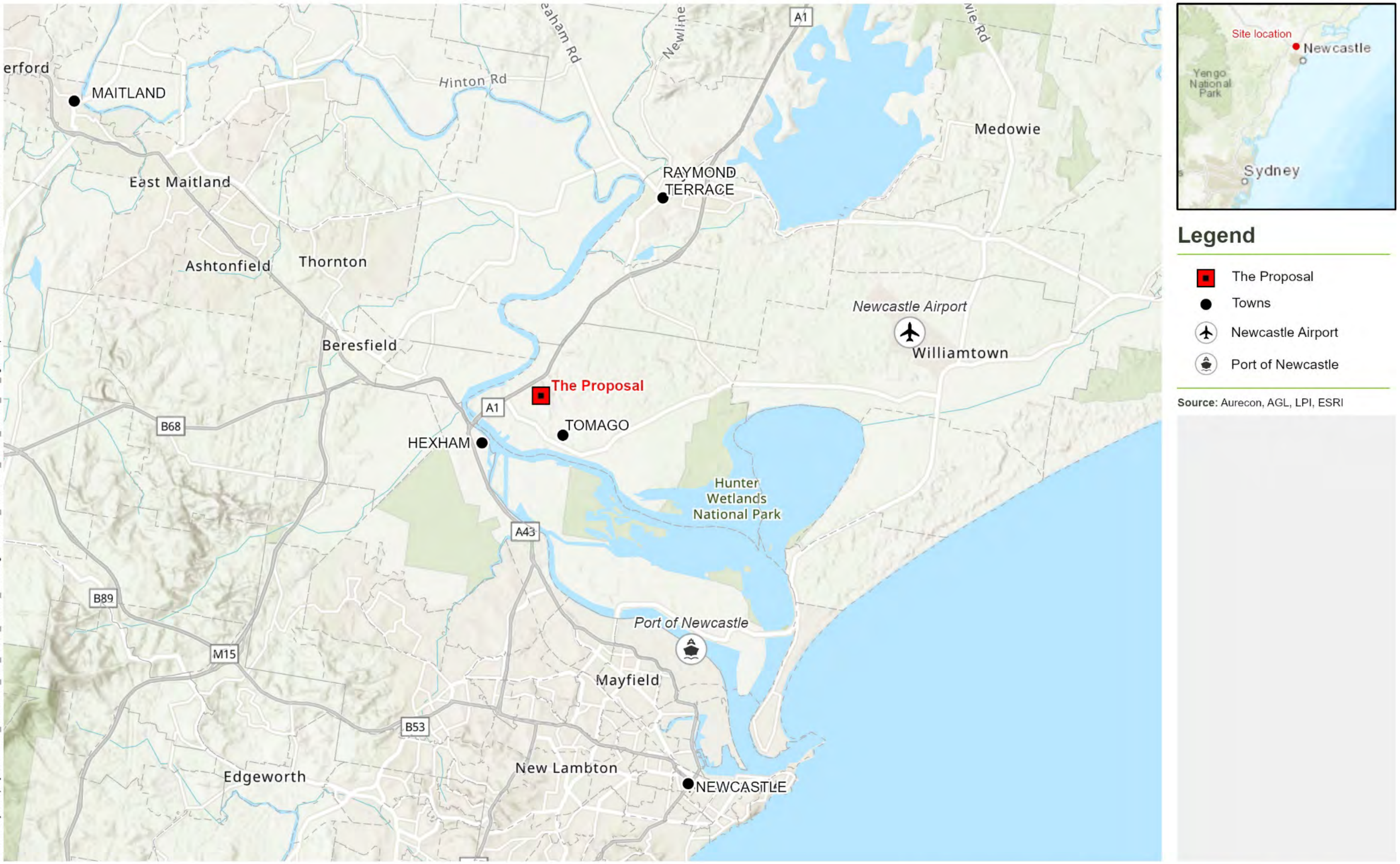

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Newcastle Power Station **Environmental Impact Statement**

Projection: GDA 1994 MGA Zone 56

Figure 1.2.1 Regional location

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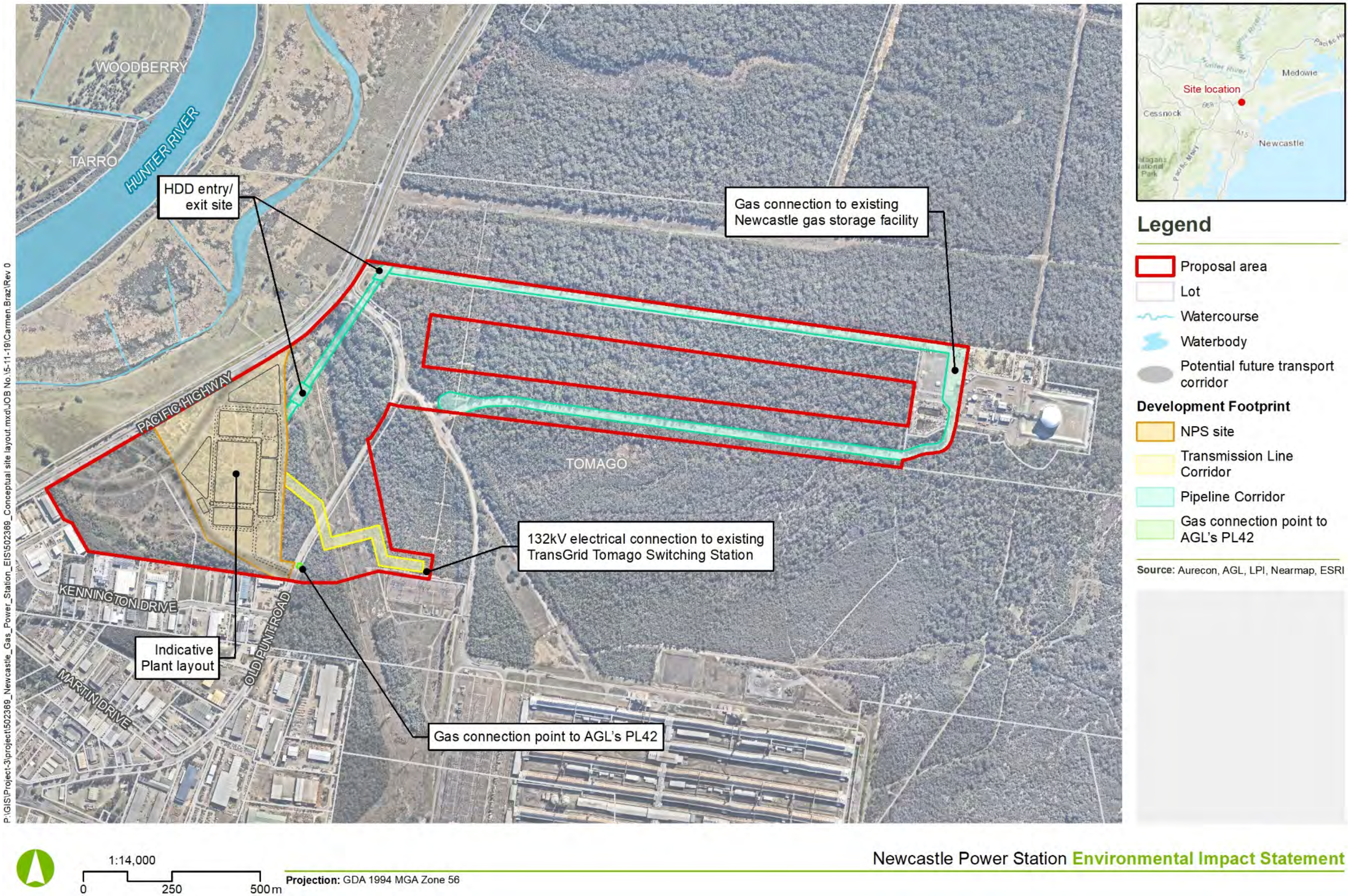

Figure 1.2.2 Conceptual site layout

1.3 Proposal summary

The NPS would be designed and constructed to achieve a nominal generating capacity of 250MW. It would be operated as a peaking plant but would be capable of continuous operation. The final generating capacity of the NPS would be confirmed when the ongoing design and contractual processes are concluded, however a nominal 250MW is considered to be the most likely scenario and has been assessed in this EIS.

The power generation technology would consist of either reciprocating engines of approximately 18MW capacity per unit, or of aero-derivative gas turbines of approximately 30 – 70MW capacity per unit. The power generation technology would be dual fuel, capable of operating efficiently on natural gas and/or diesel. It is anticipated that the NPS would be preferentially fuelled by natural gas supplied from the JGN or AGL's NGSF.

The proposed power station would be located at 1940 Pacific Highway, Tomago in Lot 3 DP1043561 (Figure 1.2.2). The NPS site is approximately two kilometres (km) north east of Hexham in the Port Stephens local government area (LGA). Lot 3 has previously been used for agricultural purposes including grazing and is predominantly cleared of canopy trees and large shrubs, with stands of native vegetation generally confined to the lot boundaries. Also on the lot, there is a single residential dwelling located near the Pacific Highway. Both Lot 3 DP1043561 and the neighbouring Lot 2 DP1043561 are owned by AGL.

The proposed gas pipelines would be located to the east of the NPS site on Lot 4 DP 1043561 and part of Lots 1201, 1202 and 1203 DP 1229590 and part Lot 202 DP1173564 as shown in Figure 1.2.2. The gas storage pipeline corridor would be constructed predominantly within existing corridors cleared and maintained for the NGSF high pressure gas pipeline and vehicle access to the NGSF.

The proposed electricity transmission lines would be located to the east of the NPS site on Lot 4 DP 1043561 and Lot 202 DP1173564 as shown in Figure 1.2.2. It would run between the NPS and the existing TransGrid 132 kilovolt (kV) switching station on Lot 101 DP1125747 and be partially located in an existing cleared transmission corridor.

The NPS site is bounded by the Pacific Highway to the northwest, Old Punt Road and the existing TransGrid transmission lines to the east, Kennington Drive to the south, and Lot 2 DP1043561 to the west. Nearby land uses include the NGSF, the Tomago Industrial Precinct along Kennington Drive, the Tomago Aluminium Company (TAC) smelter off Tomago Road, Tomago, and the TransGrid switching station. These industrial and infrastructure developments are within land zoned IN1 General Industrial under the Port Stephens Local Environmental Plan (LEP) 2013. The Proposal would be located entirely on land zoned IN1).

Access to and from the Proposal would be via a new sealed access road constructed off Old Punt Road. Services, including water, power, and telecommunications would be provided to the NPS site within the same access corridor.

Although owned by AGL and within the Proposal area, Lot 2 DP1043561 is currently subject to a Roads and Maritime Services (Roads and Maritime) proposal to construct an interchange between Old Punt Road and the Pacific Motorway M1 extension to Raymond Terrace (SSI 15_7319). As Lot 2 DP1043561 is currently cleared and construction of the Roads and Maritime Proposal would not occur during the construction of the NPS, part of this lot may be used by AGL as a temporary lay down area for the Proposal, subject to further consultation with Roads and Maritime.

1.4 Proposal objectives

The Proposal has been planned and designed to meet a number of key objectives across the areas of operations and functionality, economics and environmental benefits.

The key operational and functionality objectives of the Proposal are:

- To provide firming capacity to the NEM
- To minimise transmission line losses
- To improve electricity network reliability
- To complement existing and planned intermittent renewable generation sources

The key economic objectives are:

- To manage wholesale electricity risks and costs associated with AGL's retail customer base
- To provide a fast start firming electricity generation facility to more efficiently balance supply and demand and associated pricing pressures

The key environmental objectives are:

- To provide electricity with lower greenhouse gas emissions and acceptable environmental outcomes
- To site the Proposal where land zoning is compatible and where adequate separation exists from sensitive receivers

1.5 Purpose and structure of this report

This EIS has been prepared to provide an assessment of the potential impacts that may arise from the construction and operation of the Proposal, and to recommend management measures to avoid, mitigate, or manage identified impacts.

The EIS comprises three components:

- Executive summary – Overview of the Proposal and the outcomes of the EIS process
- Environmental Impact Statement – Detail of the Proposal, the impact assessment and avoidance, mitigation and management measures
- Appendices – SEARs, agency comments, supplementary SEARs, specialist assessment of key issues used to inform and support the assessment in the EIS and the Proponent's environmental record

Table 1.5.1 provides a summary of each chapter of the main volume (this EIS).

Table 1.5.1 Structure of the main volume

Chapter number	EIS chapter	Coverage
1	Introduction	Provides an overview of the Proposal, details the proponent, and outlines the purpose and structure of the EIS. It lists the SEARs, supplementary SEARs and references to where in the EIS each requirement is addressed and acknowledges the contribution of specialists in preparing the EIS.
2	The Proposal	Describes the need for the Proposal, why and how the specific site and technology was selected, and how sustainability was taken into account in project planning and construction and operation of the Proposal.
3	Site and context	Describes the Proposal area and surrounding context.
4	Statutory planning	Describes the applicable environmental legislation and policy.

Chapter number	EIS chapter	Coverage
5	Consultation	Describes the consultation that has been undertaken prior to and during the environmental assessment process.
6	Environmental impact assessment	Assesses environmental impacts associated with the Proposal and provides management measures to avoid or minimise these impacts.
7	Hazard and risk analysis	Analyses hazards and risks associated with the Proposal and provides management measures to avoid or minimise these risks.
8	Residual environmental risk	Assesses the risk rating of environmental issues, both before and after the application of management measures
9	Mitigation and management	Summary of the control measures recommended in the impact assessment and analyses.
10	Conclusion	A review of the project against the principles of Ecologically Sustainable Development and objects of the *Environmental Planning and Assessment Act 1979*.
11	References	References of all documentation and online resources used in the preparation of the EIS.

The EIS addresses the Secretary's Environmental Assessment Requirements (SEARs) (Appendix A) and the supplementary SEARs (Appendix C). Table 1.5.2 identifies the SEARs, and where they are addressed in the EIS. Table 1.5.3 details the supplementary SEARS and where they are addressed.

Table 1.5.2 Secretary's Environmental Assessment Requirements

Key Environmental Assessment Requirements	Reference
General requirements The EIS must include, but not necessarily be limited to, the following	
A stand-alone executive summary	Newcastle Power Station Project Executive Summary
A full description of the project, including: ■ All components, materials and activities required to construct the project (including any infrastructure that would be required for the project, but the subject of a separate approvals process)	Chapter 2
Site plans and maps at an adequate scale showing: ■ The location and dimensions of all project components	Figure 1.2.2 Figure 2.4.1
■ Existing infrastructure, land use, and environmental features in the vicinity of the project (including any other existing, approved or proposed infrastructure in the region)	Chapter 3
Likely staging or sequencing of the project, including construction and rehabilitation	Staging is not planned. Sequencing of construction is identified in Section 2.5
The likely interactions between the project and any other existing, approved or proposed major projects in the vicinity of the site (including the Newcastle Gas Storage Facility, Tomago Aluminium Smelter, and M1 to Raymond Terrace Motorway Project)	Section 3.1 Cumulative impacts discussed in each Section in Chapters 6 and 7
A justification for the proposed project as opposed to other alternatives	Section 2.3

Key Environmental Assessment Requirements	Reference
Statutory context for the project, including: ■ How the project meets the provisions and objectives of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and EP&A Regulation ■ Consideration of the project against all relevant environmental planning instruments ■ Any approvals that must be obtained before the project can commence	Section 10.2 Chapter 4
An assessment of the likely impacts of the project on the environment, focusing on the specific issues identified below, including: ■ A description of the existing environment likely to be affected by the project using sufficient baseline data ■ A description of how the project has been designed to avoid and minimise impacts (including selection of gas connection option) ■ An assessment of the potential impacts of the project, including any cumulative impacts, and taking into consideration relevant guidelines, policies, plans and industry codes of practice	Chapters 6 and 7
A consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS	Chapter 9
An evaluation of the project as a whole having regard to: ■ Relevant matters for consideration under the EP&A Act including ecologically sustainable development ■ The strategic need and justification for the project having regard to energy security and reliability in NSW and the broader National Electricity Market ■ The biophysical, economic and social costs and benefits of the project	 Section 10.1 and Chapter 4 Section 2.2 Section 10.1
Key issues	
Biodiversity, including: ■ An assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with the NSW *Biodiversity Conservation Act 2016*, the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR) ■ The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM	Section 6.2 Appendix D
Heritage, including: ■ An assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the project, including adequate consultation with Aboriginal stakeholders having regard to the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	Section 6.7 and Appendix J Section 6.12 and Appendix N

Key Environmental Assessment Requirements	Reference
Hazards and Risks, including: ▪ Preliminary Hazard Analysis (PHA), covering all aspects of the project which may impose public risks, to be prepared consistent with Hazardous Industry Planning Advisory Paper No. 6 – Guidelines of Hazard Analysis (DPE, 2011a) and Multi-level Risk Assessment The PHA must: ▪ Include a pipeline risk assessment to estimate the risks from the pipeline to the surrounding land uses, with reference to Australian Standards AS2885 Pipelines – Gas and Liquid Petroleum, Operation and Maintenance ▪ Demonstrate that the risks from the project comply with the criteria set out in Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning (DPE, 2011b)	Chapter 7 Appendix S
▪ Plume rise impact assessment prepared in accordance with CASA's guidelines for conducting plume rise assessments	Appendix Q
Land and Contamination, including: ▪ An assessment of impacts of the project on soils, land capability and geotechnical stability of the site and surrounds ▪ An assessment of the extent and nature of any contaminated materials or acid sulphate soils on site or in dredged material ▪ An assessment of potential risks to human health and the receiving environment ▪ A description of the measures that would be implemented to avoid or mitigate impacts	Section 6.6 Appendix I
Water, including: ▪ An assessment of the impacts of the project on groundwater aquifers and groundwater dependent ecosystems having regard to the NSW Aquifer Interference Policy and relevant Water Sharing Plans ▪ A detailed site water balance for the project, including water supply and wastewater disposal arrangements	Section 6.3 Appendix E
▪ An assessment of the flood impacts of the project ▪ A description of the erosion and sediment control measures that would be implemented to mitigate any impacts during construction	Section 6.4 Appendix F
Air quality, including: ▪ An assessment of the likely air quality impacts of the project in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016) ▪ Ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the Protection of the Environment Operations (Clean Air) Regulation 2010 ▪ An assessment of the likely greenhouse gas impacts of the project	Section 6.5 Appendix G Appendix H

Key Environmental Assessment Requirements	Reference
Noise and vibration, including: ■ Assessment of the likely construction noise impacts of the project under the Interim Construction Noise Guideline (DECC, 2009) ■ An assessment of the likely operational noise impacts of the project under the NSW Noise Policy for Industry (EPA, 2017) ■ An assessment of the likely road noise impacts of the project under the NSW Road Noise Policy (DECCW, 2011) ■ An assessment of the likely vibration amenity and structural impacts of the project under Assessing Vibration: A Technical Guideline (DEC, 2006) and German Standard DIN 4150-3 Structural Vibration – effects of vibration on structures	Section 6.9 Appendix L
Transport, including: ■ An assessment of the transport impacts of the project on the capacity, condition, safety and efficiency of the local and State road network including consideration of the future M1 Motorway extension to Raymond Terrace ■ An assessment of the site access point and rail safety issues ■ A description of the measures that would be implemented to mitigate any impacts during construction ■ A description of any proposed road upgrades developed in consultation with the relevant road authorities (if required)	Section 6.8 Appendix K
Visual, including: ■ An assessment of the likely visual impacts of the project on the amenity of the surrounding area and private residences in the vicinity of the project	Section 6.11 Appendix M
Socio-economic, including: ■ An assessment of the likely impacts on the local community, demands on Council infrastructure and consideration of the construction workforce accommodation	Section 6.10
Waste, including: ■ Identify, quantify and classify the likely waste stream to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste	Section 6.14 Appendix P
Consultation	
■ During the preparation of the EIS, you must consult with the relevant local, State and Commonwealth Government authorities, infrastructure and service providers, community groups and affected landowners ■ The EIS must describe the consultation that was carried out, identify the issues raised during this consultation, and explain how these have been considered and addressed	Chapter 5

Table 1.5.3 Supplementary SEARs

Supplementary Environmental Assessment Requirements	Reference
On 15 August 2019, a delegate of the Federal Minister for the Department of the Environment and Energy (DoEE) determined that the Newcastle Power Station Project was a controlled action under section 75 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The EPBC Act controlling provisions for the proposed action are: Wetlands of international importance (Ramsar wetlands) (sections 16 and 17B)	
The assessment documentation must include: ▪ An assessment of all impacts that the action is likely to have on each matter protected by a provision of Part 3 of the EPBC Act ▪ Enough information about the Proposal and its relevant impacts to allow the Federal Minister to make an informed decision on whether or not to approve ▪ Information addressing the matters outlined in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations)	Section 4.1 Chapter 2 Chapter 6
The proponent must undertake an assessment of all protected matters that may be impacted by the development under the controlling provisions identified in paragraph 1. The DoEE considers that the proposed action has the potential to significantly impact the following: ▪ The physico-chemical status of the Hunter Estuary Wetlands Ramsar site ▪ The habitat or lifecycle of native species dependent on the Hunter Estuary Wetlands Ramsar site	Section 6.2 Section 6.3 Section 6.4
The proponent must consider each of the protected matters under the triggered controlling provisions that may be impacted by the action. Note that this may not be a complete list and it is the responsibility of the proponent to undertake an analysis of the significance of the relevant impacts and make sure that all protected matters that are likely to be significantly impacted are assessed for the Commonwealth Minister's consideration.	Section 4.1
General requirements The EIS must include, but not necessarily be limited to, the following:	
Relevant regulations, including: ▪ The Environmental Impact Statement (EIS) must address the matters outlined in Schedule 4 of the EPBC Regulations and the matters outlined below in relation to the controlling provisions	Section 4.1
Project description, including: ▪ The title of the action, background of the action and current status ▪ The precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on Matters of National Environmental Significance (MNES) ▪ How the action relates to any other actions that have been, or are being taken in the region affected by the action ▪ How the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts on MNES	Section 2.1 Section 2.4 Cumulative impacts discussed in each Section in Chapters 6 and 7 Section 2.5

Supplementary Environmental Assessment Requirements	Reference
Existing environment, including: ■ The EIS must identify and describe the location, extent and ecological characteristic of the Ramsar wetland that may be impacted by all stages of the proposed action ■ If surveys are undertaken to support analysis in the EIS, they must include the survey results, including details of the scope, timing and methodology for studies or surveys and how they are consistent with (or justification for divergence from) published Commonwealth guidelines and policy statements ■ A description and quantification of habitat (including suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival of species), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advices, conservation advices and recovery plans and threat abatement plans ■ Maps displaying the above information in paragraphs 11 and 12, overlaid with the anticipated impacts from the proposed action	Section 6.2.1 Section 6.3.1 Section 6.4.1 Section 6.6.1 Section 6.9.1
Impacts, including: ■ The EIS must include an assessment of the relevant impacts of the action on the matters protected by the controlling provisions, including: – A description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long-term relevant impacts – A statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible – Analysis of the significance of the relevant impacts – Any technical data and other information used or needed to make a detailed assessment of the relevant impacts	Section 6.2.3 Section 6.3.3 Section 6.4.3 Section 6.6.3 Section 6.9.3
Avoidance, mitigation and offsetting, including: ■ For each of the relevant matters protected that are likely to be significantly impacted by the action, the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action including: – A description, and an assessment of the expected or predicted effectiveness of the mitigation measures – Any statutory policy basis for the mitigation measures – The cost of the mitigation measures – An outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing – The name of the agency responsible for endorsing or approving each mitigation measure or monitoring program	Chapter 9 There would not be any significant impact by the action on a relevant protected matter.
Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy	Chapter 8 The EIS has not identified that there would be a significant residual adverse impact to a relevant protected matter.

Supplementary Environmental Assessment Requirements	Reference
For each of the relevant matters likely to be impacted by the action the EIS must provide reference to, and consideration of, relevant Commonwealth guidelines and policy statements including any: ▪ Management plan for Ramsar wetland ▪ Any strategic assessment ▪ The risk of groundwater contamination from the site impacting on the Hunter Estuary Wetlands ▪ The ground water connectivity to the Hunter Estuary Wetlands Ramsar site ▪ The likely impacts of the Hunter Estuary Wetlands Ramsar site if groundwater contamination occurs	Section 6.4
Key Issues, the Hunter Estuary Wetlands:	Section 6.3
▪ Information is required to determine the extent of the potential surface water impacts on the downstream Hunter Estuary Wetlands Ramsar site, including but not limited to:	Section 6.4
– How stormwater will be treated, how much will be released into the environment and whether it will be monitored for contaminants	
– The extent of acid sulphate soil occurrence and how soils will be managed to avoid impacts to the Hunter Estuary Wetlands Ramsar site	Section 6.3.3 Section 6.4.4
– Results from the proposed surface water impact assessment and groundwater technical study	
▪ The EIS must include a description of the controls that will be put in place to manage the impacts of the groundwater and surface water contamination on the Hunter Estuary Wetlands Ramsar site and include an analysis of how effective each of the controls will be to make sure the ecological character of the Hunter Estuary Wetlands Ramsar site is maintained	Section 6.3.4 Section 6.4.4 Section 6.6.4
▪ Further information is required to determine the extent of the impacts of the proposed action on:	
– Habitat, such as saltmarsh and mangroves or native species such as Green and Golden Bell Frog or Migratory Shorebirds, that are dependent on the Hunter Estuary Wetlands Ramsar site, which could be impacted indirectly if water quality (through both groundwater and surface water contamination) is affected as a result of the proposed action	Section 6.2.3 Section 6.3.3 Section 6.4.3
– Wetland species indirectly impacted as a result of noise during construction or the ongoing operation of the power plant.	Section 6.9.3
▪ The EIS must include a description of the controls and measures that will be put in place to manage impacts from the proposed action of the habitat and lifecycles of the native species dependent on the Ramsar site	Section 6.2.3 Section 6.2.4
Key Issues, other approvals and conditions: ▪ Information in relation to any other approvals or conditions required must include the information prescribed in Schedule 4 Clause 5 (a) (b) (c) and (d) of the EPBC Regulations 2000	Chapter 4
Key issues, environmental record of person proposing to take the action: ▪ Information in relation to the environmental record of a person proposing to take the action must include details as prescribed in Schedule 4 Clause 6 of the EPBC Regulations 2000	Appendix U

Supplementary Environmental Assessment Requirements	Reference
Key Issues, information sources: ■ For information given in an EIS, the EIS must state the source of the information, how recent the information is, how the reliability of the information was tested, and what uncertainties (if any) are in the information	Appendix D to T

Acknowledgement for each of the specialist studies carried out in preparation of the EIS is provided in Table 1.5.4.

Table 1.5.4 Specialist consultants

Specialist input	Consultant
Air Quality Impact Assessment	Environmental Resources Management Australia Pacific Pty Ltd
Aboriginal Cultural Heritage Assessment Report	Environmental Resources Management Australia Pacific Pty Ltd
Biodiversity Development Assessment Report	Kleinfelder
Electric and Magnetic Fields (EMF) Assessment	Aurecon Australasia Pty Ltd
Fire Safety Study (Bushfire Threat Assessment)	Kleinfelder
Fire Safety Study	Aurecon Australasia Pty Ltd
Greenhouse Gas Assessment	Environmental Resources Management Australia Pacific Pty Ltd
Groundwater Specialist Study	Aurecon Australasia Pty Ltd
Noise and Vibration Assessment	Environmental Resources Management Australia Pacific Pty Ltd
Non-Aboriginal Heritage Assessment	Environmental Resources Management Australia Pacific Pty Ltd
Preliminary Hazard Analysis	Aurecon Australasia Pty Ltd
Plume Rise Assessment	Environmental Resources Management Australia Pacific Pty Ltd
Soils and Contamination Specialist Study	Aurecon Australasia Pty Ltd
Surface Water and Hydrology Specialist Study	Aurecon Australasia Pty Ltd
Traffic Impact Assessment	Seca Solution Pty Ltd
Visual Impact Assessment	Aurecon Australasia Pty Ltd
Waste Management Strategy	Aurecon Australasia Pty Ltd

The Proposal

2 The Proposal

2.1 Proposal overview

AGL proposes to construct the NPS and associated infrastructure including gas supply pipelines, electricity transmission connections, access, and utilities (the Proposal) (Figure 1.2.2).

The NPS would be a dual fuel (gas and diesel) fast-start peaking power station with a nominal generating capacity of 250MW at Tomago in NSW. The power generation technology would consist of either reciprocating engines or of aero-derivative gas turbines.

New gas pipeline connection would supply the NPS with gas from the JGN (via connection to AGL's PL42) and the NGSF (via AGL's High Pressure Pipeline (HPP)). AGL also proposes to construct a gas storage pipeline/s between the NGSF and the NPS to supplement gas supply.

A new electricity transmission line would transfer the electricity produced by the NPS to the national electricity network via connection to the existing TransGrid 132kV switching station at Tomago.

The NPS would supply electricity to the grid at short notice during periods of high electricity demand, and/or low supply, particularly during periods where intermittent renewable energy supply is low or during supply outages. This operation is aligned with AGL's move to a renewable energy mix.

The NPS is intended to be operated as a peaking plant (base case); however, it will be designed for continuous operation to maximise operational flexibility (worst case). The NPS would only be operated continuously if requisite circumstances arise in the NEM. This impact assessment considers both the base case scenario and the worst case scenario.

While gas is the preferred fuel source, the NPS would be able to operate on diesel fuel in the event of a gas supply disruption or when the power station is required to operate for extended hours.

The design of the NPS would consist of either reciprocating engines or gas turbines. AGL is seeking to use the tender and contractual processes to determine the most cost-effective technology best suited to the Proposal area and statutory requirements of NSW. The decision to install reciprocating engines or gas turbines would be made based on a range of environmental, social, engineering, and economic factors. Both reciprocating engines and gas turbines are assessed in this EIS, however, only one type would be constructed.

The Proposal has a capital investment value of approximately $400 million and would contribute to delivering greater energy security for NSW. Construction is expected to commence in 2021 with the NPS operational by the end of 2022. An overview of the Proposal is summarised in Table 2.1.1 and shown in Figure 1.2.2.

Table 2.1.1 Proposal overview

Proposal Element	Summary of the Proposal
Proposal address (NPS land)	1940 Pacific Highway, Tomago, NSW
Proposal area (Figure 1.2.2)	■ 90.59 hectares comprising: – Lot 2 of DP 1043561 – Lot 3 of DP 1043561 – Lot 4 of DP 1043561 – Part Lot 1203 of DP 1229590 – Part Lot 1202 of DP 1229590 – Part Lot 1201 of DP 1229590 – Old Punt Road corridor – Part Lot 202 of DP 1173564 The Proposal area is shown in Figure 1.2.2
Development footprint (Figure 1.2.2)	Disturbance area (construction) of approximately 26.5 hectares (refer to Figure 1.2.2)
NPS	NPS would be located on: ■ Lot 3 of DP 1043561
Electricity transmission lines	132kV electricity transmission line would be between the NPS, the TransGrid switching station and be located on: ■ Lot 3 of DP 1043561 ■ Lot 4 of DP 1043561 ■ Old Punt Road corridor ■ Part Lot 202 of DP 1173564
Gas pipeline corridors	The gas storage pipeline corridor between the NGSF and the NPS; and the gas connection to PL42 would be located on: – Lot 3 of DP 1043561 – Lot 4 of DP 1043561 – Part Lot 1203 of DP 1229590 – Part Lot 1202 of DP 1229590 – Part Lot 1201 of DP 1229590 – Old Punt Road corridor – Part Lot 202 of DP 1173564
Zoning	Zoned IN1 General Industrial under the Port Stephens Local Environmental Plan 2013
Supporting infrastructure of the Proposal	■ Site access road ■ Storage tanks ■ Laydown areas ■ Ponds ■ Generator circuit breakers, generator step-up transformers, and switchyard including overhead line support gantry

Proposal Element	Summary of the Proposal
	■ Natural gas reception yard potentially including gas metering, pressure regulation, compression, heating stations, pigging facilities and provision for flaring ■ Truck unloading facilities ■ Control room ■ Office/administration buildings ■ Workshops and storage areas ■ Parking ■ Other ancillary facilities
Existing supporting infrastructure (off-site)	■ TransGrid Tomago switching station (Lot 101 of DP 1125747) ■ The NGSF (Lot 1201 DP 1229590) ■ Hexham receiving station ■ Waste and wastewater disposal facilities in the region ■ Road network including Pacific Highway and Old Punt Road
Proposed water management	■ Raw water via a connection to the local reticulated water supply network with truck delivery as secondary source ■ Water treatment plant (demineralised) ■ Process wastewater tankered to a licensed wastewater facility ■ Contaminated drains system and chemical drains system ■ Stormwater discharge in accordance with the requirements of Port Stephens Council ■ Stormwater pit and pipe drains, oil and grease separator, bio-retention system and stormwater discharge in accordance with Council requirements ■ On site sewage system in accordance with the requirements of the Port Stephens Council On site Sewage Management Technical Manual Annual water consumption: – Peaking load operation: up to around 120,000m^3 – Continuous operation: up to around 800,000m^3 Annual wastewater volume: – Peaking load operation: up to around 22,000m^3 (requiring off-site disposal) – Continuous operation: up to around 150,000m^3 (requiring off-site disposal)
Proposed commencement of operation	Approximately 2022
Proposal life	Approximately 25 years
Construction duration	Approximately 2 years
Construction hours	Works would be undertaken during standard construction hours and out-of-hours
Construction workforce	Expected peak construction workforce of 300
Operational workforce	■ Approximately 23 persons on rotating shifts and routine maintenance
Hours of operation	■ For peaking load operations: operated only in times of peak demand or low supply, capable of 24/7 operation

Proposal Element	Summary of the Proposal
	▪ For continuous operation: 24/7 operation, 365 days a year
Capital investment	▪ Approximately $400 million

2.2 Proposal need

AGL has a broad ranging strategy to increase electricity generation capacity into the NEM to improve energy security and reliability. The Proposal is part of this strategy that includes a mix of high-efficiency gas power stations, renewable power, battery storage and demand response initiatives. The Proposal would supply electricity to the NEM at short notice during periods of high electricity demand, and/or low supply, particularly during periods where intermittent renewable energy supply is low or during supply outages.

The Proposal is required to:

- Make sure the continual supply of electricity is available to NSW residents, businesses and the community without interruption
- Contribute to lower emissions by delivering firming capacity in support of intermittent renewable generation
- Improve security of electricity to NSW as aging generation plants retire

The Proposal was declared Critical State Significant Infrastructure (CSSI) by the NSW Minister for Planning in December 2018 under the *State Environmental Planning Policy (State and Regional Development) 2011*. The NPS was recognised as being essential to NSW for the following environmental, economic, and social reasons:

- Energy security is a critical issue for NSW and Australia. Additional dispatchable capacity would improve security of supply to residential, commercial and industrial energy users in NSW
- The proposed units would be able to ramp quickly to full capacity, providing a rapid response that adapts to fluctuating changes in energy supply and demand
- Fast start flexible generation that is dispatchable 'firms' intermittent renewable generation and enables higher levels of renewables to be integrated into the generation mix, reducing coal consumption and associated carbon and other pollutant emissions

The Proposal would be of regional significance due to:

- A substantial investment in the Hunter region with an estimated cost of $400 million
- Strategic regional benefits including the supply of energy to:
  - Major industrial facilities in the Newcastle area
  - The largest regional economy in Australia
  - The Port of Newcastle which accounts for around three quarters of NSW export tonnes (t)
  - Major air defence and civilian/military air traffic management installations
- Significant direct and indirect employment during construction and operation
- Provision of affordable and reliable electricity supporting local industry and jobs

The Proposal is expected to deliver greater energy security for NSW as well as creating flow on economic and social benefits for the State, providing employment opportunities for the region as well as material investment into regional NSW.

2.2.1 NSW electricity network

NSW's peak electricity requirements are currently being met by the following key generation types:

- The Snowy Mountains and other Hydro-electric schemes
- NSW coal fired plants, some of which are approaching retirement
- Other NSW gas fired plants
- Imported electricity from Queensland and Victoria

Other generation types include renewables (as available), rooftop solar, batteries and landfill gas facilities.

The 'Final Report from the Energy Security Taskforce' prepared by the NSW Chief Scientist and Engineer released on 19 December 2017 (Chief Scientist & Engineer 2017) states that 'the electricity system is in a period of transition, innovation and reform'. It identified a series of risks and emerging issues for the NSW electricity system to maintain a reliable electricity supply. While instances of unserved energy have been rare, there are indicators that the electricity supply and demand balance in NSW is tightening and new risks are emerging, particularly with the failure of large generation plant or extreme weather events.

It is anticipated that in the early 2020s, NSW will experience a reduction in its base-load coal-fired generation capacity. In particular, the planned retirement of Liddell in the Upper Hunter Valley will remove capacity from the network.

AEMO's 2019 Electricity Statement of Opportunities (2019 ESOO) identified that "following the gradual closure of Liddell, a combination of high summer demand and unplanned generator outages will leave New South Wales exposed to significant supply gaps and involuntary load shedding if no mitigation action is taken."

The construction of the NPS forms part of AGL's staged approach to bring new investment online ahead of Liddell's retirement, as outlined in its NSW Generation Plan. The Proposal would contribute to delivering greater energy security for NSW as well as creating flow on economic and social benefits for the State, providing employment opportunities for the region as well as strong and solid investment into regional NSW.

Amendments recently made to the *Electricity Supply Act 1995* (NSW) by the *Electricity Supply Amendment (Emergency Management) Act 2017* (NSW) make it clear that 'energy security is a high priority for the New South Wales Government' and it is strongly committed to preventing electricity shortages (Second reading speech for the Electricity Supply Amendment (Emergency Management) Bill 2017). The Proposal would assist NSW in achieving greater energy security by delivering an additional nominal 250MW of fast-start, flexible capacity into the grid.

2.2.2 Power supply

The Hunter region accounts for approximately 44% of power generation in NSW. The *Hunter Regional Plan 2036* includes a goal to diversify energy supply. Specifically, the *Hunter Regional Plan 2036-Implementation Plan 2016-2018* includes Direction 12 to 'diversify and grow the energy sector' and action 12.3 to 'promote new opportunities arising from the closure of coal fired power stations that enable long term sustainable economic and employment growth in the region'. The Proposal aligns with this plan.

The NPS would assist in the reduction of volatility in the electricity market by operating during peak demand episodes and would assist in diminishing the likelihood of power supply shortages for domestic and business customers in the Hunter Region. The fast start dispatchable power generation would provide back-up to wind and solar energy and would help in the transition to a coal-constrained energy future.

2.2.3 Power supply peaking requirements

When electricity demand rapidly approaches supply capacity, electricity prices increase. As an electricity retailer, AGL must have the capacity to generate electricity at times of peak demand or procure this capacity from the market, to provide ‘peaking capacity’. During these periods, the wholesale price which AGL pays to other generators can increase by up to 200 times the standard power cost. Peaking power generation such as the NPS would assist AGL to manage the cost of electricity sold to consumers and minimise market exposure. It would also provide rapid start up generation capacity at times of reduced supply or generation capability from other plants or sources.

As Australia’s electricity market adapts to a carbon-constrained future and turns towards intermittent renewable energy sources, the NPS would assist in creating a secure energy system as the market transitions. Fast start dispatchable power generation complements renewables by providing back-up to wind and solar energy and helps respond to peak demand.

2.2.4 Sustainability

The AGL 2019 Annual Report (AGL, 2019) recognises that Australia’s energy sector is transitioning from a system dependent on ageing thermal generation assets to one characterised by renewable energy, lower emission technologies, firming technologies and energy storage. This transition requires significant capital expenditure and investments to be made into the NEM to replace higher emission generation with renewable technologies while ensuring that the lights can be reliably turned on in homes and businesses. The Proposal is reflective of the needs of the NEM to maintain system reliability while supporting federal and state government renewable energy and climate policies by providing reliable, dispatchable capacity at times of high demand and/or low supply.

AGL is committed to the orderly transition away from coal to new sources of electricity generation and energy storage and recognises the need to both modernise and decarbonise Australia’s electricity generation sector. AGL has committed to playing a leading role in this transition as the generator of approximately 25% of the energy within the NEM. As a large greenhouse gas emitter, AGL acknowledges that it has a responsibility to be transparent about the risks that climate change poses to its business, the community and the economy more broadly.

While the development of peaking power generation plants has a high investment cost, it is an important investment for AGL’s risk management strategy and corporate social responsibility objectives. It would support the transition to renewable energy sources and providing the broader NSW community with electricity that is more environmentally sustainable, affordable and reliable.

2.2.5 Regional economy

The Proposal is expected to support the delivery of greater energy security for NSW as well as creating flow on economic and social benefits for the State, providing employment opportunities for the region as well as solid investment into regional NSW.

AGL’s operational and proposed generation assets, such as this Proposal, support many regional communities throughout Australia by employing locals, supporting community groups and offering unique benefits for having AGL in their backyard. The Proposal would provide a substantial investment in the Hunter region with an estimated cost of $400 million and would generate significant direct and indirect employment during construction and operation. Further, AGL’s approach to benefit-sharing with local communities aims to create a net positive social, economic and environmental contribution to the communities in which it operates.

The Proposal would be a critical addition to the electricity infrastructure of NSW. Generation would be relatively close to areas of consumer demand, supporting reliability, particularly during peak consumption times. The Proposal would support the energy requirements of future employment growth in the area, as well as the existing Tomago aluminium smelter, Port of Newcastle and major air defence and civilian/military air traffic management installations in the Tomago area.

2.3 Proposal alternatives and options

2.3.1 Analysis of alternatives

Alternatives for the Proposal have and continue to be developed throughout the design stages to make sure the design of the NPS best meets the Proposal objectives and has consideration for all environmental, social, and economic outcomes. Alternatives have been assessed for:

- Power generation alternatives
- Power generation technologies
- Site selection
- Layout configurations
- Gas and power transmission routes
- Emissions control technology options
- Operational water and wastewater systems
- The "Do Nothing" option

2.3.2 Power generation alternatives

The Proposal would supply electricity to the grid at short notice during periods of high electricity demand and/or low supply. Thermal peaking power stations are best suited to meet this requirement and provide support to other commercial power generation alternatives such as:

- Wind
- Solar
- Hydro-electric
- Pumped storage
- Battery storage
- Coal
- Gas
- Nuclear

Solar and wind power generation are becoming viable commercial solutions, however, is an intermittent energy generation, that requires dispatchable electricity generation to 'firm' the supply.

Pumped storage facilities are geographically constrained and have long development and construction periods. Battery storage facilities are not yet able to provide long duration services. New hydro-electric and nuclear generation represent significant infrastructure developments with associated high capital expenditure. Thermal power stations remain the most effective and economic means of firming electricity supply in support of ongoing development of renewables.

Existing coal-fired power stations are economical and efficient for meeting standard demand, and account for most of the electricity generation in Australia. However, they are limited in their ability to meet variable demands and are slow to start-up and shut down.

Gas-fired peaking power stations can meet a variable demand, and have lower atmospheric emissions of greenhouse gases, oxides of nitrogen and sulphur dioxide. These are fast-start facilities that can be turned on to meet peak demands. As such, this option was selected as the preferred option as it would provide the best means of meeting its objective of supplying electricity to the NEM at commercially competitive rates to meet peak demand.

2.3.3 Power generation technologies

The proposed NPS would utilise either large reciprocating engines or aero-derivative gas turbine technology. For each technology, there are multiple suppliers and products available. Determining the chosen technology for the NPS includes the consideration of several factors, including:

- Performance characteristics such as thermal efficiency and output at different ambient conditions and loading, firing gas and/or diesel
- Operational characteristics such as start-up times, usage rates of consumables such as water, oil and catalysts and auxiliary power consumption when off-line and in service
- Compliance with legislation, codes and standards
- Capital, operating and maintenance costs

The selection of the generation technology would be developed by the chosen contractor and requires further design following EIS finalisation. Both reciprocating engines and gas turbines have been assessed in this EIS.

2.3.4 Site selection

A site selection study was commissioned by Macquarie Generation in 2000 to identify potential sites throughout NSW suitable to develop a gas fired power station (URS, 2002). Key selection criteria included:

- Proximity to a suitable and reliable gas supply
- Proximity to potential users/major clients
- Proximity to the NEM electrical transmission system
- Availability of water for cooling
- Nearby corridors for piping gas to the site and for exporting electricity from the site

Seven potential sites were identified, of which three were discounted due to difficulties securing reliable utility supply (fuel and potable water).

The proposed Tomago site was considered the most suitable site as it met all selection criteria and provided the best economic outcome. The site provides:

- Sufficient cleared land to develop a power station and associated infrastructure, with minimal environmental constraints
- Existing infrastructure to support development of the Proposal, including electricity transmission lines and roads, reliable municipal water supply, and close proximity to a highway, and natural gas pipeline
- Proximity to the existing TransGrid 132kV switching station, and near areas of potential electricity demand growth, minimising energy losses associated with transmitting electricity long distances
- Compatible land use – land is zoned industrial, with surrounding areas proposed for industrial development under the Hunter Regional Plan 2036, and limited residential dwellings in the area
- Skilled workforce within the nearby industrial areas of Newcastle and the wider Hunter region for construction, operation and maintenance workforce

In 2018, the Tomago site previously identified was re-evaluated to confirm that it was still suitable for a peaking power station and considered a number of different sites in the area. The study identified that the Proposal area was still the best suited site for the proposed power station.

2.3.5 Layout configurations

Layout configurations were developed based on the plant required for either reciprocating engines or gas turbines, ancillary and associated structures and the land available on the site.

The site layout allows for future expansion at which time further statutory approvals would be sought. Provision has been made for future connections to unit/s for fuel supply, demineralised water supply, compressed air supply, and capability for extension of fire water ring main.

The layout of the gas generation units would be developed by the chosen contractor and requires further design following EIS finalisation. Therefore, this component has been assessed throughout the EIS and specialist studies using a maximum parameters approach i.e. evaluating the maximum impact.

2.3.6 Gas storage pipelines route

Eight options were considered for analysis of the gas storage pipelines route which would be capable of storing and supplying high pressure gas to the NPS, when required. All eight options were assessed across a number of different criteria including cost, storage, constructability, safety and environmental impact. Following this assessment, the options 1A and 3C were identified as feasible and equally preferred. The preferred gas storage pipeline route options are summarised in Table 2.3.1.

Table 2.3.1 Preferred gas storage pipeline route options

Option	Description	Assessment
1A	Option 1A would comprise of two independent pipelines (twin pipelines) installed from the NGSF to the new power station, with a combined length of 4.9km. The pipelines would be located within the existing easement in the northern corridor.	This option would result in a pipeline corridor with boring pits required. There would be multiple pipelines, requiring additional manufacturing or engineering pieces such as valves, pig barrels and crossings.
3C	Option 3C would be a looped line commencing from the NGSF in the southern corridor. The looped line would be pigged separate to the pipe segment in the northern corridor.	Additional valves, licences and land would be required for this option whilst a single set of pits and pipe tunnel crossing would ease any perceived construction impacts.

A review of these options identified that the preferred option was a combination of the two, building a looped storage pipeline along both the northern corridor and the southern corridor, that would connect the NGSF and the NPS (refer to Figure 1.2.2).

2.3.7 Power transmission route

To connect the NPS to the TransGrid 132kV switching station, five options were considered and assessed for the transmission route, which are shown in Figure 2.3.1. Of the five options assessed, route options 1 and 2 were discarded as the undercrossing of the TransGrid lines proved to be impossible due to insufficient conductor height of the TransGrid circuits. Options 4 and 5 were identified as shorter and involving less forest clearing than Option 3. Option 4 was ultimately selected as the preferred option as it provides access to the NPS switchyard at the most suitable location and does not utilise power station land required for other services.

The preferred transmission route option is summarised in Figure 2.3.1.

Option 4, the preferred power transmission route option, runs from Tomago 132kV switching station, northward along the eastern side of the TransGrid lines, undercrossing both TransGrid lines south of STR-2 and STR-67D, then northward along the western side of the TransGrid lines, terminating at the SS Opt-3 location. This route requires less vegetation to be cleared than options 1, 2 or 3 and satisfies all electrical clearances at the TransGrid undercrossing.

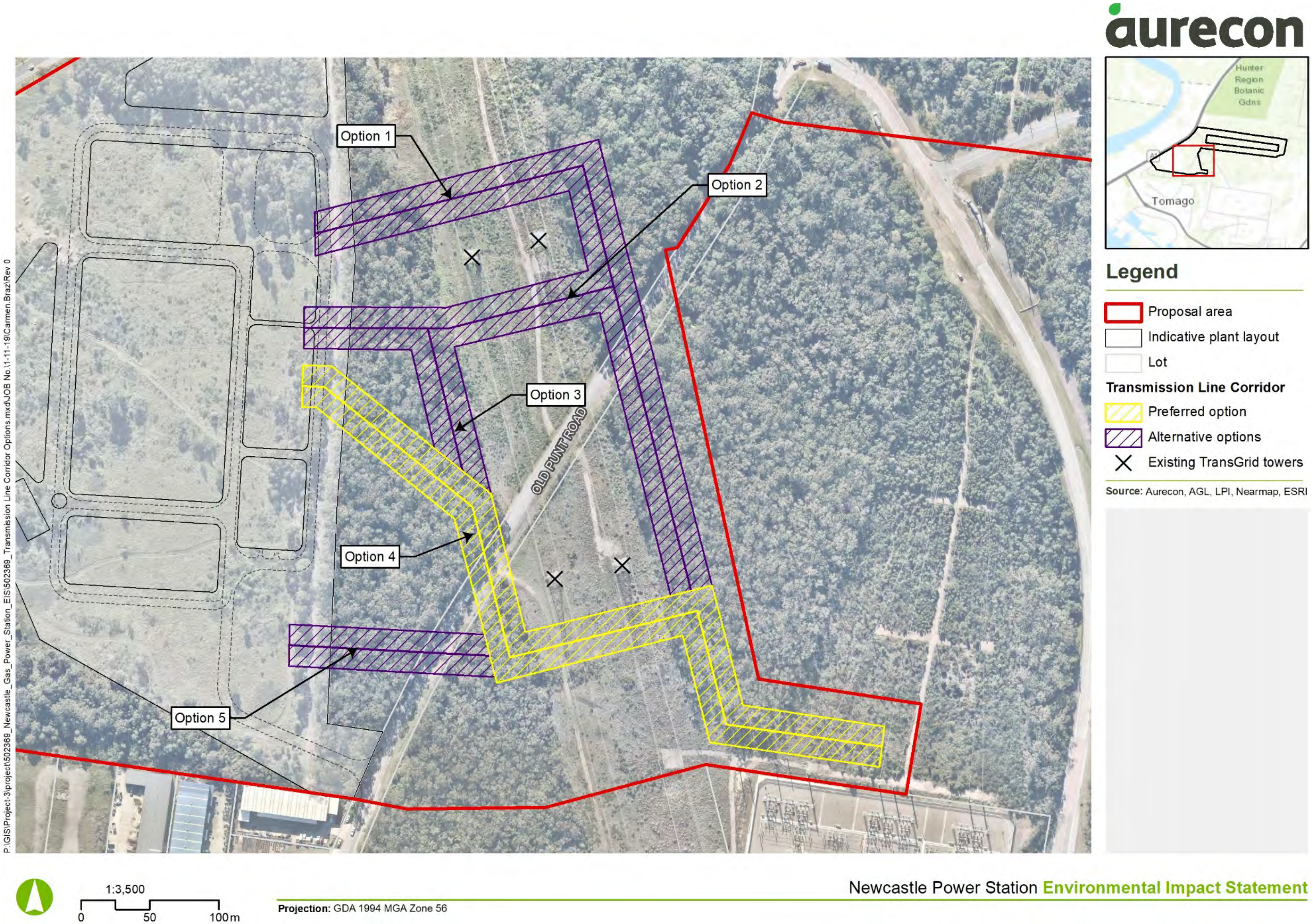

Figure 2.3.1 Power transmission route options

2.3.8 Emissions control

Oxides of nitrogen (NO_x) are formed during the combustion of air and fuel at high temperature, irrespective of the fuel source used.

NOx control options considered for the NPS include:

- No control
- Water or steam injection
- Dry Low NOx Combustion Systems
- Wet Low NOx Combustion Systems
- Selective Catalytic Reduction (SCR)

Each technology has a different power and water requirement to operate and would result in differing NO_x emissions. All technologies are capable of meeting the standards for electricity generation plant in Schedule 3 of the Protection of the Environment Operations (Clean Air) Regulation 2010.

Regardless, the power station would be fitted with a Continuous Emission Monitoring Systems (CEMS) to demonstrate ongoing regulatory compliance.

2.3.9 Operational wastewater

Wastewater from operation of the NPS would be stored on site before being removed via tankers (refer to Section 2.6.6). A number of alternatives were considered prior to arriving at this preferred position. These are presented in Table 2.3.2.

Table 2.3.2 Wastewater disposal options

Alternative	Advantages	Disadvantages	Selection
Connection to a Licensed wastewater treatment system	Permanent wastewater removal	No infrastructure available Construction of pipeline for small volumes of wastewater is uneconomical	Not selected Could be considered for future use should sewer infrastructure become available in Tomago
On site treatment and disposal	Environmentally sustainable Maximises water reuse and reduces water demand	Restrictions on disposal of effluent due to risk to environmental resources, being the: ▪ Freshwater Wetland Complex vegetation community within the Proposal area ▪ The Tomago Sandbeds ▪ The Hunter River and adjacent coastal and Ramsar wetlands	Not selected Risk to environmental resources too great
Collection and transport offsite for treatment and disposal	No treatment required on site	Worst case operation requires a large number of trucking movements	Preferred No risk to environmental resources

Process water storage ponds or tanks are expected to be used to collect and store process wastewater on site. Process water and solids/sludge would be periodically removed from the storage pond and tankered off-site for disposal at a licensed trade waste facility. A tanker loading facility would be provided adjacent to the storage pond for wastewater and solids/sludge collection and removal.

2.3.10 No Proposal alternative

Should the Proposal not proceed, there would be direct consequences which includes:

- An anticipated shortfall in NSW electricity generation, at times, following the retirement of Liddell, potentially resulting in increased NEM prices and insufficient or interrupted electricity supply for NSW residents, businesses and the community
- The benefits to the region and NSW, including the improvement of power security, firming support of renewable generation, employment and investment described earlier in this section, would not be realised
- No environmental and social impacts for development of the Development footprint

2.4 Proposal description

The Proposal would be located at Tomago, approximately 5km south west of Raymond Terrace and about 2km north east of Hexham.

The NPS would be developed on Lot 3 DP1043561 (approximately 16.6 hectares) which is owned by AGL. A large proportion of the proposed power station site has been cleared and was previously used for agricultural purposes. A single residential dwelling remains on the lot adjacent to the Pacific Highway (Figure 1.2.2). The land retains some isolated trees and stands of native vegetation which are generally confined to the boundaries of Lot 3. The land is gently undulating with a central low ridgeline grading in all directions of the NPS site. A number of earth and gravel paths cross Lot 3.

The gas pipeline corridor would be located to the east of the power station site as shown in Figure 1.2.2. The pipeline corridor would span from the NPS to the NGSF, while a new gas connection to AGLs existing pipeline would span between the NPS and PL42. These pipelines would pass across:

- Lot 3 DP 1043561
- Lot 4 DP 1043561
- Lot 202 DP1173564
- Lot 1201 DP1229590
- Lot 1202 DP1229590
- Lot 1203 DP1229590
- Old Punt Road corridor

The gas storage pipeline corridor in Lot 202 DP1173564 and Lot 1203 DP1229590 have been cleared and a sealed access constructed to provide access to the NGSF.

The electricity transmission corridor would be located to the east of the power station site in Lot 202 DP1173564 and Lot 4 DP 1043561. The corridor would run between the NPS and the existing TransGrid 132kV switching station in Lot 101 DP1125747.

The main elements of the Proposal are discussed in detail in the following sections. An indicative arrangement of key components within the development footprint is presented in Figure 1.2.2.

2.4.1 Power station

The NPS would be a dual fuel power station, meaning generation units would be able to be supplied by natural gas and/or diesel.

The selection of the generation technology (i.e. reciprocating engine or gas turbine) and arrangement of the specific generation units within the power station site are subject to ongoing design development. This EIS assesses both options and the maximum parameters of each generation technology.

Other elements of the Proposal are dependent on the generation technology chosen and are yet to be designed in detail. These elements include:

- Generating capacity
- Switching station capacity
- Number of generating units
- Number of stacks and stack height
- Process water management
- Sewage design

Notwithstanding the above, the generation units, regardless of the selected technology, would include the following key features:

- Dual fuel fired energy generation system and associated local supply connections
- Air intake systems
- Fire and gas detection and protection systems
- Lubricating and other oil systems
- Exhaust gas stacks
- Auxiliary systems

To maximise operational flexibility, each unit of the power station would be designed for continuous operation, while complying with environmental emissions limits.

Reciprocating engines would be installed inside a purpose-built engine hall. Gas turbines would be installed within an enclosure. The plant would include and not be limited to:

- A fuel gas system to supply gas from the fuel gas conditioning system and to each of the generating units
- A diesel supply system including storage tanks and local connection to units
- Lubricating oil supply via tanker and site storage tank
- Compressed air for the instrument and service air system
- Auxiliary cooling system
- Exhaust gas module and exhaust gas stack. The height of the exhaust stacks is dependent on the technology, but would be approximately 35mAHD for gas turbines and 45mAHD for reciprocating engines. The emissions control system would depend on the power generation technology chosen.
- Generator

The NPS would include the following buildings:

- Administration/office and control room building
- Workshop and store/s
- Electrical switch room/s
- Equipment room/s

- Battery room/s
- Gas turbines or reciprocating engines
- Other miscellaneous buildings (water treatment plant, gas yard, etc)

It is expected that these buildings and structures would range in height between one and three storeys, with further design to be undertaken during detailed design of the Proposal. Paved walkways would be provided around all buildings and to connect the buildings and major plant areas.

Start-up and auxiliary electrical power supply for the NPS would be drawn from the network via the 132kV switch station, and then via generator step-up transformers and unit auxiliary transformers.

A proposed earthing system would consist of a buried copper earth grid around the NPS foundations and bonded to the steel columns of any buildings. It is expected that the earth grid would be connected to the 132kV switch station to achieve a low earth grid resistance.

Gas compression, conditioning, heating and other facilities necessary to transport and store gas are also likely to be required and would be constructed at the site.

A conceptual layout overview of the NPS side is provided in Figure 2.4.1. This conceptual overview provides an indication of the key operational components of the NPS and their general arrangement, however is subject to ongoing design development.

Natural gas

The NPS would be preferentially fuelled by natural gas supplied from the JGN or AGL's NGSF. Details on the gas pipelines are in Section 2.4.2.

At the NPS, the natural gas system would include the following equipment:

- Distribution manifold from supply terminal point and associated pipework and valving to each of the unit's gas regulating skid
- Heating station (water bath heaters or equivalent)
- Compression system and/or pressure let-down station

The fuel gas system downstream of the terminal point would be designed to provide gas at a pressure and temperature as required by the generating unit's individual fuel system.

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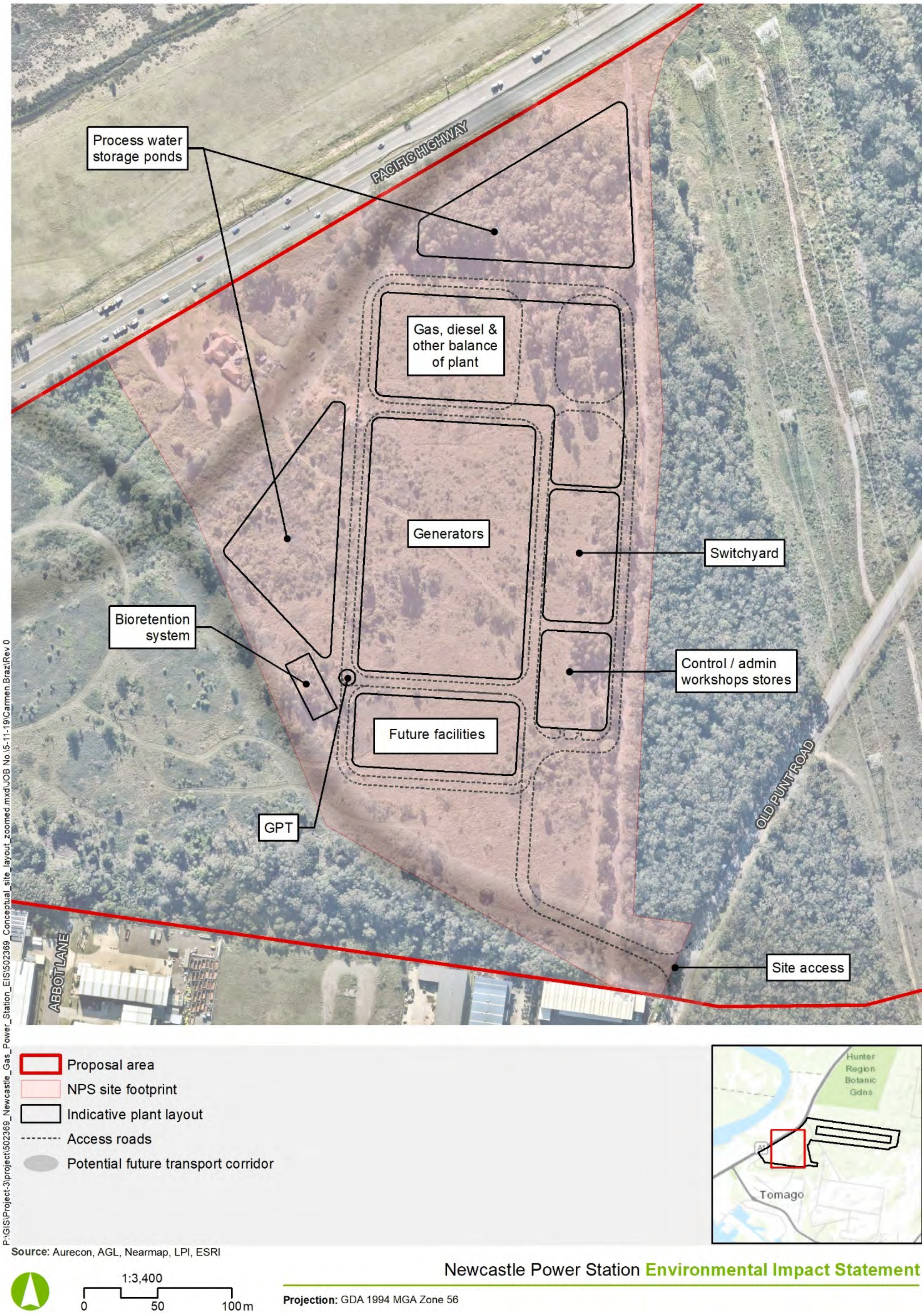

Figure 2.4.1 Conceptual power station overview

Diesel

The NPS would also be capable of being fuelled by liquid fuel, likely diesel and/or bio-diesel, which would be stored on site. Approximately 1.5 megalitres (ML) of diesel storage would be required at the NPS to enable continuous operation.

The diesel system would nominally include the following equipment:

- Tanker unloading bays, suitable for B double tankers, with provisions for spill management and unloading pump facilities
- Diesel storage tanks with bunding
- Forwarding pumps
- Filtering
- Metering
- Heating
- Supply and distribution pipework to units (including tank return), valving, and instrumentation

Around 30 B-double tankers with a volume of $50m^3$ would be required to fill 1.5ML of diesel storage capacity. Adequate B-double tanker bays would be constructed to enable multiple tanker delivery and unloading operations.

Ancillary facilities

The NPS would require supporting ancillary facilities to the abovementioned features including:

- Generator circuit breakers, generator step-up transformers and switchyard including overhead line support gantry
- Water collection and treatment facilities
- Process water storage ponds
- Closed circuit cooling systems
- Control room
- Offices and messing facilities
- Electrical switch rooms
- Occupational health and safety systems including an emergency warning and evacuation system
- Workshop and warehouse
- Firefighting system
- Communication systems
- Security fence, security lighting, stack aviation warning lights (if required) and surveillance system;
- Landscaped areas and staff parking areas
- New access road off Old Punt Road into the NPS and emergency access track to the north
- Concrete foundations, bitumen roadways, concrete pads in diesel unloading station and maintenance areas
- Concrete bunded areas with drains for diesel tanks, liquid chemicals store, oil filled transformers (if installed) and other facilities where liquids could leak
- Level construction and laydown area
- Engineered batters to support and protect the power plant platform

- Site drainage for clean water diversion and dirty stormwater collection and treatment

2.4.2 Gas pipeline and storage

The JGN Northern Trunkline transports gas from Sydney to Newcastle distributing it to city gate stations along the way. Gas is currently delivered from the Northern Trunkline to the Hexham Receiving Station, approximately 13km northwest of Newcastle. AGL owns and operates a 5.5km bidirectional pipeline between the Hexham Receiving Station and the NGSF (PL42), which is used to import, and export gas based on seasonal requirements and market demand.

There are two gas pipelines to be constructed as part of the Proposal:

- New gas pipeline connection to the PL42 on the eastern side of Old Punt Road
- New gas storage pipeline from the NPS to the NGSF

The primary source of natural gas for the NPS would be via the connection to AGL's existing PL42. This connection would allow gas to be sourced from both the JGN (subject to availability) and NGSF. New gas pipeline connections would be made between the NPS (in the gas receiving yard) to the JGN located on the eastern side of Old Punt Road. The pipeline would be designed as per AS2885 and constructed of approximately DN 300 (12") pipe and buried at a depth of approximately 900 to 1200mm.

To supplement supply, AGL would construct new gas storage pipeline capable of storing natural gas in compressed gaseous form, on land between the NPS and NGSF, partially within existing cleared corridors (refer to Figure 1.2.2). Gas would be drawn from the NGSF during periods of low gas demand, compressed, and stored for use by the NPS during periods of high-power demand. The gas storage pipelines would require up to 5km of pipeline to provide the required storage capacity. These pipelines would be of multiple diameters where the larger pipeline would be approximately DN 1050 (42"). The pipeline would be buried at a depth of approximately 900 to 1200mm. These new gas pipeline would either be constructed via trenching or horizontally directionally drilled.

Both the northern and southern cleared corridors, where the pipelines would be located, have sufficient width to house the pipelines. The maximum footprint area for pipeline construction would be around 20ha, the majority of which would be within existing cleared corridors, only a 10m wide 200m long section of vegetation clearing is required. The pipeline would be buried at a minimum 900mm to 1200mm below ground surface (depth to top of pipe) and would be installed primarily via trenching. The gas storage pipeline may be constructed via Horizontal Directional Drilling (HDD) under Old Punt Road; and along the Pacific Highway due to the existence of Freshwater Wetland Complex vegetation community in this area. Boring pits would be established at either end of the HDD lines to accommodate the rig and stringer. The corridor would be rehabilitated to pre-existing conditions following construction.

The proposed gas pipeline corridors would contain underground HPPs and would be designed, constructed and operated to meet the requirements in AS 2885:2008 Pipelines – Gas and Liquid Petroleum.

The pipeline design would include pigging facilities to enable inspection and maintenance.

Natural gas may need to be vented and/or flared during maintenance activities. A temporary (mobile) flare unit is proposed to be installed or connection made to the existing NGSF flare header system at these times. Complete depressurising and flaring of the HPPs is likely to be a rare event.

2.4.3 Electricity transmission line

A new high voltage 132kV electricity transmission line would be required to connect the NPS to the TransGrid 132kV switching station, approximately 500m south east (Figure 1.2.2). The overhead transmission line would connect to the TransGrid switching station via three transformers, each connected via a fully rated short line. The switching station would transfer the electricity to the regional electricity transmission system. Some underground sections of the transmission line may be required where construction constraints require this approach.

Where the transmission line passes over land not owned by AGL or TransGrid, a new cleared easement would be established. Where parallel to the TransGrid easements the electricity transmission line easement would be contiguous with the adjacent TransGrid easement.

The transmission line from the TransGrid Tomago 132kV switching station would require the following crossings:

- Under the Ausgrid 132kV Beresfield line
- Under TransGrid's 132kV double circuit power line which currently possesses a 45m easement and 330kV double circuit line which possesses a 60m easement
- A road crossing over Old Punt Road

A substation would be constructed comprising 132kV transformers, switchbay/s, a busbar and outgoing line switchbay/s. The substation is expected to be around 90m wide and 45m long. The switchyard would be surfaced with crushed rock and secured by a perimeter fence.

2.5 Proposal construction

AGL would engage a contractor who would be responsible for completing the detailed design before starting construction. The construction methodology is based on preliminary designs and would be further refined during the detailed design. This construction methodology has identified an indicative area of impact for the Proposal (Figure 1.2.2) and the power station (Figure 2.4.1).

2.5.1 Construction methodology

The construction of the Proposal would include:

- The power station
- The access roads and utility corridors
- The gas pipeline corridor
- The electricity transmission corridor

Following construction, the Proposal would undergo commissioning and testing. The remaining disturbed areas of the development footprint would undergo progressive landscaping and rehabilitation. AGL aims to commence operation of the Proposal in 2022, with construction due to commence in 2021. Key construction activities to meet the targeted 2022 date are detailed in the following sections.

Power station site

Enabling works

Enabling works for the Proposal would be carried out to prepare the site for construction and to provide protection to surrounding public. Enabling works would include:

- Site preparation: establishing sediment and erosion control measures, establishing marked no go areas, site clearing and grubbing, installing security fencing, establishing laydown areas, establishing construction amenities (including offices, lunchrooms, storage areas, and washrooms)
- Provision of construction power: installing on site generators until power can be sourced from the existing distribution system
- Bulk earthworks: levelling the power station site by cutting and filling as required. The detailed design would aim for a balance of cut and fill to limit the need to import or export fill. Compaction of the fill profile would be required to achieve design compaction. Topsoil would be removed in layers and stockpiled to be reused in landscaping on site.

The existing dwelling on Lot 3 would be demolished by a licensed demolition contractor following an assessment for hazardous building materials. Typically, the demolition would involve:

- Establishment of protection barriers around the perimeter of the site
- Decommissioning of services to the building to ensure safety
- Installation of asbestos controls and removal of asbestos if required
- Stripping of internal surfaces
- Demolition of the internal structure and slab using conventional methods

The property would be inspected for hazardous building materials prior to demolition of the main structure to make sure that material is removed and disposed of in accordance with the relevant legislation, codes of practice and Australian Standards (AS). Materials for salvage or recycling would be sorted and sent to applicable waste or recycling facilities. The specialist contractor would be required to meet and adhere to the requirements of a Construction Environment Management Plan (CEMP).

Materials, stockpiling and laydown areas

Materials, stockpiling and laydown areas would be designated during the detailed design and pre-construction period along with:

- Topsoil and spoil handling and storage
- Dangerous goods storage
- Workshop and equipment storage
- On site parking
- Construction compounds with site offices and staff amenities
- Site access and egress

The location of these areas would be delineated within the CEMP to be prepared by the contractor prior to commencement of construction.

Construction laydown areas, hardstands and car parks would be compacted and sheeted as required. All areas would have appropriate drainage systems and erosion controls installed.

Soil excavated during construction would be stored adjacent to the excavation as part of standard practice.

Structural, civil, mechanical, and electrical works

Following the enabling works, concrete foundations and slabs for buildings and major plant components would be constructed. Construction, installation, and connection of aboveground civil, mechanical and electrical plant, equipment, and buildings would then be carried out. Prefabricated components would be brought to site where available to reduce the construction timeframe. Major equipment would be installed and precast and in-situ concrete work, excavation, and backfilling would be completed.

Site drainage systems would be established to manage water on the site including clean and dirty stormwater and process water from the NPS operation (described further in Section 2.6.6). Paved walkways and access roads would be constructed around all buildings and connecting the buildings and major plant area.

Construction plant and equipment

The following plant and equipment would likely be used during construction of the power station. These are indicative only, as the actual mix of construction plant and equipment would be refined during detailed design.

Table 2.5.1 Indicative equipment – power station construction

Activity and equipment type	
Excavators	Compactors
Bulldozers	Loaders
Graders	Dump trucks
Concrete trucks	Mobile cranes
Concrete agitators	Delivery trucks
Power generators	Electric tools
Pneumatic tools	Elevated work platforms

Site access and utility corridor

Vehicular access to the Proposal area is likely to be via a new access road from Old Punt Road. The site access road would require the provision of a channelised right turn (CHR) on Old Punt Road for road safety reasons to cater for the higher traffic flows during construction. This is discussed in further detail in Section 6.8.

Site access would be constructed within a 30m wide mostly cleared corridor, and would comprise two lanes with formal drainage, shoulders, and setbacks for utilities that would be required to service the site.

A separate access/egress would be constructed to the Pacific Highway at the northeast of the power station site to facilitate emergency access and egress should Old Punt Road and/or the main access road be blocked. This would be considered further in consultation with Roads and Maritime.

The access road would be an all-weather, unpaved road. Construction of the access road and utility corridor would employ standard road construction techniques. Activities would include:

- Installation of sediment and erosion control measures
- Clearing vegetation for a 30m wide corridor
- Removal and stockpiling of topsoil
- Earth compaction

- Installation of drainage works
- Road surfacing
- Rehabilitation along the access road corridor

The following plant and equipment would likely be used to build the access and install utilities. These are indicative only and will be refined during detailed design.

Table 2.5.2 Indicative equipment – access and utilities construction

Activity and equipment type	
Excavators	Compactors
Bulldozers	Graders
Bobcats	Mobile cranes
Power generators	Electric tools
Vacuum trucks	Pneumatic tools
Welding rigs	Pipe bending rigs

Should an alternative access road, such as from the Pacific Highway, be considered by the construction contractor, this would require a separate approval and consultation with Roads and Maritime and be subject to additional traffic management and planning.

Gas pipelines

The gas pipeline corridors, described in Section 2.4.2, would be installed using both conventional pipeline construction methods (trenching) and HDD.

Conventional pipeline construction

Conventional pipeline construction would include:

- Survey and access, including preclearance surveys and access arrangements and marking out the centreline of the pipeline and the easement boundaries
- Clearing and grading the pipeline alignment, and establishing erosion and sediment controls
- Installing groundwater protection methods, if required, as per the Groundwater Management Plan
- Pipeline, plant and equipment delivery and stringing out lengths of pipe along the alignment using excavators. The pipe would be laid end to end adjacent to the trench on sandbags or blocks.
- Pipe welding, coating and testing – as each section of pipe is welded to the pipeline, the joint will be tested for structural integrity and it if passes, the joint would then be grit blasted and coated. If the joint fails the test, faulty material would be removed and the joint re-welded before being re-tested.
- Trenching – methods may vary to suit geotechnical conditions along the alignment. Excavated material would be placed to one side of the easement and stored separately from topsoil stockpiles to avoid soil inversion during soil reinstatement.
- Pipe laying – the welded pipeline would be progressively laid into the trench by side-boom crawler tractors or an excavator. Padding material (either sand or sifted subsoil) would be placed under and over the pipe to protect it from damage. Imported material may be required for bedding of the pipeline if the subsoil is not suitable. If required, imported padding material would be obtained from nearby sand or borrow pits.

- Hydrostatic testing – pressure testing with clean potable water to confirm the pipeline integrity. Instruments would detect any loss of pressure resulting from a failed weld or flaw in the pipeline wall. Any failed welds or damaged pipe will be repaired before retesting the pipeline. Any water, where biocide or corrosion inhibitors were added, remaining in the pipeline after pressure testing would be collected and disposed of off-site at a licensed facility.
- Backfilling of the trench with the stockpiled spoil. There may be a need to use sand as part of the trench backfill depending on soil and groundwater conditions. Marker tape would be buried within the trench to prevent potential damage to the pipeline. Excavated material would be pushed back into the trench and compacted to minimise the potential for slumping of the trench. Any excess spoil which cannot be used in the trench rehabilitation would be taken offsite for disposal.
- Cathodic protection would be installed, and pipeline marker posts installed over the pipeline centreline. The pipeline route would be registered with Dial Before You Dig.
- Rehabilitation of the disturbed pipeline corridor
- Commissioning, including nitrogen purge before filling the pipeline with natural gas, testing all equipment and controls, and confirming that all systems are operating correctly to ensure the pipeline is ready for safe operation

Horizontal directional drilling

HDD may be used in some locations such as the north east corner of the NPS site, where the pipeline needs to pass under Old Punt Road and the Freshwater Wetland Complex vegetation community. The HDD rig/s would be established at the bore entry location, with the work area for the rig being inside the development footprint as shown in Figure 1.2.2. The bore hole would follow a shallow curve, the radius of which is greater than the minimum bending radius of the pipe. Where potential to impact groundwater is identified, measures within the Groundwater Management Plan would be implemented (see Section 6.4).

A pilot hole would be drilled and reamed out to around 1.25 times the diameter of the pipe. The pipeline would be fabricated on the HDD alignment and would then be pulled through the completed bore hole by the drill rig. Drilling fluid would then be pumped into the bore hole to secure the pipelines in place. Typically, the main component of drilling fluid is bentonite, a non-toxic, naturally occurring sodium montmorillonite clay.

Detailed investigations would be undertaken prior to construction to determine the suitability of HDD and its design. These would include geotechnical investigations and shallow seismic surveys to obtain a detailed understanding of the underlying strata.

The HDD entry and exit sites would be securely bunded to prevent the release of leachate from excavated material, drilling fluids, or spills entering the surrounding environment. Appropriate mitigation measures as outlined in Chapter 6 would be employed during HDD operations.

Construction plant and equipment

The following plant and equipment would be used to construct the gas pipelines. The equipment listed is indicative and would be refined during detailed design and following award of the contract.

Table 2.5.3 Indicative equipment – gas pipeline construction

Activity and equipment type	
Conventional construction	
Excavators	Bulldozers
Graders	Mobile cranes
Power generators	Vacuum trucks

Activity and equipment type	
Electric tools	Pneumatic tools
Welding rigs	Pipe bending rigs
HDD construction	
HDD rig	Mobile cranes
Power generators	Vacuum trucks
Electric tools	Pneumatic tools
Welding rigs	Pipe bending rigs

Electricity transmission

The transmission line would be constructed as an above ground line in a cleared easement up to 30m wide on concrete poles up to 23m high. Single pole structures would be guyed at angle positions. Pocket easements approximately 10m by 20m may be required to accommodate the guy anchorages. Sections of the transmission lines may be underground due to construction constraints. Three poles would be required where the transmission line transitions from above to underground.

Adjustments to the existing transmission lines may be required to connect the new transmission line into the TransGrid Tomago 132kV switching station.

The following plant and equipment would be used to construct the transmission line. The equipment listed is indicative and would be refined during detailed design.

Table 2.5.4 Indicative equipment – transmission line construction

Activity and equipment type	
Excavators	Bulldozers
Graders	Mobile cranes
Power generators	Electric tools
Pneumatic tools	Welding rigs

Commissioning

The commissioning phase will include any testing and defect rectification required to transition from construction to operational phase. Commissioning will include the operation of all elements of the Proposal along with safety, quality, and environmental management systems and processes.

The commissioning and testing sequence of each unit of the NPS would involve the following:

- Pre-commissioning (including pre-operational tests and start-up)
- Commissioning tests
- Functional tests
- Performance tests
- Reliability test
- Post-completion tests

Successful completion of commissioning tests, functional tests, acceptance tests and rectification of construction defects would be undertaken during the commissioning and testing phase to achieve Practical Completion. The construction contractor would then handover the Proposal to AGL for operation.

Demobilisation, rehabilitation, and landscaping

The site would be rehabilitated progressively throughout the construction period. At the completion of construction, all remaining temporary construction amenities and facilities would be removed from site and final rehabilitation undertaken. As well as rehabilitation of the site, landscaping would be undertaken in accordance with the site landscaping plan (refer to Section 6.11).

2.5.2 Materials, stockpiling and laydown areas

Excavated soil would be stored adjacent to the development footprint as part of standard practice. An Acid Sulphate Soil Management Plan would be prepared as there is a risk of encountering Potential Acid Sulphate Soils/Acid Sulphate Soils (collectively referred to as ASS) during excavations, ground disturbance, and trenching.

Materials stockpiling and laydown areas would be designated in the CEMP along with:

- Topsoil and spoil handling and storage
- Dangerous goods and storage workshop
- On site parking
- Construction compound with site offices and staff amenities
- Site access and egress

Construction laydown areas, hardstands and car parks would be compacted and sheeted as required. All areas would have appropriate drainage systems and erosion controls installed before use.

2.5.3 Construction traffic management

Access to the construction site would be via Old Punt Road. A channelised right turn (CHR) treatment on Old Punt Road would be installed to provide a safe turning movement from the north into the site and to minimise traffic impacts from construction traffic.

Construction traffic would be generated by the delivery of plant, equipment and materials (estimated to be up to 50 heavy vehicles daily), and up to 300 construction workers travelling to and from site daily. Travel to the site would be via the Pacific Highway, Tomago Road, and Old Punt Road. The construction contractor would be encouraged to organise transport for the construction workforce to and from the site using shuttle buses or carpooling. However, there would remain a need to provide parking for construction light vehicles on the NPS site.

Some local roads may be affected for short periods during construction of the Proposal, particularly during the movement of oversize loads. The main components of the NPS would be assembled overseas and delivered using oversize haulage vehicles which require permits and escorts. A Construction Traffic Management Plan (CTMP) for the site would be submitted to relevant road authorities before commencement of construction to obtain relevant Road Occupancy Licences.

Further assessment of construction and operation traffic management is provided in Section 6.8 and Appendix K.

2.5.4 Construction hours and schedule

Construction work is proposed to occur during and outside of standard construction working hours. Works outside of standard construction working hours are justified on safety and efficiency grounds to make sure the Power Station is operational before the retirement of Liddell. Activities that would be undertaken outside of standard construction working hours would be undertaken in accordance with an Out of Hours Works procedure and may include:

- Site clearance, earthworks, civil works and equipment fit out
- Transporting of oversized equipment to site
- HDD activities
- Construction works for the power station
- General construction of the power station, gas pipelines and electricity transmission line
- Connection works to gas, electricity and water networks
- Emergency situations where work is required to prevent personal or property harm
- Commissioning and operational testing

2.5.5 Construction water supply and water quality management

During construction, water would be supplied by the construction contractor, but could include nearby industry and municipal water. A new potable water connection would be constructed from the NPS site to the existing water pipeline on Old Punt Road. If dewatering of groundwater is required during construction, this may be reused beneficially for construction purposes. Where required, water access licences would be obtained from relevant authorities.

Construction would require water for excavation, dust suppression, revegetation, drilling, hydrostatic testing and materials preparation and use. Accessways and construction areas would be watered to supress dust, with the frequency of watering dependent on weather conditions.

Surface water would be managed during construction through implementation of safeguards as discussed in Section 6.3. These measures would be in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction Volume 2* (DECC, 2008a). A site-specific Soil and Water Management Plan (SWMP) would be prepared prior to construction to minimise and manage potential impacts.

A Groundwater Management Plan (GMP) would also be prepared to prevent contaminated groundwater leaving the Proposal area. The GMP would aim to prevent the infiltration of contaminated surface water and the leaching of potential contaminants from the soil into the groundwater. Specific groundwater management controls would be included in the GMP for construction of the pipeline where interface with the groundwater table is more likely.

Suitably sized sediment basins would be constructed prior to earthworks to manage the risks of uncontrolled discharge of sediment-laden stormwater. Runoff from disturbed areas would be directed to these basins during construction for storage and treatment to meet discharge criteria.

Dewatering of excavations may be required and would be done in accordance with the SWMP. The Dewatering Procedure within the SWMP would describe whether excavation water would require treatment before being infiltrated to surrounding water sources or whether it would be disposed of to an offsite water treatment facility.

Water used in the hydrostatic tests may require treatment with biocides and oxygen scavengers to prevent corrosion or scale forming inside equipment; however, this would be avoided where possible and where the available water supply is of suitable quality. Should these chemicals be required, the concentrations would be calculated so that they are consumed in the hydrostatic-testing process and only trace volumes would be present in any discharge. The hydrostatic test water would be disposed offsite after suitable processing.

A spill response procedure detailing precautions when using or transporting fuels and chemicals, as well as on site spill containment and management requirements, would avoid contaminants potentially spreading via surface or groundwater.

During construction, ongoing water quality monitoring would be undertaken to assess the effectiveness of construction mitigation measures and identify improvements required.

2.5.6 Hazardous materials

The construction site would require the use of fuels, lubricants and chemicals which would be stored in appropriately bunded areas and dangerous goods containers or cabinets. Bunding and hazardous materials storage would be established on site. These measures include but are not limited to:

- Bund areas and tanker loading/unloading areas with sufficient capacity
- Bund-wall expansion joints and fire suppression incorporated into design
- Isolation valves fitted to bunds
- A high-level alarm fitted to the sewage tank
- Low- and high-level alarms fitted to the diesel tanks

Oily or contaminated water accumulating in bunds or running off in stormwater from vehicle, plant or equipment service areas would be left to evaporate or removed via sucker truck for disposal at an appropriately licenced facility.

Licenced contractors would be engaged to collect, transport and dispose of liquid hazardous materials, waste solvents, paints and hydrocarbon products to an appropriately licensed off-site facility in accordance with relevant NSW EPA guidelines.

2.5.7 Waste

Construction waste would likely include demolition materials (concrete, bricks, hazardous waste), construction materials (concrete waste, timber, plasterboard, grit/sand, spoil, and drilling mud), wastewater, general domestic garbage and green waste. All construction waste would be managed in accordance with standard waste hierarchy principals (prevention, reduction, reuse, recycle and recovery). Waste separation and management facilities would be provided at the construction site, with materials reused or recycled where possible. A licenced contractor would be engaged to collect, transport and dispose of construction waste lawfully.

Sewage and construction wastewater would be transported off-site for treatment at wastewater collection facilities. The facility would be identified in consultation with the EPA and addressed in the CEMP.

2.5.8 Security

Temporary fencing would be established to enclose the construction site/s. Security gates would be provided at construction site access points and security personnel would monitor the Proposal area as required.

2.6 Proposal operation

2.6.1 Power station

The NPS would be a fast start peaking plant with a capacity factor of around 14% during its initial years of operation. Annual starts would range from approximately 50 to approximately 200. However, the plant would be designed to be able to operate continuously. The run time for the two scenarios – peaking load (base case) and continuous operation (worst case) is shown in Table 2.6.1.

Table 2.6.1 Power station operating runtime – base case and worst case

Season	Peaking load (hrs/day)	Continuous operation (hrs/day)
Spring	0	24
Summer	5	24
Autumn	0	24
Winter	8	24
(average)	3.25	24
Annual Run-hours	1186	8760
Capacity factor*	14%	100%

* Capacity factor is the proportion of time the plant is expected to run in a year, expressed as a percentage.

The power station would be fitted with a Continuous Emission Monitoring Systems (CEMS) to demonstrate ongoing regulatory compliance, confirm the operation of pollution control equipment, and evaluate operating and emission variability.

Hardstand areas would be provided for maintenance activities. Permanent security fences would be erected around the NPS site during construction to prevent unauthorised access.

The power station would be designed for unattended and automated operation overnight and on weekends. An integrated control system would be developed to operate the power station, providing a high level of automation. The following philosophy would apply:

- Control of the power station may be possible from various locations including but not limited to:
  - A local control room at the power station (for commissioning, testing and maintenance, but would generally be unmanned)
  - The existing AGL remote-control room in Melbourne (for day to day operations)
  - Any location via an Internet connection (if required - allows off-site designated operator on duty to operate station if necessary)
- All power station equipment would be capable of being controlled and monitored from each of the control locations
- The control system would have continuous operation without operator intervention. The site is intended to be unmanned at times so the control system would be designed for unattended operation at all times and would be self-protecting.

During operation, vehicular access to the Proposal area would be provided via the newly formed access off Old Punt Road and permanent internal site roads would provide access around the NPS and buildings for operation and maintenance activities. These roads would be sealed, all weather roads with pavements designed based on AUSTROADS and local council standards. The minimum width of the internal roads would be approximately 8m between the kerbs. It is expected that this access would be predominantly used by operational and maintenance staff. Permanent parking facilities for up to 24 vehicles and one medium rigid truck inside the security gate area would be provided and would include provisions for staff and visitor parking. An additional 10 parking spaces and turnaround would be provided before the security gate into the NPS site.

Landscaping would be undertaken to reduce the visual impact of the NPS and associated infrastructure.

2.6.2 Gas pipelines

Gas would be supplied to the NPS from either:

- New gas pipeline connection to the PL42 on the eastern side of Old Punt Road
- New gas storage pipeline from the NPS to the NGSF

The operation, monitoring and control of the pipeline and associated infrastructure would be automated and/or performed remotely. Periodic inspection would be required, with maintenance and patrol activities being undertaken by the pipeline operator including inspections for subsidence, erosion, weeds and integrity surveys. Occasionally, venting of limited volumes of gas may be required for maintenance activities.

A similar set of periodic inspections and routine maintenance activities in line with AS2885 requirements is also envisaged for the gas storage pipelines.

2.6.3 Power transmission

The switchyard would transfer electricity produced at the NPS to the regional electricity transmission system via the new electricity transmission line and connection to the existing TransGrid Tomago 132kV switching station. Maintenance of the transmission line easement would be periodic slashing of regrowth and as required by legislation.

2.6.4 Operation hours and workforce

The power station would be operable 24 hours a day, 7 days a week, with control of the power station possible from remote locations (as described in Section 2.6.1). The facility would generally only be operational in times of peak demand.

Actual times of operation for the power station would be dependent on supply and demand conditions in the market at the time. Operation is anticipated to be lower in spring and autumn when climates are more moderate and be higher during summer and winter when additional heating or cooling loads are commonly observed in the NSW electricity market. The power station would be designed to be operational at any time which in turn would improve electricity supply reliability to the market.

Up to approximately 23 persons on rotating shifts (including a site manager and administrational support) and routine maintenance would be required during operation.

Additional contractors may be required as needed. Maintenance may be determined on a regular occurrence which would generate additional light and heavy car or truck movements.

2.6.5 Safety and emergency response

The design, materials, engineering, fabrication, manufacturing, inspection, testing, certification, stamping, cleaning, painting and erection of the Proposal would be in full compliance with applicable Australian codes and standards, incorporating recognised international standards. A safety management plan would be implemented for construction and operation of the facility.

The NPS would be designed to include an automatic shutdown to a safe condition, in the event of an emergency. This includes automatic plant protection actions to preserve plant integrity and site safety by restoring plant to a safe and stable operating state. The plant would be designed with a high level of automation so that it can be operated unattended whilst remaining safe and fully operable.

All ancillary facilities and buildings including office buildings and site amenities would have life saving devices installed including smoke, fire and gas detection devices and firefighting equipment, as required. Operating personnel would be required to be trained in emergency response as the first responders to on-site incidents. The first response priority would be to remotely isolate fuel sources and coordinate with emergency services.

Emergency access and egress would be designed and constructed to allow for emergency services to access the NPS without any barriers. Maintenance of the NPS site would include vegetation clearing where required and making sure the site is accessible at all times.

The Proposal would include CCTV for crime prevention, appropriate lighting and clear and evident signage for the safety of staff and contractors.

2.6.6 Water use

Water would be required to operate the NPS. A summary of the types of water and systems for the Proposal is provided in the following section.

Raw water

Raw water would be used for a range of services and systems at NPS including:

- Input to demineralised water treatment plant (if required)
- Inlet air cooling (if required)
- Input to power generation units (if required)
- Workshops
- Amenities
- Drinking water
- Firefighting and emergency facilities
- Plant wash water and landscaping irrigation

Raw water would be received from the local water authority network on Old Punt Road via a new connection or delivered by truck to site as a secondary source when necessary.

Service water

Service water would be used for plant wash down and miscellaneous uses such as site landscaping irrigation. Service water supply would be sourced from the raw water storage tank. The service water system would include a ring main and all other pipework and equipment to reticulate service water to the power station buildings and all other frequently attended plant areas.

Firefighting water system

The firefighting water storage tank would be sized to supply continuous firefighting water hose demand flow for a minimum of 120 minutes, plus largest firefighting water consumer in accordance with National Fire Protection Association (NFPA) standards. It would also comply with any additional development approval conditions. Firefighting water may be stored in the raw water tank as a reserve volume or in a dedicated firefighting water storage tank filled from the raw water tank.

Demineralised water

Demineralised water would be produced on site in the demineralised water treatment plant which would be supplied with raw water from the raw water storage tank. Demineralised water treatment would typically entail filtration, reverse osmosis (RO) and/or electro-deionisation (EDI), or ion-exchange technology to "polish" the water to produce demineralised water. The demineralised water tank would also include facilities to receive demineralised water delivered by road tanker, as a backup supply option.

Potable water

Potable water would be required in workshops, administration buildings, kitchens, staff amenities and for individual consumption. Potable water would also be required for safety showers and eyewash facilities. Potable water would be supplied directly to the site from a new connection to the existing municipal supply on Old Punt Road installed during construction. Domestic water usage of 100 litres (L) per person per day is assumed.

Water consumption

Annualised water consumption based on peaking load and continuous operation would be approximately 120,000m^3 and 800,000m^3 respectively.

2.6.7 Wastewater

The Proposal would generate wastewater streams from the operation of the NPS, including:

- Gas turbine compressor wash water (as relevant to technology proposed)
- Gas turbine power augmentation water blowdown (as relevant to technology proposed depending on water quality used)
- Auxiliary cooling water system wastewater (drain down events for maintenance)
- Water treatment plant waste
- Plant wash down water and service water drains
- Pond sludge
- Chemical drains
- Oily drains collected from bunds and workshops
- Contaminated/dirty stormwater (collected from roads, hardstand areas, etc)
- Potable water drains
- Sewage

Process water

Process wastewater includes wash water, auxiliary cooling wastewater, and water treatment plant waste, which would be collected in process water storage ponds for temporary storage and evaporation. Process wastewater and solids/sludge would be periodically removed from site via tankers and trucked offsite for disposal at a licensed wastewater facility. A tanker loading facility would be provided within the NPS site for wastewater collection and removal.

Contaminated water

A 'pit and pipe' contaminated drains system would be provided for collection and treatment of contaminated water, including dirty stormwater. Dirty stormwater treatment would include a sediment trap and multi stage oily water separator (i.e. a Gross Pollutant Trap (GPT), such as a HumeCeptor) and a bioretention system comprising selectively vegetated filter areas to break down common stormwater contaminants. Monitoring of outlets would be undertaken prior to discharge to the stormwater drain connection terminal point.

There may be contaminated water sources not suitable for treatment to meet the required Proposal discharge quality limits into the stormwater system. In this case, the particular source would be directed to the process wastewater system or designated drainage system for transport to an appropriate liquid waste disposal facility. This would include runoff generated when undertaking maintenance or cleaning activities within enclosed workshop areas, which would be the lowest quality wastewater generated by the Proposal.

Chemical drains

A chemical drains system would be provided for collection and treatment of chemical spills and stormwater falling into bunded chemical storage areas (if outdoors). Chemical drains would be collected in a drains sump for testing and treatment before being piped to the process wastewater system, or, if unsuitable for treatment, designated drainage system for transport to an appropriate liquid waste disposal facility.

Amenities and sewerage system

Amenities drains and sewage would be collected and trucked offsite or treated via a standalone septic treatment system. Discussions with HWC have identified that the only sewerage system that exists nearby currently is a private truck evacuated system at the industrial estate to the south and that there are no plans to extend the reticulated sewerage network to the NPS.

Stormwater

Depending on where rain falls within the site catchment, it would be directed to the contaminated drains system, chemical drains system, or clean stormwater drains system. The clean stormwater drains system will include a system of drains which would channel stormwater through the GPT and bioretention system before the water is discharged offsite as clean stormwater. Outlet monitoring would be undertaken to make sure that water quality meets discharge criteria. If the discharge limits are not met, the water would be directed to the designated drainage system for ultimate offsite disposal.

2.6.8 Chemical storage and handling

Diesel and small quantities of chemicals would be stored in the facility for general operation and maintenance. These may include but are not limited to:

- Diesel
- Lubricating oils for turbines and pumps
- Carbon dioxide or nitrogen for fire protection and line purging
- Urea to reduce flue gas NO_x levels
- Cleaning solvents
- Demineralisers including sulfuric acid, hydrochloric acid, and caustic

All chemicals and/or dangerous goods stored on site would have relevant safety data sheets (SDSs) provided and a spill management system would be applied to each specific product as per recommendations in the SDS. All chemicals would be stored and labelled in accordance with relevant Australian Standards in designated chemical storage facilities with emergency control systems if applicable.

2.6.9 Hazardous materials

Should hazardous materials or chemical waste disposal be required, an appropriately licenced contractor would be engaged to handle, transport and dispose of the materials lawfully.

2.6.10 Solid waste

The operation of the Proposal is not expected to result in significant generation of waste streams. Small quantities of waste would be produced through general administrative and maintenance-based activities or by-products of the NPS operation. Typical waste generation would likely include:

- General waste – office-based waste, paper, cardboard, plastics, kitchen and bathroom waste
- Maintenance waste – wood, cloth, scrap metal, chemical containers

Solid waste would be separated into waste streams for appropriate recycling or disposal. Waste is further considered in Section 6.14 and Appendix P.

2.6.11 Decommissioning

Decommissioning of the Proposal may occur when the infrastructure is no longer required due to changes in the market condition or costs associated with maintenance or repairs of the NPS. Should decommissioning be required, consultation with relevant authorities would commence and a decommissioning plan would be developed to rehabilitate the site to meet all regulatory or environmental requirements.

A decommissioning plan would include a concept design of the final closure, a plan for a care and maintenance phase, plans for noxious weeds management, hazardous materials disposal, and dangerous goods management.

Decommissioning would be assessed in consultation with regulatory authorities, council, landowners and key stakeholders in accordance with relevant legislative and policy requirements.

Where possible, materials from the decommissioning phase would be reused or recycled to reduce the volume of solid waste disposed to landfill and conserve the natural resources required for their production.

Site and Context

3 Site and context

3.1 Location and site context

The Proposal would be located off Old Punt Road, Tomago (Figure 1.2.1). The NPS would be located within Lot 3 DP1043561 and the proposed electrical transmission lines and gas pipelines would be located in Lot 4 DP 1043561, Lot 202 DP 1173564 and Lots 1201, 1202 and 1203 DP 1229590.

The NPS site is bounded by the Pacific Highway to the north and Old Punt Road to the south-east, with the Hunter River located approximately 470m north-west on the opposite side of the highway.

Existing major infrastructure within proximity to the Proposal includes the NGSF, TransGrid's Tomago switching station with associated electrical transmission and distribution lines, and the A1 Pacific Highway.

An extension to the existing M1 Pacific Motorway is planned between its current terminus at John Renshaw Drive in Beresfield and the Pacific Highway at Heatherbrae near Raymond Terrace. TransGrid has consulted with Roads and Maritime on this project (refer to Chapter 5 and Section 6.8). While construction of the Pacific Motorway upgrade will not overlap with construction of the Proposal, an interchange between Old Punt Road and the proposed M1 extension would be constructed in Lot 2 DP1043561 immediately west of the NPS and both Roads and Maritime and AGL would be required to accommodate each other's projects through design, construction, and operation. An indicative alignment for the future upgrade is shown in Figure 2.4.1.

