Eraring Battery Energy Storage System

Environmental Impact Statement

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Origin Energy Eraring Pty Limited

SSD-15950052

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Author:	Ada Zeng & Thomas Muddle
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Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
Leve 4, 12 Steward Avenue
Newcastle West NSW 2302 Australia
PO Box 2147 Dangar NSW 2309 Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

www.jacobs.com

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Certification

This Environmental Impact Statement has been prepared under Part 4 Division 4.7 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Schedule 2 Part 3 of the Environmental Planning and Assessment Regulation 2000.

Applicant name	Origin Energy Eraring Pty Limited (Origin)
Applicant ABN	31 357 688 069
Applicant address	100 Barangaroo Avenue, Barangaroo NSW 2000 Australia
Land to be developed	Eraring Power Station, Rocky Point Rd, Dora Creek, Lake Macquarie local government area.
Formal Identifier	Parts Lot 10 and 11 DP 1050120
Proposed development	The Project would include the construction, operation and decommissioning of a grid-scale Battery Energy Storage System (BESS) with a discharge capacity of 700 megawatts and storage capacity of 2,800 megawatt hours including: ▪ BESS compounds comprising of rows of enclosures housing lithium-ion type batteries connected to associated power conversion systems (PCS) and high voltage (HV) electrical reticulation equipment; ▪ A BESS substation housing high voltage transformers and associated infrastructure; ▪ Approximately 400 metres of overhead 330 kilovolt (kV) transmission line connecting the BESS substation to the existing 330 kV TransGrid switchyard; and ▪ Ancillary infrastructure and facilities including safety protection systems and site ancillary facilities such as laydown areas and site offices. A full description of the Project is included in Chapter 3 of the EIS.
Prepared by	Jacobs Group (Australia) Pty Ltd
Address	Level 4, 12 Steward Avenue, Newcastle West NSW 2302 Australia
Author	Thomas Muddle Bachelor of Environmental Science and Graduate Diploma of Urban and Regional Planning
In respect of	State Significant Development 15950052
Certification	I certify that I have prepared the contents of the Environmental Impact Statement in accordance with Schedule 2 of the Environmental Planning and Assessment Regulation 2000 and the Secretary's Environmental Assessment Requirements dated 19 April 2021. This Environmental Impact Statement contains all available information that is relevant to the environmental assessment of the development and to the best of my knowledge the information contained in the Environmental Impact Statement is not false or misleading.
Signature	
Name	Thomas Muddle
Date	22 October 2021

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Glossary of terms and abbreviations

Term	Definition
ABS	Australian Bureau of Statistics
ACHAR	Aboriginal Cultural Heritage Assessment Report Required under the NSW *National Parks and Wildlife Act 1974*, where harm may come to Aboriginal objects or a declared Aboriginal place because of a project. It is a study that looks at what can be done during and after the project to manage and protect these objects and places.
AEMO	Australian Energy Market Operator
AEP	Annual exceedance probability The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a flood event has an AEP of 5% (one in 20 chance), then there is a 5% chance of that flood event (or larger event) occurring in any one year
AHD / m AHD	Australian height datum (in metres)
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
ALR Act	*Aboriginal Land Rights Act 1983* (NSW)
ARI	Average recurrence interval The long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as big as, or larger than the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
BAM	Biodiversity Assessment Method
BCD	Biodiversity and Conservation Division of the Department of Planning, Industry and Environment
BDAR	Biodiversity development assessment report
BESS	Battery Energy Storage System
BESS compound	Portion of the Project area south of Rocky Point Road identified as accommodating battery enclosures and associated power conversion systems, high voltage reticulation, cables and switchboards, switch rooms and control rooms
BESS substation	Portion of the Project area south of Rocky Point Road and east of the BESS compound identified as accommodating up to four 330/33kV transformers within bunded transformer bays and typical electrical equipment and ancillary infrastructure for the conversion electricity between the high voltage transmission network and low voltage BESS compound
BOS	Biodiversity offset scheme
BC Act	*Biodiversity Conservation Act 2016* (NSW)
CCC	Eraring Power Station Ash Dam Community Consultation Committee
CEMP	Construction environment management plan
CEMS	Construction Environmental Management Strategy for the Project
CES	Cooranbong Entry Site (coal mine)
CMP	Conservation management plan

Term	Definition
CLM Act	*Crown Land Management Act 2016* (NSW)
CNVG	Construction Noise and Vibration Guideline
COAG	Council of Australian Governments
CPTED	Crime prevention through environmental design
CSSI	Critical state significant infrastructure
CTMP	Construction traffic management plan
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DEC	Department of Environment and Conservation NSW (former)
DECC	Department of Environment and Climate Change NSW (former)
DECCW	Department of Environment, Climate Change and Water NSW (former)
DER	Distributed Energy Resources
Development footprint	In accordance with the wording of the BAM, the BDAR uses 'development footprint' to refer to the Project area
DPE	Department of Planning and Environment NSW (former)
DPIE	Department of Planning, Industry and Environment NSW
DUAP	Department of Urban Affairs and Planning NSW (former)
EIS	Environmental impact statement
EPA	Environment Protection Authority NSW
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPBC Regulations	Environment Protection and Biodiversity Conservation Regulations 2000 (Commonwealth)
EPL	Environment protection licence
EPS	Eraring Power Station
FCAS	Frequency Control Ancillary Services
FM Act	*Fisheries Management Act 1994* (NSW)
FTA	Fire Training Area
FTE	Full time equivalent
GDE	Groundwater dependent ecosystem
GL	Gigalitre (1×10^9 litres)
GW	Gigawatts
Ha	Hectares
HV	High voltage
ICNG	Interim Construction Noise Guideline
ICOMOS	International Council of Monuments and Sites

Term	Definition
Infrastructure SEPP	State Environmental Planning Policy (Infrastructure) 2007
kV	kilovolts
ISP	Integrated System Plan
LALC	Local Aboriginal land council
LEP	Local Environmental Plan
LGA	Local Government Area
Lithium-ion battery	A type of battery that is considered most feasible for the Project. The BESS will consist of pre-assembled battery enclosures containing lithium-ion type batteries
LMCC	Lake Macquarie City Council
MNES	Matters of national environmental significance
MW	megawatts
MWh	megawatt hours
NCA	Noise catchment area
NEM	National Electricity Market
NML	Noise management level (construction noise)
NSW	New South Wales
NT Act	*Native Title Act 1993* (Commonwealth)
OEH	Office of Environment and Heritage NSW (former)
Origin landholding	Land area owned and operated by Origin associated with the Eraring Power Station and ancillary operations and buffer lands
OSOM	Oversized overmass
PMF	Probable Maximum Flood
PNTL	Project noise trigger level (operational noise)
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
Project area	The total area of physical disturbance assessed as part of the Project including BESS compound, BESS substation, 330 kV transmission easement, TransGrid switchyard works and construction laydown areas
RAP	Registered Aboriginal party
RBL	Rating Background Level (in relation to noise)
REZ	Renewable Energy Zone
RFS	Rural Fire Service NSW
RL	relative level
RMS	Roads and Maritime Services NSW (former)
SEARs	Secretary's environmental assessment requirements
SES	State Emergency Service NSW
SHR	State Heritage Register

Term	Definition
SLCPs	short-lived climate pollutants
SRAS	System Restart Ancillary Services
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2011
SSD	State significant development
Switch bays	Part of a Substation or switchyard within which the switchgear and control gear relating to a given circuit are contained
TCFD	Task Force on Climate-related Financial Disclosures
The Project	Development of a standalone 700 MW battery storage system and ancillary infrastructure within the Origin landholding at Eraring
TIA	Traffic impact assessment
TfNSW	Transport for NSW
TransGrid switchyard	Existing TransGrid operated switchyard on lot 10 DP 1050120 connected to the NEM and EPS and surrounded by the Origin landholding
VRE	Variable Renewable Energy

Executive Summary

Background

Origin Energy Eraring Pty Limited (Origin) owns and operates the Eraring Power Station (EPS) which is one of Australia's largest power station, having a capacity of 2,880 megawatts (MW). EPS is scheduled to be among 14 gigawatts (GW) of coal-fired generation plants to be retired within the next few decades (AEMO, 2020).

Origin is seeking regulatory and environmental planning approval for the construction and operation of a grid-scale Battery Energy Storage System (BESS) with a discharge capacity of 700 MW and storage capacity of 2,800 megawatt hours (MWh) within the Origin landholding (the Project).

The Project is a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) and is subject to Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) which requires the preparation of an Environmental Impact Statement (EIS) in accordance with Secretary's Environmental Assessment Requirements (SEARs).

Project overview and purpose

The Project would include construction and operation of:

- BESS compounds comprising of rows of enclosures housing lithium-ion type batteries connected to associated power conversion systems (PCS) and high voltage (HV) electrical reticulation equipment;
- A BESS substation housing high voltage transformers and associated infrastructure;
- Approximately 400 metres (m) of overhead 330 kilovolt (kV) transmission line connecting the BESS substation to the existing 330 kV TransGrid switchyard; and
- Ancillary infrastructure and facilities including safety protection systems and site ancillary facilities such as laydown areas and site offices.

The Project is currently anticipated to be commissioned in stages in line with battery supply availability and increased demand for the Product in the NEM.

Construction works associated with the Project would be likely to involve, in general order:

- Installation and maintenance of environmental controls including drainage and sediment controls;
- Upgraded construction access track from existing internal access road to battery location;
- Vegetation clearing including for transmission easement and asset protection zones;
- Cut and fill to level areas and establish a hardstand pad;
- Structural works including numerous individual slabs to support battery modules, power conversion systems and transformer structures;
- Establishment of noise control solution if required by the stage under construction;
- Delivery, installation and electrical fit-out of battery modules, power conversion systems and transformers;
- Installation of tower structures including foundation piles;
- Installation of 330 kV overhead cabling from the substation transformers to the TransGrid switchyard;
- Minor works to connect the battery to vacant bay in the existing switchyard or more extensive works for bench extension and installation of new bay if required;
- Testing and commissioning activities; and
- Removal of construction equipment and rehabilitation of construction areas.