The closest large population centre to the Proposal area is Raymond Terrace, located approximately 5km northeast of the Proposal. The main employment industries within Port Stephens LGA are manufacturing, public administration, and retail. Significant employers in the local area are the Tomago Aluminium Smelter, Royal Australian Air Force (RAAF) Base Williamtown, and Newcastle Airport.

Major transport routes within the local area are the Pacific Highway, and the New England Highway approximately 2.3km west of the Proposal. Access to the NPS site would be via Old Punt Road using either the Pacific Highway or Tomago Road.

A number of key environmental resources are in the local area, including the Hunter Wetlands National Park located approximately 2km south of Lot 3 DP1043561 at its nearest point, and the Ramsar-listed Kooragang Nature Reserve and Hunter Wetlands Centre, approximately 2.7km south southeast of the NPS site and almost 4km east of the NGSF. A wetland listed under Coastal Wetlands SEPP is located approximately 450m to the north-west of the NPS site bordering the Hunter River.

The gazetted area of the Tomago Sand Beds, a subterranean water aquifer maintained by HWC, is immediately adjacent to the eastern side of the NPS site. Part of the proposed gas storage pipelines would be within the bounds of the Hunter Water gazetted area but outside of the restricted area.

3.2 Site description

The Proposal is within Port Stephens local government area (LGA) and is located in land zoned IN1 – General Industrial in the *Port Stephens Local Environment Plan 2013* (Port Stephens LEP). Zoning of the Proposal area is shown in Figure 3.4.2.

The Proposal area includes the NPS site, the electricity transmission corridor, and the gas pipeline corridors. These are described in detail in Chapter 2.

The NPS site has previously been used for rural activities including grazing and agricultural purposes. There is a single storey residential dwelling located on the northern edge of Lot 3, adjacent to the Pacific Highway. Some isolated trees have been retained on the site, while stands of native vegetation are generally confined to the boundaries. The land is relatively flat, with a slight gradient towards the east and the west as described in Section 6.3. A number of bitumen, dirt and gravel access paths have been cleared across the site.

The area surrounding the gas storage pipeline corridors are heavily vegetated with Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest and Smooth-barked Apple - Blackbutt - Old Man Banksia woodlands. However, the development footprint for the corridors is predominantly within existing cleared areas maintained for the NGSF. Large areas south of the gas storage pipeline corridors were formerly used for sand mining and those areas host regrowth vegetation following closure of mining operations in the 1970s.

The proposed electrical transmission line would link the Proposal with the existing Tomago switching station. The corridor is partially vegetated, with the majority of the proposed alignment within the existing 132kV transmission corridor to the Tomago switching station.

3.3 Surrounding land use

3.3.1 Residential

There is no residential land in the Proposal area. The nearest residentially zoned land is approximately 2km north west of the Proposal at Woodberry in the Maitland LGA. The nearest residential zoned land in the Port Stephens LGA is approximately 5km north of the Proposal at Heatherbrae.

There is a single residence on Tomago Road near its intersection with the Pacific Highway. This residence is currently owned by TAC. It is located approximately 500m south west of the Proposal on land zoned E2 – Environmental Conservation. There is also a residence associated with the Motto Farm Stud approximately 1.4km north of the Proposal on land zoned RU2 - Rural Landscape.

3.3.2 Industrial land and infrastructure

Major industrial infrastructure near the Proposal includes AGL's NGSF, TransGrid's switching station and associated transmission and distribution lines, and the Tomago Aluminium Smelter.

The NGSF, gas pipelines, electrical infrastructure, and Tomago Aluminium Smelter are all within land zoned IN1 - General Industrial under the Port Stephens LEP. A range of other industries within the IN1 - General Industrial zone includes:

- Transportation and haulage
- Metal fabrication and galvanising
- Manufacturing
- Commercial construction
- Petrochemical
- Self-storage

Land to the north of the Proposal is zoned SP1 - Special Activities under the Port Stephens LEP. This land is owned by HWC and is zoned SP1 to protect the water catchment areas.

The Pacific Highway runs adjacent to the Proposal to the west within an area zoned SP2 - Infrastructure. Land zoned SP2 provides for infrastructure and related uses and land located west of the highway is currently set aside for the future development of the M1 Pacific Motorway extension to the Pacific Highway at Raymond Terrace.

3.3.3 Recreational and environmental land

There is no recreational or environmental land in the Proposal area. The nearest recreational zoning is the Hunter River, approximately 500m north west of the Proposal, zoned W2 - Recreational Waterway under the Port Stephens LEP. The objectives of W2 are to protect ecological, scenic, and recreation values, allow for water-based recreation, provide for sustainable fishing.

Publicly-accessible sites that are located in the Tomago and Motto Farm areas include the Hunter Region Botanic Gardens and the Hunter Wetlands National Park (Figure 1.2.1). The Botanic Gardens are approximately 800m north of the Proposal and the nearest point of the National Park is approximately 2km south.

The nearest environmental zoning is land to the west adjacent to the Hunter River, zoned E2 - Environmental Conservation. The objectives of E2 are to protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values, and to prevent development that could have an adverse effect on those values.

3.3.4 Agricultural land

There is no agricultural land in the Proposal area. Land to the north and west of the Proposal is zoned RU2 - Rural Landscape under the Port Stephens LEP and is currently used for grazing. This land is located between the Hunter River and the Pacific Highway, across the highway from the NPS site. The objectives of this zoning are to provide for agricultural land uses, encourage primary industry production, and maintain the rural landscape character.

3.4 Land ownership

The NPS would be located on land owned by AGL. The electrical transmission corridor and the majority of the gas storage pipeline corridors would be located within land owned by TAC and accessed under agreement between the two parties. The remainder of the gas storage pipeline corridor would be within land owned by AGL.

Roads that the electrical transmission line and gas storage pipeline would traverse are owned by Port Stephens Council. AGL is currently negotiating potential easements.

Figure 3.4.1shows the Proposal relative to land ownership within and outside of the Proposal area.

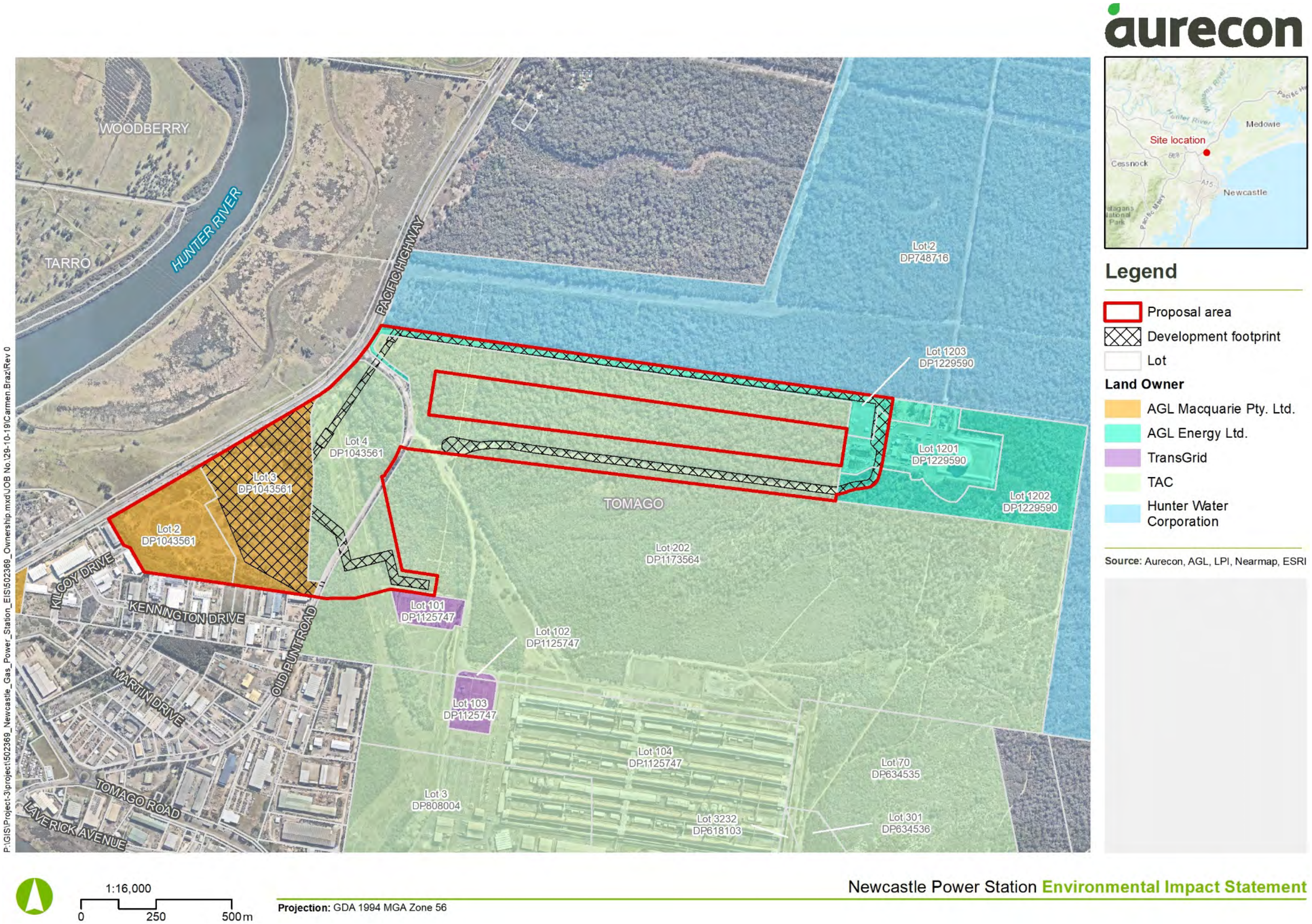

Figure 3.4.1 Land ownership

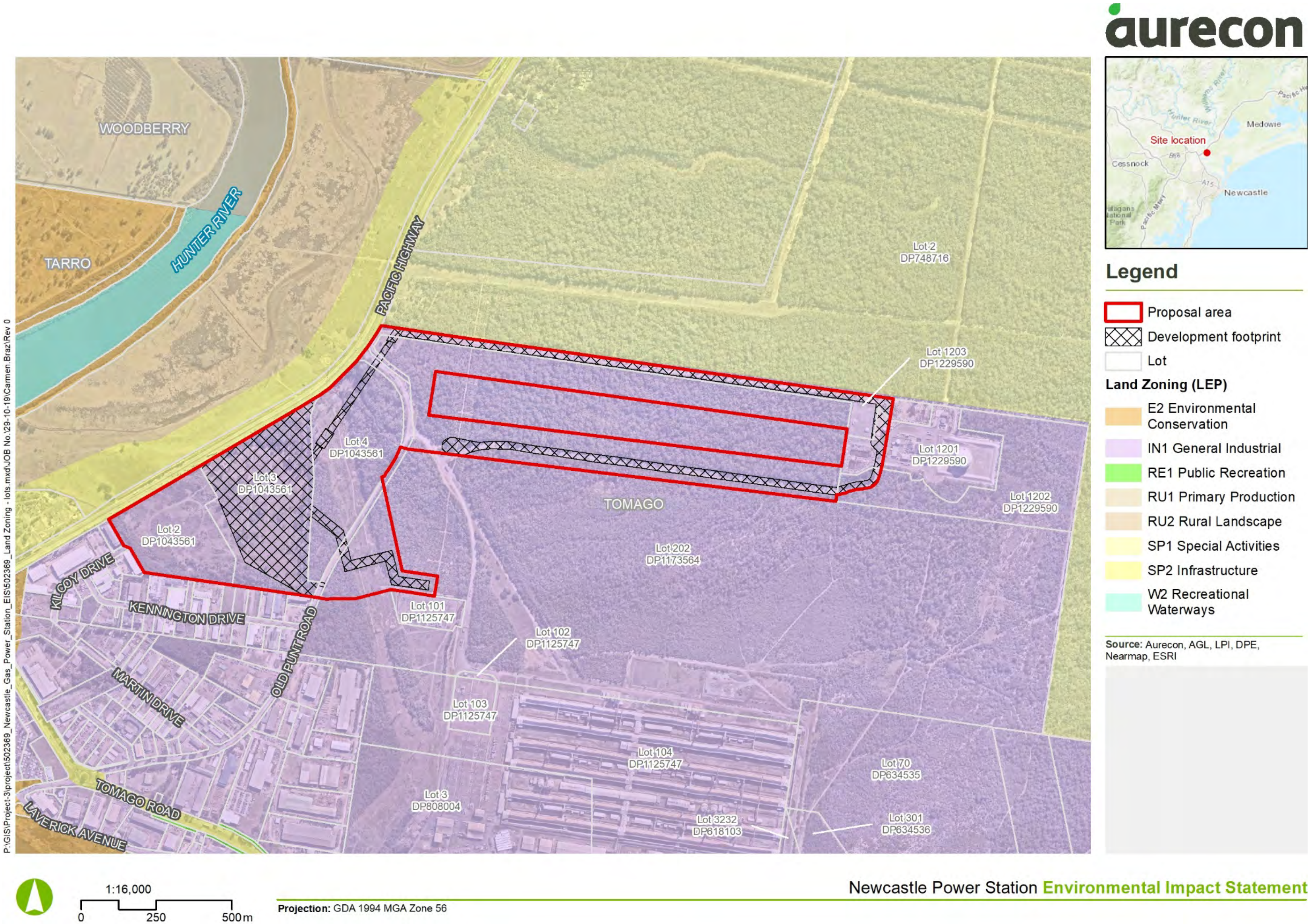

Figure 3.4.2 Zoning

Statutory planning

4 Statutory planning

4.1 Commonwealth requirements

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of Environment and Energy (DoEE) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as Matters of National Environmental Significance (MNES). There are nine MNES protected under the EPBC Act. These are:

- World heritage properties
- National heritage places
- Wetlands of international importance
- Listed threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- Water resources in relation to coal seam gas development and large coal mining development

Approval from the Commonwealth Minister for the DoEE is required for actions which:

- Would have or are likely to have a significant impact on MNES
- Would have or are likely to have significant impact on the environment on Commonwealth land or an action by a Commonwealth agency which has, would have, or is likely to have significant impact on the environment

The Proposal was determined to be a controlled action (Appendix B) due to potential impact to the Ramsar listed Kooragang component of the Hunter Estuary Wetland. These issues (biodiversity, surface waters, hydrology, groundwater, soils and contamination) have been assessed in Sections 6.2, 6.3, 6.4 and 6.6 and are supported by technical studies provided in Appendix D, Appendix E, Appendix F, and Appendix I.

For the purposes of the EPBC Act approval, the Proposal will be assessed by accredited assessment under Division 5.2 of the *Environmental Planning and Assessment Act 1979*. Requirements for the EIS are discussed in further detail in Section 4.1.2 and 4.2.1.

4.1.2 Environment Protection and Biodiversity Conservation Regulations 2000

This EIS is required to follow the general form and content requirements of Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations) (as per the supplementary SEARs). Table 4.1.1 details the Schedule 4 items and where they have been addressed in the document.

Table 4.1.1 Schedule 4 requirements – EPBC Regulations

Requirement	Where addressed
1 General information	
1.01 The background of the action including: (a) the title of the action;	EIS certification page
(b) the full name and postal address of the designated proponent;	EIS certification page
(c) a clear outline of the objective of the action;	Section 1.4
(d) the location of the action;	Section 3.1
(e) the background to the development of the action;	Chapter 2
(f) how the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action;	Chapter 6
(g) the current status of the action;	Section 2.1
(h) the consequences of not proceeding with the action.	Section 2.2
2 Description	
2.01 A description of the action, including: (a) all the components of the action;	Sections 2.4 to 2.6
(b) the precise location of any works to be undertaken, structures to be built or elements of the action that may have relevant impacts;	Sections 2.4 to 2.6
(c) how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts;	Sections 2.4 to 2.6
(d) relevant impacts of the action;	Chapters 6, 7 and 8
(e) proposed safeguards and mitigation measures to deal with relevant impacts of the action;	Chapters 6, 7 and 9
(f) any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action;	Chapters 4 and 9
(g) to the extent reasonably practicable, any feasible alternatives to the action, including: i. if relevant, the alternative of taking no action;	Section 2.3
ii. a comparative description of the impacts of each alternative on the matters protected by the controlling provisions for the action;	Section 2.3
iii. sufficient detail to make clear why any alternative is preferred to another;	Section 2.3
(h) any consultation about the action, including: i. any consultation that has already taken place;	Sections 5.3, 5.4 and 5.5
ii. proposed consultation about relevant impacts of the action;	Section 5.5
iii. if there has been consultation about the proposed action—any documented response to, or result of, the consultation;	Sections 5.3, 5.4 and 5.5

Requirement	Where addressed
(i) identification of affected parties, including a statement mentioning any communities that may be affected and describing their views	Sections 5.3, 5.4 and 5.5
3 Relevant impacts	
3.01 Information given under paragraph 2.01(d) must include: (a) a description of the relevant impacts of the action;	Chapters 6 and 7
(b) a detailed assessment of the nature and extent of the likely short term and long-term relevant impacts;	Chapters 6 and 7
(c) a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;	Chapters 6 and 7
(d) analysis of the significance of the relevant impacts;	Chapters 6 and 7
(e) any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	Appendices D to T
4 Proposed safeguards and mitigation measures	
4.01 Information given under paragraph 2.01(e) must include: (a) a description, and an assessment of the expected or predicted effectiveness of, the mitigation measures;	Chapter 9
(b) any statutory or policy basis for the mitigation measures;	Chapters 6 and 7
(c) the cost of the mitigation measures;	Chapter 9
(d) an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing;	Section 9.2
(e) the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program;	Chapter 9
(f) a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.	Section 9.2
5 Other approvals and conditions	
5.01 Information given under paragraph 2.01(f) must include: (a) details of any local or State government planning scheme, or plan or policy under any local or State government planning system that deals with the proposed action, including: i. what environmental assessment of the proposed action has been, or is being, carried out under the scheme, plan or policy;	Chapter 4
ii. how the scheme provides for the prevention, minimisation and management of any relevant impacts;	Chapters 6, 7 and 9
(b) a description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action;	No approval has been obtained from a State, Territory of Commonwealth agency or authority
(c) a statement identifying any additional approval that is required;	Chapter 4

Requirement	Where addressed
(d) a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.	Chapter 9
6 Environmental record of person proposing to take the action	
6.01 Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: (a) the person proposing to take the action; and	Appendix U
(b) for an action for which a person has applied for a permit, the person making the application.	Appendix U
6.02 If the person proposing to take the action is a corporation—details of the corporation's environmental policy and planning framework.	Appendix U
7 Information sources	
7.01 For information given in a draft public environment report or environmental impact statement, the draft must state: (a) the source of the information; and	Chapters 6 and 7 and Appendices D to T
(b) how recent the information is; and	Chapters 6 and 7 and Appendices D to T
(c) how the reliability of the information was tested; and	Chapters 6 and 7 and Appendices D to T
(d) what uncertainties (if any) are in the information.	Chapters 6 and 7 and Appendices D to T

4.1.3 Airports Act 1996 and Airports (Protection of Airspace) Regulations 1996

The Airports Act 1996 (Airports Act) and the Airports (Protection of Airspace) Regulation 1996 (Airports Regulation) establish a framework for the protection of airspace at and around airports. As the Newcastle Airport and RAAF Williamtown base do not meet the definition of airports to which Part 12 of the Airports Act applies (Part 12 deals with the protection of airspace around airports), the Airports Act and Airports Regulation do not apply to the Newcastle Airport and RAAF Williamtown base. However, as the Proposal's air stack (permanent) and construction equipment (including temporary cranes) would intrude on the airports' protected airspace, were the airports regulated under the Airports Act, AGL has and will continue to consult closely with the Department of Defence, Newcastle Airport, CASA and Airservices Australia with respect to the impact of the Proposal on the Newcastle Airport and RAAF Williamtown base.

4.2 State requirements

4.2.1 Planning legislation and regulation

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) are the primary pieces of legislation regulating the land use planning and development assessment in NSW. Other environmental planning instruments such as State environmental planning policies (SEPPs) and local environmental plans (LEPs) also inform the EIS and are discussed in the following sections.

Environmental Planning and Assessment Act 1979

The Proposal was declared CSSI in December 2018 after AGL lodged an application with the NSW Minister for Planning on 5 November 2018. The declaration came into effect following gazettal and inclusion of the Proposal in Schedule 5 of the State and Regional Development SEPP. As CSSI, the Proposal requires approval from the Minister under Division 5.2 of the EP&A Act.

In January 2019, a Preliminary Environmental Assessment (PEA) was submitted to the Department of Planning, Industry and Environment (DPIE) to request Secretary's Environmental Assessment Requirements (SEARs). The SEARs were issued to AGL on 18 February 2018 in accordance with Section 5.16 of the EP&A Act (Appendix A). Table 1.5.1 identifies where the SEARs are addressed in this EIS.

As the Proposal was declared a controlled action on 15 August 2019 to be assessed under the accredited process of Division 5.2 of the EP&A Act. Supplementary SEARs were issued to AGL from DPIE on 11 September 2019. These supplementary SEARs were provided to make sure that the Commonwealth's requirements are appropriately addressed in the EIS and are to be read in conjunction with the SEARs issued 18 February 2019 (see Section 1.5).

This EIS has been prepared in accordance with the SEARs and supplementary SEARs. DPIE will place this EIS on public exhibition. During this period, the community, project stakeholders, and government are given the opportunity to provide a submission to DPIE on the Proposal. Following the public exhibition, all submissions would be provided to AGL for review to prepare a submissions report that responds to the relevant issues raised. If changes are required to the Proposal as a result of the submissions or to minimise environmental impact, AGL would prepare a report for submission and review by DPIE. Approval from the Minister is required before AGL can proceed with the Proposal.

Environmental Planning and Assessment Regulation 2000

This EIS is required to follow the general form and content requirements of Schedule 2 of the EP&A Regulation (as per the SEARs). Table 4.2.1 details the Schedule 2 items and where they have been addressed in the document.

The environmental assessment requirements for the Project are provided in full in Table 1.5.2 and Table 1.5.3.

Table 4.2.1 General form and content requirements for the EIS

EIS requirement	Where addressed
An environmental impact statement must contain the following information:	
a) the name, address and professional qualifications of the person by whom the statement is prepared	EIS certification page
b) the name and address of the responsible person	EIS certification page
c) the address of the land i. in respect of which the development application is to be made or ii. on which the activity or infrastructure to which the statement relates is to be carried out	EIS certification page
d) a description of the development, activity or infrastructure to which the statement relates	Chapter 2
e) an assessment by the person by whom the statement is prepared of the environmental impact of the development, activity or infrastructure to which the statement relates, dealing with the matters referred to in this Schedule	EIS certification page

EIS requirement			Where addressed
f)	a declaration by the person by whom the statement is prepared to the effect that		EIS certification page
	i.	the statement has been prepared in accordance with this Schedule, and	
	ii.	the statement contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure to which the statement relates, and	
	iii.	that the information contained in the statement is neither false nor misleading	
An environmental impact statement must also include each of the following:			
a)	a summary of the environmental impact statement		Newcastle Power Station Project Executive Summary
b)	statement of the objectives of the development, activity or infrastructure		Section 1.4
c)	an analysis of any feasible alternatives to the carrying out of the development, activity or infrastructure, having regard to its objectives, including the consequences of not carrying out the development, activity or infrastructure		Section 2.3
an analysis of the development, activity or infrastructure, including			
	i.	a full description of the development, activity or infrastructure, and	Chapter 2
	ii.	general description of the environment likely to be affected by the development, activity or infrastructure, together with a detailed description of those aspects of the environment that are likely to be significantly affected, and	Chapter 3
	iii.	the likely impact on the environment of the development, activity or infrastructure, and	Chapter 6
	iv.	a full description of the measures proposed to mitigate any adverse effects of the development, activity or infrastructure on the environment, and	Chapters 6 and 9
	v.	a list of any approvals that must be obtained under any other Act or law before the development, activity or infrastructure may lawfully be carried out	Chapter 4
d)	compilation (in a single section of the environmental impact statement) of the measures referred to in item (d) (iv)		Chapter 9.2
e)	the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development set out in subclause (4)		Sections 2.2 and 10.2

4.2.2 Environmental legislation and regulation

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) contains provisions to assess biodiversity value impacts by a proposed development, calculating offsets and establishing market-based conservation measures, including biodiversity credits where required.

Part 7 of Act requires that an application for State significant infrastructure approval under the EP&A Act be accompanied by a BDAR unless DPIE and the Chief Executive of the Office of Environment and Heritage (OEH) determine that the proposed development is not likely to have any significant impact on biodiversity values.

Biodiversity values are defined in the BC Act as:

- Vegetation integrity – being the degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state
- Habitat suitability – being the degree to which the habitat needs of threatened species are present at a particular site
- Biodiversity values, or biodiversity – related values, prescribed by the regulations

The regulations made under the BC Act further define the following as biodiversity values:

- Threatened species abundance – being the occurrence and abundance of threatened species or threatened ecological communities, or their habitat, at a particular site
- Vegetation abundance – being the occurrence and abundance of vegetation at a particular site
- Habitat connectivity – being the degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range
- Threatened species movement – being the degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle
- Flight path integrity – being the degree to which the flight paths of protected animals over a particular site are free from interference
- Water sustainability – being the degree to which water quality, water bodies and hydrological processes sustain threatened species and threatened ecological communities at a particular site

A BDAR has been prepared for the Proposal and is provided in summary in Section 6.2 and in full in Appendix C. The BDAR has been prepared by an accredited person and for the purposes of the Biodiversity Offsets Scheme (BOS) in relation to the Proposal as per Section 6.12 of the BC Act.

Heritage Act 1977

The aim of the *Heritage Act 1977* (Heritage Act) is to promote the understanding and conservation of the State's heritage. The Act protects heritage items that are listed under the State Heritage Register maintained by the NSW Office of Environment and Heritage.

Division 5.2 section 5.23(1)(c) of the EP&A Act provides that an approval under Part 4 or an excavation permit under section 139 of the Heritage Act are not required for approved State Significant Infrastructure. The heritage assessment provided in Appendix N and summarised in Section 6.12 has demonstrated that the Proposal would not impact any items of heritage significance listed on the State Heritage Register.

National Parks and Wildlife Act 1974

The NSW *National Parks and Wildlife Act* (1974) (NPW Act) aims to conserve nature, objects, places or features with cultural value. It also provides for the protection of National Parks, Historic Sites, Nature Reserves, and State Recreation Areas.

Any persons who, without obtaining consent of the Director-General, through a Section 90 Aboriginal Heritage Impact Permit (AHIP) knowingly destroys or damages an Aboriginal object or place is guilty of an offence. Division 5.2 section 5.23(1)(d) of the EP&A Act provides that an AHIP is not required for approved State significant infrastructure.

Potential impacts to Aboriginal heritage items and safeguards and mitigation measures are provided in Appendix J (Aboriginal Cultural Heritage Assessment Report, or ACHAR) and summarised in Section 6.7.

The ACHAR concluded that:

- Aboriginal sites were located within the Proposal area
- Subsurface artefacts were identified within the Proposal area
- The likelihood of identifying further artefacts within the Proposal area is minimal

A number of recommendations to mitigate the impacts of the Proposal on Aboriginal heritage were provided and are incorporated into the management measures.

Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) provides for the issuing of licences for environmental protection to authorise and control certain activities and work, such as waste, air, water and noise pollution. The owner or occupier of a premises engaged in scheduled activities is required to hold an environment protection licence (EPL) and comply with the conditions of that licence.

All scheduled activities as listed in Schedule 1 of the POEO Act require an environment protection licence.

Clause 17(1) of Schedule 1 of the POEO Act identifies general electricity works with the capacity to generate more than 30MW of electrical power as a scheduled activity. General electricity works refers to the generation of electricity by means of electricity plant that, wherever situated, is based on, or uses, any energy source other than wind power or solar power.

As such, the Proposal would trigger the requirement for an EPL.

4.2.3 Other relevant legislation and regulation

Pipelines Act 1967

The *Pipelines Act 1967* (Pipelines Act) describes the approvals system for the construction and operation of transmission pipelines in NSW, with exemptions including for the supply of water or pipelines constructed by a public authority. Part 3 of the Pipelines Act outlines licensing requirements for pipelines. Under Part 3 (excluding exempt items) a licence is required to:

- Commence, or continue, the construction of a pipeline
- Alter or reconstruct a pipeline
- Operate a pipeline

A new or amended licence under Part 3 of the Pipelines Act would be required for the construction and operation of the proposed gas pipelines forming part of the Proposal.

Rural Fires Act 1997

The *NSW Rural Fires Act 1997* (Rural Fires Act) facilitates the prevention, mitigation and suppression of bush and other fires in local government areas and parts of the State considered to be rural fire districts. The NPS, electrical transmission line and gas pipeline would be on bush fire prone land.

Under the Rural Fires Act, the owner or occupier of land is obligated to take precautions to minimise the risk of bushfires starting or spreading within their land.

Section 5.23(1)(f) of the EP&A Act overrides the requirement for a bush fire safety authority to authorise the Proposal under section 100B of the Rural Fires Act. However, a Bushfire Threat Assessment has been carried out for the Proposal and is included in Appendix R and summarised in Section 7.2 of this EIS.

Roads Act 1993

The *Roads Act 1993* (Roads Act) aims to establish the rights and procedures for using, opening and closing public roads. It also provides the classifications of roads and the declaration of Roads and Maritime and other public authorities as roads authorities for classified and unclassified roads. A local council is the roads authority for public roads excluding classified roads and those declared by the roads authority.

Under section 138, consent of the roads authority is required to:

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

The Proposal requires works within road reserve areas. Construction of the gas pipelines within Old Punt Road and electricity transmission infrastructure that crosses over Old Punt Road may require a licence under Section 138.

Water Act 1912

The *Water Act 1912* (Water Act) identifies water management authorities and governs the issue of new water licences and the trade of water licences and allocations. Surface licences are administered under Part 2 of the Water Act, whilst groundwater licences are administered under Part 5 of the Water Act. There are currently a number of areas to which an embargo on new applications under Part 2 and Part 5 of the Water Act applies. It is not anticipated that AGL will require a licence under the Water Act. As described in Section 6.3 and Appendix E, provided safeguards and mitigation measures are applied, significant impacts to water are not anticipated. The application of the Water Act is limited in circumstances where the *Water Management Act 2000* (NSW) applies.

Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated management of water sources in NSW for the benefit of both present and future generations. The WM Act controls the extraction of water, how water can be used, and the carrying out of activities on or near water sources. Further provisions of this Act apply to water resources for which a water sharing plan has been gazetted.

The *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016* (North Coast WSP) includes the Tomago Groundwater Water Source which is applicable to the Proposal. Under the Act, in order to extract from a water source defined in a water sharing plan the following approvals must be obtained:

- An access licence to obtain a share of the water source
- A water use approval to obtain permission for how the water source would be used
- A water supply works approval to construct and operate water supply works (i.e. pumps, bores) for water supply, monitoring, drainage or flood mitigation work
- An aquifer interference approval for extraction or dewatering activities

Section 5.23(1)(g) of Division 5.2 of the EP&A Act provides that a water use approval under section 89, a water management work approval under section 90, or an activity approval (other than an aquifer interference approval) under section 91 is not required for approved State significant infrastructure.

The Water Management (Application of Act to Certain Water Sources) Proclamation 2016 declared that Parts 2 and 3 of Chapter 3 of the WM Act, which deal with licences and approvals, would apply to the North Coast WSP, but only in relation to all "categories and subcategories of access licences and approvals … other than floodplain harvesting access licences, drainage work approvals and aquifer interference approvals". Accordingly, as the provisions of the WM Act which relate to aquifer interference approvals have not commenced so far as they apply to the North Coast WSP, AGL does not require an aquifer interference approval.

However, AGL may require a water access licence under the WM Act for dewatering from trenches and excavations for the construction of the pipelines.

AGL may use groundwater for hydrotesting prior to project commissioning. Clause 6 of Schedule 4 of the Water Management (General) Regulations 2018 provides an exemption from the requirement for an access licence for a person lawfully engaged in hydrostatic testing of a gas pipeline – in relation to water required for initial testing of that pipeline before it is put into service for the first time, up to a maximum of 7 megalitres

The Proposal would not require works within the waterfront area defined under WM Act and a Controlled Activity Approval would not be required.

Hunter Water Regulation 2015

The Hunter Water Regulation 2015 provides for the regulation of activities within areas in the Hunter Region. The gas pipelines and transmission lines are located in the Tomago Sandbeds Catchment Area which is a catchment managed under the Regulation. The Proposal is immediately adjacent to the sandbeds.

The Regulation describes restrictions to works in special areas. Clause 8(1) provides that the owner or occupier of land in a special area must not erect, install or operate any on site sewage management facility on the land. The Proposal includes the installation and operation of an on site sewage management facility.

Clause 8(2) provides that clause 8(1) does not apply to anything done in accordance with

a) an approval under Part 3A or 5.1 of, or a development consent under Part 4 of, the *Environmental Planning and Assessment Act 1979*
b) an approval granted under the *Local Government Act 1993*
c) an environment protection licence

As the Proposal is CSSI under Clause 5.13 of the EP&A Act and as the Proposal would also require an environment protection licence, Clause 8(1) of the Regulation does not apply.

State Environmental Planning Policy (State and Regional Development) 2011

The State and Regional Development SEPP (SEPP SRD) identifies development that has been declared State Significant Development, State Significant Infrastructure, or Critical State Significant Infrastructure. Development specified in Clause 16 of SEPP SRD provides that development specified in Schedule 5:

a) May be carried out without development consent under Part 4 of the Act, and
b) Is declared to be State significant infrastructure for the purposes of the Act if it is not otherwise so declared, and
c) Is declared to be critical State significant infrastructure for the purposes of the Act.

Clause 12 Schedule 5 refers to “development for the purposes of the Newcastle Gas-Fired Power Station project” as being Critical State Significant Infrastructure. The effect of this declaration is that the Proposal would require approval under Division 5.2 of the EP&A Act.

State Environmental Planning Policy (Infrastructure) 2007

Clause 34(1) of *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) allows development for the purpose of electricity generating works to be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Electricity generating works are defined in the ISEPP as a building or place used for the purpose of making or generating electricity.

The Proposal is located within land zoned IN1 General Industrial under the Port Stephens LEP 2013 which is a listed zoning in Clause 34(1) and is therefore permissible with consent. However, Clause 12 Schedule 5 of SEPP SRD declares the Proposal to be CSSI, thereby overriding the Port Stephens LEP and the ISEPP and requiring the Proposal to seek approval under Part 5, Division 5.2 of the EP&A Act.

State Environmental Planning Policy No. 33 – Hazardous and Offensive Industries

State Environmental Planning Policy No. 33 (SEPP 33) requires developers and consent authorities to assess the hazards and risks associated with a proposed development before approval is given for construction and operation.

A potentially hazardous industry is a development where, if the development were to operate without employing any measures to reduce or minimise its impact the development would pose a significant risk to human health, life or property or to the biophysical environment. Clause 12 of SEPP 33 requires potentially hazardous developments to prepare a preliminary hazard analysis (PHA) to determine the risk to people, property and the biophysical environment at the proposed location and in the presence of controls.

A PHA has been carried out for the Proposal. The results are summarised in Chapter 7 and the full PHA provided in Appendix S.

State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No 44 (SEPP 44) aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas. SEPP 44 applies to all local government areas (LGAs) listed within Schedule 1, including Port Stephens LGA.

A BDAR that includes consideration of the impact of the Proposal on koalas has been prepared for the Proposal and is provided in summary in Section 6.2 of this EIS and in full in Appendix D.

4.3 Local requirements

The Proposal is located within the Port Stephens LGA; however, as the Proposal has been declared CSSI within the EP&A Act, the Port Stephens LEP does not apply.

Notwithstanding, relevant Port Stephens environmental planning instruments have been considered during design development and within the environmental impact statement process.

Port Stephens LEP

The proposed NPS and the investigation areas for the gas pipeline/s and electrical transmission line are zoned IN1 General Industrial by the Port Stephens LEP 2013. The objectives of zone IN1 as stated in the Port Stephens LEP are:

- To provide a wide range of industrial and warehouse land uses
- To encourage employment opportunities
- To minimise any adverse effect of industry on other land uses
- To support and protect industrial land for industrial uses

Electricity generation is not expressly prohibited within zone IN1 but may be able to be characterised as an "industry". In any event, Clause 34(1) of the ISEPP prescribes that the Proposal is permissible with consent on any land in a prescribed rural, industrial, or special use zone. Schedule of SEPP SRD overrides both the Port Stephens LEP and ISEPP and provides that the Proposal may be carried out as CSSI, with development consent under Division 5.2 of the EP&A Act.

Table 4.3.1 describes the objectives of the Port Stephens LEP and the consistency of the Proposal in relation to those objectives.

Table 4.3.1 Objectives of the Port Stephens LEP

LEP objective	Project consistency	Location in EIS
(a) to implement the community's Port Stephens Futures Strategy 2009 and Port Stephens Planning Strategy 2011.	The Port Stephens Planning Strategy is the overarching land use strategy for the Port Stephens LGA. The NPS would be located within the Tomago Industrial Precinct which is isolated from residential areas and very suitable for heavy industrial uses. The Proposal is therefore in line with the Port Stephens Planning Strategy.	Chapter 3
(b) to cultivate a sense of place that promotes community wellbeing and quality of life.	The Proposal is unlikely to impact the sense of place in the Port Stephens LGA. The Proposal would be located in an industrial area away from residents but would generate electricity to benefit the quality of life of residents in the area.	Chapter 3
(c) to provide for a diverse and compatible mix of land uses supported by sound planning policy to deliver high quality development and urban design outcomes.	The Proposal is in line with the designated land use for the area and the Port Stephens Planning Strategy. When comparing regions in the planning strategy, the industrial area adds to the diversity and compatibility of land uses in the LGA. Electricity supply helps the region to be developed for economic and social benefits.	Chapter 3
(d) to protect and enhance the natural environmental assets of Port Stephens.	This EIS assesses the existing natural environment to identify potential impacts as a result of the Proposal. Safeguards and mitigation measures would be applied to respect and protect the surrounding environment.	Chapter 6
(e) to continue to facilitate economic growth that contributes to long-term and self-sufficient employment locally.	The Proposal would create employment opportunities to the community in Port Stephens during the construction, operation and maintenance. The Proposal would also supply electricity to the region supporting businesses and be designed to the highest standards to ensure the longevity and reliability of the NPS.	Section 6.10
(f) to provide opportunity for housing choice and support services tailored to the needs of the community,	NA – The Proposal does not include provisions for additional housing opportunities.	Chapter 2
(g) to conserve and respect the heritage and cultural values of the natural and built environments,	This EIS assesses the existing environment including the natural and cultural heritage in the area to identify potential impacts from the Proposal. Safeguards and mitigation measures would be applied to respect and protect the heritage and cultural values of the natural and built environment.	Section 6.7
(h) to promote an integrated approach for the provision of infrastructure and transport services,	The Proposal is critical infrastructure required to support the development, growth and reliability of electricity supply to the region. The Proposal does not impact transport services.	Section 2.2
(i) to continue to implement the legislative framework that supports openness, transparency and accountability of assessment and decision making,	All relevant legislative requirements have been assessed and addressed in this EIS. The EIS is submitted to the public for consultation and transparency of all assessments, alternatives and impacts of the Proposal.	Chapter 4

LEP objective	Project consistency	Location in EIS
(j) to achieve intergenerational equity by managing the integration of environmental, social and economic goals in a sustainable and accountable manner.	The principles of ecologically sustainable development have been applied in consideration of this Proposal. As Australia's electricity market adapts to a carbon-constrained future and turns towards intermittent renewable energy sources, the NPS would create a secure energy system as the market transitions. The NPS' fast start dispatchable power generation complements renewables by providing back-up to wind and solar energy and would help respond to peak demand.	Chapter 10.1.2

4.4 Approvals and licences

The following licences and permits would be required by the Proposal prior to commencement of construction where these licences and permits become relevant.:

- An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997*
- A permit under Section 138 of the *Roads Act 1993*
- A licence under the *Pipelines Act 1967*
- A water access licence for activities involving the extraction of groundwater under the *Water Management Act 2000,* where no exemption applies

Of the above approvals and licences, under Section 5.24 of the EP&A Act, an environment protection licence, a permit under Section 138 of the *Roads Act 1993*, and a licence under the *Pipelines Act 1967* cannot be refused if they are necessary for the carrying out of CSSI and are to be substantially consistent with the approval of the CSSI.

Consultation

5 Consultation

5.1 AGL approach

AGL maintains a stakeholder consultation standard which it applies across all its business sectors in the development of new projects, expansions of existing infrastructure, and ongoing operations. The standard requires AGL to:

- Conduct consultation with stakeholders, including government groups, asset owners, local community groups, businesses, residents, and local media
- Establish constructive working relationships and communication channels with stakeholders
- Consider Aboriginal cultural heritage issues in the consultation process
- Seek community feedback
- Provide regular updates to interested communities on the progress of projects

5.2 NSW legislative requirements for consultation

SEARs for the Proposal were issued to AGL on 18 February 2019 with supplementary SEARs issued on 11 September 2019.

The SEARs require that the Proponent consult with the relevant local, State and Commonwealth Government authorities, infrastructure and service providers, community groups and affected landowners. This chapter details the consultation that AGL undertook during the preparation of this EIS.

5.3 Agency consultation

5.3.1 Direct consultation

AGL has carried out several face-to-face meetings with various stakeholders to introduce the Proposal and seek early involvement. A summary of these meetings follows.

Table 5.3.1 Direct stakeholder consultation

Stakeholder	Date	Discussion points/issues raised by the stakeholder	Where addressed
Department of Planning, Industry, and Environment	26 April 2018	This meeting was held to announce the Proposal.	N/A
	20 September2019	This meeting was held to provide an update on the Proposal after receipt of Supplementary SEARs.	Section 1.3 (SEARs)
Newcastle City Council	10 July 2018	This meeting was held to announce the Proposal.	N/A
	14 May 2019	This meeting was held to provide an update on the Proposal.	N/A
Port Stephens Council	10 July 2018	This meeting was held to announce the Proposal.	N/A
	20 March 2019	Easements	Chapter 2

Stakeholder	Date	Discussion points/issues raised by the stakeholder	Where addressed
	16 April 2019	The approval pathway Transmission design at Old Punt Road Depth of HDD under Old Punt Road.	Issue 1: Chapter 4 Issue 2 and 3: Details provided in Chapter 2
	28 May 2019	This meeting was held to provide an update on the Proposal.	N/A
Roads and Maritime	11 July 2018	Comparative construction scheduling.	Section 6.8 Appendix K
	21 September 2018	SEARs comments.	Appendix A
	5 March 2019	Requirements for the Proposal.	Chapter 2
	5 April 2019	Requirements for the Proposal.	Chapter 2
	8 May 2019	Roads and Maritime website information to be used to inform the EIS. Discussed the possible location of utilities so as neither project is compromised.	Refer to Chapter 2 for current location of utilities and site access
	5 June 2019	Discussed the utilities requirements for the Proposal.	Chapter 2
	23 July 2019	Discussed ongoing collaboration to ensure both projects work together.	Chapter 2
	16 October 2019	M1 Pacific Highway to Raymond Terrace Project update	Section 6.8
Department of Defence	14 August 2018	Air traffic and plume rise assessment.	Section 6.5 Section 7.1 Appendix G Appendix Q
	5 September 2018	This meeting was held to provide an update on the Proposal.	N/A
	21 September 2018	Proposal is within RAAF Base WLM controlled airspace (15km from the airport). Plume rise Structural obstructions Emissions	Section 7.1 Appendix Q
	7 February 2019	DoD requested review of the plume rise assessment. DoD requested stack height information.	Section 7.1 Appendix Q

Stakeholder	Date	Discussion points/issues raised by the stakeholder	Where addressed
	27 September 2019	Which coordinates should be used to identify the centre of the plume	Section 7.1 Appendix Q
	5 September 2019	Plume rise assessment issued to DoD	Section 7.1 Appendix Q
	26 September 2019	Plume rise assessment results for Newcastle Airport and RAAF Base Williamtown.	Section 7.1 Appendix Q
Civil Aviation Safety Authority	14 August 2018	CASA requested review of the plume rise assessment (AGL provided this to CASA 5 September 2019)	Section 7.1 Appendix Q
	7 February 2019	CASA requested review of the plume rise assessment (AGL provided this to CASA 5 September 2019). Advised DoD will need to provide approval for stack heights within its controlled airspace. DoD will require copy of EIS to review.	Section 7.1 Appendix Q Noted
	5 September 2019	Plume Rise assessment was issued to CASA	N/A
Airservices Australia	23 August 2018	ASA requested review of stack-height and the impact of plume rise. ASA confirmed that they will recommend a flight chart amendment if necessary, to show any areas of risk to aviation. ASA's initial view was that the Proposal would be unlikely to impact civilian flights given the orientation of the runway and the location of the Proposal.	Section 7.1 Appendix Q
Newcastle Airport	5 September 2018	Plume rise assessment.	Section 7.1 Appendix Q
	26 September 2019	Warning of plume rise to Newcastle Airport and RAAF Williamtown base	Section 7.1 Appendix Q
Department of the Environment and Energy	14 August 2018	DoEE advised on the referral requirements for Controlled Actions. DoEE raised the following area of interest: proximity to Ramsar wetlands.	Section 1.3 Section 6.2 Section 6.4 Appendix B Appendix F
	7 February 2019	Biodiversity requirements as an area of interest.	Section 6.2 Appendix D

Stakeholder	Date	Discussion points/issues raised by the stakeholder	Where addressed
	11 June 2019	None. This visit was held to provide a Proposal update to the Department.	N/A
	4 September 2019	Demonstrate Ramsar Wetlands will not be impacted with water runoff and acid sulphates during construction and operation. Demonstrate minimum interference to the shallow groundwaters with pipelines.	Section 6.2 Appendix B
Comprehensive Koala Plan of Management (CKPoM) – Port Stephens	30 May 2019	Koala habitat impacts.	Section 6.2 Appendix D
Department of Employment, Skills, Small and Family Business	19 June 2019	Discussed local procurement.	Section 6.10
Maitland City Council – Mayor and general manager	02 July 2019	Council raised the issues of surface water and air quality. Council also requested access to hard copy of the EIS when on exhibition.	Section 6.3 Section 6.5 Noted
RAAF Base	5 September 2018	Air traffic and plume rise	Section 7.1 Appendix Q
	21 September 2018	Air traffic and plume rise	Section 7.1 Appendix Q
	26 September 2019	Warning of plume rise to Newcastle Airport and RAAF Williamtown base	Section 7.1 Appendix Q
NSW Environmental Protection Authority (EPA)	13 September 2019	Offered meeting to provide an update on the Proposal.	N/A
NPS Select tenderers	22 July 2019 – 26 July 2019	Scope of works	Chapter 2
ARTC	19 June 2019	None. ARTC have no plans for rail projects in vicinity of the Proposal.	N/A

5.3.2 Agency comments on the SEARs

DPIE consulted with a range of various agencies and organisations in the development of the SEARs for the Proposal. The following agencies were consulted:

- Airservices Australia
- Civil Aviation Safety Authority

- Department of Industry Lands and Water Division
- Department of Planning and Environment Division of Resources & Geoscience
- Environment Protection Authority
- Fire & Rescue NSW
- Hunter Water Corporation (HWC)
- Office of Environment and Heritage
- Port Stephens Council
- Roads and Maritime
- Rural Fire Service

Feedback is provided in Appendix A.

5.4 Landowner consultation

Consultation commenced in 2018 with landowners potentially affected by the Proposal. Consultation has been face-to-face as well as via email and telephone. Direct briefings held with TransGrid, Hunter Water Corporation, and Tomago Aluminium Company are outlined in Table 5.4.1.

Table 5.4.1 Landowner consultation

Stakeholder	Date	Discussion points/issues raised by the stakeholder	Where addressed
Hunter Water Corporation	23 July 2018	Groundwater	Section 6.4 Appendix F
	5 March 2019	SEARS feedback.	N/A
	5 April	Wastewater disposal options.	Chapter 2 Section 6.3 Section 6.14
	8 May	Drainage and process wastewater removal.	Chapter 2 Section 6.3 Section 6.14
	5 June 2019	Process wastewater disposal. Options, costs, quality requirements.	Chapter 2 Section 6.3 Section 6.14
	2 July 2019	Discussed process wastewater disposal.	Chapter 2 Section 6.3 Section 6.14

Stakeholder	Date	Discussion points/issues raised by the stakeholder	Where addressed
	16 September 2019	Construction waste impact management; Stormwater management, especially in relation to the Tomago catchment area; Connection to the power grid and the NGSF in relation to potential issues during construction and operation in the Tomago catchment area. Services to or from the power station provided by Hunter Water, i.e. water and wastewater.	Chapter 2 Section 6.3 Section 6.14 Chapter 2
TransGrid	21 September 2018	Design of connection to the TransGrid 132kV Switching Station	Chapter 2
	6 November 2018	Easement widths	Chapter 2
	19 March 2019	Easements and clearance height requirements of existing infrastructure.	N/A
	26 March 2019	TransGrid supplied 132kV transmission line details	N/A
	29 August 2019	Supply of utilities (Battery) for operation	N/A
Tomago Aluminium Company	20 March 2019 23 May 2019 13 August 2019	These meetings discussed commercial easement arrangements.	N/A
	5 September 2019	Potential cumulative noise and air quality impacts.	Section 6.5 Section 6.9 Appendix L
	26 September 2019	R3 already impacted by noise. ENSR 2009 needs corrections and update.	Section 6.5 Section 6.9 Appendix L

5.5 Community consultation

5.5.1 Aboriginal consultation

Consultation was carried out in accordance with the guideline *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010). Consultation with Aboriginal people is an essential part of the heritage assessment process to:

- Determine potential harm on Aboriginal cultural heritage from proposed activities
- Inform decision making where it is determined that harm to Aboriginal cultural heritage cannot be avoided

To identify people with a potential interest in the Proposal, letters containing the location and nature of the Proposal were sent to the following bodies on 30 November 2018:

- Worimi Local Aboriginal Land Council (WLALC)
- Hunter Local Load Services (HLLS)
- National Native Title Tribunal
- Native Title Services Corporation (NTS Corp)
- NSW OEH Regional Operations Hunter Central Coast Branch
- Office of the Registrar, Aboriginal Land Rights Act
- Port Stephens Council

Responses to these letters identified 25 Aboriginal people or organisations with a potential interest in the Proposal. An invitation to register letter was sent to each of the interested parties on 21 January 2019 and 12 registrations were received. The letters and responses are provided in Appendix J of this EIS.

A newspaper advertisement was placed in the *Port Stephens Examiner* and the *Newcastle Herald* on 6 December 2018 also requesting Aboriginal participation in the Proposal. There were no additional registrations received following the advertisement.

The Registered Aboriginal Parties (RAPs) are detailed in Table 5.5.1.

Table 5.5.1 Registered Aboriginal Parties

Organisation	
Didge Ngunawal Clan	Murra Bidgee Mulangari Aboriginal Corporation
Nu-Run-Gee Pty Ltd	A1 Indigenous Services
Worimi Traditional Owners Indigenous Corporation	Mu-Roo-Ma Pty Inc.
Divine Diggers Aboriginal Cultural Consultants	Muragadi
Worimi Local Aboriginal Land Council	Karuah Indigenous Corporation
Widescope Indigenous Group	Merrigarn

An archaeological survey was undertaken over three days from 6 to 8 May 2019 and archaeological test excavations were undertaken from 15 to 18 July 2019, both with RAPs in attendance.

The results of that work have been written into the draft Aboriginal Cultural Heritage Assessment Report (ACHAR). The draft ACHAR was reviewed by the RAPs and their comments incorporated into the ACHAR provided in Appendix J. Muragadi, the Karuah Indigenous Corporation, and Mu-Roo-Ma Pty Inc. provided comments on the ACHAR that each had read and understood the report and agreed with the recommendations. Mu-Roo-Ma Pty Inc. noted that any objects located in the Proposal area are tangible cultural connections to ancestors and proposed a Cultural Heritage Management Plan be prepared and implemented for works within the Proposal Area.

5.5.2 Local community

Community engagement during the public exhibition of the EIS and construction and operations phases of the Proposal will involve a range of consultation activities to:

- Provide the community with timely project information to assist them in understanding the Proposal and its impact on the community and the environment
- Provide the community with opportunities to have input into issues that might affect them, from the Proposal planning stage through to construction and operation
- Make sure issues or concerns are addressed as early as possible and, where appropriate, addressed in the environmental assessment report
- Make sure regulatory requirements are met
- Establish the basis to ensure constructive community relationships throughout the life of the Proposal

AGL's community consultation plan includes:

- Quarterly meetings with the Newcastle Gas Storage Facility and Newcastle Power Station Community Dialogue Group (CDG)
- Preparation of collateral material to be used in public displays and information sessions
- Raising awareness of the enquiries' hotline, email, and postal address for feedback. These are currently used by the NGSF
- Preparation of media releases and advertising
- Commencement of community information and feedback sessions at popular and accessible locations
- Open display of the Proposal coordination with Department of Premier and Cabinet
- Presentation of Proposal information on AGL website

Project website

AGL has established a project-specific webpage on the AGL website. The website provides an overview of the Proposal, information on how to lodge a complaint or make an enquiry via telephone, email, or post, answers to frequently asked questions, and project updates.

The site includes an email inquiry link and advice on AGL's Community Complaints and Feedback Policy. The details are:

- Website: https://www.agl.com.au/about-agl/how-we-source-energy/newcastle-power-project
- Email: AGLCommunity@agl.com.au
- Postal address: AGL Community Complaints & Enquiries, Locked Bag 3013, Australia Square NSW 1215

Community complaints and enquiries phone number

AGL has established the AGL community complaints and enquiries phone number (Telephone: 1800 039 600) for the Proposal. The phone number provides a quick and reliable way for community members and stakeholders to ask questions and provide feedback. The phone number will continue during construction. During operation, complaints and enquiries would be handled through AGL's standard community enquiry procedures.

Stakeholder contact database

AGL maintains a stakeholder contact database to record contact details of all identified stakeholders and the issues raised to keep track of and resolve issues to the satisfaction of each stakeholder.

Direct consultation

AGL has carried out a number of face-to-face meetings with various community stakeholders to introduce the Proposal and seek early involvement. These meetings are summarised in Table 5.5.2.

Table 5.5.2 Direct community consultation

Stakeholder	Date	Details
NSW Member for Port Stephens	7 August 2018	Outlined and introduced the Proposal.
	3 July 2019	Provided an update of progress on the Proposal.
Federal Member for Peterson	14 August 2018	Outlined and introduced the Proposal.
	8 July 2019	Provided an update of progress on the Proposal. Issues discussed included impacts to land (Section 6.6), noise impacts (Section 6.9) and local employment (Section 6.10).
Federal Member for Newcastle	28 November 2018	Outlined and introduced the Proposal.
Newcastle Gas Storage Facility and Newcastle Power Station CDG. Members are: ▪ Port Stephens Koalas & Wildlife Preservation Society ▪ Hunter Wildlife Rescue ▪ Worimi LALC ▪ Wahroonga Aboriginal Corporation ▪ HWC ▪ Hunter Region Botanic Gardens	16 July 2018	Outlined and introduced the Proposal.
	30 November 2018	Provided an update of progress on the Proposal.
	5 February 2019	Provided an update of progress on the Proposal.
	29 May 2019	Provided an update of progress on the Proposal.
	6 September 2019	Provided an update of progress on the Proposal. Issues discussed included community engagement activities (Chapter 5).
Port Stephens Council Koala Steering Group	9 May 2019	Outlined and introduced the Proposal. Issues discussed included koala habitat activities (addressed in Section 6.2 and Appendix D).
Hunter Koala Preservation Society (HKPS)	22-26 November 2018	Outlined and introduced the Proposal. Issues discussed included koala habitat activities (addressed in Section 6.2 and Appendix D).
Hunter Business Chamber	18 June 2019	A meeting was held with HBC representatives to outline the Proposal and request local engagement in the procurement process. Issues discussed included local procurement (addressed in Section 6.10).
Industry Capability Network	19 June 2019	A meeting was held with ICN representatives to outline the Proposal and request local engagement in the procurement process. Issues discussed included local procurement (addressed in Section 6.10).

Stakeholder	Date	Details
The Australian Industry Group	19 June 2019	A meeting was held with AIG representatives to outline the Proposal and request local engagement in the procurement process. Issues discussed included local procurement (addressed in Section 6.10).
The Australian Industry Group	19 June 2019	A meeting was held with AIG representatives to outline the Proposal and request local engagement in the procurement process. Issues discussed included local procurement (addressed in Section 6.10).
General Public	21 September 2018	A stand was established at the Greater Hunter Makers and Technology Festival in Newcastle to outline the Proposal and answer questions. Issues discussed included local employment opportunities, the potential to use local contractor companies and engaging with the local TAFE. No concerns were raised (addressed in Section 6.10).

5.5.3 Public exhibition

The EIS will be publicly exhibited by DPIE. Interested persons and organisations can review the EIS and make a written submission on any aspect of the Proposal during this time.

Advertisement of the Proposal was placed in the *Maitland Mercury*, *Newcastle Herald* and *The Australian* on 14 October 2019 and in the *Port Stephens Examiner* on 17 October 2019. Additionally, letters were sent to landholders/occupiers within a 3km radius surrounding the Proposal on 14 October 2019. The advertisement and letters notified interested parties of the upcoming application of the Proposal to the DPIE and availability of the EIS through the Major Project website.

Copies of the EIS may be available for viewing at locations to be determined and notified by the DPIE.

The EIS will be available to view on the internet at:

- AGL website **https://www.agl.com.au/about-agl/how-we-source-energy/newcastle-power-project**
- DPIE website **https://www.planningportal.nsw.gov.au/major-projects/project/9951**

Submissions to the project during the exhibition period are to be made direct to DPIE via email, post, or via the DPIE website mentioned previously.

5.5.4 Post-approval consultation

AGL will continue consultation with affected landowners, Agencies, and the community during the construction and operational phases of the Proposal in accordance with its Community Engagement Policy.

Environmental impact assessment

6 Environmental impact assessment

6.1 Framework and risk assessment

The risks posed to the natural, built and social environment by the construction and operation of the Proposal were assessed with reference to the AS ISO 31000: Risk management guidelines, the SEARs and the supplementary SEARs.

The risk assessment process describes risk in terms of likelihood of a risk occurring and the consequence of that occurrence. A risk level is then calculated from low to extreme based on the likelihood and consequence values. Based on the potential impacts and risks identified in the PEA, this chapter and Chapter 7 assesses impacts from construction and operation of the Proposal on:

- Biodiversity
- Surface water and hydrology
- Groundwater
- Air quality
- Soils and contamination
- Aboriginal heritage
- Traffic and transport
- Noise and vibration
- Social and economic
- Visual amenity
- Non-Aboriginal heritage
- Electric and magnetic fields
- Waste
- Plume rise and aviation hazard (Chapter 7)
- Bushfire (Chapter 7)
- Hazards and risks (Chapter 7)
- Fire safety (Chapter 7)

Each area of assessment includes:

- A discussion of the existing environment relevant to each assessment
- A discussion of the possible and feasible environmental and social impacts that may be associated with the Proposal. The potential impacts identified in each assessment do not take into account any avoidance, mitigation, or management measures employed to address the potential impacts. Cumulative impacts associated with the Proposal and other projects/facilities nearby are also in discussion.
- A table of avoidance, mitigation, and management measures that illustrate AGL's commitment to the environmental and social performance of the Proposal

A summary of the potential impacts, risks, proposed mitigation measures and assessment of residual risk is provided in Chapter 8. A consolidated list of all environmental measures and monitoring programs is provided in Chapter 9.

6.2 Biodiversity

A BDAR has been prepared by Kleinfelder Australia Pty Ltd (Appendix D). The assessment reviewed the potential impacts on biodiversity from the construction of the Proposal and identified proposed mitigation measures to minimise these impacts.

6.2.1 Existing environment

The biodiversity assessment was undertaken across the Proposal area (Figure 6.2.1).

Landscape context

The Proposal is located on a small ridge in a relatively flat landscape between 4 to 16 metres above sea level. It is located on the boundary of two bioregions – the Sydney Basin Region to the west and North Coast Region to the east. The Proposal area is within the Sydney - Newcastle Barriers and Beaches Mitchell Landscape (DECC, 2008). This landscape is located on quaternary coastal sediments on long recurved quartz sand beaches between rocky headlands backed by sand dunes and intermittently closed and open lagoons (Figure 6.2.2).

The Hunter River is about 500m north west of the Proposal area and flows in a southwesterly direction. Numerous smaller waterways diverge from the river, particularly to the north and south of the Proposal area, which contribute to surrounding wetlands. Hunter Estuary Wetland Ramsar site is located more than 2km south of the Proposal area and is important for international migratory bird species.

Land to the north and east of the Proposal is covered by native vegetation. Tilligerry State Conservation Area is located about 3.5km to the north east, covering an area of 4,689ha which extends further north-east through the Tomago sand beds. Hunter Region Botanic Gardens is located to the north and covers over 130 ha, most of which is preserved native bushland. Land use to the west of the Proposal is predominantly agricultural and has been historically cleared for grazing pasture. Additionally, the Tomago industrial area is located to the south and is highly developed with little remaining native vegetation.

Vegetation communities

The Proposal area consists of remnant and managed native vegetation, managed grassland/shrubland and a wetland area with varying degrees of condition and disturbance history. Seven plant community types (PCTs) are present across the Proposal area with only two PCTs within the development footprint (PCT 1590 and PCT 1646). The PCTs within the Proposal area are shown in Figure 6.2.3 and are:

- PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest
- PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast
- PCT 1071: *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin
- PCT 1725: Swamp Mahogany – Broad-leaved Paperbark – Swamp Water Fern – Plume Rush swamp forest on the coastal lowlands of the Central Coast and Lower North Coast
- PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
- PCT 1724: Broad-leaved Paperbark – Swamp Oak Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast
- PCT 1568: Blackbutt - turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast

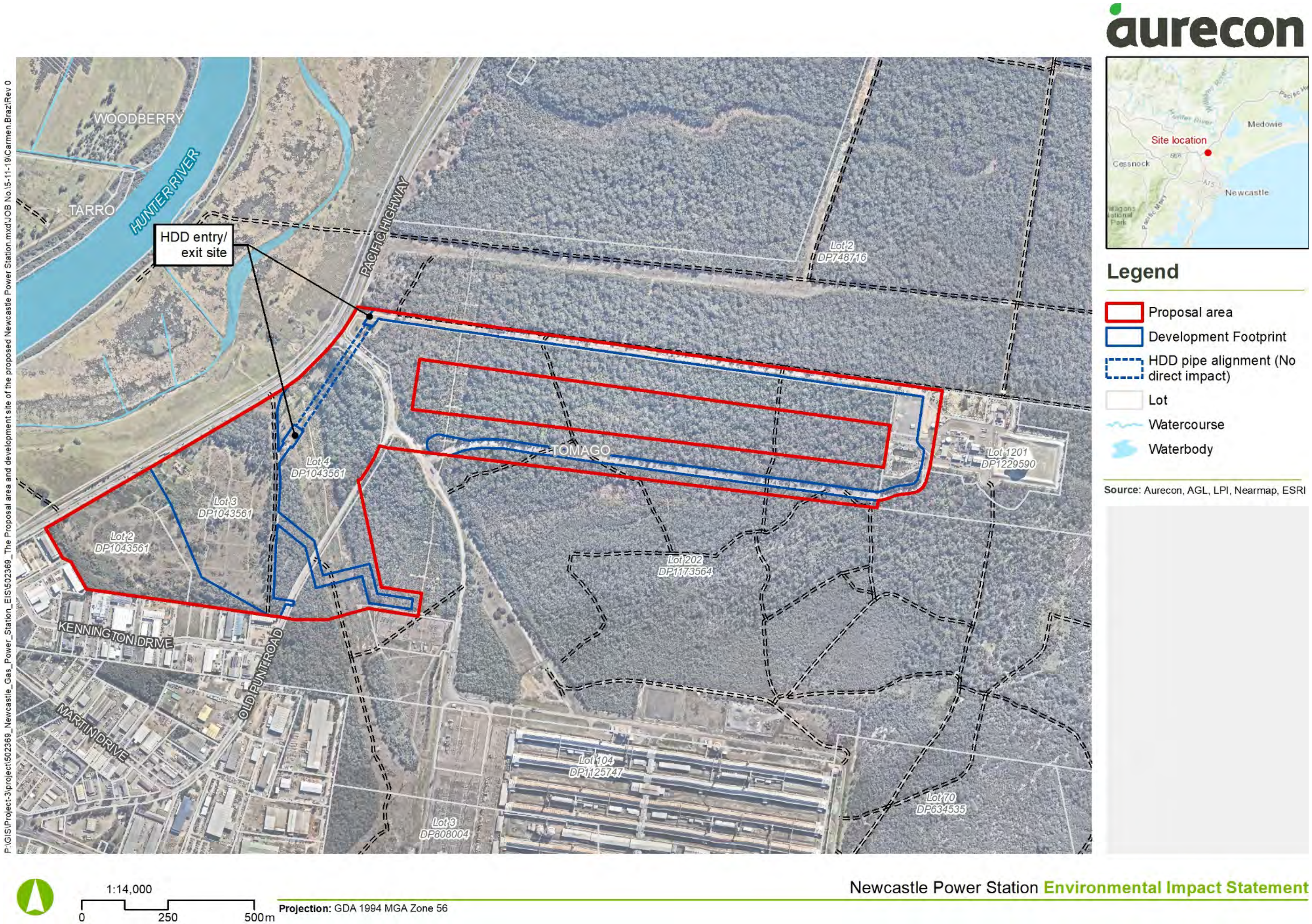

Figure 6.2.1 The development footprint and Proposal area

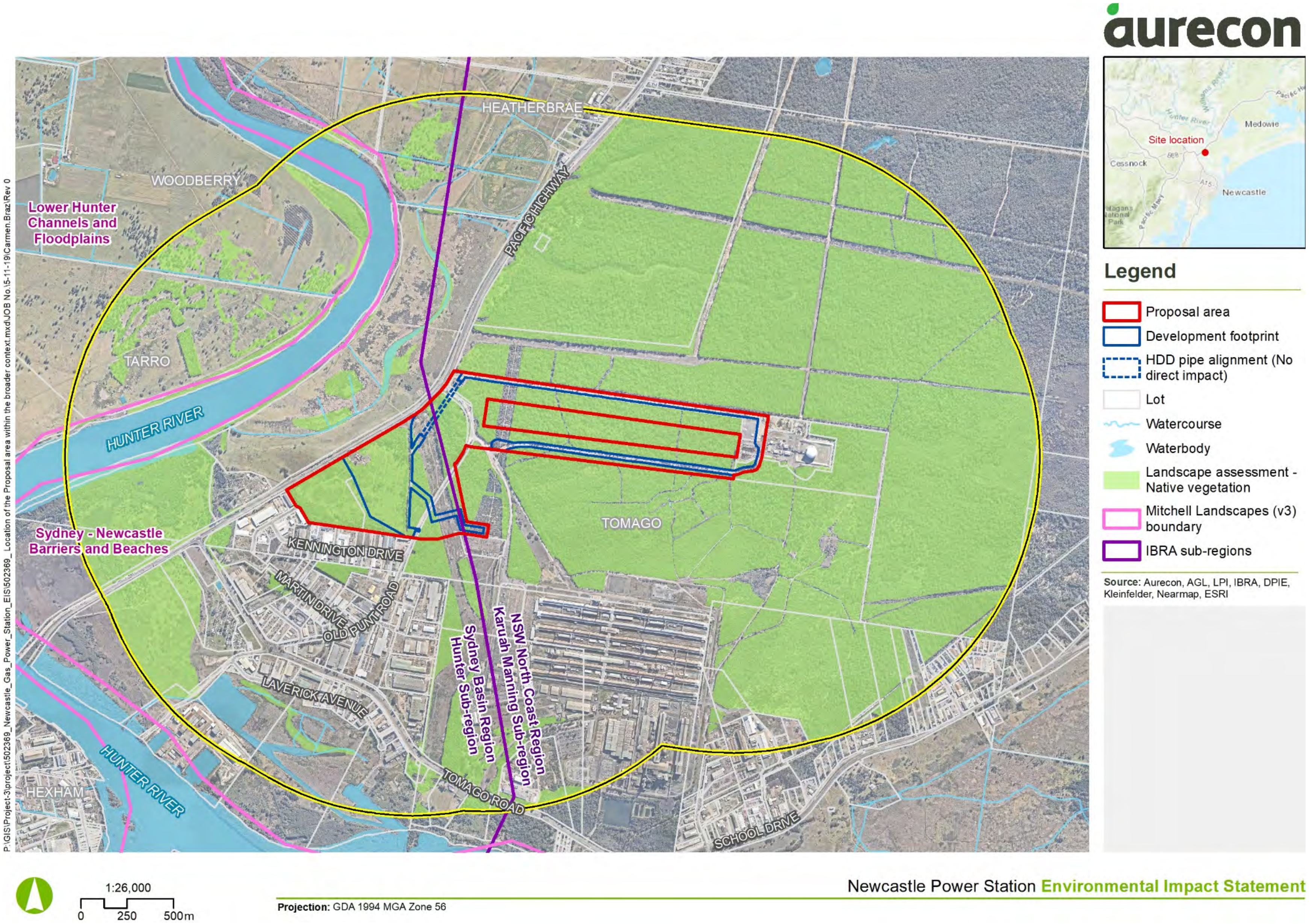

Figure 6.2.2 Location of the Proposal area within the broader context

The two PCTs within the development footprint (PCT 1590 and PCT 1646) were spilt into a further three zones each based on level of disturbance, condition and variations (refer to Section 6.2.2). Summaries of the PCTs and relevant zones are provided in Table 6.2.1 and shown in Figure 6.2.3.

Table 6.2.1 Plant Community Types within the Proposal area

Plant community Type (PCT)	Vegetation zone	Condition class	BC Act	EPBC Act
PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Zone 1	Moderate/Good	Not listed	Not listed
	Zone 2	Moderate/Good/ Endangered Ecological Community (EEC)	Lower Hunter Spotted Gum – Ironbark Forest EEC	Not listed
	Zone 3	Low	Not listed	Not listed
PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Zone 4	Managed	Not listed	Not listed
	Zone 5	Managed powerlines	Not listed	Not listed
	Zone 6	Rehabilitation	Not listed	Not listed

Endangered Ecological Community

One Endangered Ecological Community (EEC), ‘Lower Hunter Spotted Gum – Ironbark Forest’, is present within the Proposal area (zone 2) (Figure 6.2.3).

Zone 2 has been identified as EEC due to:

- Meeting the criteria for the listing in the locality (Sydney Basin Bioregion on Permian geology) under the BC Act
- Its position in the landscape (moderately fertile soils in the central to Lower Hunter Valley)
- Its dominant floristic composition and structure (open forest dominated by *Corymbia maculata*, *Eucalyptus fibrosa* and *Eucalyptus umbra*, *Aristida vagans*, *Cheilanthes sieberi* and *Lomandra multiflora*)

Threatened flora

The desktop assessment identified that 29 threatened flora species may occur in the study area. The field assessment identified a total of 138 flora species (109 native and 29 exotic) including three threatened species. The full list of flora species is provided in Appendix D. The threatened flora species identified in the study area are:

- *Eucalyptus parramattensis subsp. decadens* (Earp’s Gum)
- *Maundia triglochinoides*
- *Grevillea parviflora subsp. parviflora*

Three individual *Eucalyptus parramattensis* subsp. *decadens* (Earp’s Gum tree) were recorded within the Proposal area. These trees form part of a much larger population which occurs to the east and south of the adjacent NGSF.

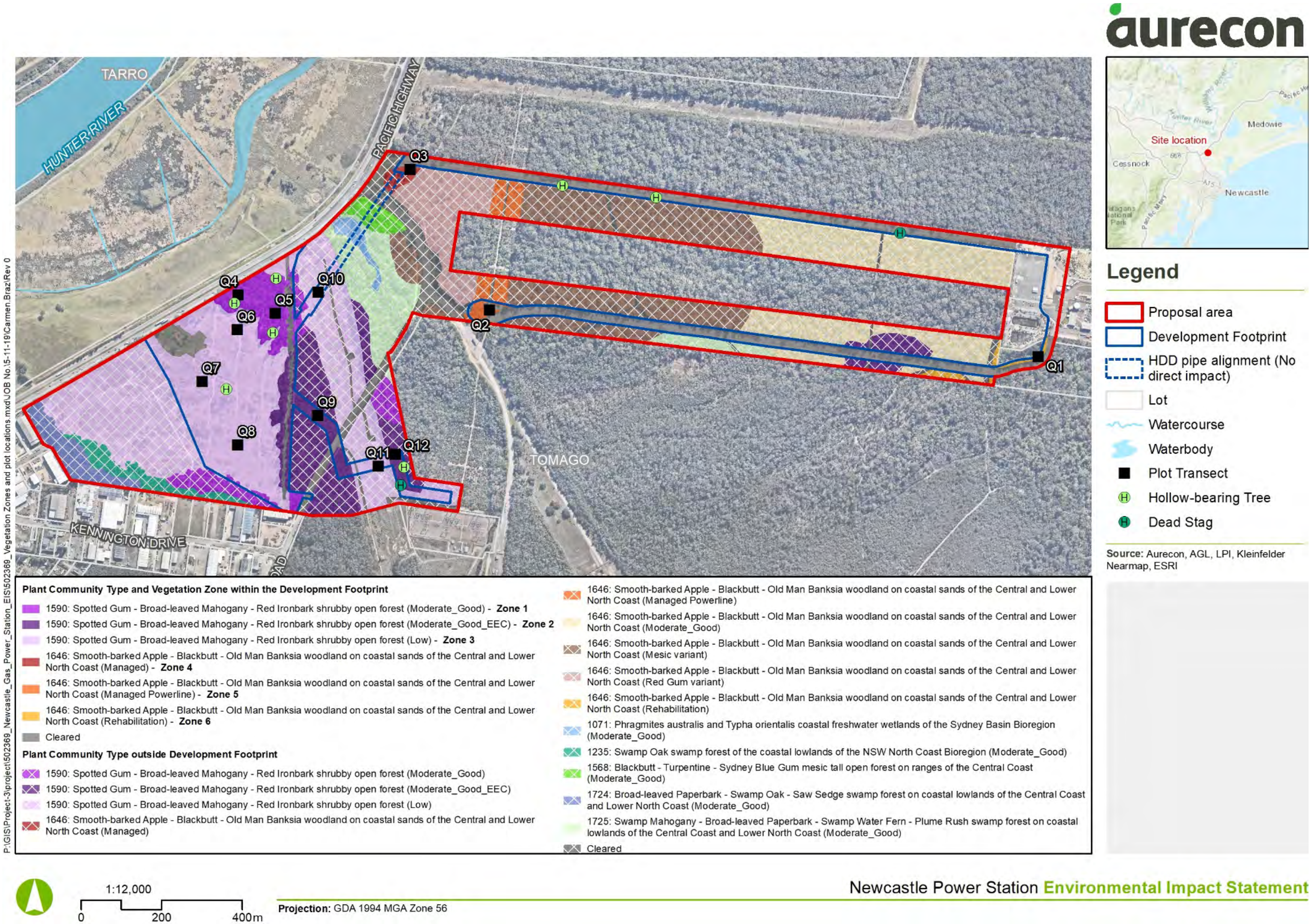

Figure 6.2.3 Vegetation zones and plot locations

Threatened fauna

The desktop assessment identified that 16 threatened fauna species may occur in the study area. The field assessment identified a total of 45 fauna species (43 native and 2 introduced) including five threatened species (one bird and four mammals). The fauna identified comprised of 21 bird, 19 mammal, four amphibian and one reptile species. The full list of flora species is provided in Appendix D. The threatened fauna species identified in the study area are:

- Masked Owl (*Tyto novaehollandiae*)
- Little bentwing bat (*Miniopterus australis*)
- Eastern freetail bat (*Miniopterus australis)*
- Squirrel Glider (*Petaurus norfolcensis*)
- Grey-headed Flying-fox (*Pteropus poliocephalus)*
- Koala *(Phascolarctos cinereus)* (species habitat only, refer to the following section)

Only the Squirrel Glider was observed within the development footprint, with other species observations occurring within the wider Proposal area.

Habitat

Four hollow-bearing trees occur within the NPS site (Figure 6.2.3), which is predominantly cleared and contains low to moderate value fauna habitat. One hollow-bearing tree and one dead stag also occur along the perimeter of the electrical transmission corridor; and four hollow-bearing trees and one dead stag occur along the perimeter of the storage pipeline corridors. One nest belonging to a Wedge tailed Eagle was observed in the east of the Proposal area, however no nests were observed in the development footprint.

Few other habitat features are present within the Proposal area (i.e. rocks and logs). One ephemeral drainage line and ephemeral pond exists within the north-eastern section of the study area. These ephemeral areas have the potential to provide habitat for commonly occurring amphibian and waterbird species; however, the density of emergent vegetation limits the potential for bodies of open water to form after rainfall.

Koala habitat

Thirteen tree species that are listed as Koala feed trees in Port Stephens LGA were identified within the Proposal area, including three preferentially utilised eucalypt species: *Eucalyptus robusta, Eucalyptus tereticornis* and *Eucalyptus parramattensis*. Koala habitat covers much of the study area with four isolated areas of preferred Koala habitat (Figure 6.2.4). Within the Proposal area, there is a total of about 0.18 ha of Koala habitat which is within PCT 1646. This area comprises of about 0.05 ha of preferred and 0.13 ha of supplementary Koala habitat.

Wildlife connectivity corridors

The Proposal area lies within a large wildlife corridor that extends from the Watagan Ranges in the south to Port Stephens in the north. This corridor is likely to provide a highly significant link between southern sandstone ranges and the coastal heaths and wetlands of Port Stephens.

On a local level, the Proposal area is situated to the north of the industrial precinct of Tomago with Old Punt Road dissecting the middle of the Proposal area in a north/south bearing. There is limited connectivity south through the industrial estate; however, linear strips of vegetation exist adjacent to powerline easements, connecting the Proposal area to riparian areas of the north channel of the Hunter River.

Another stretch of the Hunter River lies approximately 500m to the north-west of the Proposal area separated by grazed marshlands and the Pacific Highway. Large areas of intact native vegetation extend from the northern and eastern boundaries of the development footprint. The areas provide linkage to Tilligerry State Conservation Area which extends north-east through the Tomago Sandbeds. Throughout these large connective habitats, there are some cleared easements and tracks/roads which are generally no wider than 25m.

Critical habitat

There is no listed critical habitat within the study area.

Weeds

Twenty-nine exotic flora species were identified in the Proposal area. Of these, 12 were high threat weeds, four are also priority weeds in the Hunter Region and three are also weeds of national significance. The weeds in the Proposal area that would require control are listed in Table 6.2.2.

Table 6.2.2 Weed species requiring control within the Proposal area

Family	Scientific name	Common name	Weeds of National Significance (WONS)	Priority weeds of the Hunter Region (Biosecurity Act)	High Threat Weeds (BAM)
Asteraceae	*Bidens pilosa*	Cobblers pegs	-	-	Y
Asteraceae	*Senecio madagascariensis*	Fireweed	Y	Y	Y
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	-	-	Y
Poaceae	*Andropogon virginicus*	Whiskey Grass	-	-	Y
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	-	-	Y
Poaceae	*Briza subaristata*	-	-	-	Y
Poaceae	*Chloris gayana*	Rhodes Grass	-	-	Y
Poaceae	*Eragrostis curvula*	African Lovegrass	-	Y	Y
Poaceae	*Megathyrsus maximus*	Guinea Grass	-	-	Y
Poaceae	*Paspalum dilatatum*	Paspalum	-	-	Y
Rosaceae	*Rubus fruticosus* sp. *agg.*	Blackberry	Y	Y	Y
Verbenaceae	*Lantana camara*	Lantana	Y	Y	Y

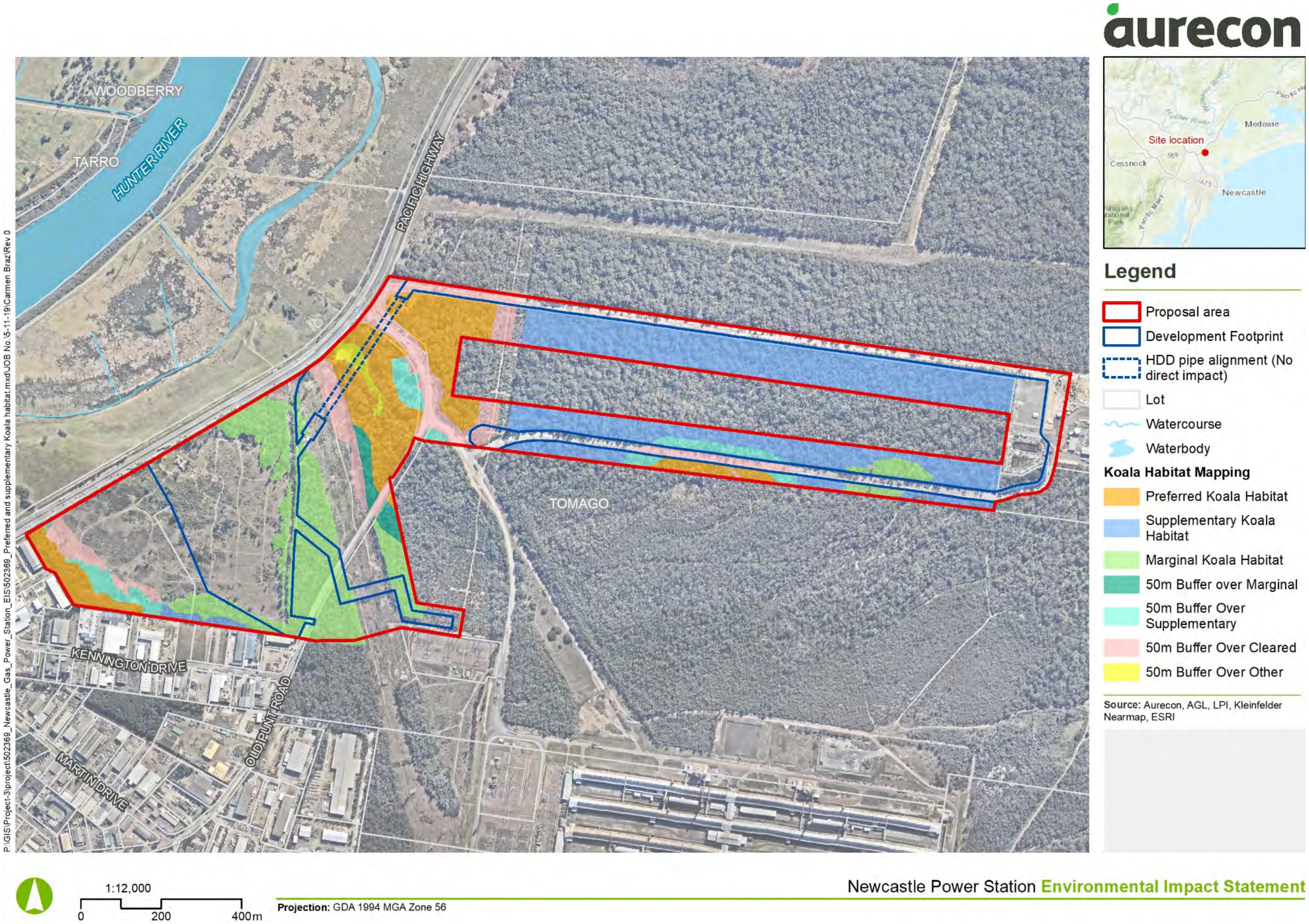

Figure 6.2.4 Preferred and supplementary Koala habitat

Hunter Estuary Wetland Ramsar site

Under the Ramsar Convention, the Kooragang component of the Hunter Estuary Wetland (the wetland) was listed as a Ramsar site in 1984. The wetland was listed as it meets three of the nine internationally accepted criteria, being:

- The wetland supports nationally and internationally listed threatened species including the Australasian Bittern (*Botoaurus poiciloptilus*), the Green and Golden Bell Frog (*Litoria aurea*) and the Estuary Stingray (*Dasyatis fluviorum*)
- The wetland provides important foraging and roosting sites for migratory shorebirds, supports waterbirds at critical stage of their life cycle and provides refuge in adverse conditions
- The wetland supports more than 1% of the East Asian Australasian flyway population of Eastern Curlew (*Numenius madagascariensis*) and more than 1% of the Australian population of Red-necked Avocets (*Recurvirostra novaehollandiae*)

The Proposal is located about 2.5km north of the Kooragang component of the wetland. The Kooragang component of the wetland covers an area of about 3000ha and is comprised of the bed of Fullerton Cove, the northern part of Kooragang Island (including the Kooragang Dykes) and the eastern section of the Tomago Wetlands (an area of former wetlands converted to grazing land by drains and levees which lie to the west of Fullerton Cove). The wetland also includes the surrounding mangroves and islands within Fullerton Cove and part of the North Arm, as well as Stockton Sandspit and the Kooragang Dykes.

Various vegetation communities are present in the wetland including mangrove forests, saltmarsh and brackish swamps. Vegetation associations within the Proposal area are largely determined by the frequency and periodicity of tidal inundation and salinity. Saltmarshes are confined to those areas periodically tidally inundated and which are hypersaline. Mangroves edge the tidal mudflats of Fullerton Cove and are found in areas which are inundated more frequently and have salinities close to full seawater (i.e. margins of Kooragang Island).

Limited information is available on changes in tidal range and the impact on mangrove expansion, saltmarsh decline and changes in the distribution of intertidal mudflats as well as how groundwater flows into and out of the estuary. However, it is recognised that large influxes of freshwater into the estuary can cause great variability in salinity, particularly after a rainfall event. Groundwater fluxes in the wetland are also influenced by tidal movement.

The wetlands provide essential habitat for many threatened fauna and migratory birds species. Migratory shorebirds are present for up to eight months of the year between September and April. A maximum of 6800 migratory waders were recorded within the wetland (Brereton and Taylor-Wood, 2010). This includes 112 species of water birds and 45 species of migratory birds listed under international agreements. Important bird habitats in the wider area surrounding the Proposal include:

- Saltmarsh ponds (important roosting and foraging habitat for shorebirds)
- Tidal mudflats and sand flats (important foraging habitat for shorebirds)
- Stockton Sandspit (important roosting habitat for shorebirds)
- Kooragang Dykes (important roosting and foraging habitat for shorebirds)

6.2.2 Study methods and criteria

The Biodiversity Assessment Method

As the Proposal is SSI and is being assessed under Division 5.2 of the EP&A Act, a BDAR is required under the BC Act. The preparation of a BDAR has a standardised methodology called the Biodiversity Assessment Method (BAM), which provides:

- A consistent method for the assessment of biodiversity on a proposed development
- Guidance on how potential biodiversity impacts can be avoided and minimised

- The number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity. Ecosystem-credits represent threatened species that can be predicted to be present by the type and condition of vegetation. Species-credits pertain to threatened species that cannot be predicted by the vegetation present.

Desktop assessment

Desktop research was undertaken prior to the commencement of field survey and included database searches and reviews of relevant literature to determine the species in which targeted surveys were required. The following databases and resources were investigated:

- BAM Calculator (OEH, 2017a)
- The NSW Office of Environment and Heritage BioNet Vegetation Classification (formerly known as the NSW Vegetation Information System Classification Database) (OEH, 2017b)
- The NSW Office of Environment and Heritage Threatened Biodiversity Data Collection (formerly known as the Threatened Species Profile Database) (OEH, 2019a)
- The NSW Office of Environment and Heritage BioNet Atlas of NSW (formerly known as the NSW Wildlife Atlas) (OEH, 2019b)
- The Department of the Environment and Energy (DoEE) Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) (DoEE, 2019)
- Relevant published literature
- Previous ecological studies within the Proposal area and wider locality including:
  - Ecological assessment for the Newcastle Gas Storage Facility project (Ecological, 2011)
  - Tomago Aluminium Company Master Plan (Kleinfelder, 2013).
  - Port Stephens Comprehensive Koala Plan of Management (CKPoM) (Port Stephens Council, 2002)
  - The Lower Hunter Regional Strategy (DoP, 2006)

Credit species

A list of likely ecosystem-credit and species-credit species relating to the Proposal was generated from the BAM calculator based on known landscape and habitat features of the development footprint. Thirty ecosystem-credit species and 53 species-credit species were identified for further assessment. Some species are both ecosystem-credit and species-credit species.

Field surveys

Field surveys were undertaken between 14 August 2018 and 29 March 2019. The field surveys were undertaken in accordance with the following guidelines:

- Biodiversity Assessment Method (OEH, 2007b)
- NSW Guide to Surveying Threatened Plants (OEH, 2016)
- Threatened Species Survey and Assessment: Guidelines for developments and activities (DEC 2004)
- Flora and Fauna Survey Guidelines Version (LWCC, 2012)

The field surveys were undertaken in the following areas and shown in Figure 6.2.1:

- 'Proposal area': Lot 2, 3 and 4 DP 1043561, Lot 1203 DP 1229590, Lot 1202 DP 1229590 and Lot 202 DP 1173564, Tomago NSW
- 'Development footprint: the area to be directly impacted due to the proposed development

The methodologies of the field survey are summarised in the following sections and detailed in Appendix D.

Vegetation communities and zones

Vegetation community surveys occurred over five survey period and consisted of plant community type (PCT) identification and assessment of condition, vegetation mapping and identification of EECs.

Plant community types and their conditions were identified via 12 plots across the study area, typically set out in 20m x 20m plots. The condition of each PCT was determined by the following attributes:

- Number of large trees
- Tree regeneration (presence/absence)
- Tree stem size class (presence/absence)
- Total length of fallen logs
- Litter cover
- High threat exotic vegetation cover (i.e. weeds)
- Hollow-bearing trees

Across the whole study area, PCTs were assigned to the vegetation based on the BioNet Vegetation Classification database (OEH, 2017). Within the development footprint, the vegetation was further spilt into zones based on the relevant PCT and condition. The extent of each PCT (over the whole study area) and zone (within the development footprint) was assessed by a combination of rapid data points and walking transects.

Endangered ecological communities, as defined in NSW and Commonwealth legislation, were also identified if present.

Threatened flora

Based on the desktop assessment and specific habitat requirements, 29 threatened flora species were identified to be targeted in field surveys, these species are listed in Table 6.2.3.

Table 6.2.3 Threatened flora targeted in field surveys

Scientific name	Common name	BC Act	EPBC Act
Angophora inopina	Charmhaven Apple	V	V
Asperula asthenes	Trailing Woodruff	V	V
Callistemon linearifolius	Netted Bottle Brush	V	Not listed
Commersonia prostrata	Dwarf Kerrawang	E	E
Corybas dowlingii	Red Helmet Orchid	E	Not listed
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V
Cynanchum elegans	White-flowered Wax Plant	E	E
Dendrobium melaleucaphilum	Spider Orchid	E	Not listed
Diuris arenaria	Sand Doubletail	E	No listed
Diuris flavescens	Pale Yellow Doubletail	CE	CE
Diuris praecox	Rough Doubletail	V	V
Eucalyptus camfieldii	Camfield's Stringybark	V	V
Eucalyptus glaucina	Slaty Red Gum	V	V
Eucalyptus parramattensis subsp. *decadens*	Earp’s Gum	V	V
Grevillea guthrieana	Guthrie's Grevillea	E	E
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V
Hakea archaeoides	Big Nellie Hakea	V	V

Scientific name	Common name	BC Act	EPBC Act
Lindernia alsinoides	Noah's False Chickweed	E	Not listed
Maundia triglochinoides	-	V	Not listed
Melaleuca biconvexa	Biconvex Paperbark	V	V
Melaleuca groveana	Grove's Paperbark	V	Not listed
Persicaria elatior	Tall Knotweed	V	V
Pomaderris queenslandica	Scant Pomaderris	E	Not listed
Prostanthera densa	Villous Mint-bush	V	V
Prostanthera cineolifera	Singleton Mint Bush	V	V
Pterostylis chaetophora	-	V	Not listed
Rhizanthella slateri	Eastern Australian Underground Orchid	V	E
Rutidosis heterogama	Heath Wrinklewort	V	V
Tetratheca juncea	Black-eyed Susan	V	V
Thesium australe	Austral Toadflax	V	V

V= Vulnerable, E= Endangered, CE = Critically Endangered

Targeted threatened flora species searches were undertaken in five survey periods from winter 2018 to summer 2019. Surveys for Netted Bottle Brush, Red Helmet Orchid, Small-flower Grevillea and Black-eyed Susan were undertaken partially outside their recommended survey periods. However, as the surveys were undertaken close to the recommended survey times and that the species are above ground, these species would have been detectable at the time of surveys.

Surveys were undertaken by systematic parallel transects and in accordance with the NSW Guide to Surveying Threatened Plants (OEH, 2016). Parallel field traverses were separated by 5 to 10m for orchids, herbs and forbs, 10 to 15m for sub-shrubs, and 10 to 20m for species in all other life forms (shrubs and trees).

Threatened fauna

Based on the desktop assessment and specific habitat requirements, 16 threatened fauna species were targeted as part of field surveys. These species are listed in Table 6.2.4.

Table 6.2.4 Threatened fauna targeted in field surveys

Scientific name	Common name	BC Act	EPBC Act
Amphibians			
Crinia tinnula	Wallum Froglet	V	Not listed
Litoria brevipalmata	Green-thighed Frog	V	Not listed
Uperoleia mahonyi	Mahony's Toadlet	E	Not listed
Litoria aurea	Green and Golden Bell Frog	E	V
Litoria littlejohni	Littlejohn’s Tree Frog	V	V
Mixophyes iteratus	Giant Barred Frog	E	E
Mixophyes balbus	Stuttering Frog	E	V
Birds			
Haliaeetus leucogaster (Breeding)	White-bellied Sea-Eagle	V	Not listed
Hieraaetus morphnoides (Breeding)	Little Eagle	V	Not listed

Scientific name	Common name	BC Act	EPBC Act
Lophoictinia isura (Breeding)	Square-tailed Kite	V	Not listed
Pandion cristatus (Breeding)	Eastern Osprey	V	Not listed
Mammals*			
Myotis macropus	Southern Myotis	V	Not listed
Petaurus norfolcensis	Squirrel Glider	V	Not listed
Phascogale tapoatafa	Brush-tailed Phascogale	V	Not listed
Phascolarctos cinereus	Koala	V	V
Pteropus poliocephalus	Grey-headed Flying-fox	V	V

V= Vulnerable, E= Endangered, CE = Critically Endangered

Fauna field surveys occurred over three survey periods and consisted of various survey techniques for arboreal and terrestrial mammals, amphibians, birds and bat species.

Arboreal mammals were surveyed through the installation of 16 remote trigger cameras baited with food. Cameras installed were active onsite for 25 nights during the survey period. Spotlighting surveys were also conducted on three nights using high-powered torches to search for all types of nocturnal fauna.

Historical records of the Koala (*Phascolarctos cinereus*) occur on and within 1km of the study area. Therefore, the species was assumed to be present and targeted surveys were not undertaken. Rather, an assessment of Koala habitat was undertaken in accordance with the Port Stephens CKPoM. This habitat assessment is detailed in the following section.

Small terrestrial mammals were surveyed through the installation of 100 ‘Elliott A traps’ bated with food. The traps were placed on the ground, along four transects (25 traps along each transect) for a period of four days. Additionally, opportunistic spotlighting and daytime observations of the signs of recent activity (i.e. diggings, droppings and scratch marks) were noted.

Amphibian surveys were carried out at four areas within the Proposal area over three nights. Nocturnal surveys involved quiet listening periods where species were identified through species-specific calls. Spotlighting surveys were also conducted in emergent vegetation.

Dawn visual and auditory bird surveys were conducted throughout the study area over eight mornings. Waterbird surveys were also conducted at the one waterbody within the study area. Call playback was conducted for the identification of large forest owls over eight nights.

Microchiropteran (micro) bat species were surveyed through the use of Anabat^{TM} bat-call detectors. Five Anabats^{TM} were set up in different locations and passively recorded passing micro bats over two nights. Spotlighting surveys were conducted on blossoming trees to detect Megachiropteran (large) bats and their camps (i.e. Grey-headed Flying-fox).

Habitat

Habitat assessments were conducted to describe the variety of native fauna to occur in the study area. Particular attention was paid to the habitat features and requirements important for the threatened species identified for further assessment (i.e. field surveys). These habitat features include:

- Vegetation connectivity, age, disturbance and PCT
- Foraging habitat and shelters including rocks, logs, peeling bark and leaf litter
- Presence of feed trees
- Presence of hollow bearing trees (living and dead trees)
- Nests
- Wetlands and water resources

Koala habitat

Koala habitat was assessed in accordance with the Port Stephens CKPoM. The assessment involved reviewing the existing CKPoM Koala Habitat Planning Map to identify if the Proposal area is within mapped Koala habitat. Following the vegetation field survey, the Koala habitat mapping for the study area was revised to identify preferred and supplementary Koala habitat with buffers. Preferred habitat was identified as areas that have preferentially utilised eucalypt species, including *Eucalyptus robusta, Eucalyptus tereticornis* and *Eucalyptus parramattensis*.

The potential impacts of the Proposal were assessed against the eight performance criteria in Appendix 4 of the CKPoM. These criteria focus on vegetation removal, rehabilitation, movement corridors and other threats (i.e. dog attacks, vehicle collisions).

Hunter Estuary Wetland Ramsar site

The Proposal is near the Hunter Estuary Wetland Ramsar site.

As a requirement of the supplementary SEARS (refer to Section 1.5), an assessment of the physico-chemical status of the wetland and the habitat or lifecycle of native species dependent on the wetland has been undertaken. The following guidelines and resources were investigated as part of the assessment:

- Matters of National Environmental Significance Significant impact guidelines 1.1 (DoE, 2013)
- Draft referral guidelines for 14 migratory bird species listed under the EPBC Act (DoE, 2015)
- EPBC Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE, 2017)
- Ecological Character Description of the Kooragang component of the Hunter Estuary Wetlands Ramsar Site (Brereton and Taylor-Wood, 2010)
- Kooragang Nature Reserve and Hexham Swamp Nature Reserve Plan of Management (NPWS, 1998)
- Assessments supporting this EIS, including:
  - Surface Water and Hydrology Assessment report (refer to Section 6.3)
  - Groundwater Assessment report (refer to Section 6.4)
  - Soils and Contamination Specialist Study (refer to Section 6.6)

6.2.3 Potential impacts

Direct impacts

Direct impacts of the Proposal are mostly related to vegetation removal and habitat removal during construction.

Vegetation removal

The Proposal is expected to impact all native vegetation within the development footprint during the construction phase, excluding the HDD pipe alignment. The Proposal would result in the removal of 15.5 ha of native vegetation within the development footprint, this includes:

- About 15.1 ha of PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (zones 1, 2 and 3)
  - Including about 1.9 ha of the Lower Hunter Spotted Gum – Ironbark Forest EEC (zone 2)
- About 0.4 ha of PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (zones 4, 5 and 6)

Native vegetation removal would result in the direct removal of flora species (i.e. whole plants) and flora and fauna habitat. About two thirds (11.1 ha) of the vegetation removal would occur in low quality (zone 3) or managed vegetation (zone 4 and 5). These areas are highly disturbed, mostly cleared of canopy trees and containing many weed species. Impacts in these areas would be lesser than in zones 1, 2 and 6 which comprise of moderate to good quality vegetation. The removal of vegetation would remove foraging, breeding, roosting, sheltering and dispersal habitat for various fauna species. It would also remove specific habitat features including between four and nine hollow bearing trees (including two dead stags) and additional fallen timber and rocks. The clearing would include the removal of three *Eucalyptus parramattensis* subsp. *decadens* (Earp's Gum) trees.