The Project has a primary purpose of delivering safe and reliable energy storage in New South Wales (NSW). The BESS will be capable of providing energy, Frequency Control Ancillary Services (FCAS), System Restart Ancillary

Services (SRAS), as well as fast frequency response and synthetic inertia – security services currently under consideration in the National Electricity Market (NEM).

Alternatives

Alternatives to the Project are considered at the site level and overall Project level and would continue to be developed through the design stages to ensure the design meets best practice requirements and can avoid or minimise any potential environmental, social and economic impacts.

Origin has assessed alternatives for the following considerations:

- A base case, 'do nothing' approach;
- Site selection alternatives; and
- BESS technology and provider alternatives.

It has been identified from reviewing the above options that the Project, as described in this EIS, best meets the Project's objective of facilitating the delivery of efficient, safe and reliable energy.

Location and existing environment

The Project would be situated within EPS located the western shore of Lake Macquarie. EPS is approximately 40 kilometres (km) south of Newcastle and approximately 120 km north of Sydney in NSW. The total area of the Origin's landholding is approximately 1,200 hectares (ha), including EPS operational areas, Eraring Ash Dam and surrounding buffer lands consisting of bushland and grassland interspersed with roads and water management and electricity transmission infrastructure.

The Project area is about 25 ha within an industrial area with the primary land use being energy generation. The Project area is located on a non-operational area in the south western portion of the Origin landholding associated with the EPS which has recently been rehabilitated.

The locality consists of broad acre rural development and low-density residential properties. The largest commercial centre and population centre nearby is Charlestown (29.1 km north east), and the closest residential suburb is Eraring then Dora Creek (1.2 km south). The closest sensitive receivers are is 600 m west and south of the Project.

The Great Northern Railway (also known as the Main North Line) alignment runs along the border of Dora Creek and Eraring suburbs, 200 m west of the Project. The M1 Pacific Motorway also runs in a north-south direction 3 km west of the Project.

The Project area and Origin landholding in proximity to the Project has been previously disturbed during the construction and operation of EPS and historic agricultural activity.

Statutory context

The Project is located within the Lake Macquarie Local Government Area (LGA). The land on which the Project is proposed to be carried out is zoned SP2 Infrastructure (Electricity generating works). Under clause 34 of State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Land which is zoned SP2 are prescribed zones for the purposes of clause 34 of Infrastructure SEPP. Accordingly, the Project is permissible with development consent.

The Project is for the purpose of 'electricity generating works' as defined in the Standard Instrument (Local Environmental Plans) Order 2006 and the SRD SEPP and has a capital investment value (CIV) of more than $30 million. The Project is accordingly SSD under the SRD SEPP and requires assessment in accordance with

Division 4.7 of the EP&A Act. The Independent Planning Commission or the Minister for Planning and Public Spaces (by delegate) is the consent authority for SSD under Division 4.2 of the EP&A Act.

This EIS has been prepared addressing the Planning Secretary's SEARs issued by the NSW Department of Planning, Industry and Environment (DPIE) on 19 April 2021 and focuses on key issues of biodiversity, heritage, land, visual, noise, transport, water, hazards, traffic, socio-economic impacts and waste. The EIS has not found any issues that would preclude the approval of the Project by the consent authority.

An *Environmental Protection and Biodiversity Conservation Act 2000* (EPBC Act) referral (2021 / 8956) was made to the Department of Agriculture, Water and the Environment (DAWE) on 1 June 2021 to consider whether the Project would be a controlled action. On 19 July 2021, DAWE determined the Project is not a 'controlled' action under the EPBC Act. Accordingly, the Project does not require assessment or approval under the EPBC Act. A summary of the findings of assessments of the key environmental issues identified in the SEARs is provided in the following sections.

Key environmental issues

Biodiversity

The Project has been located in an area of previous disturbance with relatively low biodiversity value. The vegetation present in the Project area and surrounds comprises a mixture of native woodland and forest and cleared areas of exotic pasture. Approximately 50% of the vegetation within 1500 m of the Project area is native vegetation, with the majority of this comprising of forested areas in various conditions from remnant to regrowth.

The Project would require the clearing of 15.1 ha of native vegetation, which includes about 4.6 ha of PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast moderate condition, 0.3 ha of PCT 1716 Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast low condition, and 10.2 ha of planted native vegetation. About 6.4 ha of exotic vegetation would also be cleared as a result of the Project. Two species-credit threatened species, the Swift parrot and the Squirrel glider, are assumed to be directly impacted through the potential loss of up to 3.1 ha and 4.9 ha of habitat respectively. About 0.2 ha of Small-flower grevillea and one individual of black- eyed Susan (*Tetratheca juncea*) would also be directly impacted as a result of the Project.

Considering the already disturbed nature of the development footprint, there are not expected to be any significant indirect impacts that would adversely affect areas of vegetation that would be retained. Where impacts on biodiversity cannot be avoided or minimised, appropriate offsets would be provided.

Aboriginal heritage

No previously recorded sites listed on the Aboriginal Heritage Information Management System (AHIMS) are located within 3 km of the Project area. An archaeological field survey was carried out in May 2021 which confirmed that no previously recorded sites exist within the Project area. No new Aboriginal sites or Potential Archaeological Deposits (PADs) were identified within the Project area.

No adverse impacts on Aboriginal cultural heritage (either direct or indirect) are anticipated during construction and operation of the Project.

Non-Aboriginal heritage

One locally listed heritage item – EPS (LEP 93) is located within the Project area. There are no areas of historical archaeological potential within the Project area.

The proposed works are within the LEP listed item EPS and will have a direct physical impact on the heritage item. The key elements of the power station described in the LEP listing will not be disturbed, removed or altered

by the proposed works. The proposed works have been assessed as having negligible adverse impact on the heritage significance of the EPS.

Potential risk to any unexpected finds would be managed with standard unexpected finds safeguards and mitigation measures.

Land and contamination

Current land uses and land zoning were reviewed and potential land use conflicts have been assessed.

The nearest residential property is located about 600 m west of the Project. The Project area is within a non-operation area of EPS footprint is not currently used for economic purposes and has recently been rehabilitated.

Land use conflicts for the Project are summarised as follows:

- A conflict with the use of the site for the three threatened species has been identified. Impacts have been assessed in accordance with the BAM and would be mitigated as described in **Section 6.1**
- Visual impacts within the Origin landholding would occur during both construction and operation but not to an extent they would unreasonably infringe on amenity of surrounding land uses (refer to **Section 6.5** and **Appendix I**).
- Minor exceedances of construction noise management levels are predicted in the absence of mitigation. Operational noise impacts are predicted to achieve Project noise trigger levels at all times and under all meteorological conditions. Reasonable and feasible mitigation measures are available and would be implemented to minimise noise impacts (refer to **Section 6.6).**
- Minor increase in traffic on local roads is predicted but not to the extent that it would restrict or interfere with access for the general public (refer to **Section 6.7**).
- The minor increase in impervious surface within the overall catchment would lead to a minor increase in run-off but with proposed mitigation measures this would not cause land-use conflicts (refer to **Section 6.8).**
- The Project is not considered likely to restrict the types of development compatible with current zoning or likely future uses of Origin landholdings from a hazard and risk point of view. The risk of offsite impacts is considered able to be mitigated to a level where offsite land uses are not restricted or affected.

A contamination assessment was carried out which included a review of available historical investigations for the Project area, intrusive soil investigation and surface water sampling for identified contaminants of potential concern (CoPC) to evaluate the potential risk to human health and/or environment for the Project. The contamination assessment concluded that the nature of land and water contamination across the Project area does not identify a risk to human health that requires remediation as part of the proposed Project.

Key impacts of the geology, soil and contamination include erosion and sedimentation from earthworks, and contamination risks associated with historical land uses which may be encountered during earthworks.

Soil and contamination risks associated with the Project can readily be managed by the implementation of a Construction Environmental Management Plan (CEMP) and are not an impediment to the implementation of the Project.

Visual

The Project is located within the existing Origin landholding which includes vegetated and topographical buffers to sensitive receivers. The visibility of the Project would been relatively limited from publicly accessible areas within the locality with existing vegetation within the Origin landholding and the presence of other significant infrastructure adjacent to the Project area.

The visual impacts during construction would include clearing of vegetation and stockpiling of debris from construction activities, and would be limited to Origin personnel and contractors, and construction personnel.

During operation, the visual impacts of the Project are considered negligible due to limited views of the Project, the distance over which the change would be viewed, the presence of intervening vegetation and the adjacent/ surrounding power-related built form/ infrastructure within the view.

Noise

The construction and operation of the Project would generate noise impacts.

Noise impacts are predicted to be possible during certain phases of construction, specifically cut, fill and compaction works to establish the BESS compound and during the potential use of an air track drill in transmission structures footing establishment in the absence of mitigation. Construction noise levels are predicted to be up to three decibels (dB(A)) above construction noise management levels in the absence of mitigation. These construction phases are limited in duration and a number of readily available mitigation measures, including limiting construction works to standard construction hours, will be implemented to reduce construction noise impacts to the extent reasonable and feasible.

The operation of the Project involving charging and discharging would generate noise particularly associated with battery enclosure and inverter thermal management. The operation of the Project is predicted to always comply with project noise trigger levels at all times and under all meteorological conditions. On the basis that final technology and layout is yet to be selected, the achievement of compliance with the noise limits from the combined operation of all Project stages will be incorporated as a performance expectation of contracts between Origin and the supplier(s). Origin will undertake a review of noise impacts of the ultimately chosen technology and layout for the need to implement site-specific noise controls or attenuation treatments to assure that the Project fully complies at all receivers at all times under all licensable meteorological conditions.

Transport

The Origin landholding is connected to the surrounding road network by Rocky Point Road and Wangi Road (B53).

During construction, the expected additional traffic generated by the Project would be about:

- Staff light vehicles – 128 per day (128 in and 128 out);
- Heavy vehicles – 60 per day (60 in and 60 out); and
- Oversized overmass (OSOM) – 20 total.

The traffic modelling as part of the traffic assessment for construction peak scenario when combined with cumulative traffic impacts associated with nearby proposed developments found that:

- Intersections were found to continue to have high level of service;
- The queue lengths of the exit ramps from Wangi Road to Rocky Point Road due to the Project are expected to be very low and are not expected to extend into nor impact Wangi Road; and
- The wider road network has identified for haulage has adequate capacity to accommodate forecast traffic growth including the Project.

During operation, the Project would require negligible vehicle movements that would not result in impacts to the performance of the road network.

Water

The Project area is located in the Lake Macquarie and Tuggerah Lakes catchment areas in the Hunter Region of NSW. The wetlands areas located west and north of the Project are identified as coastal wetland under State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP).

Potential impacts to water quality and hydrology during construction would be limited to erosion and sedimentation resulting from ground disturbance, stockpiling, transportation of materials and run-off. Indirect impacts to surface water and groundwater may occur as a result of potential spills or leaks during construction, however, with appropriate environmental management measures in place, construction activities are unlikely to result in any significant adverse effects on water quality, groundwater and hydrology.

The operation of the Project would not change the water use and the site water management system. The Project would involve the establishment of new permanent impervious surfaces that would include drainage management to prevent potential risks of soil erosion and subsequent transportation of sediment into nearby receiving waterways. The Project detailed design would incorporate temporary and permanent water detention facilities to prevent the off-site mobilisation of sediment and contamination to prevent pollution of water. Permanent detention facilities would be sized and provided with emergency isolation measures to address management of fire water if required based on technology selection and thermal run-away response requirements.

Water required for the Project would be supplied from the EPS or by reticulation of scheme water.

Hazards

The Preliminary Hazard Analysis (PHA) concluded that at the current stage of development there are no unacceptably high Project development and operation related hazards that could result in significant offsite effects that are not manageable through application of inherent safety in design principles and the adoption of appropriate standards and quality systems.

All hazards including thermal runaway, fire events, magnetic and electromagnetic fields (EMF), hazardous materials or reactions, leaks and spills would be mitigated by employing a combination of common management measures, including following all applicable standards, separation distances and setbacks, physical protection, and control systems measures.

Socio-economic

The Project would result in direct and indirect socio-economic impacts during construction, mainly in relation to direct employment opportunities for a peak construction workforce of 128 people and associated indirect benefits for businesses that support construction activities. The large construction and manufacturing employment sectors in Lake Macquarie LGA could support and benefit from the construction of the Project. As visitors to Lake Macquarie LGA are proportionately less than visitors to other destinations in the Hunter Region, temporary accommodation demand for the workforce is not expected to have substantial impacts on local accommodation supply. Access to and use of local social infrastructure near the Project would not be affected by construction activities or construction traffic.

The Project, once operational, would align with community values reflected in local and regional strategic plans and is expected to benefit communities, businesses and industry by increasing the reliability of electricity in the NEM. In addition, the Project would support the transition to a low emissions energy system through battery energy storage technology, which can result in a downward pressure on electricity prices and reduce costs for consumers in the long term.

Waste

Waste would be generated during construction of the Project. This waste would be typical of construction projects and would be classified and managed in accordance with industry standard practices.

The operation of the Project would not generate additional waste streams or alter currently waste management processes at EPS.

Waste management for the Project would be based on the waste management hierarchy established by the objectives of the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act). Any necessary waste disposal would be undertaken using licenced waste transporters and facilities. Local disposal options are available for all anticipated waste streams.

Battery technology is in its early stage of deployment and maturity and the rapid increase in deployment makes end of life planning for batteries an important consideration. At this stage, Origin have not appointed a technology supplier and do not have an agreement that the batteries will be returned to the supplier at the end of their useful life. Where possible, all components of the asset would be recycled or reused as to align with the preferences of the waste hierarchy and it is anticipated, based on review of current recycling schemes and opportunities, that most components would be recycled at end of life.

Justification

The Project is necessary to facilitate the delivery of efficient, safe and reliable energy storage. The benefits of the Project are considered to outweigh any identified adverse impacts. While some environmental impacts cannot be avoided, they would be minimised where possible through both the design process and implementation of sound environmental management measures.

The Project represents a continuation of the electricity generation uses, currently carried out within the Origin landholding associated with the EPS and does not conflict with the ongoing operations or any other currently proposed land uses.

The Project is considered justified based on the following:

- It meets Origin's objective of delivering safe and reliable energy storage and to contribute to lowering emissions for electricity supply in NSW;
- It will improve the average emissions intensity of the NEM as it will generally charge during periods of high renewable energy and will then shift this renewable energy to periods of high energy demand such as during the evening peak after the sun has set;
- It will be capable of providing network security services identified as critical to the future stability of the NEM as it transitions away from thermal energy generation including FCAS, SRAS, as well as fast frequency response and synthetic inertia;
- It is aligned and consistent with international, National, State and local policy in relation to climate change and the electricity industry's response;
- It would provide direct employment for 128 workers during construction and associated indirect employment and business benefits with minimal impact on social infrastructure;
- Site selection has targeted previously disturbed land to the extent possible and avoided more diverse and natural ecological communities within and nearby the Origin landholding while measures are proposed to avoid indirect impacts to off-site ecological communities and otherwise offset impacts;
- Standard and specific mitigation measures are identified and would be implemented to reduce residual environmental impacts to the extent reasonable and feasible; and
- All mandatory considerations have been identified and addressed.

The Project represents a significant and cost-efficient private investment in electricity infrastructure that would priorities minimising flowthrough costs to NSW energy consumers. It results in strong net public benefits by providing essential energy storage and firming capacity as part of the energy transition.

1. Introduction

This chapter provides a general overview of the background for the Eraring Battery Energy Storage System Project (the Project) and justification of the Project including a statement of the objectives, description of the strategic need and Project outcomes. It also describes the proponent, outlines the Project location and provides the purpose and structure of this Environmental Impact Statement (EIS).

1.1 Project overview

Origin Energy Eraring Pty Limited (Origin) (ABN 31 357 688 069) owns and operates the Eraring Power Station (EPS) which is Australia's largest power station, having a capacity of 2,880 megawatts (MW).

Origin is seeking regulatory and environmental planning approval for the construction and operation of a grid-scale Battery Energy Storage System (BESS) with a discharge capacity of 700 MW and storage capacity of 2,800 megawatt hours (MWh) within the Origin landholding associated with the EPS.

The Project and future retirement of the EPS will support Origin's carbon emission reduction goals and will align with the strategic transition away from coal in NSW. As such, Origin is now progressing an application to provide energy storage and key market services that would facilitate long term emissions reduction in the National Electricity Market (NEM) while supporting the delivery of secure and reliable electricity for consumers and businesses.

As the Project is a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP), the Project is subject to Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), which requires the preparation of an EIS in accordance with Secretary's Environmental Assessment Requirements (SEARs) (refer to **Appendix A**) and the approval of the Independent Planning Commission under circumstances described in SRD SEPP or the NSW Minister for Planning and Public Spaces.

1.1.1 Project history

EPS is Australia's largest power station and the only coal-fired generation plant in Origin's portfolio. EPS commenced operation in 1982 and currently consists of four 720 MW Toshiba steam turbines with a total output of 2,880 MW. EPS was owned by the State of NSW until 2013 when the company was acquired by Origin.

The Project area is owned by Origin with the exception of a small area within the TransGrid owned switchyard to which the Project proposed to connect and currently has limited use as a rehabilitated area south of EPS. The Project area is next to the EPS water inlet canal and attemperation reservoir. The Project area was previously disturbed during the construction of the attemperation reservoir and used as a borrow pit. Construction material and additional spoil were extracted from the borrow pit area to build the attemperation reservoir. The area has since been rehabilitated and remains unused.

The EPS coal-fired generation capacity remains the largest in Australia and represents approximately 14 per cent (%) of capacity in the NEM. The NEM is undergoing rapid transition with increased uptake of renewable generation and retirement of thermal generation across NSW. EPS among other coal-fired power plants in NSW are scheduled to close within the next two decades, which will heighten challenges in the NEM to maintain system reliability and keep electricity prices stable with increased levels of renewable generation. Origin has invested and structured its energy generation portfolio to adapt to NEM requirements and support its own transition to higher renewables penetration in order to reduce emissions and contribute to long term sustainability in the energy sector. In order to demonstrate continued leadership in climate change advocacy, Origin has identified large scale energy storage as a significant technology required for achieving decarbonisation commitments.

EPS has played a significant role in the NEM since it was first commissioned and remains crucial to the security, reliability and affordability of power supply in the NEM. However emerging low emissions technology applications such as battery storage are expected to contribute to flexible dispatchability needs of the NEM and 'firm up' variable renewable energy. Origin will exit coal-fired generation by 2032 which requires considerable planning, and Origin is anticipating EPS's capacity will be replaced by a combination of renewables, gas and storage. Prior to Origin's exit from coal, the planned closure of Liddell Power Station in 2022-2023 would leave a gap of around 13% of existing NSW energy supply. In line with projections from the Australian Energy Market Operator (AEMO) and in response to the urgent need to replace the capacity gap left by Liddell Power Station, Origin has identified the Project would close this gap to reliably meet peak demand, provide grid security services and drive the transition away from coal towards renewables firmed by highly flexible energy storage.

The Project and future retirement of EPS will support Origin's carbon emission reduction goals and the NSW State's strategic transition away from coal. The Project would support the decarbonisation objectives of Origin and NSW government and maintain reliable electricity supply by having readily dispatchable long duration storage.