During vegetation removal, there is potential for the accidental incursions into threatened flora species which are adjacent to the Proposal area including *Grevillea parviflora* subsp*. parviflora* and *Eucalyptus parramattensis* subsp*. decadens*.

Vegetation clearing and habitat loss that cannot be avoided, is likely to result in permanent impacts to threatened biodiversity values. These impacts would be offset in accordance with the BAM with ecosystem-credits (refer to Section 6.2.4).

Indirect impacts

The Proposal has the potential for various indirect biodiversity impacts such as impacts to habitat connectivity, fauna vehicle strikes, aquatic habitat degradation, increased noise, vibration and light spill, increased weed invasion and the spread of pest species.

Habitat connectivity

The removal of vegetation, particularly along the transmission line corridor (about 30m wide) in the eastern part of the Proposal area, would modify part of the wildlife corridor that provides a linkage to the Tilligerry State Conservation Area. This may result in 'barrier effects' which occur where particular species are either unable or are unwilling to move between suitable areas of habitat due to the imposition of a barrier. This can include a habitat type (i.e. a cleared area) that has become unsuitable or a physical barrier such as a fence. Species most vulnerable to barrier effects include uncommon species, smaller ground-dwelling species, and relatively sessile species with smaller home ranges.

As the transmission line corridor is relatively narrow (30m width) and the majority of clearing would be in previously disturbed areas, it is considered unlikely that there would be a significant impact on fragment local fauna populations, including the Squirrel glider and Koala.

Vehicle strikes and injury

During construction and operation, there is the potential for the increase of vehicle strikes and injury on fauna due to vegetation clearing, earthworks, trenching and increased vehicle movements. To minimise vehicle strikes, a speed limit compatible with the Port Stephens CKPoM will be enforced and Koala traffic signs will be installed along the access route from Old Punt Road.

Entrapment of wildlife in utility diversions (e.g. trenches and fencing) or other excavations associated with the Proposal may also cause physical trauma to fauna. Ground dwelling species (i.e. mammals, amphibians, and reptiles) are most vulnerable of becoming entrapped while moving across modified areas in the absence of woodland or forest habitat.

Impacts to fauna species would be permanent where mortality to the species occurs, or temporary where the species is rehabilitated and re-released.

Water quality

During construction, ground disturbing activities (i.e. vegetation removal and earthworks) as well as leaks and spills from vehicles, plant and equipment has the potential to impact water quality of the on site ephemeral waterways and downstream habitats due to sedimentation, erosion and pollution. This could result in decreased light levels for submerged aquatic vegetation and smothering of benthic organisms.

Underboring (HDD) of part of the gas storage pipeline has been chosen to minimise impacts to waterways, vegetation and soils due to the limited surface disturbance compared to trenching. The HDD launch and receive pits would be positioned in previously disturbed areas to minimise surface impacts. However, there is a potential for groundwater intersection and a potential for indirect impact from the inadvertent return of bentonite drilling slurry, or the discharge of drilling fluid. The discharge of drilling fluid occurs when drilling slurry is released through underlying fractures into the surrounding strata and travels toward the surface. Drilling slurry may impact on aquatic flora and fauna, covering these with a fine layer of bentonite clay and reducing their viability. The risk of discharge of drilling fluid and response protocols would be detailed in the CEMP.

The Proposal is located on acid sulphate soils (ASS), which, when excavated, the sulphides in the soil react with oxygen, forming sulfuric acid which is toxic to flora and fauna and can pollute waterways. Highly acidic soils and waterways can kill flora and fauna species and lower levels can make species vulnerable to disease. For more details on the potential impacts of ASS refer to Section 6.6.3.

Impacts to water quality and the subsequent impact on biodiversity is expected to be minor with the implementation of safeguards. Sections 6.3, 6.4 and 6.6 provide further details on impacts and mitigation measures relating to water quality.

Edge effects

The Proposal has the potential to increase edge effects on the adjoining vegetation due to clearing and other disturbing activities during both construction and operation. Edge effects refer to the changes in environmental conditions (e.g. altered light levels, wind speed, temperature) that occur along the edges of habitats. These new environmental conditions along the habitat edges can promote the growth of different vegetation types (including weed species), promote invasion by pest animals specialising in edge habitats, or change the behaviour of resident native animals.

Increased noise, vibration and light spill, generated from plant and equipment, would be received into adjacent environments (e.g. fauna habitat) during construction and operation. Noise and vibration may force the relocation of species and disturb breeding behaviours. Light spill has the potential to increase the susceptibility of predation by increasing visibility and also may alter foraging and habituation. Noise, vibration and light impacts would be greater during construction phases. These impacts would continue perpetually during operation, however would be minor and localised.

Weeds invasion and pest species

Proliferation of weed and pest species has the potential to occur during construction and operation due to vegetation removal, vehicle movements and increased edge effects. Weed and pest species have the potential to impact on terrestrial biodiversity as native species can become displaced through predation and competition. Pest species (i.e. dogs, rabbits, cats) can also damage native vegetation by grazing and trampling.

Within the Proposal area, there are 12 high threat weeds, four priority weeds in the Hunter Region and three weeds of national significance. Without appropriate management strategies, the Proposal has the potential to disperse weeds into areas of remnant vegetation where weed species are currently limited or occur in low densities.

The effects of proliferation of weed and pest species may not be noticeable immediately or even in the short-term, as visible signs may take several months or seasons to impact on ecological receptors. These potential impacts are likely to be long-term and affect all ecological receptors near the Proposal area, including affecting the quality and integrity of EEC, remnant vegetation and fauna habitat. Long term management of weeds and pest species within the Proposal area would be implemented.

Serious and irreversible impacts

The Proposal is unlikely to have 'serious and irreversible impacts' in accordance with the principles are set out in clause 6.7 of the *Biodiversity Conservation Regulation 2017*.

Hunter Estuary Wetland Ramsar site

Without the implementation of mitigation measures, the Proposal has the potential to cause various impacts to the physico-chemical status of the wetland and the habitat and lifecycle of native species dependent on the wetland. These potential impacts are primarily associated with changes in surface and groundwater movements, contamination and noise. The potential impacts specific to the wetlands are described below and further details of the surface water, groundwater, contamination and noise are provided in Sections 6.3, 6.4, 6.6 and 6.9 respectively.

Surface water runoff and groundwater movements have the potential to impact the mangrove and saltmarsh vegetation communities in the wetland. Impacts may result from changes to water movements and balances of fresh and saltwater due to new influxes or diverted water sources. Impacts to the vegetation communities would consequently impact important foraging and roosting habitat, and therefore lifecycles of migratory shorebirds.

Changes to surface water and hydrology from changes in stormwater runoff discharge patterns is expected to be minor. Given the relative size of the development footprint compared to the total catchment area of the Hunter River (around 22,000km^2), it is expected that there would be negligible impact on the hydraulic behaviour of the Hunter River and associated wetlands. Impacts to surface water during both construction and operation would be either be removed from site for processing at a licensed facility or treated to meet discharge criteria and discharged offsite as clean stormwater.

Groundwater flows near the Proposal generally head northwest towards the Hunter River, therefore groundwater is not expected to flow directly towards the wetlands. Groundwater may be intercepted during excavation and trenching particularly for storage pipelines, due to the shallow groundwater table. There is a higher potential of encountering groundwater along the proposed gas storage pipelines compared to the NPS site and electricity transmission line, due to the lower topography. Potential impacts and mitigation measures to groundwater is discussed further in Section 6.4.

The assessment of the wetland (refer to Appendix D) concluded that, with the implementation of the mitigation measures identified in this EIS, the Proposal is unlikely to have a significant impact on the wetland or the species that use it.

Noise impacts

Noise generated during construction and operation has the potential to impact species, particularly birds, by changing behavioural patterns including feeding, breeding and choice of habitat. During construction, noise generated from increased traffic and use of plant is not expected to impact species utilising the wetlands due to the distance from the Proposal as well as the intervening developments. The intervening developments are expected to act as buffers sufficient to attenuate noise levels to a degree that is minor or insignificant in comparison to ambient levels.

Noise levels during operation are expected to be no more than (similar or less than) levels from other industrial premises in the area. The distance and the existing industrial operations between the Ramsar site and the Proposal would mean the Proposal would not be audible from the Ramsar site during construction or operation and would not be expected to impact species utilising the wetlands. For further details on noise impacts, refer to Section 6.9.

Cumulative impacts

The Proposal would result in the removal of 15.51 ha of vegetation, the majority of which is PCT 1590- Low Condition with minimal canopy and mid-storey layers, but also includes a smaller area identified as potential habitat for threatened species Squirrel Glider and Koala. The removal of vegetation is unlikely to impact connectivity to the nearby Tilligerry State Conservation Area.

Other projects in the vicinity of the Proposal that have been submitted for approval or determined are located within or adjoining the existing Tomago industrial estate and the Kooragang Industrial area. These projects would not result in large areas of vegetation removal. As such, there is not anticipated to be a cumulative impact in regard to vegetation removal or removal of threatened species habitat.

However, there is the potential for indirect impacts to ecosystems and threatened species that inhabit the Hunter River and the Hunter Estuary Wetland Ramsar Site. Due to the distance of the Proposal from the wetland area and the implementation of water quality controls, there are anticipated to be negligible impacts to water quality in the region and would not significantly contribute to cumulative impacts in the area.

The BDAR concluded that there were no serious and irreversible impacts from the Proposal and cumulative impacts with other projects would not have a significant impact to cumulative impacts on biodiversity in the region.

6.2.4 Avoidance, mitigation and management

Avoidance through design

A number of potential sites within the Tomago area were investigated for the development of the Proposal. The potential sites were assessed against environmental, infrastructure, economic, engineering, stakeholder, and land use constraints and opportunities. The Proposal area was selected because it was best suited against the criteria for a power station and its ancillary infrastructure needs, while minimising the potential for environmental and social impacts.

AGL has worked with ecological specialists to select areas for development within the Proposal area that would minimise biodiversity impacts. This includes locating the proposed electrical transmission corridor and gas pipeline in areas that have been previously disturbed and are predominantly cleared, or which contain lower quality native vegetation. Additionally, the selection of HDD for part of the storage pipeline would minimise impacts to the ephemeral drainage line within the Proposal area.

Offsets

Under the requirements of the BAM, the Proposal would require both ecosystem-credit and species-credit offsets. The ecosystem-credit offsets provide offsetting for the impacts on vegetation removal. Higher quality vegetation required more offsets than lower quality vegetation. Species-credit offsets provide offsetting for the impacts on specific threatened species that are known to be present in the development footprint. A summary of the credits required are provided in Table 6.2.5 and Table 6.2.6 and are detailed in Appendix D.

Table 6.2.5 Summary of ecosystem-credits required for the Proposal

Vegetation zone	Vegetation zone description	Area (ha)	Ecosystem Credits required
1	PCT 1590: Moderate/Good	2.4	55
2	PCT 1590: Mod/Good/EEC	1.9	65
3	PCT 1590: Low	10.8	96
		Total credits for PCT 1590	**216**
4	PCT 1646: Managed	0.10	1
5	PCT 1646: Managed Powerline	0.20	3
6	PCT 1646: Rehabilitation	0.10	4
		Total credits for PCT 1646	**8**
		Total ecosystem-credits	**224**

Table 6.2.6 Summary of species-credits required for the Proposal

Species name	Vegetation zone	Vegetation zone description	Area (ha)	Species-credits required
Squirrel Glider	1	PCT 1590: Moderate/Good	2.39	73
	2	PCT 1590: Mod/Good/EEC	1.91	65
	4	PCT 1646: Managed	0.05	1
	6	PCT 1646: Rehabilitation	0.13	5
		Total credits for PCT 1590 Squirrel glider		**144**
Koala	4	PCT 1646: Managed	0.05	1
	6	PCT 1646: Rehabilitation	0.13	5
	Total credits for PCT 1590 Koala			**6**
Eucalyptus parramattensis subsp. *decadens*	6	PCT 1646: Rehabilitation	3	6
	Total credits for Eucalyptus parramattensis subsp. *decadens*			**6**
		Total species-credits		**156**

Impacts not requiring offsets

Offset requirements for other threatened species present within the study area was assessed according to OEH 2017, as detailed in Appendix D. Potential indirect impacts to these species has been considered in Section 6.2.3.

Mitigation and management

A range of avoidance, mitigation and management measures would be implemented for biodiversity as outlined in Table 6.2.7.

Table 6.2.7 Avoidance, mitigation and management - Biodiversity

ID	Environmental Safeguard	Timing
B-1	A Biodiversity Management Plan would be prepared as part of the CEMP and implemented throughout construction. The Plan would include, but not be limited to: ■ Plans showing areas to be cleared and areas to be protected, including exclusion zones, appropriate signage, protected habitat features and revegetation areas, vehicle and equipment parking areas, and stockpile areas ■ Site inductions ■ Location of threatened biodiversity ■ Pre-clearing survey requirements ■ Vegetation clearing procedures ■ Procedures for unexpected threatened species finds and fauna handling ■ Protocols to manage weeds and pathogens including a Plan of Management for the control of weeds, according to requirements under the NSW Biosecurity Act 2015 ■ Protocols for soil and seed material to minimise transfer between sites	Pre-construction Construction

<table>
<tr><th>ID</th><th>Environmental Safeguard</th><th>Timing</th></tr>
<tr><td></td><td>Restriction of public access and associated impacts from domestic pets, waste dumping and damage to adjoining vegetation should be enforced pre, during and post construction
Reduction in lighting levels at access road to avoid any adverse effects upon the essential behavioural patterns of light-sensitive fauna, in accordance with AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting
Noise management practices
Dust control measures</td><td></td></tr>
<tr><td>B-2</td><td>Detailed design would consider areas identified in the Biodiversity Development Assessment Report (BDAR) that host threatened species and communities and limits the intrusion of the Proposal into those areas.</td><td>Pre-construction
Construction</td></tr>
<tr><td>B-3</td><td>Limit removal of trees to that required within the development footprint and reinstate logs and rocks, which are removed for pipeline construction, along the right of ways or relocate them to appropriate nearby habitats.
A pre-clearing protocol would be implemented during clearing works, as follows:
Pre-clearance surveys would be undertaken to determine if any inhabiting fauna are present
A suitably qualified and trained fauna handler would be present during hollow-bearing tree clearing to rescue and relocate displaced fauna
Appropriate exclusion fencing around trees and woodland that are to be retained within the development footprint would be erected, considering allowance for Tree Protection zones in accordance with the Australian Standards</td><td>Pre-construction
Construction</td></tr>
<tr><td>B-4</td><td>Koala traffic signs would be installed along the access route from Old Punt Road.</td><td>Construction
Operation</td></tr>
<tr><td>B-5</td><td>Any fencing required around proposed easements (not including fencing erected for safety of operation purposes) would have a Koala-friendly design, with a 20cm gap at the bottom to allow the movement of Koalas and other terrestrial fauna.</td><td>Construction
Operation</td></tr>
<tr><td>B-6</td><td>A Biodiversity Offset Strategy would be prepared for the project.</td><td>Construction</td></tr>
<tr><td>B-7</td><td>Weed infestations within the construction footprint would be identified and mapped prior to construction.</td><td>Pre-construction</td></tr>
<tr><td>B-8</td><td>Appropriate wheel wash and hygiene procedures would be implemented to limit construction plant and vehicles spreading weed seeds, vegetation debris and loose soil to and from the Proposal area.</td><td>Construction</td></tr>
<tr><td>B-9</td><td>Weed controls would be monitored regularly to promote the rehabilitation of revegetated areas within the Proposal area. Supplementary active revegetation would be undertaken as required.</td><td>Operation</td></tr>
<tr><td>B-10</td><td>Open sections of trenches would be monitored as required for trapped animals such as small ground dwelling mammals.</td><td>Construction</td></tr>
</table>

6.3 Surface water and hydrology

An assessment of potential surface water and hydrological impacts was prepared by Aurecon Australasia Pty Ltd addressing impacts associated with the construction and operation of the Proposal. A Surface Water and Hydrology Assessment report (SWHA) is provided as Appendix E.

6.3.1 Existing environment

Water supply, use and infrastructure

The Lower Hunter Water Plan (LHWP) was released in 2014 and sets out the NSW Government's water strategy for the region. The Lower Hunter's water supplies are very reliable under typical climatic conditions but are vulnerable to drought (DFS, 2017). The focus of the LHWP is to deliver a mix of supply and demand measures to meet objectives, which include providing water security during drought and ensuring water supplies meet growing demands. HWC is the major utility responsible for supplying drinking water to the region and for treating and disposing of wastewater. Investigations and supply-demand modelling indicated that HWC's supply system could meet new growth for around 20 years, with secure supply until 2037/38 (DPI – Water, 2014).

The main water supplies in the Lower Hunter are the Chichester Dam and Grahamstown Dam, together with groundwater from the Tomago and Tomaree Sandbeds. The water storages in the lower Hunter have the capacity to store 276 billion litres of water (276GL), to manage supply in drought periods (DPI – Water, 2014). The Lower Hunter's water demand is currently around 67GL/a, with demand forecast to increase to 74.5GL/a in 2035/36. Non-Residential demand in 2016/17 was 18.8GL (DFS, 2017).

Whilst the power station would be constructed outside of the Tomago Sandbeds catchment area, the proposed storage pipeline and electricity transmission line corridors would overlie the south-western fringe of the catchment area. The Tomago Sandbeds are a natural groundwater sand aquifer which is recharged by rainfall infiltration through the permeable sandbeds. HWC extracts groundwater from this aquifer to supplement potable water supply for the Newcastle region, and the sandbeds form an important component of drought response in the Lower Hunter region. A media release from HWC on 20 May 2019 indicated that HWC would begin to draw water from the Tomago Sandbeds from June 2019 to provide additional security for the region's dams, which have fallen to their lowest levels in 13 years (HWC, 2019x)

There is an existing HWC pipeline along Old Punt Road, however, this network does not currently extend into the Proposal area including Lot 3 where the NPS would be developed. Potable water supply is available from Grahamstown Water Treatment Plant, with water supplied from either Grahamstown Dam or the Tomago Borefields (within the Tomago Sandbeds).

The Proposal area (and the wider Tomago area) is not currently serviced by the existing HWC sewer network. The nearest wastewater infrastructure includes sewage pump stations in Heatherbrae and the Raymond Terrace Wastewater Treatment Works which has recently expanded its capacity. A private sewer scheme services the industrial area to the south of the Proposal by way of a pump out system that operates under a Trade Waste Agreement with HWC.

Regional context

The Proposal area is adjacent to the Hunter River, an estuarine river which comprises a major low-land meandering waterway approximately 500m west/north-west of the Proposal area boundary and flows south before turning east and eventually discharging to the Tasman Sea through the Newcastle Port (Figure 6.3.1). A tributary to the Hunter River is located approximately 150m west/north-west of the western Proposal area boundary from where it flows west and discharges into the Hunter River. The tidal limit of the river is 40km upstream of the Proposal area, and regular flushing on incoming tides creates a relatively stable saline environment of around 35 parts per thousand (ppt) (Swanson et al., 2017).

The upper reaches of the Hunter River catchment are predominantly cleared for rural activities, while other areas of the catchment consist of mining, industrial and urban developments. The Proposal area is within the lower-mid estuary zone in the Lower Hunter River, which is considered highly modified, heavily urbanised and industrialised. The surface water and hydrology assessment identified several of the adjacent industrial sites, immediate south of the Proposal, as potential existing sources of contaminants.

While there are no protected wetlands in the Proposal area, there are multiple important wetlands close to the Proposal area, including the Ramsar-listed Hunter Estuary Wetlands. The Kooragang Nature Reserve was listed under the Ramsar convention in 1984, with the Hunter Wetlands Centre added in 2002 (Figure 6.3.1). The Kooragang component of the Hunter Estuary Wetland contains five Ramsar wetland types, and meets Ramsar Criteria 2, 4, and 6. It is located 2.2km south of the Proposal area. The Kooragang Nature Reserve and Hexham Swamp Nature Reserve became the expansive Hunter Wetlands National Park in 2007. The closest Important Wetland (SEPP Coastal Wetland) is located 450m to the north-west of the Proposal area and borders the edge of the Hunter River.

A small portion of the Port Stephens LEP wetlands is located within the Proposal area (but outside of the development footprint) (Figure 6.3.2). Some of the LEP wetland areas located within the Tomago Industrial Precinct have been subdivided and developed into industrial facilities.

Climate

Tomago is positioned within a temperate climatic region characterised by mild to warm summers and moderately cool winters. The Bureau of Meteorology (BoM) climate data indicates a prevalent ‘wet’ (January-June) and ‘dry’ (July-December) season, with March being the wettest month receiving on average 132mm of rainfall. The average annual rainfall is 1067mm. Average local rainfall and pan evaporation rates between 2009 and 2015, showed that the monthly average rainfall exceeds the evaporation rates for the period April through June, resulting in net wetting conditions. For the remainder of the year (July to March), monthly evaporation exceeds rainfall rates, resulting in net drying conditions.

The NSW Climate Impact Profile (DECCW, 2010) indicates that the climate in the Hunter Region is almost certain to become hotter year-round by 2050, with decreased rainfall in winter and increased rainfall in other seasons. Run-off and stream flow are expected to increase in summer and autumn and decrease in spring and winter. The current wetting and drying condition transitions may shift two months earlier.

Topography and drainage

The Proposal straddles a topographic ridge, sloping from a high point of 16m Australian height datum (AHD) down to 6m AHD along the southern boundary of the Proposal area where it intercepts Drainage Path 1, and 2m AHD to the north-east where it intercepts Drainage Path 2 (Figure 6.3.2).

Drainage Path 1 is an ephemeral drainage channel which flows west under the Pacific Highway via a culvert and discharges to rural land. There is no direct surficial hydraulic connection to the Hunter River or the associated tributary west of the Proposal area, however, stormwater flows may form a direct hydraulic connection during high magnitude or prolonged rainfall events. Drainage Path 1 is mapped as flowing through LEP Wetlands. Some of the LEP wetland areas located within the Tomago Industrial Precinct have been subdivided and developed into industrial facilities, including much of the area through which Drainage Path 1 flows.

Along its course, Drainage Path 1 is intersected by two secondary drains (Figure 6.3.2). The first secondary drain appears to be connected to the industrial estate’s existing stormwater drainage system, running southwards and discharging into a saturated area in a parcel of land between the LEP Wetlands and Tomago Road. The second secondary drainage to Drainage Path 1 is aligned southwards adjacent to the Pacific Highway and industrial estate, discharging into a small vegetated LEP Wetland pond approximately 500m downstream.

Drainage Path 2 is a suspected ephemeral drainage creek which flows towards the Hunter River. A small portion of the runoff from the proposed NPS site would currently feed this drainage path, as would runoff from the proposed electricity transmission line area.

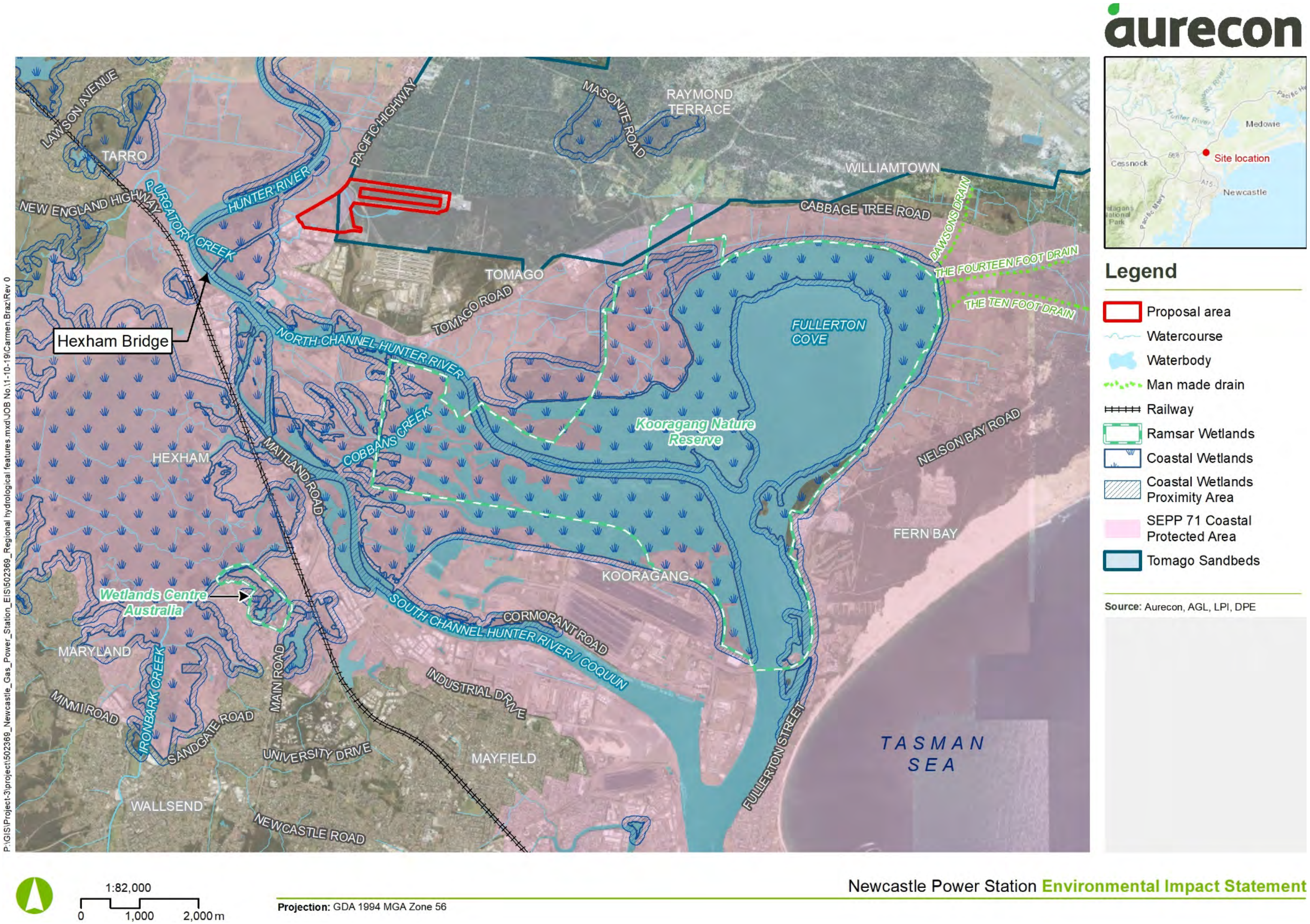

Figure 6.3.1 Regional hydrological features

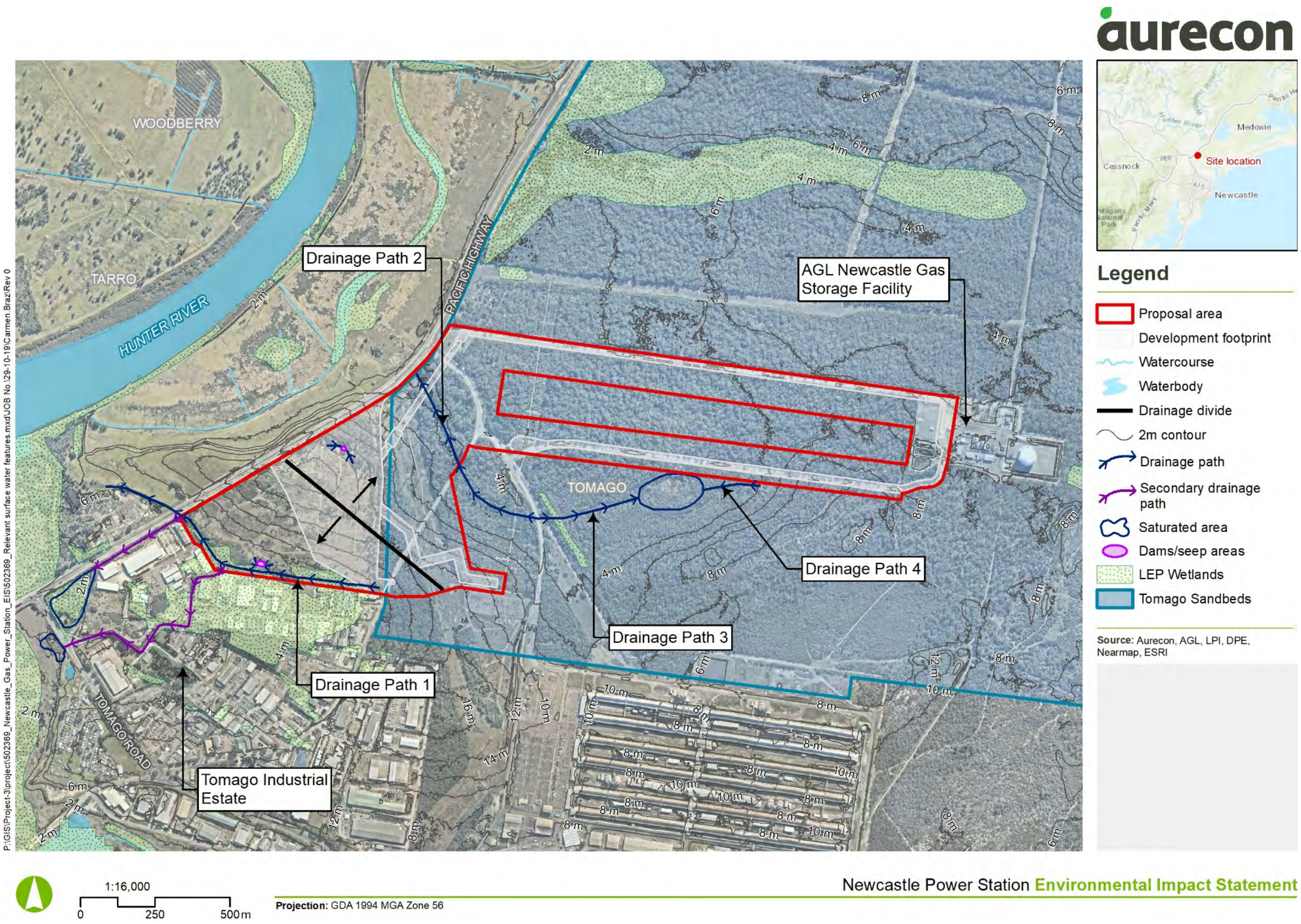

Figure 6.3.2 Topography and drainage

Runoff from the south-western section of the Proposal area would initially drain to an on site collection and seep away low-lying area which appears to have been constructed. There is an additional constructed dam in the north-west corner of the proposed NPS site (Figure 6.3.2).

In contrast to the NPS site, the topography of the proposed gas storage pipeline corridors is relatively low and flat (around 2 – 4m AHD), and cross floodway and flood storage areas. Current topographical conditions result in runoff from the north-eastern portion of the Proposal area (the gas pipeline corridors) to flow south and south-west towards Drainage Paths 2, 3 and 4.

Flooding

Historically, the main flooding risk in the region has been the Hunter River overtopping its banks and levees, with tidal inundation and excessive rainfall over the catchment (or a combination of these factors). The largest flood on record was in 1955, with a peak flood level of 4.00m AHD recorded at the Hexham bridge.

The NPS site is mostly located above the flood planning level with the southern extent bordering minimal risk flood prone land. The proposed gas storage pipelines between the NPS and the NGSF cross both high hazard floodway and high hazard flood storage areas under the Council Flood Hazard Maps (refer to Figure 6.3.3). Floodways' are areas of the floodplain where a significant discharge of water occurs during flood events and are often aligned with naturally defined channels. Flood storage areas have an important function providing temporary storage of floodwaters during the passage of a flood.

Drainage Paths 3 and 4 are outside of the Proposal area and drain inward to a low-lying saturated area south of the NGSF access road (Figure 6.3.2). If this area floods, water would spill back up into Drainage Path 2 and flow through to the Hunter River which would have swelled with flood waters.

Contamination

A Phase 1 Preliminary Environmental Site Assessment undertaken in the NPS site by Environmental Strategies (2017). Further investigation work completed by Aurecon for this EIS identified potential historic and current contaminant sources on site. These included general rubbish, minor oil stains, car bodies and car parts, storage, use of typical domestic chemicals and two septic systems. The investigation also indicated chemicals of potential concern may be present in the soil, groundwater, surface water and sediments in the Proposal area including:

- Total recoverable hydrocarbons (TRH)
- Volatile Organic Compounds (VOCs)
- CTEX (benzene, toluene, ethyl benzene, xylene)
- Polycyclic aromatic hydrocarbons (PAHs)
- Polychlorinated biphenyls (PCBs)
- Organochlorine pesticides (OCP)
- Organophosphorus pesticides (OPP)
- Naturally occurring asbestos
- Various metals
- Faecal and Total Coliforms
- E Coli

Acid sulphate soil

Most of the development footprint is classified as Class 4 (low risk of ASS above 4m beneath the surface) in the ASS Probability Map in the Port Stephens LEP. However, the north-west boundary of the Proposal area close to the Hunter River is adjacent to land classified as Class 2 (high risk ASS 0-1m beneath the surface) (Figure 6.3.4). Laboratory testing undertaken by URS in 2002 of soil samples collected across the NPS site indicated the presence of potential acid sulphate soils (PASS) at depths below 2m beneath the surface, while samples from within the upper 1m were found to be free of ASS. This was supported by additional laboratory analyses completed for this EIS of soil samples collected between 0 to 1 m, which indicate that near surface soils down to a depth of 1.0m below surface have negligible potential to generate ASS. These studies indicate that deeper soils have a high potential to contain ASS. During construction of the adjacent NGSF, some suspected ASS was encountered during trenching and excavation activities. The materials were contained, tested and treated in-situ using agricultural lime where required under a site-specific management plan, and no related incidents were encountered.

Water quality

Regional

The Hunter River has a history of industrial water pollution from untreated and unmonitored industrial discharge prior to the introduction of regulations and licencing. The OEH conducted a water quality monitoring program of the Lower Hunter River estuary between August 2014 and March 2015 (Swanson et al, 2017a) which indicated:

- Concentrations of nitrate, nitrite and phosphates typically exceeded the NSW trigger values for coastal riverine estuaries (ANZECC 2000)
- Intensive agriculture and horticulture are likely the source of elevated nitrates and phosphates in the upstream extent of the river
- Turbidity in the southern region of the lower estuary exceeded the NSW trigger values for coastal riverine estuaries (ANZECC 2000) of 2.8 to 3.5 nephelometric turbidity units (NTU), with occasional spikes of over 50 NTU following increased rainfall
- Industry is likely the primary source of elevated ammonium levels in the southern extent of the river
- Most sites near the Proposal area recorded median concentrations of chlorophyll-a below 5 micrograms per litre (µg/L) (trigger values are between 2.3 and 3.4µg/L depending on the salinity), although spikes as high as 30µg/L were recorded following periods of increased rainfall

The nearest OEH monitoring point to the Proposal area is adjacent to the Hexham bridge. Data indicated background levels of chlorophyll-a and phosphate generally exceed the ANZECC trigger values, whilst ammonia and turbidity were within acceptable ranges.

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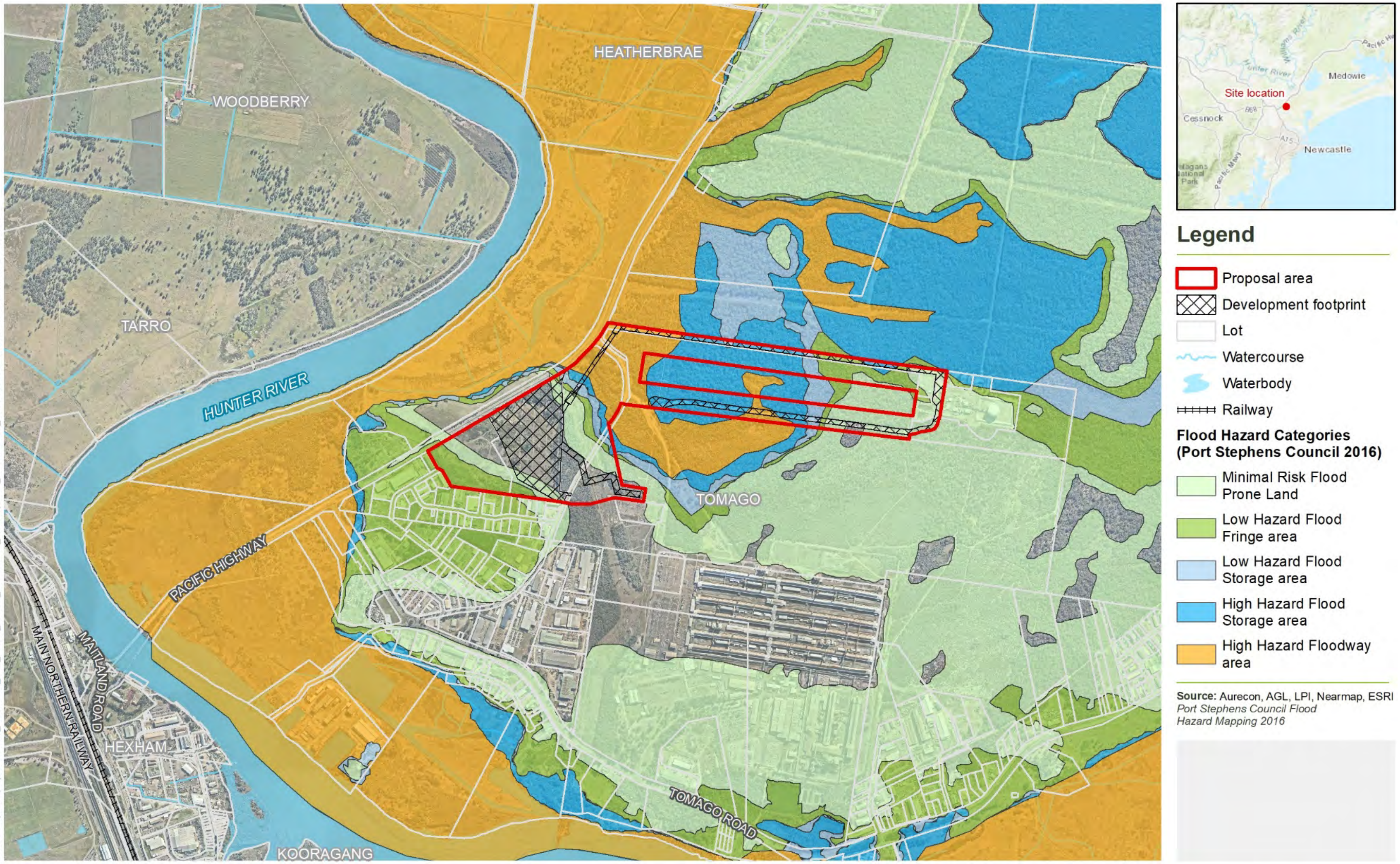

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Newcastle Power Station **Environmental Impact Statement**

Projection: GDA 1994 MGA Zone 56

Figure 6.3.3 Proposal area in the context of Council flood hazard mapping

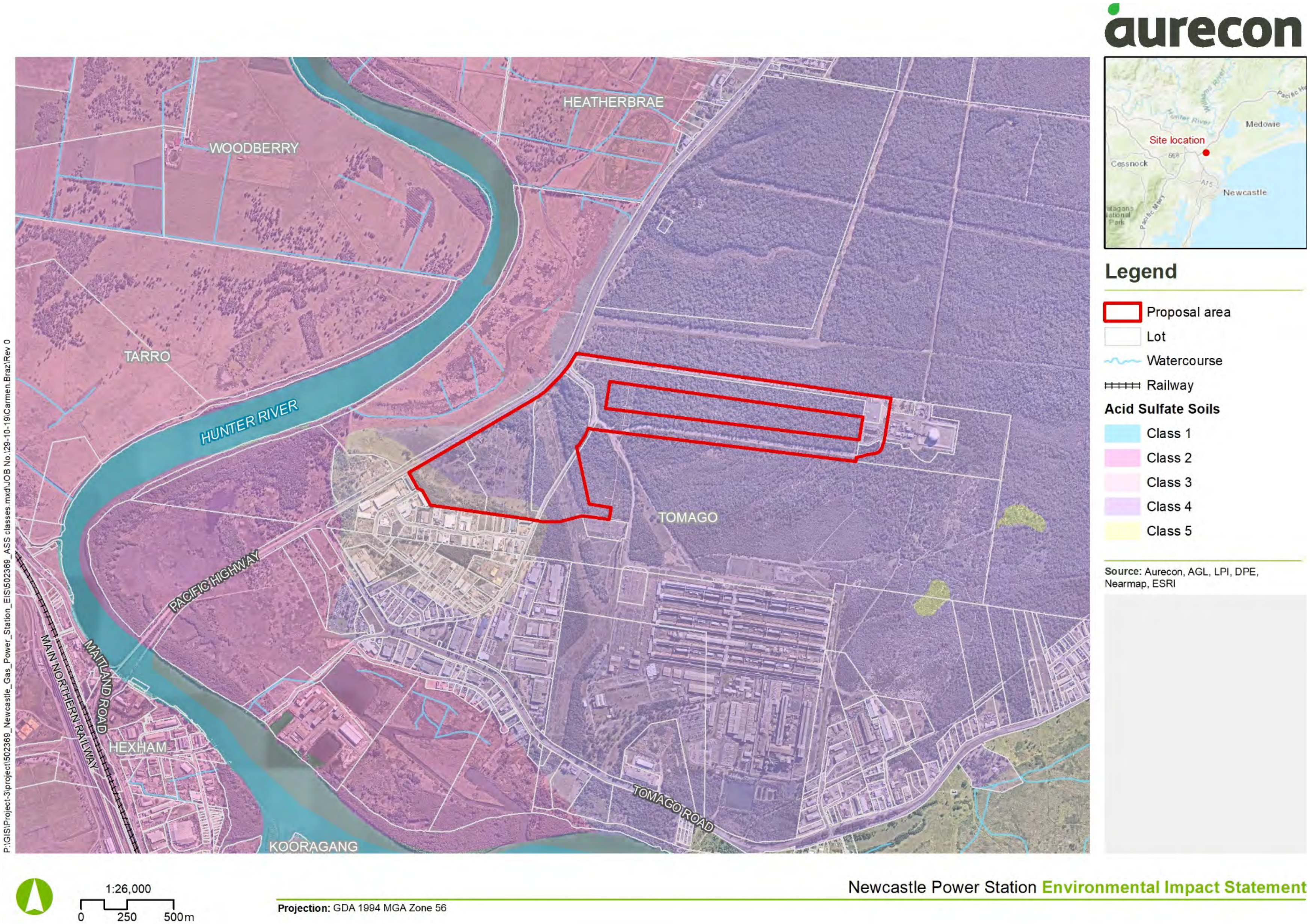


Figure 6.3.4 Proposal area and ASS risk

The OEH implemented an ‘event-based’ (i.e. after rainfall) program, sampling stormwater runoff from industrial sites and urban areas in the lower estuary (downstream of the Proposal area) to identify pollutant sources (Swanson et al. 2017b). Key findings of the program included:

- Inorganic nutrient levels (ammonium, nitrates and phosphates) were high, often exceeding NSW trigger values for coastal riverine estuaries (ANZECC 2000)
  - Peak concentrations detected following rain events were 57,600µg/L for ammonium, 3,600µg/L for nitrates, and phosphates usually below 100µg/L
  - Industrial sites (metal, chemical and fertiliser-based industries) are the major source of these nutrients to the lower estuary, with stormwater runoff delivering high concentrations to localised areas
  - Discharge from certain industrial site drains can be regarded as point source pollution
- High concentrations of dissolved zinc, copper and/or manganese were measured in urban creeks and port areas. Concentrations often approached or exceeded the ANZECC criteria for 80% protection of marine ecosystems
  - Likely sources of zinc are industrial discharges from secondary metal fabrication, handling and export of metal concentrates in port areas, and roofing in urban areas.
  - Likely sources of manganese are vehicles in urban areas, on site practices in industrial areas and contaminated landfill
  - Likely sources of copper are shipping (antifouling coatings, dispatch) and contaminated landfill
- Fine suspended material including total organic carbon (TOC) flocculates when freshwater runoff entering Throsby Creek (which meets the Hunter River near the Port of Newcastle) mixes with oceanic water

Local

Surface water quality data has been collected from six locations near the NPS site and the storage pipeline easement area (Figure 6.3.5).

In November 2015, Environmental Strategies sampled:

- SW01: The small dam located in the north-western corner of the NPS site and within an area of environmental concern (due to the presence of the dam and stockpiled material)
- SW02: A small vegetated LEP Wetland pond, located south-west of the Proposal, adjacent to the Pacific Highway, indicated as a representative “background area”

The monitoring results for SW01 and SW02 indicate lowered dissolved oxygen concentrations, likely due to these being relatively stagnant water bodies which are not connected to flowing river systems. The electrical conductivity at SW02 was also slightly elevated above the typical range of NSW coastal rivers, this was expected due to the wetland receiving local runoff from the urbanised catchment. At both locations, the measured copper, chromium, lead and zinc levels were all above the assessment criteria for 95% Level of Protection Trigger Values for Fresh Water (ANZECC, 2000).

Construction of the adjacent NGSF commenced in September 2012 and was completed in May 2015, following which the NGSF moved into the operations phase. Baseline surface water quality data was collected between June and December 2011, prior to construction of the NGSF, with an additional data collection period during construction (October to December 2012). Recent (September 2018) monitoring was completed as part of the NGSF operational Ground Water and Surface Water Monitoring Program (GHD, 2018). Monitoring points included:

- SW1 and SW2: Shallow pools of water in the eastern portion of the NGSF site when high water table conditions prevail. These pools are largely stagnant and have a close interaction with groundwater.
- SW3 and SW4: Upstream and downstream locations along Drainage Path 2 (west of the NGSF site) where stormwater (collected in wetland ponds) is discharged during operation of the NGSF. During monitoring events, these locations have been either dry or stagnant pools of water. Location SW3 is more representative of local runoff.

Dissolved oxygen, electrical conductivity, and pH were within the adopted thresholds at all locations both prior, during and post construction, apart from the conductivity at SW3 which ranged beyond the upper threshold during construction. The pH readings were generally toward the lower end of the range, particularly at SW1and SW2 (east of the NGSF), indicating acidic conditions which may be from the acid sulphate soils in the area. There was no adopted threshold for turbidity, with pre-construction readings below 40NTU and readings during construction being generally higher. Turbidity was not monitored during operations. Nitrogen and phosphorous levels were within the adopted threshold, and concentrations of metals were generally within the adopted thresholds apart from chromium at SW1 and zinc at SW2.

Records from the previous eight biannual operational sampling events at the NGSF undertaken as part of the Ground and Surface Water Monitoring Program were reviewed. The monitoring reports (GHD 2018, 2019) indicate that concentrations of water quality parameters remain within the revised adopted threshold criteria and that there is no evidence that construction and operation of the NGSF has had a significant impact on surface water (GHD, 2019).

6.3.2 Study methods and criteria

The assessment was undertaken in accordance with the following key reference documents and guidelines:

- Port Stephens Local Environment Plan (LEP), 2013
- Department of Agriculture and Water Resources – National Water Quality Management Strategy (NWQMS), 2018
- Water NSW (formerly Sydney Catchment Authority) – Neutral or Beneficial Effect on Water Quality Assessment Guideline, February 2015
- NSW DPIE – Guidelines for controlled activities on waterfront land – Riparian corridors, 2018 (ANZECC 2000)
- Landcom – Managing Urban Stormwater, Soils and Construction Volume 1, 4th Edition, 2004
- HWC – Protecting our Drinking Water Catchments - Guidelines for Development in the Drinking Water Catchments, 2017
- Institute of Engineers Australia – Australian Runoff Quality, 2006

The study method included a site inspection and survey of the Proposal area as well as review of the available local BoM data, spatial mapping resources, literature and previous investigations. A surface water quality assessment and flood assessment were completed (and are appended to the SWHA) to inform the potential impacts and recommended mitigation measures.

Surface water quality assessment

The Surface Water Quality Assessment (Appendix E) identifies the key operational surface water quality management issues for the Proposal, and to establish surface water quality management principles and concepts for the Proposal area. The assessment estimated pollutant loads and assess design parameters and efficiency of the water quality treatment controls proposed using eWater’s Model for urban stormwater improvement conceptualisation (MUSIC) software. The NPS site was the focus of the Surface Water Quality Assessment as this is the only area which would undergo substantial permanent disturbance of the existing surface conditions, thus increasing the probability for impacting the natural system. The gas pipelines and electricity transmission line corridors pose negligible risk to surface water quality during the operational phase of the Proposal.

Figure 6.3.5 Proposal area surface water sampling locations

Surface water quality assessment

The Surface Water Quality Assessment (Appendix E) identifies the key operational surface water quality management issues for the Proposal, and to establish surface water quality management principles and concepts for the Proposal area. The assessment estimated pollutant loads and assess design parameters and efficiency of the water quality treatment controls proposed using eWater's Model for urban stormwater improvement conceptualisation (MUSIC) software. The NPS site was the focus of the Surface Water Quality Assessment as this is the only area which would undergo substantial permanent disturbance of the existing surface conditions, thus increasing the probability for impacting the natural system. The gas pipelines and electricity transmission line corridors pose negligible risk to surface water quality during the operational phase of the Proposal.

Flood assessment

The Flood Assessment (Appendix E) adopted a hydraulic model of the lower extent of the Hunter River catchment, which was developed for Port Stephens Council to model a range of design flood events. This was used to evaluate potential inundation levels along the development footprint, the surrounding area and along the proposed access routes. Scenarios modelled were the 10% annual exceedance probability (AEP), 1% AEP, 1% AEP with incorporated climate change assumptions, and probable maximum flood (PMF) scenarios. The model was also used to determine whether the development would impact existing flooding conditions, other properties, assets or infrastructure, land use or ground conditions.

The NPS site was the focus of the Flood Assessment, as it would involve the most development at ground-level and would require site levelling and construction of impermeable surfaces. The gas pipelines and electricity transmission lines would predominantly be located above or below ground with minimal features at ground-level within the floodway or flood storage areas mapped by Port Stephens Council.

6.3.3 Potential impacts

Construction

Hydrology

Site levelling and landscape modification, and the addition of impervious surfaces and formal drainage systems during construction can alter infiltration and surface water flow conditions. Construction of the Proposal may cause the following potential hydrological impacts:

- Diverting drainage lines to avoid stockpile, waste or chemical storage areas
- Altered surface water flow rate and volume to the suspected ephemeral drainage creeks in the Proposal area
- Scouring (erosion) of natural waterways and wetland areas because of increased volume/rate of channelised discharges to the environment
- Localised increases in groundwater levels from land clearing and associated surface water seepage through the confining layer
- Localised decreases in groundwater levels due to a reduction in recharge to the groundwater aquifers as a result of increasing the impervious surface area
- Loss of sediment-laden stormwater to receiving waterways, resulting in sedimentation within associated nearby watercourses and potential habitat degradation along natural waterways and wetlands

Flooding

The Proposal area is located on a topographic high point beside the Hunter River, and the NPS site would be predominantly located above the flood planning level. The flood assessment determined that the entire Proposal area is expected to be immune from flooding impacts during the 10% AEP flood (Figure 6.3.6).

The proposed gas storage pipeline between the NPS and the NGSF crosses both high hazard floodway and high hazard flood storage areas and is expected to be partially affected by the 1% AEP and by the probable maximum (worst case) flood (PMF) (Figure 6.3.7). Flooding may cause a temporary loss of access to the storage pipeline and inundation of the storage pipeline corridor until flood waters subside.

The NPS site would not be affected by the 1% AEP flood, and only the extremities may experience inundation in the PMF, however, access to the site would be cut off in these flood events. The proposed electrical transmission line crosses some minimal risk flood prone land but is not expected to be impacted by the design flood events (Figure 6.3.7).

To minimise the risk of adverse environmental impacts due to flooding during construction, a Flood Preparedness Plan would be prepared based on the PMF design event. The plan would include monitoring of weather forecasts and flood warnings to enable flood preparedness procedures to be implemented ahead of potential flooding events, and site-shut down to be undertaken when required, including an evacuation route plan to minimise harm to persons, plant and the environment. This plan would focus on the management of the risk of spreading contaminants (such as sediment, hydrocarbons or chemicals) in floodwaters. Control actions may include filling excavations, completing erosion and sediment controls, removing hazardous materials and waste from the Proposal area, and sealing tanks and containers to prevent overflows.

Surface water quality

Drainage paths 1 and 2 are ephemeral, meaning they flow during rainfall, which coincides with the risk of runoff escaping from construction areas. Without management measures in place, construction activities have the potential to cause surface water contamination, and runoff may cause impacts on downstream aquatic ecosystems including the Hunter River and the connected Hunter Estuary Wetlands Ramsar sites. Potential surface water contamination may also impact groundwater, which is discussed further in Section 6.4.

Potential construction impacts include:

- Discharges of sediment-laden stormwater from stockpile areas or areas of exposed soil (e.g. recently cleared areas), or uncontrolled release of untreated water from the sediment basin/s, resulting in increased turbidity and deterioration of water quality
- Run off or unintended dewatering of contaminated water from excavations or stockpiles which include contaminated or acid sulphate soils, altering pH, water quality and causing potential soil contamination and possible downstream ecological impacts
- Run on water from offsite catchments, causing erosion or mobilisation of sediment or contaminants within the construction footprint
- Increased loading of dissolved nutrients (nitrogen and phosphorous) from exposed surfaces and stockpiled materials, which has the potential to stimulate growth of nuisance plants, algae and cyanobacteria
- Accidental release of alkaline concrete wash water, which may cause localised soil, surface water or groundwater contamination and possible downstream ecological impacts
- Spread of construction demolition wastes such as plastic, concrete, plasterboard, timber, or asbestos via surface run-off
- Leaks or spills of chemicals, heavy metals, oils, or petroleum hydrocarbons during the use and operation of machinery, resulting in ecosystem impacts
- Leaching and groundwater facilitated migration of contaminants into near site water bodies and wetlands

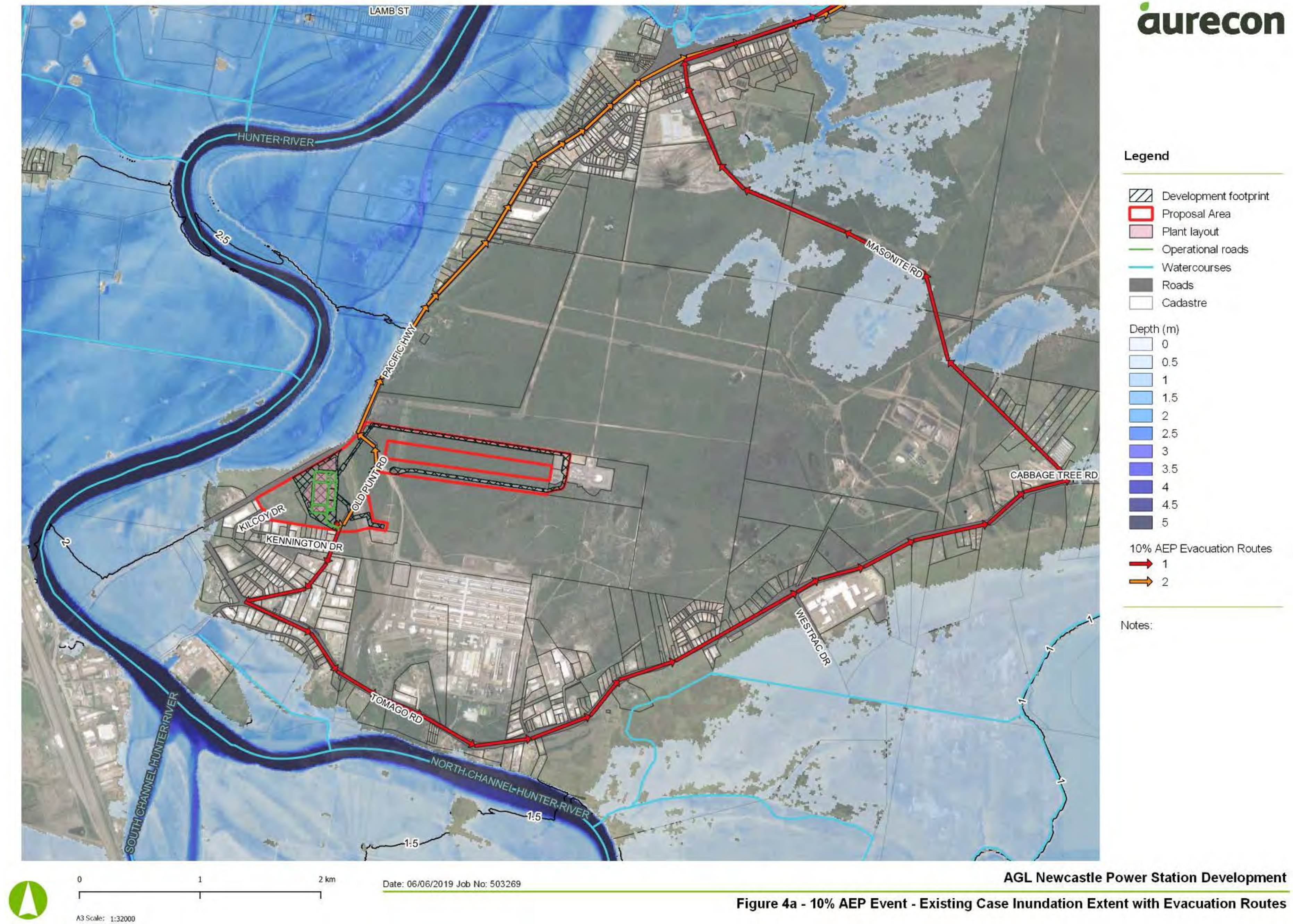


Figure 6.3.6 Proposal area with 10% AEP event inundation

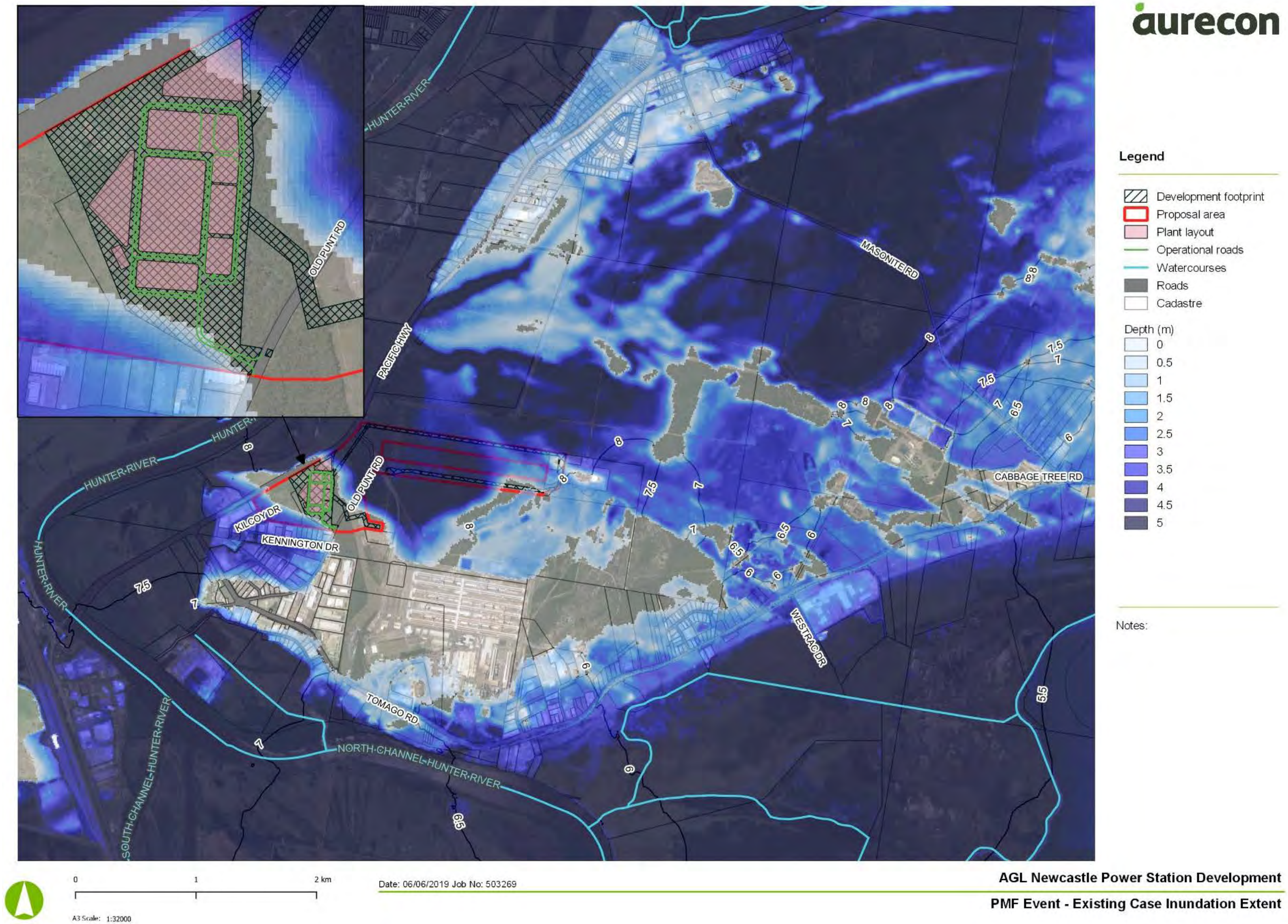


Figure 6.3.7 Proposal area with PMF event inundation

- Tannin leachate from clearing and mulching, which can increase biological oxygen demand (BOD) of the receiving environment, reduce water pH and can result in visual aesthetic issues
- Loss of drilling fluids during HDD resulting in increased sedimentation and turbidity in watercourses and potential ecosystem impacts
- Discharge of contaminated hydrostatic test water

The risk of surface water contamination during construction could be increased due to a significant flood event (between the 1% AEP and the PMF), which may inundate site drainage systems and breach containment storage facilities, thereby mobilising contaminants.

There is the potential for groundwater intersection, with potential soils contaminants and ASS, that could cause an impact on the Kooragang component of the Hunter Estuary Wetland (Ramsar wetland) located 2.2km south of the Proposal area.

During construction, there is the potential to temporarily disturb contaminated soils and ASS during excavation, including trenching and HDD for the gas pipelines. Dewatering of excavations may be required should groundwater be intercepted or in the event of excessive precipitation or flooding, and this would be undertaken in accordance with a site-specific dewatering procedure. This procedure would include a process for testing whether the water meets discharge criteria or requires further treatment before being discharged. Water treatment including flocculation and pH adjustment may be required prior to discharge due to the potential presence of sediment and ASS. The procedure would provide instruction on treatment methods and dosages, use of water testing equipment (e.g. pH probe and turbidity meter), discharge processes and locations, water quality monitoring requirements, permits required and records to be taken. Any water which cannot be treated to meet discharge criteria would be removed by sucker truck and transported for offsite disposal at a licenced facility.

A spill response procedure would be developed to detail the precautionary measures that should be made when using or transporting fuels and chemicals, as well as details relating to the management of spills, including requirements for immediate containment, and removal of the impacted material from the Proposal area, to avoid contaminants potentially spreading via surface water or groundwater pathways. With these mitigation measures in place, the likelihood of the Proposal impacting on the Kooragang component of the Hunter Estuary Wetland is low.

The NGSF environmental assessment (Coffey Environments, 2011), also included trenching for pipelines and exposure of potential ASS, identified that the likelihood of the NGSF impacting surface waters in the Ramsar wetland areas of Kooragang Nature Reserve and Wetlands Centre Australia was low. This was due to their distance from the NGSF, the planned surface runoff control measures, high groundwater infiltration rates and flat topography of the Proposal area.

The adjacent NGSF was constructed between 2012 and 2015, and since that time has been operational. Throughout this period, AGL has demonstrated their understanding of the requisite controls and their proven capability in managing risks to surface (and groundwater) contamination. This has included development and implementation of a Surface Water Management Sub-Plan, a Groundwater Management Sub-Plan, a Soil Management Plan, and an Acid Sulphate Soil Management Sub-Plan for the NGSF site. A similar approach would be applied to the Proposal.

During construction of the NGSF, dewatering was undertaken (as required) in accordance with a site-specific Dewatering Procedure. This covered water accumulated in trenches or excavations, including from the low-lying pipeline, stormwater in the sediment basin/s, and rain water collected in sumps, bunds and pits. Water quality parameters including pH and turbidity were tested prior to discharge to surface or groundwater, which was undertaken in compliance with a signed Dewatering Permit and the Soil and Water Management Standard. Where water could not be treated to adequate discharge criteria, untreated water was contained and transported off-site by a licenced contractor and disposed of to a licensed facility. No ground water contamination was recorded during this period. A similar approach would be applied to the Proposal.

Construction sedimentation basins

Conservative calculations of total annual soil loss for the Proposal area indicate that sediment basin/s may not be required, however, due to the proximity of the Hunter River and the Tomago Sandbeds aquifer, a conservative approach to sediment control would be undertaken during construction. The risk of uncontrolled discharge of sediment-laden stormwater would be managed through the construction of suitably sized sediment basin/s prior to earthworks. Runoff from disturbed areas on site would be directed into the construction sediment basin/s for temporary storage, settling and sedimentation treatment prior to discharge offsite as required.

The design and location of these basin/s would be determined by the construction contractor and would depend on the chosen technology, facility layout and construction methodology. Design and operation of the basin/s would comply with relevant best practice guidelines including the 2008 IECA *Best Practice Erosion and Sediment Control* (BPESC) document and Volume 1 of the 2004 Fourth Edition Landcom *Guidelines for Managing Urban Stormwater: Soils and Construction*.

Preliminary calculations based on constructing the NPS platform in a cut/fill balance, identified the need for two or more sediment basins to capture runoff on either side of the NPS site. One basin could be constructed at the low point in the south-western extent of the power station construction site, and one in the north-eastern extent.

An indicative analysis was completed as part of the SWHA to assess the gradients and availability of space to construct sediment basins within the NPS site (Appendix E). Conservative assumptions were made regarding the duration of construction works, soil types and basin dimension requirements to calculate upper-limit basin sizes required. The required basin sizes were feasible within the constrained development footprint, with further consideration to be applied during detailed design. The indicative large basin footprints could be reduced in size by reducing the exposed catchment areas flowing to the basins. This could be achieved by staging clearing and earthworks, periodically implementing cover measures over disturbed areas, and considering use of chemical flocculants. These basins could be re-purposed or modified to become permanent basins, such as the operational process water storage ponds. However, this would be further considered during detailed design.

Water use

During construction, water would be supplied from the Port Stephens municipal water supply system provided by HWC via a temporary pipe connection to the existing water supply infrastructure along Old Punt Road. Raw water may also be delivered to the Proposal area by truck as a secondary source. Initially, tanks would be installed to store construction water, until the operational pipe network is laid with a permanent connection to the HWC network. This component of the Proposal would be completed as early works, to facilitate the construction program.

Water would be used during construction for a range of purposes including excavation, dust suppression, drilling, hydrostatic testing, materials preparation and use, and amenities for the construction workforce. Construction areas and access tracks would be watered to suppress dust, with the frequency of watering dependent on wind and rainfall conditions.

Construction water requirements would vary based on weather (i.e. dust suppression), electricity generation technology and commissioning processes. Peak construction water demands would be negligible compared to existing water usage and total water supply in the region. The Proposal would not affect other water users in the region during construction.

Operations

Hydrology

The primary potential operational impact to surface water and hydrology relates to changes in stormwater runoff discharge patterns. As the power station is constructed, undeveloped land will become impervious surfaces, reducing infiltration and increasing stormwater runoff from the Proposal area. It is anticipated that around 30% of the NPS site would become impervious. During periods of higher rainfall, these resulting intensifications in flow rate would have the potential to erode natural waterway channels, particularly Drainage Path 1 and the connected LEP Wetland discharging locations.

The design of the NPS would incorporate the principles outlined in Port Stephens Council DCP 2007 to make sure that the post-development flow rate and volume is consistent with pre-development for all storm events, despite the increase in impervious area, which would negate this impact.

Given the relative size of the Proposal area and the development footprint compared to the total catchment area of the Hunter River (around 22,000km^2), it is expected that there would be negligible impact on the hydraulic behaviour of the Hunter River.

Flooding

Impact on the Proposal

The NPS platform would be developed at around 7.2m AHD, which being located above the flood planning level and recommended building platform of 5.1m AHD, would be immune from the 1% AEP event. This means the built surface of the power station infrastructure would be above the flood level and would remain free from inundation. The NPS is therefore considered to have good flood immunity.

Based on the conceptual site layout, the NPS facilities would not be affected by the 1% AEP flood, and only the extremities of the development footprint may experience inundation in the PMF. Infrastructure would be designed and developed to avoid this inundation extent and avoid impact. For all flooding events modelled, including the hypothetical worst case flood (the PMF), flood waters would not affect the electricity transmission route.

The proposed gas storage pipeline corridors between the NPS and the NGSF crosses both high hazard floodway and high hazard flood storage areas. The storage pipeline corridors would be partially affected by the 1% AEP event or greater, which may cause a temporary loss of access for maintenance activities, and inundation of the storage pipeline corridor until flood waters subside and drain away. Despite this, flooding is not expected to have any impact on, above or below ground infrastructure associated with the Proposal.

Impact from the Proposal

The flood modelling showed that the development of the NPS, which would be the most significant ground-level development as part of the Proposal, would not have any effect on the pattern of flood flows or on flood levels or on flood velocity outside the Proposal area. This is demonstrated in the afflux modelled, which is the difference in flood levels before and after the development, which is predominantly negligible (Figure 6.3.8). Associated infrastructure including electricity and pipelines would have minimal above-ground presence and are also expected to have a negligible effect on existing flooding conditions.

There would be no effect from the Proposal on existing flood behaviour, nor would it impede access to existing road networks. The Proposal is not expected to have any impacts on existing community emergency management arrangements for flooding.

Access roads into the Proposal area would be affected by several of the design flood events modelled, and evacuation routes would need to be considered. The safest and most direct evacuation route for flood events below the 10% AEP, would be to exit the Proposal area by turning left onto Old Punt Road and then right onto the Pacific Highway, however, for events above the 10% AEP, all potential evacuation routes may become inundated. A Flood Preparedness Plan would be prepared for the Proposal based on the PMF design event.

Surface water quality

The local LEP Wetlands, the three local low-lying seep areas and the Hunter River are all potential receptors of contaminated or sediment-laden site stormwater if the appropriate water management systems and mitigation measures are not implemented.

Without management measures and systems in place, operation of the Proposal has the potential to cause surface water contamination. Potential operational impacts include:

- Storage, transport, use and handling of diesel fuel, chemicals, oils, greases, solvents, demineralisers and firefighting products on site has the potential to introduce surface contaminants to surface water runoff and impact the quality of surrounding surface waters and wetlands through stormwater discharge and plant wash down routines

- Runoff from roads, car-parks and hardstand areas may contain low to medium levels of hydrocarbons, metals, suspended sediments and nutrients resulting from the operation of vehicles and machinery
- Leaks or spills due to overflow or failure of hydrocarbon storage tanks, septic systems, process water storage ponds.

The risk of surface water contamination during operation could be increased should one of the following events co-occur:

- A significant flood event (between the 1% AEP and the PMF), which would inundate site drainage systems and potentially breach containment storage facilities, mobilising contaminants
- A substantial fire event, which would require large volumes of firefighting water to be applied across the NPS, mobilising contaminants

Wastewater

The Proposal would generate various wastewater streams from the operation of the NPS, which are further detailed in Chapter 2.6.7. Connection to the existing HWC wastewater treatment system was considered uneconomical. A series of operational water storage or treatment systems would be established within the NPS facility including:

- Runoff generated when undertaking maintenance or cleaning activities within enclosed workshop areas would be the lowest quality wastewater generated by the Proposal, and along with any oily or contaminated water, would be collected in a designated drainage system for transport to an appropriate liquid waste disposal facility
- A chemical drains system would be established for chemical spills and stormwater falling into outdoor chemical storage areas, comprising a sump for collection, testing and treatment of water before piping to the process wastewater system or transporting to an appropriate liquid waste disposal facility
- A process wastewater system would be established to collect wastewater in ponds or tanks for temporary storage and evaporation. Process wastewater and solids/sludge would be periodically removed from the Proposal area by tankers for disposal at a licenced wastewater facility
- Potable water drains and site sewage would be discharged to a site sewerage system. Septic tank/s would be used and treated via a standalone septic treatment system or pumped out by truck as required.
- A contaminated/dirty stormwater drains system would be established to capture runoff from roads, car-park, bunds, workshop and service areas and other hardstand areas via a ‘pit and pipe’ system
  - Water would be treated via a GPT where an oil and grease separator would help to remove entrained oils and greases, suspended solids and associated attached metals from stormwater runoff, as well as capturing small to medium spills from hardstand areas
  - Stormwater would then be passed through a bioretention system made up of selectively vegetated areas with enhanced filter media to slowly filter stormwater runoff whilst physical and bio-chemical processes help break down and remove common stormwater contaminants
  - Using these systems, the expected discharge qualities would potentially be better than the current background local groundwater quality (being the ultimate receiving waterbody due to the infiltration rates in the sandy soils)
  - A monitoring point would be established to test water quality and determine whether water can be discharged offsite as clean stormwater or if the discharge limits are not met, the water would be directed to the process water system for ultimate offsite disposal
- Clean stormwater would be discharged into existing grassed areas adjacent to Lot 3 where it would then infiltrate into the water table below or runoff to existing drainage paths

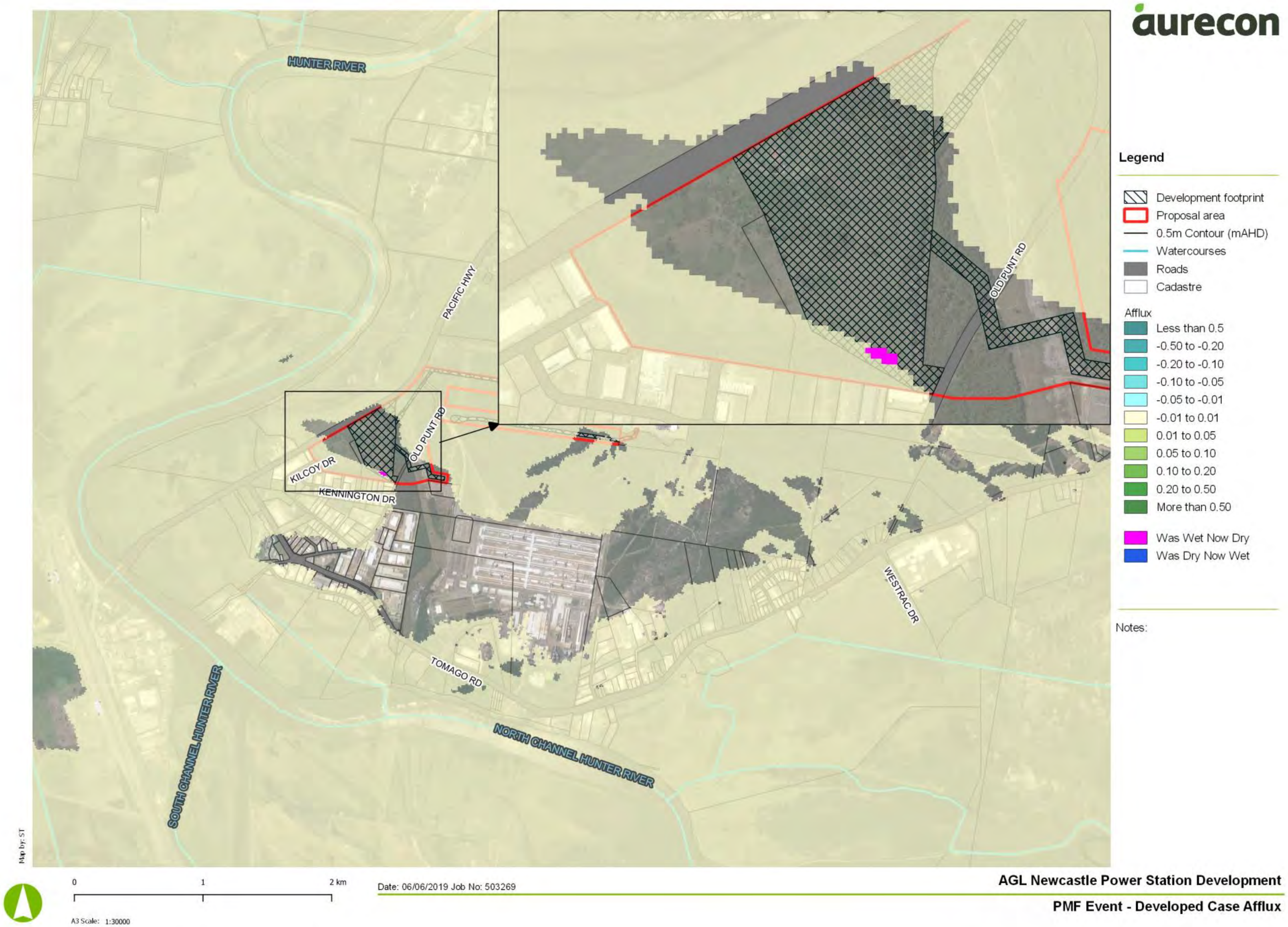


Figure 6.3.8 Proposal area and afflux post-development

The operational stormwater management arrangement is subject to ongoing design development and the ultimate layout would be determined by the chosen contractor.

A conceptual operational stormwater management arrangement is provided in Figure 6.3.9, which allows for a GPT and bioretention system in the south-western corner of the NPS site. In this conceptual layout, water discharged in small volumes would infiltrate into the ground, whilst any runoff would flow into Drainage Path 1. In low flows, the runoff in Drainage Path 1 would intercept the secondary drainage channel which is an existing concrete swale drain connected to the adjoining industrial estate's stormwater drainage system. This drain runs southwards and ultimately discharges into a parcel of land between the LEP Wetlands and Tomago Road. In high flows, the discharged water may follow Drainage Path 1 through the culvert beneath the Pacific Highway to discharge into rural land where it may form a hydraulic connection to the Hunter River and associated tributary during high magnitude or prolonged rainfall events

An alternative or additional GPT and bio-retention system could be developed towards the north-eastern corner of the NPS site. In this case, runoff would flow into Drainage Path 2.

During operation, water quality monitoring would be undertaken to assess the effectiveness of operational mitigation measures and contamination levels within the drainage system and at discharge locations do not exceed the relevant trigger values (either ANZECC trigger values or existing (baseline) water quality data to derive trigger values). Pre-construction baseline monitoring of water quality parameters would be undertaken to form a dataset which could be used for comparison during construction and operational monitoring programs.

Wastewater generated by the Proposal would therefore not impact on local sewer infrastructure and would either be removed from the Proposal area for processing at a licensed facility or treated to meet discharge criteria and discharged offsite as clean stormwater. With the implementation of all recommended mitigation measures, the Proposal is not expected to have a significant impact on surface water quality during operation.

Neutral or Beneficial Effect

Neutral or Beneficial Effect (NorBE) assessments apply to all releases of water, wastewater and other contaminants from the Proposal area that may affect water quality. A development is considered to demonstrate NorBE if the development:

- Has no identifiable potential impact on water quality, or
- Will contain any water quality impact on the development footprint and prevent it from reaching any watercourse, waterbody or drainage depression in the Proposal area, or
- Will transfer any water quality impact outside the Proposal area where it is treated and disposed of to standards approved by the consent authority

An assessment of pollutant loads and concentrations for total suspended solids (TSS), total phosphorous (TP) and total nitrogen (TN) was completed as part of the Surface Water Quality Assessment (within Appendix D) This assessment demonstrated through modelling that NorBE would be achieved by incorporating a bioretention system with a footprint of at least 735m^2, and a wet sump oil/grease separator (GPT), which would reduce the loading of pollutants in stormwater runoff to enable them to be discharged to the surrounding environment. A conceptual operational stormwater management diagram (Figure 6.3.9) indicates that overflow from the system would flow to a seepage area in the southern section of the Proposal area where it would evaporate or seep into the ground. The assessment indicated that any seepage from the depression is likely to be of a superior quality compared to the existing background conditions. Operational stormwater management is subject to refinement during detailed design and the sizing, location, and number of systems would be determined by the construction contractor.

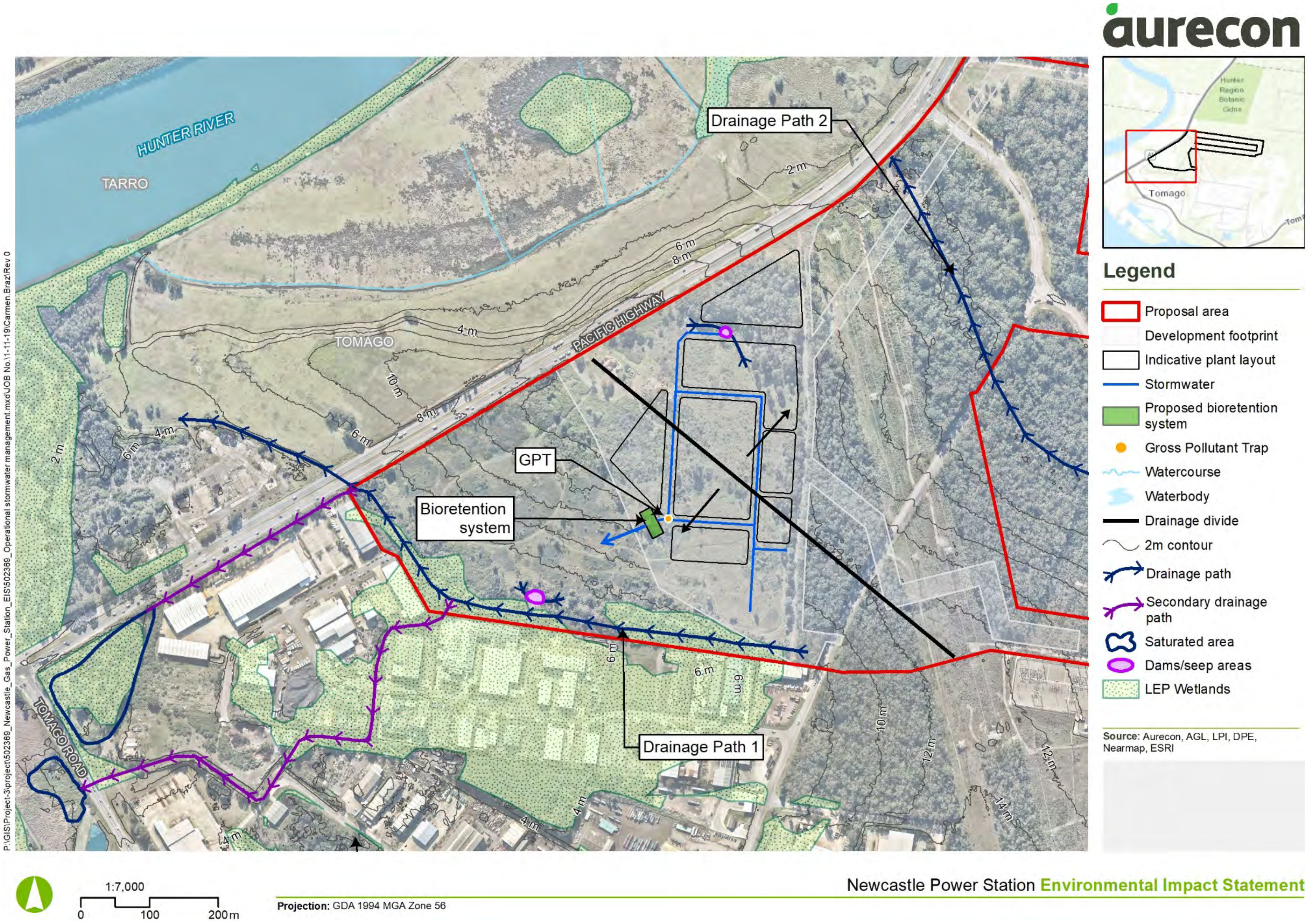


Figure 6.3.9 Proposed operational stormwater management

Water use

The Port Stephens municipal potable water supply system would be used during the operational phase of the Proposal, via the extension of the existing water supply infrastructure along Old Punt Road.

Water use during operation would include input to a demineralised water treatment plant (if required), inlet air cooling (if required), input to power generation units (if required), workshops, amenities, drinking water, firefighting and emergency facilities, plant wash water and landscaping irrigation. The operational water requirements, proposed supply and storage systems are described in Section 2.6.6.

The process water balance would be influenced by the engine technology installed. The expected water demand rates associated with the current considered technologies are provided in Table 6.3.1. This indicates a large variance in potential water demand (1.77 to 95.8m^3/h or 42 to 2,300m^3/d).

Table 6.3.1 Operational Water Balance scenarios (m^3/h)

Parameter	Reciprocating engine		Gas turbine	
	Gas	Diesel	Continuous operation (at average 19.5°C)	Base case (at 35°C)
Demands				
Demineralised water treatment plant	1.54	20.69	90.76	95.68
Potable water	0.17	0.17	0.06	0.06
Service water	0.06	0.06	0.06	0.06
Supply				
Municipal water	1.77	20.92	90.88	95.8
Discharge/loss				
Process wastewater	0.61	8.27	18.15	19.14
Septic tanks	0.06	0.06	0.06	0.06

Annualised water consumption based on the highest estimated water use scenario under peaking load and continuous operation would be approximately 120,000m^3 and 800,000m^3. Worst case operational water demands (continuous operation) represent a small percentage of the total water supply available in the region (0.03%) and a fractional increase on current annual water usage (0.12%) (Table 6.3.2). Therefore, the Proposal would not affect other water users in the region during operation.

Table 6.3.2 Operational water requirements – regional context

Worse case operational demand	Regional water supply (%)	Current water usage (%)
0.08GL/a	276GL (0.03%)	67GL/a (0.12%)

Cumulative impacts

There are several industrial sites in the Tomago industrial area and Kooragang industrial area, which may contribute to cumulative impacts. The stormwater drainage network within the industrial estate is a potential flow pathway for clean stormwater. In alignment with the site's potential operational impacts and mitigation measures, the combination of water discharge from the power station and existing industrial estate land uses has the potential to continually degrade the natural integrity (i.e. erosion and water quality) of the adjoined wetland and Hunter River system. However, as the Proposal would capture and treat surface water prior to discharge, and capture and dispose of process water offsite, it is unlikely to contribute towards cumulative water quality impacts.

A NorBE assessment carried out for the Proposal demonstrated that the operational stage bioretention and oil/water separator would reduce the pollutant load in stormwater to a level suitable for discharge to the surrounding environment.

The Proposal would not alter flood levels or behaviour. Surrounding industrial development and projects would be located on land that is identified as minimal and low risk flood prone land and as such, are unlikely to result in a change in flood behaviour locally or in the region.

6.3.4 Avoidance, mitigation and management

Avoidance through design

The location of the NPS on a topographic high point above the flood planning level was selected in part to minimise the risk of the Proposal construction activities causing impacts to water quality during flood events or changing flood patterns and flow rates. The elevated location would also make sure the Proposal is immune from flood events during operation and eliminate the risk of floodwaters spreading potential contaminants from the NPS site.

A number of separated drainage systems have been proposed as part of the Proposal to capture wastewater generated by the Proposal and avoid impact on local sewer infrastructure. Wastewater would either be removed from the Proposal area for processing at a licensed facility or treated to meet discharge criteria and discharged offsite as clean stormwater.

The selection of HDD for the construction of the storage pipeline would avoid impacts to the *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands PCT adjoining the Pacific Highway (near Old Punt Road). Using this methodology, the bore and pipeline would pass below rather than directly impacting vegetation and soils.

Mitigation and management

A range of avoidance, mitigation and management measures would be implemented for surface water and hydrology outlined in Table 6.3.3.

Table 6.3.3 Avoidance, mitigation and management – Surface water and hydrology

ID	Environmental Safeguard	Timing
SW-1	A Surface Water Management Plan (SWMP) will be prepared as part of the CEMP and implemented throughout construction. It would include, but not be limited to: ■ Erosion and Sediment Control Plan ■ Stormwater Management Strategy ■ Dewatering Procedure ■ Acid Sulphate Soil Management Plan (ASSMP)	Pre-construction Construction
SW-2	A site-specific Erosion and Sediment Control Plan (ESCP) would be developed in accordance with the Blue Book. At minimum this would include: ■ Scheduling construction works to avoid periods of heavy rainfall, where possible ■ Incorporating a designated stable vehicle access road and construction phase car park ■ Minimisation of the area of exposed and unstable ground surfaces during construction ■ Using sediment control systems including geofabric on stockpiles, silt fences, sediment traps, contour berms, energy dissipators ■ Resealing or revegetating exposed surfaces as soon as practical	Pre-construction Construction

ID	Environmental Safeguard	Timing
	■ Dust suppression methodologies including the use of a mist/spray and limiting certain tasks once a wind threshold is reached ■ Clean/dirty water separation and management via a Stormwater Management Strategy ■ Contact with soil, sediment, groundwater and surface water where possible ■ A description of monitoring required (dust as well as certain contaminants) ■ A description of the inspection and maintenance of erosion and sediment controls required	
SW-3	A Stormwater Management Strategy would be developed including: ■ Clean water diversion drains or berms to divert clean water runoff from the surrounding catchment around the construction site and into existing drainage lines to prevent the formation of new surface flow paths ■ Separation of clean and dirty/contaminated stormwater within the construction site ■ All surface runoff from disturbed areas will be directed via dirty water drains to sediment control structures which will ultimately run into the sediment basin/s ■ Sediment basin sizing, location and maintenance regime in accordance with Blue Book and IECA guidelines ■ Turbidity testing and treatment (via a Dewatering Procedure) ■ A description of disposal/reuse options (e.g. reuse for dust suppression or irrigation or disposal to stormwater or sewer). ■ Water quality monitoring ■ Siting of waste and chemical storage areas ■ Disposal of contaminated water at a licensed facility	Construction
SW-4	A Dewatering Procedure would be developed to instruct: ■ Process for testing whether water meets discharge criteria ■ Water treatment methods including flocculation and pH adjustment ■ Discharge process and location/s including avoiding erosion or scour ■ Water quality monitoring requirements ■ Permits and records required ■ Any water which cannot be treated to meet discharge criteria would be removed by sucker truck and transported for offsite disposal at a licenced facility	Construction
SW-5	An ASSMP would be developed and implemented and would include: ■ Further site investigations to determine the areas of ASS that may generate sulphuric acidity from sulphide oxidation ■ Preparation in accordance with the Port Stephens LEP 2013, the Port Stephens Council ASS Policy 2004, and the Acid Sulphate Soils Manual (ASSMAC 1998) ■ Protocol to minimise the disturbance and exposure of ASS ■ A description of the management/stockpiling requirements for each of the scenarios that may generate ASS (i.e. excavation or HDD) ■ Methods for storing excavated ASS in conditions which simulate its natural state; or treatment and storage away from water bodies and drainage lines ■ Bunding of exposed ASS storage and treatment areas to minimise and prevent spread of leachate ■ Appropriate signage, barricading and sediment controls ■ Recommended liming rates for generated ASS	Pre-construction Construction

ID	Environmental Safeguard	Timing
	■ Method for lime treatment with machinery sufficient to perform adequate mixing ■ A description of the maximum onsite residency time for untreated ASS ■ A description of an emergency response protocol (i.e. where acidic runoff is generated) ■ Steps to minimise groundwater dewatering (potentially oxidising unoxidised ASS) ■ A field screening test using hydrogen peroxide (H_2O_2) would be performed on excavated soils in areas where ASS or PASS is anticipated, or on suspect soils. Soils which record a pH of below 4 following oxidation should be managed as ASS ■ Record keeping requirements including: – ASS monitoring and laboratory testing results – Excavation records – Stockpile tracking – Register of lime used for ASS treatment – Register of any offsite disposal of treated ASS	
SW-6	The permanent piped connection to the Hunter Water Corporation (HWC) network would be installed as early works to provide water for construction purposes and minimise water deliveries to the Proposal area.	Pre-construction
SW-7	A procedure would be developed and implemented to minimise the risk of drilling waste (in the form of drilling fluids and hydraulic stimulation fluids) contaminating watercourses during drilling, completion, hydraulic stimulation and workover activities. Drilling fluid spills would be immediately contained, cleaned up and reported.	Construction
SW-8	The HDD entry and exit sites would be securely bunded to prevent the release of leachate from excavated material, drilling fluids, or spills entering the surrounding environment.	Construction
SW-9	A designated concrete washout area for concrete mixers and pump trucks, concrete chutes, tools and equipment would be established away from drainage lines and water bodies, which would be lined with impervious material. The washout capacity would be regularly checked before being used. The wash water would be left to evaporate, with dried concrete removed for recycling as required. Inspection of the capacity of the washout area and integrity of the liner would be undertaken prior to each use, and prior to rainfall events or site shut down, with improvements made as required. Wash water would be pumped out as required to maintain capacity or prior to rain events and disposed of as contaminated water.	Construction
SW-10	The use of pesticides in the project footprint would be limited where possible to avoid contamination of nearby watercourses/wetland areas.	Construction Operation
SW-11	Use of chemical treatment of hydrostatic test water would be avoided where possible. If necessary, chemical concentration to be calculated such that they are consumed in the hydrotesting process and only trace volumes would be present in any discharge.	Construction
SW-12	Water used in pressure testing would be collected following testing and disposed of off-site at a licensed facility.	Construction
SW-13	Any mulch stockpiles from cleared vegetation must be located at high points away from watercourses, with upgradient water diverted to avoid entering the stockpile.	Construction
SW-14	Mulch should not be used as part of erosion controls in the floodplain or along concentrated flow paths.	Construction
SW-15	Bunding and hazardous materials storage requirements include: ■ Appropriately bunded in accordance with relevant Australian Standards	Construction Operation

ID	Environmental Safeguard	Timing
	■ Bund-wall expansion joints and fire suppression to be incorporated into design. ■ Sufficient capacity ■ Isolation valves for all bunds ■ A high-level alarm would be fitted to the sewage tank ■ Low- and high-level alarms would be fitted to the diesel tanks ■ Inspection and maintenance after rainfall ■ Bund areas and tanker loading/unloading areas having sufficient capacity	
SW-16	A register of all hazardous chemicals kept in the Proposal area is to be maintained and updated regularly.	Construction Operation
SW-17	Dedicated re-fuelling areas and spill controls, and appropriate chemical, fuel and liquid storage and handling would be undertaken during construction, in accordance with Australian standards.	Construction Operation
SW-18	Spill kits to be maintained in appropriate locations in accordance with Australian Standards, including where required inside machinery and vehicles.	Construction Operation
SW-19	A Spill Response and Containment Procedure would be developed including: ■ Training and PPE ■ Precautionary measures for handling and storage of chemicals and fuels ■ Spill response protocols (control, contain, clean up) ■ Contaminated soils to be disposed of appropriately ■ All spills to be reported and recorded in the Spills Register ■ Spill kits to be restocked following use	Construction Operation
SW-20	All vehicles, plant and equipment to be checked regularly for fuel tank and line leaks or failures.	Construction Operation
SW-21	Bunds and sumps should be regularly inspected, and capacity maintained by regular draining and disposal.	Construction Operation
SW-22	Licenced contractors would be engaged to collect, transport and dispose of liquid hazardous materials, waste solvents, paints and hydrocarbon products to an appropriate off-site facility in accordance with relevant NSW Environment Protection Authority (EPA) guidelines.	Construction Operation
SW-23	Management and maintenance of the sewage system must be carried out by suitably trained personnel.	Construction Operation
SW-24	The civil design of the power station will incorporate the principles in the Port Stephens Council DCP 2007 to ensure that the post-development flow rate and volume is equal to pre-development for all storm events.	Pre-construction
SW-25	The power station would be developed above the PMF level.	Pre-construction
SW-26	A Flood Preparedness Plan would be developed based on the PMF event, and would include: ■ Roles, responsibilities and communication procedures including emergency contacts ■ Monitoring procedures for rainfall and flood warnings (including BoM and local flood warning services) ■ Requirement for an environmental risk assessment prior to commencing excavation or trenching work in the event of a flood warning ■ Site shut-down and flood preparedness procedures to minimise harm to persons, plant and the environment	Construction Operation

ID	Environmental Safeguard	Timing
	■ Actions in the lead up to the flood (such as monitoring water levels, filling excavations, completing erosion and sediment controls, removing hazardous materials and waste from the Proposal area, barricading, sealing tanks and containers to prevent overflows, tying down loose items) ■ Actions at the time of the flood (may include further evacuation, rescue, pollution prevention, spill response, and contingency measures) ■ Actions post-flood (including clean up and rectification) ■ Evacuation routes and procedures ■ Rescue procedures ■ Procedure for resuming operations ■ Reporting requirements and corrective actions During its development, the Flood Preparedness Plan would be discussed with the SES and Council to ensure alignment with community evacuation arrangements.	
SW-27	Pre-construction surface water quality monitoring would be undertaken at the following monitoring locations: ■ Drainage Path 1 (at culvert crossing Pacific Highway) ■ Drainage Path 2 (at culvert crossing Pacific Highway) Water quality testing would be undertaken monthly (if water is present) and following elevated periods of rainfall for a period of at least 3 months prior to construction. Test results from pre-construction monitoring would be correlated with available monitoring data from the adjacent NGSF site to create a baseline dataset which could be used for comparison during construction and operation of the Proposal.	Pre-construction
SW-28	A surface water quality monitoring program would be implemented at the following monitoring locations: ■ Construction phase sediment basin/s (construction only) ■ Wet sump oil and grease separator (GPT) ■ Bio-retention system outflow ■ Drainage Path 1 ■ Drainage Path 2 ■ LEP Wetlands discharge location (downstream of the secondary drainage that meets Drainage Path 1) Water quality testing would be undertaken monthly and following elevated periods of rainfall.	Construction Operation
SW-29	Regular inspection, monitoring and maintenance of erosion and sediment control structures would be undertaken in accordance with the ESCP and Blue Book. In addition, inspections would be undertaken immediately prior to and following heavy rainfall and rectifications made as required.	Construction
SW-30	Regular inspection and maintenance would be undertaken of: ■ Hazardous material containment facilities ■ Bunds and sumps ■ Vehicles, plant and equipment including tanks and line failures ■ Sewage tanks ■ Water storage tanks or ponds ■ GPT	Construction Operation

ID	Environmental Safeguard	Timing
	■ Spill kits In addition, inspections would be undertaken immediately prior to and following heavy rainfall and rectifications made as required.	
SW-31	An Operation Environmental Management Plan (OEMP) will include a Stormwater Management Strategy including: ■ Drainage and temporary water storage systems, including separation of clean and dirty/contaminated water ■ Use of GPT (sediment and oil/water separator) and bioretention area ■ Reuse options (e.g. irrigation) ■ Water quality monitoring ■ Clean water discharge location and method ■ Disposal of contaminated water and sewage at a licensed facility	Operation
SW-32	A chemical drains system would be provided for collection and treatment of chemical spills and stormwater falling into bunded chemical storage areas (if outdoors). Chemical drains would be collected in a drains sump for testing and treatment before being piped to the process wastewater system.	Operation

6.4 Groundwater

A Groundwater Assessment report (GWA) was prepared by Aurecon Australasia Pty Ltd to address the potential groundwater impacts associated with the construction and operation of the Proposal. The GWA is provided as Appendix F.

6.4.1 Existing environment

The existing climatic and hydrologic environment is described in Section 6.3.1.

Geology and soils

The Proposal area is in the northern part of the Sydney Basin. The geology typically comprises sandstone and siltstone, with underlying coal seams. The majority of the Proposal area traverses the Tomago Coal Measures (Pt) from the Newcastle Coalfield group, with typical lithologies of shale, mudstone, sandstone, claystone, tuff and coal.

The Proposal area is predominantly situated across two soil landscape groups (Figure 6.4.1). The Beresfield landscape which covers most of the NPS site has slope gradients of 3-15% and moderately deep, imperfectly drained soils which are known for water erosion hazard, seasonal waterlogging and being highly acidic. The Tea Gardens – variant A landscape underlies most of the electricity transmission and gas pipeline corridors. This landscape is relatively flat with slope gradients <5%. The soils are known to be deep and well drained on ridges but poorly drained in swales. This landscape has a number of risks including permanently high water tables, seasonal waterlogging, strongly to extremely acid soils and groundwater pollution hazard.

Investigations previously undertaken at the NPS site indicate a range of depths to bedrock from 0.2m to 15.8m below ground level (m BGL). The geology is dominated by shallow bedrock, and the overlying Quaternary alluvium is dominated by a clay fraction.

The presence of potential or actual ASS across the Proposal area has been discussed in Section 6.3.1, with soil samples indicating a high potential for ASS in deeper soils.

Previous investigations at the Proposal area have indicated chemicals of potential concern may be present in soil, groundwater, surface water and sediments. The presence of soil contamination is discussed in Section 6.3.1.

Hydrogeology

The Proposal area is within the Hunter Valley alluvial aquifer formation, which is made up of clays, silts, sands and gravels, with highly permeable materials at the base of the alluvial deposit. The water table is generally shallow and is very responsive to flooding and rainfall. The hydraulic conductivity in the formation ranges from 10 – 239m/day (Williamson,1958).

The Tomago Sandbeds, which lie beneath the storage pipeline and electricity transmission corridors, consist of highly permeable fine-grained sands underlain with impermeable clay and rock. The transmissivity (hydraulic conductivity multiplied by the aquifer thickness) of the sandbeds is between 400 – 600m^2/day. Between 25 – 40% of the rainfall in the area becomes diffuse net recharge, which are the highest rates in the region (Crosbie, 2003).

The Proposal area falls within the same groundwater catchment zone as the Ramsar-listed Kooragang Nature Reserve, being the Tomago Groundwater Source catchment zone.

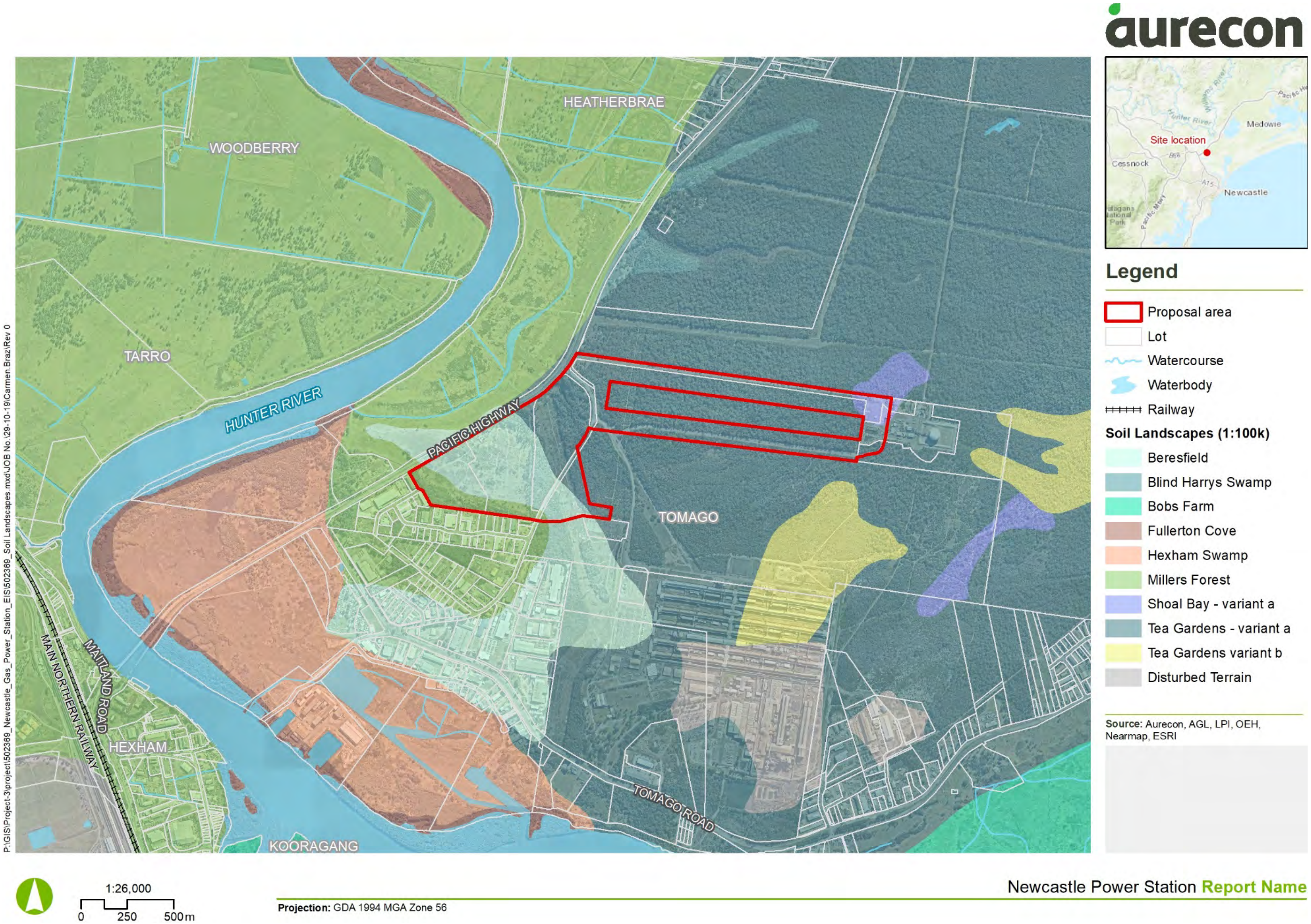


Figure 6.4.1 Proposal area and soil landscape groups

Groundwater levels and flow

Groundwater flow

The regional water sharing plan (WSP) (DPI, 2016) indicates that private bore yields within the North Coast Fractured and Porous Rock Groundwater Sources are typically low (0.1 to 1L/s), but higher yields of up to 20L/s are associated with fracture zones which enable enhanced groundwater flow. Water levels within monitoring bores were observed to be sub-artesian (non-flowing) to artesian (flowing), meaning the aquifer water is trapped by surrounding layers of impermeable rock or clay. Valley floors with overlying Quaternary alluvium are areas of groundwater discharge.

At a local level, groundwater monitoring wells were installed across the NPS site for the *Additional Pre-existing Contamination Study* in 2018 (Environmental Strategies, 2018) to define the site geology and hydrogeology and survey groundwater elevations. Drilling encountered very little water entry, and boreholes showed that while moist or damp conditions were recorded, there was insufficient water to record an accurate water strike (the level at which water is first encountered). There was no observable water measured an hour after well installation, so standing water level data could not be determined. Purging and sampling of the wells two weeks after drilling indicated low levels of water entry and low permeability, despite heavy rainfall over that period (late November).

The boreholes drilled confirmed the geology beneath the NPS was dominated by bedrock, ranging from 2m BGL to 6m BGL at monitoring well T-ES-MW09 (refer to Figure 6.4.2). The overlying alluvium was not found to contain any significant water bearing zones and was considered to have low effective permeability. Given low hydraulic conductivity of 0.1m/day, and hydraulic gradient ranging from 1.4×10^{-2} to 1.3×10^{-2}, the study suggested a seepage velocity of around 2m per annum is indicated at the NPS site, which is a low rate of migration of groundwater flow.

Flow direction

A contour map of regional groundwater levels measured in the Newcastle Bight groundwater management area was produced by Woolley et al in 1995, which included the Proposal area, the Tomago Sandbeds aquifer, lower Hunter River, and the Fullerton Cove area (the Hunter Estuary Wetlands) (refer to Appendix F). This contour map indicated that groundwater in the Proposal area flows to the north-northwest towards the Hunter River and that a groundwater divide exists to the south-southeast of the Proposal area. This is supported by the Environmental Strategies 2018 study, where a groundwater mound was interpreted at monitoring well T-ES-MW09 with a radial flow from the NPS site towards the Hunter River and the lowlands flanking the site (Figure 6.4.2).

A groundwater contour map was produced as part of the March 2019 *Newcastle Gas Storage Facility Groundwater and Surface Water Monitoring Program* which indicated groundwater flow near the NGSF was generally to the north-west (GHD, 2019). This was consistent with previous monitoring at the NGSF including during baseline and construction period monitoring.

These local observations of groundwater flow in the Proposal area to the north-west in the direction of the Hunter River are consistent with the mapped regional flow of groundwater towards the Hunter River near the Proposal (Woolley et al, 1995). Groundwater in the Proposal area is therefore not expected to flow towards the Ramsar-listed wetlands of the Kooragang Nature Reserve (including Fullerton Cove or the Hunter Estuary Wetlands).

Groundwater depth

Previous geotechnical studies have indicated that groundwater may be present at shallow depths in the Proposal area and is likely above bedrock within 1.5m BGL, in particular the southern section of the proposed NPS site (Environmental Strategies, 2017).

The depth to groundwater measured in the Environmental Strategies wells (detailed in Table 6.4.1 and shown in Figure 6.4.2) indicates the water table is close to the ground surface in some parts of the Proposal area, which is consistent with it being a high hazard floodway and high hazard flood storage area. The majority of groundwater was encountered just above the bedrock surface, and Environmental Strategies considered the conditions to be confining and the alluvium to be a low effective permeability aquifer.

Table 6.4.1 Groundwater levels and depth below ground

Well ID	Groundwater level (m AHD)	Ground level (m AHD)	Groundwater depth (m BGL)
T_ESMW08	4.591	4.78	0.189
T_ESMW07	4.183	4.45	0.267
T_1_ESMW01	7.07	13.59	6.52
T_2_ESMW02		16.12	
T_3_ESMW03		18.11	
T_ESMW09	8.8	9.85	1.05
T_ESMW10	6.413	14.81	8.397
T_5_ESMW06	7.173	7.72	0.547
T_5_ESMW04	2.932	4.26	1.328
T_5_ESMW05	6.382	10.71	4.328

An interpolation of the groundwater levels on the NPS site was undertaken to determine the depth from the ground surface to the groundwater table across two approximately east-west and north-south cross sections (Figure 6.4.3). This interpolation indicated that the depth to the groundwater table near the NPS ranges from a minimum of 0.1m BGL to a maximum of 11m BGL along the east- west cross section, and between approximately 0.75 and 10m BGL along the north-south cross section.

The groundwater data used for the interpolation is restricted to a single monitoring point in time (December 2018) and is therefore indicative only. However, the monitoring was undertaken at the end of the wet season and following a period of intense rainfall, which would have locally recharged the groundwater table, and can therefore be considered conservative.

Groundwater monitoring from the NGSF boreholes (Coffey, 2011 and AGL, 2013) indicate that groundwater levels in the Proposal area and within the Tomago Sandbeds aquifer fluctuate and are driven by periods of high and low rainfall. Groundwater levels are expected to be at their lowest at the end of the dry season, before the summer rains recharge the system. Depth to groundwater ranged from 0.08 to 3.15m across the boreholes and sampling periods for the NGSF study, with horizontal hydraulic conductivity ranging between 7.4 and 11.3m/d across the three boreholes. More recent groundwater monitoring done for the operation of the NGSF indicated depth to groundwater across the boreholes sampled ranged from 1.26 to 4.97m BGL (GHD, 2019). Analysis as part of the *Newcastle Gas Storage Facility Groundwater and Surface Water Monitoring Program* indicated groundwater levels are generally responsive to rainfall, typically responding by 1-3 mm per 1 mm of atypical rainfall.

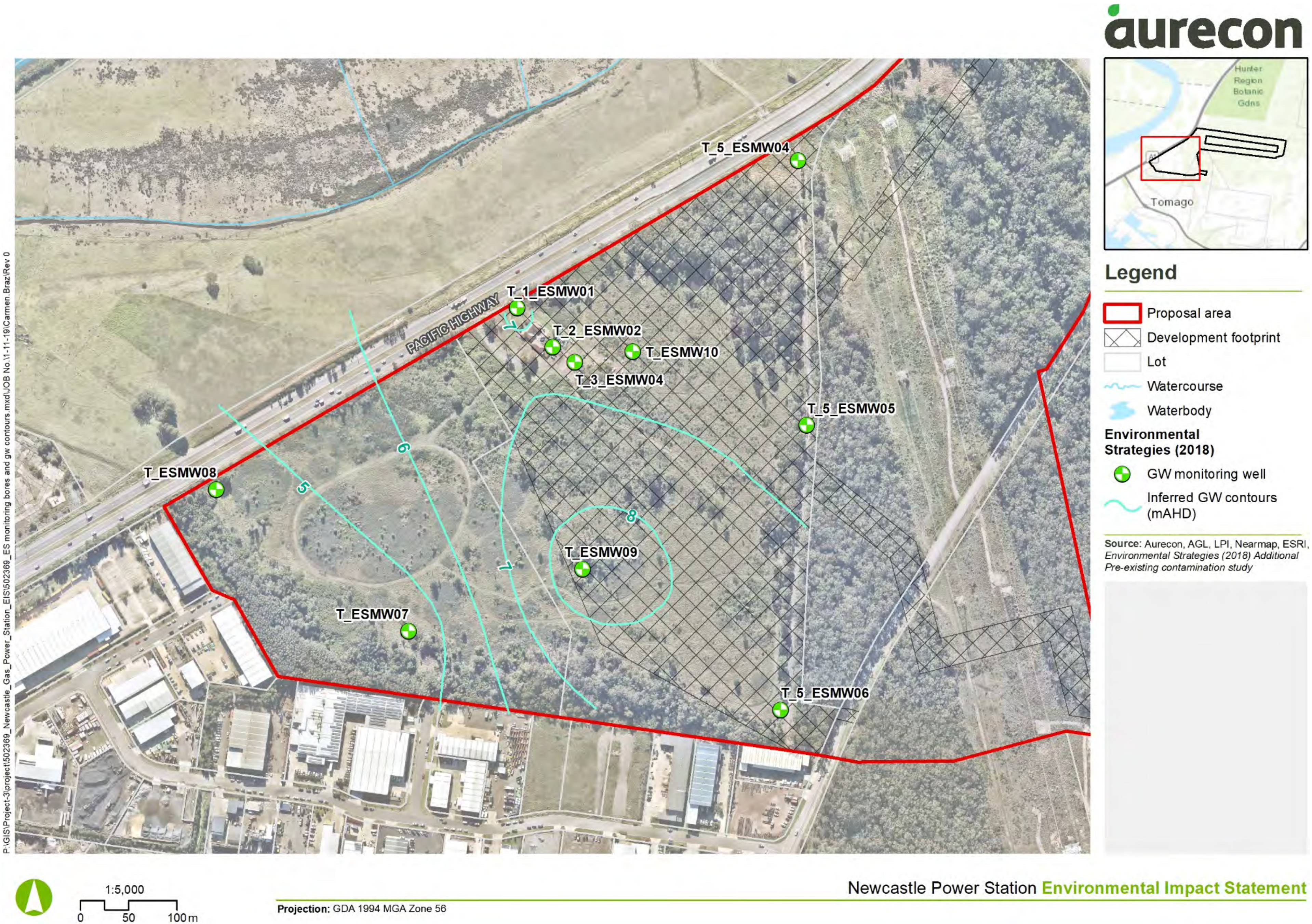


Figure 6.4.2 Inferred groundwater elevation contours

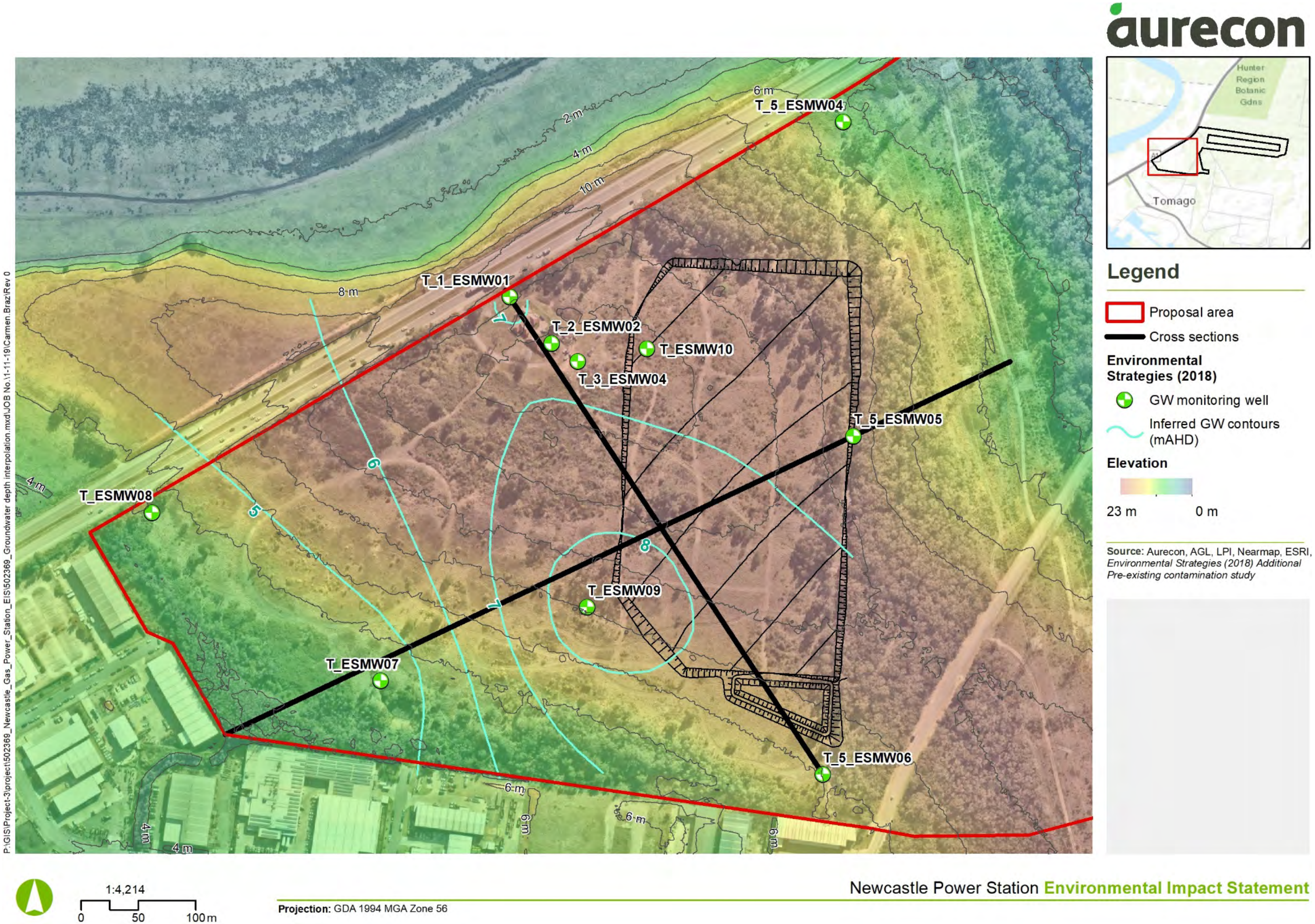


Figure 6.4.3 Groundwater depth interpolation near the NPS site

Regional groundwater users and Water Sharing Plans

The Proposal area falls within the Hunter River Catchment 'Estuary Zone'. The quality of groundwater needs to be protected within this zone, particularly in the Kooragang and Fullerton Cove areas, which are within the Ramsar wetlands. Groundwater levels should not be depleted in areas of acid sulphate soils, which underlie most of the estuary.

While the proposed power station is not located within a drinking water catchment, the proposed gas storage pipelines and electricity transmission line overlay the south-western fringe of the Tomago Sandbeds. The sandbeds are a natural groundwater sand aquifer which is recharged by rainfall infiltration and used to supplement dam water to provide potable water to the region in times of drought (refer Section 6.3.1).

The Proposal area is within the Sydney Basin-North Coast Groundwater Source, covered by the WSP for the North Coast Fractured and Porous Rock Groundwater Sources (DPI, 2016). The Tomago Sandbeds groundwater source is fully allocated with no new licences being issued.

Local groundwater resource and users

There are 35 registered groundwater bores within 1km of the Proposal area (Figure 6.4.4). The status and purpose of 20 of these are unknown, while 15 were established as groundwater monitoring bores for the adjacent NGSF. The closest bore to the NPS is GW201068, located 500m south-east, which was drilled to 7.5m BGL. Geological information from this bore indicates the underlying geology includes a top layer of sand to a depth of 8m BGL, underlain by clay which extends down to 20m BGL, which is typical of the Tomago Sandbeds.

Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are ecosystems that rely on groundwater for some or all of their water requirements. There are a number of potential GDEs mapped in the Proposal area, the north-east corner of the site is identified as a moderate potential GDE featuring woodlands on coastal sand vegetation that rely on the availability of shallow groundwater (see Figure 6.4.5). The proposed ultimate stormwater discharge location from the secondary drainage line into the LEP Wetlands is identified as a low potential GDE. The gas pipelines and electricity transmission line would be developed across land identified as high, moderate and low potential GDE. The Hunter River is classified as an aquatic high potential GDE.

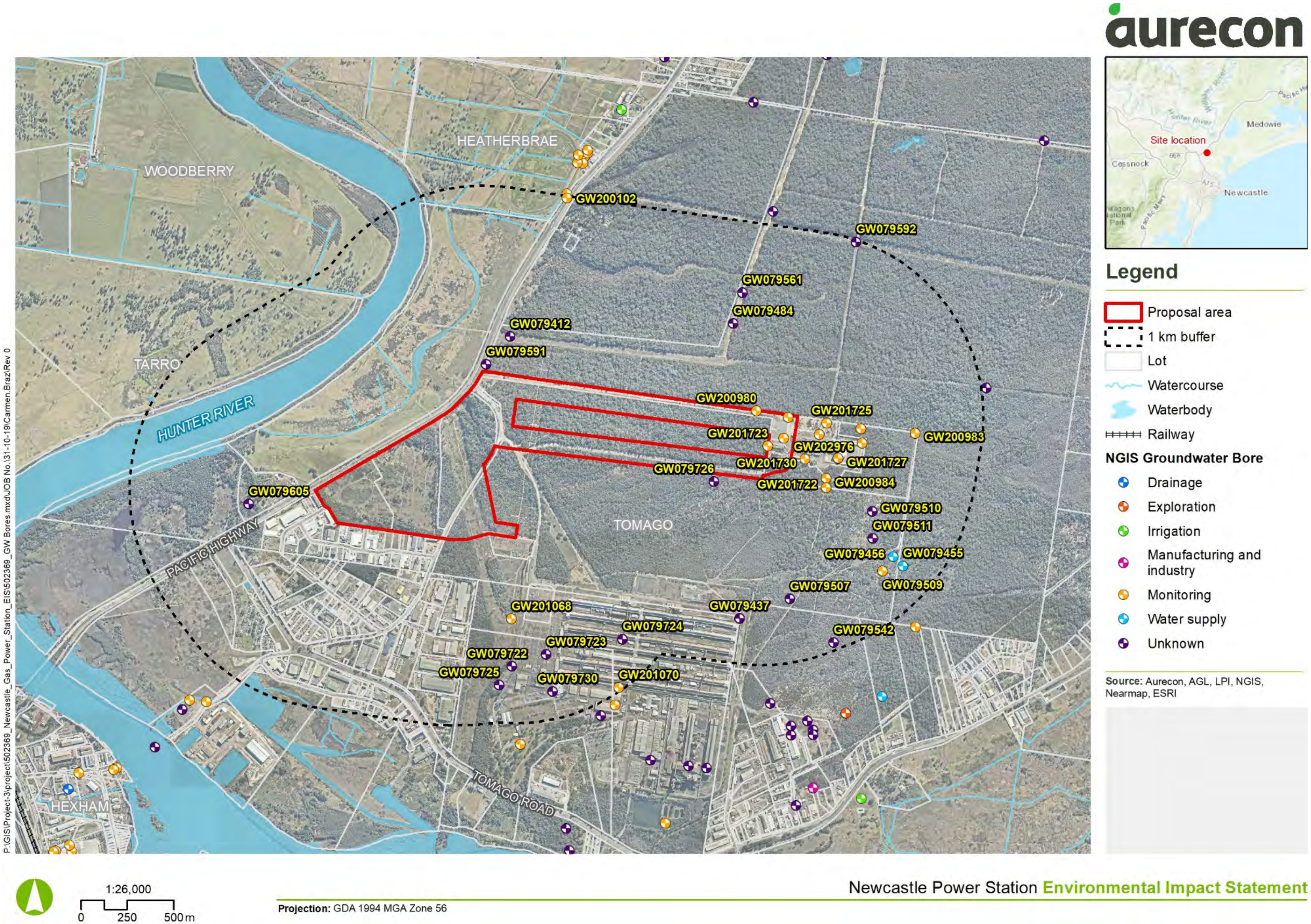


Figure 6.4.4 Groundwater monitoring bores

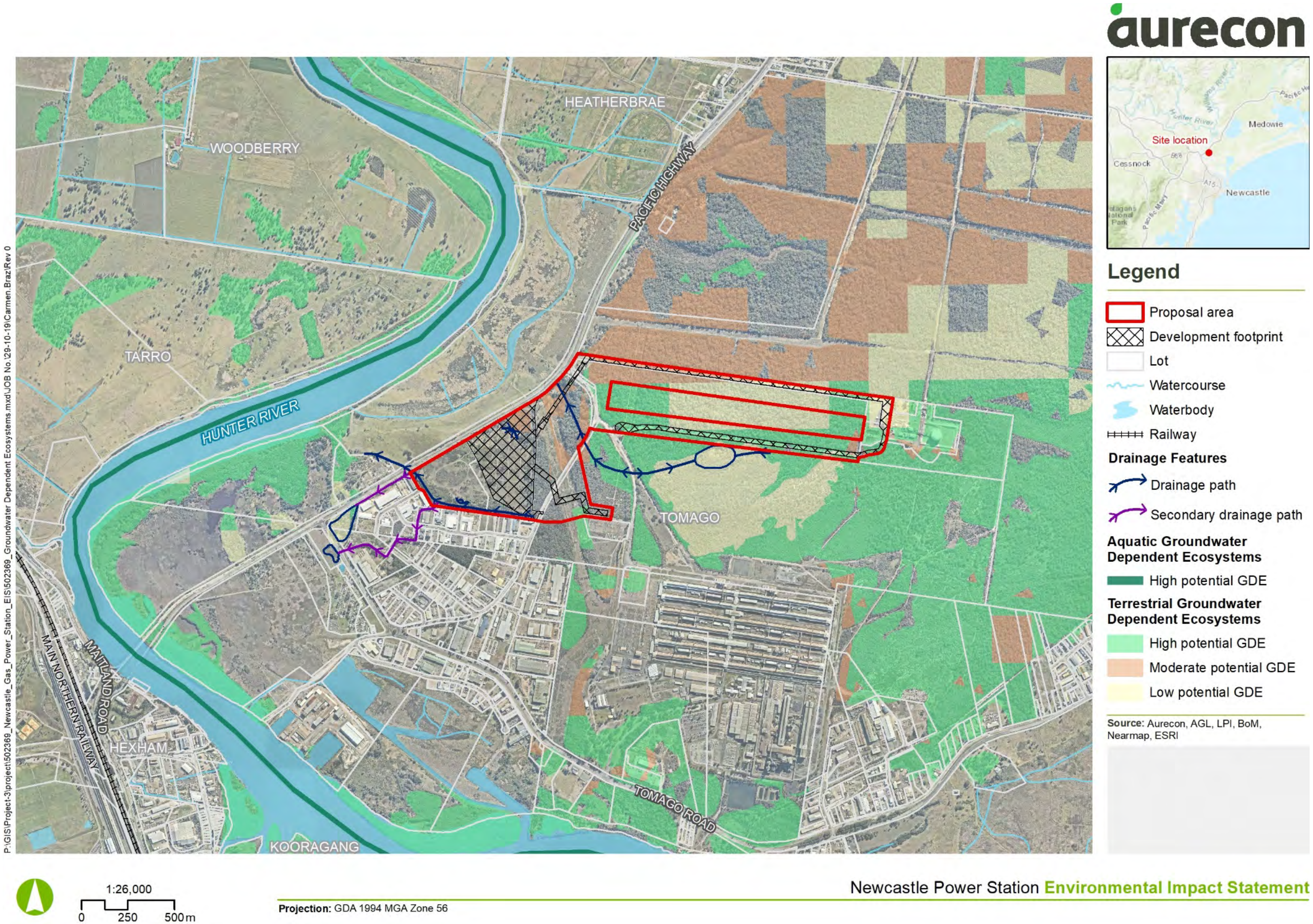


Figure 6.4.5 Groundwater Dependent Ecosystems (GDE)

Groundwater quality and existing contamination

In 2018, Environmental Strategies undertook a contamination assessment across the NPS site, including soil, sediment, surface water and groundwater sampling in Lots 2 and 3. This assessment included the installation of 10 groundwater monitoring wells. Groundwater monitoring wells were installed in areas of concern (AEC) identified in the assessment (including dumped waste, stockpiled materials, septic tanks, abandoned motor vehicles and the residence), which may be sources of localised contamination. These local contamination sites are mapped on Figure 6.6.6.

Other groundwater monitoring wells were installed across the rest of the Proposal area, where there were no known contaminating activities. Several chemicals of potential concern (CoPC) were detected in the groundwater samples above the groundwater assessment criteria (GAC) in both the AEC and the rest of the Proposal area, which were considered to constitute contamination or pollution.

High concentrations of copper were detected in groundwater samples across the eastern half of the NPS site, in both background and AEC. It was considered unlikely that these levels were evidence of impact but may be indicative of naturally elevated copper levels in local groundwater in the general area (Environmental Strategies, 2018).

The groundwater well with highest standing water level (T_ESMW09, see Figure 6.4.2) was considered unlikely to have been impacted by the existing residence near the NPS site and most likely to represent background conditions. Apart from nickel, all metals were below the GAC at this well. The nickel result was adopted as a low reliability background screening level (LRBSL) (Environmental Strategies, 2018).

Groundwater monitoring undertaken in 2011 as part of the NGSF environmental assessment indicated chromium levels exceeding the Fresh Water Criteria and zinc levels exceeding the Fresh Water and Marine criteria for all three wells. However, the remainder of the parameters tested were below the criteria or below detection limit, indicating a relatively pristine environment. The results indicate a significant difference in water quality profiles between the NPS site and the gas storage pipelines area, which supports the understanding that these areas are underlain by different aquifer systems.

This difference in profiles was again observed during the 2018 Environmental Strategies sampling program. Measurements of electrical conductivity indicated that groundwater was fresh to brackish at the NPS site, while readings along the proposed storage pipeline corridor indicated that groundwater was fresh, which is typical for groundwater in the Tomago Sandbeds aquifer (Woolley et al, 1995). In both areas, pH readings were low, ranging from 3.4 to 5.3, indicating acidic groundwater conditions which is likely due to the acid sulphate soils in the area.

6.4.2 Study methods and criteria

The GWA included a site inspection and survey of the Proposal area as well as review of the available local BoM data, spatial mapping resources, literature and previous investigations, including monitoring and construction reports from the adjacent NGSF.

An interpolation of the groundwater levels beneath the NPS site was undertaken using kriging in ESRI ArcMap with the inferred groundwater contours mapped (Figure 6.4.2) and the groundwater depths recorded from the boreholes in the Environmental Strategies 2018 study (Table 6.4.1). This data was compared with the existing topography and the NPS conceptual design along two cross-sections oriented approximately east-west and north-south. This comparison determined the risk of intercepting the groundwater table when constructing the NPS.

This GWA was undertaken in accordance with the following key reference documents and guidelines:

- Port Stephens Local Environment Plan (LEP), 2013
- Department of Agriculture and Water Resources – National Water Quality Management Strategy (NWQMS), 2018
- Department of Primary Industries – NSW Aquifer Interference Policy, 2012

- Department of Primary Industries – Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources: Background Document, 2016
- Department of Land & Water Conservation – NSW Groundwater Dependent Ecosystem Policy, 2002
- Department of Land & Water Conservation – NSW Groundwater Quality Protection Policy, 1998
- State Environmental Planning Policy (Coastal Management) 2018
- HWC – Protecting our Drinking Water Catchments – Guidelines for Development in the Drinking Water Catchments, 2017
- HWC – Hunter Water Regulation, 2010

6.4.3 Potential impacts

Construction

Acid sulphate soil leachate

Due to the depth of the pipeline, there is a risk of encountering potential or actual ASS (collectively referred to as ASS) during excavations, ground disturbance and shallow dewatering from trenches, which could release acidic leachate into adjacent drains and wetlands if not contained. There is also an increased risk of encountering ASS where HDD is used in pipeline construction, due to the depth of the underbore below the ground surface.

The construction of the adjacent NGSF demonstrates AGL's understanding of the controls required when constructing pipelines in potential ASS, and their capability in managing the risks of acid leachate. This included development and implementation of a Construction Environmental Management Plan (CEMP) including the following sub plans:

- Surface Water Management Sub-Plan
- Groundwater Management Sub-Plan
- Soil Management Plan
- Acid Sulphate Soil Management Sub-Plan

This proven approach would be applied to the Proposal.

During construction of the NGSF, field pH screening tests were undertaken on excavated soils where ASS was anticipated or suspected along the construction footprint. The NGSF ASSMP was activated during works near Old Punt Road and within the Ausgrid easement where potential ASS was encountered. During trenching, ASS encountered was treated in-situ with agricultural lime and trenches were backfilled within 24 hours where possible. Excess excavated material was taken to a designated ASS storage and treatment area for pH treatment in accordance with the Acid Sulphate Soils Manual. This area was established near the entrance to the NGSF site, away from water bodies and drainage lines to limit the potential for impacts from the generation of acidic runoff. Bunding was installed to prevent leachate mobilising from the area into the surrounding environment. Here, treated ASS was tested for assessment and waste classification prior to final disposal as solid waste. This proven approach would be applied to the Proposal.

During construction of the Proposal, ASS testing and management procedures, including containment and lime treatment in accordance with the Acid Sulphate Soils Manual, would be required. These procedures and requirements would be set out in a Proposal area-specific ASS management sub plan, which would be prepared prior to construction.

Groundwater levels and flow

The groundwater system underlying the Proposal area is reliant on rainfall as its primary recharge method. Therefore, altered surface water runoff due to vegetation removal during vegetation clearing activities may potentially affect the local groundwater level. As most of the development footprint has been previously cleared, this is not expected to be a significant impact.

Groundwater may be intercepted during excavation and trenching, particularly for pipelines, due to the shallow groundwater table. There is a higher potential of encountering groundwater along the proposed gas storage pipelines compared to the NPS site and electricity transmission line, due to the lower topography.

NPS site

An interpolation of the groundwater levels beneath the NPS site was undertaken to determine the risk of intercepting the groundwater table when constructing the NPS concrete pad. A conceptual pad profile was compared to existing topography and interpolated water table levels to create approximately north-south and east-west cross-sections (Figure 6.4.6 and Figure 6.4.7). The cross sections indicate that construction of the pad in cut/fill balance is not anticipated to intersect the water table, as the proposed NPS concrete pad straddles part of the interpreted groundwater mound. The NPS pad would be predominantly constructed on fill where closest to the water table. The minimum clearance between the interpolated groundwater level and the finished concrete pad is approximately 2 m, interpolated in the south-west. The depth to groundwater interpolated should be sufficient to enable all proposed construction activities without intercepting the groundwater table. These activities include tree removal, grubbing, topsoil stripping, cut-and-fill earthworks, compaction, and installation of underground services.

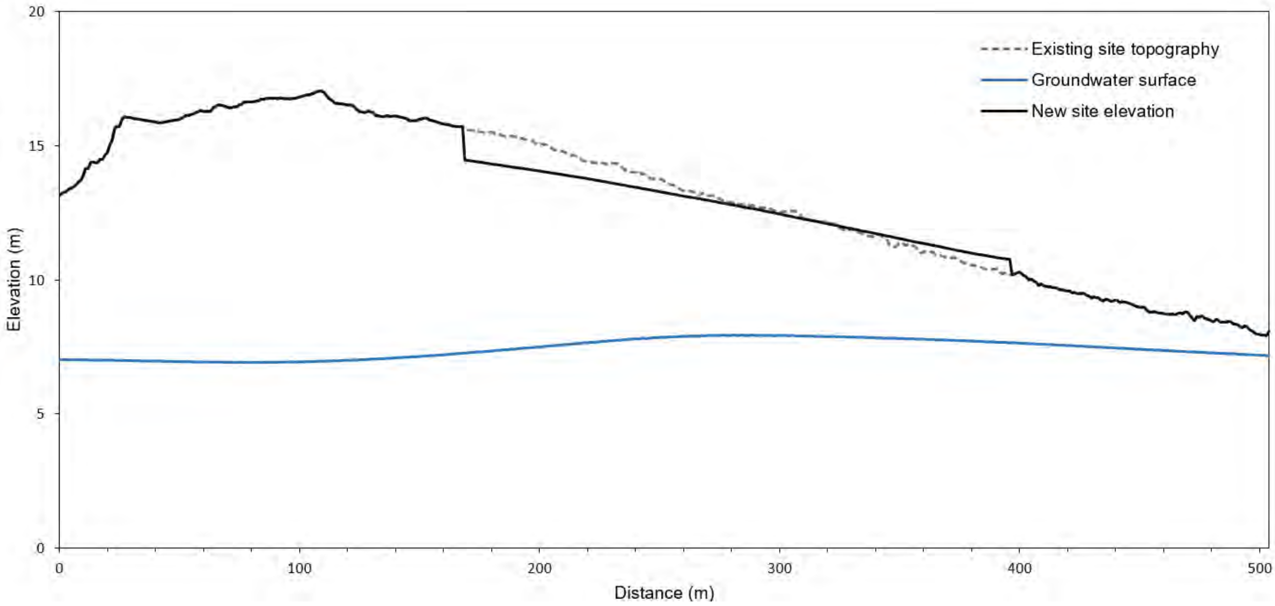


Figure 6.4.6 Conceptual cut/fill balance and groundwater table (north-south)

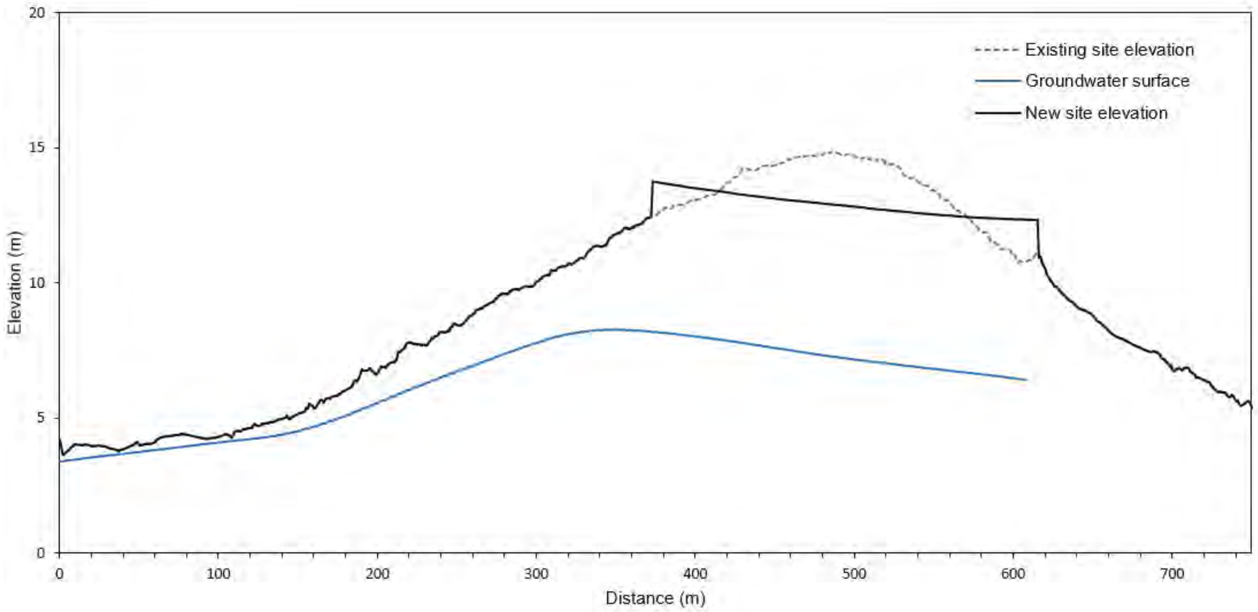


Figure 6.4.7 Conceptual cut/fill balance and groundwater table (east-west)

Localised perched water may be encountered during excavation for the NPS, but it is not anticipated that these shallow excavations would encounter significant in-flow or create enduring impact on regional groundwater level.

Following construction of the proposed pad, the groundwater table would be between approximately 5 and 6m below the finished surface (east to west) and between approximately 2 and 8m below the finished surface (north to south)

Electricity transmission line

Installation of the electricity transmission line would have minimal sub-surface intervention and due to the elevated topography along the alignment, is unlikely to have any impact on the existing groundwater levels.

Gas pipeline

Interception of the groundwater table and dewatering of groundwater is likely to be required during construction of the gas storage pipeline due to the low-lying topography and depth to groundwater table (which may be between 10cm and 3m BGL). Due to the low permeability of the clay dominated alluvial soils, it is not expected that shallow excavations would encounter significant inflow or create an enduring impact on regional groundwater level.

Early concept design indicates excavation for the pipelines would be undertaken around 2-3m below the ground surface, to accommodate an approximately 42" diameter pipe (107cm). This may be below the water table, and therefore dewatering would be required during construction, which may temporarily impact groundwater flows. Beneficial reuse of this water will be considered. Installation of the pipeline would require boring pits and associated tunnelling HDD where it crosses existing services or roads, while the remainder of the pipeline would be trenched.

The installation of the pipelines may impact on groundwater flows within the development footprint. Where the buried pipeline is placed across the flow direction of groundwater, damming of shallow groundwater could occur, however the soil surrounding the pipeline will typically be coarse-grained material (sand or gravel assigned to the Tomago Sandbeds) that would facilitate the flow of groundwater around the pipe. Where this is not the case, installing sand or gravel in the base of the trench and surrounding the pipeline would enable groundwater to flow around the pipe and mitigate adverse impact on the flow of shallow groundwater from the pipeline. Design development may include installation of permeable zones to allow groundwater to bypass the buried gas pipeline if required.

During construction of the NGSF, management of groundwater encountered was undertaken in accordance with a Groundwater Management Sub-Plan. Dewatering of water accumulated in trenches or excavations, including incursion of groundwater, was undertaken in accordance with a site-specific Dewatering Procedure. Based on experience during construction of the pipeline for the NGSF it is not anticipated that adverse impact on the groundwater resource would occur because of the short-term duration of dewatering.

Based on a review of available groundwater monitoring data from the NGSF, the March 2019 *Newcastle Gas Storage Facility Groundwater and Surface Water Monitoring Program* concluded that there is no evidence that the operation of the NGSF has had a significant influence on groundwater levels.

The implementation of the management controls detailed in the GWA including implementation of a Groundwater Management Sub Plan and lining the pipelines with coarse-grained materials such as sand would avoid measurable impacts on groundwater levels or flow.

Groundwater users

It is not proposed to extract any groundwater for construction use. The Proposal would source potable water from municipal supply. The Proposal is therefore not expected to impact on any adjacent licenced water users or existing groundwater infrastructure. Management plans would be put in place to make sure that the development of the Proposal does not affect the water quantities, water qualities or associated ecosystems recognised under the North Coast Fractured and Porous Rock Groundwater Sources WSP.

Should any groundwater be encountered and abstracted from the Tomago Sandbeds aquifer, it may be used for construction purposes, or locally reinjected back into the aquifer following a visual inspection for contamination and water quality testing. The water quality characteristics would be compared to data from groundwater monitoring wells, and if there is more than a 10% difference in parametrics, the groundwater would require treatment prior to re-injection. If treatment is unsuccessful or not possible, the water would be disposed of to a licenced waste facility capable of accepting the contaminated water.

Groundwater dependent ecosystems

As the construction of the NPS concrete pad would not intercept or alter groundwater levels, it would not impact on GDEs in this area.

The installation of gas pipelines may impact on GDEs in the area. Where the trench extends below the water table, excavating the trench over short lengths will reduce the volume of groundwater extracted during construction. This would reduce the change in recharge and discharge volumes and qualities. By lining the pipeline trenches with permeable sand or gravel, the flow of shallow groundwater along the proposed pipeline alignment would not be impeded, which would mitigate potential adverse impacts on GDEs. Using these approaches, there is not expected to be any measurable groundwater impact on the GDEs near the Proposal area.

It is expected that there would be no measurable groundwater impact from construction of the Proposal on GDE in the immediate vicinity of the NPS, along the proposed pipeline and transmission line or further away at the Hunter Estuary Wetlands Ramsar Site.

Groundwater quality and contamination

As the ground water table is close to the ground surface, there is the potential to impact on groundwater quality through infiltration of contaminated surface water or direct spills or leakages to unpaved ground. The potential impacts to water quality from contaminant spills, leaks and from mobilisation of soil and dust during the construction phase are discussed in Section 6.3.3.

The Tomago Sandbeds aquifer is considered vulnerable because of the highly permeable sandy soils, the shallow water table, its value as a water supply source for the region and a source of environmental water for GDEs (Coffey, 2011). Water quality sampling undertaken for the Proposal has indicated the pipeline corridor is underlain by a relatively good water quality, while the NPS site has elevated chemical concentrations in the groundwater which is considered to be contaminated. The results indicate a significant difference in water quality profiles between the NPS and the proposed pipeline area, which supports the understanding that these areas are underlain by different aquifer systems.

The key to preventing impacts to groundwater is to prevent surface water contamination. A suite of mitigation and management measures to prevent surface water contamination are described in Section 6.3.4. These include a Dewatering Procedure which requires that all water encountered is tested to determine whether it meets discharge criteria, and that any water which cannot be treated to meet discharge criteria would be transported for offsite disposal at a licenced facility.

The Surface Water Quality Assessment completed as part of the SWHSS for the Proposal indicated that operational stormwater discharges from the bioretention system would likely be of a superior quality compared to the existing background conditions. With the implementation of a site-specific Soil and Water Management Plan and Groundwater Management Plan for the Proposal and the suite of control measures recommended in this EIS, a Neutral or Beneficial Effect (NorBE) on the receiving groundwater quality can be demonstrated. The Proposal would meet the required groundwater policies regarding protecting water quality and quantity. The likelihood of the Proposal impacting on the Kooragang component of the Hunter Estuary Wetland is low.

During the construction of the NGSF, water quality parameters including pH and turbidity were tested prior to discharge to surface or groundwater, which was undertaken in compliance with a signed Dewatering Permit and the Soil and Water Management Standard. Where water could not be treated to adequate discharge criteria, untreated water was contained and transported offsite by a licenced contractor and disposed of to a licensed facility. No ground water contamination was recorded during this period. The NGSF water quality monitoring did not identify any adverse impacts.

As similar measures would be implemented as part of the Proposal, it is also expected that construction of the Proposal would not adversely impact on groundwater quality.

The implementation of the management controls detailed in the GWA including development and implementation of a Groundwater Management Sub Plan, Soil and Water Management Sub Plan, and an Acid Sulphate Soil Management Sub Plan, would assist in preventing contamination of groundwater by negating the infiltration of contaminated surface water and the leaching of potential contaminants from the soil into the groundwater. Implementing these controls would avoid measurable impacts of the Proposal on groundwater quality, levels or flow, and on GDEs.

Operation

Groundwater levels and flow

The groundwater system underlying the Proposal area is heavily reliant on rainfall as the primary recharge method. There is the potential for altered surface water flow and reduced local groundwater recharge in the Proposal area due to vegetation removal and an increase in impermeable surfaces, which would cover around 30% of the NPS site. Due to the clayey nature of the underlying geology, this may cause local groundwater levels in the Tomago Coal Measures aquifer to drop.

The gas pipeline and electricity transmission line would not result in large new areas of impermeable surfaces that would adversely affect the recharge of the Tomago Sandbeds aquifer. This aquifer is mostly recharged directly by rainfall rather than lateral flow from surrounding aquifers.

Groundwater users

Potential groundwater pathways between the operational NPS and the Tomago Sandbeds are unlikely to occur due to the low seepage velocity and hydraulic conductivity of the alluvial materials in the Proposal area. The Proposal is thus not expected to impact the Tomago Sandbeds aquifer or the Hunter Water boreline during operations.

Groundwater dependent ecosystems

By ensuring no perceptible net change in recharge and discharge volumes and qualities as a result of the Proposal, there is not expected to be any measurable groundwater impact on the GDEs in the immediate vicinity of the Proposal area. Refer Section 6.2 for more information on potential biodiversity impacts on GDEs within the Proposal area.

Groundwater quality and contamination

During operation of the NPS, there is the potential for fuel and contaminant spills such that shallow groundwater could be impacted. Appropriate design of fuel storage infrastructure would reduce this risk, however, there may be accidental spills within storage and unloading areas or leaks from power station infrastructure. This risk can be mitigated by a chemical storage and containment plan and through the installation of separate stormwater and chemical drains.

Discharges from the NPS, including effluent from sewage or process water storage ponds, or contaminated stormwater releases, have the potential to affect the water quality in the receiving groundwater environment. The proposed operational wastewater and stormwater management systems, including the GPT and bioretention system, will achieve NorBE. The operational wastewater management system is described in Section 2.6.7.

The presence of a groundwater divide located to the south-southeast of the Proposal area would prevent potentially impacted groundwater from reaching the Ramsar-listed Hunter River Estuary wetlands.

Cumulative impacts

The Proposal is situated in an area that is zoned for industrial purposes, it is adjacent to areas currently used for industrial purposes and is more than 2km from the nearest residential zoning. Any minimal disturbance of groundwater flow from the Proposal is unlikely to adversely impact on the ecological character of nearby waterways. As the power station is located at a groundwater mound and the alluvial materials nearby is of low effective permeability, there is low potential for the Proposal to contribute to cumulative impacts. The storage pipelines are to be partially constructed on the Tomago Sandbeds aquifer, however, groundwater flow is away from the aquifer so there would be minimal impacts on the groundwater flow of the sandbeds.

None of the projects in the area are likely to have a substantial long-term impact on groundwater due to the large catchment area for recharge of the groundwater resource. Other projects near the Proposal could result in impacts to the groundwater aquifers due to improved drainage and increase in the impermeable area.

Short-term impacts on groundwater quality and levels during construction are expected to be managed by on site controls for the Proposal and other nearby projects and are not anticipated to be significant.

6.4.4 Avoidance, mitigation and management

A range of avoidance, mitigation and management measures would be implemented for ground water outlined in Table 6.4.2.

Table 6.4.2 Avoidance, mitigation and management - Groundwater

ID	Environmental Safeguard	Timing
GW-1	A Groundwater Management Plan would be prepared, implemented and updated as required as part of the CEMP and OEMP. The plan would describe best practice control measures to reduce the risk of contamination of groundwater, or the substantial alteration of groundwater flows due to drawdown effects. The plan would detail: ■ Background groundwater quality and levels ■ Management of groundwater interference and dewatering ■ Groundwater testing and assessment ■ Groundwater discharge or reinjection criteria ■ Best practice controls ■ Spill response and containment plan ■ Contamination response plan ■ Drawdown contingency plan ■ Groundwater monitoring program The Groundwater Management Plan would include a groundwater monitoring program which would detail: ■ Groundwater monitoring required – Analytes/parameters (water quality) – Background concentrations – Criteria/thresholds ■ Groundwater levels ■ Frequency ■ Bore locations – The 10 existing monitoring bores on the NPS site – Available boreholes at the NGSF site near the proposed pipeline corridor – Additional locations along the pipeline corridor – At the directional drilling entry and exit pits (during construction) – Upstream and downstream of the operational stormwater discharge point/s ■ Potential impacts – Change in groundwater quality or levels – Drawdown impacts – Effects on GDE – Effects on beneficial aquifers (including groundwater users) ■ Reporting requirements ■ Protocol for the investigation, notification and mitigation of any identified exceedances of the groundwater quality criteria Monitoring requirements would be reviewed once the details of the construction are finalised and during construction.	Construction Operation

ID	Environmental Safeguard	Timing
GW-2	Limit the extent of impervious surfaces to allow aquifer recharge.	Pre-construction
GW-3	Minimise long-term disturbance of groundwater flows through design, such as incorporating permeable zones that allow groundwater to bypass the buried gas pipeline.	Pre-construction Construction
GW-4	When constructing the gas pipeline in areas of shallow groundwater, the following techniques should be considered to minimise groundwater impact: ■ Trenches below the water table would be excavated over short lengths to reduce the volume of groundwater impacted during construction ■ As required, use appropriate materials, such as trench shields or sheet piles, to maintain the stability of excavation walls ■ If practical, dewater to locally lower the water table beneath the floor of the excavation to provide a safe and dry working surface ■ Abstracted groundwater would be stored pending water quality testing, for either re-injection or infiltration (if water quality criteria are met) or disposal offsite at a licensed disposal facility ■ Replace material excavated from trenches to minimise changes to groundwater flows ■ Where possible, pipelines will be bedded on sand in the base of the trench	Construction
GW-5	When working along the pipeline route, additional precautions should be made when using or transporting fuels and chemicals, and any spills should be immediately contained and cleaned up. Any contaminated material to be removed from the Proposal area is to be sent to a licensed facility.	Construction
GW-6	Any water encountered and abstracted from the Tomago Sandbeds aquifer should be locally reinjected back into the aquifer on the hydraulically down gradient side, approximately 50m from the edge of the construction works Prior to re-injection the abstracted groundwater must be inspected for any signs of contamination (high turbidity, oily sheen or odour of hydrocarbons) and tested for water quality parameters (temperature, dissolved oxygen, redox, EC, and pH), which would be compared to measurements from nearby monitoring wells. If greater than 10% difference with the groundwater measurements treatment would be required prior to re-injection. If collected groundwater does not meet criteria for re-injection, then the collected groundwater must be disposed to a facility licenced to accept and treat contaminated water.	Construction
GW-7	Undertake infiltration rate tests at locations of proposed groundwater discharge areas or infiltration basins to determine local infiltration rates and the presence of indurated sand layers capable of inhibiting groundwater recharge.	Construction Operation
GW-8	Process water would be managed to prevent discharge to surface water systems or groundwater.	Operation
GW-9	Sealed pavement areas should be used for refuelling and chemical storage areas to minimise the risk of spills infiltrating to groundwater.	Construction Operation
GW-10	Prepare a remediation action plan for major spills or other incidents which may cause impact to groundwater quality. This may include hydraulic containment using downgradient berms and pumps.	Construction Operation
GW-11	Rehabilitate compacted areas which are not needed for operational activities by loosening the soil, adding organic matter and revegetating the area.	Post-construction

6.5 Air quality

An air quality impact assessment (AQIA) and a greenhouse gas emissions assessment (GHGA) were prepared by Environmental Resources Management Australia Pacific Pty Ltd (ERM). The assessments reviewed the potential impacts on air quality and greenhouse gas (GHG) emissions from the construction and operation of the Proposal and identified mitigation measures to minimise these impacts.

The AQIA and GHGA are provided in Appendix G and Appendix H respectively.

6.5.1 Existing environment

Climate and meteorology

The Proposal would be located approximately 11.5km inland of the east coast of Australia in the Hunter region of NSW. The area has a humid subtropical climate with warm summers and mild winters. Air quality in the region is heavily influenced by land and sea breeze flows in normal and extreme weather conditions.

The closest weather station to the Proposal is located approximately 9km south at the Newcastle University. Climate data from the station is described in Table 6.5.1 (BoM, 2019). This data describes average weather recordings from 1998 to 2019 (a 20-year period) and provides the most accurate representation of the current climate for the Proposal area.

Table 6.5.1 Climate statistics for Newcastle University weather station (#061390)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Twice daily temperature observations (°C)													
9am mean	23.3	22.6	20.7	18.5	14.8	12.3	11.3	13.0	16.7	19.3	20.2	22.3	17.9
3pm mean	27.3	26.5	25.0	22.1	19.5	17.0	16.6	18.2	21.1	22.7	23.7	26.0	22.1
Twice daily relative humidity observations (%)													
9am mean	72	78	78	77	78	79	77	69	65	62	71	70	73
3pm mean	57	62	60	61	59	60	54	48	48	50	58	58	56
Temperature Range (°C)													
Mean maximum	29.5	28.5	26.9	24.2	21.2	18.3	18.0	19.7	22.7	24.9	26.0	28.0	24.0
Mean minimum	19.5	19.4	17.6	14.1	10.5	8.8	7.3	8.0	10.7	13.4	15.9	17.9	13.6
Rainfall (mm)													
Mean Rainfall	84.5	133.1	124.4	127.3	88.3	133.2	54.0	57.5	66.9	66.2	109.2	69.4	1147.1
Mean rain days	7.6	9.4	9.0	8.6	7.6	9.2	7.0	6.3	6.0	6.4	9.2	7.4	93.7
Sky Condition													
Mean clear days	9.3	6.1	8.3	8.1	11.4	10.0	11.5	12.0	12.3	9.9	6.3	6.6	111.8
Mean cloudy days	9.8	10.9	8.9	8.0	7.8	7.9	8.0	5.8	5.4	8.2	11.5	9.5	101.7

The highest average monthly temperature at the Newcastle University weather station is 29.5°C which occurs in January, while the lowest average temperature of 7.3°C occurs in July. The highest precipitation occurs during November to April in autumn, which then tends towards a drier winter from August to October.

The DPIE operate six air quality monitoring stations (AQMS) in the Newcastle region that collect meteorological and ambient air quality data. Of the six stations, the closest is Beresfield located 4.5km to the north west of the Proposal. The other five stations (Mayfield, Stockton, Wallsend, Carrington and Newcastle) are located to the south east of the Proposal within 14km (Figure 6.5.1). Average data of these stations has been used to inform the meteorological and ambient air conditions relevant to the Proposal, while data from the 2018 Beresfield recordings were selected for modelling due to proximity and local representation.

Figure 6.5.1 DPIE's air quality monitoring stations

Wind speed and direction

Average wind speed at the Beresfield weather station from 2014-2018 was 2.5m/s with calm conditions occurring approximately 5% of the time. The Hunter Valley topography influences the wind flow in the region with dominant winds on the north-westerly/south-easterly axis (Figure 6.5.2).

North westerly winds are dominant during winter, while south-easterly winds are dominant during summer. The direction of wind in autumn and spring are variable, with strong north-westerly winds present during early spring. This is illustrated in Figure 6.5.2 which shows the annual and seasonal windrose at the Beresfield weather station in 2018.

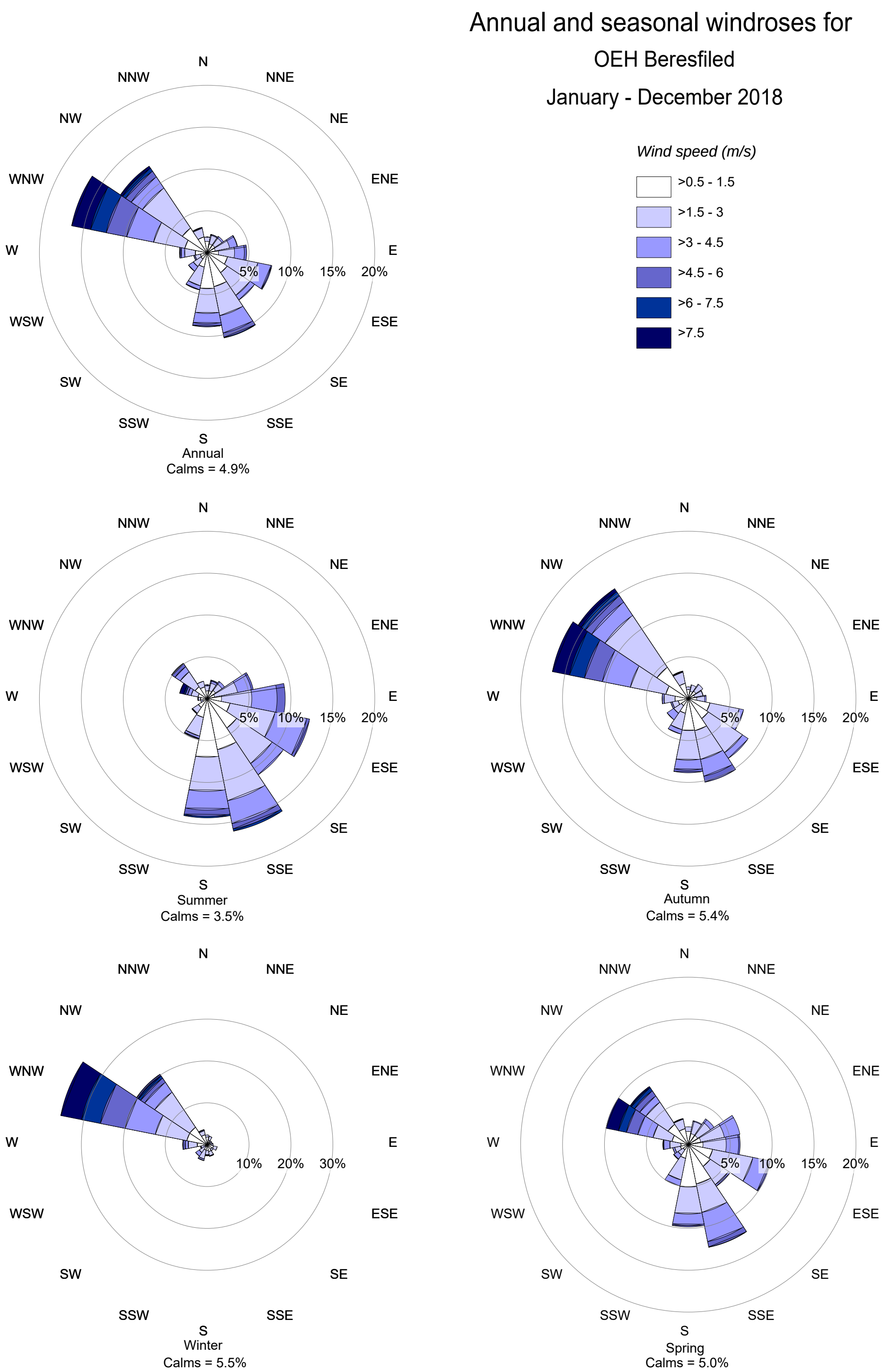


Figure 6.5.2 Annual and seasonal windroses, Beresfield 2018

Ambient air quality

As described in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods), potential impacts from the Proposal need to be assessed against the most relevant air quality pollutants. The AQIA collected relevant air quality pollutant data from 2014 to 2018 from the six Newcastle region weather stations (Figure 6.5.1). The data was then assessed by a quantitative dispersion modelling analysis to estimate compliance of operational phase emissions with the NSW EPA impact assessment criteria (discussed further in Sections 6.5.2 and 6.5.3).

A summary of the existing ambient air quality and the NSW EPA's impact assessment criteria regarding these pollutants is provided in Table 6.5.2. The measurements include approximately 200,000 readings taken over a five-year span (44,000 hours per year).

Table 6.5.2 Summary of relevant ambient air pollutants and the NSW EPA impact assessment criteria

Pollutant	NSW EPA impact assessment criteria	Description
Nitrogen dioxide (NO_2)	246µg/m³ (hourly)	All measurements for peak concentrations across the recording period (except for two) were below 100µg/m³, with higher measurements observed during winter months. Over the last five years, peak concentrations tended to be approximately five times higher than average concentrations. The site with the highest average concentration of NO_2 was Mayfield (18.0µg/m³), followed by Beresfield (17.9µg/m³) and the lowest being Stockton (14.2µg/m³).
Carbon monoxide (CO)	30,000µg/m³ (hourly)	Newcastle is the only station in the region that measures CO. At this station, CO peak concentration was generally below 2,500µg/m³, with higher concentrations observed in winter months. Peak values have been decreasing over the last five years, whilst average values have been variable.
Sulphur dioxide (SO_2)	570µg/m³ (hourly)	All measurement for peak concentrations across the recording period (except for three) were below 200µg/m³. There are no visible trends for concentration levels between seasons or temperature. Trends over the last five years have been consistent, with peak concentrations approximately 30 times higher than average concentrations. The site with the highest average concentration of SO_2 was Stockton (7.7µg/m³), followed by Carrington (6.3µg/m³) and the lowest being Wallsend (3.6µg/m³). It was interpreted that the higher concentrations of SO_2 at Stockton and Carrington may be due to shipping emissions.
Particulate matter less than 2.5µm ($PM_{2.5}$)	25 µg/m³ (24 hours)	Peak measurements exceeded the NSW EPA 24-hour criterion at all locations. These measurements were due to interregional dust storms, hazard reduction burns and bushfire events. Over the past five years, trends varied with peak concentrations being approximately four times higher than average concentrations. In 2016, extensive hazard reduction burns influenced elevated $PM_{2.5}$ levels. Stockton had the highest average concentrations (9.8µg/m³) with Wallsend (7.3µg/m³) the lowest.
Particulate matter less than 10µm in aerodynamic diameter (PM_{10})	50 µg/m³ (24 hours)	Peak measurements exceeded the NSW EPA 24-hour criterion at all locations. These measurements were due to interregional dust storms, hazard reduction burns and bushfire events. Due to the coarser makeup of coastal sea salt, seasonal effects were identified in these larger particulate sizes when compared to $PM_{2.5}$. It was identified that Stockton contained 12µg/m³ more annual average PM_{10} sea salt than Mayfield, with differences most prevalent during the summer months when onshore winds are present. Over the last five years, peak concentrations were approximately four times higher than average concentrations. Stockton had the highest average concentrations (38µg/m³) with Wallsend (17µg/m³) the lowest. Variability between years was due to dust storms and bushfire activity.

In summary, existing ambient air quality in the Newcastle region was below NSW EPA impact assessment criteria for NO_2, CO and SO_2 over the last five years, whilst exceedances in $PM_{2.5}$ and PM_{10} were attributed to extreme bushfire or dust storm events. The ambient air quality is consistent with the region being influenced by shipping and the coastline.

Adopted background concentrations

The 2018 adopted background concentrations (averaged across the six air quality monitoring sites) are described in Table 6.5.3.

Table 6.5.3 Summary of adopted 2018 pollutant background concentrations

Pollutant	Assessment statistic	Adopted background concentration (µg/m³)	NSW EPA Impact assessment criterion (µg/m³)
NO_2	1 hour maximum	82*	246
	Annual mean	18.1	62
CO	15 minutes maximum	1,980**	100,000
	1 hour maximum	1,500	30,000
	8 hours maximum	1,125	10,000
SO_2	10 minutes maximum	286	712
	1 hour maximum	200	570
	24 hours maximum	20	228
	Annual mean	4.7	60
$PM_{2.5}$	24-hour maximum	17.1	25
	Annual mean	**8.1**	8
PM_{10}	24-hour maximum	40.6	50
	Annual mean	20.0	25

* Maximum hourly value shown. Time varying background concentration applied in analysis.
** Value converted using power law.

It is noted that the adopted background concentration for $PM_{2.5}$ annual mean is higher than the impact assessment criterion. This adopted background concentration has removed 7 exceptional value events when interregional dust storms and/or bushfires were present, to exclude extraneous events.

GHG emissions

GHG emissions should be reviewed in the context of global, National and state emissions.

On a global scale, industrialised countries[1] (including Australia) collectively decreased GHG emissions over the period of 1990- 2016 by 13%, excluding land use, land-use change and forestry (LULUCF) activities, and by 18.5% including LULUCF activities (UNFCCC 2018). In 2016, the average GHG emissions for industrialised countries were 17,127 megaton of carbon dioxide (Mt of CO_2). The total GHG emissions from Annex I and non-Annex I countries (developing countries) is estimated at 29,812Mt CO_2 excluding LULUCF and 28,447Mt CO_2 including LULUCF.

[1] Industrialised countries refers to the Annex I Parties that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

On a National scale, Australia's net emission for 2018 were reported as 538.2Mt CO_2 (DoEE, 2019a). This is about 2% of global GHG emissions. Australia's 2018 emissions were up 0.7% on the previous year, primarily due to increased liquefied natural gas exports. Overall, Australia's GHG emissions have decreased by 14.2% since the peak in the year to June 2007.

Australia's target under the Paris Agreement is to reduce emissions by 26-28 per cent below 2005 levels by the year 2030. Australia's targets will be achieved through a credible policy suite that is already reducing emissions, encouraging technological innovation and expanding Australia's clean energy sector. The Proposal would be consistent with the objectives of the agreement because it would support the transition to renewables by providing 'firming' capacity for grid security when renewables are not generating while releasing lower emissions than coal fired generation.

In NSW, total GHG emissions (including LULUCF) were 131.5Mt CO_2 in 2017 (DoEE, 2019b). This is a 18.2% decrease from 2005. NSW is the second highest GHG emitting state, following Queensland and contributes about a quarter of Australia's GHG emissions.

6.5.2 Study methods and criteria

Relevant policies and guidelines

The AQIA and GHGA were undertaken in accordance with relevant state, federal and international guidelines, policies and regulations that manage and regulate air quality impacts and GHG emissions. The following policies and regulations were used to inform the assessments.

Air Quality Impact Assessment

NSW State regulations, policies and guidelines provide proposed infrastructure with operating conditions, plant emission limits and ambient air quality criteria which are required during impact assessment and through to management of operations. Those relevant to the Proposal include the following (with criteria applicable to the Proposal discussed in further detail in the following section):

- POEO Act
- Protection of the Environment Operations (Clean Air) Regulation 2010 (Clean Air Regulation)
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (Approved Methods).

Clean Air Regulation

The Clean Air Regulation provides emissions limits for operational conditions (excluding the plant start-up and shutdown). As engine technology is to be determined (gas turbine or reciprocating engines), emissions limits for both technologies are provided in Table 6.5.4. These limits would be applied to procurement of the assets to ensure compliance can be adhered to from the plant manufacturers.

Table 6.5.4 Summary of Clean Air Regulation emissions limits

Substance	Fuel and engine type			
	Gas turbine (Units are measured in mg/m³, dry, 273K, 101.3kpa 15% O_2)		Reciprocating engine (Units are measured in mg/m³, dry, 273K, 101.3kpa 3% O_2)	
	Natural gas	Diesel	Natural gas	Diesel
Solid particles (total)	-	50	50	
Nitrogen dioxide (NO_2) or Nitric oxide (NO) or both, as NO_2 equivalent	70	90	450	

Substance	Fuel and engine type			
	Gas turbine (Units are measured in mg/m^3, dry, 273K, 101.3kpa 15% O_2)		Reciprocating engine (Units are measured in mg/m^3, dry, 273K, 101.3kpa 3% O_2)	
	Natural gas	Diesel	Natural gas	Diesel
Smoke	-	Ringelmann 1 or 20% Opacity	Ringelmann 1 or 20% Opacity	
Volatile organic compounds (VOCs), as n-propane, *or*	N/A		40	1,140
Carbon Monoxide (CO)*			125	5,880

*The standard for volatile organic compounds *or* carbon monoxide is satisfied if either of those standards is met

Approved Methods

The assessment methodology for the AQIA was informed by the Approved Methods (as required in the SEARs and agency consultation). The Approved Methods identifies that relevant air quality pollutants need to be considered to assess the potential impacts to human health, visual amenity and the surrounding ecology. Table 6.5.5 represents the relevant NSW EPA impact assessment criteria for air emissions.

Table 6.5.5 Relevant air quality criteria

Pollutant	Assessment statistic	Criteria (µg/m³)	Assessment basis
Nitrogen dioxide (NO_2)	1 hour maximum	246	
	Annual mean	62	
Carbon dioxide (CO)	15 minutes maximum	100,000	
	1 hour maximum	30,000	
	8 hours maximum	10,000	
Sulphur dioxide (SO_2)	10 minutes maximum	712	
	1 hour maximum	570	Cumulative (including background)
	24 hours maximum	228	
	Annual mean	60	
$PM_{2.5}$	24-hour maximum	25	
	Annual mean	8**	
PM_{10}	24-hour maximum	50	
	Annual mean	25	
Formaldehyde		20	
Acrolein		0.42	
Benzene	99.9th percentile, 1 hour maximum	29	Incremental (Proposal in isolation)
PAHs (B[a]P TEQ) *		0.4	
Ammonia		330	

Note: *PAHs as Benzo(a)Pyrene equivalent.

** As described above, although the EPA impact assessment criteria is 8, the existing background conditions are 8.1.

Greenhouse gas assessment

GHG emissions are considered a global issue, as such, international guidance documents and recommended methodologies as well as Federal and state legislative instruments and guidelines have been used to within this assessment. Relevant agencies and agreements are described in Table 6.5.6.

Table 6.5.6 Relevant agencies and agreements for GHG emissions regulation and reporting

Governance	Regulations, policies and guidelines
State	▪ The NSW Climate Change Policy Framework – Office of Environment and Heritage, 2016.
Federal	▪ The National Greenhouse and Energy Reporting (NGER) Scheme. The NGER Scheme includes: – National Greenhouse and Energy Reporting Act 2007 (the NGER Act) – National Greenhouse and Energy Reporting Regulations 2008 – National Greenhouse and Energy Reporting (Measurement) Determination 2008 – National Greenhouse and Energy Reporting (Audit) Determination 2009 – National Greenhouse and Energy Reporting (Measurement) Technical Guidelines – National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015
International	▪ Intergovernmental Panel on Climate Change (IPCC) ▪ United Nations Framework Convention on Climate Change (UNFCC) ▪ Kyoto Protocol ▪ Paris Agreement ▪ Greenhouse Gas Protocol (GHG Protocol)

Kyoto Protocol

The Kyoto Protocol builds upon the UNFCC and commits nations to legally binding targets that aim to limit or reduce GHG emissions. GHG emissions that are included in the Kyoto Protocol are:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF_6).

Paris Agreement

In 2015, a historic global climate agreement was reached under the UNFCCC at the 21st Conference of the Parties (COP21) in Paris (known as the Paris Agreement). The Paris Agreement sets in place a durable and dynamic framework for all countries to act on climate change from 2020. Australia ratified the Paris Agreement in November 2016. Australia's target under the Paris Agreement is to reduce emissions by 26-28 per cent below 2005 levels by the year 2030, thus progressing the levels of reduction required to meet the Kyoto Protocol targets.

GHG Protocol

The GHG Protocol provides an international corporate accounting and reporting standard for the reporting of GHG emissions. Within the protocol, three 'scopes' of emissions are defined which was adopted in the GHGA. The three scopes assessed are:

- Scope 1, direct GHG emissions: Direct GHG emissions are emissions that occur from sources that are owned or controlled by the reporting entity
- Scope 2, energy product use indirect GHG emissions: Indirect GHG emissions are emissions generated through the purchase of energy products by the entity
- Scope 3, other indirect GHG emissions: Other indirect GHG emissions are considered those that are a consequence of the activities of an entity but arise from sources not owned or controlled by the entity

NGER Act

The NGER Act establishes the legislative framework for the NGER Scheme, which comprises a National framework for reporting greenhouse gas emissions, greenhouse gas projects and energy consumption and production by corporations in Australia. Companies with operational control over facilities that exceed the reporting thresholds are required to report their annual emissions, energy consumption and production as part of their NGER report. The NGER reporting thresholds are listed in Table 6.5.7.

Table 6.5.7 NGER reporting thresholds

<table>
<tr><th>Category</th><th>Corporate</th><th>Facility</th><th>Contractors</th></tr>
<tr><td>Scope 1 and Scope 2 GHG emissions</td><td>50kt CO_{2-e}/year or more</td><td>25kt CO_{2-e}/year or more</td><td></td></tr>
<tr><td>Energy consumption</td><td rowspan="2">200TJ/year or more</td><td rowspan="2">100TJ/year or more</td><td rowspan="2"></td></tr>
<tr><td>Energy production</td></tr>
</table>

Summary of assessment methodology

Air quality impact assessment

The technical approach adapted in the AQIA included:

- Background data was sourced from the Beresfield air quality monitoring site (AQMS), see Section 6.5.1
- Selection of the CALPUFF model due to the presence of buoyant air emissions in a coastal region
- Selection of CALMET to model regional meteorology. CALMET is a meteorological pre-processor that is utilised in the CALPUFF dispersion model. The 2018 calendar year dataset was compiled for CALPUFF which included hourly spatially-varying fields of meteorological variables relevant to the estimation of pollutant dispersion.
- Identification of 14,641 'gridded' receptor locations within a 30 by 30km grid surrounding the proposed NPS to assess potential impact on surrounding receivers and 36 'discrete' receptors allocated to localities across the gridded modelling domain. This domain extent is considered adequate for the capture of peak model predictions.

- Detailed modelling of one gas turbine and one reciprocating engine option, representative of the proposed generator technologies and scale of the Proposal output. Emissions estimates were scaled upward by 10% to accommodate minor variability in plant specifications that may exist.
- Modelling of both natural gas fuel and diesel was completed for each technology option
- Modelling was based on continuous operation at 100% plant load and fuel specification
- An assessment of the impacts of exhaust's proximity to buildings which can impact the direction of pollutant dispersion
- An estimation of nitrogen oxide (NO) conversion to NO_2 which occurs progressively by the atmosphere and has an impact on human health. The Ozone Limiting Method (OLM) was used to estimate NO_2 concentrations, as this allows a conservative representation of conversion. Formaldehyde, benzene and PAHs was predicted using an estimation of pollutant concentrations over 3-minute averaging periods.
- Proposal emissions were estimated using manufacturer data supplemented by US EPA AP-42 emission factors and fuel specifications. For pollutants where manufacturer information is not available, emission factors allow the estimation of individual pollutant emissions on the basis of fuel consumption and generator technology.

Greenhouse Gas Assessment

The technical approach adapted in the GHGA included:

- A review of the relevant legislation, policies, regulations and organisational bodies at State, Federal and international levels
- Identification of the key emission sources and activity estimates
- Separation of sources into Scope 1 and Scope 3 GHG emissions:
  - Scope 1 emissions: GHG emissions which are released into the atmosphere as a direct result of an activity or series of activities. This includes the burning of gas for energy production.
  - Scope 3 emissions: GHG emissions which occur as a result of activities of a facility, but from sources not owned or controlled by that facility's business. These include extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.
- Quantification of GHG emissions was performed in accordance with the GHG Protocol, IPCC and Australian Government GHG accounting/classification systems
- GHG emissions have been expressed as a measure of carbon dioxide equivalents ($CO_{2\text{-}e}$). Carbon dioxide equivalent ($CO_{2\text{-}e}$) was used to compare emissions from various GHGs based on their Global Warming Potential (GWP).
- The estimation of emissions was based on the operating conditions proposed for the power station, in that the Proposal would operate at either peaking load (base case) or continuous operation (worst case).
- The expected emissions factors for the natural gas and diesel fuel combustion used in the assessment are listed in Table 6.5.8, as sourced from DoEE (2017b) *National Greenhouse Accounts (NGA) Factors.*

Table 6.5.8 Summary of NGA Emission Factors – fuel combustion for stationary energy (kg $CO_{2\text{-}e}$/GJ)

Emission scope and source	Natural gas	Diesel
Scope 1 (natural gas and diesel fuel combustion)	51.5	70.2
Scope 3 (importation of electricity)	13.6	3.6
Scope 1 + Scope 3	65.4	73.8

6.5.3 Potential impacts

Construction

Air quality

The main potential air quality impacts during construction would be associated with the disturbance of dust and particulates. Sources of dust generation and particulate emissions associated with construction activities would include:

- Clearing of vegetation and topsoil
- Demolition of buildings and structures
- Earthworks including excavation, levelling and compaction of soil
- Movement of soil and fill by dump trucks and scrapers
- Wind erosion from unsealed surfaces and stockpiles
- Vehicles travelling along unsealed areas
- Landscaping.

The potential for dust generation and movement would be dependent on the silt and moisture content of the soil and daily weather conditions. During windy conditions, there is potential for dust to become airborne from any exposed surfaces and stockpiles. Stockpiles would be covered or stabilised where possible to minimise dust generation during windy conditions. Construction activities may be stopped during such conditions to minimise the spread of dust to surrounding areas.

Demolition of the residential dwelling on Lot 3 could result in temporary wind-blown dust and particulates. Demolition work may also encounter hazardous materials such as asbestos. Additional precautions would be investigated for any discovery of hazardous materials that has potential to become wind-borne.

Odours would potentially be generated during the laying of concrete, asphalt and/or bitumen for foundations and the access road. Other odours sources include domestic refuse produced by onsite personnel, skip bins, wastes from portable amenities, paints, fuels and solvents.

Exhaust emissions from construction plant, equipment and vehicles may also impact air quality during construction. Specific types of plant and equipment anticipated to be used in construction are described in Section 2.5.

Potential dust, odour and exhaust impacts are likely to be short-term and localised to the work site. Considering the scale of the construction footprint and the distance to the site boundaries, it is considered appropriate that potential air quality impacts be addressed by the implementation of conventional management measures for construction operations. However, if inappropriately managed, dust impacts may impact off-site receivers. Potential impacts would be controlled through the application of the mitigation measures listed in Table 6.5.16.

Greenhouse gas

Emissions associated with the construction of the Proposal, including the importation of electricity and trucking of wastewater were considered to be negligible in the context of the quantitative assessment completed for the operation of the Proposal. No mitigation measures for construction have been proposed.

Operation

Air quality

The main potential air quality impacts associated with the operation of the Proposal would be from:

- The main generator plant (comprising either gas turbine or reciprocating technology)
- Distillate storage tanks
- Gas reception infrastructure including heating stations, compressors (if not electrically powered) and flaring (if required)
- Diesel generators.

Operation of these structures would emit the following key air pollutants. Their sources and basis of formation are listed in Table 6.5.9.

Table 6.5.9 Key air pollutant emissions and their sources

Pollutant	Source
Oxides of Nitrogen (NO_x), inclusive of nitric oxide (NO) NO_2	Oxidation of atmospheric nitrogen in high temperature combustion reactions
CO	Incomplete oxidation of fuel-bound carbon
SO_2	Oxidation of fuel-bound sulphur
$PM_{2.5}$ and PM_{10}	Incomplete oxidation of fuel-bound carbon. Oxidation of fuel-bound sulphur to sulphate, emission of residual ash material within diesel.
Hazardous air pollutants (HAPs) inclusive of: Acrolein, benzene, formaldehyde and other volatile organic compounds (VOCs) Polycyclic Aromatic Hydrocarbons (PAHs) Ammonia (residual from Selective Catalytic Reduction (SCR))	Incomplete oxidation of fuel-bound carbon

Potential impacts of these pollutants have been assessed across the modelled terrain (Figure 6.5.3). As described in Section 6.5.2, the 'gridded' receptors refer to 14,641 receptors across 900km^2 (a 30 by 30km grid surrounding the proposed NPS), whilst 'discrete' receptors refer to 36 localities identified within this grid.

The AQIA modelled one gas turbine and one reciprocating engine option based on vendor specifications for a range of options considered for the Proposal. All estimates were scaled upward by 10% to accommodate minor variability in plant specifications that may exist. Both the use of natural gas and diesel were modelled as per consumption estimates provided in Appendix G. As such, modelling considered the following operational scenarios:

- Gas turbine option – natural gas
- Gas turbine option – diesel
- Reciprocating Engine option – natural gas fuel
- Reciprocating Engine option – diesel

The modelling results are summarised for both the gas turbine option (Table 6.5.10) and the reciprocating engine option (Table 6.5.11).

As seen in the 'maximum cumulative prediction' columns for both technologies, all predictions are compliant with the NSW EPA impact assessment criteria, with the exception of the VOC acrolein (reciprocating engine option under natural gas fuel operation; shown in bold) and annual average $PM_{2.5}$ (under all operational scenarios), due to elevated background levels.

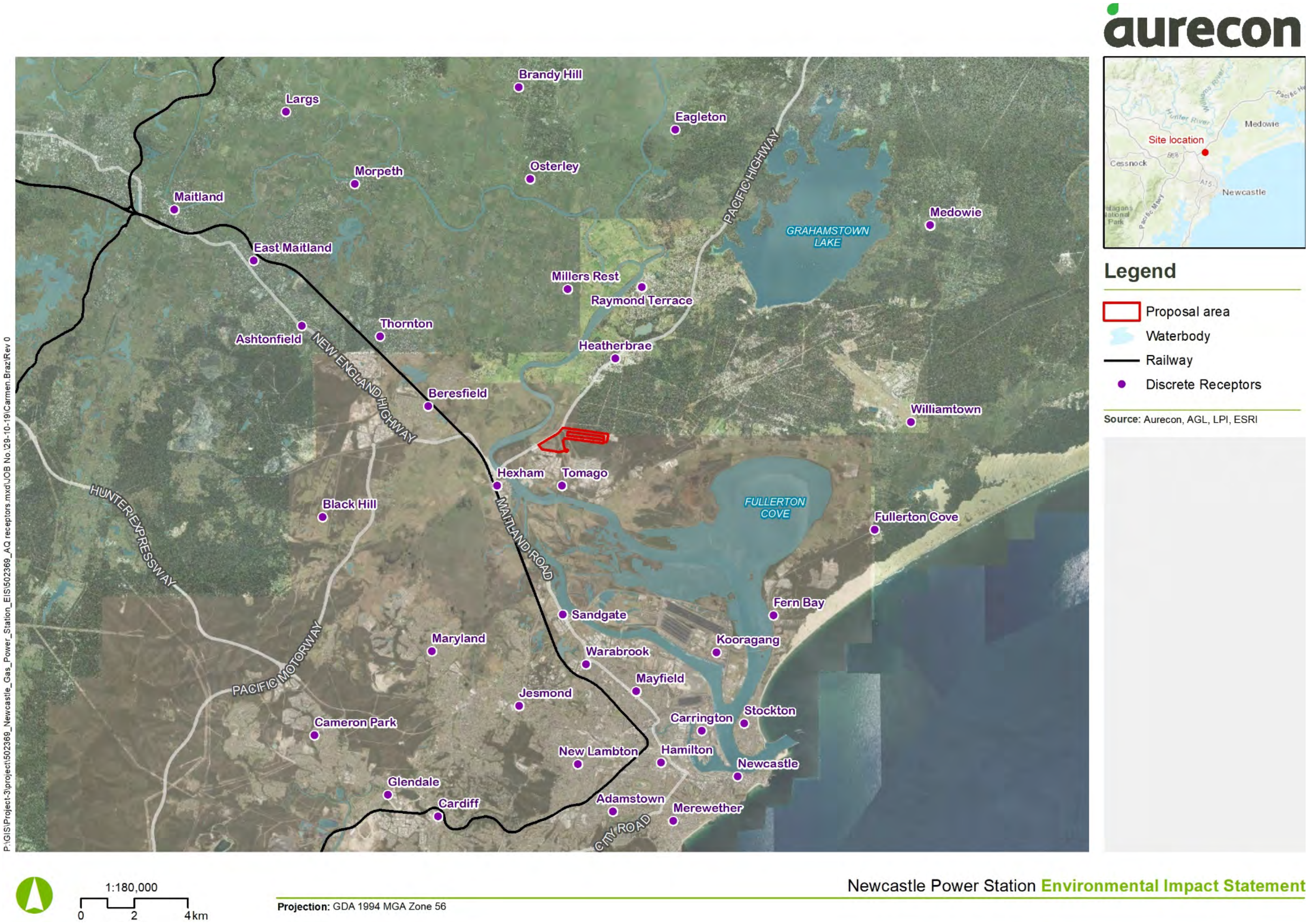


Figure 6.5.3 Aerial image of 36 'discrete' receptors

Table 6.5.10 Assessment summary – Gas turbine option

Substance	Averaging period	Prediction at maximum impacted receptor (µg/m³)				Maximum incremental prediction (µg/m³)	Background* (µg/m³)	Maximum prediction (µg/m³)	Criterion (µg/m³)
		Natural gas fuel		Diesel fuel					
		Discrete	Gridded	Discrete	Gridded				
NO_2	1 hour maximum	58	61	63	84	84	82*	100	*246*
	Annual mean	0.2	0.3	0.4	0.4	0.4	18.1	18.5	*62*
CO	15 minutes maximum	139	535	292	1,198	1,198	1,980	3,178	*100,000*
	1 hour maximum	174	669	365	1,498	1,498	1,500	2,998	*30,000*
	8 hours maximum	63	133	139	295	295	1,125	1,420	*10,000*
SO_2	10 minutes maximum	8	30	1	4	30	286	316	*712*
	1 hour maximum	5	21	1	3	21	200	221	*570*
	24 hours maximum	0.8	1.5	0.1	0.2	1.5	20	21	*228*
	Annual mean	0.01	0.02	0.002	0.003	0.02	4.7	4.7	*60*
$PM_{2.5}$	24-hour maximum	1.6	3.1	3.9	7.6	7.6	17.1	24.7	*25*
	Annual mean	0.03	0.04	0.08	0.10	0.10	**8.1***	**8.2***	*8.0*
PM_{10}	24-hour maximum	1.6	3.1	3.9	7.6	7.6	40.6	48.0	*50*
	Annual mean	0.03	0.04	0.08	0.10	0.10	20.0	20.1	*25*
Acrolein	1 hour 99.9th percentile	0.002	0.003	0.002	0.002	0.003	-	0.003	*0.42*
Benzene	1 hour 99.9th percentile	0.002	0.005	0.01	0.02	0.02	-	0.02	*29*
Formaldehyde	1 hour 99.9th percentile	0.2	0.3	0.1	0.1	0.3	-	0.3	*20*
PAHs	1 hour 99.9th percentile	0.0003	0.0004	0.001	0.002	0.002	-	0.002	*0.4*

*Exceedances are marked in bold. *Time varying background concentration applied in contemporaneous analysis. Maximum 1-hour background shown*

Table 6.5.11 Assessment summary – Reciprocating engine option

Substance	Averaging period	Prediction at maximum impacted receptor (µg/m³)				Maximum incremental prediction (µg/m³)	Background* (µg/m³)	Maximum prediction (µg/m³)	Criterion (µg/m³)
		Natural gas fuel		Diesel fuel					
		Discrete	Gridded	Discrete	Gridded			Discrete	Gridded
NO_2	1 hour maximum	76	113	71	95	113	82*	123	*246*
	Annual mean	0.6	1.0	0.6	1.0	1.0	18.0	19.1	*62*
CO	15 minutes maximum	21	98	26	104	104	1,980	2,084	*100,000*
	1 hour maximum	26	123	32	130	130	1,500	1,630	*30,000*
	8 hours maximum	8	30	11	29	30	1,125	1,155	*10,000*
SO_2	10 minutes maximum	11	52	12	50	52	286	338	*712*
	1 hour maximum	8	36	9	35	36	200	236	*570*
	24 hours maximum	1.0	4.3	1.3	3.4	4.3	20	24	*228*
	Annual mean	0.05	0.10	0.05	0.08	0.10	4.7	5	*60*
$PM_{2.5}$	24-hour maximum	1.1	4.5	2.5	6.4	6.4	17.1	23	*25*
	Annual mean	0.05	0.10	0.09	0.16	0.16	**8.1***	**8.3***	*8*
PM_{10}	24-hour maximum	1.1	4.5	2.5	6.4	6.4	40.6	47.0	*50*
	Annual mean	0.05	0.10	0.09	0.16	0.16	20.0	20	*25*
Acrolein	1 hour 99.9th percentile	**0.68**	**1.25**	0.001	0.003	**1.25**	-	**1.25**	*0.42*
Benzene	1 hour 99.9th percentile	0.1	0.2	0.1	0.3	0.3	-	0.3	*29*
Formaldehyde	1 hour 99.9th percentile	6	11	5	9	11	-	11	*20*
PAHs	1 hour 99.9th percentile	0.00001	0.00001	0.0001	0.0002	0.0002	-	0.0002	*0.4*
Ammonia	1 hour 99.9th percentile	4	9	4	7	9	-	9	*330*

*Exceedances are marked in bold. *Time varying background concentration applied in contemporaneous analysis. Maximum 1-hour background shown.*

Emissions from diesel storage tanks would comprise volatile organic compounds (i.e. acrolein, benzene, formaldehyde). Diesel proposed for the Proposal would be of conventional automotive diesel grade, and compliant with the *Fuel Quality Standards (Automotive Diesel) Determination 2019* (DoEE, 2019a) or bio-diesel. Accordingly, emissions would be highest during tank filling, where emissions would be similar in nature to those which occur from storage tank filling operations at a retail service station when tanker filling occurs. Given the large buffer distance surrounding this infrastructure, potential air quality impacts are likely to be negligible, and accordingly have not been considered further within this assessment.

Details of the predicted emissions and potential impacts are discussed in the following sections.

NO_2

Assessment results

Modelling predicts that for both the one-hour maximum and the annual mean of either the gas turbine or reciprocating engine options, no exceedances of the NSW EPA impact assessment criterion for NO_2 are anticipated.

The highest incremental increase in NO_2 levels was predicted for the reciprocating engine option using natural gas fuel at 113µg/m³. When added to the peak background concentration of 82µg/m³, this results in a cumulative concentration of 123µg/m³, which is equal to only 50% of the criterion. The highest predicted emissions, for both the maximum one-hour average and annual average under both technologies, would be at Hexham, located to the south west of the Proposal.

Potential impacts

NO_2 would be emitted by the combustion of fuel resulting in the oxidation of atmospheric nitrogen. Exposure to high levels of NO_2 can impact human health and result in respiratory problems such as wheezing, coughing, colds, flu and bronchitis. Environmental impacts of NO_2 emissions can include reduced visibility and haze, increasing acidity of waterbodies and formation of acid rain, changing nutrient balances in waterbodies and soils and damaging vegetation growth and form.

As the predicted emissions of NO_2 are well below the NSW EPA impact assessment criteria, emissions of NO_2 are not expected to have a significant impact on human or environmental health with the implementation of standard safeguards in Table 6.5.16.

Particulate matter

Assessment results

Modelling predicts that the maximum cumulative prediction for annual mean levels of $PM_{2.5}$ would exceed the NSW EPA impact assessment criterion for all operational scenarios. This is based on a maximum incremental prediction of 0.1µg/m³ for the gas turbine option and 0.16µg/m³ for the reciprocating engine option.

Although predictions show an exceedance in NSW EPA impact assessment criteria by 0.2µg/m³ (gas turbine option) and 0.3µg/m³ (reciprocating engine option), it is noted that the background criteria is already in exceedance by 0.1µg/m³, and incremental contributions are less than 1% of the criteria. As such, the increases are not considered material in terms of potential cumulative impacts. Additionally, these results are based on a worst case scenario of continuous operations. Given the intermittent and typically short duration of proposed peaking load operations, it is expected that the emissions would be lower.

Peak 24-hour $PM_{2.5}$ predictions for the gas turbine option are predicted to approach but not exceed the criteria, with a peak incremental $PM_{2.5}$ prediction of 7.6µg/m³. When added to the peak background concentration of 17.1µg/m³, this results in a cumulative concentration of 24.7µg/m³. Peak 24-hour $PM_{2.5}$ predictions for the reciprocating engine option is not expected to breach the EPA criterion.

The highest predicted emissions, for both the maximum one-hour average and annual average under both technologies, would be at Hexham, located to the south west of the Proposal.

Potential impacts

Particulate matter (including $PM_{2.5}$ and PM_{10}) would be emitted by residual ash material within diesel fuel and through the formation of secondary particles. These secondary particles formed by chemical reactions of gaseous pollutants including incomplete oxidation of fuel-bound carbon and oxidation of fuel-bound sulphur to sulphate. Particulate matter includes inhalable particles that are small enough to penetrate the thoracic region of the respiratory system. High levels of particulate matter can potentially result in respiratory and cardiovascular health impacts and environmental impacts such as reduced visibility, haze and impact to ecosystems. As identified, the background levels in the region are currently assessed as above the NSW EPA impact assessment criteria due to the existing regional environment (e.g. hazard reduction burns and onshore winds). The assessment identified that in the worst case scenario (i.e. continuous operations), a maximum of 0.2µg/m³ $PM_{2.5}$ above background conditions would be added to the existing environment. This contribution is less than 1% and not considered material in terms of cumulative impacts. As the predicted emissions of $PM_{2.5}$ are not material, they are not expected to have a significant impact on human health.

Acrolein

Assessment results

The dispersion modelling predicts that the cumulative 1-hour 99th percentile levels of acrolein would exceed the NSW EPA impact assessment criterion for the reciprocating engine option when operational on natural gas fuel. This prediction is based on US EPA emissions factors for a 4-stroke lean burn gas engine with a conservative estimate of oxidation catalyst control efficiency. The maximum emission of acrolein is predicted to reach 1.25 µg/m³ which is above the NSW EPA impact assessment criterion of 0.42 µg/m³ (see Table 6.5.11).

Due to the potential impacts of acrolein to human health and the environment, the AQIA completed a refined assessment of acrolein impacts (discussed in Appendix A of the AQIA). In summary, the assessment included:

- A review of the background and basis of derivation for the NSW EPA acrolein criterion
- A review of contemporary public health-endpoint based screening criteria
- An expanded assessment of acrolein predictions against alternative screening criteria

Based on a review of contemporary public health standards, additional dispersion modelling under all operational scenarios was completed. The maximum predictions against each criterion is shown in Table 6.5.12. The modelling predictions was assessed against the following health standards:

- Texas Commission on Environmental Quality Effects Screening Levels (TCEQ ESL)
- Ontario Ministry of the Environment and Climate Change Ambient Air Quality Criteria (Ontario AAQC)
- Agency for Toxic Substances and Diseases Registry Minimal Risk Levels (ATSDR MRL)
- California EPA Air Toxics Hot Spots Program – Reference Exposure Levels (OEHHA REL)

Table 6.5.12 Acrolein screening criteria

Criterion	Model prediction	Value (µg/m³)	Assessment statistic	Applicable result
NSW EPA	**1.25**	0.42	1 hour (99.9th percentile)	Grid maximum
TCEQ ESL	2	3.2	1 hour maximum	Maximum residential receptor
Ontario AAQC		4.5		
OEHHA REL	0.5	0.7	8 hour maximum	
Ontario AAQC	0.2	0.4	24 hour maximum	
ATSDR MRL		7.0		
	0.05	0.1	7 day maximum	
TCEQ ESL	0.01	0.82	Annual	
OEHHA REL		0.35		

As seen in Table 6.5.12, except for the NSW EPA impact assessment criteria, all other predictions are below the respective criteria.