1.1.2 Project objectives

The Project has a primary objective of delivering safe and reliable energy storage and to contribute to lowering emissions for electricity supply in NSW.

1.1.3 Project summary

The Project would include the construction, operation and decommissioning of a grid-scale BESS with a discharge capacity of 700 MW and storage capacity of 2,800 MWh including:

- BESS compounds comprising of rows of enclosures housing lithium-ion type batteries connected to associated power conversion systems (PCS) and high voltage (HV) electrical reticulation equipment;
- A BESS substation housing high voltage transformers and associated infrastructure;
- Approximately 400 metres (m) of overhead 330 kilovolt (kV) transmission line connecting the BESS substation to the existing 330 kV TransGrid switchyard; and
- Ancillary infrastructure and facilities including safety protection systems and site ancillary facilities such as laydown areas and site offices.

A full description of the Project is included in **Chapter 3**.

The Project will also be capable of providing energy, Frequency Control Ancillary Services (FCAS) and System Restart Ancillary Services (SRAS), as well as typical BESS based security services under consideration in the NEM such as fast frequency response and synthetic inertia, aligned with the Post 2025 electricity market design options and reforms shortlisted by the Energy Security Board (Schott et al., 2021).

The Project location is shown in **Figure 1-1**. A detailed description of the Project and each component is provided in **Chapter 2**.

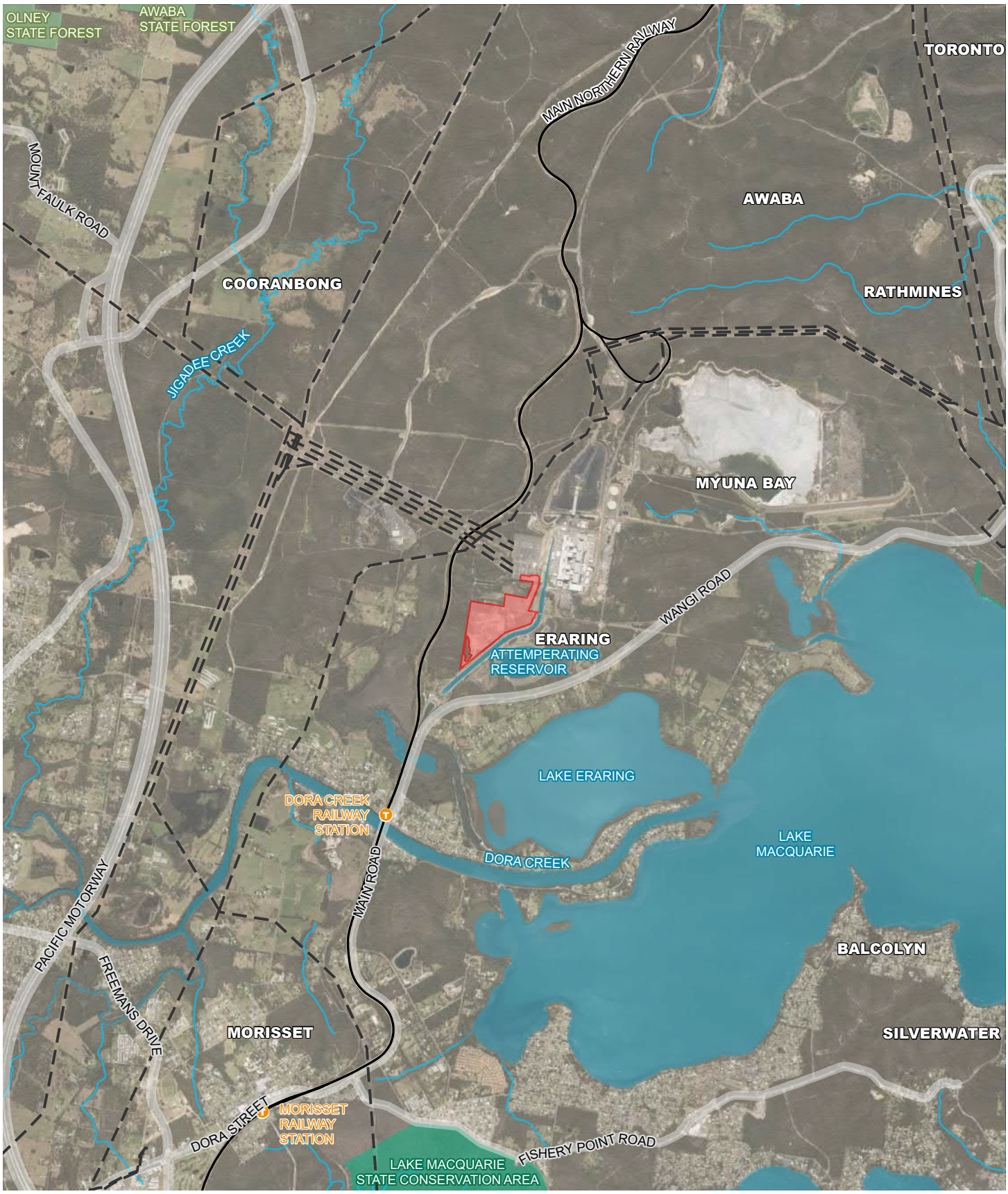


Figure 1-1 Project location

1.2 Site and surrounds

The Project would be situated within EPS located the western shore of Lake Macquarie. EPS is approximately 40 km south of Newcastle and approximately 120 km north of Sydney in NSW. The total area of the Origin's landholding is approximately 1,200 hectares (ha), including EPS operational areas, ancillary infrastructure and surrounding buffer lands consisting of bushland and grassland interspersed with roads and water management and electricity transmission infrastructure. The Project area is about 25 ha and is shown on **Figure 1-1**. The Origin landholding is shown in **Figure 1-2** with land use zonings illustrated in **Figure 1-3.**

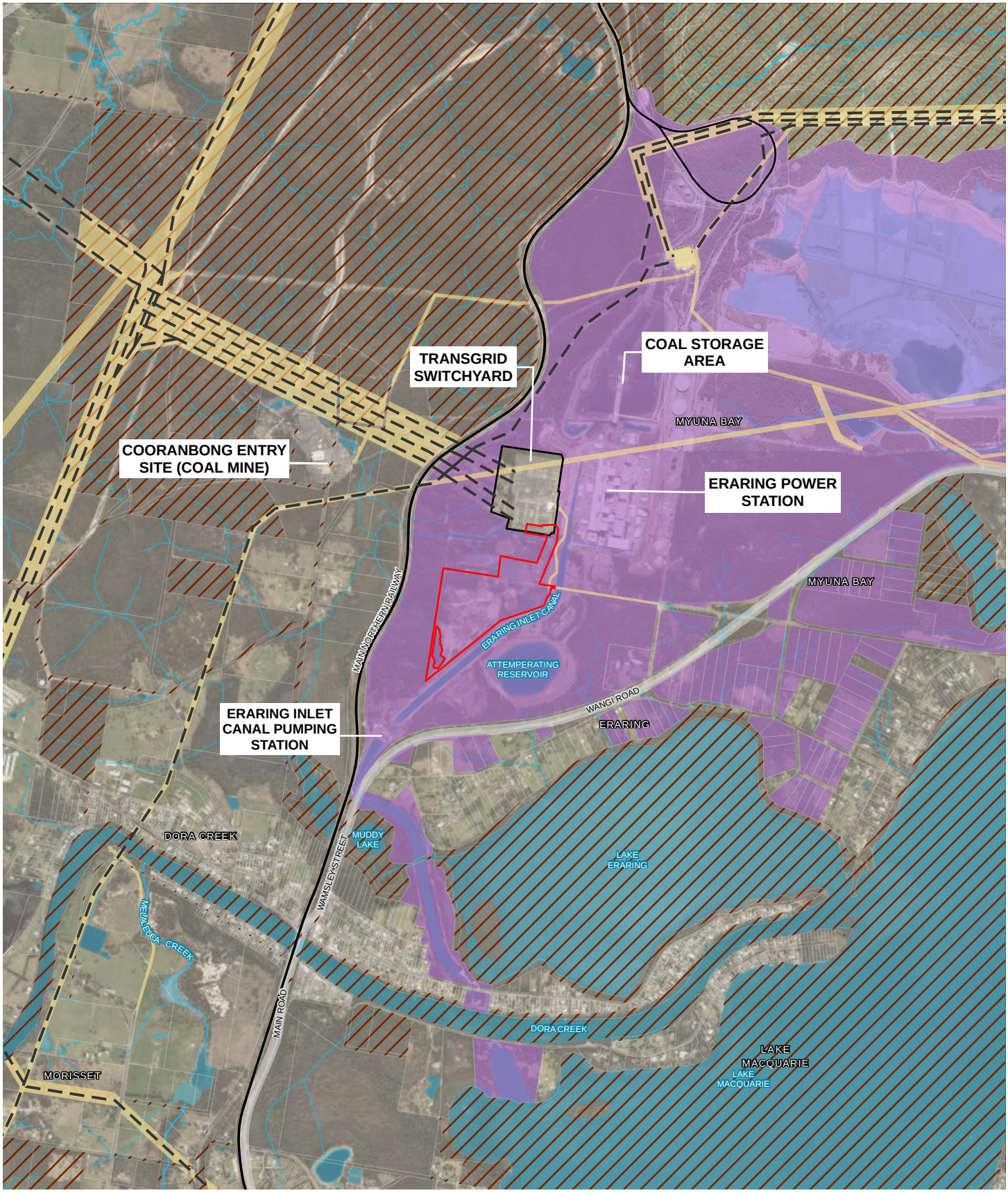
The scale and nature of the EPS is depicted in **Photo 1-1** below. **Photo 1-1** also illustrates the context for the Project area which extends to the south from the existing TransGrid switchyard located in the centre right of the photo. Also depicted is the EPS inlet canal and attemperation reservoir to the east and south of the Project area and prior disturbance associated with the reservoir construction.