Potential impacts

Acrolein would be emitted by the incomplete oxidation of fuel-bound carbon. Exposure to acrolein can impact human health and result in irritation to the eyes, nose and throat. Acrolein is expected to break down quickly in environmental media (i.e. air and water) and therefore accumulation is not anticipated. However, environmental impacts of acrolein emissions could include the formation of ground level ozone which can damage vegetation.

As identified above, although the cumulative 1-hour 99th percentile levels of acrolein would exceed the NSW EPA impact assessment criterion for the reciprocating engine with natural gas fuel, these levels are considered below international screening criteria which are formulated to be protective of adverse public health outcomes. Additionally, the dispersion modelling is based on a worst case scenario of continual operations, and standard operation is likely to be well below these criteria. Safeguards as described in Table 6.5.16 would be applied to further mitigate potential impacts to human health.

Formaldehyde

Assessment results

Modelling predicts that the 1-hour 99th percentile levels of formaldehyde would not exceed the NSW EPA impact assessment criteria. The highest incremental increase in formaldehyde levels was predicted for the reciprocating engine option using natural gas fuel at 11µg/m^3, which is equal to only 55% of the criterion. However, actual levels of formaldehyde may be higher if background levels are present. The AQIA did not include a cumulative concentration as background levels are unknown. The highest predicted emissions for both technologies, would be at Hexham.

Potential impacts

Potential impacts of formaldehyde are similar to those of acrolein (discussed above), including potential impacts to human health through irritation of eyes, nose and through and impact to the environment damaging vegetation. As the predicted emission of formaldehyde are significantly below the NSW EPA impact assessment criteria, emissions of formaldehyde are not expected to have a significant impact on human or environmental health with the implementation of standard safeguards in Table 6.5.16. Accordingly, the analysis conducted within this assessment indicates that the potential for the Proposal to generate exceedances is low, and manageable through effective operation of the proposed emission controls.

Other pollutants

Assessment results

Modelling predicts that the levels of SO_2, CO_2, benzene, ammonia (only assessed for the reciprocating engine option) and PAHs would not exceed the EPA criteria (refer to Table 6.5.10 and Table 6.5.11). Actual levels of benzene, ammonia and PAHs may be higher as background levels are unknown and were therefore not included in the cumulative concentration.

Potential impacts

As the predicted emission of SO_2, CO_2, benzene, ammonia and PAHs are significantly below the EPA criteria, emissions are not expected to have a significant impact on human or environmental health with the implementation of standard safeguards in Table 6.5.16.

Greenhouse gas

The GHG emissions for the Proposal were calculated based on the energy used during operation and associated emissions factors. Other operation related GHG emissions relating to maintenance activities, waste generation and materials used in maintenance were considered negligible and not included in the operational GHG assessment.

The operational GHG emissions assessment focussed on Scope 1 (direct GHG emissions) and Scope 3 (other indirect GHG emissions) emissions associated with natural gas and diesel fuel combustion.

A summary of the $CO_{2\text{-}e}$ emission estimates for the technology option with the highest emissions is outlined in Table 6.5.13. All modelled options described in Appendix H.

Table 6.5.13 Annualised operational emission estimates (kt CO_2-e/annum)

Plant option	Natural gas operation			Diesel operation		
	Scope 1	Scope 3	Scope 1 + 3 (total)	Scope 1	Scope 3	Scope 1 + 3 (total)
Reciprocating Engine*	145	38	183	196	10	206
Gas Turbine*	174	46	220	222	11	234

*Estimates are based on the operating conditions proposed for the NPS, in that the NPS is intended to be operated as a peaking plant (base case scenario); however, it will be designed for continuous operation to maximise operational flexibility (worst case scenario). Expansion of these estimates to continuous operation would result in a seven-fold increase (assuming continuous operation in addition to 200 start-up and 200 shutdown events per annum).

Over the expected lifetime of 25 years, the Proposal is predicted to emit between 4.6 to 5.8 Mt $CO_{2\text{-e}}$ (based on estimates for the technology option with the highest emissions), as shown in Table 6.5.14. All modelled options described in Appendix H. As the estimates are based on the base case scenario, the NPS operating at worst case scenario for its entire lifetime would be up to 40.6 Mt $CO_{2\text{-e}}$.

Table 6.5.14 Proposal lifetime emission estimate (Mt CO_2-e)

Plant option	Natural gas operation			Diesel operation		
	Scope 1	Scope 3	Scope 1 + 3	Scope 1	Scope 3	Scope 1 + 3
Reciprocating Engine	3.6	1.0	4.6	4.9	0.3	5.2
Gas Turbine	4.3	1.1	5.5	5.6	0.3	5.8

*Estimates are based on the operating conditions proposed for the NPS, in that the NPS is intended to be operated as a peaking plant (base case scenario); however, it will be designed for continuous operation to maximise operational flexibility (worst case scenario). Expansion of these estimates to continuous operation would result in a seven-fold increase (assuming continuous operation in addition to 200 start-up and 200 shutdown events per annum).

Additionally, the annualised operational emission intensity of the Proposal has been calculated for each combination of plant option and fuel type. Emission intensity is the volume of emissions per unit gross domestic product (GDP). It is an alternative measure of emissions that fluctuates depending on the GDP value of a commodity and demonstrates the intensity of GHGs relative to production. It does not show the total amount of GHGs released.

The annualised operational emission intensity is predicted to be between 568 to 785kg CO_2-e/MWh. For context, the emissions intensity for the NSW electricity grid is estimated to be about 830kg CO2-e/MWh (DoEE, 2017a).

Assuming that the Proposal operates at base case, it has been estimated that the total annualised operational Scope 1 emissions would be approximately 140 – 220kt CO_2-e per annum, requiring reporting of emissions under the NGER scheme. Expansion of this estimate to a continuous operating scenario resulted in estimated emissions of approximately 1.0 – 1.6 Mt $CO_{2\text{-e}}$ per annum.

In the base case, GHG emissions from the Proposal would be approximately 0.46% and 0.12% of the 2017 NSW and national inventories for electricity generation (respectively), and to approximately 0.18% and 0.04% of the 2017 NSW and national inventory totals (respectively). With expansion of this estimate to continuous operation, GHG emissions from the Proposal were estimated to equate to approximately 3.3% and 0.9% of the 2017 NSW and national inventories for electricity generation (respectively), and to approximately 1.3% and 0.3% of the 2017 NSW and national inventory totals (respectively).

The corresponding full fuel cycle (Scope 1 + 3) emission intensity has been estimated at between 568 – 780kg CO2-e/MWh, indicating that the achievable emission intensities are broadly consistent with the best achievable emission intensity utility scale fossil fuel peaking power generation.

Based on the assessment in the GHGA, the potential GHG emissions impacts of the construction and operation of the Proposal are anticipated to be below the current grid average emission intensity of 910kg $CO_{2\text{-e}}$/MWh, while also providing fast response electricity generation, consistent with the accommodation of an increased proportion of renewable energy sources into the electricity grid.

Cumulative impacts

Cumulative impacts

Potential cumulative impacts with other local sources of air emissions was conducted by searching the National Pollutant Inventory database (DoEE, 2019b). The search identified three facilities within 2km of the Proposal, namely:

- Hunter Galvanising
- Tomago Aluminium Smelter
- Newcastle Gas Storage Facility

The potentially significant local air emission sources identified through the review included other industrial development including the NGSF, Tomago Aluminium Smelter and Hunter Galvanising.

Table 6.5.15 describes these sources near the Proposal and annualised emission quantities for relevant pollutants.

Table 6.5.15 Annualised air emission quantities for sources near the Proposal

Facility	Distance to and bearing from the Proposal	Annualised air emissions (NPI 2017/18) (kg)			
		NO_x	CO	SO_2	$PM_{2.5}$
Hunter Galvanising	1km SSE	2,500	2,400	27	200
Tomago Aluminium Smelter	1.5km SE	350,000	47,000,000	11,000,000	53,000
The NGSF	2km E	2,900	3,200	29	34
The Proposal*	-	49,000	115,000	2,100	8,100

*Assuming base case scenario, maximum of both technology options, 50/50 fuel mix (natural gas/diesel).

The maximum offsite 1-hour NO_x (as NO_2) smelter predictions approach 80µg/m³ in areas near to the smelter. Assuming a typical ambient NO_2: NO_x ratio of 0.2, this would equate to a maximum incremental NO_2 concentration of approximately 15µg/m³. Should peak 1-hour impacts from the smelter and the Proposal occur at a common location and coinciding times, the cumulative NO_2 concentration is unlikely to exceed the ambient 1-hour average NO_2 standard of 246µg/m³.

CO emissions for the smelter were calculated in the AQIA using conservation of mass assumptions. Peak localised CO increments around 15% of the 1-hour criterion were applied which, when considered with the worst case cumulative Proposal predictions, would equate to approximately 25% of the 1-hour average criterion. On this basis, the cumulative CO concentration is unlikely to exceed the 1-hour standard.

The maximum 1-hour average incremental SO_2 prediction from the Proposal is approximately 30µg/m³, limiting the potential for the Proposal to contribute quantifiably to cumulative impacts that either approach or exceed the ambient air quality standard for SO_2 of 570µg/m³.

The 99.9th percentile Proposal contours were modelled for the emission scenario with highest 1-hour SO_2 impact[2]. These resultant contours show a maximum of 9µg/m³, and predictions in excess of 5µg/m³ confined to small regions near the Proposal. These predictions comprise approximately 1% of the criterion and are predicted to occur 0.1% of the time assuming continuous operation, further emphasising the limited potential for the Proposal to form a material contribution to cumulative SO_2 concentrations.

[2] This percentile statistic is considered a conservative representation of peak impacts from a source that operates on an intermittent basis and is effectively the worst hour out of 1,000 hours of operation

6.5.4 Avoidance, mitigation and management

A range of avoidance, mitigation and management measures would be implemented for air quality outlined in Table 6.5.16.

Table 6.5.16 Avoidance, mitigation and management measures – Air quality

ID	Environmental safeguards	Timing
AQ-1	The power station would be fitted with a Continuous Emission Monitoring Systems (CEMS) to demonstrate ongoing regulatory compliance, ensure proper and efficient operation of pollution control equipment, and evaluate operating and emission variability.	Pre-construction Operation
AQ-2	The CEMP will include requirements to monitor and manage potential air quality impacts associated with the construction of the Proposal. The CEMP will identify project construction activities with the potential to have air quality impacts and the controls required to avoid, minimise and mitigate these impacts. The plan will include measures to: ▪ Minimise dust generation from stockpiles, haulage routes, work activities and exposed ground surfaces ▪ Minimise generator and vehicle emissions ▪ Cover or minimise truck loads ▪ Reduce speeds on unsealed roads ▪ Modify or cease dust generating works during unfavourable weather conditions ▪ Inspect and address corrective actions.	Construction
AQ-3	Any long-term stockpiles would be stabilised and are to be managed to suppress dust emissions.	Construction
AQ-4	Demolition activities, including removal of hazardous building materials, will be planned and carried out in a manner that minimises the potential for dust generation. Removal of hazardous building materials will be completed prior to the commencement of general demolition works.	Construction
AQ-5	Vegetation or other materials are not to be burnt on site.	Construction Operation
AQ-6	All air quality requirements and monitoring would be adhered to in accordance with an EPA license.	Operation

6.6 Soils and contamination

A Soils and Contamination Specialist Study was completed by Aurecon Australasia Pty Ltd (Appendix I). The assessment includes a review of contaminated materials and acid sulphate soils on site and potential risks to human health and the receiving environment. Mitigation measures to minimise potential risks are also provided.

6.6.1 Existing environment

Soils

A review of the NSW DPIE's online mapping system (eSPADE), which sources information from the Sydney 1:100,000 Soil Landscape Series (Soil Conservation of NSW, 1966) identified that the Proposal area is predominately situated across Millers forest and Beresfield soils, however, the following four soil landscapes are present across the Proposal area:

- Millers forest (mf) – Estuarine landscape
- Beresfield (be) – Residual soil landscape
- Tea Gardens (tn) – Aeolian landscape
- Shoal Bay (sb) – Aeolian landscape

A summary of the key characteristics of these soil landscapes including the properties, qualities, limitations, and susceptibility to erosion is provided in Table 6.6.1. As seen in Figure 6.4.1 (Section 6.4), the soil landscape differs between the NPS site and the gas pipeline corridors and electricity transmission line.

The NPS site is predominately in Beresfield soils with Millers forest to the southern portion of the lot and Tea gardens in the north eastern corner. Beresfield soils are an urban erosion hazard with moderate to high erodibility that can suffer considerable erosion in disturbed areas if it is not appropriately managed. The soil types be1, be2, be5, mf1, mf2, tn1, tn2, tn4 are likely to be identified within the NPS site.

The remaining infrastructure associated with the Proposal would be located in the Tea Gardens soil landscape, with Shoal Bay present in the eastern corner of the Proposal area. Tea Gardens and Shoal Bay soil types are both susceptible to wind erosion hazards when on localised dry, sandy ridges. Erosion can be prevented with sufficient ground cover that is appropriately fertilised. Soil types tn1, tn2, tn4, sb1, sb2 and sb3 are likely to be present within the Proposal area and specifically the gas pipeline corridor and electricity transmission line.

The Proposal would be located across two Australian soil classifications (Figure 6.6.1):

- Dermosols (in the south western portion of the Proposal area)
- Podosols (in the centre and northern portions of the Proposal area)

Dermosols soils are heavy, sandy loam with a maximum clay content exceeding 15%, while Podosols have a clay field texture of 35% or more. Podosols often have open cracks throughout the year (unless conditions are moist) that are at least 5 mm wide and extend upward to the surface.

The Australian soil landscapes mapping is consistent with the hydrologic soil groups, with the south western portion of the Proposal area identified as Group C soils (slow infiltration rates), and the centre and northern portions of the Proposal having Group A soils (high infiltration rates) (Figure 6.6.2).

Soil fertility varies across the Proposal location as described below and in Figure 6.6.3:

- High in the southern portion of the Proposal area (150m width)
- Moderate in the central portion of the Proposal area and proposed power station
- Low in the northern and north eastern portion of the Proposal area

Table 6.6.1 Soil landscapes of the Proposal area

Soil landscape	Proposal area	Geology and regolith	Qualities and limitations	Soils (Proposal area landscape) and erodibility K factor	Non-concentrated flows	Concentrated flows	Wind
Millers forest (mf)	Small portion of the southern Proposal area.	Quaternary Holocene alluvial sediment—predominantly clay, silt and sand from overbank deposition of the lower Hunter and Williams Rivers, which overlies estuarine mud deposits at depth.	Flood hazard, permanently high-water tables, seasonal waterlogging and foundation hazard and low wet bearing strength soils.	Deep (>150cm), imperfectly to poorly drained Prairie soils, urban erosion hazard	Moderate	Moderate to high	Very low
				mf1: Well-structured brownish black silty clay loam (topsoil—A horizon), 0.023	Moderate	Moderate	Very low
				mf2: Well-structured brown silty clay (subsoil—B horizon), 0.036	Low	Moderate	Slight
Beresfield (be)	Covers majority of proposed power station area.	Permian Tomago Coal Measures—shale, mudstone, sandstone, coal, tuff and clay. Permian Mulbring Siltstone—siltstone, claystone, thin sandstone, and limestone. Small areas of Permian Waratah Subgroup also occur— cross-laminated grey brown sandstone.	High foundation hazard, water erosion hazard, Mine Subsidence District seasonal waterlogging and high run-on on localised lower slopes and highly acid soils of low fertility.	Imperfectly to poorly drained Yellow Podzolic Soils, yellow Soloths and Gleyed Podzolic	Moderate	High	Very low
				be1: Friable brownish black loam (topsoil—A1 horizon), 0.028	Moderate to high	High	Slight
				be2: Hard setting dull yellowish-brown sandy loam, 0.033	Moderate	Moderate	Very low
				be5: Gleyed "puggy" silty clay, 0.048	High	High	Very low
Tea Gardens (tn)	Covers the northern most parts of the Proposal area and gas pipeline options.	Pleistocene beach ridges and sandsheets consisting of marine and aeolian quartz sands.	Permanently high-water tables, seasonal waterlogging, ground water pollution hazard and strongly to extremely acid soils of low fertility.	Deep (>200 cm), very poorly drained Acid Peats in swamps, urban erosion hazard	Slight	Moderate	Very high
				tn1: Sandy peat, peaty	Very low	High	Moderate
				tn2: Brownish black to brownish grey loose loamy sand, 0.016	Low	Very high	High
				tn4: Massive organic pan, pan	Very low	Moderate	Low
Shoal Bay (sb)	Covers a very small portion in the north eastern Proposal area near the NGSF.	Pleistocene aeolian sand sheets and low dunes composed of quartz sands.	Wind erosion hazard, ground water pollution hazard, steep slopes (localised), foundation hazard, permanent waterlogging, permanent high-water tables, seasonal waterlogging and acid sandy non-cohesive soils with very low fertility.	Deep (>300cm), well-drained Podzols, with deep, imperfectly drained Humus Podzols	Slight	Very high	Very high
				sb1: Brownish grey loose sand, 0.000	Very low	High	Moderate
				sb2: Loose bleached light grey sand, 0.009	Very low	Very high	High
				sb3: Coherent organic- and iron-stained sand, 0.000	Very low	High	Moderate

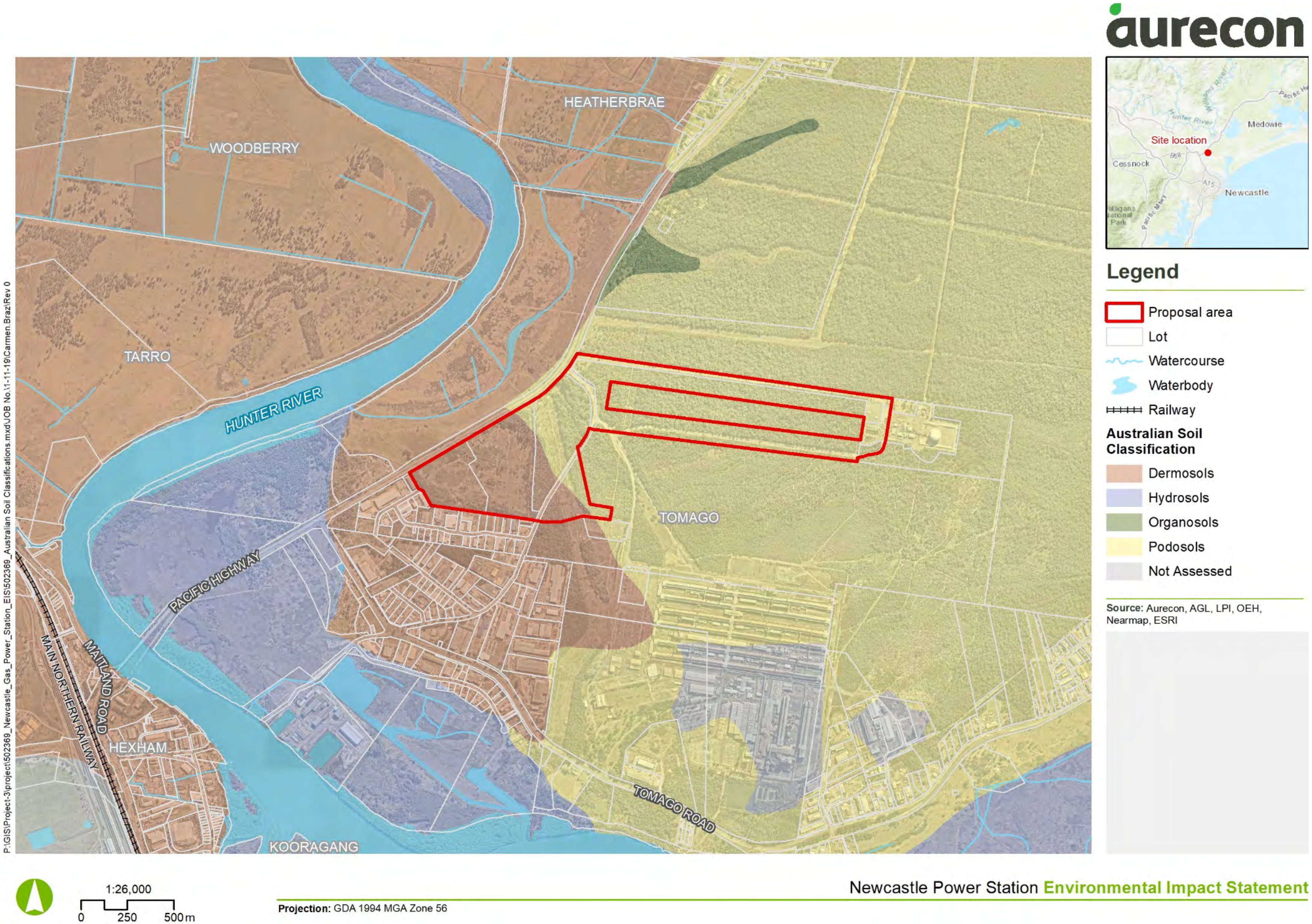
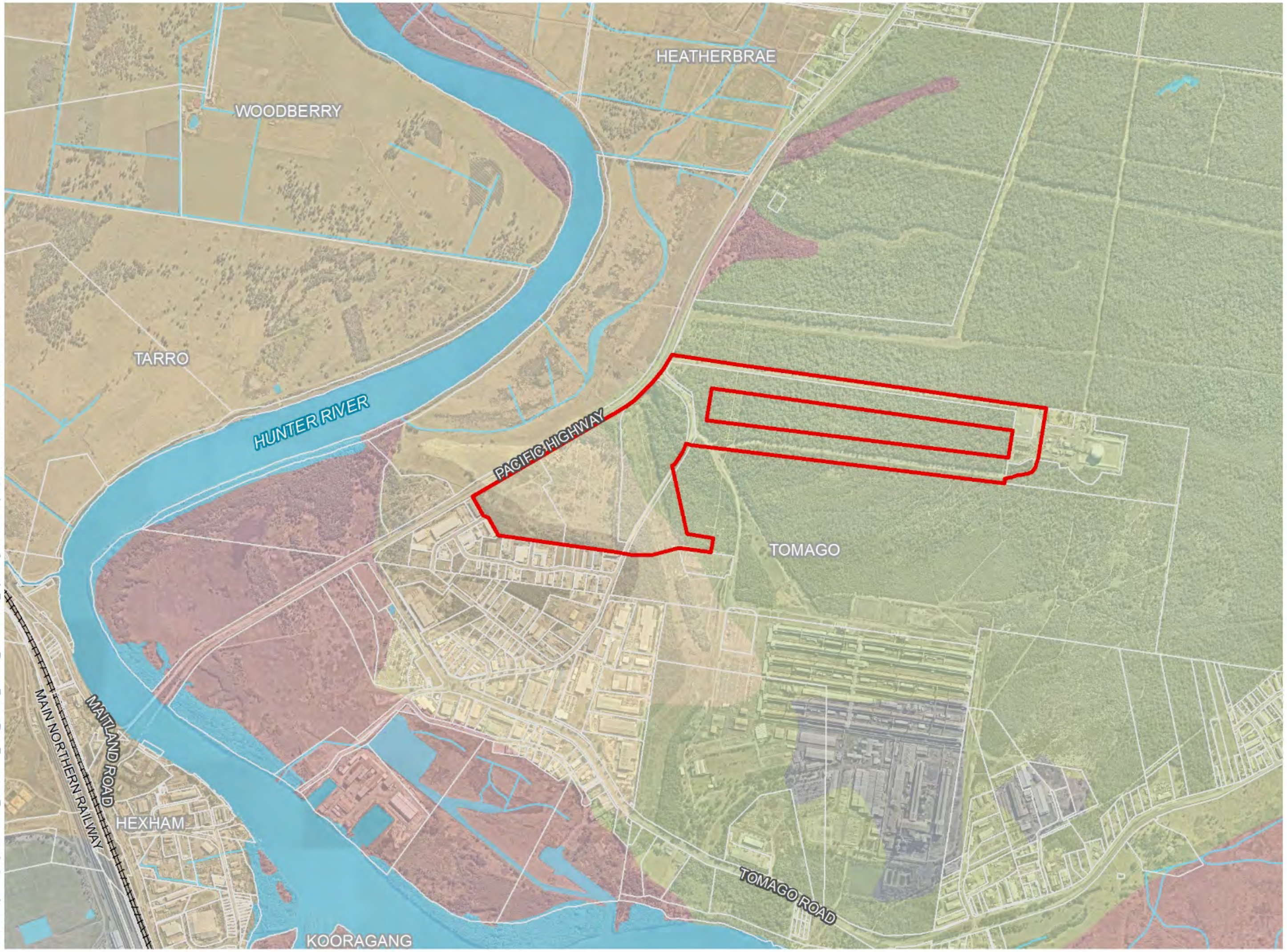


Figure 6.6.1 Australian soil landscapes

aurecon



Legend

- Proposal area
- Lot
- Watercourse
- Waterbody
- Railway

Hydrologic Soil Group

- A
- B
- C
- D
- Not assessed

Source: Aurecon, AGL, LPI, OEH, Nearmap, ESRI

1:26,000

0 250 500 m

Projection: GDA 1994 MGA Zone 56

Newcastle Power Station **Environmental Impact Statement**

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Figure 6.6.2 Hydrologic soil groups

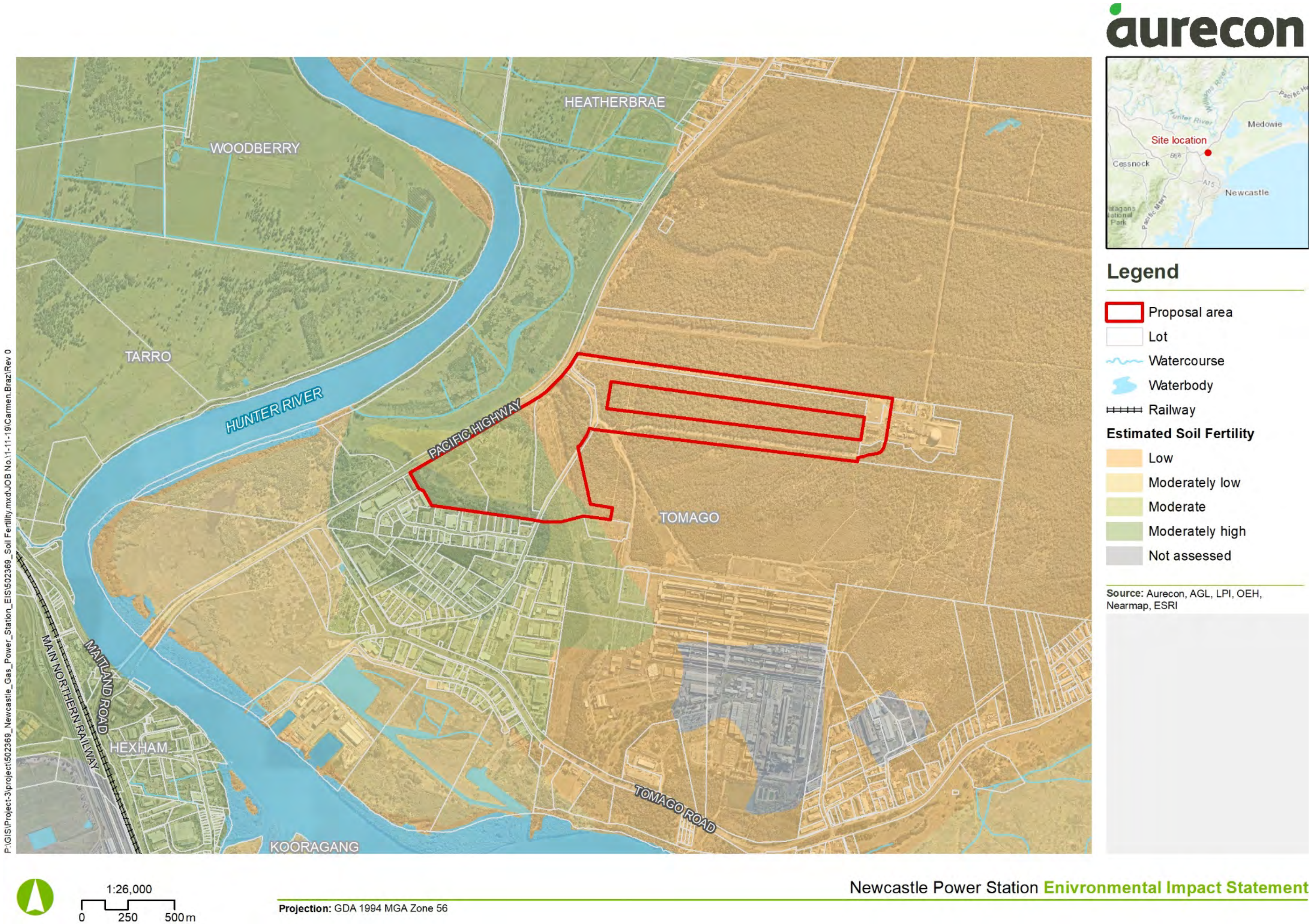

Figure 6.6.3 Soil fertility

Land and soil capability

Land and soil capability is the physical capacity of land to sustain a range of land uses and management practices. Classification of land into classes on a scale of 1 to 8 identifies the types of land use that would be appropriate in each classification. The land capability and classifications of the Proposal is described in Table 6.6.2 and Figure 6.6.4.

Table 6.6.2 Land and soil capability

Location	LSC class	General definition
Central and southern portions of the Proposal area and covering the proposed power station site	4	**Moderate capability land** Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
Southern portion of the Proposal area (150m width)	5	**Moderate–low capability land** Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Central and northern portions of the Proposal area	6	**Low capability land** Land has very high limitations for high-impact land uses. Land use restricted to low impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.
Located in a very small portion of the north eastern Proposal area near the NGSF	8	**Extremely low capability land** Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

Acid sulphate soils

Acid sulphate soils (ASS) are naturally occurring soils that when disturbed react with oxygen to form sulphuric acid that can impact vegetation, groundwater and concrete or steel infrastructure. As identified in Section 6.3.1, most of the development footprint is classified as Class 4 (low risk of acid sulphate soils (ASS) above 4m beneath the surface), however, the north-west boundary of the site close to the Hunter River is classified as Class 2 (Figure 6.3.4).

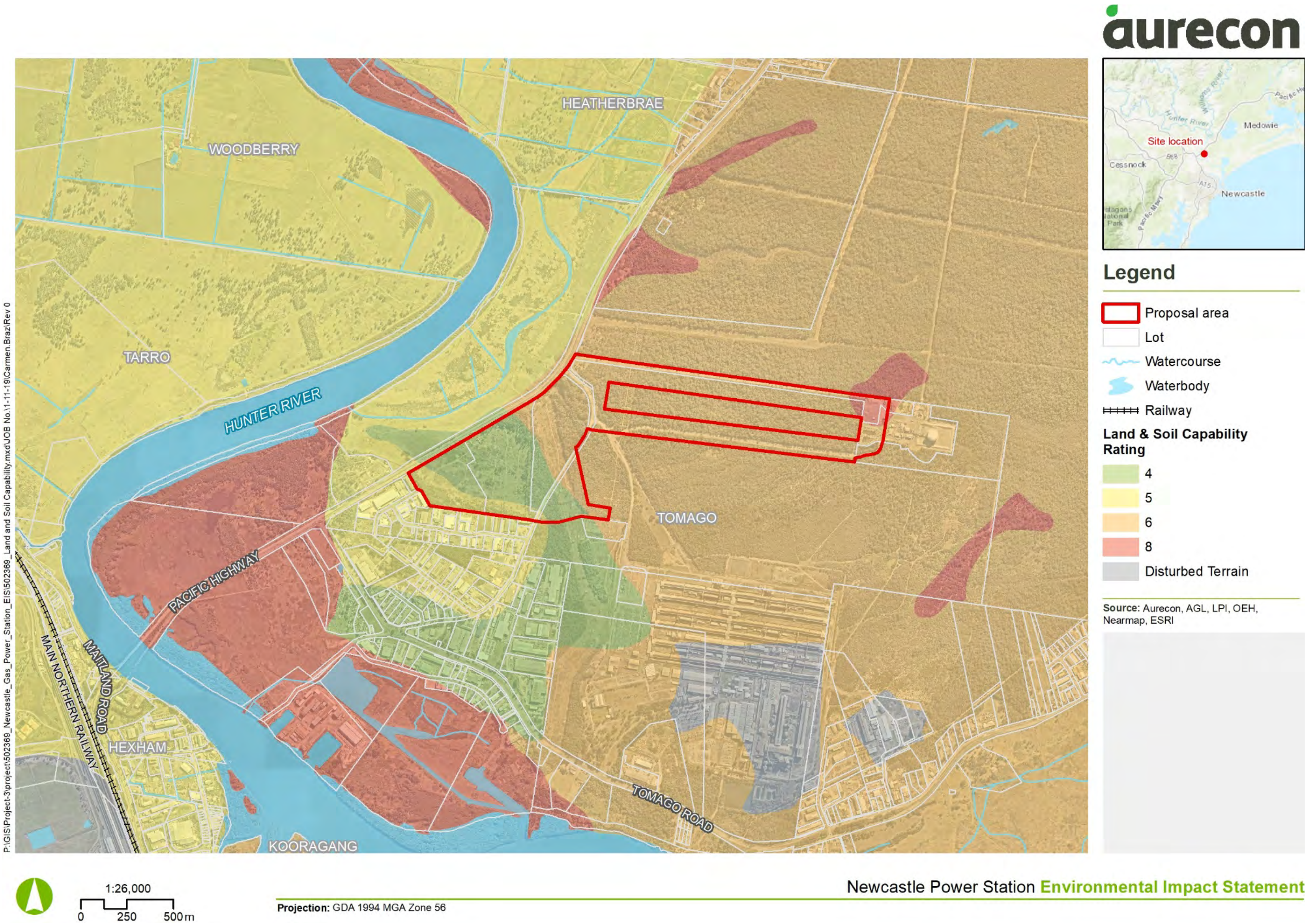

Figure 6.6.4 Land and soil capability

Topography

The Proposal area would be located adjacent to and partially within a designated floodplain area. The NPS site is located on a topographic high point adjacent to the Hunter River and divided by a topographic ridge approximately central to the Proposal, as shown in Figure 6.3.2. The average elevation along the ridge is approximately 15m AHD with a high point of 16m AHD in the north west portion. The southern portion of the Proposal area gently slopes away from the boundary, with elevations dropping to approximately 6-7m AHD. The gradient north of the central ridge is slightly steeper, dropping to 8m AHD over nearly half the distance. The gas pipeline corridors in the north are typically gently sloping to near flat with a slight rise towards the NGSF at approximately 6m AHD.

Contamination

A review of the NSW EPA register of notified contaminated sites indicate that there are two contaminated sites within 1km of the Proposal (refer to Figure 6.6.5). This includes RZM, located across Pacific Highway from the Proposal area, which is currently being assessed by the EPA to determine any regulatory requirements. The second contaminated site notified to the EPA is the Balcombe Sweat Furnace. The NSW EPA has determined this does not require regulation under the *Contaminated Land Management Act 1997* (CLM Act). The Balcombe Sweat Furnace is considered likely to be down gradient hydraulically (via groundwater) of the Proposal area and therefore a low risk of contamination impacting the Proposal. The RZM Tomago site is also considered to be down gradient hydraulically (via groundwater) or cross gradient and therefore a low risk of contamination impacting the Proposal area.

A review of the Phase 1 Preliminary Environmental Site Assessment by Environmental Strategies identified seven areas of environmental contamination (AEC) which relate to activities/observations such as dumped waste or stockpiled material within the Proposal area. The AECs (Figure 6.6.6) were:

- AEC 1: Septic Tanks
- AEC 2: Residential Compound
- AEC 3: Abandoned Motor Vehicles
- AEC 4: Mounds/Potentially Stockpiled Material
- AEC 5: Dumped Waste
- AEC 6: Dam and Stockpiled Material
- AEC 7: Stockpiled Material Encroaching TDS-2 (Eastern Boundary from Adjacent Property)

Dumped waste was identified sporadically adjacent to the alignment of the former section of Old Punt Road as indicated in Figure 6.6.6.

The Proposal area is currently not identified as having potential PFAS contamination (per- and poly-fluoroalkyl substances) used for firefighting. However, there is potential for nearby industrial sites to the south to have historically used aqueous film forming foam (AFFF) fire suppression systems (which are a source of PFAS). These are unlikely to be impacted by the Proposal.

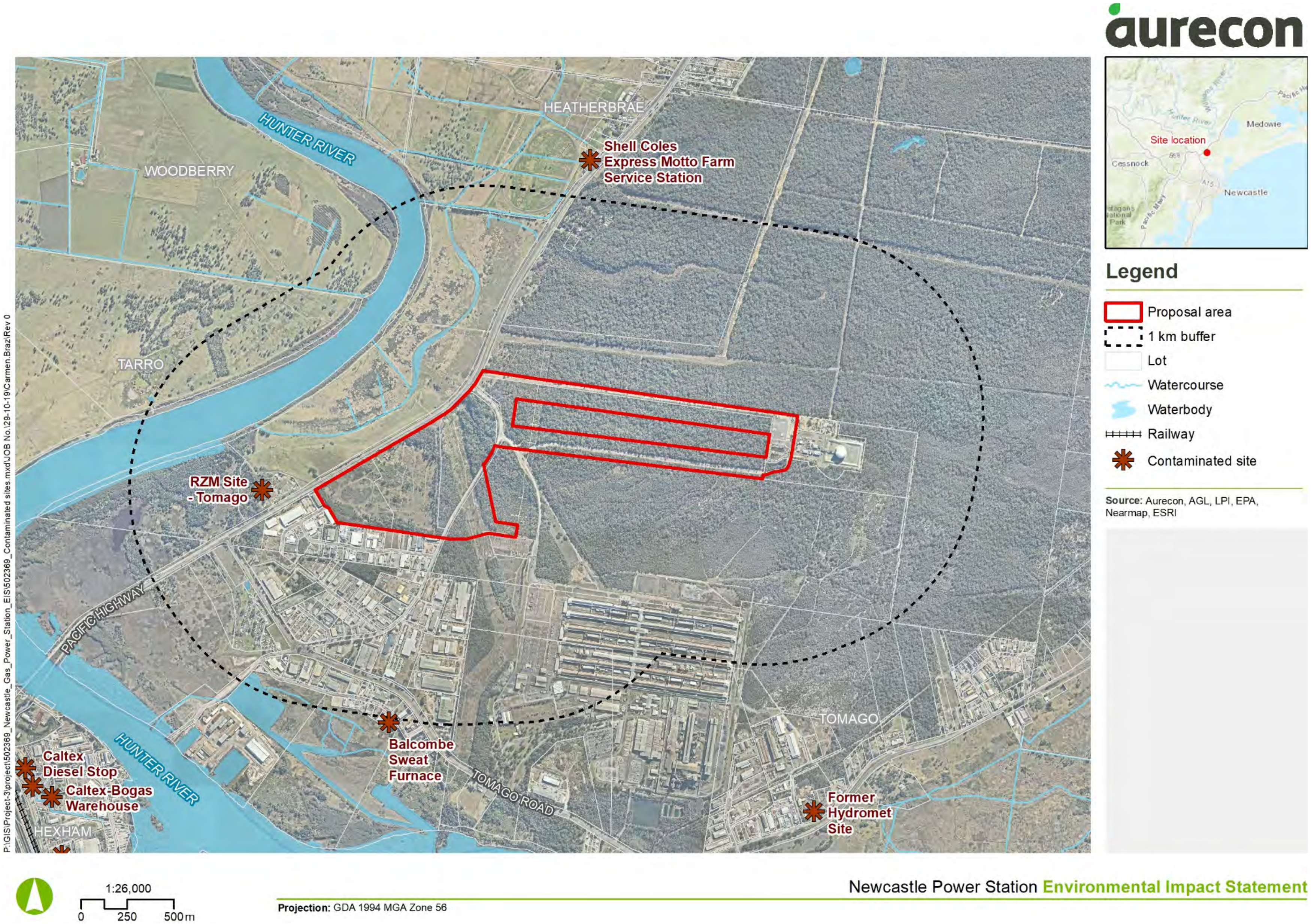

Figure 6.6.5 NSW EPA contaminated land site

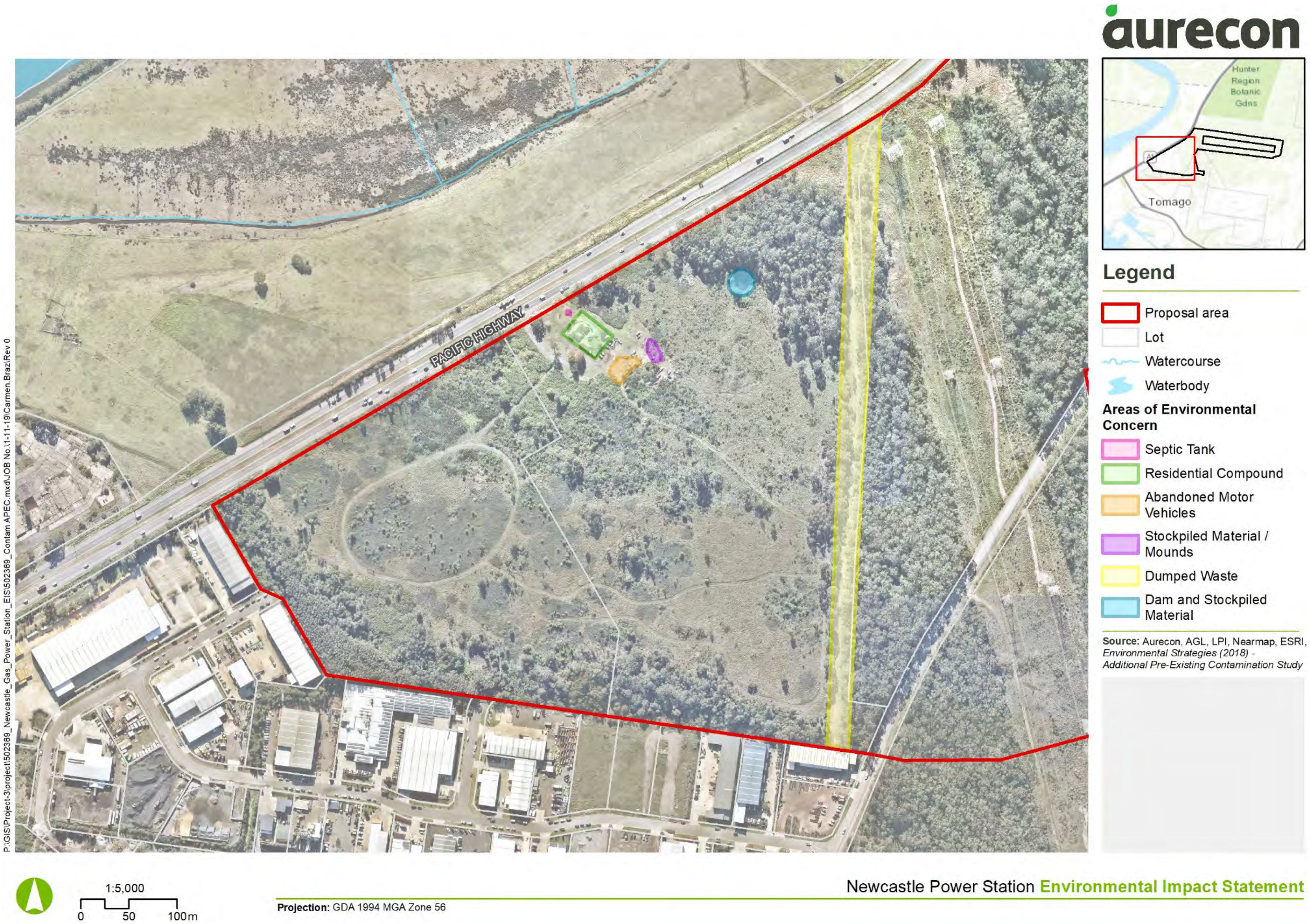

Figure 6.6.6 AECs

6.6.2 Study methods and criteria

The soils and contamination assessment included:

- A desktop review of existing information and previous ground investigation reports to assess the current environmental conditions of the Proposal area, including soil types, land capability and to establish the sources of historical contamination as well as potential contamination during the construction and operational phase of the Proposal
- A review of available Government land quality and environmental data bases for soils, geology, hydrology, hydrogeology, acid sulphate soils (ASS), contaminated lands and other relevant attributes as applicable
- A site walkover and inspection to confirm the findings of the background desktop assessment and assess the Proposal area (where access was available) for potential signs and sources of land contamination. The inspection included observation and recording of the Proposal area terrain, surface condition, topography, vegetative cover, drainage pathways, contaminated land risk areas and surrounding land uses
- A review of relevant legislation, policy and guidelines to address SEARs and agency requirements, and to inform potential construction, operational and cumulative impacts, in conjunction with possible mitigation and management measures for the Proposal
- A review of Aurecon's Concept Design Report (2019) for the Proposal enabled the identification of construction and operational phase activities relevant to this soils and contamination specialist study. The potential impacts and associated mitigation measures were also assessed with consideration to the relevant components of the Proposal.

Relevant policies and guidelines

The following guidelines were considered within the specialist study:

- *Contaminated Land Management Act 1997* (NSW) (CLM Act)
- *Protection of the Environment Operations Act 1997* (NSW) (POEO Act)
- *Environmentally Hazardous Chemicals Act 1985* (NSW) (EHC Act)
- EP&A Act
- Protection of the Environment Operations (General) Regulation 2009
- Protection of the Environment Operations (Waste) Regulation 2005
- *Fisheries Management Act 1994*
- Department of Urban Affairs and Planning (DUAP) and NSW EPA, 1998. *State Environmental Planning Policy No. 55 – Remediation of Land*
- NSW WHS Regulation 2017
- *Port Stephens Local Environmental Plan,* 2013. (specifically, part 7.1 – Acid Sulphate soils)
- *Port Stephens Development Control Plan*, July 2019. (specifically, part B3 Environmental Management Acid Sulphate soils)

Additionally, a number of NSW EPA, NSW OEH and DECC guidelines were used within the specialist study. A full list of the guidelines considered is provided in Appendix I.

6.6.3 Potential impacts

Construction

During construction, disturbance of soils and contamination sources have the potential to affect human health and the environment through soil erosion, contact with contamination sources or mobilisation of contaminants to surface waters and groundwaters. The potential pollutants which could be introduced to the receiving environment during construction activities include sediment, acid sulphate soils and other areas of environmental contamination which are considered in further detail below.

Soils

Ground disturbance and excavation for the construction of the Proposal would temporarily expose the ground surface and sub-surface through the removal of vegetation and topsoils. Removal of topsoil and vegetation would expose soils to risk of erosion which could impact surrounding water or air quality. Soil erosion may occur in the form of runoff during rainfall, flooding events or windblown.

The majority of earthworks across the Proposal area would occur within the NPS site which consists of the Beresfield soil landscape that have a moderate to high risk of erosion during non-concentrated flows. Remaining earthworks would include ground disturbance for gas pipelines (including the HDD pipeline) and electricity transmission line. Associated construction activities such as heavy vehicle movements have the potential to destabilise soil which can increase the impacts of soil movement and erosion in wet or windy conditions.

Topsoils would be removed and stockpiled for beneficial reuse within the Proposal area. Excavated soils that cannot be beneficially reused within the Proposal area (for works such as filling) would be handled and managed in accordance with the Proposal CEMP. This may include offsite disposal to a licensed waste facility or beneficial reuse where appropriate to do so under NSW waste and resource recovery legislation and guidance.

Potential soil erosion and degradation impacts would be avoided, mitigated or managed through standard stormwater, erosion and dust control measures such as sediment basin/s. These would be sized and located by the contractor during detailed design.

A feasibility assessment identified that the disturbance footprint contains sufficient space for sediment basin/s to be developed. The assessment included a RUSLE equation which adopted the highest K factor for the soil types (D and F) identifying annual soil loss of 147.64t/ha. This estimation is considered conservative and is marginally below the IECA trigger value for sediment basins of 150t/ha/yr. Despite this, as the area of disturbance would exceed 2,500 m^2 and the Proposal area is adjacent to the sensitive receiving water bodies including the Hunter River and Tomago Sandbeds, sediment basin/s would be incorporated into the construction of the Proposal.

Sediment basin/s and additional mitigation measures that would be implemented are discussed in Table 6.6.3. As a result of the implementation of these measures, erosion and sedimentation impacts are not considered to be significant for the Proposal.

Acid sulphate soils

There is a moderate to high risk of encountering ASS during excavation, ground disturbance and shallow dewatering, including during HDD activities (for pipeline construction). As discussed in Sections 6.3 and 6.4, ASS have the potential to impact surface water and groundwater. These impacts would be mitigated through the application of the ASSMP.

Construction activities also have the potential to spread ASS which can disturb and impact vegetation. As Lot 3 would be cleared during construction, impacts to existing vegetation from ASS at the NPS site are unlikely. Vegetation in the eastern side of the Proposal area has the potential to be impacted by the spread of ASS. The aeolian derived soil landscapes in the northern portion of the Proposal area require careful management so not to generate acidity (if sulphide is present), nor add excessive neutralising agents that are unnecessary. Potential impacts would be managed by the ASS measures described in Table 6.3.3, specifically the ASSMP.

The likelihood of an impact on the Ramsar wetland (Kooragang Nature Reserve) is low (the lowest risk assessment category) given the distance (greater than 2.5km) and the implementation of avoidance, mitigation, and management measures recommended in Section 6.6.4.

Contamination

Construction has the potential to disturb and interact with existing contaminants on the Proposal area. Construction and operation of the Proposal would also involve the storage, treatment or handling of fuels, chemicals building materials, wastes and other potential contaminants. Based on a review of the background information, there is the potential for contamination to be encountered at the seven AECs located throughout the Proposal. Of the identified AECs (see Section 7.6.1); AEC2, AEC5 and AEC7 have the potential to cause ecological or human health risks due to the identification of polycyclic aromatic hydrocarbons (PAHs) in the contaminate material.

These localised areas that pose potential human health or ecological risk would require further assessment and potential management or remediation prior to or during construction. The existing contamination dataset shows elevated concentrations are localised and are not representative of broad/site wide contamination issues based on the available information reviewed. State Environmental Planning Policy 55 (Remediation of Land), 1998 states that land must not be developed if it is unsuitable for a proposed use because it is contaminated. If the land is unsuitable, remediation must take place before the land is developed. As investigations and site observations conclude that potential sources of contamination and associated impacts are likely to be localised, remediation would be possible where required using construction machinery.

Construction of the Proposal would also involve the storage, treatment or handling of fuels, chemicals building materials, wastes and other potential contaminants. Any contamination spill during construction would be managed and mitigated to make the land suitable for the Proposal and to prevent impacts on human health and the environment. Contamination risks would be managed through the application of Australian Standards for the storage and handling of fuels and chemicals and appropriate engineering design. In the unlikely event of significant leaks or spills of contaminants, remediation would be implemented immediately during construction.

Land contamination risks for the Proposal are not considered to be significant based on the assessment of desktop information and previous reports available and would be avoided, mitigated and managed during construction and operation of the Proposal by implementing mitigation measures detailed in Table 6.6.3.

Land capability and topography

Based on a review of the land capability of the Proposal area, there are no major geotechnical constraints for the Proposal (for hydrogeological constraints and characteristics of the Proposal area refer to Section 6.4). However, normal engineering design and practice are to be implemented in accordance with relevant Australian Standards and their engineering design principles.

The Proposal bulk earthworks would change the topography and current landscape, impacting the upper geological layers and topography within the Proposal area. Following Proposal development and construction, the built structures would be higher than pre development and the secondary impact would mainly relate to hydrology and visual amenity discussed in separate technical specialist reports for the Proposal.

Operation

Potential impacts from the Proposal's operation and proposed controls are discussed in further detail below and outlined in Table 6.6.3.

Soils

Although soil disturbance is unlikely to occur during operational activities, ASS, if disturbed, have the potential to erode and decay building materials. As the potential for ASS to occur has been identified, in ground structure materials such as concrete and steel would be selected at the design stage to address the potential acidic conditions (guidance provided in Australian Standards 2159 and 2885).

Soil erosion could also occur during wind and rain events, particularly in the highly erodible Beresfield soil landscape. Proper soil stabilisation and revegetation would minimise potential soil dispersion impacts. Provided the mitigation measures described in Table 6.6.3 are implemented, operational impacts of the Proposal on soils are considered minimal.

Contamination

During the operation phase of the Proposal, there is a potential for minor spills and incidents of fuel, oil and chemicals that could potentially contaminate soils. A control plan would be implemented as part of the OEMP that would identify the procedure for any major chemical or fuel spills or leaks. As part of the plan, NSW EPA would need to be notified if any significant chemical spills have occurred. Land contamination risks for the Proposal are not considered to be significant based on previous reports available and by implementing mitigation measures detailed in Table 6.6.3.

Cumulative impacts

Construction of the Proposal has the potential to cause ground disturbance resulting in soil erosion, sedimentation and disturbance of ASS or existing land contaminants. These impacts have the potential to be compounded by the occurrence of mismanaged activities at surrounding construction sites. As the Proposal would implement a range of management measures during construction, reducing sedimentation and contamination impacts, the Proposal is not anticipated to contribute to cumulative impacts.

The Proposal also has the potential for contaminates and pollutants to be generated during operations (including accidental spills associated with the storage, treatment or handling of fuels). As the surrounding developments are industrial, there is the potential for cumulative impacts to the receiving environment. It is anticipated that cumulative impacts would not occur due to the Proposal's implementation of operational management measures.

6.6.4 Avoidance, mitigation and management

A range of avoidance, mitigation and management measures would be implemented for soils and contamination outlined in Table 6.6.3.

Table 6.6.3 Avoidance, mitigation and management measures - Soils and contamination

ID	Environmental safeguards	Timing
SC-1	Heavy vehicles and machinery would use allocated tracks where possible to minimise soil erosion.	Construction
SC-2	Where highly contaminated soil and/or groundwater is impacted, a site-specific remediation action plan would be required to manage the material. This would include management requirements that are above those outlined within the CEMP. It may be specific to the selected remediation technique and detail the requirements of a specialist remediation contractor.	Pre-construction Construction
SC-3	A pre-demolition hazardous materials survey is required for the demolition of the residential dwelling on Lot 3. Based on the findings, required controls would be implemented for removing the identified materials.	Construction
SC-4	A spills protocol would be developed as part of the OEMP, including: ■ Fuel/chemical spill protocols – spill kits to be available and relevant workers to be trained on response protocols ■ A formal reporting procedure - any spills to be reported on the Spill Register ■ A register of all hazardous chemicals kept on site is to be maintained and updated regularly ■ Appropriate recorded spill capture points (i.e. bunding, collection sump, etc) ■ Maintenance requirements of effluent-related infrastructure or disposal to stormwater or sewer)	Operation
SC-5	Monitoring of contamination would be included in the CEMP which would include: ■ Further assessment of identified contamination AECs prior to construction to determine remedial actions ■ Hazardous materials (HAZMAT) asbestos and lead paint surveys of any buildings or structures within the Proposal area prior to demolition ■ Monitoring to be detailed in Proposal construction environmental management plans	Construction
SC-6	Construction of sediment basin would be in accordance with the specifications outlined in Appendix I.	Construction Operation

6.7 Aboriginal heritage

An Aboriginal Cultural Heritage Assessment Report (ACHAR) was prepared by Environmental Resources Management Australia Pty Ltd (ERM, 2019) to assess the potential Aboriginal heritage impacts associated with the construction and operation of the Proposal. The ACHAR is provided in Appendix J.

6.7.1 Existing environment

Context

The assessment of the existing environmental context found:

- The Proposal is within the Newcastle Bight dune barrier system, which is divided into an inner Pleistocene series of dune deposits and an outer Holocene sequence located immediately adjacent to Stockton Beach. There have been three periods of dune transgression that have resulted in three distinct Holocene dune sequences within the study area and formed three distinct parallel ridges oriented north-east to south-west. The Proposal is within the inner stable Pleistocene dune system.
- The Proposal is located to the south and east of the Hunter River. A number of small unnamed creeks are located within 750m of the Proposal area; however, these were assessed as unreliable water sources and not suitable for providing subsistence.
- The Proposal is located in an ecologically diverse area containing vegetation communities such as *Spotted Gum – Ironbark Open Forest*, *Melaleuca Casuarina Forest* and *Closed Grassland*. The area was assessed as containing sufficient resources for manufacturing tools and weapons and edible subsistence species. Furthermore, these communities may have provided habitat for a number of subsistence species including possums, koalas and fruit bats.
- The Proposal area is rural and has been previously used for crop farming and stock grazing during the mid to late 19th Century. Later activities included construction of the transmission line and corridor between 1923 and 1933, and the resumption of land to construct the Pacific Motorway (A1) prior to 1961. A house located on the western boundary of the NPS site appears to have been constructed in the 1940s or early 1950s around the time the highway was constructed or shortly after. Sheds and other small buildings at the house site were constructed throughout the second half of the 20th century. These activities would have resulted in significant ground disturbance which may have affected archaeological potential.

Archaeological background

History

The Proposal is in a region with rich Aboriginal cultural heritage with numerous archaeological sites previously recorded. It is within the Tomago area where the Worimi people are the traditional owners. The Awabakal people occupied the land immediately south and the Birpai people to the north. Historical data suggests the Worimi people relied heavily on swamps and wetlands for sustenance, which provided a diverse profile of plant and animal resources. Dense occupation sites have been previously identified indicating a rich economic, social and spiritual life and strong connections to the land and cultural traditions.

A number of archaeological investigations of the regional context including Hughes 1984, Hiscock 1986, Koettig 1986 and Baker 1994 concluded:

- Open artefact scatter sites are found within the landscape on areas of preserved original soils and increase in frequency, size and complexity near water sources (e.g. creeks, rivers, swamps)
- Isolated finds (stone artefacts) are found within the landscape in equal distribution independent of the environment (e.g. near a watercourse, inland etc.)
- Midden sites are found near estuaries and the coastline

- Aboriginal burials are often found in soft substrates such as sand and often within occupation contexts such as middens
- Scarred and carved trees are found within areas of remnant bushland containing old growth trees
- Aboriginal rock shelters, rock shelter art, rock engravings and axe grinding stones are found within sandstone outcropping and escarpments

Previous assessments

Gloucester Gas Project Pipeline Modification Environmental Impact Statement

In 2013, AGL commissioned an EIS for the Gloucester Gas Project. The project included a gas transmission pipeline from Stratford to the gas delivery station at Hexham. An ACHAR was carried out for the Proposal which included an area immediately north-west of the Proposal.

The ACHAR reported that none of the surveyed areas were archaeologically sensitive and no Aboriginal archaeological sites would be impacted by the Proposal. The RAPs involved in the site survey identified the area as having cultural significance through intangible links to the Awabakal ancestors.

Tomago Gas Fired Power Station Environmental Impact Statement

In 2002 Macquarie Generation commissioned an EIS for the proposed Tomago Gas Fired Power Station. The NPS site was part of a larger assessment for an industrial subdivision in Tomago and included the proposed NPS site.

The field survey identified no Aboriginal objects within or immediately surrounding the NPS site.

M12RT Biodiversity and Aboriginal Heritage Investigations

Roads and Maritime commissioned biodiversity and Aboriginal heritage investigations in 2015 within the site of the proposed NPS to support the M1 Pacific Motorway extension to Raymond Terrace early feasibility studies.

Archaeological surveys and test excavations were carried out in the north-eastern portion of the proposed NPS site as well as on both sides of the Pacific Highway and in the neighbouring Lot to the west. The works identified one large site now registered on the Aboriginal Heritage Information Management System (AHIMS) Database as Hexham M12RT (AHIMS ID #38-4-1751). The current alignment for the Hexham M12RT upgrade extends into the Proposal area.

Aboriginal Heritage Information Management System

An extensive search of the Office of Environment and Heritage (OEH) AHIMS database was conducted on 13 March 2019. This revealed a total of five sites within the search area, none of which were located within the Proposal area. Of the five, three were identified as artefacts, one as a potential archaeological deposit (PAD), and the last as art (pigment or engraved).

Based on the above examination of landforms, geology, archaeological patterning, and prior archaeological reports, the most likely site type to be found would be artefact sites. Stone artefacts are likely to be present across the area irrespective of landscape and are more likely to be present in areas which are close to water sources.

Field survey results

Three previously unidentified Aboriginal heritage sites were recorded during the field survey. These were identified within 1.5km of the Hunter River to the north-west. Two of the three sites were identified as isolated finds (single stone artefacts) and the third a large artefact scatter likely associated with a previously identified site (Hexham M12RT) on the opposite side of the highway. A PAD encompassing finds at NPS01 and NPS02 was also found. No Aboriginal heritage sites were identified within the gas storage pipeline corridors. One isolated flake (NPS03) was found in the proposed electrical transmission line corridor but was suspected of being deposited with fill material. Figure 6.7.1 shows the survey results across the Proposal area and Table 6.7.1 describes the sites found during the survey.

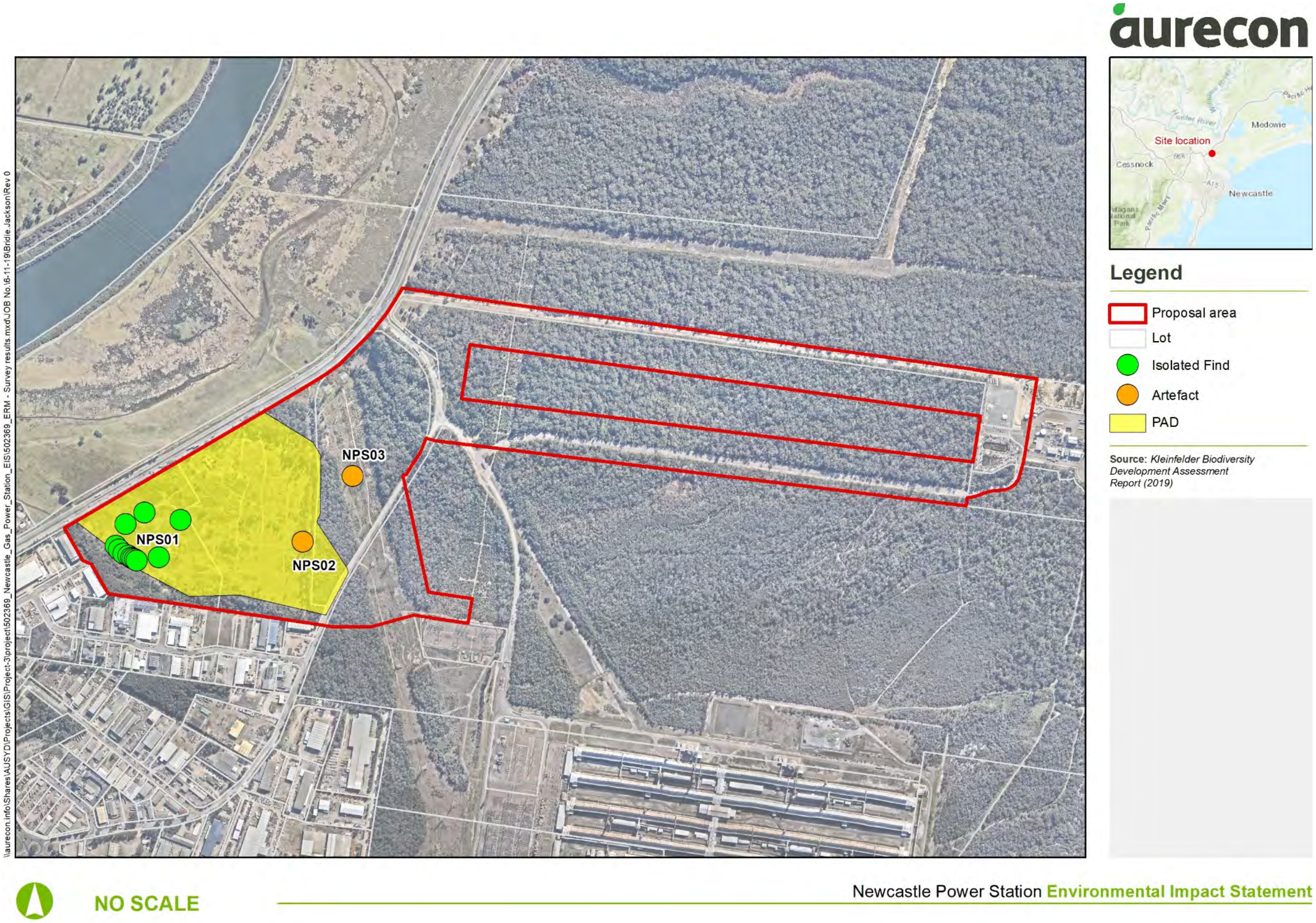

Figure 6.7.1 Aboriginal heritage survey results

Table 6.7.1 Aboriginal cultural heritage field survey results

Site	Description	Examples
NPS01	This site is comprised of 23 stone artefacts located along a circular track. The site covers an approximate area of 175m by 20m. Given ground visibility was 0% it is highly unlikely that all artefacts located on the surface were identified within the area. Artefacts comprised of cores and flakes consisted of a variety of stone material including silcrete, chert and mudstone. This site is believed to be associated with the previously identified AHIMS site 38-4-1751 (Hexham M12RT). A PAD was identified in associated with this site and it is believed to extend across the entire site and a large section of the mid slope and into NPS02. The site is within Survey Unit 1 and the Mid slope Landform.	 
NPS02	This site is an isolated find and contains a silcrete core. Ground visibility at the site was 100%. A PAD was identified in association with this site and NPS01. The site is within Survey Unit 2 and the Mid slope Landform.	
NPS03	This site is an isolated find and negative flake scars are present. It was found at the base of a transmission tower and is likely to be deposited with fill material. The site is within Survey Unit 3 and the Lower slope Landform.	

Test excavation results

Test excavations were limited to areas subject to impact by the Proposal and to where the survey results indicated the presence of sites was most likely. Excavations were therefore limited to NPS02 and its associated PAD (the excavation area).

Test excavations were conducted in two stages using a systematic grid. A total of 28 excavations of 0.5m by 0.5m on a 50m grid were carried out as part of stage 1. Where dense concentrations of artefacts or archaeological features were identified, additional stage 2 pits of 0.5m by 0.5m were excavated on a 20m grid around the stage 1 pit. Ten test excavations were not completed due to access restrictions from dense vegetation (five pits), location to tenant property (one pit), and being assessed in the field as being of low potential or sensitivity (four pits).

A full list of test pits and results are provided in Appendix J. The following section describes only those test pits where artefacts were uncovered.

Those test pits where artefacts were uncovered are:

- Test pit 1 – located in the north-west corner of the development footprint, near the Pacific Highway. A total of four splits were excavated with five artefacts found. These were two silcrete flakes, one silcrete core, one chert chore and one charcoal sample.
- Test pit 26 – three artefacts were found at TP26, located in the north-east corner of the development footprint. The artefacts were identified as two grey silcrete flakes and one silcrete core.
- Test pit 27 – six artefacts were identified at TP27, which was located on the western boundary of the development footprint. Two cream silcrete cores, two silcrete flakes, one red silcrete core and one light red silcrete flake were identified.
- Test pit 28 – a single grey silcrete flake was identified at TP28, which was located along the western boundary of the NPS site approximately 20m east of TP27.

Summary

In total, the test excavation identified 15 artefacts across the four test pits mentioned above. The full list of artefacts is provided in Appendix J.

No further surface artefacts were identified during the test excavation program indicating that while the PAD still exists it is limited in size and density. Further material may be present to the west of the excavation area, but access to this part of the site was restricted because of the proximity of the tenanted house. Although material may be present, it is considered a low likelihood due to previous heavy disturbance.

Assessment of significance

As part of the ACHAR, an assessment of the cultural significance of the Proposal area and surrounds was conducted. Cultural significance refers to the aesthetic, historic, scientific and social value of past, present and future generations.

These four principles are outlined below:

- Social/cultural value refers to the spiritual, traditional, historical and contemporary associations, attachments and meanings Aboriginal people have to places. This value is assessed by the traditional owners and First Nations people.
- Historic value refers to the associations a place has with historical persons, events or activities and as such is not always related to a physical structure. This value is assessed by the traditional owners, First Nations people and non-Aboriginal historical specialists.
- Scientific (archaeological) value refers to the importance and the subsequent associations of a landscape, area, place or object. Assessments are conducted on a scale from low, to moderate and lastly high significance. Low significance is commonly associated with highly disturbed sites. Often sites with low significance are unable to contribute new information about the occupation of the area by Aboriginal communities. Moderate significance is often attributed to sites that provide information not previously known. High significance is often associated with rare and unique sites, the loss of which would reduce one’s ability to understand the occupation of the area by Aboriginal communities. This value is assessed by professional archaeologists.
- Aesthetic value refers to the sensory, architectural and social value of the place. It considers the form, scale, colour, texture and material of the place or site and the smell, sounds and use associated with the place.

Social significance

No information was received from the RAPs to suggest the Proposal area is or was of social significance to the local Aboriginal community.

Historic significance

No evidence suggests the Proposal area holds historical significance for local Aboriginal people.

Scientific significance

The Aboriginal sites located during test excavations are consistent with the sites found in the region, being of open camp sites (artefact scatters) and isolated finds. Materials are similarly consistent with those in the region, containing predominantly silcrete and less predominantly chert and mudstone.

Artefacts were identified in disturbed areas with heavily eroded exposures and evidence of vehicle use. Given the level of disturbance at the sites, the low density of surface and subsurface archaeological material and the commonness of the sites within the regional landscape, the scientific significance of the sites has been determined as low. Furthermore, as the sites were found within 200mm of the surface, the potential distribution of unidentified artefacts around the area was determined as low.

Aesthetic significance

No evidence suggests the Proposal area and identified artefacts hold aesthetic significance.

Aboriginal Heritage Statement of Significance

The Proposal area has no social, historical, or aesthetic value for local Aboriginal people. Based on the results of archaeological survey and test excavation, the scientific significance of the Proposal area was assessed as low.

No comments were received from the RAPs on the cultural value of the Proposal area, and it has been concluded in the ACHAR that the overall significance of the Proposal area to local Aboriginal people is low.

6.7.2 Study methods and criteria

Study criteria

The assessment was undertaken in accordance with the following key reference documents and guidelines:

- NSW Office of Environment and Heritage’s (OEH) Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (the Guidelines)
- Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW 2010 (Code of Practice)
- Aboriginal cultural heritage consultation requirements for proponents (DECCW 2010)
- NSW Heritage Manual (1996)
- Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW, 2010a)
- The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
- Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH, 2011)
- Assessing Heritage Significance (NSW Heritage Office, 2001)
- Statements of Heritage Impact (Heritage Office and Department of Urban Affairs and Planning, 2002)

The Due Diligence Code of Practice describes the process that must be followed to manage cultural heritage matters to the appropriate standard. The scope of the ACHAR included the following:

- Consultation with the Aboriginal community
- Understanding the environmental context

- Understanding the archaeological background
- Archaeological survey
- Archaeological test excavations

Consultation methodology

Aboriginal community consultation was undertaken in accordance with the guideline *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010) to:

- Determine the potential harm on Aboriginal cultural heritage from the Proposal
- Inform decision making for applications of Aboriginal Heritage Impact Permits (AHIP), in such cases where harm is unavoidable

  Consultation was conducted in a four-step process which involved:

- Notification of Proposal and registration of interest
- Presentation of information about the Proposal
- Determining the potential impacts and proposed mitigation measures
- Review of the draft ACHAR

Stage 1: Notification of Proposal and registration of interest

This stage identified, notified and registered Aboriginal people with cultural knowledge of Aboriginal objects and or places within the Proposal area. Seven parties were contacted on 30 November 2018 to identify stakeholder groups or people with a potential interest in the Proposal.

The seven parties were:

- Worimi Local Aboriginal Land Council
- Hunter Local Load Services
- National Native Title Tribunal
- Native Title Services Corporation
- NSW OEH Regional Operations Hunter Central Coast Branch
- Office of the Registrar, Aboriginal Land Rights Act 1983
- Port Stephens Council

Twenty-five Aboriginal people and organisations with a potential interest responded, with a total of 12 registrations received following issuance of the Proposal notification on 21 January 2019. These were:

- Didge Ngunawal Clan
- Nu-Run-Gee Pty Ltd
- Worimi Traditional Owners Indigenous Corporation
- Divine Diggers Aboriginal Cultural Consultants
- Worimi Local Aboriginal Land Council
- Widescope Indigenous Group
- Murra Bidgee Mulangari Aboriginal Corporation
- A1 Indigenous Services
- Mu-Roo-Ma Pty Inc
- Muragadi
- Karuah Indigenous Corporation

- Merrigarn

Full details of notification of Proposal and registration of interest process are provided in Appendix J.

Stage 2: Presentation of information about the Proposal

Aboriginal people and organisations were presented with the scope of the Proposal and the proposed cultural heritage assessment process.

The proposed field survey methodology was sent to each of the RAPs on 4 April 2019 along with a request form for RAPs to identify particular areas of interest for surveying. Five responses were received, acknowledging the report had been read and supporting the methodology and recommendations.

Following the field inspection, the requirement for test excavation was identified. A test excavation methodology was provided to the RAPs on 5 June 2019 and five responses were received, again acknowledging the report and supporting the methodology and recommendations.

Copies of the correspondence with the RAPs provided in Appendix J.

Stage 3: Determining the potential impacts and proposed mitigation measures

Archaeological field survey and test excavations were undertaken with RAPs to gather in field information on cultural significance. The field survey and test excavations were undertaken between 15 and 18 July 2019 and are described further in the following sections, and in the ACHAR provided as Appendix J.

Stage 4: Review of the draft ACHAR

The Draft ACHAR was provided to RAPs on 7 August 2019 and each was given 28 days to review the report and provide comments on its content, findings, and recommended management and mitigation measures.

Comments were received from three of the RAPs. These are summarised in Table 6.7.2 and provided in full in Appendix J. The comments were reviewed and incorporated into the recommendations of the ACHAR.

Table 6.7.2 Outcomes of the RAP consultation

Organisation	Comment summary
Muragadi	■ Read and understood the draft ACHAR ■ Agree with recommendations
Karuah Indigenous Corporation	■ Read and understood the draft ACHAR ■ Agree with recommendations ■ Willing to be consulted again on this Proposal
Mur-Roo-Ma Incorporated	■ Read and understood the draft ACHAR ■ Agree with recommendations ■ Notes that objects located in the Proposal area are tangible cultural connections to ancestors ■ Propose the implementation of a Cultural Heritage Management Plan for works to be undertaken within the Proposal area, including potential monitoring and salvage works

Archaeological investigations methodology

Archaeological survey

An archaeological survey was undertaken over three days from 6 to 8 May 2019 by a qualified heritage consultant. The survey was conducted on foot with four RAPs in attendance. The Proposal area was assessed by walking transects approximately 5m apart to cover the entire Proposal area.

Areas of archaeological potential such as raised landforms near water sources and areas with good exposure and ground visibility were targeted, as were any areas of interest to the RAPs. Any cultural heritage information conveyed by the RAPs was recorded and treated in confidence.

The survey captured test excavations within Proposal area, and specifically within the western part of the Proposal area (being the NPS site and surrounds where majority of excavations are likely to occur).

The results of the field survey are provided in Appendix J and summarised in Section 6.7.1.

Archaeological test excavations

Test excavations were undertaken over four days from 15 to 18 July 2019. All test excavations were carried out in accordance with the standard sampling strategy and Requirements 16 and 17 of the Code of Practice.

RAPs were in attendance for the duration of the test excavations. They were conducted in two stages using a systematic grid. For stage 1 test pits of 0.5m by 0.5m were located on a 50m offset grid. Excavations were conducted by hand using trowels, mattocks and shovels. This methodology resulted in testing of at least 60% of the area. For stage 2, eight 0.5m by 0.5m test pits were placed on a grid at 20m intervals. This was conducted for areas containing densely populated artefacts (>60 artefacts per square metre).

The results of the test excavation are provided in Appendix J and summarised in Section 6.7.1.

6.7.3 Potential impacts

Construction

A total of four identified archaeological sites were discovered from the field survey and test excavation programs in the Proposal area. This included a large low-density artefact scatter (NPS01) comprising of 23 artefacts, two isolated artefacts (NPS02 and NPS03) and an associated PAD comprising of 15 stone artefacts.

NPS01 is outside of the development footprint and as such, would not be impacted by the Proposal. The Proposal would involve the total removal of sites NPS02 and NPS03 and the partial removal of the associated PAD, predominantly at the eastern extent.

NPS02, NPS03, and the PAD were assessed as having no scientific significance and low overall Aboriginal significance.

The likelihood of identifying additional subsurface objects during the proposed works was determined as unlikely.

Operation

There are not expected to be any Aboriginal heritage impacts from the operation of the Proposal.

Cumulative impacts

Aboriginal heritage artefacts that would be impacted by the Proposal have no social, historical, or aesthetic value, with a low scientific significance. Based on this, the Proposal would not contribute to cumulative adverse impacts to Aboriginal heritage in the region.

6.7.4 Avoidance, mitigation and management

The ACHAR identified a number of recommendations to mitigate the proposed construction works impacts on Aboriginal heritage. These measures are provided in Table 6.7.3.

Table 6.7.3 Avoidance, mitigation and management measures – Aboriginal heritage

ID	Environmental Safeguard	Timing
AH-1	Cultural awareness induction for any personnel involved in ground breaking activities. This could include a Cultural Awareness Training Program.	Construction
AH-2	A Cultural Heritage Management Plan including potential monitoring and salvage works procedures would be prepared and implemented for the Proposal construction.	Construction
AH-3	Chance Finds Procedure to be followed for any Aboriginal heritage objects found during the works. In the event an Aboriginal heritage object is found all activity in the immediate area must cease and an appropriately qualified heritage professional should be consulted. OEH and local Aboriginal stakeholder groups must be immediately contacted and informed of the Aboriginal heritage object found. The qualified heritage professional should record the location and the attributes of the site and determine its Aboriginal cultural significance. If Aboriginal remains (human skeletal material or suspected human skeletal material) are discovered during construction all activities in the immediate area must cease. The State Police and OEH must be contacted and any sand or soil removed from the near vicinity identified and set aside for investigation purposes.	Construction
AH-4	Repatriation of archaeological material is to be conducted for artefacts and charcoal recovered during test excavations. The location of the reburial must be determined by the RAPs and should be as close as possible to the location at which the sites were recovered.	Construction
AH-5	A copy of the final ACHAR should be distributed to all Aboriginal organisations who expressed interest in the proposed works.	Pre-construction
AH-6	A copy of the final ACHAR including comments and recommendations by RAPs should be provided to the relevant OEH regional branch.	Pre-construction

6.8 Traffic and transport

A Traffic Impact Assessment (TIA) was carried out by Seca Solution Pty Ltd (Seca). The TIA is provided in Appendix K. It assessed current traffic data and traffic operations of the external road network to identify potential impacts of the Proposal on traffic and transport.

6.8.1 Existing environment

The NPS site is south east of the Pacific Highway between the Highway and Old Punt Road, Tomago and is currently accessible from three locations:

- An access off Old Punt Road to the south-east corner of the site
- An alternative access off the Pacific Highway in the north east corner adjacent to the transmission easement
- A residential driveway off the Pacific Highway

The proposed gas storage pipeline and electrical transmission lines would be located off Old Punt Road with access via the NGSF and/or Old Punt Road. The major road intersections are shown in Figure 6.8.1 to Figure 6.8.4. The key roads in the surrounding road networks are discussed in the following section.

Pacific Highway

The Pacific Highway (HW10) is the main road that passes by the Proposal area and forms part of the State road network providing the major connection between Sydney, northern NSW and Queensland. Locally, it provides a dual carriageway with two lanes in each direction separated by a vegetated central median. The posted speed limit in this area is 80km/hr.

Tomago Road

Tomago Road forms part of the State road (MR302) mostly between Nelson Bay Road to the east and the Pacific Highway to the west. Tomago Road is one lane in each direction, with increased lanes at some intersections. At the intersection of Old Punt Road, approximately 700m south-east of the Pacific Highway, two lanes are present, and the speed limit is 60km/hr. This provides left and right turn/movements. This layout is shown in Figure 2-3 of Appendix K.

The MR302 intersection with the Pacific Highway is a signalised T-intersection with a left turn only out of Tomago Road. The Pacific Highway provides dual carriageway at the intersection, with a channelised left turn lane for southbound vehicles turning into Tomago Road and two channelised right turn lanes provided on the northbound approach. The Pacific Highway/Tomago Road intersection is shown in Figure 6.8.2.

Old Punt Road

Old Punt Road provides access from Tomago Road and the Pacific Highway into and through the Tomago industrial precinct. It operates as a single lane in each direction with a posted speed limit of 60km/hr. It intersects with the Pacific Highway at a signalised T-intersection with a left turn slip lane for southbound travel along the Pacific Highway and a single lane right turn lane for northbound traffic.

On Old Punt Road, a left turn slip lane is present for southbound travel along the Pacific Highway. This is not controlled by traffic signals. An acceleration lane is present at the intersection and is approximately 150m long allowing vehicles to merge into the traffic stream. The right turn from Old Punt Road onto the Pacific Highway is controlled by traffic signals and is shown in Figure 6.8.3.

Figure 6.8.1 Major road intersections

Figure 6.8.2 Pacific Highway/Tomago Road intersection

Figure 6.8.3 Pacific Highway/Old Punt Road intersection

Figure 6.8.4 Tomago Road/Old Punt Road intersection

Roadworks and traffic management

There is currently a Roads and Maritime planned road upgrade project near the Proposal, being the M1 Pacific Highway to Raymond Terrace (M12RT) upgrade. The Roads and Maritime upgrade was declared State Significant Infrastructure (SSI), with an EIS prepared in 2017. The upgrade is anticipated to have positive impacts on the existing intersections of Tomago Road/Pacific Highway and Old Punt Road/Pacific Highway.

Consultation indicated that the two projects were unlikely to overlap timewise; however, engagement with Roads and Maritime will be ongoing.

A new motorway connection to Tomago Road, planned as a component of the proposed M12RT upgrade, would comprise an interchange immediately adjacent to the Proposal. Figure 6.8.1 illustrates the location of the Proposal in relation to this potential future transport corridor.

Pedestrian and cycling facilities

There are no dedicated pedestrian or cycling facilities across the local roads, reflecting the isolated nature of the area. Pedestrian and cycling activity was observed during the traffic surveys to be low.

Traffic flows

Traffic surveys were carried out at the Old Punt Road/Tomago Road intersection during the morning (6am to 8.30am) and afternoon (2pm to 5pm) in February 2018. These counts identified the peak hours as being from 6am to 7am and 4pm to 5pm and showed a tidal movement. The proportion of heavy vehicles during peak hours was about 12% in the morning, and approximately 8% in the afternoon. This equates to 195 heavy vehicles and 140 heavy vehicles respectively.

The peak hour flows are shown in Figure 6.8.5 for the morning (left) and the afternoon (right). Complete survey data is provided in Appendix K.

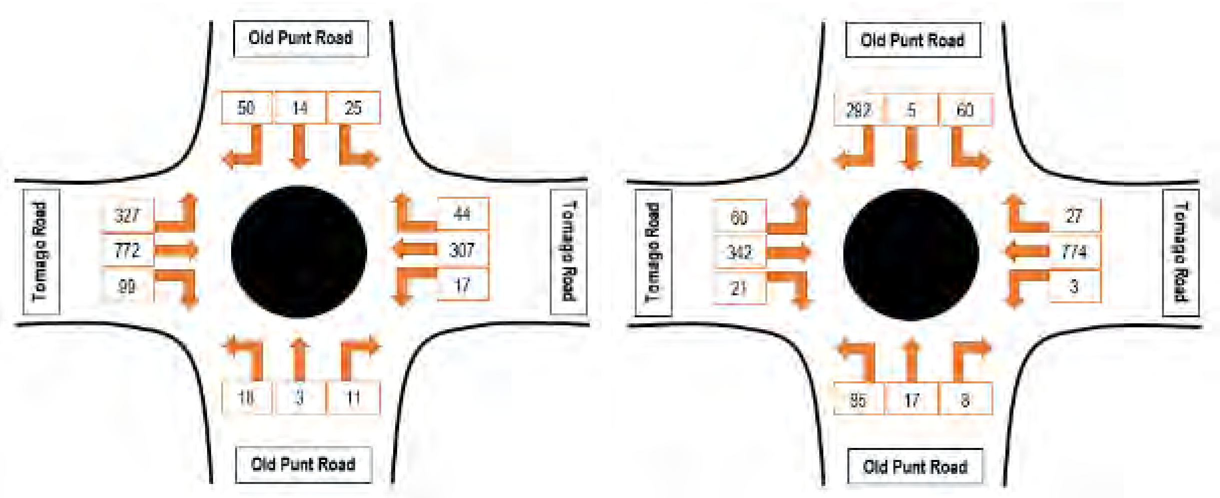

Figure 6.8.5 Peak hour flows at Old Punt Road and Tomago Road (AM to the left, PM to the right)

Peak traffic demand on Tomago Road is eastbound in the morning and westbound in the afternoon, with 1,198 and 1,151 vehicles counted respectively. Based on the Roads and Maritime Guide to Traffic Generating Developments, the peak traffic flows along Tomago Road are Level of Service (LoS) D. This indicates that drivers are restricted in their freedom to select desired speed and to manoeuvre within the traffic stream. The peak flows on Old Punt Road northbound in the morning and southbound in the afternoon (374 and 357 respectively) provide LoS B, being stable traffic flow with a high degree of freedom to select speed and operating conditions.

Using the peak traffic counts, daily traffic flows were estimated at approximately 15,800 vehicles on Tomago Road (west of Old Punt Road) and approximately 4,600 vehicles on Old Punt Road (north of Tomago Road).

Traffic growth information was extrapolated from permanent traffic counters undertaken by Roads and Maritime. A Roads and Maritime sample classifier located on Tomago Road, 180m north-west of Old Punt Road (Station Id: 05590) showed 2010 weekday flows of 13,401 vehicles evenly distributed in both directions with 12% heavy vehicles. Based on the 2018 daily traffic volumes of 15,800 vehicles obtained from the survey data, there has been a 17.8% increase in traffic flows along Tomago Road in this location between 2010 and 2018 (about 2.2% per annum). A permanent counter 380m south-west of Tomago Road (Station Id: 05001) on the Pacific Highway showed weekday flows of 52,680 vehicles in 2018. The weekday daily flows recorded along the Pacific Highway in 2010 were 43,801 vehicles per day, equating to a 20.3% increase in traffic flows between 2010 and 2018 (about 2.5% per annum).

Road network operation

Traffic was assessed at three intersections on 30 April 2019 with the following observations made:

- Pacific Highway and Tomago Road:
  - The major traffic movement is along the Pacific Highway
  - Delays and congestion for the southbound movement are high during the morning and afternoon peak periods but low otherwise
  - During peak times there are long queues southbound created by the high demand for right turning traffic in and out of Tomago Road
  - Right turn demand was high prior to 6am as workers arrived to access the various industrial premises and during 8am to 9am associated with general commuter demands
  - Traffic signals timings are vehicle actuated and maximise intersection capacity
  - The intersection operated well with delays and congestion considered acceptable
- Pacific Highway and Old Punt Road:
  - Delays and congestion are very low with queues dissipating within one phase of the signals
  - Traffic signals timings are vehicle actuated and maximise intersection capacity
  - The intersection operated well with delays and congestion considered acceptable
- Tomago Road and Old Punt Road:
  - Delays and congestion on Tomago Road to the west of the roundabout were observed in the evening peak
  - This queue cleared quickly in conjunction with the green phase of the Pacific Highway signals 700 metres to the west
  - The intersection operated well with delays and congestion considered acceptable

Sidra software was used to model the current operation of the Tomago Road/Old Punt Road intersection. The results provided in Table 6.8.1 indicate that the intersection is currently operating well with minimal delays or congestion. LoS A allows for free-flow traffic with individual users virtually unaffected by the presence of others.

Table 6.8.1 Sidra results

Approach	Movement	Level of Service	Average delay (seconds)	95% queue length (metres)
Tomago Road (West of Old Punt Road)	Left	A/A	4.4/5.4	5.1/11.8
	Through	A/A	4.7/5.6	10.5/27.0
	Right	A/A	11.4/12.8	10.5/27.0
Old Punt Road (North of Tomago Road)	Left	A/A	8.9/5.1	8.5/11.1
	Through	A/A	8.4/5.2	8.5/11.1
	Right	B/A	15.0/9.4	8.5/11.1
Tomago Road (East of Old Punt Road)	Left	A/A	3.4/3.7	11.5/4.4
	Through	A/A	3.9/3.8	31.3/8.3
	Right	A/A	10.8/11.0	31.3/8.6
Old Punt Road (South of Tomago Road)	Left	A/A	5.5/7.1	1.2/5.5
	Through	A/A	4.9/7.2	1.2/5.5
	Right	A/A	9.5/11.5	1.2/5.5

Traffic safety and accident history

Collision data provided by Roads and Maritime for the period between July 2012 and June 2017 showed that no accidents were recorded on Old Punt Road near the Proposal. Three accidents were recorded during the same period near the intersection of Tomago Road and Old Punt Road. No repeat causes were identified. The intersection provides a good level of safety given the high volume of traffic and very low number of accidents.

Parking supply and demand

No provision for formal on-street or off-street public parking was observed near to the Proposal. There is a verge with sufficient width for informal parking; however, no demand for parking along the site boundary on Old Punt Road was observed during the survey. Employee and customer parking is provided on site at a number of industrial premises in the surrounding area.

Public transport

Public transport routes near the Proposal is limited to the 140 Hunter Valley Bus service. The 140 operates between Raymond Terrace and Newcastle along Tomago Road and Old Punt Road, with services every half hour during peak hours. There are bus stops either side of Pacific Highway to the east of the Tomago Road intersection.

The closest railway station is 2.3km away at Hexham.

6.8.2 Study methods and criteria

The scope of the TIA was to:

- Assess additional traffic flows associated with the development during both the construction and operational phases and the likelihood of impact on the local road network
- Review the proposed access arrangements for the development
- Assess the likelihood of the development affecting any other transport modes/vehicles, including cumulative impacts associated with other proposed and existing projects in the area

The study assessed the impacts of the construction and operation phases of the Proposal. Vehicle movements are expected to be much greater during construction than operation, as the expected workforce will be significantly higher during that phase.

In preparing the TIA, the following publications were considered:

- Roads and Maritime Guide to Traffic Generating Developments, Version 2.2 Dated October 2002
- Austroads Guide to Traffic Management Part 12: Traffic Impacts of Project
- Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections
- Port Stephens Development Control Plan 2014
- Port Stephens Local Environment Plan 2013
- Australian / New Zealand Standard – Parking Facilities Part 1: off-street car parking (AS2890.1:2004)

The TIA used existing traffic data and observed the traffic operations at key intersections in the locality of the Proposal during peak periods.

Assessment of northbound operational traffic impacts modelled the peaking load operation of the power station (base case) and the continuous operation (worst case).

Consultation

The future M1 Pacific Highway extension to Raymond Terrace (M12RT) was included in the scope of the TIA as a proposed interchange at Old Punt Road would comprise infrastructure currently planned for construction adjacent to the NPS.

Consultation between Seca, AGL and Roads and Maritime was undertaken on 8 May 2019. Roads and Maritime confirmed at that meeting that the construction phase of the M12RT was unlikely to begin until after the Proposal commenced operation, and that construction timeframes were unlikely to overlap.

Roads and Maritime also confirmed that it could identify no safety or capacity issues with the nominated road access for the Proposal in the south-west corner. It was noted that as the M12RT design progressed Roads and Maritime may require the Proposal access location to be moved north to accommodate its interchange, but that there was not sufficient design detail at this stage for the future M12RT alignment to confirm a revised access location for the NPS.

6.8.3 Potential impacts

Construction traffic

Construction traffic demand is likely to coincide with the morning peak but would vary depending on the stage of construction and works underway. The highest anticipated demand for construction traffic movements for a single day has been applied to assess the worst case impact on the local road network. The highest anticipated demand has been estimated as 270 construction staff per day during the initial stages of construction, rising to 300 further into the program, and 50 deliveries per day. It was assumed that two thirds of all deliveries and all inbound staff movements would take place during the morning peak.

Heavy vehicle traffic would therefore be about 50 inbound and 50 outbound movements per day. Additional deliveries include tanker movements to fill the two 750kL diesel tanks required for dual fuel capabilities. Filling would initially generate 30 tanker movements each with a capacity of 50m^3 (50kL).

Over Size Over Mass vehicles would be required to deliver components for the Proposal and would operate under Roads and Maritime and local road authority requirements.

At the Pacific Highway/Old Punt Road intersection, the distribution of heavy construction traffic has been assessed as being 90% from the south and west (30 vehicles) and 10% from the north (3 vehicles) during the peak morning period. Vehicles would be directed to use the Pacific Highway/Old Punt Road intersection to access the Proposal. The distribution of light construction traffic has been assessed as being 70% from the south and west during the peak morning period (189 vehicles), 20% from the north (54 vehicles), and 10% from the east (27 vehicles). The distribution of traffic on the local road network in the peak morning period is shown in Figure 6.8.6.

Construction related traffic on the Pacific Highway and Tomago Road for the Proposal would last for around 2 years.

Figure 6.8.6 Construction traffic at Old Punt Road / Tomago Road in the AM peak

An assessment of the AM peak during construction of the Proposal was conducted in the TIA. For this assessment the following assumptions were made:

- 66% of all vehicles would be heavy vehicles travelling inbound and outbound
- 34% of all vehicles would be light vehicles travelling inbound and outbound
- 90% of all heavy vehicles would be inbound/outbound from the south (Sydney/Newcastle) using the Pacific Highway (using Pacific Highway/Old Punt Road intersection)
- 10% of all heavy vehicles would be inbound/outbound from the north (Raymond Terrace/Brisbane) using the Pacific Highway (using Pacific Highway/Old Punt Road intersection)

For construction staff during the AM peak the following allowances were made:

- 20% of all construction staff would be inbound/outbound north utilising the Pacific Highway/Old Punt Road
- 70% of all construction staff would be inbound/outbound south utilising the Pacific Highway/Old Punt Road. Of this 70% approximately half (35%) would utilise the intersection of the Pacific Highway/Tomago Road and the remaining half (35%) would utilise the intersection of Tomago Road/Old Punt Road to access the Proposal area
- 10% of all construction staff would be inbound/outbound east utilising the intersection of Tomago Road/Old Punt Road to access the Proposal area

Using the information for construction traffic generation, the TIA calculated inbound and outbound construction traffic, as listed in Table 6.8.2 and shown in Figure 6.8.6.

Table 6.8.2 Construction traffic inbound and outbound

	Heavy vehicles (Inbound/outbound)		Light vehicles (Inbound/outbound)	
	AM	Daily	AM	Daily
From the north	33/33	50/50	149/0	149/149
From the south	-	-	94/0	94
From the east	-	-	27/0	27/27
Total	33/33	50/50	270/0	270/270

The short-term increase in the daily traffic flows during construction can be accommodated on the existing road network, which currently carries high traffic volumes. The anticipated construction traffic would have a negligible impact on the local road network.

Tomago Road/Old Punt Road intersection

Sidra modelling was used to determine the capacity of the roundabout intersection of Tomago Road and Old Punt Road to support increased traffic demands associated with construction. With the additional traffic from the construction of the Proposal, and assuming a traffic increase of 2.5% annual growth, the intersection would continue to perform at its current standard (overall being a LoS A). However, there would be some slight increases to the average delay and queue lengths.

Overall, the intersection of Tomago Road and Old Punt Road provides sufficient spare capacity to support the Proposal, catering for the traffic generation during construction.

Construction access

Access to the Proposal would be off Old Punt Road. A new access road would be constructed in the south-east corner of the site, approximately 110m north of the intersection of Kennington Drive and Old Punt Road. This would be the primary access route for heavy vehicles and site vehicles during construction. A secondary gated access point to the site from the Pacific Highway may be provided in case of emergency for evacuation purposes. The Pacific Highway access would require Roads and Maritime approval and implementation of traffic management. No safety or capacity issues have been identified with the nominated access locations.

The site access road would require the provision of a channelised right turn (CHR) treatment on Old Punt Road for road safety reasons to cater for the higher traffic flows during construction. All heavy vehicles would approach the site from the north, thereby turning right into the site, with up to 50 trucks per day undertaking this manoeuvre the majority of which would occur in the morning peak period. An additional 30 tanker movements would be required to fill the on site diesel tanks. The provision of a CHR/s turn treatment at the site access would allow any vehicles turning right into the site to do so with negligible impact upon through traffic flows along Old Punt Road.

Operational traffic

Traffic movements

The Proposal would generate regular daily staff traffic and heavy vehicle movements on an as required basis for the removal of waste process water and the delivery of diesel. Regular staff numbers on rotating shifts, including maintenance personnel, are estimated as 23, with peak demand shifting across the morning and afternoon periods.

Heavy vehicle movement was assessed based on two scenarios:

- Peaking load operation – base case. The removal of wastewater using 20m^3 capacity tankers is not required under this scenario. Typical peaking operation will utilise piped gas fuel, requiring no tanker movements. Peaking operation using diesel fuel may require up to 60 B-double 50m^3 capacity tankers (one way) per day (60 inbound and 60 outbound).
- Continuous operation – worst case. During continuous operation there may be up to 94 trucks (one way) per day (94 inbound and 94 outbound) per day consisting of:
  - Up to 34 wastewater tankers (20m^3 capacity) (one way) per day (34 inbound and 34 outbound)
  - Up to 60 B-double 50m^3 capacity tankers (one way) per day (60 inbound and 60 outbound)

Combined heavy vehicle tanker and staff movements during peaking load operation are summarised in Table 6.8.3 for peaking operations using piped gas fuel or diesel fuel based on a 10 hour daytime period.

Table 6.8.3 Operational traffic demands during peaking load operation

	Deliveries			Workforce and visitors	
	Trucks per day	Trucks per peak hour	Truck movements per peak hour	AM peak hour	PM peak hour
Gas fuel	0	0	0	46	46
Diesel fuel	60	6	12	46	46

The combined traffic movements during continuous operation, with truck movements within a 10 hour daytime period, are summarised in Table 6.8.4.

Table 6.8.4 Operational traffic demands during continuous operation (using diesel fuel)

Deliveries			Workforce and visitors	
Truck per day	Trucks per peak hour	Truck movements per peak hour	AM peak hour	PM peak hour
94	10	20	46	46

The Pacific Highway/Old Punt Road intersection is expected to continue to operate well within its capacity, however over time, increased traffic demand may result in some approaches experiencing increases in delays (with some queuing). With these increases, the intersection is still expected to operate at an acceptable standard.

Additional traffic movements are expected to be accommodated on the local road network. Overall, operational traffic volumes would be minor and would have a minor impact on the local road network.

Access

As per construction, access to the NPS would be off Old Punt Road.

Cumulative impacts

Should other projects be constructed at the same time as the Proposal, there could be cumulative impacts to the local and regional road network. Other known projects which are in development within the industrial estate could generate a high number of construction vehicles. It is not anticipated that this traffic would result in an impact that would affect the performance of the Pacific Highway. There is the potential that this increased traffic would be noticeable on Tomago Road and Old Punt Road.

Consultation with Roads and Maritime undertaken for the TIA confirmed that the construction phase of its M12RT project was unlikely to begin until after the Proposal commenced operation, and that construction timeframes were unlikely to overlap.

During operations using diesel fuel, the Proposal would include regular heavy vehicle (tanker) movements to site. These traffic movements would most likely be from the north of the site. Increased traffic movements could affect both heavy and light vehicles using the Pacific Highway/Old Punt Road corridor to access the Tomago Industrial Estate. The cumulative impacts to the local road network are expected be minimal, however additional vehicles on these roads during peak periods may slightly increase waiting periods at intersections (particularly at the Tomago Road/Old Punt Road intersection).

The proposed Roads and Maritime M12RT project, and associated interchange with Old Punt Road, would result in significant changes to local traffic flows. The M12RT would see traffic volumes along the Pacific Highway decrease significantly, with an improvement in the operational efficiency of the existing intersections of Tomago Road and Old Punt Road with the Pacific Highway and a positive impact on traffic flows in the locality generally. This is expected to be able to handle increase in traffic from the Proposal and surrounding development in the industrial estate.

6.8.4 Avoidance, mitigation and management

The TIA has demonstrated that traffic, parking, and access arrangements for the Proposal are satisfactory and that the local road network is sufficient to continue to operate both efficiently and safely during construction and operation. Recommendations of the TIA to mitigate any potential environmental impact are provided in Table 6.8.5.

Table 6.8.5 Avoidance, mitigation and management measures – Traffic and transport

ID	Environmental safeguards	Timing
T-1	Parking for construction staff is to be provided within the NPS site.	Construction
T-2	A Construction Traffic Management Plan (CTMP) would be prepared by the contractor to safely manage traffic movements to and from the Proposal.	Pre-construction
T-3	Over Size Over Mass vehicle requirements would be addressed in Traffic Control Plans within the CTMP.	Pre-construction
T-4	A Drivers Code of Conduct would be prepared that directs all heavy vehicles to access the site via the Pacific Highway and Old Punt Road intersection.	Pre-construction
T-5	A CHR turn treatment on Old Punt Road is required to allow for the safe movement of construction traffic turning right into the site. This must be designed in accordance with the Austroads Guidelines.	Pre-construction

6.9 Noise and vibration

An assessment of potential construction and operational noise impacts on surrounding receivers was completed by Environmental Resources Management Australia Pty Ltd (ERM). The NVIA is provided in Appendix L.

6.9.1 Existing environment

Sensitive receivers

Existing ambient noise in the surrounding area of the Proposal consist of local community activity, fauna including birds and insects, and traffic on nearby arterial roads. The nearest residential areas to the Proposal are suburban residential areas, a caravan park and larger rural residential blocks.

Sensitive receivers were grouped into Noise Catchment Areas[3] (NCAs) as listed in Table 6.9.1. NCAs were established to define the existing acoustic environment and ensure common assessment and mitigation recommendations was given to similar noise receivers. A total of five NCAs were identified in the study area. Within the five NCAs, a total of thirteen noise sensitive receivers were identified (Table 6.9.2). These noise sensitive receivers are representative of the nearest and potentially most affected locations within the study area. The existing noise environment comprises of four receptors; residential (depicted as red (R1 to R8)), commercial (depicted as purple (C1 to C2)), industrial (depicted as blue (I1 to I2)) and a place of worship (depicted as green (W1)) as shown in Figure 6.9.1.

Table 6.9.1 The five identified Noise Catchment Areas (NCAs)

NCA	Minimum distance from Proposal (metres)	Description
NCA 1	1,200	NCA 1 consists of three types of receivers in Heatherbrae – residential, commercial and industrial
NCA 2	2,200	NCA 2 consists of residential receivers in Woodberry
NCA 3	450	NCA 3 consists of residential and temporary accommodation receivers in Tomago – 838 Tomago Road and the Tomago Village Van Park
NCA 4	5	NCA 4 consists of industrial receivers only
NCA 5	1,300	NCA 5 consists of two types of receivers – residential and industrial

[3] A noise catchment would include all receptors that are exposed to similar noise levels and are usually at a similar proximity to the noise source together with a logical delineation of the catchment area (e.g. by topography, cuttings, setbacks, road, rail or utility corridors, breaks in the landscape etc.)

Table 6.9.2 Nearby noise receptors

Receiver ID	Receiver Type	Address	NCA
R1	Residential	2171 Pacific Highway, Heatherbrae	NCA 1
R2	Residential	135 Oakfield Road, Woodberry	NCA 2
R3	Residential	838 Tomago Road, Tomago	NCA 3
R4	Residential	Tomago Village Van Park – 819 Tomago Road, Tomago	NCA 3
R6	Residential	47 School Drive, Tomago	NCA 5
R7	Residential	7 Graham Drive, Tomago	NCA 5
R8	Residential	18 Homebush Drive, Woodberry	NCA 2
C1	Commercial	Hunter Botanic Gardens Office – 2100 Pacific Highway, Heatherbrae	NCA 1
C2	Commercial	Tomago Bowling Club – 657 Tomago Road, Tomago	NCA 5
C5	Commercial	587 Tomago Road, Tomago	NCA 5
I1	Industrial	14 Kennington Drive, Tomago	NCA 4
I2	Industrial	11 Laverick Avenue, Tomago	NCA 4
W1	Place of Worship	Tomago House and Chapel – 421 Tomago Road, Tomago	NCA 5

Baseline noise survey

The baseline noise survey consisted of unattended noise logging and operator attended noise measurements. Noise measurements were taken for ambient and background noise levels. Noise monitoring was conducted at three locations as listed in Table 6.9.3. Locations were chosen to represent the existing conditions experienced by the community in the Proposal area.

Unattended monitoring was undertaken at Heatherbrae and Woodberry between 14 and 25 February 2019 and at Tomago between 4 and 14 February 2019. Attended monitoring was undertaken between 4 February and 14 February 2019.

Table 6.9.3 Noise monitoring locations during the baseline noise survey (MGA zone 56)

Monitoring Location ID	Address	Suburb	Easting (m)	Northing (m)
L1	2171 Pacific Highway	Heatherbrae	378113	6368179
L2	135 Oakfield Road	Woodberry	377293	6370389
L3	838 Tomago Road	Tomago	380034	6370501

Noise level measurements recorded included L_{10}, L_{90} and L_{eq} represents the noise level exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels. L_{90} represents the noise level exceeded for 90 per cent of the time and is approximately the average of the minimum noise levels, and is the Rating Background Level (RBL) for this Proposal. L_{eq} represents the equivalent or average noise energy during a measurement period.

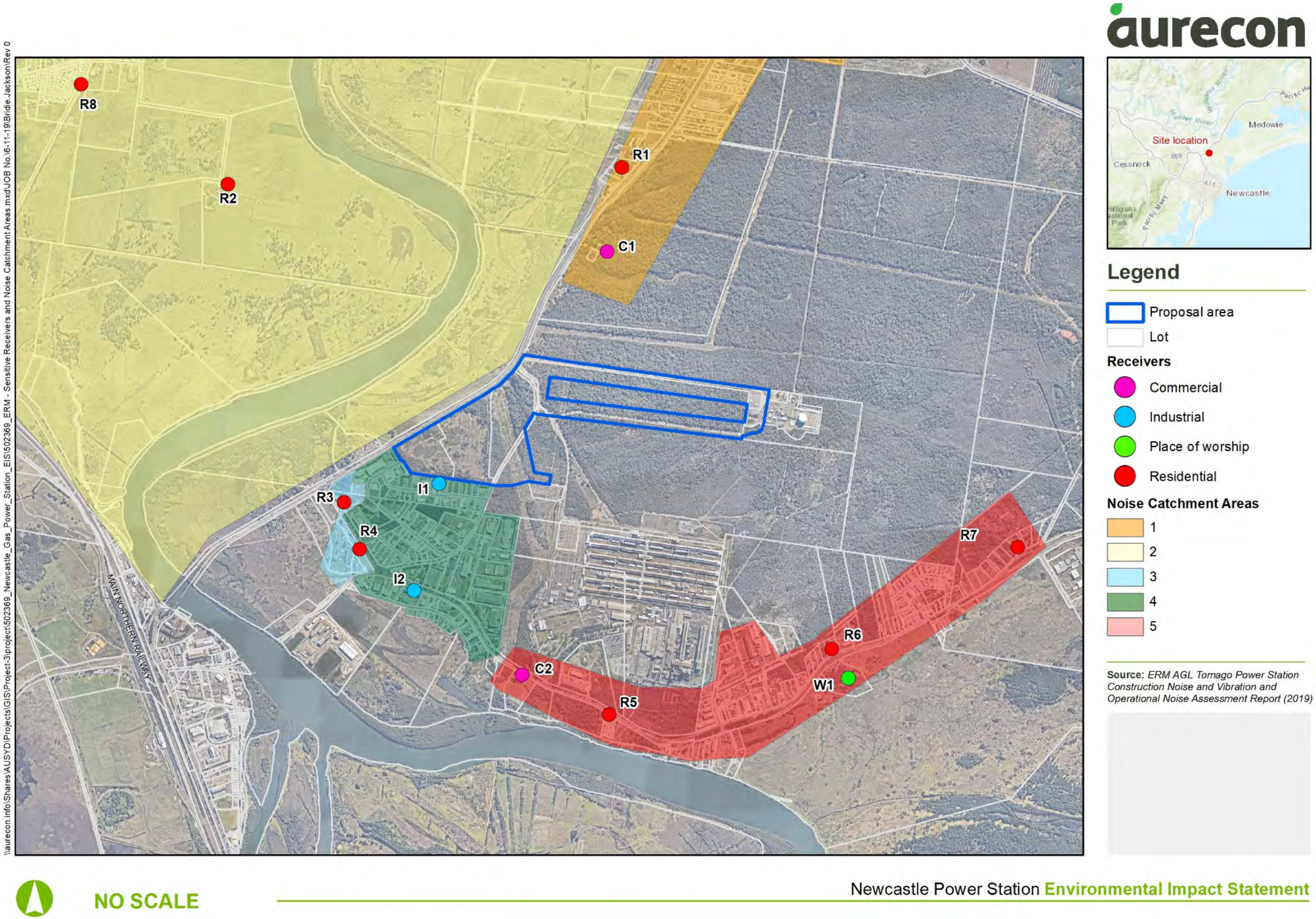

Figure 6.9.1 Existing noise environment

Unattended noise monitoring results are shown in Table 6.9.4. Background noise levels were measured between 37dBA and 52dBA, which is typical of rural and suburban areas. Residential receptors were grouped together according to their proximity to the logging locations to set noise criteria that are relevant to each receiver.

Table 6.9.4 Long term noise monitoring results

Monitoring location	Applicable representative residential receivers (NCA)	Measured noise level, dBA								
		Day (7:00 am to 6:00 pm)			Evening (6:00 pm to 10:00 pm)			Night (10:00pm to 7:00 am)		
		L_{10}	L_{90} (RBL)	L_{eq}	L_{10}	L_{90} (RBL)	L_{eq}	L_{10}	L_{90} (RBL)	L_{eq}
L1	R1 (NCA 1)	57	46	55	56	44	52	54	41	49
L2	R2 & R8 (NCA 2)	54	37	52	59	38	52	52	37	47
L3	R3 to R7 (NCAs 3 & 5)	65	52	60	62	48	57	62	41	56
Note: NCA 4 includes industrial receivers and did not require baseline monitoring.										

Attended monitoring was undertaken at three noise logging locations. L1 and L2 were conducted on 14 February 2019. L3 was conducted on 4 February 2019. This was undertaken to measure the broader acoustical environment and ensure the unattended noise logging device was not influenced by extraneous noise sources. Results are displayed in Table 6.9.5.

Table 6.9.5 Operator attended noise measurements

Location	Measured existing noise levels, dBA					
	L_{max}	L_{min}	L_{eq}	L1	L_{10}	L_{90}
L01	68	49	53	59	55	50
L02	68	30	43	55	42	34
L03	76	53	62	70	64	56

6.9.2 Study methods and criteria

The assessment was undertaken in accordance with the following key reference policies, documents and guidelines:

- German Institute for Standardisation – DIN 4150 (2016) Part 3 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*
- International Organisation for Standardisation (ISO) 9613-2:1996 (ISO 9613:2) - Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation
- CONCAWE Report No. 4/81, Manning C.J., 1981, The propagation of noise from petroleum and petrochemical complexes to neighbouring communities
- International Organisation for Standardisation (ISO) 17534:2015 – (ISO 17534:2015) – *Acoustics-Software for the Calculation of Sound Outdoors*, as achieved by the modelling software referenced in this report

- NSW Department of Environment and Climate Change (DECC) – *NSW Interim Construction Noise Guideline* (ICNG, 2009), July 2009
- NSW Department of Environment, Climate Change and Water (DECCW) – *NSW Road Noise Policy* (RNP), March 2011
- NSW Department of Environment and Conservation – *NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline* (the NSW Vibration Guideline), February 2006
- NSW Environment Protection Authority – *Noise Policy for Industry* (NPI, 2017), October 2017
- Standards Australia AS1055–2018™ (AS 1055) – Description and Measurement of Environmental Noise
- Standards Australia AS IEC 61672.1–2004™ (AS 61672) – Electro Acoustics - Sound Level Meters Specifications Monitoring or Standards Australia AS 1259.2-1990™ (AS 1259) – Acoustics – Sound Level Meters – Integrating Averaging as relevant to the device
- Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC 60942) – Australian Standard™ Electroacoustics – *Sound Calibrators*
- Standards Australia AS 2436–2010™ (AS 2436) – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites

The proposal specific management levels and criteria for the NVIA included:

- Construction Noise Management Levels (NMLs)
- Operation Noise Criteria comprising
  - Proposal Intrusive Noise Levels
  - Proposal Amenity Noise Levels
  - Proposal Noise Trigger Levels
- Road Noise Criteria
- Construction Vibration Management Levels comprising
  - Human Comfort
  - Building Damage

Construction noise management levels

The NVIA was assessed for both standard construction hours as identified in the ICNG and out-of-hours work.

Standard construction hours are:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- No work on Sundays or public holidays

It is anticipated that some works would be carried out outside of standard construction hours. This is necessary to safely and efficiently construct the Proposal to be operational before the proposed closure of Liddell Power station. Activities could include:

- Site clearance, earthworks, civil works and equipment fit out
- HDD operations
- Connection works to gas, electricity, and water networks
- General construction of the power station, gas pipelines and electricity transmission line
- Emergency situations where work is required to prevent personal or property harm
- Commissioning and operational testing

Construction noise management levels for construction work within and outside recommended standard hours, specifically for residential and other sensitive receivers, is detailed in Table 6.9.6

Further, the potential for sleep disturbance from maximum noise levels generated during the night time period was considered. Sleep disturbance refers to both awakenings and disturbance to sleep stages. This was evaluated using the screening method listed in the NPI which states that sleep disturbance or awakening issues are limited when:

- the predicted Proposal night time noise level ($L_{eq,\ 15\ minute}$ in dBA) at any residential receptor is below 40dBA or the prevailing night time background noise level plus 5dBA (whichever is greater)
- the predicted Proposal night time noise level (L_{max} in dBA) at any residential receptor is below 52dBA or the prevailing night time background noise level plus 15dBA (whichever is greater)

Table 6.9.6 Construction noise management levels (NML)

Receptor type	Construction noise management levels, $L_{eq(15\ min)}$, dBA				Highly noise affected, $L_{eq(15\ min)}$, dBA	Sleep disturbance, dBA	
	Standard hours	Out-of-hours			Daytime (standard hours)	Night-time only	
	Day	Day	Evening	Night		$L_{eq(15\ min)}$	L_{max}
Residences in NCA 1	56	51	49	46	75	46	56
Residences in NCA 2	47	42	43	42	75	42	52
Residences in NCA 3 and NCA 5	62	57	53	46	75	46	56
Educational facility***	55*	55*	55*	55*	-**	-**	-**
Medical facility***	55*	55*	55*	55*	-**	-**	-**
Places of Worship	55*	55*	55*	55*	-**	-**	-**
Active recreation***	65	65	65	65	-**	-**	-**
Commercial	70	70	70	70	-**	-**	-**
Industrial	75	75	75	75	-**	-**	-**

* External goal of 55dBA applies. The ICNG recommends that construction noise levels do not exceed 45dB (Laeq, 15minute) internally within school classrooms, hospital wards and places of worship when in use. For the purpose of this assessment the internal noise level has been translated to an external level of 55dB (Laeq, 15minute) based on the accepted level of attenuation (10dB) that is readily achieved through windows, partially opened for ventilation.

** Indicates that these criteria do not apply to that receptor.

*** Receptor type not located in proximity to project area.

Construction vibration management levels

Vibration effects on buildings are considered in relation to human comfort (annoyance), building damage (cosmetic and structural) and sensitive equipment (scientific and medical). Applicable to the Proposal are human comfort and building damage. Compliance should be targeted at human comfort limits which are more stringent than building damage, to achieve compliance for both objectives.

Human comfort

The NSW Vibration Guideline informed the assessment of vibration impacts to human comfort (annoyance). The guideline is based on *British Standard (BS 6472–1992) – Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*. Table 6.9.7 lists the criteria used to determine the impact on human comfort for the Proposal.

Table 6.9.7 Human comfort – vibration dose values

Location	Assessment period	Preferred values		Maximum values	
		z axis	x and y axes	z axis	x and y axes
Continuous vibration (m/s^2)					
Critical areas	Daytime or Night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.020	0.014	0.040	0.028
Workshops	Daytime or Night-time	0.040	0.029	0.080	0.058
Impulsive vibration (m/s^2)					
Critical areas	Daytime or Night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.64	0.46	1.28	0.92
Workshops	Daytime or Night-time	0.64	0.46	1.28	0.92
Intermittent vibration (m/s$^{1.75}$)					
Critical areas	Daytime or Night-time	0.10		0.20	
Residences	Daytime	0.20		0.40	
	Night-time	0.13		0.26	
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.40		0.80	
Workshops	Daytime or Night-time	0.80		1.60	

Note: Daytime is 7am-10pm and Night-time is 10pm-7am.

Note: For continuous and impulsive vibration, the preferred and maximum values are weighted acceleration values (Wg for z-axis and Wd for x and y-axis)

Note: For intermittent vibration, the preferred and maximum values are Vibration Dose Values (VDVs), based on the weighted acceleration values

Building damage

Building damage was assessed in accordance with the guidelines and methods of the German Standard *DIN 4150-3-1999 Structural Vibration – Part 3* as listed in Table 6.9.8.

Table 6.9.8 Guideline vibration values for short term vibration on structures (mm/s)

Type of building	Guideline values for velocity (mm/s)			
	1 to 10Hz	10 to 50Hz	50 to 100Hz	Vibration at horizontal plane of highest floor at all frequencies
Commercial and Industrial Building	20	20-40	40-50	40
Dwellings and buildings of similar occupancy or design	5	5-15	15-20	15
Structures that, because of their particular sensitivity to vibration cannot be classified under lines 1 and 2 and are of great intrinsic value	3	3-8	8-10	8

Operational noise criteria

The operational noise criteria used to assess potential impacts included the proposal specific intrusiveness and amenity noise levels as specified in the NPI. The PNTL considers the lowest of the intrusive or amenity residential receptor criterion making sure the most stringent threshold is set for the existing industrial noise in the area. All identified residential (dwelling) and other sensitive receptors were assessed during the daytime, evening and night time.

Proposal intrusive noise levels

Proposal intrusive noise levels are detailed in Table 6.9.9. Non-intrusive noise levels are classified if the monitored $L_{eq,\ 15minute}$ noise level of the development does not exceed the RBL by more than 5dBA.

Table 6.9.9 Proposal intrusiveness noise criteria

Residential location	Intrusive noise criteria $L_{eq,\ 15\ minute}$ – dBA		
	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
R1	51	49	46
R2	42	43	42
R3	57	53	46
R6	57	53	46
R7	57	53	46
R8	42	43	42

Note: Receiver R4 is a caravan park and accommodation and not considered residential according to the NPI. Hence, the intrusiveness noise criteria are not applicable to R4.

Proposal amenity noise levels

The proposal amenity noise levels for specific activities are defined by the recommended noise levels in Table 6.9.10 minus 5dBA. Residential areas R1, R3, R4, C5, R6 and R7 have been classified as urban comparative to R2 and R8 which were classified as rural and were done so in accordance with noise environment descriptions in the NPI.

Table 6.9.10 Proposal amenity noise criteria

Receiver location	Receiver type	Noise amenity area	NPI recommended amenity levels $L_{eq,\ 15minute}$ – dBA		
			Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
R1, R3, R6 and R7	Residential	Urban	(60-5=) 55	(50-5=) 45	(45-5=) 40
R2 and R8	Residential	Rural	(50-5=) 45	(45-5=) 40	(40-5=) 35
R4 and C5	Caravan Park & Detention Centre	Urban	(60+5=) 65	(50+5=) 55	(45+5=) 50
C1	Commercial	-	65*	65*	65*
C2	Active Recreation	-	55*	55*	55*
I1, I2	Industrial	-	70*	70*	70*
W1	Place of worship (internal)		40**	40**	40**

* Limit applies when facility is in use.

** The NPI recommends amenity noise levels do not exceed 40dB ($L_{aeq,\ 15minute}$) internally within places of worship when in use.

Proposal noise trigger levels

PNTL represent the lower and more stringent value of the proposal intrusive noise levels as listed in Table 6.9.11. This criteria was adopted for the project.

Table 6.9.11 Proposal noise trigger levels

Receiver location	PNTL $L_{eq,\ 15minute}$ – dBA		
	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
R1	51	45	40
R2	42	40	35
R3	55	45	40
R4	65	55	50
C5	65	55	50
R6	55	45	40
R7	55	45	40
R8	42	40	35
C1	65*	65*	65*
C2	55*	55*	55*

Receiver location	PNTL $L_{eq, 15minute}$ – dBA		
	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
I1, I2	70*	70*	70*
W1	40**	40**	40**

* Limit applies when facility is in use.

** The NPI recommends amenity noise levels do not exceed 40 dB ($L_{aeq, 15minute}$) internally within places of worship when in use.

Road noise criteria

The NSW Road Noise Policy (RNP) provides guidance, criteria, and procedures for the assessment of noise impacts from existing, new and redeveloped roads and traffic generating developments. Noise assessment criteria are determined based on road categories and land uses. Road access for the Proposal includes Pacific Highway and Old Punt Road. These roads are classified as arterial and sub-arterial roads and the assessment criteria used for assessment of Pacific Highway and Old Punt Road are detailed in Table 6.9.12.

Table 6.9.12 RNP residential road traffic noise criteria

Road category	Type of project/land use	Assessment criteria – dBA	
		Day 7am to 10pm	Night 10pm to 7am
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	$L_{Aeq,15hr}$ 60 (external)	$L_{Aeq,9hr}$ 55 (external)

6.9.3 Potential impacts

Noise Modelling Construction

Noise modelling was undertaken in accordance with the ISO 9613 *Acoustics – Attenuation of sound during propagation outdoors* (ISO, 1996) algorithm within SoundPLAN version 8.1.

The noise modelling takes into consideration the following factors:

- Sound power level (SWL) of the proposed site operations
- Activities and equipment[4]
- Acoustic shielding from intervening ground topography
- Ground effects
- Meteorological effects
- Atmospheric absorption

Construction plant SWLs were adopted from the UK DEFRA construction noise database and adjusted in line with the Transport for NSW's Construction Noise Strategy and Roads and Maritime's Construction Noise and Vibration Guideline.

Noise modelling was undertaken using CONCAWE's *Special Task Forces in Noise Propagation* (CONCAWE, 1981) algorithm within SoundPLAN 8.1. The noise modelling assessed the sound power level of the site operations, activities and equipment, and applied adjustments for attenuation from geometric

[4] It should be noted that the final selection of engine technology will not affect the construction scenarios which are applicable to both technologies (Noise and Vibration Assessment, 2019, ERM).

spreading, acoustic shielding from intervening ground topography, ground effect, meteorological effects and atmospheric absorption. Based on the analysis of the existing environment near the Proposal, the meteorological conditions presented in Table 6.9.13 were adopted for the assessment.

Table 6.9.13 Meteorological scenarios

ID	Description	Temp (C°)	Relative humidity (%)	Wind speed (m/s)	Wind direction (°)	Pasquil-Gifford stability class
1	Calm	20	70	-	-	D
2	Prevailing SE winds	20	70	3	135	D
3	Inversion	0	70	2	Source to receiver	F

Construction noise impact assessment

Various construction scenarios were formed based on the likely construction method and typical construction activities for the Proposal (Table 6.9.14).

Table 6.9.14 Construction assessment scenarios

Scenario	Equipment	Sound Power Level[1] – dBA
S1 Site Preparation and Earthworks	Excavator	110
	Bulldozer	110
	Grader	116
	Roller	108
	Loader	108
	Dump truck	105
S2 Concrete Foundation Works	Concrete truck	108
	Concrete mixer	110
	Compactor	114
	Crane	106
S3 Building Construction	Crane	106
	Delivery trucks	106
	Pneumatic tools	112
	Electric tools	104
	Power generators	104
	Hammers	110
S4 Pre-Pipeline Construction	Excavator	110
	Track trencher	114
	Crushing Machine	110
	Truck	106

Scenario	Equipment	Sound Power Level[1] – dBA
	Crane	106
S5 Pipeline Construction	Welding/Bending Machine	96
	Pipe layer	102
	Bulldozer	110
	Padding machine	102
S6 Transmission Line Construction	Excavator	110
	Track trencher	114
	Crushing Machine	110
	Truck	106
	Crane	106

Note 1: Sound Power Levels of equipment were either sourced from Transport for NSW's "Construction Noise and Vibration Strategy", the UK's Department for Environment, Food and Rural Affairs "Update of Noise Database for Prediction of Noise on Construction and Open Sites", or ERM's construction plant & equipment noise database

Predicted construction noise levels

Predicted construction noise levels ($L_{eq,\ 15minutes}$) for all six construction scenarios are provided in Table 6.9.15 at the NCA receiver locations. These noise levels would meet the construction NMLs for standard hours, out-of-hours and highly noise affected receivers.

Predicted construction noise levels undertaken at night would also comply with sleep disturbance criteria as shown in Table 6.9.16. As such, sleep arousal to surrounding residential receivers is unlikely.

Predicted construction levels at receivers C5 and R7, which are the closest receiver points to the Hunter Estuary Wetlands, indicate that $L_{eq,\ 15minutes}$ construction noise impacts would be up to 34dBA. Construction noise (L_{max}) was predicted at 42dBA. Given the additional distance to the wetlands, it is anticipated the wetlands would be 2 to 3dBA below the predicted levels. Further, the predicted construction noise impacts at the wetland areas to the south and the east are expected to be less than or equivalent to existing ambient industrial noise levels.

Table 6.9.15 Predicted construction noise levels – ICNG

Receiver (NCA)	Predicted construction noise levels of each construction scenario $L_{eq,\ 15minute}$ – dBA						Construction noise management levels $L_{eq,\ 15minute}$ – dBA			Compliant?		
	S1	S2	S3	S4	S5	S6	Standard day	Out-of-hours (Day/Evening/ Night)	Highly noise affected	Standard hours	Out-of-hours	Highly noise affected
R1 (NCA 1)	26	28	34	37	26	36	56	51/49/46	75	Yes	Yes	Yes
R2 (NCA 2)	24	27	30	33	14	29	47	42/43/42	75	Yes	Yes	Yes
R3 (NCA 3)	38	38	38	34	20	37	62	57/53/46	75	Yes	Yes	Yes
R4 (NCA 3)	36	36	37	34	20	37	62	57/53/46	75	Yes	Yes	Yes
C5 (NCA 5)	25	29	30	34	21	33	62	57/53/46	75	Yes	Yes	Yes
R6 (NCA 5)	20	25	28	35	21	30	62	57/53/46	75	Yes	Yes	Yes
R7 (NCA 5)	16	23	25	33	17	27	62	57/53/46	75	Yes	Yes	Yes
R8 (NCA 2)	17	23	26	30	9	25	47	42/43/42	75	Yes	Yes	Yes
C1 (NCA 1)	31	31	38	42	32	38	65	65	75	Yes	Yes	Yes
C2 (NCA 5)	29	31	33	35	22	35	55	55	75	Yes	Yes	Yes
I1 (NCA 4)	50	51	49	37	26	45	75	75	75	Yes	Yes	Yes
I2 (NCA 4)	35	38	36	34	21	37	75	75	75	Yes	Yes	Yes
W1 (NCA 5)	19	25	27	34	20	29	45	45	75	Yes	Yes	Yes

Table 6.9.16 Predicted construction noise levels – sleep disturbance

Receiver (NCA)	Predicted construction noise levels of each construction scenario $L_{eq,\ 15minute}$ – dBA						Sleep disturbance $L_{eq,\ 15minute}$ Criteria (dBA)	Compliant?	Predicted maximum construction noise levels of each construction scenario[1] – L_{max} (dBA)						Sleep disturbance L_{max} criteria (dBA)	Compliant?
	S1	S2	S3	S4	S5	S6			S1	S2	S3	S4	S5	S6		
R1 (NCA 1)	26	28	34	37	26	36	46	Yes	34	36	42	45	34	44	56	Yes
R2 (NCA 2)	24	27	30	33	14	29	42	Yes	32	35	38	41	22	37	52	Yes
R3 (NCA 3)	38	38	38	34	20	37	46	Yes	46	46	46	42	28	45	56	Yes
R4 (NCA 3)	36	36	37	34	20	37	46	Yes	44	44	45	42	28	45	56	Yes
C5 (NCA 5)	25	29	30	34	21	33	46	Yes	33	37	38	42	29	41	56	Yes
R6 (NCA 5)	20	25	28	35	21	30	46	Yes	28	33	36	43	29	38	56	Yes
R7 (NCA 5)	16	23	25	33	17	27	46	Yes	24	31	33	41	25	35	56	Yes
R8 (NCA 2)	17	23	26	30	9	25	42	Yes	25	31	34	38	17	33	52	Yes

Note 1: The prediction of the Lmax level has been based on the assumption that the Lmax nose level is 8dBA above the Leq,15min noise level.

Construction vibration impact assessment

Plant and equipment anticipated to generate construction vibration include a vibratory roller and a hydraulic hammer. Distances of vibration generating equipment to sensitive receivers are outlined in Table 6.9.17. The closest residential receiver is approximately 850m from the Proposal and the closest industrial receiver approximately 260m.

BS 6472–1992 and DIN 4150-3-1999 describe safe working distances based on the type of equipment for cosmetic building damage and human response. As the proposed vibration-inducing equipment would be located at a significant distance from the closest receivers, it is not anticipated that vibration would be a significant issue. The safe working distances for cosmetic building damage and human response are provided in Table 8-2 of Appendix L. The largest safe working distances listed are 100m for human response and 25m for cosmetic building damage when using a vibratory roller of greater than 18t.

Table 6.9.17 Location of vibration equipment and distances to receivers

Plant/equipment	Location	Nearest receiver to plant/equipment	Approximate distance to nearest receiver (metres)
Vibratory Roller (15t)	Proposal area	I1 (Industrial Receiver)	260
		R3 (Residential Receiver)	850
Hydraulic Hammer	Proposal area	I1 (Industrial Receiver)	260
		R3 (Residential Receiver)	850

It is anticipated that during construction, up to 300 light vehicle movements and 80 heavy vehicle movements per day would occur to the site. Based on these traffic volumes, at night, traffic noise would result in a noise increase of less than 0.5dBA at the nearest sensitive receiver. This is not expected to be audible.

Operational noise impact assessment

The operational noise assessment was based on vendor specifications provided for gas turbine and reciprocating engine technologies. Emission data were adopted for each technology as being representative of the Proposal generating capacity and the respective generation technology.

Operational noise levels were modelled for worst case scenarios including concurrent equipment usage and activities across the site were employed for 24-hour $L_{eq,\ 15\ minute}$ noise levels. The predicted values for both engine design options are presented in Table 6.9.18 and Table 6.9.19 with exceedances of the PTNL are highlighted in bold in Table 6.9.18 and Table 6.9.19.

The predicted $L_{eq,\ 15minutes}$ noise levels of the worst case operations scenario show that without any sound attenuation (noise control), the Proposal would exceed the PNTLs at most residential receivers. The predicted noise levels show that with sound attenuation the Proposal would comply with the PNTLs at all surrounding residential and non-residential receivers.

With mitigation, operational noise levels ($L_{ew\ 15\ minutes}$) at C5 are up to 29dBA and 27dBa and 18dBA and 20dBA for R7.

Noise levels to the wetland are expected to be 2-3dBA less than the C5 and R7 receivers. Further, the predicted operational noise impacts are anticipated to be lower than the existing ambient industrial noise level for the wetland areas to the south and east.

Table 6.9.18 Predicted operational noise levels and compliance – Gas turbine

Receptor ID	PNTLs Leq – dBA			Predicted operational noise levels Leq, 15 minute – dBA			
	Day	Evening	Night	Neutral (No attenuation)	SE Wind (No attenuation)	Temperature Inversion (No attenuation)	Temperature Inversion (With attenuation)
R1	51	45	40	**55**	**58**	**59**	27
R2	42	40	35	**53**	**57**	**57**	25
R3	55	45	40	**68**	**70**	**71**	39
R4	65	55	50	**66**	**66**	**69**	37
C5	65	55	50	55	50	60	27
R6	55	45	40	**50**	**45**	**55**	23
R7	55	45	40	**45**	**41**	**50**	18
R8	42	40	35	**46**	**51**	**51**	19
C1	65	65	65	59	61	64	31
C2	55	55	55	**59**	55	**63**	31
I1	70	70	70	**84**	**83**	**85**	53
I2	70	70	70	65	63	69	37
W1	40*	40*	40*	39[2]	34**	**44****	12**

* The NPI recommends that industrial noise levels do not exceed 40dB (Laeq, 15minute) internally within places of worship when in use.

** The noise level presented is internal noise level as the noise criteria is an internal noise criteria. For the purpose of this assessment the predicted noise level has been translated to an internal level based on the accepted 10dB attenuation that is readily achieved through windows, partially opened for ventilation.

Table 6.9.19 Predicted operational noise levels and compliance – Reciprocating engine

Receptor ID	PNTLs Leq – dBA			Predicted operational noise levels Leq, 15 minute – dBA			
	Day	Evening	Night	Neutral (No attenuation)	SE Wind (No attenuation)	Temperature Inversion (No attenuation)	Temperature Inversion (With attenuation)
R1	51	45	40	**52**	**56**	**57**	28
R2	42	40	35	**49**	**54**	**54**	26
R3	55	45	40	**63**	**67**	**68**	40
R4	65	55	50	**62**	**63**	**67**	38
C5	65	55	50	52	44	58	29
R6	55	45	40	**47**	**40**	**53**	24
R7	55	45	40	**41**	35	**47**	20
R8	42	40	35	**41**	**47**	**47**	20
C1	65	65	65	57	59	62	32
C2	55	55	55	**56**	49	**62**	32
I1	70	70	70	**75**	**76**	**80**	52
I2	70	70	70	62	57	67	37
W1	40*	40*	40*	36**	28**	**42****	13**

*The NPI recommends that industrial noise levels do not exceed 40dB (Laeq, 15minute) internally within places of worship when in use.

**The noise level presented is internal noise level as the noise criteria is an internal noise criteria. For the purpose of this assessment the predicted noise level has been translated to an internal level based on the accepted 10dB attenuation that is readily achieved through windows, partially opened for ventilation.

Based on the above analysis, the Proposal would need to install noise mitigation measures to achieve operational noise compliance. Mitigation measures could include silencers, lined ducts, acoustic enclosures, noise screens/barriers, selection of quieter plant/equipment, or a combination of the above.

Table 6.9.20 details the attenuated sound power levels for the Proposal to achieve compliance. The selection of plant and equipment would be based on these attenuated sound power levels to achieve compliance with NPI criteria for all periods at all surrounding receivers.

Table 6.9.20 Attenuated sound power levels at source

Design option	Plant/equipment	Total number of equipment	SWL with No Attenuation, L_{eq} (dBA)	Required Attenuation Level[2, 3] (dBA)	Attenuated SWL at Source[2], L_{eq} (dBA)
Turbine Engine	Exhaust	4	140	40	100
	Generator	4	104	10	94
	Fin Fan Cooler	4	102	5	97
Reciprocating Engine	Engine	13	134	40	94
	Exhaust Gas	13	108	15	93

Design option	Plant/equipment	Total number of equipment	SWL with No Attenuation, L_{eq} (dBA)	Required Attenuation Level[2, 3] (dBA)	Attenuated SWL at Source[2], L_{eq} (dBA)
	HT/LT Radiator Field	13	109	14	95
	Intake Air Noise	13	110	18	92
	Power House Vent (Outlet)	13	103	9	94
	Power House Vent (Inlet)	26	98	5	93

Note 1: "At Source" refers to at the plant/equipment and does not refer to at the receiver.

Note 2: The "Required Attenuation Level" and "Attenuated SWL at Source" have been calculated based on the un-mitigated predicted operational noise levels presented in Noise and Vibration Assessment, 2019, ERM.

Note 3: The "Required Attenuation Level" is preliminary for further investigation.

Cumulative impacts

During construction, should other projects be constructed at the same time near the Proposal, there is the potential for cumulative noise impacts to affect the local area. Other projects that could be constructed at the same time as the Proposal are located within the neighbouring industrial area, where there are few sensitive receivers. There are not expected to be significant cumulative noise impacts during construction.

A cumulative noise impact assessment was carried out using existing noise assessments for nearby industrial developments coupled with modelled operational noise levels and predicted operational traffic numbers.

The noise levels of the existing operation of the TAC facility and the predicted operational noise of the Proposal were modelled together under a low-level temperature inversion meteorological condition to represent a worst case scenario. The results indicate that sensitive receivers are primarily influenced by the existing industrial noise, and for residential receivers R1, R2, R4-R8 no noise impacts are anticipated from the Proposal.

Existing noise levels exceed the operational noise trigger level at receivers R1, R3, and R6 during the night time and at R3 during the evening, under continuous operation (worst case conditions). The Proposal was calculated to contribute an increase of 1dB at receiver R3 and not contribute to the noise levels at any other receiver. The NVIA described a 1dB contribution as not acoustically significant and undetectable by the human ear.

6.9.4 Avoidance, mitigation and management

The NVIA recommended a number of safeguards designed to ensure construction and operational noise emissions are maintained within the acceptable levels for all sensitive receivers. These are listed in Table 6.9.21.

Table 6.9.21 Avoidance, mitigation and management measures – Noise and vibration

ID	Environmental safeguards	Timing
NV-1	A Construction Noise and Vibration Management Plan (CNVMP) would be prepared prior to the commencement of works to manage high noise works, affected receivers, complaints handling and consultation protocols, and out of hours work.	Construction
NV-2	Respite periods of one hour would be employed for every three hours of work where works are anticipated to generate noise levels > 75dBA at a receiver.	Construction
NV-3	Appropriate plant and equipment would be selected for the task at hand and efficient work practices would be adopted to minimise the construction period and the number of noise sources on site.	Construction
NV-4	Power down plant and equipment when not in use and avoid high engine speeds when lower speeds are sufficient.	Construction
NV-5	All construction plant and equipment would be maintained in suitable condition prior to mobilisation to the site and during construction.	Construction
NV-6	Particular emphasis would be placed on construction maintenance of exhaust silencers, covers on engines and transmissions, and poorly maintained components.	Construction
NV-7	Excessively noisy machines would be taken out of service for repair or removed from the site.	Construction
NV-8	Tonal motion alarms (beepers) would be avoided in favour of broadband motion alarms (quackers).	Construction
NV-9	Where night works are required, works with the potential to generate impulsive noise would be avoided.	Construction
NV-10	Noise complaints would be managed by the construction contractor in accordance with the CEMP.	Construction
NV-11	Appropriate plant and equipment would be selected for the task at hand so that lower vibration/lower impact plant would be chosen over that with a higher impact.	Construction
NV-12	Plant and equipment selected for the Proposal would have sound power levels not exceeding those presented in Section 6.9 of the EIS – Attenuated Sound Power Levels at Source.	Operation
NV-13	Where the attenuated noise levels from the Proposal exceed the predicted noise levels, further attenuation and/or analysis would be carried out to assess and recommend additional measures.	Operation
NV-14	Where noise complaints are validated, operator attended noise measurements would be undertaken to measure and compare the site noise level contributions with the NMLs presented in the EIS.	Construction
NV-15	Where noise monitoring is carried out, all site noise levels would be measured.	Construction
NV-16	Where noise monitoring identifies an exceedance, management measures would be designed and implemented to ensure ongoing compliance.	Construction
NV-17	Where vibration complaints are validated, vibration monitoring would be undertaken to identify the nature and extent of any exceedances.	Construction
NV-18	Where vibration monitoring identifies an exceedance, management measures would be designed and implemented to ensure ongoing compliance.	Construction

6.10 Social and economic

This assessment measures the total economic contribution of the Proposal on the economy. The assessment considers the direct and indirect economic impacts of construction and ongoing operation of the Proposal on the Australian economy, which encompasses all local, state, and national impacts.

6.10.1 Existing environment

Community profile

Land use

The land zoning around the Proposal area is General Industrial, with the Tomago Industrial Precinct extending from the Pacific Highway along Tomago Road (Figure 6.10.2). A number of industrial business parks have been developed along Tomago Road and Old Punt Road, including the Hunter Industrial Estate, Tomago Industrial Estate, and Speedway Industrial Park (Figure 6.10.2), with further industrial developments proposed.

The Pacific Highway forms the border between industrial development and electrical infrastructure and the Hunter River and rural land. Land to the east and north-east of the Proposal comprises of native vegetation. There is limited residential development near the Proposal.

Major infrastructure near the Proposal includes AGL's NGSF, TransGrid's Tomago switching station and associated transmission and distribution lines, and the Tomago Aluminium Smelter owned by TAC.

The smelter is located around 800m from the Proposal and is Australasia's largest aluminium smelter. TAC contributes $1.5 billion annually to the Australian economy, of which $800 million is spent locally. The company employs 950 staff (full time equivalent) as well as 190 contractors.

The Proposal area falls within the 'buffer zone' for the Tomago Aluminium Smelter. This was land compulsorily acquired by TAC due to proximity to the smelter, which precludes residential and rural activity but enables industrial activity 24 hours a day, seven days a week.

Accommodation

The closest residences to the Proposal are within the Tomago Village Van Park, located around 900m south. The park is located to the south of Tomago Road and the Tomago Industrial Estate development. The nearest zoned residential areas to the Proposal are in Heatherbrae around 2km north-west, Woodberry around 2.3km north-east, and along School Drive around 2.3km south-east.

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Projection: GDA 1994 MGA Zone 56

Newcastle Power Station **Environmental Impact Statement**

Figure 6.10.1 Proposal area and local facilities

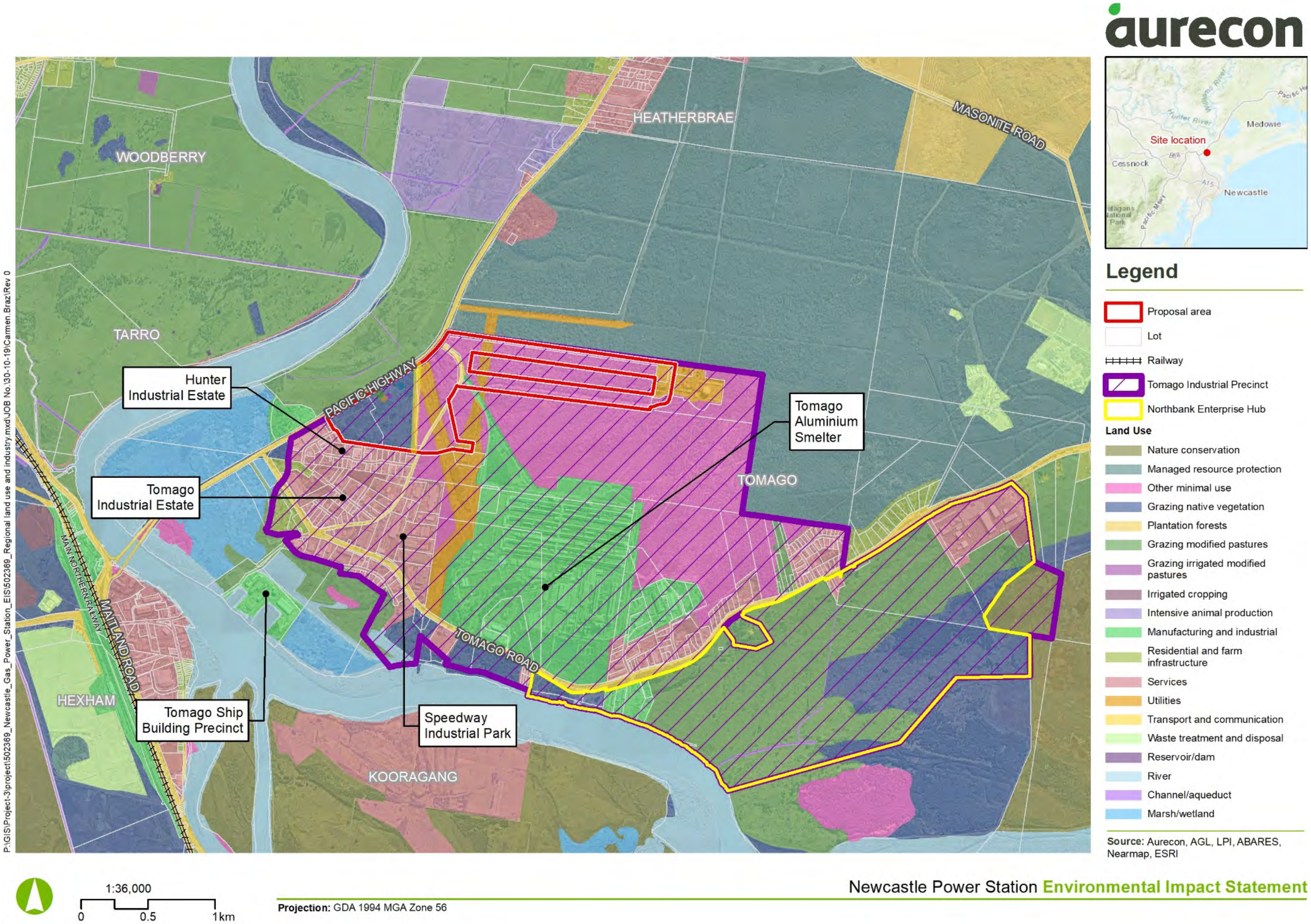

Figure 6.10.2 Regional land use

There is an array of temporary accommodation within a short drive of the Proposal area, including several motels, hotels and other large caravan parks. These include the Comfort Inn Sir Francis Drake, Kingston Motel, Motto Farm Hotel, Pacific Gardens Village and Bellhaven Caravan Parks in Heatherbrae (Figure 6.10.1).

The area hosts tourists and mobile workers travelling through the region including to nearby Maitland and Newcastle, and the Hunter Valley area. The area can accommodate short-term increases in demand for temporary accommodation, such as for the annual Groovin the Moo festival in Maitland, 15km north-west of the Proposal area, which has an annual attendance of over 20,000 people.

Food and beverage facilities

The nearest food and beverage outlets are the Old Punt Road Café, which is a large truck-stop style café with ample seating and parking, the Tomago Bowling and Sporting Club, and the Windstock Café in the industrial estate at Hexham. Further along the Pacific Highway towards Heatherbrae is Kookaburra Café within the Botanic Gardens. There are a number of eateries in Heatherbrae including Heatherbrae Hardware Café, with a McDonalds, Subway, KFC and Hungry Jacks as well as several independent restaurants. There is a wider range of restaurants and recreational activities to the north east in Raymond Terrace and south in the city of Newcastle.

Recreational facilities

Recreational and sporting facilities near the Proposal include:

- Hunter Region Botanic Gardens
- Tomago Bowling and Sporting Club
- Hexham Bowling Club
- Hexham Park
- Shortland Waters Golf Club
- Skywood Equestrian Centre
- Newcastle Golf Club

Nearby attractions include the Hunter Regional Botanic Gardens which span over 130ha and have guided tours, educational excursions, special events and weddings; and Fighter World in Williamtown which has displays of aircraft, armament, equipment and engines spanning over 100 years of aviation history.

Council infrastructure

The main access to the Proposal area would be via Old Punt Road, which is a sealed, two-way Council road. The surrounding road network including Tomago Road and the Pacific Highway is well suited to heavy haulage vehicles due to the existing industrial land uses (Figure 6.10.2). Old Punt Road connects to the Pacific Highway approximately one kilometre to the north of the proposed power station access point.

Water infrastructure

Potable municipal water is available via the HWC pipeline on Old Punt Road. There is no sewerage system in Tomago.

Health infrastructure

The nearest medical facilities to the Proposal area are the Beresford Avenue Medical Centre in Beresfield and the Raymond Terrace Family Practice. The nearest hospital is the Hunter Valley Private Hospital and the John Hunter Hospital is the closest public hospital with an emergency and trauma department. The closest ambulance, fire and police services are located at Raymond Terrace.

Demographics

Demographics from the 2016 ABS census have been examined from the Tomago, Heatherbrae and Hexham community profiles to compile an understanding of the local area, and compared with data from the Port Stephens LGA, NSW, and national data to complete the socio-economic characterisation of the study area.

Population

The population and demographics data for the study area, LGA and State are summarised in Table 6.10.1.

The Proposal is located within the Port Stephens LGA which had a population of 69,556 in the 2016 census. Port Stephens LGA is one of ten local government areas within the Hunter region. The Hunter has the largest share of both regional population and regional employment in NSW and is in the State's fastest growing corridor, from the northern edge of Sydney to Newcastle. The major population centre of Port Stephens LGA is Raymond Terrace, approximately five kilometres north west of the Proposal, with a population of 12,820. Raymond Terrace is a major rural service centre for the surrounding districts.

Tomago is the closest suburb to the Proposal area and is a small semi industrial and rural locality with a residential population of 277 people concentrated to the east and southeast of the industrial area. The population of Tomago has tripled in the past decade, from 95 people in 2006 to 277 people in 2016. Much of the surrounding area is within the Tomago Industrial Precinct (Figure 6.10.2) with limited residential development present. The Proposal area is within the 'buffer zone' for the Tomago Aluminium Smelter, land compulsorily acquired by TAC, which precludes residential and rural activity and enables industrial activity 24 hours a day, seven days a week. Across the Hexham bridge over the Hunter River, the suburb of Hexham developed along the Pacific Highway and reflects its industrial history, with restricted residential settlement and a population of 130. The suburb of Heatherbrae to the north has a slightly larger population (512) and is more rural-residential in character, although there is a semi-industrial area east of the highway (Figure 6.10.2).

There is a significantly lower proportion of females in Tomago compared to the proportion in the LGA and State. Tomago recorded the highest proportion of males (per total resident population) in the 2016 Census at 64.9% (ABS, 2018). Heatherbrae (44.5%) and Hexham (47%) had slightly less females as a proportion compared to the LGA and State, which had over 50% women.

The median age of residents in Tomago (55), Heatherbrae (54) and Hexham (50) compared with NSW (38), reflects the ageing population in the Proposal area. This is also reflected in the smaller than average household size in these suburbs, compared with the broader region and the state. These statistics indicate the availability of working-age males in the local area.

In Tomago (27.8%) and Hexham (33%) there is a significantly higher proportion of single parent families compared to the LGA (16.4%) and the State (16%).

There is a higher percentage of Aboriginal and/or Torres Strait Islander people in the suburbs comprising the Proposal area and within the Port Stephens LGA compared to the State of NSW and Australia.

Table 6.10.1 Demographics

Statistic	Study area			Port Stephens LGA	NSW
	Tomago	Heatherbrae	Hexham		
Population	277	512	130	69,556	7,480,228.00
Male	64.9%	55.5%	53.0%	49.4%	49.3%
Female	35.1%	44.5%	47.0%	50.6%	50.7%
Median age	55	54	50	45	38
Aboriginal and/or Torres Strait Islander people	4.4%	5.3%	8.1%	4.8%	2.9%
Average children per family (for families with children)	1.6	1.7	1.3	1.9	1.9
One parent family	27.8%	17.3%	33.0%	16.4%	16.0%
Average people per household	1.7	1.9	2.3	2.5	2,6

Linguistic and cultural diversity

The linguistic and cultural diversity data for the study area, LGA and State are summarised in Table 6.10.2. The study area and LGA are not as linguistically diverse as NSW, with 80-90% of households speaking only English at home compared to around 70% at the state level. Similarly, less than 7% of households in the study area speak a language other than English at home, compared to almost 27% of homes in NSW.

In the study area, 11% or less people had both parents born overseas, compared to 37% for NSW. Similar patterns exist in the study area and the Port Stephens LGA with a larger proportion of people being born in Australia, and with both their parents born in Australia, compared to the State. This indicates that the area is less culturally and linguistically diverse than the state or the nation.

Within the study area, the countries of birth identified other than Australia were Pakistan, England, Malta, Thailand, New Zealand, Germany and China.

Table 6.10.2 Linguistic and cultural diversity

Statistic	Study area			Port Stephens LGA	NSW
	Tomago	Heatherbrae	Hexham		
Country of birth – Australia	72.7%	80.5%	84.7%	81.0%	65.5%
Both parents born overseas	8.9%	11.2%	10.1%	13.6%	37.0%
Both parents born in Australia	61.4%	70.9%	79.1%	67.9%	45.4%
English only spoken at home	80.4%	86.3%	86.0%	89.5%	68.5%
Households where a non-English language is spoken	4.1%	6.9%	5.4%	5.1%	26.5%

Housing

The housing data for the study area, LGA and State are summarised in Table 6.10.3. The number of unoccupied private dwellings in Tomago (2.3%) and Heatherbrae (4.5%) is significantly lower than the LGA (18.1%) and State (9.9%) indicating a potential housing shortage in the study area. There are no flats or apartments in the study area, while this form of housing comprises 19.9% of the housing types in the State. The high proportion of other dwelling types (such as caravans and cabins) in the study area (>70% in Tomago and >50% in Heatherbrae compared with around 2% for the LGA and 1% for the State) further indicates a potential shortage of affordable and/or available housing in the local area.

While higher levels of home ownership in Tomago imply higher levels of financial security, the lower value of caravan and cabin type dwellings reflect the lower median incomes.

Table 6.10.3 Housing

Statistic	Study area			Port Stephens LGA	NSW
	Tomago	Heatherbrae	Hexham		
Occupied private dwellings	97.7%	95.5%	87.7%	81.9%	90.1%
Unoccupied private dwellings	2.3%	4.5%	12.3%	18.1%	9.9%
Separate house	27.7%	39.4%	100.0%	79.8%	66.4%
Semi-detached, row or terrace house, townhouse etc	0.0%	3.8%	0.0%	13.9%	12.2%
Flat or apartment	0.0%	0.0%	0.0%	3.5%	19.9%
Other dwelling	72.3%	54.7%	0.0%	2.3%	0.9%
Owned outright	50.8%	25.8%	33.9%	38.6%	32.2%
Owned with mortgage	7.7%	10.6%	27.1%	31.3%	32.3%
Rented	36.9%	14.8%	33.9%	26.2%	31.8%

Education

The nearest education facility to the Proposal is Hunter River High School in Heatherbrae. There are several schools in nearby Raymond Terrace, Woodberry, and Beresfield. The nearest TAFE campuses are in Newcastle and Maitland, and the nearest universities in Newcastle.

The educational attainment data for the study area, LGA and State are summarised in Table 6.10.4. The majority of residents in the study area have not completed a Year 12 equivalent education. The percentage of the population who have completed education beyond Year 12 in the study area ranges from 21.5% (Hexham) to 33.7% (Heatherbrae), compared with around 47% across the State. Similarly, around 20% of the population in the study area have completed year 10 as their highest education, almost double the state (11.5%). This indicates a lower level of education in the study area. There are a high proportion of people who have a Certificate 3 (around 18%) (trade and para-professional) in the study area compared with 12% at the State level. This is both reflective of the lower education levels in this area, as well as the local industry requirements in the area, which is driven by industry including manufacturing.

Table 6.10.4 Educational attainment

Statistic	Study area			Port Stephens LGA	NSW
	Tomago	Heatherbrae	Hexham		
Attained education level beyond Year 12	29.7%	33.7%	21.5%	42.7%	47.1%
Highest level = Certificate III	18.7%	19.3%	15.7%	18.6%	12.0%
Highest level = Year 10	19.4%	21.4%	20.6%	16.5%	11.5%

Employment

As shown in Table 6.10.5, a similar percentage of the population in the local area work full time compared to the region, state and nation; however, the unemployment levels in Tomago (12%) and Heatherbrae (11.1%) are nearly double the State (6.3%) average. There is a slightly lower proportion of the population in the working age group (15-65) in the study area compared to the State, however, detailed age breakdowns for each suburb indicate a reduced percentage of persons under the age of 50 and an increased percentage of persons over 50 compared to NSW. This indicates an ageing workforce; however, a workforce with a longer period of industry exposure in which to gain skills, experience and further education.

When the predominant occupations are considered, Tomago has four times the percentage of people employed as machinery operators and drivers and twice as many as labourers compared to the state, but less than one quarter the percentage of professionals employed. Labourers comprise nearly 40% of the workforce in Hexham, and machinery operators and drivers over 20%, yet there are no working professionals residing in the suburb. Similarly, there are less managers and more technicians and trades workers employed as a percentage of the workforce in Tomago and Heatherbrae compared to the state. This is reflective of a more blue-collar, skilled manual workforce in the study area.

Table 6.10.5 Employment and occupation

Statistic	Study area			Port Stephens LGA	NSW
	Tomago	Heatherbrae	Hexham		
Worked full-time	54.6%	55.1%	59.2%	53.5%	59.2%
Unemployed	12.0%	11.1%	6.1%	7.2%	6.3%
Working age (15-65)	63.9%	62.2%	61.1%	-	65.1%
Labourers	20.7%	9.4%	37.8%	11.0%	8.8%
Machinery Operators and Drivers	24.1%	12.8%	22.2%	8.2%	6.1%
Technicians and Trades Workers	19.5%	23.9%	6.7%	17.6%	12.7%
Professionals	4.6%	11.1%	0.0%	14.7%	23.6%
Managers	8.0%	8.3%	8.9%	10.9%	13.5%

Employment industries

Of the 3.5 million people employed in NSW in 2010, the Health Care and Social Assistance industry employed the most people (11%), followed by the Retail Trade industry (10.5%) and Manufacturing industry (8.8%) (ABS, 2011). Whilst manufacturing is still one of the top employers, there has been a steady decline in manufacturing jobs in the wider NSW region due partly to delayed public expenditure, government decisions on import duties and trading conditions, rising strength of the dollar, and increased automation.

This has seen closure of key industrial facilities including motor vehicle manufacturers and more locally the Forgacs Shipyard in Tomago. Forgacs was Australia's largest privately-owned engineering and shipbuilding company, which was purchased by Civmec in 2016 leading to the skilled manufacturing workforce being made redundant.

The Hunter is Australia's largest regional economy, valued at over $40 billion. It drives around 28% of regional NSW's total economic output and is the largest regional contributor to the State's gross domestic product. The Hunter is the oldest wine making region in Australia, with a strong tourism industry, and is one of the world's best thoroughbred centres.

The top industries of employment in the study area are shown in Table 6.10.6. Hospitals are a key employer across the region, whilst the industrial character of the study area is reflected in the more industrial and manual employment industries including building and industrial cleaning services, iron smelting and steel manufacturing, concreting services, automotive repair and maintenance, other heavy and civil engineering construction, other hardware goods wholesaling and road freight transport.

Table 6.10.6 Top industries of employment

Tomago	Heatherbrae	Hexham	Port Stephens LGA
Road freight transport	Accommodation	Other hardware goods wholesaling	Defence
Hospitals (except psychiatric hospitals)	Hospitals (except psychiatric hospitals)	Iron smelting and steel manufacturing	Supermarket and grocery stores
Building and other industrial cleaning services	Other automotive repair and maintenance	Other heavy and civil engineering construction	Aged care residential services
Iron smelting and steel manufacturing	Other social assistance services	Road freight transport	Take-away food services
Concreting services	Road freight transport	Aged care residential services	Hospitals (except psychiatric hospitals)

Income and expenditure

As shown in Table 6.10.7, the median weekly household income in the study area is significantly less than the wider region and the state. The median weekly income in Tomago ($784) is just over half the state median income ($1,486). Close to 40% of the population surrounding the Proposal earn less than $650 per week, compared with only around 20% in the State. This is also reflected in the percentage of the population earning over $3,000/week, being 4.8% of the population in Tomago and Heatherbrae and 0% of the population of Hexham, compared with 10% in the Port Stephens LGA and 18.7% in the state of NSW. The comparative difference in median monthly mortgage repayments and median weekly rent figures between the study area compared to the State is less significant; in Heatherbrae the median weekly rent ($268) is on par with NSW ($270). This indicates a higher level of financial pressure within the local households, as a larger portion of income would be going towards rent or mortgage payments.

Table 6.10.7 Income and expenditure

Statistic	Study area			Port Stephens LGA	NSW
	Tomago	Heatherbrae	Hexham		
Median weekly household income	$784.00	$841.00	$916.00	$1,180.00	$1,486.00
Less than $650 gross weekly income	40.3%	38.8%	26.9%	23.2%	19.7%
More than $3000 gross weekly income	4.8%	4.8%	0.0%	10.0%	18.7%
Median monthly mortgage repayments	$1,517.00	$1,083.00	$1,300.00	$1,733.00	$1,733.00
Median weekly rent	$221.00	$268.00	$245.00	$305.00	$270.00

Mode of transport

The mode of transport data for the study area, LGA and State are summarised in Table 6.10.8. The percentage of people travelling to work by public transport in the local area and region is significantly lower than the state and national average, indicative of the reduced public transport options and the geographic spread of dwellings and employment opportunities in the semi-rural, semi-industrial area. Some residents indicated that they travelled to work by truck.

Table 6.10.8 Mode of transport

Statistic	Study area			Port Stephens LGA	NSW
	Tomago	Heatherbrae	Hexham		
Average motor vehicles per dwelling	1.4	1.9	1.9	1.9	1.7
Travelled to work by public transport	0.0%	2.7%	0.0%	1.7%	16.0%
Travelled to work in a car	68.5%	66.5%	79.6%	76.3%	64.6%

Local development plans and priorities

In October 2016, the *Hunter Regional Plan 2036* was launched, outlining the Government's vision to grow and diversify the region's economy over 20 years and guide land use planning priorities and decisions. Direction 24: Protect the economic functions of employment land, notes that there are opportunities to grow the significant employment precincts at Tomago, Hexham and at the convergence of the national road network around Beresfield. Within this plan, Tomago and Heatherbrae are listed as a regionally significant employment land cluster.

The *Greater Newcastle Metropolitan Plan 2036* identifies Tomago as a catalyst area with an immediate focus for employment and infrastructure investment. A target of 700 additional jobs by 2036 would see local employment increase from 7,800 to 8,500 jobs. The plan recognises Tomago as a significant advanced manufacturing and industrial area. Outcomes of the plan include to promote staged delivery of industrial lands and supporting infrastructure and protect freight routes connecting Tomago to Newcastle Airport at Williamtown (via Tomago Road) and to Newcastle Port (via Pacific Highway and Industrial Drive), and to promote the development of shipbuilding industries that maximise opportunities to secure defence contracts.

6.10.2 Study method and criteria

This assessment was prepared in accordance with the NSW Planning and Environment *Social Impact Assessment Guideline*, the SEARs, and agency comments.

Baseline data for the study area, LGA, region and State were gathered from ABS Census data for 2016. This assessment considers the social impact of the Proposal on local population, labour workforce, accommodation, council and community infrastructure, amenity and facilities. The socio-economic profile of the community, data used from the Australian Bureau of Statistics 2016 Census period for:

- Nearest state suburbs to the Proposal area (which together form the study area for the socio-economic characterisation): Tomago (nearest suburb (ABS, 2016a)), Hexham (ABS, 2016b), and Heatherbrae (ABS, 2016c) (Figure 6.10.1)
- Local government area of Port Stephens (ABS, 2016d)
- State of New South Wales (NSW) (ABS, 2016e)

The assessment has considered information from other resource projects in the surrounding region and online articles, and from relevant strategic plans and policies including the *Hunter Regional Plan 2036* and the *Greater Newcastle Metropolitan Plan 2036*.

Ongoing consultation throughout the development of this EIS has further informed this social and economic impact assessment. The study has also considered feedback from community and stakeholder engagement including from Port Stephens Council, TAC, Newcastle Airport, local community groups, environmental groups and Aboriginal stakeholder groups.

6.10.3 Potential impacts

Construction

Potential or perceived impacts during construction of the Proposal include:

- Generation of employment opportunities
- Impacts of the labour requirements on the local employment market
- Pressure on existing accommodation and inflation of the housing market due to an increased population
- Short-term pressure on existing community services and social infrastructure due to an increased population
- Investment in the local community including facilities and educational opportunities
- Concerns regarding social integration of Proposal workforce within the community
- Amenity impacts during construction including dust, noise, traffic and visual impacts
- Concerns regarding public safety from traffic around the Proposal area
- Potential impacts on air traffic passing over the Proposal area

Employment

The Proposal would provide significant local and regional economic benefits including direct and indirect employment opportunities and injection of expenditure in the local area.

The *Greater Newcastle Metropolitan Plan 2036* identifies a target of 700 additional jobs in Tomago by 2036, predominantly through development of advanced manufacturing and industrial areas and shipbuilding industry. The Proposal would support the energy requirements of future employment growth in the area, contributing to further industrial development of the Tomago area and achieving the objectives of the metropolitan plan.

Construction of the Proposal would generate up to 300 direct roles during the peak construction period, with the majority of these roles sustained for the full construction duration of 24 months. Efforts will be made to source the workforce from the surrounding area, or within commuting distance.

Construction will require a workforce with trade and para-professional qualifications. It is possible that employment for the Proposal could be met by local and regional residents, as:

- the higher than average number of residents in the local area and Port Stephens LGA with trade and para-professional qualifications
- a higher unemployment rate in the local area compared with the State

The Proposal would provide access to employment with industry awards and standards and would build local and regional workforce skills.

There is the potential for existing local businesses to lose staff to the Proposal, particularly if salary offerings from the Proposal are higher. While there may be some competition for labour and higher labour costs, generally the impacts to local businesses from the Proposal would be positive.

There would also be indirect employment opportunities through retail and associated services, and business and procurement opportunities for local and regional small and medium-sized enterprises. Indirect employment opportunities would include food and beverage retailers, temporary accommodations, catering and cleaning services, vehicle servicing and fuel, tradespeople, equipment suppliers, medical and other practitioners. Given the general multiplier of 3:1 jobs created for every new job in industry, the Proposal would contribute up to 900 indirect jobs during construction.

Local businesses will be prioritised, where possible, to service the Proposal during construction and operation. Advanced notice of goods and services required would be provided to assist local businesses meet the Proposal's needs and contribute towards local economic stability.

Accommodation and housing

The construction workforce would be up to 300 persons at peak. Efforts will be made to source the workforce from the local area to avoid placing undue pressure on temporary accommodation in the area. Where external candidates are employed, short term accommodation would be required during the construction period for up to 24 months. There is the potential for the Proposal to cause actual or perceived short-term pressure on local housing and accommodation availability, and inflation of rental and house prices due to increased housing demand. These impacts, if noticeable, would be short-term in duration.

ABS statistics for the suburbs closest to the Proposal area indicate a potential housing shortage, due to the low percentage of unoccupied private dwellings and the large percentage of caravans and cabins in the nearest suburbs. Whilst the caravan parks have many long-term residents, they have continued vacancy for vans and cabin accommodation available for short term guests. There are also several hotels and motels in the neighbouring suburbs to the Proposal area (Figure 6.10.1).

There is limited residential development surrounding the Proposal area due to the industrial zoning, which creates the existing local housing pressure. There is, however, ample rental accommodation available within 15km of the Proposal area which could accommodate potential increased housing demand during construction of the Proposal. This includes rental accommodation in nearby suburbs such as Beresfield, Tarro and Shortland, and the larger metropolitan centres of Raymond Terrace, Maitland, and Newcastle.

It is expected that there would be ample short-term accommodation available including rental properties, caravan parks and hotels/motels to accommodate any external construction workforce moving into the area. It is not intended to build a construction accommodation camp within the development footprint. This will make sure economic benefits from the presence of the construction workforce are experienced by local businesses and accommodation providers.

There is the potential to reduce the availability of short-term hotel and cabin accommodation in the surrounding suburbs which may have otherwise been used for regional festivals and events. It is considered that alternate accommodation could be found in the wider region for these events, however, due consideration would be given when scheduling peak construction activities.

Community services

The additional vehicle movements related to the Proposal are not expected to have a significant impact on the road or road users. AGL's contracts with construction contractors would contain make-good provisions for any impact to roads, pavement, gutters, drainage or associated infrastructure.

As parking would be provided for the workforce within the Proposal area, the Proposal would not place any noticeable demand on Council-managed parking nor is it expected to have an impact on existing transport infrastructure.

The Proposal would employ rigorous erosion and sedimentation and water quality controls to achieve NorBE and is not expected to have any discernible impact on council's stormwater drainage systems.

The Proposal would use municipal water services which would be paid for in arrangement with HWC.

Statutory payments for the Proposal will contribute to providing and maintaining services and infrastructure in the region.

The Proposal compound would have its own medical facilities to respond to first aid and minor industrial accidents and is not expected to place undue pressure on infrastructure services and facilities. A robust safety management system including inductions, risk controls and AGL's existing 'Fitness for Work Policy' will reduce the likelihood of accidents and injuries occurring.

The temporary accommodation of some new employees in the area during construction may slightly increase the demand for general medical and health services in the region.

AGL has developed working relationships with local area emergency providers including police, ambulance and fire services in Raymond Terrace and regional hospitals during construction and operation of previous projects in the area, which would continue during construction and operation of this Proposal.

Community investment

The Proposal would present opportunities for upskilling and training of the workforce, as well as offering scholarships and other training opportunities for the local community.

The Proposal and its employees would facilitate, or support initiatives aimed at community development, capacity building and strengthening of community institutions. AGL has an active community engagement philosophy and has developed an existing relationship with the local community due to the nearby NGSF.

A Local Community Investment Program would be established as part of the Proposal to provide a voluntary fund for the local community. The community would be invited to present proposals on how the funds could be apportioned and used for community projects and developments. This program would provide a source of continued investment in the local community.

AGL has established a similar Local Community Investment Program for the NGSF which provides grants to fund community and non-government projects. Recent recipients include the Hunter Region Botanic Gardens, Men's Shed, Port Stephens Koalas, Tomaree Neighbourhood Centre, and Irrawang Public School. AGL has also established a Community Dialogue Group to communicate Proposal planning and progress with key local stakeholders including HWC and Hunter Region Botanic Gardens.

Social infrastructure

Some of the construction workforce may temporarily relocate to the region and may intermittently use recreational and sporting facilities within the Port Stephens and Newcastle LGAs during their leisure times. Impacts to the availability, capacity or condition of local and regional recreational and sporting infrastructure are expected to be minimal, although, service times and availabilities may be affected during weekends and mid-week meal times. There may also be a perceived pressure on community recreation facilities and local cafes and eateries and a perceived or actual inflation in pricing due to the potential influx of new construction workers. Whilst this is not considered to be a significant risk, consultation with the community will be undertaken to understand and manage this. Some local businesses would benefit from this additional patronage and expenditure during construction, and the injection of money into the local economy may increase community wellbeing.

Social integration

Two thirds of the Tomago population are employed as machinery operators and drivers, labourers and technicians and tradespeople, reflecting a predominantly male and blue-collar workforce. Therefore, it is expected that any additional construction workforce required for the Proposal, if not from the local community, will socially integrate into the local community.

Local procurement will help prevent social impacts associated with the introduction of a new and potentially higher paid workforce into the community. Personnel employed by the Proposal would be expected to behave appropriately and exhibit professional standards when in the community.

Due to the relatively small employment numbers compared to the surrounding industrial developments and the potential to source much of the labour force locally, the Proposal is not expected to affect interaction within the community or change the daily lifestyle of the communities in which it would operate.

Amenity

The Proposal would be constructed in an industrial area with limited residential dwellings and would be consistent with surrounding industrial land uses. Due to the distance between the industrial area and residences, the impact of Proposal construction activities on residential properties is expected to be minimal. AGL would meet the construction noise goals for the Proposal to minimise disturbance to sensitive receptors. Erosion and sediment controls would be employed during construction to minimise dust generation and dust suppression would be employed if required. Any odour or emission impacts during construction would be minor, short-term and localised to the work site and would be unlikely to affect off-site receivers.

Construction traffic would be generated by the delivery of plant, equipment and materials, the removal of waste from the construction site, and the movement of up to 300 construction workers travelling to and from site daily. Due to the limited public transport options, construction staff would travel to work using private vehicles. The construction contractor would be encouraged to organise transport for the construction workforce to and from the site using shuttle buses and car pooling; however, there would remain a need for construction traffic access and parking. Some local traffic may be affected for short periods during construction of the Proposal, and during the movement of oversize loads.

The Proposal would not alter access routes within the area or restrict use of the natural and built environment. No transport network modifications are anticipated to be required for the construction or operation of the power station. This includes the public transport network, pedestrian, cyclist and road networks. The Proposal is not expected to have any discernible impact on the way the community travels or influence their choice of mode of transport.

As the area surrounding the Proposal is already highly industrial in nature with ongoing construction and heavy vehicle movements, it is not expected that construction of the Proposal would affect the amenity value of the area. Mitigation and management measures for amenity impacts including visual, noise, air, traffic and transportation are discussed elsewhere in this chapter and these impacts are considered acceptable and manageable.

Traffic

The TIA has demonstrated that the local road network is sufficient to continue to operate both efficiently and safely during construction of the Proposal. The extra vehicle movements during construction on the Pacific Highway, Tomago Road and Old Punt Road would be acceptable and represent negligible impacts on the existing operation of the local road network, which currently carries high traffic volumes.

Air traffic

The height of the permanent exhaust stacks and the maximum height cranes that could be used during construction are expected to breach the CASA Obstacle Limitation Surface (OLS) restriction height, however this would be confirmed by the construction contractor. Airservices Australia have indicated that the Proposal would be unlikely to impact civilian flights given the orientation of the runway and the location of the

Proposal. AGL would continue to consult with Airservices Australia, Department of Defence, and CASA and provide information necessary to allow for safe air traffic movements during construction of the Proposal.

Operation

Potential or perceived socio-economic impacts during operation include:

- Sustained direct and indirect employment opportunities
- Positive local, regional and national economic contributions
- In the public interest
- Deflation or correction of the local economy and housing market at the end of the construction period
- Amenity impacts during operation of the NPS including air and noise emissions, increased road traffic, and reduced visual amenity
- Concerns regarding public safety around the NPS

Employment

During operation, the employment benefits of the Proposal would be at a smaller scale than during construction, however for a more sustained duration. During the proposed operational life of around 25-years, approximately 23 full-time staff would be required, operating on shifts, and including routine maintenance staff. Relative to other major industrial employers in the area this is a small contribution, however, these would be 23 new full-time roles in an area of higher than average unemployment.

Indirect employment opportunities would continue throughout the operational life of the Proposal, and the Proposal would seek to maximise the participation of local businesses. Given the general multiplier of 3:1 positions created for every new job in industry, the Proposal would contribute up to 69 indirect jobs during operation. The operational life of the power station is 25 years, providing sustained direct and indirect employment opportunities.

Economy

The proposed 250MW power station has a capital investment value of approximately $400 million and is anticipated to be operational in 2022. The Proposal is expected to provide approximately $1 million in tax contributions from those employed during construction and approximately $100,000 annually by those employed full-time during operations, which would filter into the local economy. As well as income tax levied by the Commonwealth Government, State Government revenues will also increase due to land and payroll tax and rental payments for accommodation. Local land taxes and other statutory payments would be made as applicable.

As well as employee wages contributing to the regional economy, a large proportion of the Proposal's operating expenditure would flow direct to regional contractors and suppliers for raw materials and utility purchases, and local service suppliers. The presence of the Proposal and the injection of money into the local economy through accommodation, recreation, goods and services, food and beverage, retailers, fuel stations, and other associated expenditure may increase living standards and community wellbeing. Infrastructure projects have been known to improve the social makeup of local communities, strengthen regional economies and bolster national prosperity.

The Proposal would not be developed in an important tourism area such as the NSW Coast or Hunter wine area, and therefore would not impact on the thriving visitor economy of the Hunter region. The Proposal is close to high electricity demand industry in the Newcastle region and will provide reliable power to the state and create flow-on economic benefits for NSW and the region.

The Proposal would present continued economic benefits in the local area through the Local Community Investment Program and ongoing opportunities for upskilling and training of the workforce, as well as offering scholarships and other training opportunities for the local community.

Given the small number of people who will be employed to operate the Proposal, housing demand in the surrounding area is unlikely to be affected during operation. There may be some short-term market correction in rental pricing and availability as the external construction workforce leaves the area, however, due to the geographic spread of accommodation available surrounding the Proposal area this is not expected to be discernible in any particular area nor is it expected to have any significant or lasting effects on any particular businesses.

Public interest

The Proposal is considered to be in the public interest as it assists in the transition towards cleaner electricity generation with a lower environmental footprint than other electricity generation technologies. It would also generate a range of economic benefits to the local area and the Hunter region through direct and indirect employment opportunities, local business opportunities and skills development.

The Proposal would assist in reducing volatility and cost fluctuation in the electricity market by operating during peak demand periods and would diminish the likelihood of power supply shortages for domestic and business customers in the Hunter Region.

Amenity

The Proposal is a compatible land use with the existing industrial and electricity infrastructure in the surrounding area. There is additional industrial development proposed in the area under the *Hunter Regional Plan 2036*.

As the Proposal is consistent with surrounding development, it would have a low operational impact on amenity. The appearance of the power station would be in keeping with the existing industrial estate and existing gas and electrical infrastructure. Whilst the infrastructure would be visible at some viewpoints from the Pacific Highway, this would be short term views as the receivers are travelling on the road. Proposed vegetation planting and retention of trees where possible, would assist in reducing visual impacts.

Due to the limited residential development surrounding the Proposal, the sensitivity to operational amenity impacts is relatively low. Despite this, predicted noise levels indicate that the Proposal would require noise mitigation measures to achieve operational compliance. AGL would provide sound attenuation and noise mitigation measures to meet the operational noise goals for the Proposal to minimise disturbance to sensitive residential and non-residential receivers.

The Proposal would not alter access routes within the area or restrict use of the natural and built environment. The TIA has also demonstrated that the local road network is sufficient to continue to operate both efficiently and safely during operation of the Proposal, and that operational traffic volumes associated with the Proposal would be minor and would result in a minor effect on the road network

The main generator plant within the NPS would be the major source of air emissions during operation of the Proposal. The maximum cumulative predictions of emissions are generally within relevant criteria, with the exception of two substances under specific scenarios. The potential particulate matter emissions ($PM_{2.5}$) are considered minor and are not expected to have a significant impact on human or environmental health with the implementation of standard safeguards. The potential acrolein emissions would be reviewed with potential engine manufacturers to obtain plant specific performance characteristics.

The potential GHG emissions impacts during operation of the Proposal are anticipated to be below the current grid average emission intensity and represent a minor portion of the GHG emissions from electricity generation.

Public safety

The Proposal would be designed to minimise the risk to public safety associated with accidental events. The preliminary hazard assessment assessed a low societal risk from the operation of the Proposal due to the relatively low population density in the area. The risk of property damage and accidental propagation from a failure of a gas pipeline and associated infrastructure was assessed to be low. An asset protection zone would be established around the NPS to reduce the potential to cause or spread fires including bushfires, and an emergency response system would be in place. It was also considered unlikely that EMF generated by the Proposal either individually or in combination with the existing transmission lines would have an impact on human health.

A range of avoidance, mitigation and management measures to manage public safety have been provided in Chapter 7 of this EIS.

Cumulative impacts

The Proposal would have a range of socio-economic impacts during construction including impacts to local accommodation, food and beverage outlets, and community recreation spaces. With additional projects being constructed at the same time, this could provide greater job opportunities for the local area, but could also result in increasing population to the local area should there be insufficient population to meet the construction demand. Additional population in the local area could result in short term stress to accommodation, community services and social infrastructure during the construction.

During operation, the Proposal would generate both direct and indirect jobs which would provide benefits to the region. The electricity generation from the Proposal would also support other projects and developments in the area.

6.10.4 Avoidance, mitigation and management

A range of avoidance, mitigation and management measures would be implemented for social and economic as outlined in Table 6.10.9.

Table 6.10.9 Avoidance, mitigation and management measures – Social and economic

ID	Environmental safeguards	Timing
SE-1	AGL would use social procurement policies to employ local labour, local and regional businesses, contractors and supply companies for provision of labour, goods and services.	Construction Operation
SE-2	Detailed advanced notice of goods and services required by the Proposal would be issued to assist local businesses and services meet the needs of the Proposal. AGL would require all tenderers on the Proposal to prepare a Local Industry Participation Plan and an Indigenous Engagement Plan as a mandatory component of each tender.	Construction Operation
SE-3	Community consultation would be ongoing throughout the Proposal life. Public notifications, letterbox drops, and emails would be used to update the local community on the Proposal's progress and scheduling of works, particularly works which would have an impact on public amenity such as noisy night works.	Construction Operation

ID	Environmental safeguards	Timing
SE-4	Throughout the Proposal planning, construction and operation, AGL would continue consultation with the following key stakeholders: ■ DPIE ■ Paterson electoral division ■ Newcastle electoral division ■ Port Stephens Council ■ Roads and Maritime ■ Hunter Water Corporation ■ Department of Defence ■ Civil Aviation Authority ■ Newcastle Airport ■ Department of Energy and Environment	Pre-construction Construction Operation
SE-5	AGL would continue dialogue groups with representatives from Port Stephens Koalas, Hunter Wildlife Rescue, Wahroonga Aboriginal Corporation, HWC and Hunter Region Botanic Gardens.	Construction Operation
SE-6	A Local Community Investment Program would be established for the Proposal once construction commences and would continue into operation. The Proposal would further facilitate, or support initiatives aimed at community development, capacity building and strengthening community institutions.	Construction Operation
SE-7	AGL would continue to develop their working relationships with local area emergency service provides including Raymond Terrace police, ambulance and fire services, and regional hospitals, to prepare for emergencies and advise on risks to or from the Proposal. Proposal design will provide sufficient access for emergency vehicles and equipment including firefighting and rescue.	Construction Operation
SE-8	AGL's existing 'Fitness for Work Policy' will be enforced, and all staff, contractors and visitors will undergo site inductions to be familiar with the construction safety management plan and emergency management plan, as well as occupational health and safety requirements.	Construction Operation
SE-9	First aid facilities will be provided on site.	Construction Operation
SE-10	Community liaison would be undertaken throughout the construction and operation phases. A 24-hour information line would be established for any concerned residents to enquire about the Proposal, and a complaints register would be maintained for the life of the Proposal.	Construction Operation
SE-11	AGL would monitor socio-economic parameters so that the effects of the Proposal on the socio-economic conditions of the local area can be quantified during the Proposal and additional management measures can be applied where required. These parameters may include: ■ Number of direct jobs created for local and regional residents ■ Number of contracts with local businesses and their monetary value ■ Funding provided to community organisations and groups ■ Housing and accommodation requirements of the workforce ■ Number of staff who remain in the community after construction ■ Stakeholder and community feedback	Construction Operation

6.11 Visual amenity

A visual amenity assessment was completed to address the likely visual impacts of the Proposal on the amenity of the surrounding area and residences near the Proposal. The assessment was supported by a Visual Impact Assessment (VIA) which is provided in Appendix M.

6.11.1 Existing environment

The Proposal would be located at 1940 Pacific Highway, Tomago NSW, which borders the Pacific Highway to the north west, Old Punt Road to the south east and an industrial area towards the south. The southern boundary backs on to the industrial area along Kennington Drive, Kilcoy Drive, and Abbot Lane.

The surrounding areas are characterised by industrial development, large buildings and electrical infrastructure. There are no residential zones in the area; however, there is a residence in Oakfield Road in the Maitland LGA.

The VIA considered the relationship between the Proposal and the viewshed in which it is proposed and would be seen. Potential representative viewing locations were identified as shown in the following list and illustrated in Figure 6.11.1:

- Viewpoint A: Oakfield Road looking southeast
- Viewpoint B: Pacific Highway looking east
- Viewpoint C: Pacific Highway looking southeast
- Viewpoint D: Pacific Highway looking south
- Viewpoint E: Hunter Region Botanic Gardens looking south
- Viewpoint F: New England Highway heading south
- Viewpoint G: Old Punt Road heading south
- Viewpoint H: Old Punt Road heading north
- Viewpoint I: Kennington Drive looking north

The following describes the existing environment at each viewpoint used within this assessment. Figure 6.11.1 shows the location and direction of the representative viewpoints.

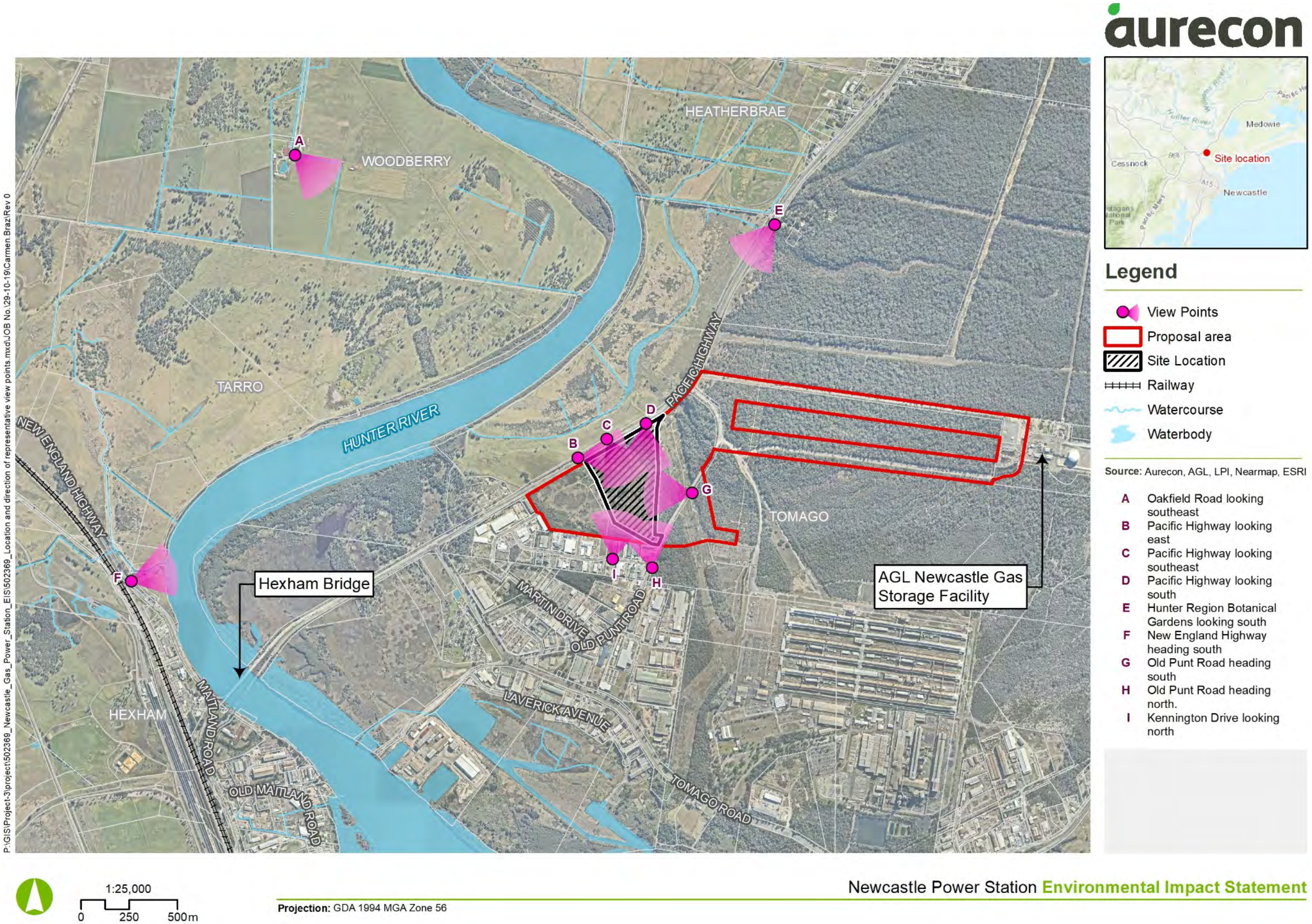

Figure 6.11.1 Location and direction of representative view points

Viewpoint A - Oakfield Road

Oakfield Road is located approximately 2.2km northwest of the Proposal area. A single residence and several farm buildings occupy the only built area on the road (located at Lot 12 DP 1189457). The surrounding land is agricultural.

The current view at this location for residents and farm workers is of the surrounding agricultural land, with riparian vegetation of the Hunter River in the background, as can be seen in Figure 6.11.2 (the approximate location of the proposed power station highlighted by a green arrow). The land is generally low, and is in the Hunter River floodplain, although the residence and associated buildings are raised on fill platforms to combat flooding.

Figure 6.11.2 The current view from Oakfield Road

Viewpoint B - Pacific Highway looking east

The Pacific Highway runs adjacent to the Proposal area along the northwest boundary of Lot 3 DP1043561. Motorists view the Proposal area from the side when travelling north. This view is currently defined by the highway cutting and vegetation consisting mainly of grasses and trees.

Figure 6.11.3 The current view from Pacific Highway looking east

Viewpoint C - Pacific Highway heading south east

Heading south east, the Proposal area is visible to the side, with a similar view of highway cutting and vegetation consisting mainly of grasses and trees (Figure 6.11.4).

Figure 6.11.4 The current view from the Pacific Highway looking heading south east

Viewpoint D - Pacific Highway looking south

From the north, heading south, the Proposal area is predominately blocked by an existing stretch of vegetation (Figure 6.11.5).

Figure 6.11.5 The current view from the Pacific Highway looking south

Viewpoint E - Hunter Region Botanic Gardens

The Hunter Region Botanic Gardens, a popular tourist site, is located approximately 1.2km north of the Proposal area as indicated in Figure 6.10.1 (Section 6.10). The Proposal area is not visible directly from the gardens as indicated by the green arrow in Figure 6.11.6. The current view from the Hunter Region Botanic Gardens is of agricultural land, road and electricity infrastructure, grasses and trees.

Figure 6.11.6 The current view from the Hunter Region Botanic Gardens

Viewpoint F - New England Highway

From the New England Highway heading south, the Proposal area is to the left approximately 2.5km across the Hunter River and wetlands, as shown in Figure 6.11.7.

Figure 6.11.7 The current view from the New England Highway

Viewpoint G - Old Punt Road looking north

Old Punt Road is a local road that connects the Pacific Highway with Tomago Road via the Tomago industrial area. Motorists heading north pass the Proposal area to their left as shown in Figure 6.11.8. The current view at this location for motorists in either direction is dominated by trees and the transmission easement.

Figure 6.11.8 The current view from Old Punt Road heading north

Viewpoint H - Old Punt Road looking west

As above, the current view at this location for motorists in either direction is dominated by trees and the transmission easement. Motorists heading north first pass through the industrial area before encountering the trees and the transmission easement (Figure 6.11.9).

Figure 6.11.9 The current view from Old Punt Road looking west

Viewpoint I - Kennington Drive

Kennington Drive runs perpendicular to Old Punt Road in an approximate east/west direction south of the Proposal area and is accessed via Old Punt Road. Kennington Drive is located within the Industrial area of Tomago and provides access to businesses. Existing vegetation is visible from the view towards the Proposal area (Figure 6.11.10).

Figure 6.11.10 The current view from Kennington Drive

6.11.2 Study methods and criteria

The Proposal would be located within the Port Stephens LGA, which has no guidelines relating to the assessment of visual impacts. The VIA and this assessment were based on:

- The Guidance Note for Landscape and Visual Assessment (ALIA, 2018)
- The Department of Planning and Environment's *Rural Land Evaluation* (DoP, 1988)
- AS4282-1997 Control of the obtrusive effects of outdoor lighting

The assessment method comprised of the following:

- An analysis of aerial imagery, transport routes, infrastructure, services, adjacent and nearby land uses
- A desktop review to determine locations where the visual character may be impacted on by the Proposal
- Representative accessible viewpoints (such as areas of high ground, parks and other public venues, road corridors, rail corridors and residential areas) were identified
- Site inspection at each of the pre-determined viewpoints
- Photography and written descriptions at each viewpoint to illustrate the local context
- Impact assessment to describe the visual properties of the Proposal within its location and to understand the overall visual effect

Visual effect

The visual effect was determined by measuring the level of visual contrast or integration of the Proposal with the surrounding landscape by considering its form, shape, pattern, line, and colour. The visual effect assessment described in Figure 6.11.1 is based on the assessment provided in Guidance Note for Landscape and Visual Assessment, Australian Institute of Landscape Architects, June 2018. The proportion of the landscape view occupied by the Proposal is defined as the Primary View Zone (PVZ). Table 6.11.1 demonstrates the relationship between contrast, integration and effect.

Table 6.11.1 Contrast, integration, and visual effect

Visual properties		Visual effect levels		
Contrast	**Integration**	**High**	**Moderate**	**Low**
High Development elements do not borrow, form, shape, line, colour, texture or scale from existing features of the visual setting and contrast levels are high with existing landscape.	Low The development lacks integration with visual setting because of scale totally dominating the ability of site or surrounding features, vegetation and or topographic features to integrate the development.	The development occupies more than 2.5% of the primary viewshed.	The development occupies between 1 – 2.5% of the primary viewshed.	The development occupies less than 1% of the primary viewshed.
Moderate Development elements borrow from some features of the visual setting in terms of form, shape, line pattern and/or colour and scale, reducing visual contrast with existing setting.	Moderate The development has some degree of visual integration with setting from other features, vegetation and or topography achieve some level of integration.	The development occupies more than 20% of the primary viewshed, generally when in a foreground location.	The development occupies between 10-20% of the primary viewshed.	The development occupies less than 10% of the primary viewshed.
Low Development elements borrow extensively from features in visual setting in terms of form, shape, line, pattern colour and scale minimizing contrast with the existing setting.	High Visual integration is high due to other features, vegetation and / or topography achieving dominance and screening or filtering.	The development occupies more than 40% of the primary viewshed.	The development occupies 30-40% of the primary viewshed.	The development occupies less than 30% of the primary viewshed.

Visual sensitivity

Visual sensitivity[5] considers the use of the land from which the Proposal is being viewed. This gives an indication of the expectations of the users of the landscape. Visibility was determined based on representative accessible viewpoints and field inspection. Table 6.11.2 indicates the relationship between land use and visual sensitivity levels.

[5] Visual sensitivity is a measure of how critically a change to the existing landscape is viewed by people from different land use areas in the vicinity of a development

Table 6.11.2 Relationship of land use and visual sensitivity levels

Land use	Visual sensitivity levels			
	Nearest visible elements less than 2.5km away	Nearest visible elements 2.5 – 7.5km away	Nearest visible elements 7.5 – 12.5km away	Nearest visible elements more than 12.5km away
Residential areas	High	High	Moderate	Low
Tourist areas	High	Moderate	Low	Low
Highway traffic	Moderate	Low	Low	Low
Local traffic	Moderate	Low	Low	Low
Rural lands	Low	Low	Low	Low

Visual impact methodology

Table 6.11.3 shows how the assessment of visual impact includes the consideration of sensitivity and effect to quantify what is considered a subjective matter. This method provides a reasonable basis from which possible impacts are determined and mitigation measures proposed.

Table 6.11.3 Visual impact methodology

Visual effect	Visual sensitivity		
	High	Moderate	Low
High	High visual impact	High to moderate visual impact	Moderate to Low visual impact
Moderate	High to moderate visual impact	Moderate visual impact	Moderate to Low visual impact
Low	Moderate to Low visual impact	Moderate to Low visual impact	Low visual impact

Relationship between the Proposal and visual setting

The VIA considered the relationship between the Proposal and the viewshed in which it would be seen. Potential representative viewing locations were identified as described in Section 6.11.1 and illustrated in Figure 6.11.1. The M1 to Raymond Terrace upgrade (M12RT) view was also addressed in terms of potential future cumulative impact.

In addition, four photographic montages were prepared from four of the viewpoints illustrating two optional power station technologies within the existing context. These viewpoints were:

- Viewpoint B: Pacific Highway looking east
- Viewpoint C: Pacific Highway looking southeast
- Viewpoint D: Pacific Highway looking south
- Viewpoint K: Kennington Drive looking north.

A copy of these photomontages is provided below with full size images available in Appendix M.

6.11.3 Potential impacts

The VIA considered the effect and sensitivity of the Proposal in the context of the landscape within which it would be visible. Visual sensitivity varies depending on the viewer, with residents and tourists likely to be more sensitive to a change to the landscape than workers and motorists. This relationship between land use and visual sensitivity which forms part of the impact assessment is described in Table 6.11.2. Of the nine viewpoints assessed in the VIA, two are considered to be residential (Viewpoint A and Viewpoint E).

The assessment of visual impact considers sensitivity and effect but does not include assessment of visibility. Factors that influence visibility include topography, vegetation, buildings, gardens, street trees, distance, timeframe and viewing angle. An assessment of visibility has been provided for each view point that places the visual impact in context with the actual view. Table 6.11.4 provides a summary of the visual impact rating from each of the viewing locations (Figure 6.11.1) with further discussion provided in the following sections.

Table 6.11.4 Potential visual impacts

Viewpoint	Location	Visual effect	Visual sensitivity	Visual impact
A	Oakfield Road (residential)	Low	Low	Low
B	Pacific Highway looking east	High	Moderate	High to Moderate
C	Pacific Highway looking south	High	Moderate	High to Moderate
D	Pacific Highway looking south	High	Moderate	High to Moderate
E	Hunter Region Botanic Gardens looking south (residential)	Low	High	Moderate
F	New England Highway heading south	Low	Low	Low
G	Old Punt Road heading south	Low	Moderate	Moderate to Low
H	Old Punt Road heading north	Low	Moderate	Moderate to Low
I	Kennington Drive looking north	Low	Moderate	Moderate to Low
M12RT*	M12RT interchange	High	Moderate	High to Moderate

* The proposed extension of the Pacific Motorway M1 to Raymond Terrace (M12RT) is in its planning stages This view cannot be definitively assessed as the M12RT has not yet been constructed nor design finalised; however, the potential impacts have assessed. Further details regarding the M1 to Raymond Terrace upgrade can be found on the Roads and Maritime website.

Viewpoint A - Oakfield Road

The Proposal would have a low visual effect at the Oakfield Road property as the Proposal would occupy less than 1% of the primary view shed. Given the locality is of a rural nature, the site would have a low visual sensitivity to change. The overall visual impact would be low. From this location the Proposal would be partially obstructed by proposed vegetation and the potential visual impact would be diminished by distance.