Photo 1-1: Aerial view of Origin landholding from above Lake Eraring (south east)

The Project area is undulating, with surface levels across the Project area varying between relative level (RL) 9.5 m and RL 22.0 m Australian Height Datum (AHD) (GHD, 2021). This is due to the Project area having been used as a borrow pit and for stockpiling of material for the construction of the attemperation reservoir and has subsequently been rehabilitated.

The Project area is surrounded by the following features with the Origin landholding:

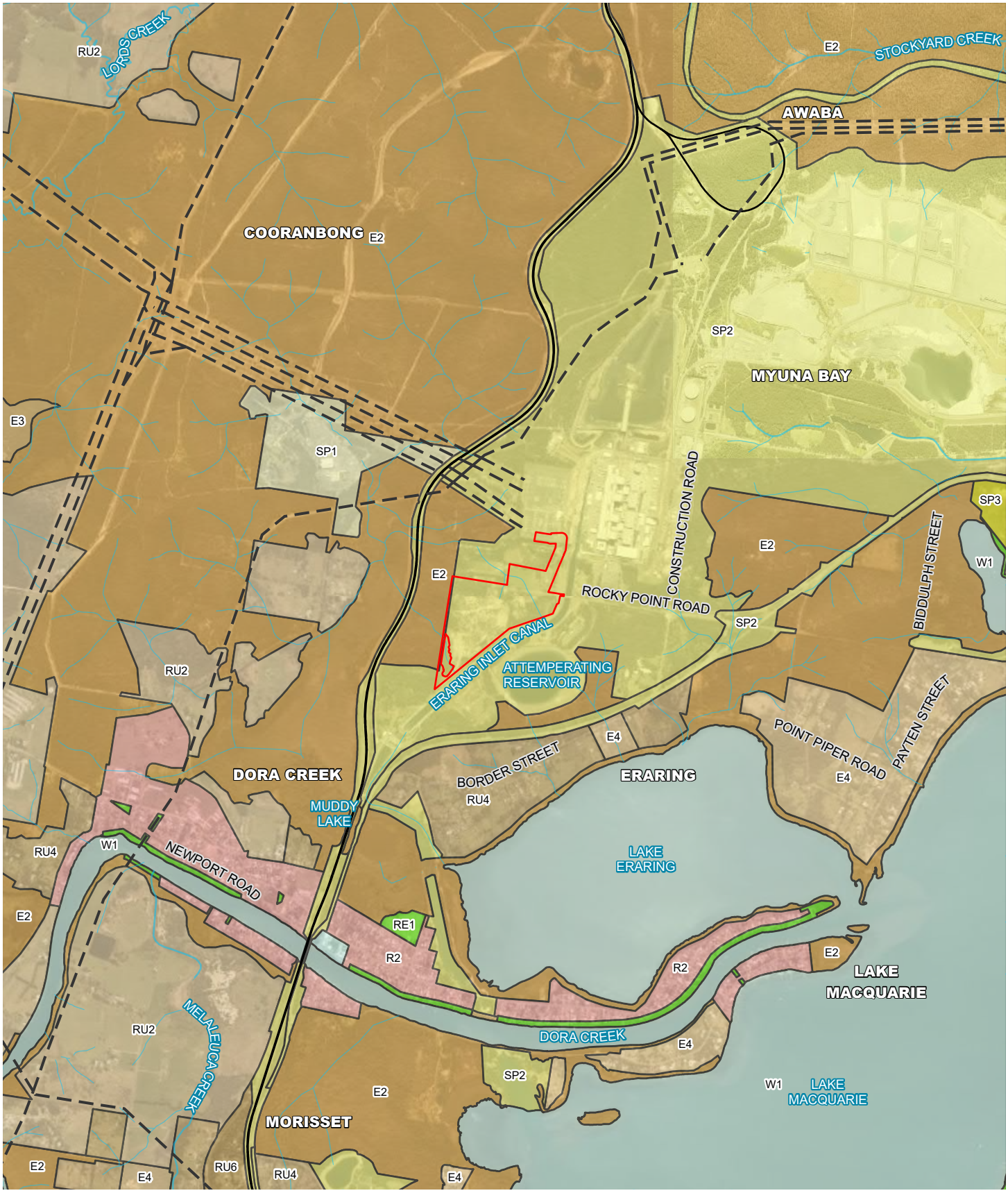
- EPS operations area, elevated TransGrid switchyard, coal yards and extensive EPS buffer lands to the north;
- Elevated attemperating reservoir to the east;
- Elevated EPS inlet canal to the south and east; and
- Mature vegetation within E2 environmental protection zoned land along a ridge line to the west.



Data sources

Origin 2021,
Jacobs 2021
© Department Finance, Services and Innovation Dec 2020

Figure 1-2 Origin landholding



Project area

Land zoning

- B1 Neighbourhood Centre
- E2 Environmental Conservation
- E3 Environmental Management
- E4 Environmental Living
- R2 Low Density Residential
- RE1 Public Recreation
- RU2 Rural Landscape
- RU4 Rural Small Holdings
- RU6 Transition
- SP1 Special Activities
- SP2 Infrastructure
- SP3 Tourist
- W1 Natural Waterways

Railway

Electricity transmission line

0 800 m

1:30,000 at A4

GDA94 MGA56

Data sources

Origin 2021,
Aerometrex 2020,
© Department Finance, Services and Innovation Dec 2020
© Department of Customer Service 2020

Figure 1-3 Land zoning

The surrounding land consists of broad acre residential development and low-density residential properties. The closest commercial centre and population centre nearby is Charlestown (29.1 km north east), and the closest residential suburbs are Eraring (south and east) and Dora Creek (1.2 km south). In between, the centres of Toronto and Morisset are located approximately 8 km northeast and 4km southwest respectively. The closest sensitive receiver is 600 m west of the Project on Gradwells Road and south on Border Street.

The Great Northern Railway (also known as the Main North Line) alignment between Sydney and Newcastle runs along the border of Dora Creek and Eraring suburbs, 200 m west of the Project. The M1 Pacific Motorway also runs in a north-south direction 3 km west of the Project.

1.3 Proponent

Origin is a wholly owned subsidiary of Origin Energy Limited and the proponent for the Project. Origin owns and operates the EPS in Lake Macquarie in the Hunter Region of NSW (refer to **Figure 1-1**). Origin Energy Limited was established in 2000 and acquired the EPS in 2013. The EPS is Australia's largest power station with a combined capacity of 2,880 MW. Apart from the EPS, Origin Energy Limited also operates natural gas-fired power stations, cogeneration plants and pumped storage hydropower stations across Australia, with 6,010 MW in electricity generation capacity that can meet 13% of consumption needs in the NEM (Origin, 2018).

1.4 EIS Structure and purpose

The EIS has been prepared to address the form and content requirements of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) and the *Environmental Protection and Biodiversity Conservation Act 2000* (EPBC Act) and regulations including Project specific SEARs. The EIS is structured to reflect the general form and content requirements of the *State significant development guidelines – preparing an environmental impact statement* (DPIE, 2021d) as follows:

- **Chapter 1** provides a general Project overview and describes the environmental and historic context in which it would occur. It also identifies the Project objectives;
- **Chapter 2** provides the strategic context of the Project and alternatives considered;
- **Chapter 3** provides the full description of the Project including activities associated with construction, operation and decommissioning, where relevant, of each Project component based on current available design information;
- **Chapter 4** provides the statutory context for the Project;
- **Chapter 5** provides a summary of consultation undertaken by Origin with the relevant local, State or Commonwealth Government authorities, exploration licence and mining lease title holders, service providers, community groups and affected landowners;
- **Chapter 6** provides an assessment of key environmental issues, assesses the impacts and proposes environmental management measures;
- **Chapter 7** provides a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS;
- **Chapter 8** presents an evaluation of the Project as a whole, drawing conclusions on the overall merits of the Project;
- **Appendix A**. Project SEARs compliance;
- **Appendix B**. Statutory compliance table;
- **Appendix C**. Community engagement table;
- **Appendix D**. Proposed mitigation measures;
- **Appendix E**. Biodiversity Development Assessment Report;

- **Appendix F**. Aboriginal Cultural Heritage Assessment Report;
- **Appendix G**. Statement of Heritage Impact;
- **Appendix H**. Contamination Assessment;
- **Appendix I**. Visual Impact Assessment;
- **Appendix J**. Noise Impact Assessment;
- **Appendix K**. Transport Impact Assessment;
- **Appendix L**. Water Impact Assessment;
- **Appendix M**. Preliminary Hazard Analysis; and
- **Appendix N**. Bushfire Assessment Report.

2. Strategic context

This chapter provides the strategic context and detailed consideration of the capability of the Project to contribute to the security and reliability of the electricity system in the NEM. It also identifies the need for the Project and details the alternatives considered.

2.1 Project need

The NEM operates as a wholesale electricity market for all states in Australia apart from Western Australia and Northern Territory, incorporating a spot market that controls the physical power system such as transmission lines and power stations. The NEM supplies around 80% of Australia's electricity consumption and has experienced a rapid increase in renewable generation in the past decade. This rise is attributed to various policies and pricing incentives, as well as the need for Variable Renewable Energy (VRE) to replace coal-fired generation, 63% of which are set to approach end of design life and retire within the next few decades (AEMO, 2020). It is estimated that more than 26 GW of new VRE is needed, while 6-19 GW of new dispatchable resources, such as battery storage, are needed to firm up the increased input of renewables in the NEM (AEMO, 2020).

To enable the expected rise in VRE now and into the future, flexible dispatchable electricity supply is needed to firm up the variable output from renewable sources such as wind and solar and provide storage of surplus generation to meet times of peak demand. Where previously gas-fired generation has supported peak demand, storage options such as using batteries are becoming favoured due to cost reduction and lack of geographic constraints (IHS Markit, 2020) such as gas supply infrastructure and gas availability. The Project would become one of the largest battery projects in Australia once operational, contributing to overall storage capacity in the NEM.