Viewpoint B, C, D - Pacific Highway

Visual sensitivity from the Pacific Highway is considered to be moderate from viewpoints directly adjacent to the Proposal area. As demonstrated in the photographic montages (Figure 6.11.11 to Figure 6.11.14), the Proposal requires clearing of existing vegetation which would make the Proposal visible to motorists using the Pacific Highway. As such, the overall visual impact is identified to be high to moderate. Proposed vegetation planting would assist in providing some screening from views adjacent to the proposed NPS site, however, it is recognised that the Proposal would be visible from these viewpoints. However, receivers in these locations would only be affected for short periods of time as they would be in transit.

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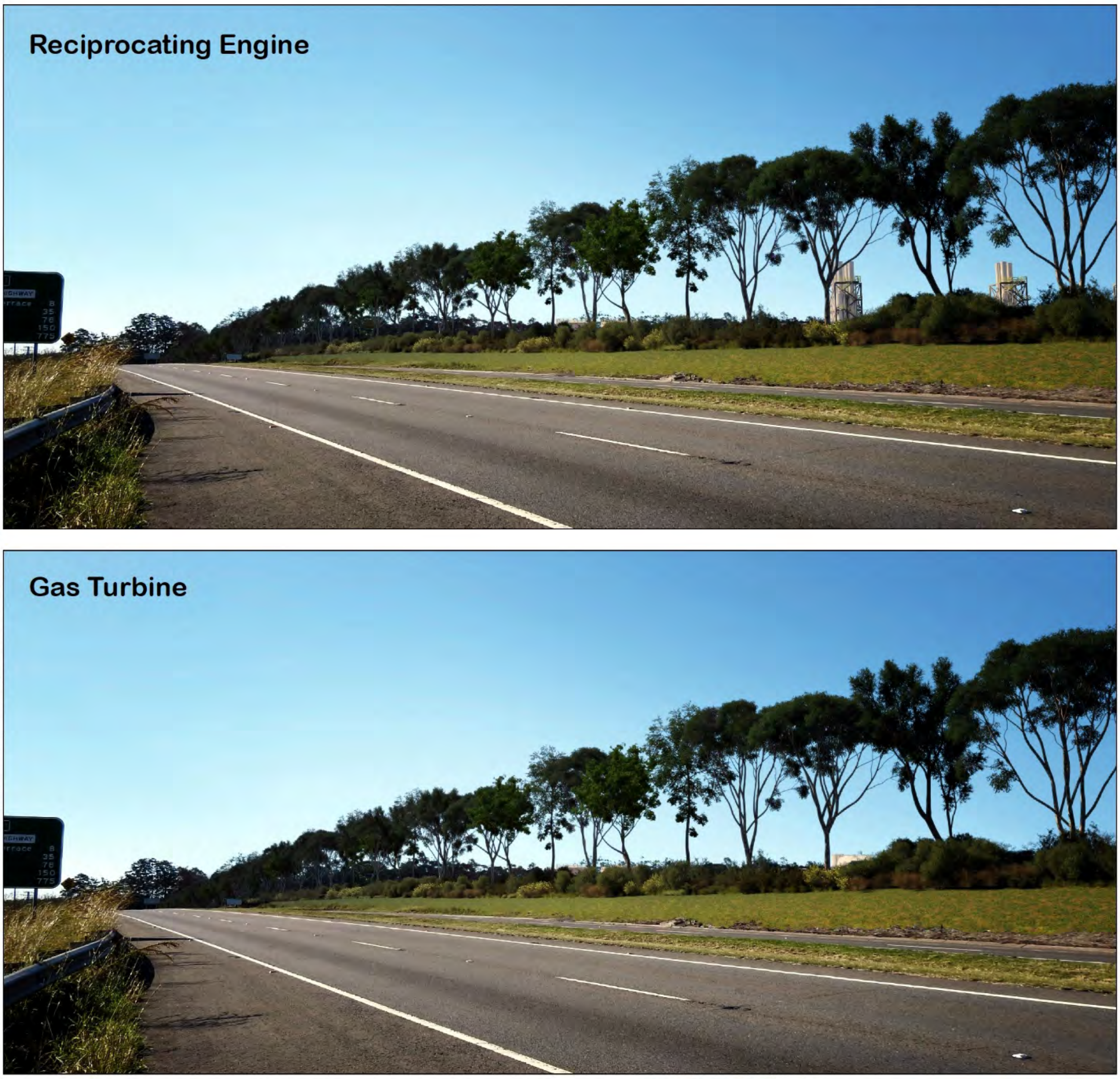

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NO SCALE

Newcastle Power Station **Environmental Impact Statement**

Figure 6.11.11 Photomontage viewpoint B

Figure 6.11.12 Photomontage viewpoint C

Figure 6.11.13 Photomontage viewpoint D

Viewpoint E - Hunter Region Botanic Gardens

The Proposal would have a low visual effect from the Hunter Region Botanic Gardens occupying less than 1% of the view shed. Visual sensitivity would be high, given the Hunter Region Botanic Gardens is less than 2.5km away and tourist use of the location; however, the Proposal would be somewhat obstructed from views by existing and proposed vegetation resulting in a moderate visual impact.

Viewpoint F - New England Highway

The New England Highway intersects the Pacific Highway at the Hunter River overbridge at Hexham. Motorists would view the Proposal when heading south; however, the view is likely to be fleeting given the distance to the site and the velocity of the traffic. The overall visual impact would be low and the Proposal would have a low visual effect, occupying less than 1% of primary viewshed.

Viewpoint G, H - Old Punt Road

The Proposal would have a low visual effect at the Old Punt Road location looking north and west, as it would occupy less than 1% of the primary view shed. As the nearest visible elements would be less than 2.5km away for local traffic, the visual sensitivity would be moderate. The Proposal would remain largely screened with existing vegetation resulting in a moderate to low overall visual impact.

Viewpoint I - Kennington Drive

The viewpoint from Kennington Drive would have a low visual effect as the Proposal would occupy less than 1% of the primary view shed. The nearest visible elements would be less than 2.5km away from local traffic and so the visual sensitivity is moderate. As illustrated in the photomontages in Figure 6.11.14, from this direction the power station would be obscured by existing vegetation. The overall visual impact is considered to be moderate to low.

M12RT

The proposed extension of the Pacific Motorway M1 to Raymond Terrace (M12RT) is in its planning stages and while the route has not been finalised, it would include an interchange with Old Punt Road with vehicles exiting to the west of the Proposal.

The Proposal would have a high to moderate visual impact on motorists exiting the proposed M12RT, as it would occupy more than 2.5% of their view. It should be noted that as motorists exit the M12RT they would have an unobstructed view of the existing Tomago industrial estate and TAC as well as of the Proposal.

Figure 6.11.14 Photomontage viewpoint I

Cumulative impacts

The VIA found that the visual impact would be moderate to low from most viewpoints, and it is therefore unlikely to contribute towards cumulative visual impacts from those locations. As the Proposal would be constructed near the proposed M12RT upgrade, when considered together, the cumulative impact on visual amenity may be substantial; however, at this point in time there is insufficient information available in regard to the upgrade to assess the degree of impact with a high degree of certainty.

The M12RT is likely to exhibit a high degree of contrast to the existing features of the visual setting and a low integration. It will dominate the view from the Pacific Highway and Oakfield Road location, occupying over 2.5% of the primary viewshed.

AGL and Roads and Maritime have consulted throughout the EIS preparation and will continue to consult through the detailed design and construction phases. The proposed power station would include landscaping and revegetation of disturbed areas which will reduce the contrast and improve the integration with the surrounding land, whilst M12RT upgrade will follow standard Roads and Maritime Practices to reduce contrast.

6.11.4 Avoidance, mitigation and management

A range of avoidance, mitigation and management measures would be implemented for visual amenity as outlined in Table 6.11.5.

Table 6.11.5 Avoidance, mitigation and management measures – Visual amenity

ID	Environmental Safeguard	Timing
VA-1	The power station design including all plant facilities such as diesel storage and operational and amenity buildings would be located insofar as is practical to reduce the requirement to clear vegetation and to reduce the angle from passing viewpoints.	Pre-construction
VA-2	A landscape design workshop would be considered to establish the means to minimise the visual impact and visibility of the Proposal. The workshop would assess the retention of trees, the planting of new and endemic vegetation, and viewpoint specific plantings to eliminate visual impacts from specific locations.	Pre-construction
VA-3	A site landscape plan would be prepared that emphasises integration of new plantings with existing vegetation and that includes opportunities to provide screen plantings. The landscape plan would include (but not limited to): ▪ Visual and ecological planting patterns of locally endemic species to emulate existing mixes of tree and grass cover in the surrounding landscape ▪ Installation of temporary screens to minimise exposure of construction areas from local viewpoints ▪ Specific plantings would be considered for screening the nearest residential receivers	Pre-construction Construction
VA-4	The power station design would seek to include the selection of visually sympathetic cladding and security fencing materials to reduce contrast and improve integration of the balance of plant and of the site as a whole.	Pre-construction
VA-5	The lighting design would be in accordance with AS4282-1997 Control of the obtrusive effects of outdoor lighting.	Pre-construction

ID	Environmental Safeguard	Timing
VA-6	The site-specific CEMP would include the following: ■ Where possible, lights would be used at the lowest effective level and would be directed downwards to the work area and away from incoming viewpoints ■ Construction lighting would be kept to a minimum necessary for safety and security needs and would not be directed in a manner so as to shine toward oncoming traffic on the Pacific Highway ■ Night works would be limited where possible to avoid areas that are exposed to direct views along Pacific Highway and workers will be trained in the management of night time lighting ■ Inspection and maintenance schedules of the following construction elements and mitigations for visual impacts: ■ Construction lighting direction ■ Temporary construction fencing and screening ■ Delineated no-go areas – Vegetation plantings and rehabilitation	Construction
VA-7	A site-specific OEMP will be prepared for the Proposal. The OEMP would include the following inspection requirements: ■ Inspection and maintenance of security lighting direction to ensure it is directed to the worksite and away from neighbouring land uses ■ Inspection and maintenance of security fencing to remove litter and graffiti ■ Inspection and maintenance of vegetation plantings and rehabilitation	Operation

6.12 Non-Aboriginal heritage

A non-Aboriginal Heritage Assessment (NAHA) was undertaken by Environmental Resources Management Australia Pty Ltd (ERM). The report is provided in Appendix N.

6.12.1 Existing environment

Background research identified a number of listed heritage items proximate to the Proposal area. These are shown in Table 6.12.1. Other items of historic heritage associated with early European settlement and industry were identified on the opposite side of the Hunter River to the west and south. None of the listed historical heritage items would be impacted by the Proposal.

Table 6.12.1 Listed heritage sites near Proposal area

Site name	LEP	Item # / register	Location	Distance from Proposal area
State listed heritage sites				
Tomago House and Tomago Chapel	Port Stephens	SHR #00207	421-3 Tomago Road	approximately 2.5km SE
Hexham Bridge over Hunter River	Newcastle	s.170 register	Pacific Highway, Hexham	approximately 2km SW
Tomago # 2 Spray Basin	Port Stephens	s.170 register	2034 Pacific Highway, Heatherbrae	approximately 1km N
Tomago # 8 Vacuum Pumping Station	Port Stephens	s.170 register	2034 Pacific Highway, Heatherbrae	approximately 1km N
Tomago Sands Scheme	Port Stephens	s.170 register	2034 Pacific Highway, Heatherbrae	approximately 1km N
LEP listed heritage sites				
Tomago House", including pinetum, pleasure garden and landscape setting	Port Stephens	I103	421 Tomago Road	approximately 2.5km SE
Tomago House Chapel	Port Stephens	I104	423 Tomago Road	approximately 2.5km SE
Hexham Bridge	Newcastle	I187	Pacific Highway, Hexham	approximately 2km SW

There are no registered or known non-Aboriginal heritage sites within or adjacent to the Proposal area. While there is some evidence of early agricultural activities, such as timber harvesting, fence lines, tracks, and evidence of rudimentary outbuildings in the Proposal area, the historic background suggests that the area was primarily used as grazing land.

A landform survey was carried out and classified the Proposal area as consisting of three landform types – mid slopes, lower slopes, and flats. The Proposal area was also divided into six survey units based on fencing and accessibility for ease of recording. The field survey team surveyed each of the different landforms identified to consistently cover all landforms across all survey units. The survey units are shown in Figure 6.12.1.

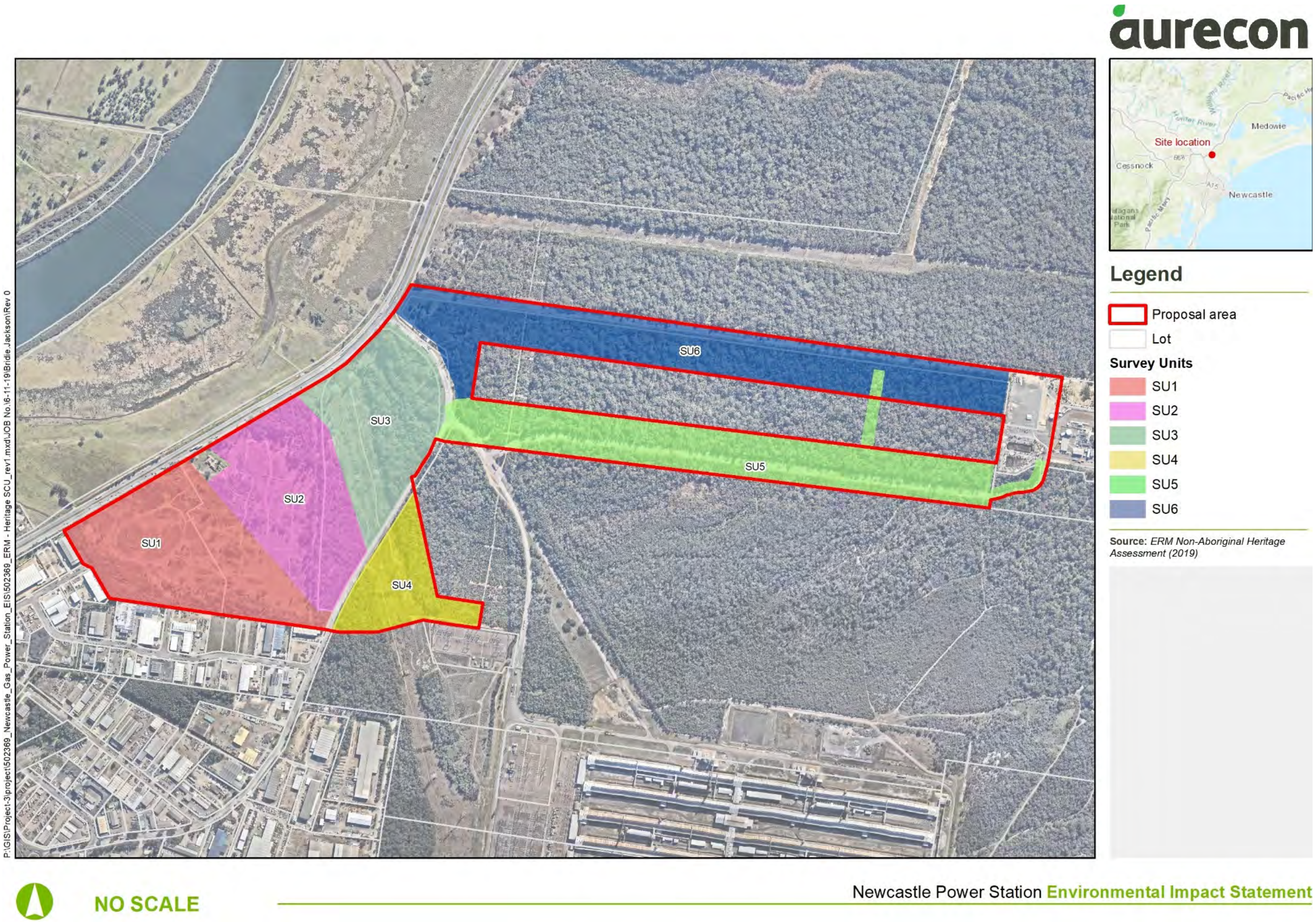

Figure 6.12.1 Non-Aboriginal Heritage assessment area and survey coverage units

During the field survey, ERM observed that the Proposal area consisted of highly disturbed grazing land or similar in Survey Units 1 and 2, while Units 3 to 6 are partially disturbed by existing infrastructure easements. Disturbance observed in Units 3 to 6 included fencing, tracks, roads, transmission infrastructure, and vegetation clearance.

Survey Unit 1

Survey unit 1 (SU1) is bordered by bush areas towards the eastern and southern boundaries. The largest part of SU1 has previously been cleared but had significant grass and weed regrowth. A disused road runs from north to south, just west of the eastern bush area. Tracks run from this road to a large circular track in the western portion of SU1 from which another track leads to a single dwelling in SU2. The tracks were generally free of vegetation except for grass plants.

No historic (non-Aboriginal) heritage features or items were identified in SU1.

	
Dense vegetation in SU1	Section of track in SU1 cleared of vegetation

Figure 6.12.2 Dense vegetation and section of the unused track in SU1

Survey Unit 2

Survey unit 2 (SU2) is bordered by mature bush towards the eastern border (Refer to Figure 6.12.3). As with SU1, the largest part of SU2 has not recently been cleared. Coverage included grass and weed species such as lantana and blackberry. The original Pacific Highway runs from north to south, just west of the south-eastern bush area, and a track runs from this to the dwelling located alongside the current Pacific Highway. The house is currently occupied and was not included in the survey. The tracks also have little or no ground visibility but are generally free of vegetation except for grasses.

No historic (non-Aboriginal) heritage features or items were identified in SU2.

	
Dense vegetation and sealed road in SU2	Ground visibility in SU2

Figure 6.12.3 Dense vegetation and ground visibility within SU2

Survey Unit 3

Survey Unit 3 (SU3) contains a large area of regrowth bush in the north and a power transmission corridor that transects SU3 from north to south-south west in the southern section of the survey unit (Refer to Figure 6.12.4). The transmission corridor has not recently been slashed and the occurrence of grass and weed species, such as lantana, blackberry as well as prickly pear was observed. A gravel maintenance track is associated with the transmission line as are modified drainage areas and areas of fill material. Dense vegetation was observed towards the north of SU3.

No historic (non-Aboriginal) heritage features or items were identified in SU3.

	
Transmission corridor within SU3	Maintenance track within SU3

Figure 6.12.4 Transmission corridor and maintenance track within SU3

Survey Unit 4

Survey Unit 4 (SU4) consists of two densely-vegetated bush areas towards the north and south of the survey unit and a transmission corridor that bisects SU4 from the north to south-south west. The transmission corridor has not been slashed for some time and grass and weed species such as lantana and blackberry dominate. A gravel maintenance track, modified drainage areas, and areas of fill material were also observed in SU4. Nesting boxes and new plantings were observed in the south-eastern corner. An electrical switching station is located to the south-east of SU4 outside the Proposal area. The northern and southern bush areas were populated with dense vegetation.

No historic (non-Aboriginal) heritage features or items were identified in SU4.

	
Vegetation planting in SU4	Northern bush area and nesting boxes in SU4

Figure 6.12.5 Vegetation planting and nesting boxes within SU4

Survey Unit 5

Survey Unit 5 (SU5) consists of a new sealed road running east to west, grassed road shoulders, and areas of remnant or mature regrowth bush further afield. These bush areas were populated with dense vegetation.

No historic (non-Aboriginal) heritage features or items were identified in SU5.

	
View of the road, east to west in SU5	Road shoulder in SU5

Figure 6.12.6 View of the road within SU5

Survey Unit 6

Survey Unit 6 (SU6) comprises a maintenance access road for the NGSF. The road runs from east to west and consists of grass road shoulders cleared to a width of approximately 25m. An area of remnant or mature regrowth bush area was observed either side of the road. This area was populated with dense vegetation, although it should be noted that only the southern portion is within the Proposal area.

No historic (non-Aboriginal) heritage features or items were identified in SU6.

	
View of the road towards the west in SU6	View of the road towards the east in SU6

Figure 6.12.7 View of the road within SU6

6.12.2 Study methods and criteria

The aims of the report were to:

- Identify non-Aboriginal heritage resources within the Proposal area, including archaeological and built values
- Evaluate the impact of the proposed works on the identified non-Aboriginal heritage resources
- Provide recommendations for the mitigation of impacts and management of the identified heritage resources

The report was also prepared to meet relevant SEARs and agency comments for the Proposal provided by DPIE on 18 February 2019.

The report is based on a background and desktop historic heritage review and a field survey carried out from 6-8 May 2019. The assessment was carried out across the Proposal area (Figure 6.12.1).

The assessment, background research, field survey and data analyses were undertaken in accordance with:

- The Australia International Council on Monuments and Sites, Charter for Places of Cultural Significance (also known as the Burra Charter, Australia ICOMOS 2013)
- Assessing Significance for Historical Archaeological Sites and 'Relics' (Heritage Branch, Department of Planning 2009)
- NSW Heritage Manual (Heritage Office 2006)
- Statements of Heritage Impact (NSW Heritage Office 2002)
- Assessing Heritage Significance (NSW Heritage Office 2001)

Background research

The background research method used to identify potential non-Aboriginal heritage values within the Proposal area comprised of a:

- Review of primary and secondary resources (heritage assessments, reports, publications, historical maps and aerial imagery for the local area)
- Review of historical heritage databases.

The review of the primary and secondary resources informed the Proposal area's history over time. Database searches to determine whether non-Aboriginal heritage sites are present within the Proposal area included:

- the Australian Heritage Database, which includes:
  - the Commonwealth Heritage List (CHL)
  - the Register of the National Estate (RNE)
  - the National Heritage List (NHL)
- the NSW State Heritage Register (SHR) and State Heritage Inventory (SHI)
- Port Stephens LEP 2013
- the National Trust of Australia (NSW)

The database searches were conducted on 13 May 2019.

Field survey

A field survey was carried out by a qualified archaeologist from 6 to 8 May 2019. The survey focused on all landform types within the Proposal area and targeted areas of soil exposures, zones with low vegetation where erosion occurred and any tracks or paths where possible historical features and objects could be found. The survey was undertaken on foot, traversing the Proposal area in transects of up to 5m where vegetation growth permitted.

The field survey methodology was adopted with the aim to discover new archaeological sites, take accurate recordings of such sites and provide sufficient information to provide an assessment of the Proposal area's historic (non-Aboriginal) heritage significance.

The Proposal area was examined in six survey units (SU1-SU6), based on fenced areas and accessibility for ease of recording and analysis, as depicted in Figure 6.12.1. Exposures associated with tracks and other disturbances such as fences, cleared areas and roads were examined for artefacts and features.

6.12.3 Potential impacts

Assessment of Heritage Significance

No non-Aboriginal heritage features or items were identified in the Proposal area and there was no evidence of structures or subsurface expressions identified during the survey. The desktop review did not identify any known historic heritage elements within the Proposal area.

It is considered unlikely that the Proposal area contains historic heritage values that reach the threshold for local or state historic heritage significance.

The historical archaeological potential of the Proposal area is very low.

Construction

Considering that the primary historical land-use of the Proposal area was likely grazing, that no previous historic heritage sites have been identified, and that no historic heritage items or sites were identified during the field survey in May 2019, it is very unlikely that the Proposal would have any impact on non-Aboriginal heritage.

It is therefore also very unlikely that the Proposal would have any serious and irreversible impacts on non-Aboriginal heritage.

Operation

There are not expected to be any non-Aboriginal heritage impacts from the operation of the Proposal.

Cumulative impacts

The Proposal doesn't have any non-Aboriginal heritage impacts and would not contribute to cumulative impacts to non-Aboriginal heritage in the region.

6.12.4 Avoidance, mitigation and management

The impact assessment demonstrated that it is very unlikely that the Proposal would have an impact on non-Aboriginal heritage. However, it is prudent to implement an unexpected heritage finds protocol as described in Table 6.12.2.

Table 6.12.2 Avoidance, mitigation and management measures – Non-Aboriginal heritage

ID	Environmental safeguards	Timing
NAH-1	If any heritage objects and/or relics are uncovered during the construction of the Proposal the following steps would be followed: ■ All activity in the immediate area would cease immediately ■ The project manager would be notified ■ Flagging or fencing would be erected to demarcate and protect the area ■ Site personnel and visitors would be advised to avoid the area until further notice ■ An appropriately qualified heritage professional would be consulted to confirm if the object/s is a heritage item or relic ■ The Office of Environment and Heritage (OEH) would be contacted ■ An appropriately qualified heritage professional would record the location and attributes of the site and determine the significance of the find Heritage objects and/or relics may include glass, ceramic, metal, building footings, and building materials etc., as protected under NSW legislation.	Construction
NAH-2	In the event of the discovery of human skeletal material (or suspected human skeletal material) during project activities in the Proposal area the following steps would most likely be followed: ■ All activities and/or works in the immediate area would cease ■ The NSW Police would be immediately contacted along with the project manager and OEH ■ Flagging or fencing would be erected to demarcate and protect the area ■ Site personnel and visitors would be advised to avoid the area until further notice ■ Any sand or soils removed from the near vicinity of the find would be identified and set aside for assessment by the investigating authorities	Construction

6.13 Electric and magnetic fields

Aurecon Australasia Pty Ltd was engaged to carry out an assessment of the electric and magnetic fields (EMF) resulting from electricity infrastructure. The EMF assessment is in Appendix O.

6.13.1 Existing environment

The EMF assessed the section of 132kV transmission line proposed between the NPS and the existing TransGrid 132kV switching station (Figure 6.13.1). The majority of this route is located on private industrial land or existing easements that is not readily accessible by the public. However, the transmission line would cross the publicly accessible Old Punt Road.

East of Old Punt Road, the transmission line would cross over or under existing transmission lines including TransGrid 132kV, 330kV and an Ausgrid 132kV near the Tomago switching station. Through this area, the proposed alignment is already subject to EMF.

6.13.2 Study methods and criteria

Operating electrical equipment would produce an electric field associated with the voltage and a magnetic field associated with the current. The possibility of adverse health effects due to EMF has been the subject of extensive research although, to date, adverse health effects have not been established. However, conversely, the possibility that they exist has not been ruled out.

The EMF assessment addressed the possible impacts on human health, assessed the compliance of anticipated field levels against relevant national and international guidelines, and provided precautionary and prudent avoidance principles. The assessment was undertaken along and within the corridor of the proposed 132kV line (the ‘proposed route’) (Figure 6.13.1).

Health criteria

The EMF assessment was undertaken in accordance with human health reference levels as summarised in Table 6.13.1. These levels were established in 2010 by the International Commission on Non-Ionising Radiation Protection (ICNIRP) and adopted by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). These criteria are independent of duration of exposure.

Table 6.13.1 ICNIRP Guideline reference levels (general public) for EMFs

Parameter	Reference level
Electric field	5,000 Volts per metre (V/m)
Magnetic field	2,000 milligauss (mG)

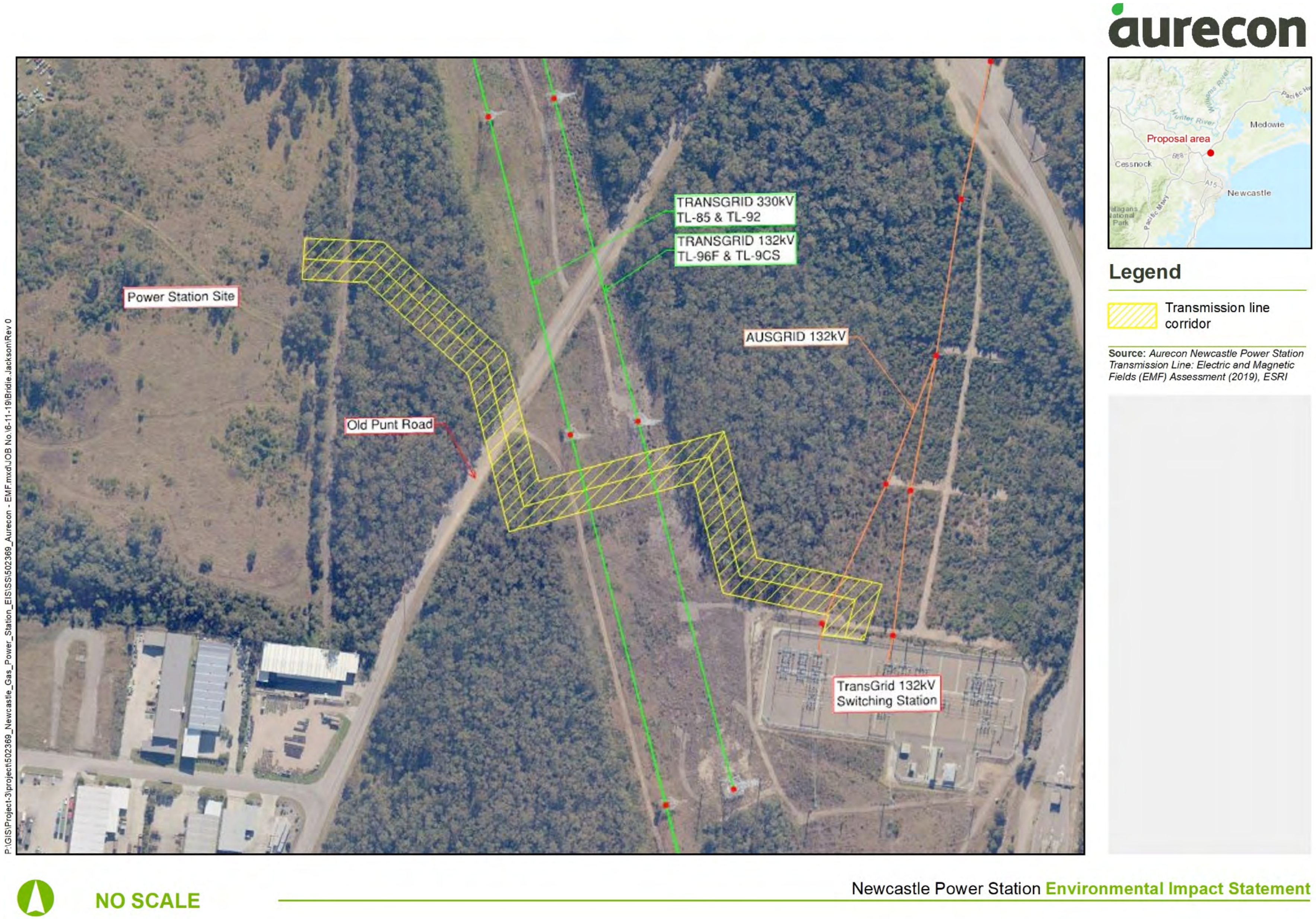

Figure 6.13.1 Proposed route of the 132kV line

Prudent avoidance criteria

A prudent or precautionary approach continues to be the most appropriate response to health concerns regarding EMF. Under this approach, the operators of electricity infrastructure are encouraged to design their facilities to reduce the intensity of the magnetic fields they generate and locate them to minimise the fields that people encounter over prolonged periods.

Study methods

Information

The information and input data on which the EMF assessment was based on the design of the proposed 132kV line and information from the owners of the existing lines. The information provided included the following:

- Design details of the proposed 132kV line structures
- Aerial views showing the relative locations of the proposed line and the adjacent existing 132kV and 330kV lines
- An indicative run-time profile for the power station for the peaking load (base case) and continuous operation (worst case)
- Generating capacity of the power station to be a nominal 250MW
- 12 months' records of loadings on in the existing 132kV and 330kV lines (provided by TransGrid and Ausgrid)
- Other electrical data regarding the various lines

Modelling approach

The following approach was adopted in undertaking the EMF assessment:

- The EMF was modelled in a series of load scenarios in 25% increments. This approach was chosen as the load cycle of a peaking plant differs from a conventional load, with the load being zero for much of the time and then stepping up progressively, at times to the maximum output.
- The predicted EMF levels associated with the various sections of the proposed route were modelled separately as follows:
  - The first span of line from the power station, where the conductors are in vertical configuration
  - The two spans of line which run parallel to the TransGrid easement, considering the configuration of the conductors on the proposed line and the contribution of the TransGrid lines
  - Within the existing easements where the proposed line under crosses the existing lines
- The intermittent nature of the power station's base case was factored into the overall assessment
- Electric fields are relatively constant over time, are readily shielded, and in the health context, are generally no longer associated with the same level of interest as magnetic fields. Accordingly, the magnetic fields were addressed in more detail in this assessment than electric fields.

A number of assumptions have been incorporated into the EMF modelling. These were:

- In calculating line currents, the reactive power requirements under the National Electricity Rules have been applied to derive a power factor of 0.93. This gives a line load of 269MVA.
- As the individual spans of the proposed 132kV line are short, the design minimum clearances have been adopted for modelling purposes[6]
- As much of the proposed line route is in proximity to existing lines, their interaction may influence the resulting fields. Material influences are reflected in the modelling results

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[6] This is a conservative (worst case) assumption.

- The loadings in the existing transmission lines have been taken as the time-weighted average values, derived from comprehensive load records provided by TransGrid and Ausgrid
- The influence of the Ausgrid 132kV lines exiting the 132kV switching station will not exceed the range of field levels in proximity to the TransGrid lines and need not be modelled separately

The loadings used for modelling are summarised in Table 6.13.2.

Table 6.13.2 Line loadings used for modelling

Line	Line load (MVA)	Corresponding amps
Proposed 132kV Line	269	1176
TransGrid 330kV SCN 95	253	443
TransGrid 330kV SCN 82	443	774
TransGrid 132kV SCN 9C5	10	43
TransGrid 132kV SCN 96F	13	55
Ausgrid 13 kV line	20	88

Field characterisation

The magnetic fields near the proposed 132kV line have been modelled using in-house software and public domain packages. The electric fields were estimated based on widespread measurements of similar lines over many years.

6.13.3 Potential impacts

Magnetic fields

The results of the magnetic field modelling are shown in the following figures for each span described Table 6.13.2. In all cases, the fields cited apply at a height of 1m above ground and the profiles are as seen by an observer looking along the line towards the proposed power station.

Figure 6.13.2 shows that the predicted magnetic field directly under the proposed 132kV line for the first span is 104mG, decreasing to 28mG at the edge of the proposed easement, 15m away in either direction.

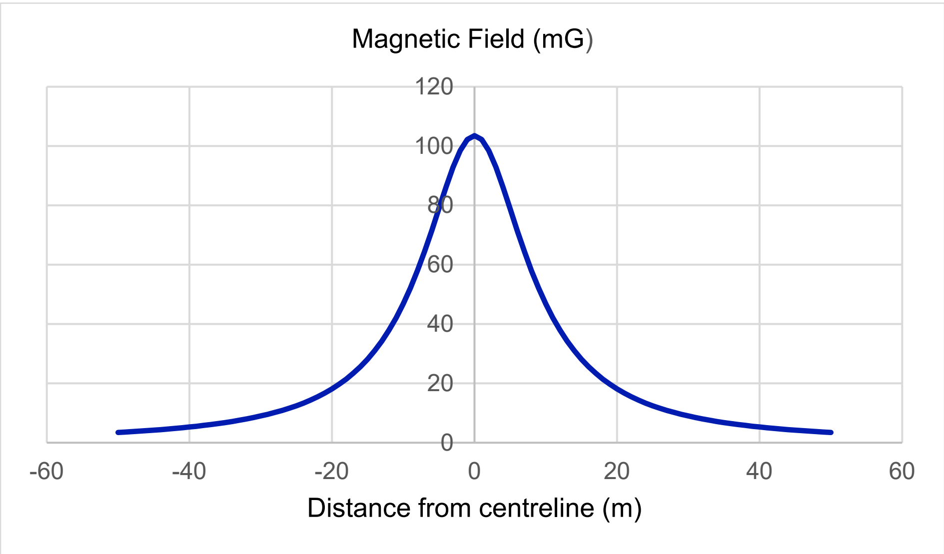


Figure 6.13.2 Calculated magnetic field profile for the first span

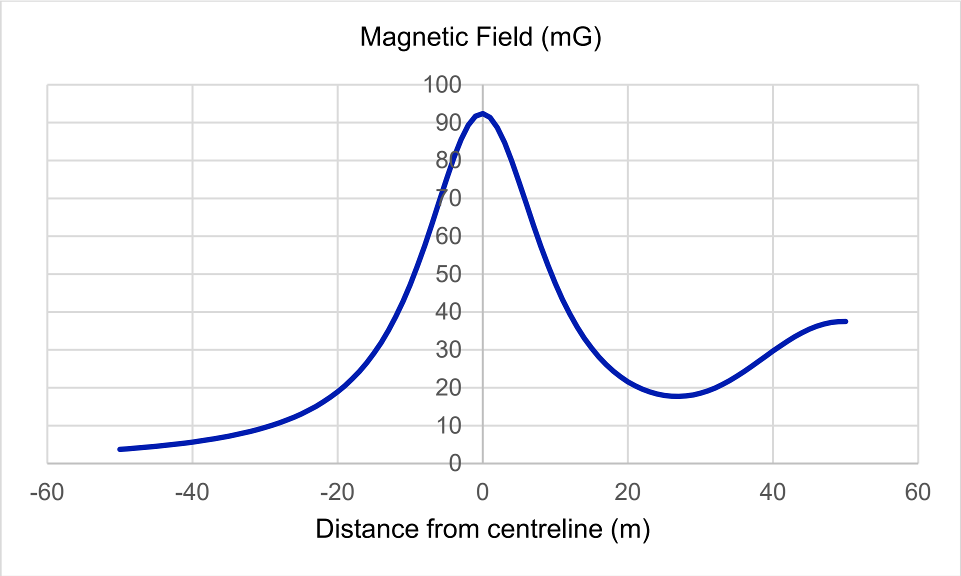


Figure 6.13.3 Calculated magnetic field profile – mid-span along western edge of TransGrid easement

For the mid span, the predicted magnetic field directly under the proposed 132kV line is 92mG, decreasing to 29mG at the edge of the proposed easement.

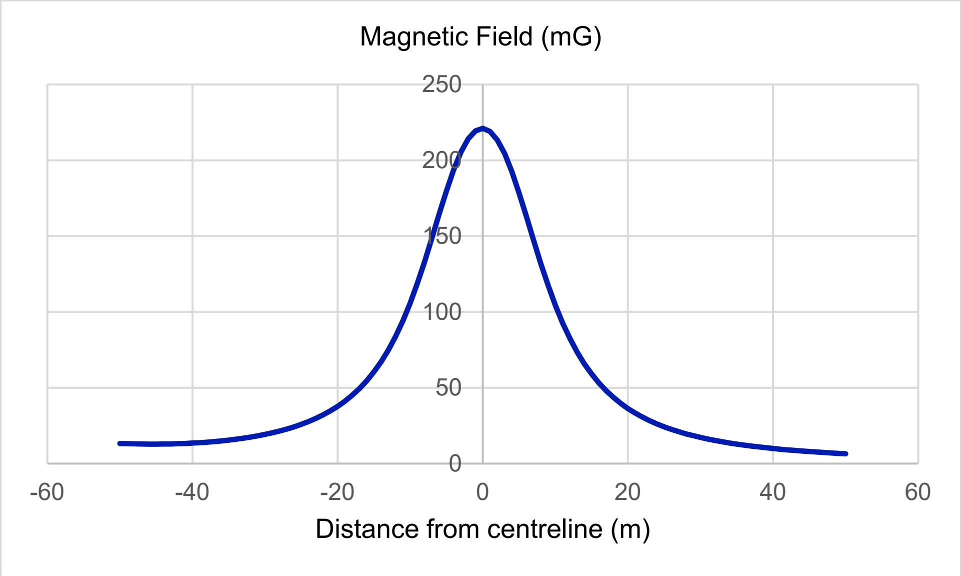


Figure 6.13.4 Calculated magnetic field profile – span along eastern edge of TransGrid easement

The predicted magnetic field along the eastern edge of the TransGrid easement is 221mG directly under the proposed 132kV line and 60mG at the edge of the proposed easement.

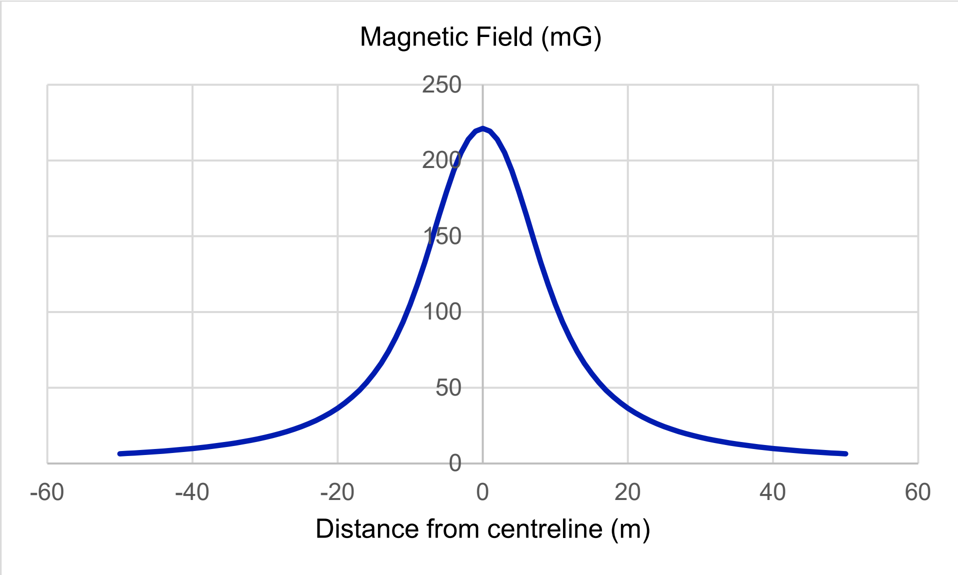


Figure 6.13.5 Calculated magnetic field contribution in span along northern edge of 132kV switching station and in undercrossing spans

The predicted magnetic field along the northern edge of the 132kV switching station and in the undercrossing spans is 219mG directly beneath the proposed 132kV line and 59mG at the edge of the proposed easement. This field would interact with the existing TransGrid and Ausgrid lines and would be higher in some parts of the undercrossing and lower in others.

The magnetic field associated with a typical electrical transmission line ranges from 10 to 200mG directly under the line and 2 to 50mG at the edge of the easement. For a typical residential distribution line, the magnetic field ranges from 2 to 30mG. A full list is provided in Table 4-1 of Appendix O.

When the NPS is generating, the predicted magnetic field contributions associated with the proposed 132kV line are at the upper end of those typically encountered around transmission lines. However, the proposed 132kV route is not in an area frequented by passers-by and the periodic operation further reduces to the likelihood of any sustained human interaction.

Electric fields

The electric field produced by a power line is dependent on the line's voltage, and the contribution of the existing 330kV lines to the overall electric field would be more significant than from the proposed 132kV lines. The existing electric field directly below the power transmission lines has been estimated at between 3000 and 4500 volts/metre (V/m) under the 330kV lines and between 1200 and 1800V/m under the existing 132kV lines. The electric field under the proposed 132kV lines has been estimated at between 1100 and 1500V/m, decreasing to 500V/m at the edge of the easement.

The proposed 132kV line would therefore not cause a significant increase to the existing electrical fields including where the proposed line crosses underneath the existing lines.

Health impacts

The highest contribution of the proposed 132kV line to the magnetic field environment is predicted to be within the ICNIRP Guideline Reference Level of 2,000mG individually or in combination with the existing transmission lines. With the Proposal in operation and at full load:

- The highest predicted magnetic field contribution directly beneath the proposed 132kV line would be 11% of the Reference Level
- The highest predicted magnetic field contribution at the edge of the proposed easement would be 3% of the Reference Level

- The highest predicted cumulative magnetic field at the proposed under crossings would be less than 15% of the Reference Level

The highest contribution of the proposed 132kV line to the electric field environment is predicted to be within the ICNIRP Guideline Reference Level of 25000V/m individually or in combination with the existing transmission lines. With the Proposal in operation and at full load:

- The highest predicted electric field contribution directly beneath the proposed 132kV line would be 30% of the Reference Level

Prudent avoidance principles

Under this approach designers would reduce the intensity of magnetic fields generated by electricity infrastructure and locate the infrastructure on sites where there is limited interaction with people, and particularly prolonged interaction.

The route of the proposed transmission line is approximately 570m, is already used for electricity infrastructure, and is not frequented by people other than by passing motorists.

It is unlikely that EMF generated by the Proposal either individually or in combination with the existing transmission lines would have an impact on human health.

Cumulative impacts

Cumulative impacts for EMF are highly localised and would occur where the proposed transmission lines are within close proximity to existing transmission lines. These cumulative impacts have been considered in the assessment above. The transmission line would cross the existing AGL and TransGrid transmission lines. In this location, there would be a cumulative electric and magnetic emissions. The assessment concluded that, at these locations, cumulative EMF would be below the ICNIRP Guideline Reference Level, directly under the lines (where EMF would be highest).

As EMF declines with distance from the Proposal, no cumulative impacts with surrounding infrastructure would occur.

6.13.4 Avoidance, mitigation and management

Given the proposed transmission line would be constructed in an area where there would be no prolonged human exposure, further technical measures aimed to reduce the magnetic fields generated by the Proposal are unnecessary.

6.14 Waste

An assessment of the potential waste generated during construction and operation of the Proposal was completed. The assessment provided a review of the types of wastes likely to be generated and described measures to manage, reduce, reuse, recycle and safely dispose of all identified waste streams. The assessment was informed by a Waste Management Strategy (WMS) (Appendix P).

6.14.1 Existing environment

Power station site

The NPS site would be located off Old Punt Road, Tomago, in Lot 3 DP 1043561 (Figure 1.2.2).

The NPS site and adjoining lot are both owned by AGL. The site is zoned IN1 – General Industrial under the Port Stephens LEP and is bounded by the Pacific Highway to the north and industrial buildings to the south. Access to the site is gained through Old Punt Road at the south eastern corner. Both lots have previously been used for agricultural purposes (grazing) and have been predominantly cleared of native vegetation with isolated patches of shrub and grass vegetation visible.

The NPS site has a single storey residential building in the north western corner which would be demolished during construction. An assessment of the hazardous materials inside the building and waste generation has not been completed at this stage as its use is still to be determined.

A site history assessment (as part of the WMS) identified that the eastern portion of Lot 3 DP 1043561 was used for heavy mineral sand mining between the 1970's and 1990's and has since primarily been used as an industrial buffer zone for the Tomago Aluminium smelter since 1981. As described in Section 6.6.1, 7 AECs exist on site (Figure 6.6.6). Of these, one AEC is classified as 'dumped waste', which may contain PAHs.

Illegal dumping locations were found during a site walk on 25 March 2019 which identified items such as fill containing shale, brick and asphalt, cement sheeting, tyres, paint cans and car parts. An estimate in the quantity of existing waste at the site is approximately less than 100kg of paint waste and 10t of demolition waste.

Utilities investigation areas

The proposed gas pipeline/s corridor and electricity transmission line would be located between the proposed NPS site to the west and the existing NGSF and TransGrid Tomago 132kV switchyard to the east (Figure 1.2.2). The investigation areas have predominately native vegetation with previous clearing only existing in areas required for transmission line or road and access way easements. Land within the utilities investigation areas is zoned IN1- General Industrial under the current Port Stephens LEP. There are no dwellings in the investigation areas.

6.14.2 Study methods and criteria

Relevant policies and guidelines

The WMS was prepared in accordance with relevant legislation, policies and guidelines that are applicable to the activities likely to generate waste as part of the Proposal.

In NSW, the primary regulator of waste management and recycling is the NSW EPA, who manage the transport and disposal of hazardous waste and work with industry to find sustainable solutions to minimise the amount of waste going to landfill. The NSW EPA enforce the following relevant acts and regulations to govern waste management:

- POEO Act
- Protection of the Environment Operations (Waste) Regulation 2014
- *Contaminated Land Management Act 1997*
- *Waste Avoidance and Resource Recovery Act 2001*
- *National Environment Protection Council (New South Wales) Act 1995*
- *Environmentally Hazardous Chemicals Act 1985*
- *Pesticides Act 1999*
- *Radiation Control Act 1990*
- *Dangerous Goods (Road and Rail Transport) Act 2008*

In addition, the NSW EPA Waste Classification Guidelines (2014) and the NSW Waste Strategy (2019) were also considered in the development of the WMS.

Waste assessment

The WMS assessed the potential waste streams generated by the construction and operation of the Proposal. The WMS included site investigations and a review of the findings of the Newcastle Power Station Soils and Contamination Specialist Study (Appendix I).

The WMS assessment was based on the waste management hierarchy which follows a sustainable waste management methodology with the aim of reducing waste at all stages of construction and operation. The hierarchy comprises:

- Prevention: Preventing the use of materials and products should be the first point of action when considering reducing waste through introducing management tools or innovative solutions to avoid the use of materials
- Reuse: If materials cannot be prevented from being used, they should be collected and re-used through cleaning, repairing or re-furbishing parts to ensure the quality of the item for re-use
- Recycling: Once a material has reached the end of its lifecycle, materials or products should be sorted and recycled appropriately
- Recovery: Waste recovery can be separated into the recovery of materials and the recovery of energy. Materials or energy can be recovered and is generally done in consideration of environment and human health factors.
- Disposal: Disposal should be considered as a last resort when all other opportunities have been explored

Applying this hierarchy, the WMS identified waste types that are likely to be generated during the construction or operation of the Proposal. Waste types were classified into categories as described within the NSW EPA Waste Classification Guidelines (Table 6.14.1).

Table 6.14.1 NSW EPA waste classification guidelines

Waste classification	Waste definition
Special	Includes waste that has unique regulatory requirements such as asbestos or tyres and includes anything classified as special waste under an EPA gazettal notice.
Liquid	Waste (excluding special waste) that has an angle of repose of less than 5 degrees above horizontal, becomes free-flowing at or below 60ºC or when it is transported, is generally not capable of being picked up by a spade or shovel or is classified as liquid waste under an EPA gazettal notice.
Hazardous	Hazardous waste (other than special waste or liquid waste) includes waste that is a dangerous good that is classified under the Transport of Dangerous Goods Code as a 'Class 1' to 'Class 8' type of waste. It can also include coal tar or coal tar pitch waste, lead-acid or nickel-cadmium batteries lead paint waste or any mixture containing one of these types of wastes.
General solid waste – putrescible (GSWp)	GSWp waste (other than special waste, liquid waste, hazardous waste or restricted solid waste) includes standard household and litter bins waste that is collected by or on behalf of local councils, food waste, animal waste, manure and night soil and any grit of screening from sewage treatment systems.
General solid waste – non-putrescible (GSWnp)	GSWnp waste (other than special waste, liquid waste, hazardous waste, restricted solid waste or GSWp) includes household recyclable waste that does not contain food waste, garden waste, wood waste, waste that was previously in dangerous containers that have been thoroughly cleaned out, virgin excavated material and building and demolition waste.

6.14.3 Potential impacts

Construction

Construction of the Proposal would result in the generation of waste through the following construction activities:

- Clearing of vegetation at the proposed power station site and as required along the electrical transmission and gas pipeline easements
- Demolition of the existing house
- Trenching and horizontal directional drilling as required to install gas pipeline/s
- Installation of gas pipeline/s and electrical transmission line infrastructure
- Earthworks to prepare the power station site and construction areas
- Installation of foundations and underground services
- Installation of above ground civil, mechanical and electrical plant and equipment

Construction activities that are likely to generate the waste streams have been identified and classified in Table 6.14.2. The amounts estimated are based on the entire construction period for the Proposal, excluding food waste which is based per week on peak construction workforce.

Table 6.14.2 Proposal construction waste likely to be generated

Waste classification	Waste identified	Waste description	Estimated quantity
Special	Asbestos waste	Demolition of existing buildings containing asbestos (if found during assessment).	~ 6t
Liquid	Contaminated water	Water encountered during construction (e.g. from runoff or groundwater accumulating in excavations) which is unable to be treated within discharge criteria Wastewater from construction processes not suitable for discharge Oily drains collected from bunds and workshops, chemical drains, spills.	Unknown
	Sewage	Septic tank discharge	~10ML
Hazardous	Fuels, lubricants and chemicals (including AEC 5)	Containers that previously contained Class 1, 3, 4, 5 or 8 substances used for construction plant.	~ 2t
	Waste oils	Used oil from construction plant.	~ 200kg
GSWnp	Excavated Natural Material (ENM)	Earthworks spoil and drilling mud from trenching and HDD as required to install gas pipeline/s. Earthworks spoil to prepare the power station site and construction areas.	~ 24,473t
	Green waste	Clearing of vegetation at the proposed NPS site and as required along the electrical transmission and gas pipeline/s easements.	~ 31,223t
	Demolition waste	Demolition of existing buildings (not containing asbestos).	~ 756t
	Construction waste	Timber, packaging, metal, asphalt, concrete, glass, plastic, rubber, plasterboard, ceramics, bricks from the installation of foundations and underground services and above ground civil, mechanical and electrical plant and equipment.	~ 50t
	Construction plant waste	Drained oil filters and motor oil containers.	~ 500kg
	Grit, sediment, litter and gross pollutants	Collected in, and removed from, stormwater treatment devices and/or stormwater management systems.	~ 8t
	Hydrocarbon contaminated soils	Oil spills from construction plant.	~ 250kg
	Site office waste	Paper, cardboard.	
GSWp	Food waste	Generated from worker's lunches.	~ 825kg /week*

* The indicative level of site personnel and the duration required for construction (peak, average) for a 65-week construction schedule is an average range of 80-100 personnel, with the peak being approximately 300 personnel. The average waste generation rate is 0.5kg per person per day (National Waste Report 2013, 7 May 2019).

Potential impacts to the existing environment may result from excessive waste generation from the inefficient use of resources or from the improper management of wastes generated during the construction. These impacts may include:

- Generation of green waste which requires treatment or disposal

- Reduction in space in local landfills resulting in increased need for travel or filling other landfills
- Controlled or accidental release of waste (including oil, fuel or chemical spills) causing contamination of air, land, surface or ground water
- Generation of inert construction and demolition wastes requiring treatment or disposal
- Excessive use of natural resources
- Generation of virgin excavated natural material (VENM) requiring reuse or disposal
- Generation of hazardous liquid wastes requiring treatment or disposal

Operation

Operation of the Proposal would also result in the generation of both solid and liquid waste from the following activities:

- Operation of the proposed power station
- Operation of the proposed gas compressor units
- Storage tanks
- Process water management infrastructure including pond/s
- Diesel storage and truck unloading facilities
- Office/administration, amenities, workshop/storage areas

Operation of the Proposal would likely result in the generation of solid waste that is captured either from the air pollution environmental controls or chemical wastes (including scale, sludge and scrapings from the generator, tanks and pipelines). Pollutants that are emitted and captured through air controls are SO_2, NO_x, and particulate matter ($PM_{2.5}$ and PM_{10}). These pollutants are discussed in greater detail in Section 6.5. Other wastes that are likely to be generated during operation of the proposed power station are described in Table 6.14.3.

Most liquid waste from the operation of the Proposal would be managed as wastewater. AGL has been in consultation with HWC regarding disposal of wastewater generated during operation of the Proposal. HWC has indicated that they are able to accept and treat the wastewater generated by the Proposal at their existing wastewater treatment facilities in the Hunter region or would create additional capacity should this be required. Wastewater volumes and quantities would be influenced by the chosen technology, which is subject to further contractor involvement and detailed design. Regardless, the worst case estimates for wastewater volumes generated during operation of the Proposal (Table 6.14.3) represent a fraction of the wastewater which is currently processed at the existing wastewater treatment facilities near the Proposal, including the Raymond Terrace Wastewater Treatment Works which currently treats 7.3mL/day.

Table 6.14.3 Expected operational waste streams

Activity/ area of waste generation	Description of waste	Waste classification	Estimated quantity per year
Workshop	Tyres	Special	~ 2t
	Oil water separator waste, solvents, wash waste, ethylene glycol	Liquid	~ 500kg
	Oils, grease, and fuel containers, acid containers, batteries	Hazardous	~ 600kg
	Scrap metal, packaging	GSWnp	~ 1.5t
On site fuel storage/management	Above and underground gas and oil tanks and pipes, fuel spills, pipe leaks	Hazardous	~ 4t

Activity/ area of waste generation	Description of waste	Waste classification	Estimated quantity per year
Use of equipment/plant	Hydrocarbons, empty cylinders, empty containers	Hazardous	~ 10t
Water treatment plant (demineralisation) Wash water Auxiliary cooling water system	Process wastewater which would range in viscosity from sludge to water, and therefore would range in water quality and salinity. The water may require pH treatment due to the use of acid or caustic in the demineralisation process. The process water volume would be influenced by the engine technology installed and the rates of evaporation achieved during temporary storage in the process water ponds. A worst case volume has been assessed in this EIS	Liquid	~ 25t
Septic tank	Septic tank discharge	Liquid	~ 0.5mL
Incidental spills	Oily drains collected from bunds and workshops, chemical drains, spills	Liquid	Negligible
Stormwater controls	Grit, sediment, litter and gross pollutants	GSWnp	~ 8t
Landscaping	Green waste, grass cuttings etc.	GSWnp	~ 40t
Power station equipment	Generators, turbines, boilers, precipitators, pumps	Liquid GSWnp	~ 80t
Transmission and distribution equipment	Cables, wiring, poles, transmission towers	GSWnp	~ 20t
Power electronics	Inverters, transformers	Liquid Hazardous GSWnp	~ 850kg
Recyclable/salvageable wastes	Steel, copper, brick, concrete	GSWnp	~ 1t
Office	Paper, cardboard, plastic, E-waste, light bulbs, cleaning chemicals	Hazardous GSWnp	~ 1,820kg*
	Food waste	GSWp	

* Based on the anticipated General Solid Waste (combined non-putrescible and putrescible) generation for approximately 23 persons on rotating shifts and routine maintenance estimated in the order of 35kg per week.

Table 6.14.4 below lists additional materials that are likely to be used on site that are defined as hazardous either under the Waste Classification Guidelines or the *Hazardous Waste (Regulation of Exports and Imports) Act 1989* that have been considered in the WMS as requiring management or specific disposal requirements.

Table 6.14.4 Potentially hazardous waste from chemicals used on site

Waste chemical	Area of waste generation	Classification (Australian Dangerous Goods Code)	Estimated quantity per year
Sulphuric Acid	Demineraliser resin for regeneration and neutralization in the water treatment plant	8	~ 10kg
Hydrochloric acid (HCl)	Water treatment plant	8	~ 10kg
Caustic (e.g. NaOH)	Demineraliser resin regeneration and neutralization water treatment plant	8	~ 10kg
Turbine Oils	Lubrication of turbines and pumps	6	~ 10kg
Hydraulic Fluid	Steam turbine lubrication	6	~ 10kg
Diesel	Workshop	6	~ 100kg
Hydrazine (H_{2N4})	Water treatment plant	6	~ 10kg
Ammonia (NH_3)	Water treatment plant	8	~ 10kg
Trisodium Phosphate ($Na_3 PO_4$)	Water treatment plant	8	~ 10kg
Ethylene Glycol	Workshop	6	~ 10kg
Solvents	Water treatment plant	3	~ 10kg
Urea	Used to reduce flue gas No_x levels in reciprocating engines	-	~ 10kg

Potential impacts to the existing environment which may occur from improper management of wastes include:

- Generation of hazardous liquid or materials waste requiring treatment or disposal
- Reduction on local landfill airspace
- Release of waste (controlled or uncontrolled) causing contamination of air, land, surface or groundwater
- Generation of oily or liquid wastes requiring treatment or disposal
- Generation of general office type recyclable materials requiring treatment or disposal
- Generation of putrescible waste requiring treatment or disposal
- Increase in vermin and pests
- Excessive use of natural resources
- Generation of tyres requiring disposal
- Generation of maintenance wastes (scale, sludge, and scrapings removed from the generator, tanks, and pipelines) requiring treatment or disposal

Cumulative impacts

The Proposal would generate waste during construction and operation. The waste would be appropriately handled and transported offsite for disposal at a licenced facility, including wastes with potential contaminants and pollutants. Assuming similar processes would occur at nearby projects or facilities, there is not expected to be excessive waste generated that would stretch the regional landfills or waste facilities. The Proposal would appropriately treat or dispose of all wastes as part of their operations and any relevant licences. The Proposal is also not expected to impact the environment on site or locally from waste generation.

6.14.4 Avoidance, mitigation and management

The following mitigation measures would be implemented to address the potential waste management impacts (Table 6.14.5).

Table 6.14.5 Avoidance, mitigation and management - Waste

ID	Environmental safeguards	Timing
WR-1	Appropriate construction and demolition waste storage and disposal methods would be completed in accordance with the CEMP and Protection of the Environment Operations Act 1997 during possible demolition of the onsite property. This aims to reduce any transportation of harmful contaminant via surface water run-off into the surrounding waterway systems.	Construction
WR-2	A Construction Waste Management Plan (CWMP) and Operational Waste Management Plan (OWMP) would be developed and implemented prior to each stage. The plans would be developed with the following criteria: ■ A hierarchical waste management approach would be used, from the most preferable (reduce, reuse or recycle wastes) to the lease preferable (disposal) to prioritise waste management strategies to avoid waste generation ■ The CWMP and OWMP would be developed in accordance with the mitigation strategies described in the WSM which provides avoidance, mitigation, reuse, recycle or disposal methods for each waste stream identified in the NPS ■ The plans would promote the use of materials with minimal packaging requirements, removal of packaging offsite by suppliers and fabrication of parts offsite ■ Where waste cannot be avoided, waste materials would be segregated by type for collection and removal (for processing or disposal) by licensed contractors ■ All waste types would be separated at source for recycling and apply a system of colour-coded waste storage containers to ensure the segregation of waste is affected as far as possible ■ A licensed service provider would be appointed to collect general solid waste and hazardous waste during construction and operation ■ Each waste type would be classified for transport to ensure correct handling Any waste that cannot be recovered or recycled would need to go to a licensed treatment or disposal facility where it would will be treated and disposed of according to its classification.	Construction Operation
WR-3	An audit regime would be implemented, in accordance with the AGL Health and Safety Environmental Management System (HSEMS) during construction and operation which includes (but not limited to) quantities of waste, storage areas and contractor services.	Construction Operation
WR-4	Spoil that can be beneficially reused would be done so in accordance with the project spoil re-use hierarchy.	Construction
WR-5	Ongoing consultation would be required between AGL and HWC regarding the arrangement for the disposal of wastewater.	Construction Operation

Hazard and risk analysis

7 Hazard and risk analysis

7.1 Plume rise and aviation hazard

This assessment identifies the potential aviation impacts of plume rise and structural obstructions during construction and operation and provides mitigation measures to address these impacts.

A Plume Rise Assessment (PRA) was undertaken by ERM Australia Pacific Pty Ltd (ERM) to determine the extent of emission plumes generated by the Proposal. The PRA is provided in Appendix Q. The Proposal has the potential to emit exhaust into the atmosphere at velocities and heights of interest to aviation operations. The potential plume rise extent has been investigated in accordance with methods prescribed by the Civil Aviation Safety Authority (CASA) to meet CASA and Airservices Australia requirements.

7.1.1 Existing environment

The Proposal would be located off Old Punt Road at Tomago, in an area that contains a number of industrial premises such as the NGSF and the TAC smelter. The NGSF was approved in 2012 following submission of an EIS that included a plume rise assessment. In the case of the NGSF, the assessment found that the plume rise for the sour gas flare and the two vaporisation stacks would fall below the critical velocity within a second of being released and that the critical vertical plume velocity of the flare operating under start-up / shutdown and emergency conditions was less that the Obstacle Limitation Surface (OLS).

The proposed power station would be located approximately 10 kilometres west of Newcastle Airport and the co-located RAAF Base Williamtown (Figure 7.1.1). Newcastle Airport serves a total catchment area of around 1.1 million people, and in 2017, the most recent year for when statistics have been published, more than 1.2 million passengers used its services. The average number of flights is 418 movements per week. Newcastle Airport maintains an airfield curfew from 10:00pm to 6:00am daily for civilian aircraft movements.

Normal flying operations for RAAF Base Williamtown are from 8:00am to 10:00pm Australian Eastern Standard Time (AEST) and up to 11:00pm during Australian Eastern Daylight Time (AEDT). Night flying can be conducted at Salt Ash Air Weapons Range (SAAWR) until 9:00pm AEST and 10.30pm AEDT. The average number of military aircraft movements is 285 per week.

7.1.2 Study methods and criteria

Criteria

Plume rise

Aviation authorities in Australia have determined that exhaust plumes that rise at a velocity greater than 4.3m/s have the capacity to damage aircraft or impact their stability. Part 139.370 of the Civil Aviation Safety Regulations 1998 prescribes CASA as the regulatory authority charged with determining whether a plume is a hazardous object if it exceeds that velocity.

CASA has provided guidance and requirements for plume rise assessments in Advisory Circular AC 139-05 v3.0, Guidelines for Conducting Plume Rise Assessments (CASA, 2004) and Plume Rise Assessment – Technical Brief (CASA, 2013a).

CASA 2004 describes the assessment of critical plume velocity (CPV) and critical plume height (CPH) to determine plume impacts. In January 2019 CASA released guidance that a CPV of 6.1m/s may be considered the default value for analysis of plume impacts (CASA, 2019). CASA has also provided guidance that vertical wind gusts in excess of 10.6m/s may result in turbulence sufficient to cause momentary loss of aircraft control.

CASA 2019 describes CPVs as:

- Light (1.5 – 6.1m/s) – can cause momentary changes in altitude and attitude
- Moderate (> 6.1 – 10.6m/s) – can cause appreciable changes in altitude and attitude
- Severe (>10.6m/s – 15.2m/s) – can cause large abrupt changes in altitude and attitude and momentary loss of control
- Extreme (> 15.2m/s) – can be practically impossible to control the aircraft, and which can cause structural damage

CASA, 2013a describes the method to determine the CPH as requiring:

- Site-specific meteorology
- A five-year assessment period
- Use of TAPM Version 4 (or later) or CALPUFF Version 6.267 (or later)
- Use of Manins (1992) to account multiple plumes
- Determination of the 0.1% exceedance level for each of the five years of modelling
- Determination of the maximum extent of the plume for each of the five years

The PRA in Appendix Q has assessed the Proposal against CPVs of 4.3, 6.1, and 10.6m/s, and follows the method described in CASA, 2013a to determine CPH.

Structural obstructions

CASA has provided guidance and requirements for the erection of tall structures in the vicinity of Newcastle Airport and the RAAF Base Williamtown. The A*C 139-08(0) – CASA Advisory Circular – Reporting of Tall Structures* (CASA, 2013b) outlines that approval must be granted by CASA for the following:

- All proposed permanent structures exceeding 30m AHD within a 15km radius from Newcastle Airport
- All cranes and any tall temporary structures exceeding 30m above ground level within a 15km radius from Newcastle Airport

Figure 7.1.1 Proximity to Newcastle Airport

Methodology

Plume rise modelling was carried out using the TAPM V4.05. The model was run in meteorological mode to provide five years (2014 to 2018 inclusive) of hourly surface temperature estimates at the Proposal area. The assessment was undertaken using conservatively constructed modelling scenarios for the following technology options:

- Gas turbine generator
- Reciprocating engine generator

The analysis was conducted for a worst case scenario i.e. the continuous operation of all proposed generation units at full load throughout all hours within a five year (43,824 hour) modelling period.

Vendor specifications for a range of gas turbine and reciprocating engine options were screened to determine one gas turbine and one reciprocating engine option as representative of the scale of potential CPV and CPH.

Exhaust temperatures over time were calculated using surface temperatures and supplied vendor specifications. Maximum exit velocities used in the model were representative of the design capacity of each.

The Obstacle Limitation Surface (OLS) for RAAF Base Williamtown was provided through Department of Defence. A Procedure for Air Navigation Services – Aircraft Operations (PANS OPS) was not available for the assessment.

For context, the Proposal would be located approximately 6 nautical miles WSW of the western extent of the RAAF Base Williamtown runway. Figure 7.1.2 shows the Proposal location relative to the RAAF Base Williamtown on a non-spatially referenced schematic of the OLS.

Site specific spatial information used in the analysis is shown in Table 7.1.1.

Table 7.1.1 Plume rise analysis spatial information

Parameter	Value		Units
Plant easting*	378 986		m MGA94 Zone 56 H
Plant northing*	6368 609		
Base elevation**	15**		mAHD
OLS height	156.5		
PANS-OPS height	-		
	Gas Turbine	**Reciprocating Engine**	
Height of exhaust stack**	20	30	mAGL
Top of exhaust stack**	35	45	mAHD

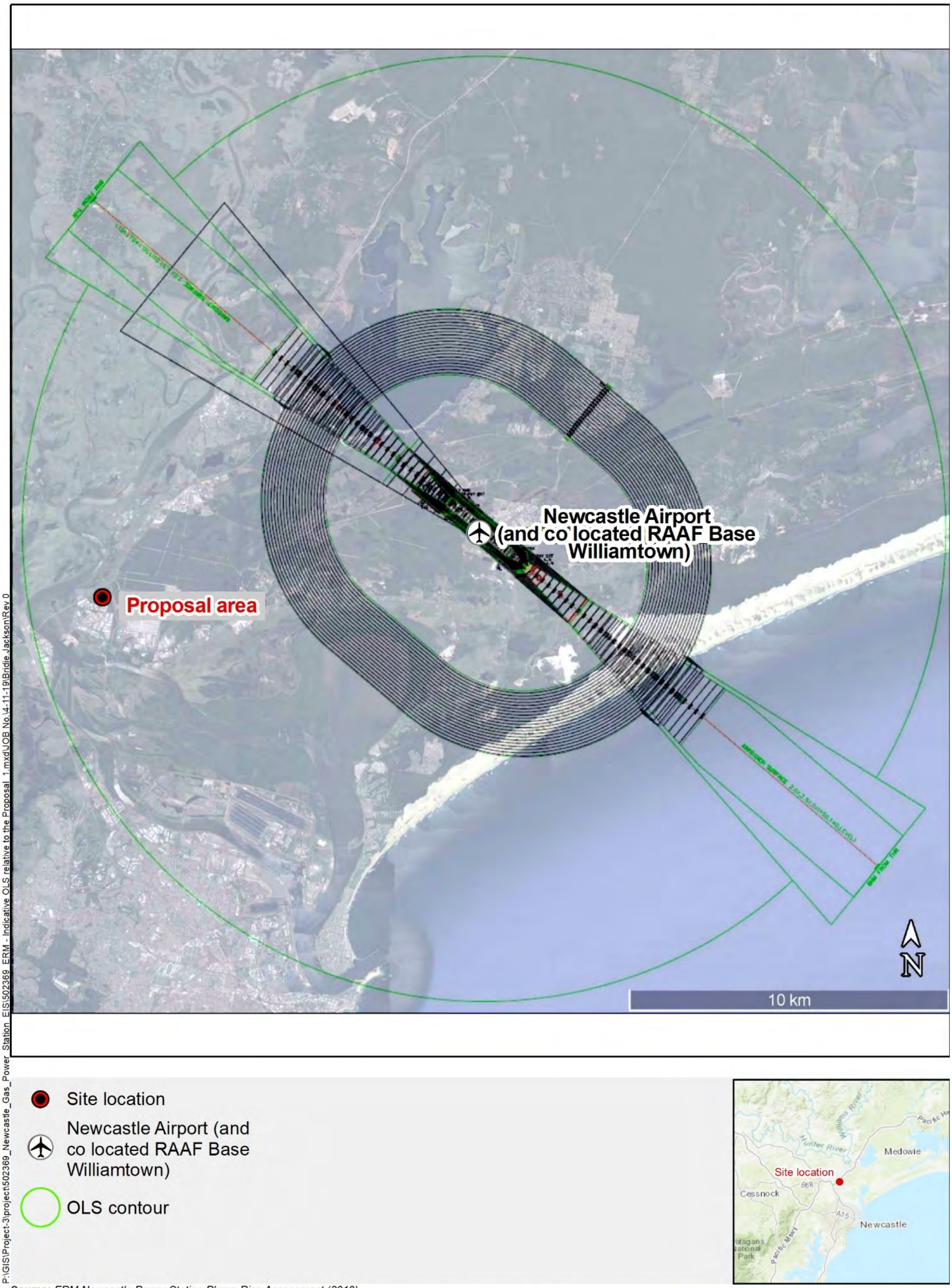
*Values represent approximate centre of generator yard (based on preliminary design).

**Approximate values provided (based on preliminary design).

mAGL (metres elevation – Above Ground Level).

mAHD (metres elevation – Australian Height Datum).

aurecon



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Source: *ERM Newcastle Power Station Plume Rise Assessment (2019)*

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NO SCALE

Figure 7.1.2 Indicative RAAF Base Williamtown OLS relative to the Proposal

When multiple plumes are sited in proximity to one another they can overlap and interact, resulting in plume rise enhancement. This process and the calculations required to determine plume rise enhancement for gas turbines and reciprocating engine generators are fully described in Appendix Q. Modelling was run to generate five years of hourly plume rise profiles for a single stack, and Manins methodology applied to determine the buoyancy effect of multiple plumes. The plume rise model was re-run to generate five years of hourly plume rise profiles inclusive of buoyancy. The modelled emission parameters are provided in Table 7.1.2.

The plume rise profiles generated over time were processed to determine the spatial extent of the Proposal plume and where the plume exceeds CASA's CPVs above the OLS for Newcastle Airport.

Table 7.1.2 Summary of emission parameters

Parameter	Gas turbine	Reciprocating engine	Units
Base elevation	15	15	mAHD
Location	All sources located at plant centre[1]: 378 986mE 368 609mN		MGA94
Height	20	30	mAGL
Exit temperature	413 – 448[2]	385	°C
Exit velocity	60	27.2	m/s
Stack diameter	2.782	1.6	m
Total number of stacks	4	15	-

Parameter	Single stack run	Plume merging run	Whole plant run	Plume merging run	Units
Effective diameter	2.782	2.782	6.197[3]	2.771[3]	m
Buoyancy Enhancement (N_E)	1	3.23	1	2.72	-

1: Stack separation included as per generic manufacturer site layouts. Meteorology included based on location defined in this table.

2: Time varying temperature incorporated (as a function of ambient conditions).

3: Equivalent cross-sectional area of 15 and 3 stacks for Whole Plant and Plume Merging runs (respectively).

7.1.3 Potential impacts

Plume rise

Hourly plume rise profiles were processed to identify the vertical and horizontal regions in which the Proposal plume possesses a velocity greater than or equal to the CPV. Modelling results were produced for CPVs of 4.3m/s, 6.1m/s, and 10.6m/s, and for gas turbine and reciprocating engine generators. The analysis was of the worst case (continuous operation).

The modelling results are summarised in Table 7.1.3 and Table 7.1.4. The results show that the plume from the gas turbine generator extends up to 410mAHD for a CPV of 6.1m/s. The 99.9th percentile prediction extends up to 285 m.

Table 7.1.3 Plume rise modelling results for the gas turbine

Statistic	2014	2015	2016	2017	2018	All	Units
Maximum vertical velocity at OLS	8.1	8.2	8.3	8.5	8.4	8.5	m/s
CPV 4.3m/s							

Statistic	2014	2015	2016	2017	2018	All	Units
Maximum critical plume height	**592**	**647**	**757**	**616**	**882**	**882**	
99.9th percentile critical plume height	**509**	**538**	**551**	**474**	**567**	**533**	mAHD
Percentage of hours within OLS	92.5%	90.9%	90.5%	91.7%	91.4%	91.4%	
CPV 6.1m/s							
Maximum critical plume height	**374**	**377**	**387**	**361**	**410**	**410**	
99.9th percentile critical plume height	**257**	**309**	**280**	**272**	**290**	**285**	mAHD
Percentage of hours within OLS	98.6%	98.2%	98.0%	98.4%	98.0%	98.2%	
CPV 10.6 m/s							
Maximum critical plume height	61	61	60	61	61	61	
99.9th percentile critical plume height	60	60	60	60	60	60	mAHD
Percentage of hours within OLS	100%	100%	100%	100%	100%	100%	

*Incursions through the OLS are in bold type.

Table 7.1.4 Plume rise modelling results for the reciprocating engine

Statistic	2014	2015	2016	2017	2018	All	Units
Maximum vertical velocity at OLS	6.0	6.1	6.2	6.5	6.4	6.5	m/s
CPV 4.3 m/s							
Maximum critical plume height	**375**	**376**	**390**	**358**	**417**	**417**	
99.9th percentile critical plume height	**247**	**300**	**268**	**260**	**281**	**272**	mAHD
Percentage of hours within OLS	98.9%	98.8%	98.5%	98.9%	98.4%	98.7%	
CPV 6.1 m/s							
Maximum critical plume height	151	155	**168**	**183**	**176**	**183**	
99.9th percentile critical plume height	123	139	140	128	143	135	mAHD
Percentage of hours within OLS	100%	100%	99.98%	99.98%	99.95%	99.98%	
CPV 10.6 m/s							
Maximum critical plume height	58	57	58	58	58	58	
99.9th percentile critical plume height	57	57	57	57	57	57	mAHD
Percentage of hours within OLS	100%	100%	100%	100%	100%	100%	

*Incursions through the OLS are in bold type.

Probability density plots were generated to show the region of space over the Proposal where the plume exceeds the CPV with increasing frequency. The plots represent the worst case operation for each generator type and show both the vertical and horizontal extent of the plume for various probabilities.

Figure 7.1.3 shows the plot for the gas turbine and Figure 7.1.4 shows the plot for the reciprocating engine.

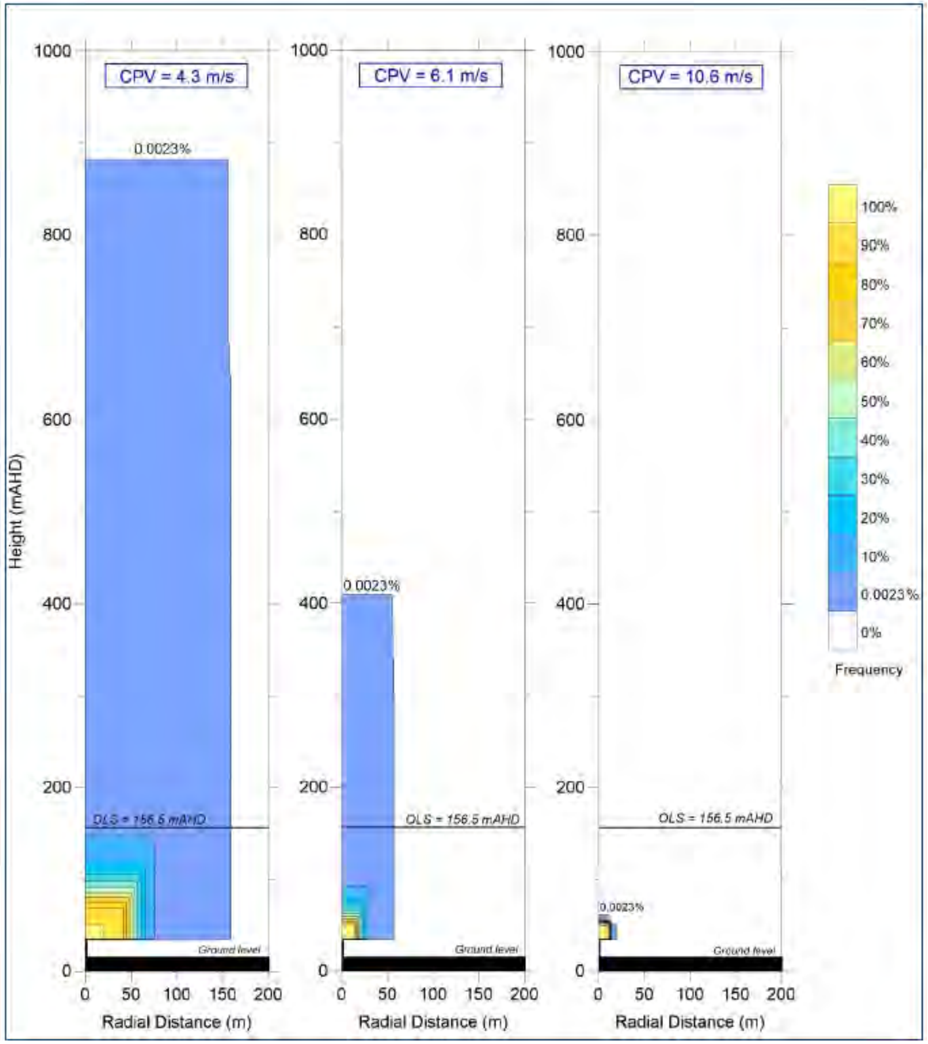


Figure 7.1.3 Critical plume extent probability density plots for the gas turbine

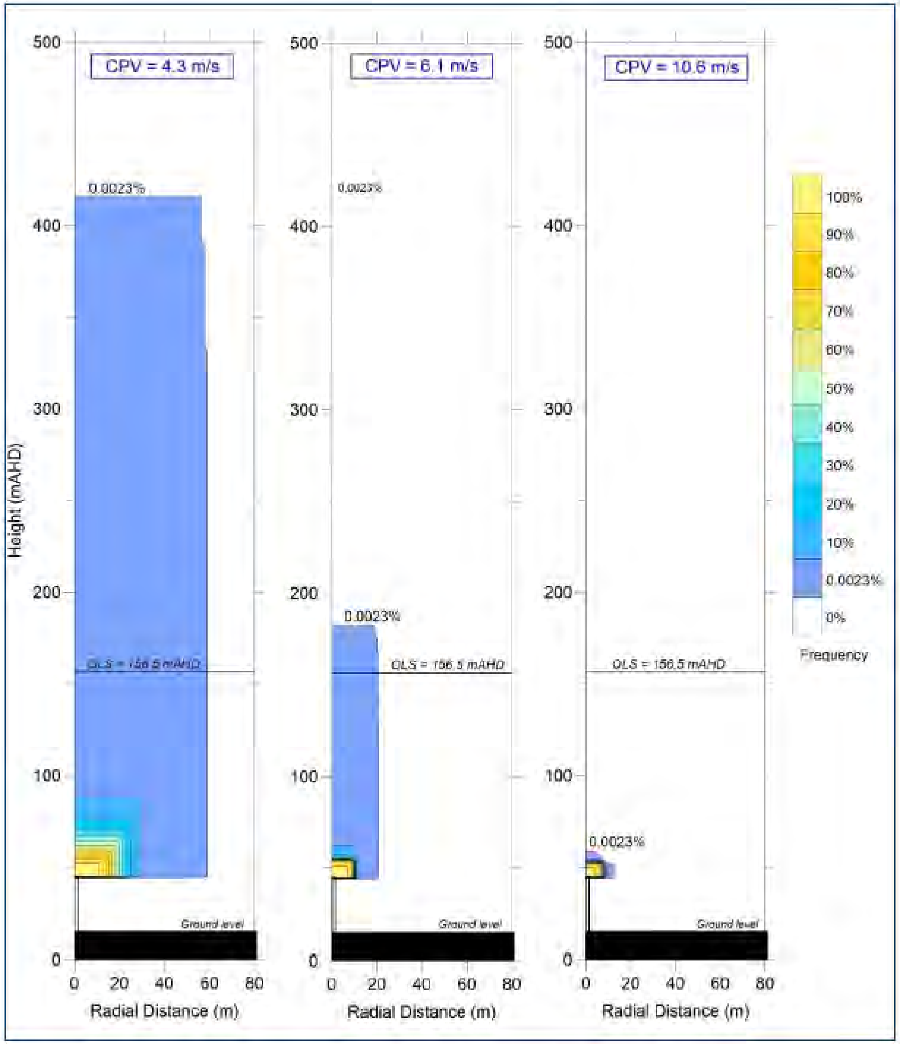


Figure 7.1.4 Critical plume extent probability density plots for the reciprocating engine

The worst case modelling showed that:

- For a CPV of 4.3m/s:
  - Incursions of the OLS were predicted for both modelled generators
- For a CPV of 6.1m/s:
  - The peak reciprocating engine CPH prediction extends to 410 mAHD within the OLS for greater than 98% of the modelled period
  - The peak gas turbine CPH prediction extends to 183 mAHD within the OLS for 99.98% of the modelled period

Diurnal and seasonal variability in model predictions is provided in Appendix Q. In summary, it shows that CPH is typically higher during daylight hours and varies between seasons.

- For a CPV of 10.6m/s:
  - CPH predictions were within the OLS for both modelled generators for 100% of the modelled period

Structural obstructions

The Proposal would involve the construction of permanent exhaust stacks and temporary cranes used during construction. The estimated heights are listed in Table 7.1.5.

Table 7.1.5 estimated heights of permanent and temporary structuctures

Structure	Longevity	Gas turbine option	Reciprocating engine option	CASA height restriction	Units
Top of exhaust stack	Permanent	35	45	30	mAHD
Mobile crane	Temporary	60	60	30	

Both the gas turbine and reciprocating engine options would require permanent exhaust stacks that extend into the OLS of 30m (CASA, 2103b). Additionally, the maximum height cranes that could be used during construction are expected to breach the CASA restriction height, however this would be confirmed by the contractor during construction planning.

The tall structures have potential to impact the safety of both civil and military aircraft operations due to potential collisions, impacts to onboard guiding instruments and changes to landscape visibility.

Cumulative impacts

The PRA concluded that the Proposal would generate a plume likely to exceed the OLS for a CPV of 4.3m/s but would be within the OLS 98% of the time for a CPV of 6.1m/s. There are no other industrial facilities in the local area that contribute a plume in excess of the OLS, and therefore the Proposal would not contribute towards a cumulative plume rise impact.

Structural obstruction into the OLS would occur during both construction and operation of the Proposal. Most of the other approved or in planning projects would not result in a breach of the OLS, however, some projects may result in structures that may be taller than are currently there. Overall, it is not anticipated that there would be any cumulative impact that would significantly affect the operation of the airports.

7.1.4 Avoidance, mitigation and management

A range of avoidance, mitigation and management measures would be implemented for plume rise and aviation hazard as outlined in Table 7.1.6.

Table 7.1.6 Avoidance, mitigation and management measures - Plume rise and aviation hazard

ID	Environmental safeguards	Timing
PR-1	AGL would provide the plume rise assessment report to Airservices Australia, Department of Defence, and CASA for review prior to the commencement of construction.	Pre-construction
PR-2	AGL would consult with Airservices Australia, Department of Defence, and CASA and provide information necessary to allow for a flight chart amendment.	Pre-construction Construction Operation
PR-3	AGL would apply for approval from the Directorate of External Land Planning (DELP) for the erection of permanent and temporary structures in accordance with AC 139-08(0) – CASA Advisory Circular – Reporting of Tall Structures.	Pre-construction

7.2 Bushfire

This assessment identifies the potential impact of bushfires occurring on site or spreading to the NPS during construction and operation and provides mitigation measures to address these impacts. The assessment has been informed by a Bushfire Threat Assessment (BTA) which was prepared by Kleinfelder (Appendix R). The BTA focuses on hazard identification, consequence analysis and development of protection strategies.

7.2.1 Existing environment

The study area for the BTA considered the entire Proposal area when addressing potential construction related impacts and focused on the NPS site for operational impacts (Figure 7.2.1).

The proposed NPS site would comprise all above ground infrastructure associated with the power station and would be where workers are located during operations. A single residential dwelling is located to the northern end of the site which may be demolished during construction. Access to the site would be via Old Punt Road in the south east corner.

Vegetation

The BTA identified the following vegetation communities within the study area:

- Alluvial Tall Moist Forest
- Seaham Spotted Gum – Ironbark Forest
- Swamp Mahogany – Paperbark Swamp Forest
- Woodland rehabilitation
- Coastal Sand Apple – Blackbutt Forest
- Freshwater Wetland Complex
- Redgum – Apple – Banksia Forest
- Coastal Foothills Spotted
- Gum Ironbark Forest
- Lower Hunter Spotted Gum – Ironbark Forest and Swamp Oak Forest

The vegetation communities are identified as containing 'bushfire fuel' which refers to materials that burn and carry fire forward. Bushfire fuel can include both living and dead vegetation and generally accumulates over time. Common bushfire fuels include forest litter, shrubs and healthy plants, grasses, trees, logs and bark.

The NPS site consists of mainly low-quality Red Ironbark shrubby open forest that has been historically cleared for agricultural purposes including grazing. The remainder of the study area consists of other infrastructure and extensive remnant or regenerated native bushland.

Figure 7.2.1 Bushfire prone land

Bush fire prone land

Bush fire prone land (BFPL) is land that is identified by local council that can support or is subject to bushfires that requires specific management strategies to reduce the risk of bushfire occurrence or spread. The Proposal would be located on land that is mapped as BFPL by the Port Stephens Council, under the Port Stephens LEP. No relevant fire history has been recorded at the site.

The study area is mapped as BFPL Category 1 across Lot 4 DP 1043561 and towards the eastern and southern boundaries of Lot 3 DP 1043561 which includes a vegetation Buffer Zone towards the centre of this lot (Figure 7.2.1).

Vegetation Category 1 is at the highest risk for bushfire and is given a vegetation buffer of 100m.

This area has the potential to realise a maximum rate of spread and fire intensity. The vegetation is on a slight downward slope assessed at 4% (2 degrees downslope).

The vegetation mapped as Vegetation Category 1 to the north of the study area would be removed during construction of the NPS and associated infrastructure and therefore would not pose a bushfire threat.

The secondary bushfire hazard and risk is the grassland vegetation to the north, south and west (the vegetation buffer, and low-quality Red Ironbark shrubby open forest) located in the power station site. This secondary bushfire hazard risk is considered minimal.

Weather conditions

The Proposal would be located in the NSW Fire Area 3, Greater Hunter (Port Stephens Council) which has a Fire Danger Index (FDI) of 100. The FDI is attributed to fire areas by the NSW Rural Fire Service (NSW RFS) and denotes an evaluation of the rate of spread or suppression of bushfire based on weather history and fuel combinations or moisture for a region that can influence bushfire behavior. The index combines a record of dryness (based on rainfall and evaporation) with meteorological variables for wind speed, temperature and humidity. Climate variances influencing weather and drought conditions can contribute to the drying of grasslands which influences when the bushfire season start and end dates (the period where there is an elevated risk for bushfires to occur).

The Greater Hunter area receives summer rainfall (peak in January) which is followed by a period in which the vegetation will grow until autumn. The weather, dryness of the landscape and the bushfire fuel availability determines the bushfire season in the area. The bush fire season for the Greater Hunter nominally runs from 1 September and continues through to March, with the early onset of fire season brought about by cold and dry weather conditions during winter and levels of accumulated of natural bushfire fuel (vegetation). Prevailing weather conditions over this period are north westerly winds, high daytime temperatures, and low relative humidity.

Local fire services

A review of the existing Fire Emergency Services in the area and their potential response times in the event of a bushfire at the proposed NPS was completed for the BTA and is described in Table 7.2.1.

Table 7.2.1 Existing Fire Emergency Services response times

Facility	Agency	Status	Response time (minutes)
Tarro Fire Station	Fire and Rescue NSW	Retained	14
Raymond Terrace Fire Station	Fire and Rescue NSW	Retained	16
Raymond Terrace Rural Fire Brigade	NSW Rural Fire Service	Volunteer	21
Thornton Rural Fire Brigade	NSW Rural Fire Service	Volunteer	23

7.2.2 Assessment methodology

The BTA is a 'Fire Safety Study (Bushfire)' that has been written in accordance with guidelines provided by the NSW DPIE for hazardous industries and includes a number of Hazardous Industry Planning Advisory Papers (HIPAPs) which assist stakeholders in implementing and integrating assessment processes.

The BTA considered the assessment of bushfire hazards and risks and made recommendations for prevention and mitigation strategies in accordance with the following guidelines and Australian Standards:

- NSW RFS's Planning for Bush Fire Protection 2006 (PBP 2006)
- NSW RFS's Planning for Bush Fire Protection 2018 (PBP 2018)
- Australian Standard 3959:2018 Construction of buildings in bushfire-prone areas (AS3959:2018)
- Hazardous Industry Planning Advisory Paper No. 2 *Fire Safety Study Guidelines* (HIPAP 2)
- Hazardous Industry Planning Advisory Paper No. 4 *Risk Criteria for Land Use Safety Planning* (HIPAP 4)
- Hazardous Industry Planning Advisory Paper No. 6 *Guidelines of Hazard Analysis* (HIPAP 6)
- Industry Standards Safety Committee 3, 2016's (ISSC 3, 2016) Guide for the Management of Vegetation in the Vicinity of Electricity Assets

As a key guidance document for the BTA, the PBP 2006's aims, and objectives were incorporated into the methodology of the assessment. The PBP 2006 aims to provide for the protection of human life and minimise impacts on property from the threat of bush fire, while having due regard to development potential, site characteristics and protection of the environment. The core objectives are to:

- Afford buildings and their occupants protection from exposure to a bush fire
- Provide for a defendable space to be located around buildings
- Provide appropriate separation between a hazard and buildings which, in combination with other measures, would minimise material ignition
- Ensure that appropriate operational access and egress for emergency service personnel and residents is available
- Provide for ongoing management and maintenance of BPMs
- Ensure that utility services are adequate to meet the needs of firefighters

As described above, the study area for the BTA considered the entire Proposal area and the power station site. Exposure to radiant heat was calculated using the PBP 2006 guideline and Method 2 of AS3959:2018.

7.2.3 Potential impacts

Construction

Construction of the Proposal would include the power station, gas pipeline/s and electricity transmission lines which are all located within the primary bushfire hazard. Potential impacts during construction would mainly involve the health and safety of construction workers, then impacts to materials and assets.

During construction, the primary sources of bushfire and potential risks and impacts would be from:

- Hot works such as welding during igniting surrounding vegetation and causing a bushfire
- Inadequate bushfire emergency response system in place resulting in serious injury or death
- Insufficient training of construction workers dealing with bushfire risk

Operation

During operation, many ignition sources would be located within the Proposal that have the potential to cause or spread bushfire which would have direct impacts on the site, site assets and adjoining landowners. Potential ignition sources or scenarios within the study area during operation and associated consequences and are discussed in Table 7.2.2 and Figure 7.2.2.

Table 7.2.2 Potential ignition sources, scenarios and consequences

Ignition source	Cause and consequence
Powerlines	Powerlines have the potential to arc during high winds causing line or insulator failure. Damaged or disrupted powerlines may cause ignition of vegetation under and surrounding the powerlines causing bushfire on site and potentially impact adjoining landowners.
Gas pipelines (above and below ground)	Physical damage causing pipeline failure can be caused by poorly managed maintenance or construction activities. Damaged gas pipelines can cause jet fire igniting surrounding vegetation causing bushfire on site and potentially impact adjoining landowners.
Substation and Fuel Storage areas (Diesel)	Equipment failure or physical damage to assets could result in explosions causing bushfire on site of impacting surrounding landowners.
Operational activities	Hot works such as welding during maintenance or land management activities can ignite surrounding vegetation causing bushfire.
Generator exhaust (carbon particle emission)	Hot exhaust carbon particles can cause ignition of surrounding vegetation causing bushfire on site or on adjoining landowner's properties.
External bushfire	Surrounding bushfire (such as a potential bushfire to the east of the Proposal) could result in embers, radiant heat or direct flame igniting vegetation on site causing bushfire.

Five key areas of potential impacts of an uncontrolled bushfire within the study area. These areas included people, generators and storage areas, buildings, gas pipeline/s and electrical transmission lines and continuity of operations.

People

Radiant heat levels from bushfire have potential consequences to human health depending on the intensity of the exposure. Heat radiation at 2.1kW/m^2 has the potential to cause pain to an unprotected person after one minute.

In the event of a bushfire impacting the NPS site and if outside, NPS staff or visitors may be exposed to an unacceptable level of radiant heat from the primary bushfire hazard areas. Primary bushfire hazard areas are the eastern and southern boundaries of Lot 3 DP1043561 and in Lot 4 DP 1043561. If unmitigated the impacts to human health could range from minimum pain to the chance of a fatality.

Generators, gas storage and fuel storage

The design and construction of generator plant equipment and fuel storage generally provides a level of inherent fire resistance; however, the levels of radiant heat exposure during bushfires have the potential to reduce infrastructure integrity and make the operating environment unsafe. Specifically, the thermal failure level (heat radiation levels which cause infrastructure failure) for generators and fuel storage infrastructure is 23kW/m^2. If heat radiation on these assets exceeds 23kW/m^2, there is the potential for this quantity of combustible material to become a source of ignition in a bushfire. To achieve a radiant heat impact of 23kW/m^2 or less, a separation of 32m is required between infrastructure and the bushfire hazard. Currently, the distance between the generators, gas storage and fuel storage is 23m (Figure 7.2.2), however, additional mitigation measures described below can achieve the radiant heat impact of 23kW/m^2 or less.

Buildings

The proposed locations for the administration, workshops and stores buildings would be located approximately 23m from the primary bushfire hazard on the eastern and southern boundary of the lot (Figure 7.2.2). A review of the PBP 2006 identified that this distance places these buildings as a bushfire attack level (BAL) of BAL 40, meaning that damage to the building would occur if heat radiation exceeds 40kW/m^2. If buildings and workshops are not designed to be resistant for BAL 40 conditions, or additional bushfire protection measures are put in place (such as heat shielding), the assets may be at risk of damage from bushfire events occurring in the primary bushfire hazard area.

Gas pipeline/s and electrical transmission lines

Underground gas pipeline/s and electrical transmission lines have the potential to add additional fuel to bushfires if adequate planning and vegetation removal has not occurred surrounding the assets. Damage to infrastructure assets would also result in a disruption of electricity services as described in the following sections.

Continuity of operations

The NPS is required to:

- Ensure continual supply of electricity to NSW
- Contribute to lower emissions
- Improve security of electricity to NSW
- Provide substantial investment in regional NSW

A break in continuity of operations due to bushfire attack (and subsequent damage to people and places) would significantly impact the key requirements of the Proposal.