A BESS can mitigate against price volatility and smooth out the varying electricity supply from wind and solar power, potentially balancing out price increases expected during unanticipated outages as well as the closure or exit of large scale thermal plants (Australian Energy Council, 2020). Having long duration storage ready to dispatch into the grid as coal-fired generation gradually retires or when renewable sources are not readily available, can help stabilise the electricity grid as the NEM approaches higher renewable capacity.

A BESS will also improve the average emissions intensity of the NEM as it will generally charge during periods of high renewable energy (making more room for renewable energy on the grid during these times), and will then shift this renewable energy to periods of high thermal energy (such as during the evening peak after the sun has set).

The staged closures of large-scale coal-fired plants including Liddell Power Station, Vales Point Power Station, EPS, Bayswater Power Station and Mount Piper Power Station will begin in 2022 with first turbine to be retired at Liddell. The identified need for new capacity in NSW following Liddell Power Station closure is to cover peak demand events which coincide with periods where NSW cannot source electricity supply through its interconnection with other states. Origin is capturing this opportunity to support an orderly transition to renewables by aiming for Stage 1 of the Project to be operational prior to or as soon as possible after Liddell Power Station retirement, and for the full capacity of the Project to be available in 2026.

The Project would make use of the existing infrastructure on the Origin landholding and connect to the electricity grid through the existing TransGrid switchyard and transmission lines. Effectively this means that no transmission works outside the Origin landholding are needed as part of the Project and would increase the speed of renewables penetration into the NEM while large interconnector transmission projects such as Energy Connect, Humelink and Victoria to NSW Interconnector West (VNI West) are still in planning or early execution stages.

The BESS Project would strengthen electricity supply in NSW during the transition from coal fired generation having key flexibility to discharge over various durations. The Project would contribute to Origin's and NSW's emission reduction commitments and provide crucial renewable energy with reliable supply at reasonable prices.

2.2 Alternatives considered

Origin continues to consider all available technology and options for the decarbonisation transition in the NEM and accordingly, in Origin's own generation fleet. The Project is identified as a significant part of the response to phased coal-fired generation retirement in NSW, particularly to firm up renewables and provide immediate storage and dispatchability support following the exit of the Liddell Power Station. Alternatives to the Project are considered at the site level and overall Project level and would continue to be developed through the design stages to ensure the design meets best practice requirements and can avoid or minimise any potential environmental, social and economic impacts.

Origin has assessed alternatives for the following considerations:

- A base case, 'do nothing' approach;
- Site selection alternatives; and
- BESS technology and provider alternatives.

2.2.1 Base case 'do nothing' approach

The 'do nothing' approach would involve not constructing and operating the Project or any BESS at the existing Origin landholding. The option is not feasible as it would not meet the needs of the NEM to effectively fulfil the energy gap left by upcoming retirement of coal-fired plants. This option is also not a feasible alternative to achieving the Project objectives due to the following:

- Origin has committed to exiting coal-fired generation at EPS by 2032, with the existing 2,880 MW capacity being replaced with technology such as battery storage being the most cost-effective use of existing site and infrastructure; and
- Origin has aimed to achieve net zero emissions by 2050, which would largely be supported by the entry of firming capacity and energy storage provided by the Project.

The consequences of not carrying out the Project would reduce firming for wind and solar in the NEM, jeopardise the future reliability and integrity of the NSW grid, leave Origin with a diminished role in the future energy markets, and is not in keeping with Origin's climate change commitments.

2.2.2 Site selection alternatives

An alternative site selection would involve constructing the Project at a location different to the site proposed, but within the existing Origin owned land around the EPS. There are several potential areas surrounding the Origin landholding that may potentially be able to host a BESS and associated infrastructure, however the chosen Project area is considered preferable on the following basis:

- The Project's current site is selected based on site size and availability, appropriate land zoning, land use compatibility, proximity to existing transmission infrastructure, established buffer to other sensitive receptors and land uses, as well as for avoidance of biodiversity impacts as far as possible; and
- The remainder of the Origin landholding is either vegetated, currently used for EPS operational purposes or reserved for other uses.

While Origin may pursue storage or renewables projects in other locations at the broader Origin landholding, the current landholding represents an efficient use of capital, is owned by Origin, close to network connections with available capacity and has a prior history of disturbance and as such represents a logical location for the Project.

2.2.3 BESS technology and provider alternatives

Origin has reviewed current options for the battery technology most viable for the Project area and for capacity requirements. Origin has completed a Request for Tender (RFT) process from which the preferred technologies will be selected. Currently the most feasible BESS option consists of lithium-ion batteries offered in the form of

containerised or otherwise enclosed battery arrangements. The layout of the BESS units would be confirmed during detailed design.

Origin's selection criteria has included assessment of:

- Project Management;
- Strategic Business Value;
- Commercial feasibility;
- Technical capability;
- Health and Safety; and
- Environment, Community and Sustainability.

Origin has prioritised safety, energy density, flowthrough cost to NSW consumers and compliance requirements when selecting the technology provider of the BESS during the tender.

2.2.4 Impact avoidance

The key strategies that have been adopted during EIS preparation and preparation for detailed design, and which will be adopted during construction and operation to minimise any potential impacts include:

- Site selection of Project area to minimise vegetation clearing and where practicable avoid land zoned E2 Environmental Conservation;
- Project footprint would not intrude on sensitive land uses and would retain the established vegetation screening to the west which is an ecological corridor as well as a natural buffer to sensitive receptors;
- Project design would consider hydrology and drainage to manage water run-off to neighbouring coastal wetlands to achieve relevant water quality standards;
- Project design would consider need and sizing of asset protection zones and other forms of bushfire protection to reduce need for intrusion into E2 zoned woodland to the extent possible; and
- Project design would consider the need, size and location of noise walls to reduce noise levels to achieve amenity criteria to the extent possible and otherwise explore noise mitigation through selection of less noise intensive plant and equipment.

2.3 Surrounding land use compatibility and potential conflicts

Outside the Origin landholding, surrounding land consists of broad acre rural development and low-density residential properties. The largest commercial centre and population centre nearby is Charlestown (29.1 km north east), and the closest residential suburb is Dora Creek (1.2 km south). A railway alignment runs along the border of Dora Creek and Eraring suburbs, 200 m west of the proposed action. The closest sensitive receiver is 600 m west of the Project area on Gradwells Road, Dora Creek and southeast on Border Street, Eraring.

Nearby industrial land uses include the Cooranbong Entry Site (CES) (coal mine) located approximately 800 m north west of the Project area at the end of Gradwells Road. The Great Northern Railway alignment runs along the border of Dora Creek and Eraring suburbs, 200 m west of the Project area. The railway separates the Project area from nearest sensitive receptors. No major roads or pipeline infrastructure are located near the Project area. Access to the Project area is provided by designated heavy vehicle and oversized overmass (OSOM) load carrying vehicles network approved roads.

Connection works into the TransGrid switchyard is targeting existing vacant connection bays but allowance is made for bench extension and installation of additional infrastructure.

Sensitive environmental features are limited to the E2 zoned land immediately west of the Project area and Muddy Lake which is a classified coastal wetland and provides habitat for an important population of Green and Golden Bell Frogs. The Project is not located near any National parks, scenic or conservation areas. The wetlands area adjacent to the western boundary of the Project footprint is identified as Fauna Key Habitats (NE NSW), with identified possible Squirrel Glider Crossing Zone around 230 m west of the Project area. The Project is located within the Fauna Corridor for North East NSW area and habitat connectivity would be considered in the design and EIS. The wetlands area north and west of the Project is also identified partially as Flood Planning Area under the Lake Macquarie Local Environmental Plan 2014 (Lake Macquarie LEP 2014), around 100 m west and to the north of the Project area.

The following potential for conflicts is identified and has been assessed in the EIS and supporting technical assessments:

- Noise and visual impacts to neighbouring residential receptors including cumulative noise impacts from the EPS, rail corridor and the CES and
- Traffic impacts including cumulative impacts with the EPS and associated ash recycling.

The Project is largely within the Origin owned lands with the exception of the tie-in to the TransGrid switchyard which is encompassed by Origin land. While Origin may contemplate additional developments within this landholding, they will be assessed independently on their merits and be compatible with the ongoing operational status of EPS.

2.4 Strategic policy context

The strategic policy context underpins the Project objectives and the Project need, and includes plans, policies, key strategic directions, and framework at the national, State and local levels. The Project would also directly respond to Origin's commitment to achieve net zero emissions by 2050. These policies and commitment both respond to and facilitate the rapid transformation in the NEM towards less emission-intensive and more renewable options in power generation and are described in the sections below.

2.4.1 AEMO and the National Energy Market

AEMO manages the NEM and operates Australia's electricity and gas markets which allow energy to be priced, sold and delivered. AEMO has forecast in its latest Integrated System Plan (ISP) that Australia will need 26-50 GW of additional grid-scale renewables by 2040 (AEMO, 2020). Currently the NEM has 2,000 MW of announced withdrawal in coal, and more than 45,200 MW of proposed solar, wind and hydro generation (AEMO, 2021). Enabling energy storage would help stabilise and increase reliability in this rapid growth and penetration of renewables. The key findings from the *Independent Review into the Future Security of the National Electricity Market 2017* (the Finkel Review) (Finkel et al., 2017) became one of the key reports that contributed to energy policy development in Australia aiming to achieve Australia's emission reduction commitments while providing affordable, secure and reliable electricity. The Finkel Review recommended the NEM to transition early on towards emissions reduction trajectory and emphasised the need for stability solutions like battery energy systems to balance out the fluctuations of renewable energy.