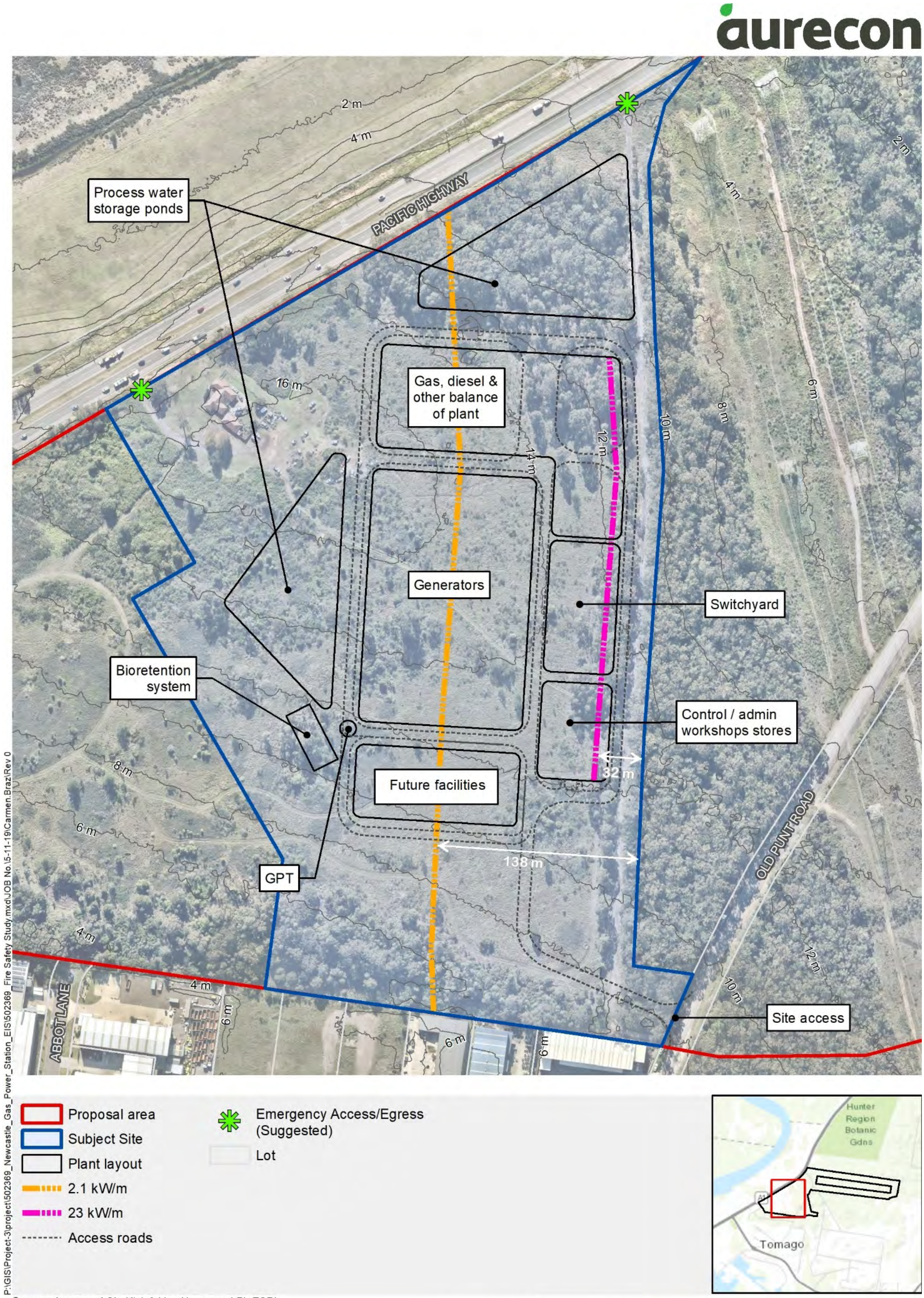
Additional considerations

In bushfire events, access to the NPS site or to water for the purposes of firefighting may be inhibited by poorly planned road and water infrastructure systems. Access to the site would be via Old Punt Road however, should Old Punt Road, internal access routes or water hydrants be inaccessible in extreme bushfire events, severe damage to infrastructure and human health could occur.

An emergency evacuation from the NPS site could be via Pacific Highway, using the existing Lot 2 residential driveway, however agreement would be required from Roads and Maritime.

Cumulative impacts

The Proposal would establish relevant asset protection zones around the site to avoid, as far as practicable hazardous materials on site becoming ignition sources that could have wider effects. It is anticipated that similar protection measures would be employed at other facilities in the area and no cumulative impacts would result.



Source: Aurecon, AGL, Kleinfelder, Nearmap, LPI, ESRI

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0 50 100m

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Projection: GDA 1994 MGA Zone 56

Figure 7.2.2 Potential APZ and bushfire impacts

7.2.4 Avoidance, mitigation and management

The following mitigation measures would be implemented to address the potential impacts to human health and infrastructure assets identified (Table 7.2.3).

Table 7.2.3 Avoidance, mitigation and management measures – Bushfire

ID	Environmental safeguards	Timing
BF-1	An Emergency Management and Evacuation Plan (EMEP) would be developed and implemented prior to construction and operation. The EMEP would be developed in accordance with: ■ NSW RFS - A guide to developing a Bush Fire Emergency Management and Evacuation Plan ■ Australian Standard AS 3745:2010 - Planning for emergencies in facilities The EMEP would include: ■ Identify designated buildings or safe places that can provide refuge from bushfires (in accordance with AS3959:2018). ■ Consultation with the local NSW RFS, NSW Fire and Rescue and Port Stephens Bush Fire Management Committee ■ Assessment of response times and access for fire services ■ Ensuring persons are not exposed to bushfire impacts	Construction Operation
BF-2	Road access to the proposed NPS site would be available to the Fire Emergency Services through the incorporation of the following measures in design: ■ The NPS road system would consist of a perimeter road and a network of services roads to allow for multiple access routes ■ The perimeter road would be sealed and a minimum 8m wide forming part of the Asset Protection Zone (APZ) ■ Service roads would be sealed and a minimum of 4m wide, sign posted, and with direct access toward the main entry ■ An alternate access/egress will be considered during design in the event access to Old Punt Road or Old Punt Road itself is cut off or closed	Construction Operation
BF-3	A radiant heat impact of 23kW/m^2 or less would be achieved within design for the generator plant, equipment and fuel storage. This would be achieved through either: ■ Implementation of an APZ between the asset and the site boundary (as large as reasonably possible), ■ Installation of radiant heat barriers such as metal clad fencing or construction within a shed (in order to be able to decrease the APZ distance less than 32m), or ■ Suitable siting of infrastructure within the construction compound	Pre-construction Construction
BF-4	The bulk fuel (diesel) storage would be designed to be compliant with the Australian Standards AS1692:2006 and AS 1940:2017. The location of these storage areas would be located as far as possible from the primary bushfire hazard area. If compliance with AS1692:2006 and AS 1940:2017 is not possible, fire protection on the primary bushfire hazard side (east) of the plant and equipment area would as a minimum be compliant with AS 2419.1:2005 for the installation of fire hydrants.	Pre-construction
BF-5	Design of the proposed pipelines would take advantage of the existing bushfire protection measures. Where the final design layout demonstrates that any existing measures are insufficient, compliance with the requirements of the applicable pipeline standard; European LNG Code, EN 1473:2007 would be necessary.	Pre-construction

ID	Environmental safeguards	Timing
BF-6	Electrical transmission lines would have vegetation easements in accordance with the bushfire protection requirements of the Guide for the Management of Vegetation in the Vicinity of Electricity Assets (ISSC 3 – 2016).	Pre-construction Construction
BF-7	As described in ISSC 3, 2016, a 10m APZ would be established surrounding the boundary fence, where only maintained lawn or grasses are permitted.	Construction
BF-8	Administration, workshops and stores buildings located on the eastern side of the site (within 23m of the primary bushfire hazard) would be designed to a construction standard minimum of BAL 40.	Pre-construction Construction
BF-9	An emergency egress onto the Pacific Highway, using the existing Lot 2 residential access, will be further considered and included in the EMEP and operational management plans.	Construction Operation
BF-10	Water for firefighting would be provided through the installation of a ring main water supply and hydrants throughout the site. The water supply for the site would be capable of complying with the Australian Standard AS2419.1:2017.	Construction
BF-11	AZP's would be monitored through vegetation clearing maintenance activities.	Operation

7.3 Hazard assessment

A Preliminary Hazard Analysis (PHA) was undertaken for the Proposal and is Appendix S.

7.3.1 Existing environment

The Proposal is more than 2km from the closest residential zoned area. There is a single residence in the north-west corner of the NPS site that is owned by AGL and which will be demolished prior to or during construction.

There are no sensitive receptors near the NPS site. The closest for the purposes of the PHA are a single residence on Tomago Road near its intersection with the Pacific Highway and the Tomago Village Van Park, approximately 700m and 900m south west of the NPS respectively.

The surrounding land use is industrial, with nearby infrastructure including:

- The NGSF
- Tomago to Hexham gas pipeline
- TransGrid Tomago switching station
- Tomago Aluminium Smelter
- Pacific Highway

Australian Bureau of Statistics data was accessed to estimate the demographics of the local area. The population of Tomago as of the 2016 census was 277 persons across an area of 7,100,000m^2 resulting in a population density of 0.000039 persons/m^2. In the industrial areas surrounding the Proposal a population density was estimated based on the assumed population density of the Tomago Aluminum Smelter of 0.0011 persons/m^2.

When applied to Tomago the population densities indoors and outdoors at day time and at night were estimated as shown in Table 7.3.1.

Table 7.3.1 Population density for Tomago

Population Density		Day	Night
Industrial (persons/m^2)	Indoors	1.06E-03	1.13E-03
	Outdoors	7.96E-05	1.14E-05
Rural* (persons/m^2)	Outdoors	3.90E-06	3.90E-06

* Rural populations are assumed to be outdoors during both day and night times.

Climatic variables for the Proposal area was identified using Bureau of Meteorology data and are provided in full in Appendix S. In summary, four broad dominant weather categories were recognised and are provided in Table 7.3.2.

Table 7.3.2 Weather parameters

Category	1/D	3/B/C	1/A	5/D
Wind speed (m/s)	1	3	1	5
Pasquil stability*	D – neutral	B/C – moderately unstable, moderate sun and moderate wind	A – very unstable, sunny and light winds	D – neutral, little sun and high wind
Atmospheric temperature (°C)	15	19	28	23
Relative humidity (%)	76	66	76	56
Solar radiation flux (kW/m²)	0	0.5	1	0.25
Proportion weather in each category (day time)	13%	-	48.5%	38.5%
Proportion weather in each category (night time)	37%	49.5%	-	13.5%

* Pasquil atmospheric stability classes categorise the amount of atmospheric turbulence present. Atmospheric turbulence is categorised as A, B, C, D, E or F with class A being the most unstable or most turbulent class, and class F the most stable.

7.3.2 Study methods and criteria

The PHA considered the hazard and risk and made recommendations for prevention and mitigation strategies in accordance with the following documents:

- Hazardous Industry Planning Advisory Paper No. 4 Risk Criteria for Land Use Safety Planning (HIPAP 4)
- Hazardous Industry Planning Advisory Paper No. 6 Guidelines of Hazard Analysis (HIPAP 6)
- Applying SEPP 33 – Hazardous and Offensive Development Application Guidelines
- Assessment Guideline: Multi-Level Risk Assessment

The objective of the PHA was to develop a comprehensive understanding of the hazards and risks associated with the Proposal. The purpose of the report was to evaluate the design and operation of the Proposal to reduce any identified hazards to "as low as reasonably practicable" (ALARP) and to enable appropriate land use safety planning.

Preliminary risk screening

A preliminary risk screening was carried out to determine whether SEPP 33 applies to the Proposal. The screening was based on the following:

- Identification and description of dangerous goods and hazardous chemicals handled or stored at the Proposal
- Maximum quantities of dangerous goods and otherwise hazardous chemicals involved in the Proposal
- Dangerous Goods classifications for the dangerous goods handled or stored at the Proposal
- Distance from the boundary for each hazardous chemical
- Average number of road movements (and the quantities) of dangerous goods and otherwise hazardous chemicals to and from the Proposal
- The NPS site layout
- A locality plan showing immediate neighbours and land use

SEPP 33 applies to any proposal for an industrial development that consent and is either potentially hazardous or potentially offensive industry.

Potentially hazardous industry

The *Multi-Level Risk Assessment* guidelines were used to provide a graded framework to assessing whether the Proposal is potentially hazardous industry. The levels in the framework are:

- Level 1 – a qualitative approach based on comprehensive hazard identification to demonstrate that the activity does not pose a significant risk
- Level 2 – a quantitative approach that supplements the qualitative analysis by sufficiently quantifying the key risk contributors to show that risk criteria will not be exceeded
- Level 3 – full quantitative analysis (adopted in this assessment)

Risk from the Proposal was assessed against the qualitative and quantitative criteria set out in *HIPAP Paper No 4 – Risk Criteria for Land Use Safety Planning.* The qualitative risk criteria relate to whether avoidable risks can be avoided, whether major hazards can be eliminated or reduced, and whether the consequences of significant events can be kept within the boundaries of the facility. Quantitative risk criteria relate to individuals and society.

Individual risk includes fatality, injury, AND property damage and accident propagation.

Fatality risk is the risk of death to a person at a particular point. In calculating this risk, it is assumed that the person will be at the Proposal 24 hours per day for the whole year. If a risk from a potentially hazardous industry is below most risks being experienced by the community then that risk may be tolerated. The assessment criteria for fatality risk are provided in Table 7.3.3.

Table 7.3.3 Individual fatality risk criteria

Land use	Suggested criteria (risk in a million per year)
Hospitals, schools, child-care facilities, old age housing	0.5
Residential, hotels, motels, tourist resorts	1
Commercial developments including retail centres, offices and entertainment centres	5
Sporting complexes and active open space	10
Industrial	50

Injury risk is the risk of injury as a result of the Proposal in this case, as a result of heat radiation or explosion over-pressure. The injury risk criteria for these scenarios are included in Table 7.3.4.

Table 7.3.4 Injury risk criteria

Injury risk criteria	Maximum value	Maximum tolerable risk (x10^{-6} per year) at residential & sensitive use areas
Over-pressure	7 kPa	50
Heat Radiation	4.7 kW/m^2	50

Property damage and accident propagation criteria are provided in *HIPAP No 4 – Risk Criteria* and are provided here in Table 7.3.5.

Table 7.3.5 Property damage and accident propagation criteria

Property damage	Maximum value	Maximum tolerable risk ($x10^{-6}$ per year) at neighbouring potentially hazardous installations
Over-pressure	14 kPa	50
Heat Radiation	23 kW/m^2	50

Societal risk is based on ALARP principles and is based on *Applying SEPP 33 – Hazardous and Offensive Development Application Guidelines.* Where the frequency and number of fatalities fall between negligible and intolerable, the risk is considered ALARP.

Potentially offensive industry

Following the above assessment, the Proposal was assessed using *Applying SEPP 33* which provides a list of categories of industries with the potential for off-site offensive impacts. Off-site impacts may include air emissions, water quality, noise, or other environmental impacts. The key consideration in the assessment of a potentially offensive industry is that the consent authority is satisfied there are adequate safeguards and that these safeguards ensure that emissions can be controlled to a level at which they are not significant.

7.3.3 Potential impacts

Overview of the Proposal

The Proposal would have the capacity to operate 24 hours a day, 7 days a week and while the expected generating capacity factor is less than this, for the purposes of the PHA it is assumed to be always operational.

The Proposal is likely to require up to approximately 23 persons on rotating shifts and routine maintenance. The Proposal includes the following components that have been considered in this assessment:

- The power station, being a dual fuel peaking power plant with a nominal generating capacity of 250MW
- The gas supply pipelines, including the take-off from the Tomago to Hexham pipeline and the gas storage pipeline to be constructed between the NGSF and the proposed power station. Pre-existing gas pipelines have not been considered in this assessment
- A fuel gas compression system to increase the fuel gas pressure from the minimum pipeline supply pressure to the required supply pressure
- 1.5ML of diesel storage in above ground bulk tanks

An approximate layout of the generators and balance of plant is provided in Figure 1.2.2.

Chemicals being handled, stored or processed in significant quantities are restricted to natural gas and diesel fuel.

At any given time, 1.5mL of Class C1 Combustible Liquid (diesel) would be stored on site. The diesel storage would be designed in accordance with AS 1940:2017 The storage and handling of flammable and combustible liquids. Diesel fuel would be transported to site by road vehicles of approximately 50m^3 capacity. This equates to 60 heavy vehicle movements per day.

Minor quantities of hazardous chemicals have not been considered in the assessment as they do not contribute significantly to the overall risk profile.

Approximately 42,600m^3/h and 71,000m^3/h of Class 2.1 Flammable Gas would be stored in the gas storage pipeline and the Tomago to Hexham pipeline respectively.

Potentially hazardous

Section 7 and Appendix 4 of *Applying SEPP 33 – Hazardous and Offensive Development Application Guidelines* provides a risk screening method to determine whether the Proposal is potentially hazardous. The preliminary screening assessment for natural gas to be used at the Proposal is provided in Table 7.3.6.

Table 7.3.6 Preliminary screening assessment for natural gas

Factor	Assessment
Material	Natural Gas
Type	Class 2.1 Flammable Gas
Maximum Quantity on site	3t (Note 1)
Distance to Site Boundary [m]	< 20m
Distance to Sensitive Receptor	2,000m
Screening Threshold or minimum separation distance (Other Land Uses)	70m (Note 2)
Screening Threshold or minimum separation distance (Sensitive Receptors)	90m (Note 2)
Finding	Above threshold
Note 1: Assuming density equal to 0.7226kg/m^3 Note 2: References Figure 7.3.1	

Figure 7.3.1 shows that the minimum separation distance for 3t of natural gas is 70m, whereas Table 7.3.6 indicates the actual separation distance is less than 20m. As the actual separation distance is less than the minimum separation distance there is potential for off-site risk and the storage of natural gas has been analysed further in the PHA.

Where Class C1combustible liquids are stored in a separate bund or within a storage area and no flammable materials are stored with them, they are not considered to be potentially hazardous. The Proposal would include storage of Class C1 diesel in two storage tanks within a bunded area, with no intention to store Class 3PGI, II, or II flammable liquids in site. Therefore, the storage of diesel is not considered to be potentially hazardous.

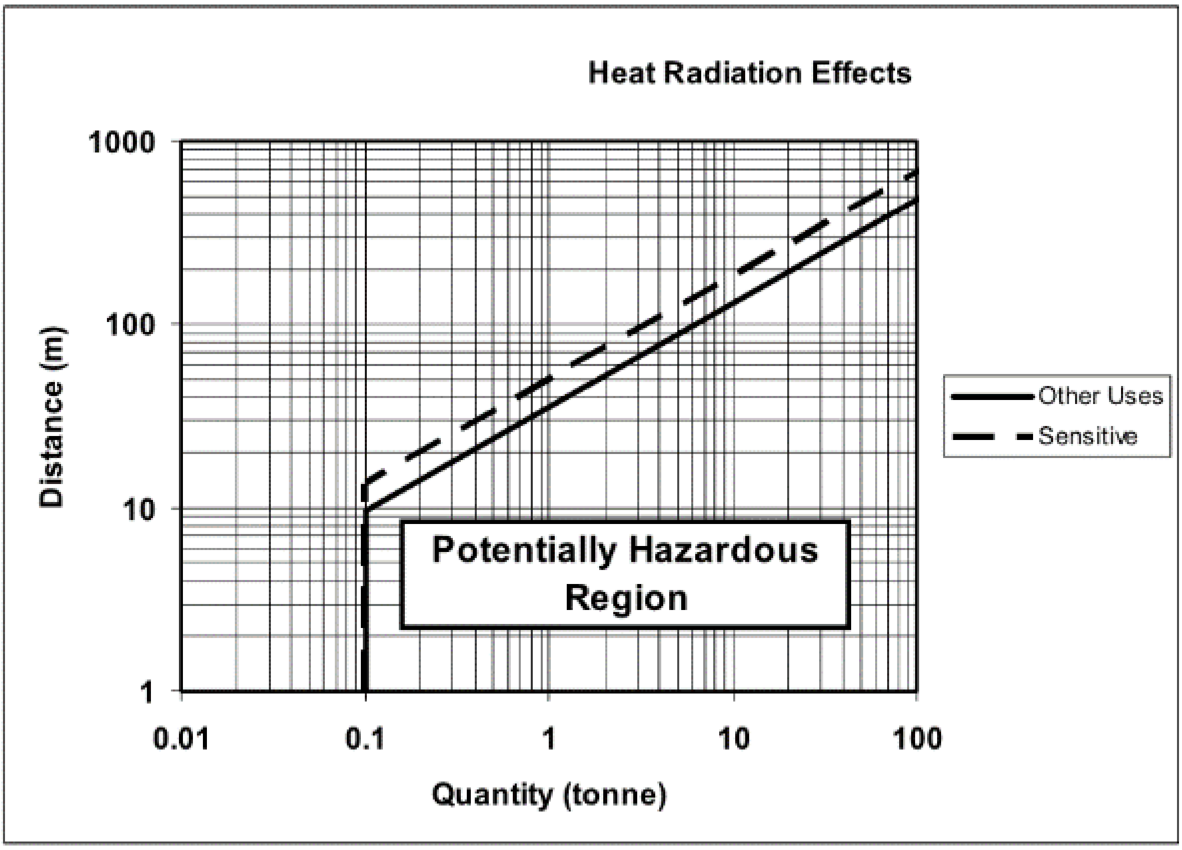

Figure 7.3.1 Class 2.1 Flammable Gases Pressurised (Excluding LPG)

Source: Applying SEPP 33, Hazardous and Offensive Industry Development Application Guidelines. 2011

Natural gas would be transported to the site via pipelines, while diesel would be transported to the site via road. Diesel is classified as a Class 9 Dangerous Good for road transport purposes. SEPP 33 provides transportation screening thresholds for all dangerous goods transport classes and advises that a proposal may be potentially hazardous if the number of generated traffic movements for significant quantities of hazardous materials entering or leaving the site is above the annual or weekly cumulative vehicle movements.

The threshold for Class 9 is greater than 1,000 cumulative annual or greater than 60 weekly transport movements. The Proposal, operating on a continuous basis (worst case scenario) would generate greater than 60 weekly transport movements and therefore the transportation of diesel to and from NPS site would require an environmental protection licence (EPL).

Potentially offensive

Schedule 3 of the EP&A Act Regulations describe categories of industry with a potential for significant environmental impact that are therefore considered to be potentially offensive industries. Schedule 3 states that electricity generating stations supplying or capable of supplying more than 30 megawatts (MW) of electrical power from energy sources including gas are potentially offensive. As the Proposal exceeds the 30MW threshold it is considered a potentially offensive industry, however appropriate management measures have been adopted to reduce potential impacts to below the threshold of significance.

Hazardous event identification

The Proposal elements that have potential to cause a hazardous event include:

- Tomago to Hexham Pipeline connection to gas compression inlet/ bypass (around 1750 to 4000kPag)
- Piping from gas compression units to gas turbines, when sourced from the Tomago to Hexham Pipeline (5,500kPag)
- Piping from gas compression bypass to let down station, when sourced from the Tomago to Hexham Pipeline (2,500kPag)
- Piping from gas let down station to gas engines, when sourced from the Tomago to Hexham Pipeline (1,000kPag)
- Piping from gas compression units to storage pipeline (15,000kPag)
- Gas storage pipelines (15,000kPag)
- Gas storage pipeline to let down station, including water bath heater (15,000kPag)
- Piping from gas let down station to gas engines, when sourced from storage pipeline (1,000kPag)
- Piping from gas let down station to gas turbines, when sourced from storage pipeline (5,500kPag)
- Gas leak within a compressor house

The frequency of a gas generator housing explosion has been taken from industry examples and was estimated as 7.2 x 10^{-8} per year per housing (refer to Appendix S for more information on this calculation). Multiple generators arithmetically increase the likelihood of a housing explosion so that:

- With four turbines, the frequency of explosion inside the turbine housing is 2.88 x 10^{-7} per year
- With eight turbines, the frequency of explosion inside the turbine housing is 5.76 x 10^{-7} per year

Risk analysis

The risk of individual injury, fatality, and property damage and accident propagation were assessed in accordance with *HIPAP No 4 – Risk Criteria.* Injury was assessed for heat radiation and explosion over-pressure and is provided in Table 7.3.7. The criteria are met for over pressure and heat radiation as sensitive and residential areas are located more than 2km from the Proposal.

Table 7.3.7 Injury risk criteria

Criteria	Maximum tolerable risk at residential & sensitive use areas (x10^{-6} per year)	Criteria satisfied
Maximum over-pressure		
7kPa	50	Yes
Maximum heat radiation		
4.7kW/m^2	50	Yes

Property damage and accident propagation were assessed for heat radiation and explosion over-pressure and is provided in Table 7.3.8. The criteria are met for over pressure and heat radiation as the only neighbouring potentially hazardous facility is the gas storage pipeline which has a failure frequency of zero.

Table 7.3.8 Property damage and accident propagation risk criteria

Criteria	Maximum tolerable risk at neighboring land and potentially hazardous facilities ($x10^{-6}$ per year)	Criteria satisfied
Maximum over-pressure		
14kPa	50	Yes
Maximum heat radiation		
$23kW/m^2$	50	Yes

Fatality was assessed based on a leak scenario at the gas storage pipeline and at the supply connection pipeline and using the generic failure frequency of 5×10^{-7} per year per km discussed above. The criteria are met for all land uses. Figure 7 of Appendix S and Table 7.3.9 below provide details of the land uses and risk criteria.

Table 7.3.9 Individual fatality risk criteria

Land use	Suggested risk criteria ($x10^{-6}$ per year)	Criteria satisfied
Hospitals, schools, child-care facilities, old age housing	0.5	Yes
Residential, hotels, motels, tourist resorts	1	Yes
Commercial developments including retail centers, offices and entertainment centers	5	Yes
Sporting complexes and active open space	10	Yes
Industrial	50	Yes

Societal risk criteria use the ALARP principle when there is a risk of multiple fatalities occurring in one event. Societal risk is low due to the low population density in the vicinity of the Proposal.

The PHA demonstrated that it is unlikely that the Proposal would introduce an unacceptable risk of individual injury, individual and multiple fatalities, and property damage and accident propagation in the local area. The PHA provided in Appendix S demonstrates that the risks from the Proposal comply with the criteria set out in *Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning*.

Cumulative impacts

Safety and asset protection measures would be implemented at the Proposal site which would limit a cumulative hazard with neighbouring industrial facilities. However, the Proposal is considered hazardous as it would require ongoing diesel deliveries. It is assumed that other industrial premises nearby would also require the delivery of diesel, which would result in a cumulative increase in the hazard risk on the surrounding roads that are used to transport the fuel. However, as this is an established route, this cumulative impact is anticipated to be minor and can be managed through compliance with relevant standards and road rules.

7.3.4 Avoidance, mitigation and management

A range of avoidance, mitigation and management measures would be implemented for hazard assessment as outlined in Table 7.3.10.

Table 7.3.10 Avoidance, mitigation and management measures – Hazards and risks

ID	Environmental Safeguard	Timing
HR-1	The detailed design of the generator building/housing and associated equipment would clearly outline the basis of safety used to ensure that the explosive situations do not arise.	Pre-construction
HR-2	Rotating machines would be designed such that the risk associated with failure leading to uncontained projectiles is minimised.	Pre-construction
HR-3	The safety assessment process would continue to identify controls that prevent or limit the effects of major hazardous incidents on site, such as fire and explosion that could result in significant off-site effects.	Pre-construction

7.4 Fire safety

A Fire Safety Study (FSS) for the Proposal was undertaken and is in Appendix T. The FSS provides an assessment of the risks and hazards associated with fire on the Proposal and provides measures to minimise potential risks.

7.4.1 Existing environment

The FSS assessed the infrastructure assets related to the Proposal including the proposed power station (Lot 3 DP1043561) and the gas storage pipeline/s and electricity transmission lines (Lot 4 DP 1043561 and Lots 1201, 1202 and 1203 DP 1229590).

Existing major infrastructure close to the Proposal includes the NGSF, TransGrid's Tomago switching station and associated electrical transmission and distribution lines, and the Pacific Highway A1. The NPS site is bounded by the Pacific Highway to the north and Old Punt Road to the south-east, with the Hunter River located approximately 470 metres north-west on the opposite side of the highway.

The NPS site has previously been used for rural activities including grazing and agricultural purposes. It hosts a single storey residential dwelling located on the northern edge of Lot 3, adjacent to the Pacific Highway. Some isolated trees have been retained on the site, while stands of native vegetation are generally confined to the boundaries. The land is relatively flat, with a slight gradient towards the east and the west. Several dirt or gravel access paths exist across the site from previous clearances.

The Bushfire Threat Assessment provided in Appendix R shows that the Proposal area is mapped as Bushfire Prone Land Category 1 and Buffer Zone (NSW Planning Portal 2019). However, within the Proposal area, the primary bushfire hazards are in the east of Lot 3 DP1043561, on Lot 4 DP 1043561, and Lot 202 DP 1173564. The grasslands that occur towards the north, south and west are regarded as secondary hazards that can contribute to a bushfire in the area.

The development footprint for the proposed gas storage pipeline corridors would be predominantly within existing cleared corridors maintained for the NGSF. The proposed electrical transmission line would link the Proposal with the existing Tomago switching station. The corridor is partially vegetated, with the majority of the proposed alignment within the existing 132kV transmission corridor to the Tomago switching station.

7.4.2 Study methods and criteria

The FSS is based on hazards identified in a Preliminary Hazard Analysis and a preliminary assessment of the consequence effects of potential fires and explosions associated with such hazards. It identifies firefighting systems, plant and equipment that would reduce the risk of a fire and/or explosion to acceptable levels.

The objective of the FSS was to address the SEARs and in doing so, define minimum performance requirements for fire and explosion preventative and protective systems and equipment based on relevant and applicable standards, codes of practice and regulations. The FSS was prepared in accordance with relevant policies, guidelines and standards.

Preliminary risk screening

A preliminary risk screening was carried out in conjunction with the PHA to determine whether *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* (SEPP 33) applies to the Proposal. SEPP 33 applies to any proposal for an industrial development that consent and is either potentially hazardous or potentially offensive industry.

For the purposes of this FSS the preliminary screening assessment identified natural gas as the only hazardous chemical likely to be used at the Proposal in sufficient quantities to trigger SEPP 33. According to *Applying SEPP 33* Class C1 Combustible Liquids such as diesel that are stored in a separate bund and away from Class 3PGI, 3PGII or 3PGIII flammable liquids are not considered to be potentially hazardous. Table 7.4.1 provides the results of the preliminary screening assessment for natural gas and Figure 7.3.1

illustrates the relationship between distance to receivers and quantity of Class 2.1 Flammable Gases to determine hazard.

Table 7.4.1 Preliminary screening assessment

Material	Type	Max quantity on site	Distance to site boundary [m]	Distance to sensitive receptor	Screening threshold or minimum separation distance (other land uses)	Screening threshold or minimum separation distance (sensitive receptors)	Notes
Natural Gas	Class 2.1 Flammable Gas	3t (Note 1)	< 20m	2,000m	70m (Figure 7.3.1)	90m (Figure 7.3.1)	Above threshold

Note 1: Assuming density equal to 0.7226 kg/m^3

7.4.3 Potential Impacts

Identified hazards

Transport fire hazards

Natural gas would be transported to the proposed power station via gas pipelines. Generic transport hazards associated with natural gas include:

- Loss of containment from pipework due to corrosion, mechanical damage, and fitting leaks
- External events including earthquake, flooding, lightning, and bushfire
- Releases due to venting operations
- Loss of containment during pigging operations
- Failure of temperature and pressure controls
- Dispersion of natural gas from the stack during venting operations with the potential for ignition

Pipeline fire hazards

Specific transport hazards associated with the storage of natural gas are:

- Fatigue resulting from the pressure changes in the pipeline
- Low temperatures resulting from pipeline pressure reduction and blowdown operations
- Inadequate support of the pipeline resulting in increased pipeline stress and reduced pipeline life

Cumulative impacts

The Proposal would be designed to relevant standards to appropriately contain, maintain and operate potential fire ignition and explosive sources. It is anticipated that similar design and safety and protection measures would be employed at other facilities in the area and no cumulative impacts would result.

7.4.4 Avoidance, mitigation and management

The FSS provided a number of key fire prevention strategies and measures to avoid, manage or minimise the potential risks identified above. These measures are summarised in Table 7.4.2.

Table 7.4.2 Avoidance, mitigation and management measures – Fire safety

ID	Environmental Safeguard	Timing
FS-1	The storage and associated piping systems for gases in the gaseous or liquefied states would comply with NFPA 54, NFPA 55, NFPA 56, NFPA 58, and ASME B31.1/B31.3/B31.8 as applicable.	Pre-construction
FS-2	The detailed design would provide for the subdivision of separate fire areas for the purpose of limiting the spread of fire, protecting personnel, and limiting the resultant consequential damage to the plant. Fire areas would be separated from each other by fire barriers, spatial separation, or other approved means.	Pre-construction
FS-3	Hydrocarbon detection systems would be provided in areas of the facility where congestion and hydrocarbon loss may occur.	Pre-construction
FS-4	Hot works would be controlled by appropriate Control of Work permitting processes, if required.	Construction Operation
FS-5	Diesel tanks would be designed, installed, and operated in accordance with relevant Australian Standards.	Construction Operation
FS-6	A hydrant system comprising at least one hydrant riser per tank would be installed along with a mobile monitor.	Construction
FS-7	Foam concentrate and powder-type extinguishers would be provided along with a minimum of three powder-type extinguishers for the storage area.	Pre-construction
FS-8	A smoke detection system would be installed throughout rooms containing electrical equipment, including walk-in-type consoles, above suspended ceilings where combustibles are installed, and below raised floors. Where the only combustibles above the false ceiling are cables in conduit and the space is not used as a return air plenum, smoke detectors are permitted to be omitted from this area.	Pre-construction
FS-9	An aspirating smoke detection system would be considered for fire detection with Argonite gaseous suppression systems in cabinets and FM200 gaseous suppression in the switch rooms.	Pre-construction
FS-10	A fire detection system would be provided for each generator housing.	Pre-construction
FS-11	Fireproofing of supports and structures potentially exposed to a jet fire would be considered during design based on the requirements of API 2118.	Pre-construction
FS-12	Bund capacity in the diesel storage area would be sufficient for spill containment and firefighting purposes.	Pre-construction
FS-13	Fire water storage capacity would be provided to comply with NFPA 850 requirements.	Pre-construction

Residual environmental risk

8 Residual environmental risk

This section provides an overview of the risk assessment process undertaken within this EIS. It provides a summary of identified risks, proposed mitigation measures and potential residual risks following the application of the mitigation and management measures identified in Chapter 9.

8.1 Assessment methodology

The risk assessment was guided by AS ISO 31000:2018 Risk management guidelines and involved identifying a 'likelihood' and 'consequence' to each identified environmental impact due to the construction and operation of the Proposal. The 'likelihood' of a risk occurring is represented by the probability of its occurrence, whilst the 'consequence' explores the magnitude of impact should the risk occur. The associated risk is then calculated based on the identified level of likelihood and consequence as described in Table 8.1.1 and Table 8.1.2.

Table 8.1.1 Consequence and likelihood criteria

Consequence			Likelihood	
Descriptor	**Social**	**Environmental**	**Descriptor**	**Likelihood definition**
Insignificant	No adverse human health effects.	No adverse effects on natural environment.	Rare	May occur in exceptional circumstances i.e. less than 10% chance of occurring in the identified time period if not mitigated.
Minor	Short term disruption to employees, customers or neighbours.	Minimal effects on natural environment.	Unlikely	Has a 10-30% chance of occurring in the future if the risk is not mitigated.
Moderate	Frequent disruptions to employees, customers or neighbours.	Some damage to the environment, including local ecosystems, some remedial action may be required.	Possible	Has a 40-60% chance of occurring in the identified time period if the risk is not mitigated.
Major	Permanent physical injuries and fatalities may occur.	Significant effect on the environment and local ecosystems. Remedial action likely to be required.	Likely	Has a 60-90% chance of occurring in the identified time period if the risk is not mitigated.
Catastrophic	Severe adverse human health effects, leading to multiple events of total disabilities.	Very significant loss to the environment, may include localised loss of species, habitats or ecosystems.	Almost certain	Has a greater than 90% chance of occurring in the identified time period if the risk is not mitigated.

Table 8.1.2 Risk rating criteria

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Low	Moderate	High	Extreme	Extreme
Likely	Low	Moderate	Moderate	High	Extreme
Possible	Low	Low	Moderate	High	Extreme
Unlikely	Low	Low	Moderate	Moderate	High
Rare	Low	Low	Low	Moderate	Moderate

8.2 Risk and residual risk assessment

The aim of the risk assessment is to identify the environmental and social impacts of the Proposal and how, through the design of the Proposal, and the implementation of mitigation and management measures, these impacts have been reduced. As such, the risk assessment considers potential environmental impacts that have a 'moderate' or higher risk before the application of any mitigation or management measures. Unmitigated environmental impacts that have a low risk such as GHG emissions, impact to Aboriginal values (excluding archaeology), EMF and flooding were not reviewed through this process, as while these impacts would reduce, the risk would remain low or negligible. These risks have been assessed under the worst case scenario (continuous operation) as per the impact assessment section and actual impacts under peaking operation would be lesser.

The results of the risk and residual risk assessment are presented in Table 8.2.1.

A summary of remaining residual risks and description of further management is provided in Section 8.3.

Table 8.2.1 Risk and residual risk assessment

Potential impact	Risk assessment			Proposed mitigation	Residual risk assessment		
	Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Biodiversity							
Adverse impacts to the Ramsar-listed Hunter Estuary Wetlands	Unlikely	Major	Moderate	B1, B2	Rare	Minor	Low
Adverse impacts to threatened flora species and habitat including *Eucalyptus parramattensis* subsp. decaden*s* (Earp's Gum)	Almost certain	Moderate	High	B1, B2, B3, B7, B8, B9, B10	Almost certain	Minor	Moderate
Adverse impacts to threatened fauna species including the Squirrel Glider	Possible	Moderate	Moderate	B1	Possible	Minor	Low
Adverse impacts to Koala habitat	Unlikely	Minor	Low	B4, B5	Possible	Minor	Low
Impacts to wildlife corridors and connectivity	Possible	Minor	Low	B1, B2	Unlikely	Minor	Low
Impacts to Coastal Protected Area under the SEPP (no. 71 – Coastal Protection)	Possible	Moderate	Moderate	B1, B2	Unlikely	Minor	Low
Adverse impacts to migratory species	Unlikely	Minor	Low	B1	Unlikely	Minor	Low
Adverse impacts to native vegetation (excluding Earps gum)	Almost certain	Moderate	High	B1, B2, B3, B6, B7, B8, B9, B10	Likely	Minor	Moderate
Surface water and hydrology							
Impacts to surface water quality affecting the Ramsar-listed Hunter Estuary Wetlands – Construction	Unlikely	Major	Moderate	SW1, SW2, SW3, SW4, SW5, SW7, SW8, SW9, SW10, SW11, SW16, SW17, SW18, SW19, SW21, SW22, SW27, SW28, SW29	Rare	Insignificant	Low
Impacts to surface water quality affecting the Ramsar-listed Hunter Estuary Wetlands – Operation	Rare	Major	Moderate	SW10, SW16, SW17, SW18, SW19, SW21, SW27, SW29, SW30	Rare	Minor	Low

Potential impact	Risk assessment			Proposed mitigation	Residual risk assessment		
	Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Impacts to surface water quality locally - Construction	Possible	Moderate	Moderate	SW1, SW2, SW3, SW4, SW5, SW7, SW8, SW9, SW10, SW11, SW16, SW17, SW18, SW19, SW21, SW22, SW27, SW28, SW29	Unlikely	Minor	Low
Impacts to surface water quality locally - Operation	Possible	Moderate	Moderate	SW10, SW16, SW17, SW18, SW19, SW21, SW27, SW29, SW30	Unlikely	Minor	Low
Adverse impacts to localised and downstream hydrology - Construction	Possible	Moderate	Moderate	SW1, SW2, SW3, SW4, SW7, SW7, SW8, SW10, SW11, SW12, SW16, SW17, SW18, SW21, SW22, GW6	Unlikely	Minor	Low
Adverse impacts to localised and downstream hydrology - Operation	Unlikely	Moderate	Moderate	SW3, SW16, SW17, SW18, SW21, SW30, GW7	Unlikely	Minor	Low
Groundwater							
Adverse impacts to groundwater quality affecting the Ramsar-listed Hunter Estuary Wetlands	Unlikely	Moderate	Moderate	GW1, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9, GW10, GW11, SC4	Rare	Moderate	Low
Impacts to aquifer levels and flows (not linked to Tomago Sandbeds)	Possible	Moderate	Moderate	GW2, GW3, GW7	Rare	Minor	Low
Adverse impacts to the drinking water catchment	Unlikely	Moderate	Moderate	SW1, SW2, SW3, SW4, SW7, SW8, SW9, SW10, SW11, SW16, SW17, SW18, SW26, SW27, SW28, SW30, GW6	Unlikely	Minor	Low
Adverse impacts to GDEs	Likely	Minor	Moderate	B1, B2	Rare	Minor	Low
Air quality							
Impacts to air quality on site during construction due to erosion, dust and excavation works	Almost certain	Minor	Moderate	AQ2, AQ3, AQ4	Unlikely	Minor	Low
Impacts to surrounding sensitive receivers from dust moving offsite during construction	Possible	Minor	Low	AQ2, AQ3, AQ4	Rare	Minor	Low

Potential impact	Risk assessment			Proposed mitigation	Residual risk assessment		
	Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Project contributing to exceedance of operational air quality criteria including $PM_{2.5}$ and acrolein	Almost certain	Moderate	High	AQ1, AQ6	Possible	Moderate	Moderate
Soils and contamination							
Disturbance and spread of ASS - Construction	Likely	Moderate	Moderate	SC2, SC3, SW5	Possible	Minor	Low
Disturbance of existing contamination on site during construction	Likely	Moderate	Moderate	SC2, SC3, SC4, SW2, SW3, SW7, SW8	Possible	Minor	Low
Fuel and chemical spills during construction causing land contamination	Unlikely	Moderate	Moderate	SC5, SW7, SW10, SW11, SW16, SW17, SW18, SW19, SW21, GQ6, GW5, GW10	Rare	Minor	Low
Fuel and chemical spills during operation causing contamination	Unlikely	Moderate	Moderate	SC6, SW10, SW16, SW17, SW18, SW21, GW10	Rare	Minor	Low
Ground disturbance for excavation and ground works mobilising erosive soils during construction	Almost certain	Moderate	High	SC1, SW1, SW2, SW28	Unlikely	Minor	Low
Aboriginal heritage							
Impacts to Aboriginal heritage archaeology during construction	Possible	Moderate	Moderate	AH3, AH4	Unlikely	Minor	Low
Traffic and transport							
Increase in traffic on local and regional road network - Construction	Possible	Moderate	Moderate	T1, T2, T3, T4, T5	Rare	Insignificant	Low
Decrease in road safety on local and regional road network - Construction	Possible	Moderate	Moderate	T1, T2, T3, T4, T5	Rare	Insignificant	Low
Decrease in LOS at local intersections - Construction	Possible	Moderate	Moderate	T1, T2, T3, T4, T5	Rare	Insignificant	Low
Noise and vibration							
Exceedances of construction noise criteria	Possible	Moderate	Moderate	NV1, NV2, NV7, NV16	Rare	Minor	Low

Potential impact	Risk assessment			Proposed mitigation	Residual risk assessment		
	Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Project causing exceedances of operational noise criteria	Possible	Moderate	Moderate	NV12, NV13	Rare	Minor	Low
Social and economic							
Impacts to local businesses during construction as a result of increased noise and traffic	Possible	Minor	Low	SE1, SE2	Rare	Insignificant	Low
Adverse impacts to the community and residents including safety, traffic, amenity etc.	Possible	Moderate	Moderate	SE3, SE6, SE10	Rare	Insignificant	Low
Visual amenity							
Adverse visual impacts of the Proposal from identified viewpoints	Likely	Moderate	Moderate	VA1, VA2, VA6	Possible	Minor	Low
Hazard and risk							
The Proposal directly impacts the safe operation of civilian and/or military aircraft	Rare	Major	Moderate	PR1, PR2, PR3	Rare	Moderate	Low
The Proposal increases the risk of a bushfire during operation	Unlikely	Major	Moderate	BF4, BF5, BF7, BF10, BF11	Rare	Moderate	Low

8.3 Conclusion

A summary of remaining residual risks and description of further management is provided in Section 8.2.

Table 8.1.2 identified that following the application of avoidance, mitigation, and management measures, the residual risks for the environmental impacts are considered to be either low or moderate. As such, the Proposal is unlikely to have a significant impact on the environment.

Of the risks assessed, 14 were identified as being of moderate risk following the application of appropriate management measures. These risks would either have a rare or low likelihood to occur but would result in significant consequences; or would occur regardless of the safeguards but with only minor consequences. The following sections discuss the environmental impacts where the residual risks are moderate.

8.3.1 Biodiversity

Impacts to threatened flora species and habitat would be caused through clearing of the Proposal area as described in Section 6.2.3. These impacts cannot be avoided, as the likelihood of occurrence is certain. In recognition of this impact, offsets have been recommended in the BDAR in Appendix D and would be implemented in accordance with the NSW Biodiversity Offsets Scheme.

8.3.2 Air quality

The residual risk from air quality human health impacts is the potential to exceed air quality criteria, should the reciprocating engine technology be used. Exceedances in air quality criteria would be managed through further discussions between AGL and the precured reciprocating engine manufacturer. However, this is based on the worst case scenarios and based on the use of the reciprocating engine technology. Should other technology be used (i.e. gas turbines), this residual risk would be low.

8.3.3 Soils and contamination

Contamination of land through accidental fuel or chemical spills may occur at any point during construction or operation. Although the likelihood of these incidents occurring is rare due to either measures incorporated during design or procedural mitigation management through the proposed CEMP and OEMP, they still may require continued monitoring or accidental procedures and remediation.

8.3.4 Noise and vibration

Operational noise levels would exceed the criteria without the installation of acoustic attenuation systems designed to achieve the attenuated sound power levels provided in the EIS. These levels would be specified in tender and contract documentation to ensure operational noise levels meet the attenuated sound power levels and the Proposal Noise Trigger Level. The modelling of exceedance criteria has been based on absolute worst case scenarios and would be rare occurrences due to mitigation proposed.

8.3.5 Hazards and risks

Safety and bushfire/structural fire risks are unlikely to occur with standard mitigation and management; however, they have the potential to result in a significant consequence, being injury or fatality. The hazard and risk assessments in this EIS recommend the design, specification, and installation of safety systems and procedures to inherently reduce the likelihood of such risks. The implementation of various safety and other management plans and procedures to educate personnel on safety, bushfire, fire, and explosion further reduces the risk to human health and the environment. Management plans would also require the implementation of regular inspections, checks, and safety routines into the operations schedule as required.

Mitigation and management

9 Mitigation and management

9.1 Introduction

This section summarises the avoidance, mitigation, and management measures recommended for the Proposal and any suggested monitoring programs. The implementation of these measures and programs through the design, construction, and operation would reduce the impact of the Proposal to that detailed in Chapter 6 of this EIS. These measures and programs would be prescribed through contract for inclusion within the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP) as applicable for application across all stages of the Proposal.

9.2 Environmental management

Construction Environmental Management Plan

Environmental management during construction of the Proposal would be undertaken in compliance with an approved Construction Environmental Management Plan. The CEMP would be prepared in accordance with the NSW *Guideline for the preparation of Environmental Management Plans* and the relevant Minister's Conditions of Approval.

Operational Environmental Management Plan

Environmental management during operation of the Proposal would be undertaken in compliance with an approved Operational Environmental Management Plan. The OEMP would be prepared in accordance with the NSW *Guideline for the preparation of Environmental Management Plans*, the relevant Minister's Conditions of Approval, and plant maintenance, monitoring, and inspection documentation.

Environmental measures and monitoring

Environmental measures and monitoring programs have been recommended at each stage of the impact assessment provided in Chapters 6 and 7of this EIS. These measures and programs would be incorporated into the CEMP and OEMP and implemented throughout all stages of the Proposal. The measures and programs are provided in Table 9.2.1.

Table 9.2.1 Summary of environmental measures and monitoring programs

ID	Measures and programs	Timing
General		
G-1	AGL would carry out the Proposal in accordance with the Project Application documents and the Minister's Conditions of Approval.	Pre-construction Construction Operation
G-2	Monitoring would be carried out in accordance with the requirements of an Environmental Protection Licence.	Operation
Cumulative impacts		
CU-1	AGL would continue to engage with Roads and Maritime as to the collaborative design and construction processes to reduce the cumulative visual impact of the projects (the Proposal and M12RT project).	Pre-construction Construction
Management planning		

ID	Measures and programs	Timing
M-1	The construction and operation would be carried out under the provisions of an Environmental Management System prepared in accordance with ISO 14001 or equivalent.	Construction Operation
M-2	The construction would be carried out under the provisions of a Construction Environmental Management Plan.	Construction
M-3	The operation would be carried out under the provisions of an Operational Environmental Management Plan.	Operation
Consultation		
CO-1	Consultation would continue with stakeholders during all stages of the Proposal.	Pre-construction Construction Operation
CO-2	Stakeholders, including adjoining landholders and the local community would be notified when construction and operation are planned to commence.	Construction Operation
Biodiversity		
B-1	A Biodiversity Management Plan would be prepared as part of the CEMP and implemented throughout construction. The Plan would include, but not be limited to: ▪ Plans showing areas to be cleared and areas to be protected, including exclusion zones, appropriate signage, protected habitat features and revegetation areas, vehicle and equipment parking areas, and stockpile areas ▪ Site inductions ▪ Location of threatened biodiversity ▪ Pre-clearing survey requirements ▪ Vegetation clearing procedures ▪ Procedures for unexpected threatened species finds and fauna handling ▪ Protocols to manage weeds and pathogens including a Plan of Management for the control of weeds, according to requirements under the NSW Biosecurity Act 2015 ▪ Protocols for soil and seed material to minimise transfer between sites ▪ Restriction of public access and associated impacts from domestic pets, waste dumping and damage to adjoining vegetation should be enforced pre, during and post construction ▪ Reduction in lighting levels at access road to avoid any adverse effects upon the essential behavioural patterns of light-sensitive fauna, in accordance with AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting ▪ Noise management practices ▪ Dust control measures	Pre-construction Construction
B-2	Detailed design would consider areas identified in the Biodiversity Development Assessment Report (BDAR) that host threatened species and communities and limits the intrusion of the Proposal into those areas.	Pre-construction Construction
B-3	Limit removal of trees to that required within the development footprint and reinstate logs and rocks, which are removed for pipeline construction, along the right of ways or relocate them to appropriate nearby habitats. ▪ A pre-clearing protocol would be implemented during clearing works, as follows: – Pre-clearance surveys would be undertaken to determine if any inhabiting fauna are present	Pre-construction Construction

ID	Measures and programs	Timing
	– A suitably qualified and trained fauna handler would be present during hollow-bearing tree clearing to rescue and relocate displaced fauna ■ Appropriate exclusion fencing around trees and woodland that are to be retained within the development footprint would be erected, considering allowance for Tree Protection zones in accordance with the Australian Standards	
B-4	Koala traffic signs would be installed along the access route from Old Punt Road.	Construction Operation
B-5	Any fencing required around proposed easements (not including fencing erected for safety of operation purposes) would have a Koala-friendly design, with a 20cm gap at the bottom to allow the movement of Koalas and other terrestrial fauna.	Construction Operation
B-6	A Biodiversity Offset Strategy would be prepared for the project.	Construction
B-7	Weed infestations within the construction footprint would be identified and mapped prior to construction.	Pre-construction
B-8	Appropriate wheel wash and hygiene procedures would be implemented to limit construction plant and vehicles spreading weed seeds, vegetation debris and loose soil to and from the Proposal area.	Construction
B-9	Weed controls would be monitored regularly to promote the rehabilitation of revegetated areas within the Proposal area. Supplementary active revegetation would be undertaken as required.	Operation
B-10	Open sections of trenches would be monitored as required for trapped animals such as small ground dwelling mammals.	Construction
Surface water and hydrology		
SW-1	A Surface Water Management Plan (SWMP) will be prepared as part of the CEMP and implemented throughout construction. It would include, but not be limited to: ■ Erosion and Sediment Control Plan ■ Stormwater Management Strategy ■ Dewatering Procedure ■ Acid Sulphate Soil Management Plan (ASSMP)	Pre-construction Construction
SW-2	A site-specific Erosion and Sediment Control Plan (ESCP) would be developed in accordance with the Blue Book. At minimum this would include: ■ Scheduling construction works to avoid periods of heavy rainfall, where possible ■ Incorporating a designated stable vehicle access road and construction phase car park ■ Minimisation of the area of exposed and unstable ground surfaces during construction ■ Using sediment control systems including geofabric on stockpiles, silt fences, sediment traps, contour berms, energy dissipators ■ Resealing or revegetating exposed surfaces as soon as practical ■ Dust suppression methodologies including the use of a mist/spray and limiting certain tasks once a wind threshold is reached ■ Clean/dirty water separation and management via a Stormwater Management Strategy ■ Contact with soil, sediment, groundwater and surface water where possible ■ A description of monitoring required (dust as well as certain contaminants)	Pre-construction Construction

ID	Measures and programs	Timing
	▪ A description of the inspection and maintenance of erosion and sediment controls required	
SW-3	A Stormwater Management Strategy would be developed including: ▪ Clean water diversion drains or berms to divert clean water runoff from the surrounding catchment around the construction site and into existing drainage lines to prevent the formation of new surface flow paths ▪ Separation of clean and dirty/contaminated stormwater within the construction site ▪ All surface runoff from disturbed areas will be directed via dirty water drains to sediment control structures which will ultimately run into the sediment basin/s ▪ Sediment basin sizing, location and maintenance regime in accordance with Blue Book and IECA guidelines ▪ Turbidity testing and treatment (via a Dewatering Procedure) ▪ A description of disposal/reuse options (e.g. reuse for dust suppression or irrigation or disposal to stormwater or sewer). ▪ Water quality monitoring ▪ Siting of waste and chemical storage areas ▪ Disposal of contaminated water at a licensed facility	Construction
SW-4	A Dewatering Procedure would be developed to instruct: ▪ Process for testing whether water meets discharge criteria ▪ Water treatment methods including flocculation and pH adjustment ▪ Discharge process and location/s including avoiding erosion or scour ▪ Water quality monitoring requirements ▪ Permits and records required ▪ Any water which cannot be treated to meet discharge criteria would be removed by sucker truck and transported for offsite disposal at a licenced facility	Construction
SW-5	An ASSMP would be developed and implemented and would include: ▪ Further site investigations to determine the areas of ASS that may generate sulphuric acidity from sulphide oxidation ▪ Preparation in accordance with the Port Stephens LEP 2013, the Port Stephens Council ASS Policy 2004, and the Acid Sulphate Soils Manual (ASSMAC 1998) ▪ Protocol to minimise the disturbance and exposure of ASS ▪ A description of the management/stockpiling requirements for each of the scenarios that may generate ASS (i.e. excavation or HDD) ▪ Methods for storing excavated ASS in conditions which simulate its natural state; or treatment and storage away from water bodies and drainage lines ▪ Bunding of exposed ASS storage and treatment areas to minimise and prevent spread of leachate ▪ Appropriate signage, barricading and sediment controls ▪ Recommended liming rates for generated ASS ▪ Method for lime treatment with machinery sufficient to perform adequate mixing ▪ A description of the maximum onsite residency time for untreated ASS ▪ A description of an emergency response protocol (i.e. where acidic runoff is generated)	Pre-construction Construction

ID	Measures and programs	Timing
	■ Steps to minimise groundwater dewatering (potentially oxidising unoxidised ASS) ■ A field screening test using hydrogen peroxide (H_2O_2) would be performed on excavated soils in areas where ASS or PASS is anticipated, or on suspect soils. Soils which record a pH of below 4 following oxidation should be managed as ASS ■ Record keeping requirements including: – ASS monitoring and laboratory testing results – Excavation records – Stockpile tracking – Register of lime used for ASS treatment – Register of any offsite disposal of treated ASS	
SW-6	The permanent piped connection to the Hunter Water Corporation (HWC) network would be installed as early works to provide water for construction purposes and minimise water deliveries to the Proposal area.	Pre-construction
SW-7	A procedure would be developed and implemented to minimise the risk of drilling waste (in the form of drilling fluids and hydraulic stimulation fluids) contaminating watercourses during drilling, completion, hydraulic stimulation and workover activities. Drilling fluid spills would be immediately contained, cleaned up and reported.	Construction
SW-8	The HDD entry and exit sites would be securely bunded to prevent the release of leachate from excavated material, drilling fluids, or spills entering the surrounding environment.	Construction
SW-9	A designated concrete washout area for concrete mixers and pump trucks, concrete chutes, tools and equipment would be established away from drainage lines and water bodies, which would be lined with impervious material. The washout capacity would be regularly checked before being used. The wash water would be left to evaporate, with dried concrete removed for recycling as required. Inspection of the capacity of the washout area and integrity of the liner would be undertaken prior to each use, and prior to rainfall events or site shut down, with improvements made as required. Wash water would be pumped out as required to maintain capacity or prior to rain events and disposed of as contaminated water.	Construction
SW-10	The use of pesticides in the project footprint would be limited where possible to avoid contamination of nearby watercourses/wetland areas.	Construction Operation
SW-11	Use of chemical treatment of hydrostatic test water would be avoided where possible. If necessary, chemical concentration to be calculated such that they are consumed in the hydrotesting process and only trace volumes would be present in any discharge.	Construction
SW-12	Water used in pressure testing would be collected following testing and disposed of off-site at a licensed facility.	Construction
SW-13	Any mulch stockpiles from cleared vegetation must be located at high points away from watercourses, with upgradient water diverted to avoid entering the stockpile.	Construction
SW-14	Mulch should not be used as part of erosion controls in the floodplain or along concentrated flow paths.	Construction
SW-15	Bunding and hazardous materials storage requirements include: ■ Appropriately bunded in accordance with relevant Australian Standards	Construction Operation

ID	Measures and programs	Timing
	■ Bund-wall expansion joints and fire suppression to be incorporated into design. ■ Sufficient capacity ■ Isolation valves for all bunds ■ A high-level alarm would be fitted to the sewage tank ■ Low- and high-level alarms would be fitted to the diesel tanks ■ Inspection and maintenance after rainfall ■ Bund areas and tanker loading/unloading areas having sufficient capacity	
SW-16	A register of all hazardous chemicals kept in the Proposal area is to be maintained and updated regularly.	Construction Operation
SW-17	Dedicated re-fuelling areas and spill controls, and appropriate chemical, fuel and liquid storage and handling would be undertaken during construction, in accordance with Australian standards.	Construction Operation
SW-18	Spill kits to be maintained in appropriate locations in accordance with Australian Standards, including where required inside machinery and vehicles.	Construction Operation
SW-19	A Spill Response and Containment Procedure would be developed including: ■ Training and PPE ■ Precautionary measures for handling and storage of chemicals and fuels ■ Spill response protocols (control, contain, clean up) ■ Contaminated soils to be disposed of appropriately ■ All spills to be reported and recorded in the Spills Register ■ Spill kits to be restocked following use	Construction Operation
SW-20	All vehicles, plant and equipment to be checked regularly for fuel tank and line leaks or failures.	Construction Operation
SW-21	Bunds and sumps should be regularly inspected, and capacity maintained by regular draining and disposal.	Construction Operation
SW-22	Licenced contractors would be engaged to collect, transport and dispose of liquid hazardous materials, waste solvents, paints and hydrocarbon products to an appropriate off-site facility in accordance with relevant NSW Environment Protection Authority (EPA) guidelines.	Construction Operation
SW-23	Management and maintenance of the sewage system must be carried out by suitably trained personnel.	Construction Operation
SW-24	The civil design of the power station will incorporate the principles in the Port Stephens Council DCP 2007 to ensure that the post-development flow rate and volume is equal to pre-development for all storm events.	Pre-construction
SW-25	The power station would be developed above the PMF level.	Pre-construction
SW-26	A Flood Preparedness Plan would be developed based on the PMF event, and would include: ■ Roles, responsibilities and communication procedures including emergency contacts ■ Monitoring procedures for rainfall and flood warnings (including BoM and local flood warning services) ■ Requirement for an environmental risk assessment prior to commencing excavation or trenching work in the event of a flood warning	Construction Operation

ID	Measures and programs	Timing
	■ Site shut-down and flood preparedness procedures to minimise harm to persons, plant and the environment ■ Actions in the lead up to the flood (such as monitoring water levels, filling excavations, completing erosion and sediment controls, removing hazardous materials and waste from the Proposal area, barricading, sealing tanks and containers to prevent overflows, tying down loose items) ■ Actions at the time of the flood (may include further evacuation, rescue, pollution prevention, spill response, and contingency measures) ■ Actions post-flood (including clean up and rectification) ■ Evacuation routes and procedures ■ Rescue procedures ■ Procedure for resuming operations ■ Reporting requirements and corrective actions ■ During its development, the Flood Preparedness Plan would be discussed with the SES and Council to ensure alignment with community evacuation arrangements.	
SW-27	Pre-construction surface water quality monitoring would be undertaken at the following monitoring locations: ■ Drainage Path 1 (at culvert crossing Pacific Highway) ■ Drainage Path 2 (at culvert crossing Pacific Highway) Water quality testing would be undertaken monthly (if water is present) and following elevated periods of rainfall for a period of at least 3 months prior to construction. Test results from pre-construction monitoring would be correlated with available monitoring data from the adjacent NGSF site to create a baseline dataset which could be used for comparison during construction and operation of the Proposal.	Pre-construction
SW-28	A surface water quality monitoring program would be implemented at the following monitoring locations: ■ Construction phase sediment basin/s (construction only) ■ Wet sump oil and grease separator (GPT) ■ Bio-retention system outflow ■ Drainage Path 1 ■ Drainage Path 2 ■ LEP Wetlands discharge location (downstream of the secondary drainage that meets Drainage Path 1) ■ Water quality testing would be undertaken monthly and following elevated periods of rainfall.	Construction Operation
SW-29	Regular inspection, monitoring and maintenance of erosion and sediment control structures would be undertaken in accordance with the ESCP and Blue Book. In addition, inspections would be undertaken immediately prior to and following heavy rainfall and rectifications made as required.	Construction
SW-30	Regular inspection and maintenance would be undertaken of: ■ Hazardous material containment facilities ■ Bunds and sumps ■ Vehicles, plant and equipment including tanks and line failures ■ Sewage tanks	Construction Operation

ID	Measures and programs	Timing
	■ Water storage tanks or ponds ■ GPT ■ Spill kits In addition, inspections would be undertaken immediately prior to and following heavy rainfall and rectifications made as required.	
SW-31	An Operation Environmental Management Plan (OEMP) will include a Stormwater Management Strategy including: ■ Drainage and temporary water storage systems, including separation of clean and dirty/contaminated water ■ Use of GPT (sediment and oil/water separator) and bioretention area ■ Reuse options (e.g. irrigation) ■ Water quality monitoring ■ Clean water discharge location and method ■ Disposal of contaminated water and sewage at a licensed facility	Operation
SW-32	A chemical drains system would be provided for collection and treatment of chemical spills and stormwater falling into bunded chemical storage areas (if outdoors). Chemical drains would be collected in a drains sump for testing and treatment before being piped to the process wastewater system.	Operation
Groundwater		
GW-1	A Groundwater Management Plan would be prepared, implemented and updated as required as part of the CEMP and OEMP. The plan would describe best practice control measures to reduce the risk of contamination of groundwater, or the substantial alteration of groundwater flows due to drawdown effects. The plan would detail: ■ Background groundwater quality and levels ■ Management of groundwater interference and dewatering ■ Groundwater testing and assessment ■ Groundwater discharge or reinjection criteria ■ Best practice controls ■ Spill response and containment plan ■ Contamination response plan ■ Drawdown contingency plan ■ Groundwater monitoring program The Groundwater Management Plan would include a groundwater monitoring program which would detail: ■ Groundwater monitoring required – Analytes/parameters (water quality) – Background concentrations – Criteria/thresholds ■ Groundwater levels ■ Frequency ■ Bore locations – The 10 existing monitoring bores on the power station site – Available boreholes at the NGSF site near the proposed pipeline corridor	Construction Operation

<table>
<tr><th>ID</th><th>Measures and programs</th><th>Timing</th></tr>
<tr><td></td><td>– Additional locations along the pipeline corridor
– At the directional drilling entry and exit pits (during construction)
– Upstream and downstream of the operational stormwater discharge point/s
■ Potential impacts
– Change in groundwater quality or levels
– Drawdown impacts
– Effects on GDE
– Effects on beneficial aquifers (including groundwater users)
■ Reporting requirements
■ Protocol for the investigation, notification and mitigation of any identified exceedances of the groundwater quality criteria
Monitoring requirements would be reviewed once the details of the construction are finalised and during construction.</td><td></td></tr>
<tr><td>GW-2</td><td>Limit the extent of impervious surfaces to allow aquifer recharge.</td><td>Pre-construction</td></tr>
<tr><td>GW-3</td><td>Minimise long-term disturbance of groundwater flows through design, such as incorporating permeable zones that allow groundwater to bypass the buried gas pipeline.</td><td>Pre-construction
Construction</td></tr>
<tr><td>GW-4</td><td>When constructing the gas pipeline in areas of shallow groundwater, the following techniques should be considered to minimise groundwater impact:
■ Trenches below the water table would be excavated over short lengths to reduce the volume of groundwater impacted during construction
■ As required, use appropriate materials, such as trench shields or sheet piles, to maintain the stability of excavation walls
■ If practical, dewater to locally lower the water table beneath the floor of the excavation to provide a safe and dry working surface
■ Abstracted groundwater would be stored pending water quality testing, for either re-injection or infiltration (if water quality criteria are met) or disposal offsite at a licensed disposal facility
■ Replace material excavated from trenches to minimise changes to groundwater flows
■ Where possible, pipelines will be bedded on sand in the base of the trench</td><td>Construction</td></tr>
<tr><td>GW-5</td><td>■ When working along the pipeline route, additional precautions should be made when using or transporting fuels and chemicals, and any spills should be immediately contained and cleaned up. Any contaminated material to be removed from the site is to send to a licensed facility.</td><td>Construction</td></tr>
<tr><td>GW-6</td><td>Any water encountered and abstracted from the Tomago Sandbeds aquifer should be locally reinjected back into the aquifer on the hydraulically down gradient side, approximately 50m from the edge of the construction works
Prior to re-injection the abstracted groundwater must be inspected for any signs of contamination (high turbidity, oily sheen or odour of hydrocarbons) and tested for water quality parameters (temperature, dissolved oxygen, redox, EC, and pH), which would be compared to measurements from nearby monitoring wells.
If greater than 10% difference with the groundwater measurements treatment would be required prior to re-injection.
If collected groundwater does not meet criteria for re-injection, then the collected groundwater must be disposed to a facility licenced to accept and treat contaminated water.</td><td>Construction</td></tr>
</table>

ID	Measures and programs	Timing
GW-7	Undertake infiltration rate tests at locations of proposed groundwater discharge areas or infiltration basins to determine local infiltration rates and the presence of indurated sand layers capable of inhibiting groundwater recharge.	Construction Operation
GW-8	Process water would be managed to prevent discharge to surface water systems or groundwater.	Operation
GW-9	Sealed pavement areas should be used for refuelling and chemical storage areas to minimise the risk of spills infiltrating to groundwater.	Construction Operation
GW-10	Prepare a remediation action plan for major spills or other incidents which may cause impact to groundwater quality. This may include hydraulic containment using downgradient berms and pumps.	Construction Operation
GW-11	Rehabilitate compacted areas which are not needed for operational activities by loosening the soil, adding organic matter and revegetating the area.	Post-construction
Air quality		
AQ-1	The power station would be fitted with a Continuous Emission Monitoring Systems (CEMS) to demonstrate ongoing regulatory compliance, ensure proper and efficient operation of pollution control equipment, and evaluate operating and emission variability.	Pre-construction Operation
AQ-2	The CEMP will include requirements to monitor and manage potential air quality impacts associated with the construction of the Proposal. The CEMP will identify project construction activities with the potential to have air quality impacts and the controls required to avoid, minimise and mitigate these impacts. The plan will include measures to: ▪ Minimise dust generation from stockpiles, haulage routes, work activities and exposed ground surfaces ▪ Minimise generator and vehicle emissions ▪ Cover or minimise truck loads ▪ Reduce speeds on unsealed roads ▪ Modify or cease dust generating works during unfavourable weather conditions ▪ Inspect and address corrective actions	Construction
AQ-3	Any long-term stockpiles would be stabilised and are to be managed to suppress dust emissions.	Construction
AQ-4	Demolition activities, including removal of hazardous building materials, will be planned and carried out in a manner that minimises the potential for dust generation. Removal of hazardous building materials will be completed prior to the commencement of general demolition works.	Construction
AQ-5	Vegetation or other materials are not to be burnt on site.	Construction Operation
AQ-6	All air quality requirements and monitoring would be adhered to in accordance with an EPA license.	Operation
Soils and contamination		
SC-1	Heavy vehicles and machinery would use allocated tracks where possible to minimise soil erosion.	Construction
SC-2	Where highly contaminated soil and/or groundwater is impacted, a site-specific remediation action plan would be required to manage the material. This would include management requirements that are above those outlined within the CEMP. It	Pre-construction Construction

ID	Measures and programs	Timing
	may be specific to the selected remediation technique and detail the requirements of a specialist remediation contractor.	
SC-3	A pre-demolition hazardous materials survey is required for the demolition of the residential dwelling on Lot 3. Based on the findings, required controls would be implemented for removing the identified materials.	Construction
SC-4	A spills protocol would be developed as part of the OEMP, including: ▪ Fuel/chemical spill protocols – spill kits to be available and relevant workers to be trained on response protocols ▪ A formal reporting procedure - any spills to be reported on the Spill Register ▪ A register of all hazardous chemicals kept on site is to be maintained and updated regularly ▪ Appropriate recorded spill capture points (i.e. bunding, collection sump, etc) ▪ Maintenance requirements of effluent-related infrastructure or disposal to stormwater or sewer)	Operation
SC-5	Monitoring of contamination would be included in the CEMP which would include: ▪ Further assessment of identified contamination AECs prior to construction to determine remedial actions ▪ Hazardous materials (HAZMAT) asbestos and lead paint surveys of any buildings or structures within the Proposal area prior to demolition ▪ Monitoring to be detailed in Proposal construction environmental management plans	Construction
SC-6	Construction of sediment basin/s would be in accordance with the specifications outlined in Appendix I.	Construction Operation
Aboriginal heritage		
AH-1	Cultural awareness induction for any personnel involved in ground breaking activities. This could include a Cultural Awareness Training Program.	Construction
AH-2	A Cultural Heritage Management Plan including potential monitoring and salvage works procedures would be prepared and implemented for the Proposal construction.	Construction
AH-3	Chance Finds Procedure to be followed for any Aboriginal heritage objects found during the works. In the event an Aboriginal heritage object is found all activity in the immediate area must cease and an appropriately qualified heritage professional should be consulted. OEH and local Aboriginal stakeholder groups must be immediately contacted and informed of the Aboriginal heritage object found. The qualified heritage professional should record the location and the attributes of the site and determine its Aboriginal cultural significance. If Aboriginal remains (human skeletal material or suspected human skeletal material) are discovered during construction all activities in the immediate area must cease. The State Police and OEH must be contacted and any sand or soil removed from the near vicinity identified and set aside for investigation purposes.	Construction
AH-4	Repatriation of archaeological material is to be conducted for artefacts and charcoal recovered during test excavations. The location of the reburial must be determined by the RAPs and should be as close as possible to the location at which the sites were recovered.	Construction
AH-5	A copy of the final ACHAR should be distributed to all Aboriginal organisations who expressed interest in the proposed works.	Pre-construction
AH-6	A copy of the final ACHAR including comments and recommendations by RAPs should be provided to the relevant OEH regional branch.	Pre-construction

ID	Measures and programs	Timing
Traffic and transport		
T-1	Parking for construction staff is to be provided within the NPS site.	Construction
T-2	A Construction Traffic Management Plan (CTMP) would be prepared by the contractor to safely manage traffic movements to and from the Proposal.	Pre-construction
T-3	Over Size Over Mass vehicle requirements would be addressed in Traffic Control Plans within the CTMP.	Pre-construction
T-4	A Drivers Code of Conduct would be prepared that directs all heavy vehicles to access the site via the Pacific Highway and Old Punt Road intersection.	Pre-construction
T-5	A CHR turn treatment on Old Punt Road is required to allow for the safe movement of construction traffic turning right into the site. This must be designed in accordance with the Austroads Guidelines.	Pre-construction
Noise and vibration		
NV-1	A Construction Noise and Vibration Management Plan (CNVMP) would be prepared prior to the commencement of works to manage high noise works, affected receivers, complaints handling and consultation protocols, and out of hours work.	Construction
NV-2	Respite periods of one hour would be employed for every three hours of work where works are anticipated to generate noise levels > 75dBA at a receiver.	Construction
NV-3	Appropriate plant and equipment would be selected for the task at hand and efficient work practices would be adopted to minimise the construction period and the number of noise sources on site.	Construction
NV-4	Power down plant and equipment when not in use and avoid high engine speeds when lower speeds are sufficient.	Construction
NV-5	All construction plant and equipment would be maintained in suitable condition prior to mobilisation to the site and during construction.	Construction
NV-6	Particular emphasis would be placed on construction maintenance of exhaust silencers, covers on engines and transmissions, and poorly maintained components.	Construction
NV-7	Excessively noisy machines would be taken out of service for repair or removed from the site.	Construction
NV-8	Tonal motion alarms (beepers) would be avoided in favour of broadband motion alarms (quackers).	Construction
NV-9	Where night works are required, works with the potential to generate impulsive noise would be avoided.	Construction
NV-10	Noise complaints would be managed by the construction contractor in accordance with the CEMP.	Construction
NV-11	Appropriate plant and equipment would be selected for the task at hand so that lower vibration/lower impact plant would be chosen over that with a higher impact.	Construction
NV-12	Plant and equipment selected for the Proposal would have sound power levels not exceeding those presented in Section 6.9 of the EIS – Attenuated Sound Power Levels at Source.	Operation
NV-13	Where the attenuated noise levels from the Proposal exceed the predicted noise levels, further attenuation and/or analysis would be carried out to assess and recommend additional measures.	Operation

ID	Measures and programs	Timing
NV-14	Where noise complaints are validated, operator attended noise measurements would be undertaken to measure and compare the site noise level contributions with the NMLs presented in the EIS.	Construction
NV-15	Where noise monitoring is carried out, all site noise levels would be measured.	Construction
NV-16	Where noise monitoring identifies an exceedance, management measures would be designed and implemented to ensure ongoing compliance.	Construction
NV-17	Where vibration complaints are validated, vibration monitoring would be undertaken to identify the nature and extent of any exceedances.	Construction
NV-18	Where vibration monitoring identifies an exceedance, management measures would be designed and implemented to ensure ongoing compliance.	Construction
Social and economic		
SE-1	AGL would use social procurement policies to employ local labour, local and regional businesses, contractors and supply companies for provision of labour, goods and services.	Construction Operation
SE-2	Detailed advanced notice of goods and services required by the Proposal would be issued to assist local businesses and services meet the needs of the Proposal. AGL would require all tenderers on the Proposal to prepare a Local Industry Participation Plan and an Indigenous Engagement Plan as a mandatory component of each tender.	Construction Operation
SE-3	Community consultation would be ongoing throughout the Proposal life. Public notifications, letterbox drops, and emails would be used to update the local community on the Proposal's progress and scheduling of works, particularly works which would have an impact on public amenity such as noisy night works.	Construction Operation
SE-4	Throughout the Proposal planning, construction and operation, AGL would continue consultation with the following key stakeholders: ▪ DPIE ▪ Paterson electoral division ▪ Newcastle electoral division ▪ Port Stephens Council ▪ Roads and Maritime ▪ Hunter Water Corporation ▪ Department of Defence ▪ Civil Aviation Authority ▪ Newcastle Airport Department of Energy and Environment	Pre-construction Construction Operation
SE-5	AGL would continue dialogue groups with representatives from Port Stephens Koalas, Hunter Wildlife Rescue, Wahroonga Aboriginal Corporation, HWC and Hunter Region Botanic Gardens.	Construction Operation
SE-6	A Local Community Investment Program would be established for the Proposal once construction commences and would continue into operation. The Proposal would further facilitate, or support initiatives aimed at community development, capacity building and strengthening community institutions.	Construction Operation
SE-7	AGL would continue to develop their working relationships with local area emergency service provides including Raymond Terrace police, ambulance and fire services, and regional hospitals, to prepare for emergencies and advise on risks to	Construction Operation

ID	Measures and programs	Timing
	or from the Proposal. Proposal design will provide sufficient access for emergency vehicles and equipment including firefighting and rescue.	
SE-8	AGL's existing 'Fitness for Work Policy' will be enforced, and all staff, contractors and visitors will undergo site inductions to be familiar with the construction safety management plan and emergency management plan, as well as occupational health and safety requirements.	Construction Operation
SE-9	First aid facilities will be provided on site.	Construction Operation
SE-10	Community liaison would be undertaken throughout the construction and operation phases. A 24-hour information line would be established for any concerned residents to enquire about the Proposal, and a complaints register would be maintained for the life of the Proposal.	Construction Operation
SE-11	AGL would monitor socio-economic parameters so that the effects of the Proposal on the socio-economic conditions of the local area can be quantified during the Proposal and additional management measures can be applied where required. These parameters may include: ▪ Number of direct jobs created for local and regional residents ▪ Number of contracts with local businesses and their monetary value ▪ Funding provided to community organisations and groups ▪ Housing and accommodation requirements of the workforce ▪ Number of staff who remain in the community after construction ▪ Stakeholder and community feedback	Construction Operation
Visual amenity		
VA-1	The power station design including all plant facilities such as diesel storage and operational and amenity buildings would be located insofar as is practical to reduce the requirement to clear vegetation and to reduce the angle from passing viewpoints.	Pre-construction
VA-2	A landscape design workshop would be considered to establish the means to minimise the visual impact and visibility of the Proposal. The workshop would assess the retention of trees, the planting of new and endemic vegetation, and viewpoint specific plantings to eliminate visual impacts from specific locations.	Pre-construction
VA-3	A site landscape plan would be prepared that emphasises integration of new plantings with existing vegetation and that includes opportunities to provide screen plantings. The landscape plan would include (but not limited to): ▪ Visual and ecological planting patterns of locally endemic species to emulate existing mixes of tree and grass cover in the surrounding landscape ▪ Installation of temporary screens to minimise exposure of construction areas from local viewpoints ▪ Specific plantings would be considered for screening the nearest residential receivers	Pre-construction Construction
VA-4	The power station design would seek to include the selection of visually sympathetic cladding and security fencing materials to reduce contrast and improve integration of the balance of plant and of the site as a whole.	Pre-construction
VA-5	The lighting design would be in accordance with AS4282-1997 Control of the obtrusive effects of outdoor lighting.	Pre-construction
VA-6	The site-specific CEMP would include the following:	Construction

ID	Measures and programs	Timing
	■ Where possible, lights would be used at the lowest effective level and would be directed downwards to the work area and away from incoming viewpoints ■ Construction lighting would be kept to a minimum necessary for safety and security needs and would not be directed in a manner so as to shine toward oncoming traffic on the Pacific Highway ■ Night works would be limited where possible to avoid areas that are exposed to direct views along Pacific Highway and workers will be trained in the management of night time lighting ■ Inspection and maintenance schedules of the following construction elements and mitigations for visual impacts: ■ Construction lighting direction ■ Temporary construction fencing and screening ■ Delineated no-go areas ■ Vegetation plantings and rehabilitation	
VA-7	A site-specific OEMP will be prepared for the Proposal. The OEMP would include the following inspection requirements: ■ Inspection and maintenance of security lighting direction to ensure it is directed to the worksite and away from neighbouring land uses ■ Inspection and maintenance of security fencing to remove litter and graffiti ■ Inspection and maintenance of vegetation plantings and rehabilitation	Operation
Non-Aboriginal heritage		
NAH-1	If any heritage objects and/or relics are uncovered during the construction of the Proposal the following steps would be followed: ■ All activity in the immediate area would cease immediately ■ The project manager would be notified ■ Flagging or fencing would be erected to demarcate and protect the area ■ Site personnel and visitors would be advised to avoid the area until further notice ■ An appropriately qualified heritage professional would be consulted to confirm if the object/s is a heritage item or relic ■ The Office of Environment and Heritage (OEH) would be contacted ■ An appropriately qualified heritage professional would record the location and attributes of the site and determine the significance of the find Heritage objects and/or relics may include glass, ceramic, metal, building footings, and building materials etc., as protected under NSW legislation.	Construction
NAH-2	In the event of the discovery of human skeletal material (or suspected human skeletal material) during project activities in the Proposal area the following steps would most likely be followed: ■ All activities and/or works in the immediate area would cease ■ The NSW Police would be immediately contacted along with the project manager and OEH ■ Flagging or fencing would be erected to demarcate and protect the area ■ Site personnel and visitors would be advised to avoid the area until further notice ■ Any sand or soils removed from the near vicinity of the find would be identified and set aside for assessment by the investigating authorities	Construction
Waste and recycling		

ID	Measures and programs	Timing
WR-1	Appropriate construction and demolition waste storage and disposal methods would be completed in accordance with the CEMP and Protection of the Environment Operations Act 1997 during possible demolition of the onsite property. This aims to reduce any transportation of harmful contaminant via surface water run-off into the surrounding waterway systems.	Construction
WR-2	A Construction Waste Management Plan (CWMP) and Operational Waste Management Plan (OWMP) would be developed and implemented prior to each stage. The plans would be developed with the following criteria: ▪ A hierarchical waste management approach would be used, from the most preferable (reduce, reuse or recycle wastes) to the lease preferable (disposal) to prioritise waste management strategies to avoid waste generation ▪ The CWMP and OWMP would be developed in accordance with the mitigation strategies described in the WSM which provides avoidance, mitigation, reuse, recycle or disposal methods for each waste stream identified in the NPS ▪ The plans would promote the use of materials with minimal packaging requirements, removal of packaging offsite by suppliers and fabrication of parts offsite ▪ Where waste cannot be avoided, waste materials would be segregated by type for collection and removal (for processing or disposal) by licensed contractors ▪ All waste types would be separated at source for recycling and apply a system of colour-coded waste storage containers to ensure the segregation of waste is affected as far as possible ▪ A licensed service provider would be appointed to collect general solid waste and hazardous waste during construction and operation ▪ Each waste type would be classified for transport to ensure correct handling ▪ Any waste that cannot be recovered or recycled would need to go to a licensed treatment or disposal facility where it would will be treated and disposed of according to its classification	Construction Operation
WR-3	An audit regime would be implemented, in accordance with the AGL Health and Safety Environmental Management System (HSEMS) during construction and operation which includes (but not limited to) quantities of waste, storage areas and contractor services.	Construction Operation
WR-4	Spoil that can be beneficially reused would be done so in accordance with the project spoil re-use hierarchy.	Construction
WR-5	Ongoing consultation would be required between AGL and HWC regarding the arrangement for the disposal of wastewater.	Construction Operation
Plume rise and aviation hazard		
PR-1	AGL would provide the plume rise assessment report to Airservices Australia, Department of Defence, and CASA for review prior to the commencement of construction.	Pre-construction
PR-2	AGL would consult with Airservices Australia, Department of Defence, and CASA and provide information necessary to allow for a flight chart amendment.	Pre-construction Construction Operation
PR-3	AGL would apply for approval from the Directorate of External Land Planning (DELP) for the erection of permanent and temporary structures in accordance with AC 139-08(0) – CASA Advisory Circular – Reporting of Tall Structures.	Pre-construction
Bushfire		

ID	Measures and programs	Timing
BF-1	An Emergency Management and Evacuation Plan (EMEP) would be developed and implemented prior to construction and operation. The EMEP would be developed in accordance with: ■ NSW RFS - A guide to developing a Bush Fire Emergency Management and Evacuation Plan ■ Australian Standard AS 3745:2010 - Planning for emergencies in facilities The EMEP would include: ■ Identify designated buildings or safe places that can provide refuge from bushfires (in accordance with AS3959:2018). ■ Consultation with the local NSW RFS, NSW Fire and Rescue and Port Stephens Bush Fire Management Committee ■ Assessment of response times and access for fire services ■ Ensuring persons are not exposed to bushfire impacts	Construction Operation
BF-2	Road access to the proposed NPS site would be available to the Fire Emergency Services through the incorporation of the following measures in design: ■ The NPS road system would consist of a perimeter road and a network of services roads to allow for multiple access routes ■ The perimeter road would be sealed and a minimum 8m wide forming part of the Asset Protection Zone (APZ) ■ Service roads would be sealed and a minimum of 4m wide, sign posted, and with direct access toward the main entry ■ An alternate access/egress will be considered during design in the event access to Old Punt Road or Old Punt Road itself is cut off or closed	Construction Operation
BF-3	A radiant heat impact of 23kW/m^2 or less would be achieved within design for the generator plant, equipment and fuel storage. This would be achieved through either: ■ Implementation of an APZ between the asset and the site boundary (as large as reasonably possible), ■ Installation of radiant heat barriers such as metal clad fencing or construction within a shed (in order to be able to decrease the APZ distance less than 32m), or ■ Suitable siting of infrastructure within the construction compound	Pre-construction Construction
BF-4	The bulk fuel (diesel) storage would be designed to be compliant with the Australian Standards AS1692:2006 and AS 1940:2017. The location of these storage areas would be located as far as possible from the primary bushfire hazard area. If compliance with AS1692:2006 and AS 1940:2017 is not possible, fire protection on the primary bushfire hazard side (east) of the plant and equipment area would as a minimum be compliant with AS 2419.1:2005 for the installation of fire hydrants.	Pre-construction
BF-5	Design of the proposed pipelines would take advantage of the existing bushfire protection measures. Where the final design layout demonstrates that any existing measures are insufficient, compliance with the requirements of the applicable pipeline standard; European LNG Code, EN 1473:2007 would be necessary.	Pre-construction
BF-6	Electrical transmission lines would have vegetation easements in accordance with the bushfire protection requirements of the Guide for the Management of Vegetation in the Vicinity of Electricity Assets (ISSC 3 – 2016).	Pre-construction Construction
BF-7	As described in ISSC 3, 2016, a 10m APZ would be established surrounding the boundary fence, where only maintained lawn or grasses are permitted.	Construction

ID	Measures and programs	Timing
BF-8	Administration, workshops and stores buildings located on the eastern side of the site (within 23m of the primary bushfire hazard) would be designed to a construction standard minimum of BAL 40.	Pre-construction Construction
BF-9	An emergency egress onto the Pacific Highway, using the existing Lot 2 residential access, will be further considered and included in the EMEP and operational management plans.	Construction Operation
BF-10	Water for firefighting would be provided through the installation of a ring main water supply and hydrants throughout the site. The water supply for the site would be capable of complying with the Australian Standard AS2419.1:2017.	Construction
BF-11	AZP's would be monitored through vegetation clearing maintenance activities.	Operation
Hazard and risk		
HR-1	The detailed design of the generator building/housing and associated equipment would clearly outline the basis of safety used to ensure that the explosive situations do not arise.	Pre-construction
HR-2	Rotating machines would be designed such that the risk associated with failure leading to uncontained projectiles is minimised.	Pre-construction
HR-3	The safety assessment process would continue to identify controls that prevent or limit the effects of major hazardous incidents on site, such as fire and explosion that could result in significant off-site effects.	Pre-construction
Fire safety		
FS-1	The storage and associated piping systems for gases in the gaseous or liquefied states would comply with NFPA 54, NFPA 55, NFPA 56, NFPA 58, and ASME B31.1/B31.3/B31.8 as applicable.	Pre-construction
FS-2	The detailed design would provide for the subdivision of separate fire areas for the purpose of limiting the spread of fire, protecting personnel, and limiting the resultant consequential damage to the plant. Fire areas would be separated from each other by fire barriers, spatial separation, or other approved means.	Pre-construction
FS-3	Hydrocarbon detection systems would be provided in areas of the facility where congestion and hydrocarbon loss may occur.	Pre-construction
FS-4	Hot works would be controlled by appropriate Control of Work permitting processes, if required.	Construction Operation
FS-5	Diesel tanks would be designed, installed, and operated in accordance with relevant Australian Standards.	Construction Operation
FS-6	A hydrant system comprising at least one hydrant riser per tank would be installed along with a mobile monitor.	Construction
FS-7	Foam concentrate and powder-type extinguishers would be provided along with a minimum of three powder-type extinguishers for the storage area.	Pre-construction
FS-8	A smoke detection system would be installed throughout rooms containing electrical equipment, including walk-in-type consoles, above suspended ceilings where combustibles are installed, and below raised floors. Where the only combustibles above the false ceiling are cables in conduit and the space is not used as a return air plenum, smoke detectors are permitted to be omitted from this area.	Pre-construction
FS-9	An aspirating smoke detection system would be considered for fire detection with Argonite gaseous suppression systems in cabinets and FM200 gaseous suppression in the switch rooms.	Pre-construction

ID	Measures and programs	Timing
FS-10	A fire detection system would be provided for each generator housing.	Pre-construction
FS-11	Fireproofing of supports and structures potentially exposed to a jet fire would be considered during design based on the requirements of API 2118.	Pre-construction
FS-12	Bund capacity in the diesel storage area would be sufficient for spill containment and firefighting purposes.	Pre-construction
FS-13	Fire water storage capacity would be provided to comply with NFPA 850 requirements.	Pre-construction

Conclusion

10 Conclusion

This chapter provides justification for the Proposal based on a review against the principles of Ecologically Sustainable Development, and consistency of the Proposal against the objects of the EP&A Act.

10.1 Ecologically Sustainable Development

An objective of the EP&A Act is to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment. Section 6(2) of the *Protection of the Environment Administration Act 1991* (POEA Act) states that ecologically sustainable development can be achieved through the implementation of the following principles and programs:

- The precautionary principle
- Inter-generational equity
- Conservation of biological diversity and ecological integrity
- Improved valuation, pricing and incentive mechanisms

The application of these principles to the Proposal is discussed in the following sections. This section shows that the Proposal is fully justifiable on the basis that it addresses each of the principles of ESD as enshrined in the POEA Act.

10.1.1 The precautionary principle

Section 6(2) of the POEA Act states that “if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation”. In the application of the precautionary principle, public and private decisions should be guided by careful evaluation to avoid serious or irreversible damage to the environment and an assessment of the risk-weighted consequences of various options.

In assessing and evaluating options for the Proposal, AGL has sought to understand the full environmental impact of the alternatives and to err on the side of caution in design decisions and in construction methodologies. Following extensive assessment of several locations, the Proposal area was chosen to minimise environmental impacts, and particularly to reduce the likely impacts of the Proposal on biodiversity, heritage, surface water, and groundwater. The proposed NPS site, electrical transmission corridor, and gas storage pipeline corridors have been located to minimise the removal of vegetation. Pipeline and transmission routes have been selected to maximise use of existing cleared easements and previously disturbed land. The use of HDD has been preferred over trenching in Freshwater Wetland Complex vegetation areas and under existing infrastructure to minimise environmental impacts.

The Proposal is subject to ongoing design development to determine the most cost-effective technology best suited to the Proposal requirements, the local environment, and the relevant statutory requirements of NSW. The impact assessment provided in Chapter 6 and the risk analysis in Chapter 7 have adopted a maximum parameters approach in accordance with Section 3.7.2 of the NSW *Draft Environmental Impact Assessment Guidance Series Preparing an Environmental Impact Statement* (DPE, 2017) to entrench the precautionary principle into the assessment of the Proposal. Lack of certainty around selection of a specific generation technology has been countered by assessing both options and using their maximum parameters to identify potential impacts.

A number of safeguards have been recommended in the EIS to assist in the mitigation and management of impacts. These safeguards would be adopted during construction and operation through the preparation and implementation of a CEMP and OEMP as appropriate. No safeguards recommended in the EIS would be deferred because of a lack of scientific certainty. The CEMP would instead be used as an opportunity to focus the recommended safeguards so as to be project and technology specific.

10.1.2 Intergenerational equity

Section 6(2) of the POEA Act states that "the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations".

The Proposal would be able to add balance to a fluctuating power market and to facilitate longer term reductions in greenhouse gas emissions. The majority of Australia's largest capacity power stations are powered by black and brown coal, and a large portion of these power plants are either reaching the end of their commercial lives or are already working beyond it (EA 2017). The development of gas powered generation will result in a 50 and 70% reduction in greenhouse gas emissions (APPEA 2019).

Increasing gas fired generation for electricity supply can assist in the transition towards a mix of renewables backed by peaking plants, energy storage technologies, interconnectors and improved demand management systems (EA 2017). The Proposal would support secure electricity generation in the future and reduce greenhouse gas emissions.

10.1.3 Conservation of biological diversity and ecological integrity

Section 6(2) of the POEA Act states "that conservation of biological diversity and ecological integrity should be a fundamental consideration" to achieve ecologically sustainable development.

A biodiversity assessment undertaken for the Proposal identified that biological diversity and ecological integrity would be maintained based on the Proposal described in Section 6.2 and the management measures recommended in Section 6.2.4. The BDAR provided an assessment of the impacts of the construction and operation of the Proposal on species, communities, and habitat within the Proposal area and the development footprint, as well as within the Ramsar-listed Kooragang Nature Reserve.

The BDAR is provided in full in Appendix D.

10.1.4 Improved valuation, pricing and incentive mechanisms

Section 6(2) of the POEA Act states that "environmental factors should be included in the valuation of assets and services". The Act describes polluter pays, life cycle costs, and incentive structures to efficiently address environmental problems.

The Proposal would operate under a number of polluter pays systems. Once commissioned, but before operations may commence, the Proposal would be subject to an Environmental Protection Licence issued by the EPA under Chapter 3 of the POEO Act. Process wastewater generated by the operation of the Proposal would be collected on site and transferred by tanker to an appropriately licensed offsite treatment facility. AGL would be responsible for the costs of this service, which would include the EPA's liquid waste levy that applies to trackable liquid waste when it is received at a waste facility. Other systems would include the requirement for a Section 138 permit under the *Roads Act 1993* to impact on public roads and the requirement for a licence under Part 3 of the *Pipelines Act 1967*.

AGL has applied life cycle cost analysis at the feasibility stage of programming in order to determine the overall viability of the Proposal, and business management planning for the Proposal includes the costs of planning, design, construction, operation, and decommissioning.

AGL is committed to social procurement through its 2017 *Procure to Pay Policy* and associated *Supplier Code of Conduct* that embeds sustainability principles into its supply chain practices. *Procure to Pay* establishes procurement principles including AGL's aim to meet its sustainability targets by:

- Implementing sustainability principles and values
- Selecting suppliers with similar sustainability values and commitments
- Influencing suppliers to reduce the social and environmental impact of the products and services provided to AGL
- Contributing to the development of local communities affected by AGL's operations through the creation of employment opportunities and the development of skills at a local level

- Investing in long-term collaborations with suppliers to support the implementation of initiatives aimed at reducing the social and environmental impacts of their products/services

Through the *Supplier Code of Conduct* AGL aims to collaborate with its suppliers in the areas of

- Strong corporate governance and ethical behaviours
- Robust risk management frameworks covering environmental, social and corporate governance
- Responsible labour policies, human rights, and non-discrimination
- Safe, healthy and secure work environments
- Improved community development
- Reduced direct environmental impact of its operations and that of the activities occurring along its supply chain
- Reduced adverse social, economic, and environmental effects of activities occurring along its supply chain

10.2 Objects of the EP&A Act

Table 10.2.1 provides a summary of the consistency of the Proposal against the objects of the EP&A Act. It shows that the Proposal is fully justified on the basis of its consistency with the EP&A Act.

Table 10.2.1 Consistency with the objectives of the EP&A Act

Object	Consistency
Clause 5(a) (i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The Proposal is an essential investment in the NSW energy sector. It is expected to deliver greater energy security as well as creating flow on economic and social benefits for the State, providing employment opportunities for the region, and investment into regional NSW. The proposed dual fuel power station would efficiently use resources and produce electricity at lower greenhouse gas emissions and with reduced environmental impacts than traditional coal fired power. The Proposal would also contribute to lower emissions by delivering firming capacity in support of intermittent renewables. The Proposal has been designed and located to minimise impacts on the environment, including on biodiversity, water quality, and visual amenity, and would bring positive social experiences to the local community and to the region. As part of the Proposal, AGL would offset: ■ Spotted Gum - Broad-leaved Mahogany- Red Ironbark shrubby open forest requiring 216 ecosystem credits ■ Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast requiring 8 ecosystem credits ■ Eucalyptus parramattensis subsp. Decadens, requiring 6 species credits ■ Squirrel Glider habitat, requiring 144 species credits ■ Koala habitat, requiring 5 species credits Full details of the proposed management regime for these offsets would be included in a requisite management plan prepared in consultation with NSW OEH.
Clause 5(a) (ii) To encourage the promotion and coordination of the orderly economic use and development of land.	The development footprint is wholly within land zoned IN1 Industrial under the Port Stephens LEP. Surrounding areas are proposed for industrial development under the Hunter Regional Plan 2036. The objectives of zone IN1 as stated in the Port Stephens LEP are: ■ To provide a wide range of industrial and warehouse land uses

Object	Consistency
	▪ To encourage employment opportunities ▪ To minimise any adverse effect of industry on other land uses ▪ To support and protect industrial land for industrial uses The Proposal is consistent with the objectives of IN1.
Clause 5(a) (iii) To encourage the protection, provision and co-ordination of communication and utility services.	The Proposal would contribute to the supply of electricity within the National Electricity Market and within NSW. It would supply electricity to the grid on short notice and at times when additional capacity is required. The Proposal would facilitate the protection, provision and co-ordination of electricity services.
Clause 5(a) (iv) To encourage the provision of land for public purposes.	The Proposal would allow for the supply of electricity to the National Electricity Market on short notice and at times when additional capacity is required. The Proposal would facilitate the provision of land for a public purpose, being electricity supply.
Clause 5(a) (v) To encourage the provision and coordination of community services and facilities.	The Proposal is to develop a power station and would not negatively impact on any community services or facilities in construction or operation. The Proposal would support community services and facilities by providing reliable power supply to the community and providing employment, expenditure, and investment in the local area.
Clause 5(a) (vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	The Proposal has been designed and located to protect and minimise impacts on the environment, including on biodiversity and water quality. This includes offsetting biodiversity impacts as mentioned in response to Clause 5(a) (vi). Full details of the proposed management regime for these offsets would be included in a requisite management plan prepared in consultation with NSW OEH. AGL is committed to achieving excellence in environmental management and performance, and their Environmental Policy includes adhering to high standards to protect the environment where they do business.
Clause 5(a) (vii) To encourage ecologically sustainable development.	The Proposal would encourage ecologically sustainable development. This is discussed in detail in Section 10.1.
Clause 5(a) (viii) To encourage the provision and maintenance of affordable housing.	The provision and maintenance of affordable housing is not relevant to the Proposal.
Clause 5(b) To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	The Proposal was declared CSSI in December 2018 after AGL lodged an application with the NSW Minister for Planning on 5 November 2018. The declaration came into effect following gazettal and inclusion in Schedule 5 of the State and Regional Development SEPP. As CSSI the Proposal requires approval from the Minister under Division 5.2 of the EP&A Act. Relevant clauses with the Port Stephens LEP have been considered during design development and within the environmental impact assessment process. This is discussed further in Section 4.3.
Clause 5(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.	Consultation with the community, key stakeholders, and relevant government agencies was undertaken during the planning and development of the Proposal. This EIS will be placed on public exhibition and submissions form the public will be invited. AGL has committed to ongoing consultation activities. Details of consultation undertaken and proposed are provided in Chapter 5.

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Appendix A SEARs and Agency Comments

Appendix B DoEE Controlled Action

Appendix C Supplementary SEARs

Appendix D Biodiversity Development Assessment Report

Appendix E Surface Water and Hydrology Specialist Study

Appendix F Groundwater Specialist Study

Appendix G Air Quality Impact Assessment

Appendix H Greenhouse Gas Assessment

Appendix I Soils and Contamination Specialist Study

Appendix J Aboriginal Cultural Heritage Assessment Report

Appendix K Traffic Impact Assessment

Appendix L Noise and Vibration Assessment

Appendix M Visual Impact Assessment

Appendix N Non-Aboriginal Heritage Assessment

Appendix O EMF Assessment

Appendix P Waste Management Strategy

Appendix Q Plume Rise Assessment

Appendix R Bushfire Threat Assessment

Appendix S Hazard Assessment

Appendix T
Fire Safety Study

Appendix U Proponent Environmental Record

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