Following the endorsement of the Finkel Review findings by the Council of Australian Governments (COAG) Energy Council, AEMO subsequently published ISPs for the NEM in 2018 and 2020. ISPs form whole-of-system roadmaps for the development of the NEM over the next 20 years. The 2018 ISP identified that 'retiring coal plants can be most economically replaced with a portfolio of utility-scale renewable generation, storage, Distributed Energy Resources (DER), flexible thermal capacity, and transmission' (AEMO, 2018). This aim is further explored in the 2020 ISP which stated that the 'least-cost transition of the NEM will be a highly diverse portfolio consisting of DER and VRE and supported by multiple dispatchable resources', and at least 6-19 GW of new dispatchable resources such as battery storage are needed to back up renewables (AEMO, 2020). The 2020 ISP highlighted the need for strategic investments in low-cost firming resources to enable a cost-effective way to enable the expected rise in renewable energy.

The Eraring BESS Project would contribute to the storage and dispatchability requirements identified in the 2020 ISP.

2.4.2 The Paris Agreement COP 21

Australia is party to the Paris Agreement, which came into force in 2016. Parties to the Paris Agreement reached consensus at the 2015 United Nations Climate Change Conference (COP 21) to strengthen the global response to climate change by:

- Keeping the increase in global average temperature to well below 2°C above pre-industrial levels; and
- Pursuing efforts to limit temperature increase to 1.5°C.

Under the Paris Agreement, the Australian Government in 2015 committed to reduce emissions by 26–28% below 2005 levels by 2030. In 2020, Australia recommunicated the 2030 emissions reduction target and published the *Australia's Emissions Projections 2020* report which demonstrates Australia is on track to meet and beat its 2030 target due to the continued strong growth in renewables uptake (Commonwealth of Australia, 2020a).

The energy sector is a key part of the low emissions effort, as electricity generation contributes to a significant proportion of total carbon emissions and the growth of renewables is as such crucial in the transition to low emission future. As identified above, the Project facilitates the growth of renewables by shifting surplus energy generated to periods of higher demand and providing network services of increasing importance to the NEM.

Origin continues to support a national goal of net zero emissions in the electricity sector by 2050, and are proud of their ongoing contribution to the decarbonisation of the NEM. Origin believes that the electricity sector should be responsible for more than its proportional share of emissions reductions, and the proposed Project is part of Origin's decarbonisation strategy to help achieve its goal of exiting coal-fired generation by 2032, while continuing to ensure a reliable energy supply for its customers, and the NSW community.

2.4.3 COAG Energy Council Post 2025 Market Design

The COAG Energy Council is a ministerial forum for Australian and New Zealand governments to pursue national energy reforms. The Energy Council initiated the Post 2025 project and tasked the Energy Security Board (ESB) to develop advice on long-term electricity market design and provide a framework for a changing NEM to better adapt to diversifying generation sources. After stakeholder consultation, the ESB released the *Post 2025 Market Design Directions Paper* in January 2021 (Schott et al., 2021a) and set out four reform directions as part of the Post 2025 project as follows:

- Resource adequacy mechanisms and ageing thermal transmission – ensuring the right mix of resources is available to the system through the transition to deliver reliable supply to customers;
- Essential system services and scheduling and ahead mechanisms – ensuring those resources and services required to manage the complexity of dispatch and deliver secure supply to customers are available when needed;
- Demand side participation – progressively unlock the potential of the demand side to compete in the wholesale market and deliver local benefits while maintaining system security; and
- Transmission and access – providing the network to meet future needs, arrangements for early implementation of renewable energy zones, and longer-term arrangements to ensure efficient use of the national network.

The ESB flagged the need for the construction of 26 GW to 50 GW of VRE over the next two decades which would need to be backed by storage capacity such as grid scale batteries and pumped hydro to ensure stability.

Given some uncertainties in the current policy and market context, the ESB will continue to explore development that can ensure flexible, dispatchable resources are valued in the market and have an incentive to be available

when they are needed. The ESB also seeks to ensure timely entry of resources into the market and orderly exit of thermal generation as they retire from the system. Timely entry focuses on having new resources in operation when they are needed and costs are minimised by avoiding investment too early or too late. Orderly exit ensures reliability and security after a generator exits and price shocks are minimised.

The ESB handed its final advice on the NEM redesign to energy ministers on the Energy National Cabinet Reform Committee and it was publicly released on 26 August 2021. The recommendations include key pathways to manage the orderly exit of old technologies such as coal fuelled generation, while planning for input of new technologies. The aim of the NEM redesign is to get firm and flexible supply of electricity that is also affordable. Specifically, new technical backups (frequency, inertia, system strength, operating reserves) are urgently needed, such as large-scale batteries and flexible demand that will make the system stronger (Schott et al., 2021b).

The Project would facilitate the orderly transition of the system following the expected closure of Liddell Power Station in 2023. By providing services such as flexible dispatchability, frequency control and fast frequency response, the Project would specifically address the priorities identified in the Post 2025 Market Design Directions Paper, as well as the ESB final advice July 2021

2.4.4 Commonwealth context

The *Report of the Expert Panel Examining Additional Sources of Cost Abatement* (The King Review) (King et al., 2020) builds a robust platform to expand and incentivise low cost abatement opportunities, with a focus on emission-intensive sectors and energy efficiency. The findings of the King Review indicated deeper renewables penetration is inevitable and requires additional storage capacity to decarbonise the economy. The Australia Government have agreed (or agreed in principle) with 21 of the recommendations from the King Review.

2.4.4.1 Technology Investment Roadmap 2020

The Australian Government released the *Technology Investment Roadmap 2020* to provide a national framework to accelerate low emissions technologies. The *Technology Investment Roadmap 2020 Discussion Paper* (Commonwealth of Australia, 2020b) investigated long-duration energy storage as a cost-effective technology pathway and offered support to invest and build in various forms of storage including pumped hydro and large-scale batteries. This investment intends to balance the rapid rate of renewables deployment. Energy storage and backup technology is set as an immediate priority (to 2022) for the electricity generation sector to enable orderly management of increased variable supply to maintain security and reliability. Growing storage technology capacity and driving down the costs of such technology are observed as medium and long-term opportunities (2030 to 2050 and beyond).

2.4.4.2 Low Emissions Technology Statement 2020

First published in 2020 and set to be delivered annually thereafter, low emissions statements prioritise low emissions technologies and direct investment towards priority technology stretch goals. Energy storage is identified as one of the priority low emissions technology that will support employment and provide the highest abatement and economic potential in areas of comparative advantage for Australia. This priority stretch goal aims to bring such emerging technologies to economic parity with existing mature technologies. The *Low Emission Technology Statement 2020* also seeks to drive investor confidence and targe international partnerships in the private sector to ensure Australia stays at the forefront of low emissions technology investment in global markets (Commonwealth of Australia, 2020c).

The Technology Investment Roadmap and first Low Emissions Statement will be the cornerstone of Australia's long term emissions reduction strategy, which will be presented at the 2021 UNFCCC COP26 in Glasgow.

The Project is consistent with the Commonwealth Government's low emissions technology priorities and overall investment roadmap to establish energy storage as a key technology that can respond to electricity market needs and reduce emissions in the energy sector.

2.4.5 NSW context

The *NSW Climate Change Policy Framework* (Office of Environment and Heritage (OEH), 2016) establishes the net zero emissions target for 2050 and represents the NSW Government position on responding to climate change. The *Net Zero Plan Stage 1: 2020-2030* (State of NSW, 2020)is the current strategy to enable NSW to reach net zero emissions by 2050 and aligns with the Climate Change Policy Framework. Current NSW policies align with and support the implementation of the 2020 ISP (AEMO, 2020).

The NSW Government has established several Renewable Energy Zones (REZs) across the state and are currently in the early feasibility stages for REZs to be established in the Hunter-Central Coast and Illawarra regions, as set out under the *Electricity Infrastructure Investment Act 2020*. REZs will become hubs that connect multiple renewable energy generation with storage, such as batteries in the same location, in order to deliver affordable and reliable electricity (NSW Government, 2021a). Three REZs have been planned for regional NSW and while the Hunter-Central Coast REZ is still yet to be fully defined, the Project would fulfil the storage objectives and support the continued power generation in the Hunter region.

The Project would utilise existing transmission infrastructure and is not contingent on the development of REZs being completed. The Project can provide an advanced delivery schedule for energy storage and dispatchable firming while REZs are being built across NSW.

2.4.5.1 NSW Electricity Strategy 2019

The *NSW Electricity Strategy* was released in 2019 and sets out actions to address NSW electricity needs while supporting national solutions and reforms. One of the key propositions in the Electricity Strategy is that 'new generation, delivered by competitive markets, should reduce electricity prices and protect the environment' (DPIE, 2019a). In particular, renewables are the lowest cost form of reliable electricity generation when firmed by dispatchable technologies such as storage.

The Electricity Strategy emphasised that variable renewable energy needs to be complemented by firm and flexible power and batteries are becoming more feasible as a provider of commercial firming services due to the downward trend in costs (DPIE, 2019a). The Project would provide important grid services that facilitate renewable energy input into the grid network, by enabling large scale storage that has flexible dispatchability to respond to real-time electricity demands.

2.4.5.2 NSW Electricity Infrastructure Roadmap 2020

The NSW Electricity Infrastructure Roadmap establishes the NSW government's 20-year plan to transition the electricity sector towards more renewable generation, transmission, long duration storage and firming within the system. One of the key principles of this roadmap is to deliver renewables and new firming resources to support stable, long-term energy storage in NSW (DPIE, 2020a). The Roadmap aims to provide confidence and encourage private investment to support the development of 12 GW of renewable energy assets and 2 GW of energy storage by 2030. Strategic planning is seen as crucial to this roadmap, to allow new generation, transmission and storage infrastructure to be built and come online before coal-fired power stations close over the next few decades, in order to replace the energy lost and avoid a rapid increase in electricity prices.

The Roadmap aligns directly with the 2020 ISP which identified that by mid-2030s NSW will need around 2.3 GW of energy storage with 4 to 12 hours of duration to maintain system reliability and security (DPIE, 2020a). The Project would contribute to the identified requirements for energy storage capacity in NSW by providing peak capacity of 700 MW that can be dispatched as needed to boost reliability.

2.4.6 Origin policies

As one of Australia's largest energy retailer, Origin has committed to achieve net zero emissions by 2050. As outlined in the *Origin Sustainability Report 2020*, Origin's climate change targets include reducing Scope 1 and Scope 2 emissions by 50% by 2032 and Scope 3 emissions 25% by that year (Origin, 2020).

Origin has announced new short-term emissions targets in 2020, to reduce Scope 1 emissions over the next three financial years to FY2023 by an average of 10%, compared to the FY2017 baseline. In FY2021, new climate change targets will be linked to executive renumeration. Origin continues to implement the recommendations by the Task Force on Climate-related Financial Disclosures (TCFD) to disclose climate-related risks and opportunities. The established emissions reduction goals and climate change reporting commitments align with Origin's strategic priority to effectively manage the transition to a low-carbon economy.

Origin is a member of the We Mean Business coalition with the aim of accelerating corporate action on climate change. In 2015 Origin was the first energy company in the world to sign up to seven commitments as follows:

- Report climate change information;
- Commit responsible corporate engagement in climate policy;
- Adopt a science-based emissions reduction target;
- Set measures to factor in a cost of carbon internally, to judge its effect on investment decisions to drive down carbon emissions;
- Become Australia's leading renewable and low-carbon energy provider, helping customers to procure electricity from renewable sources and procure 100% of energy from renewable sources for Origin's office premises, and where possible, all other operations by 2050;
- Reduce short-lived climate pollutants (SLCPs) (that contribute to greenhouse gas emissions); and
- Remove commodity-driven deforestation from all supply chains.

Origin has committed to phasing out coal with the scheduled closure of EPS in 2032. Origin is also focused on building battery storage capacity through the Project which is set to become a significant part of emissions reduction commitments to deliver cleaner energy in the future.

2.4.7 Regional context

2.4.7.1 Hunter Regional Plan

The *Hunter Regional Plan 2036* (Department of Planning and Environment (DPE), 2016) is a 20-year blueprint for the future of the Hunter region, which includes the City of Lake Macquarie. The overall vision for the region is to be the leading regional economy in Australia with a vibrant new metropolitan city at its heart.

This vision is supported by a range of goals, directions and actions. The Project would align with the Hunter strategic direction to 'diversify and grow the energy sector' and promote 'new opportunities arising from the closure of coal-fired power stations that enable long term sustainable economic and employment growth in the region' (DPE, 2016).

2.4.7.2 Greater Newcastle Metropolitan Plan 2018-2036

The City of Lake Macquarie is considered part of the Greater Newcastle region and the *Greater Newcastle Metropolitan Plan 2018-2036* (DPE, 2018a) establishes key strategies to support sustainable local and regional growth. Strategy 15 sets out to align with NSW Government plans to achieve net zero emissions, and establishes the Plan for a Carbon Neutral Greater Newcastle by 2050. Specific actions of this strategy include that Greater Newcastle councils will align plans to encourage initiatives to re-use power generating sites for renewable energy generation and re-purposing of electricity distribution infrastructure in West Lake Macquarie and other suitable locations with existing infrastructure.

The Project would align with Strategy 15 in particular and is consistent with overall objectives and outcomes of the Metropolitan Plan.

2.4.7.3 Lake Macquarie Community Strategic Plan 2017-2027

The Lake Macquarie Community Strategic Plan 2017-2027 (Lake Macquarie City Council (LMCC), 2017) sets out community visions and values such as the need to protect and enhance natural environments and to encourage an adaptable and diverse economy.

In particular, LMCC seeks to achieve the established values through actions such as supporting key industries to change and adapt to a diversifying economy, and to support businesses to build capability in using new technology in order to realise economic opportunities. Origin is capitalising on emerging technology in battery storage and facilitate industry transitioning away from coal towards renewable energy. The Project is consistent with the community visions established in the *Lake Macquarie Community Strategic Plan 2017-2027*.

2.4.7.4 Lake Macquarie City Council Environmental Sustainability Strategy and Action Plan 2020-2027

The *Environmental and Sustainability Strategy and Action Plan* (LMCC, 2020) sets out how the council can approach and implement key strategic directions in the Community Strategic Plan. Key environmental concerns for the community include efficient use of energy and water and climate change mitigation and adaptation. Targets set for 2027 include creating sustainable city and communities that maximise the efficient use of energy and reduce reliance on non-renewable energy sources. The Lake Macquarie key community values also emphasise creative process and outcomes that bring together history, culture knowledge and expertise that support new technologies and ways of thinking.

The Project is consistent with the established environmental and sustainability strategies as it highlights the use of emerging low emissions technology such as battery storage to facilitate the transition towards renewable energy on a local and regional scale.

2.4.7.5 Imagine Lake Mac 2050 and beyond

Imagine Lake Mac 2050 and beyond (LMCC, 2019) aims to make the most of identified opportunities and public and private investment aligned with efforts to enhance social and environmental wellbeing to become one of the most productive, adaptable, sustainable and liveable places in Australia. It outlines the aspirations, strategies and how progress will be evaluated.

The following strategies and their evaluation are of relevance to the Project:

- Maximise the potential of existing infrastructure and natural assets to encourage investment, and economic and employment growth and provide for more diverse industries, including renewables, emerging and creative industries and the development of new small business in the new economy with evaluation linked to increased use of alternative energy sources;
- Avoid and minimise the impact of development on areas of high ecological value, while supporting opportunities to enjoy our natural areas as evaluated by the percentage of high ecological value areas maintained; and
- Once operations cease, EPS is remediated and repurposed to another economic use, such as renewable energy generation.

The Project is wholly aligned with the aims of *Imagine Lake Mac 2050 and beyond* in that it seeks to repurpose previously disturbed land associated with the EPS while avoiding the high ecological value E2 zoned land and facilitating the increased penetration of renewables. The Project represents a significant private investment in infrastructure required to support renewables and does not preclude the future economic use of the wider Origin landholding.

3. Project description

3.1 Overview

Origin is proposing to develop a major grid-scale battery Project at the existing Origin landholding next to the EPS. The battery will use lithium-ion technology and will have a peak generation output of 700 MW. The battery configuration will offer significant operational flexibility being capable of providing 700 MW for up to four hours and storage capacity of 2,800 MWh able to dispatch over variable durations.

The Project design would target four aspects vital for meeting NSW demand requirements and provide grid security including:

- The capacity to deliver additional energy supply at peak times of up to 700 MW;
- The ability to flexibly shift up to 2,800 MWh of energy from low demand periods to higher demand periods such as the evening peak, or overnight as renewable energy penetrates further into the NSW market;
- Potential to provide intra-regional transmission services which could support the development of the Central West Orana and New England REZs at lower costs than alternatives; and
- Ability to provide grid security services to support reliable energy supply, which are of increasing importance as NSW moves towards the retirement of coal-fired generation over the decade ahead. The range of grid security benefits include FCAS, fast frequency response, black start and synthetic inertia.

A summary of the overall Project is provided in **Table 3-1**. A more detailed description of the Project is provided in **Sections 3.2** and **3.3**. The works described in these sections are subject to detailed design. The Project description represents a reasonable worst case to facilitate impact assessment.

Table 3-1: Project summary

Project element	Summary of the Project
Site context	
Local Government Area (LGA)	Lake Macquarie
Project location	Origin landholding associated with the EPS located off Rocky Point Rd, Eraring NSW 2264 about 40 km southwest of Newcastle
Formal identifier	Part Lot 11 DP 1050120 with connection works in part Lot 10 DP 1050120
Zoning	SP2 Infrastructure (Electricity generating works) under the Lake Macquarie LEP 2014
Access	Access to and from the Project is via dedicated EPS access provided from Rocky Point Road with slip-lanes to and from the B53 Wangi Road.
Project area/Development footprint	The overall Project area, the subject of the application, is approximately 25 ha within the Origin landholding. Connection works into the TransGrid switchyard is targeting existing vacant connection bays but allowance is made for bench extension and installation of additional infrastructure.
Specifications	
Discharge capacity	Up to 700 MW.
Storage capacity	Up to 2,800 MWh or four hours of maximum discharge capacity.

Project element	Summary of the Project
Typical operating cycle	As required by the NEM. One cycle per day on average assumed for assessment purposes.
BESS compound components	The approximate component requirements to achieve the maximum storage capacity for the BESS has been calculated with reference to potential technology providers as follows: ▪ 1000-8500 pre-assembled battery enclosures containing lithium-ion type batteries, internal cooling and safety management systems; ▪ 170-350 inverter / transformers; and ▪ Ancillary infrastructure including electrical switchrooms, control and ancillary buildings, earthing, lightning protection, lighting, security fencing, closed-circuit television (CCTV) and environmental controls. Numbers provided are indicative only and subject to confirmation on selection of technology provider which may change between stages.
BESS substation components	New substation compound including: ▪ 330 kV line incomer; ▪ Three 330 kV transformer switch bays; ▪ Three 330/33/33 kV 235/117.5/117.5 MVA transformers; ▪ Up to four 33/0.436 kV 315 kVA auxiliary transformers; ▪ Up to four 33 kV earthing transformers; and ▪ One auxiliary Services Building including AC/DC, control, protection and communications systems. Numbers provided are indicative only and subject to confirmation on selection of technology provider.
New on-site connection infrastructure	Approximately 400 m of 330 kV double circuit overhead transmission line strung on: ▪ 330 kV double circuit steel lattice tension structures; and ▪ 330 kV single circuit steel pole terminal structure.
TransGrid connection works	The Project is proposing to connect into the existing TransGrid switchyard via existing vacant gantry structures. This is expected to require the connection of overhead cables only. If vacant bays are not available, the following additional work would be required: ▪ Switchyard bench extension; ▪ Removal and relocation of security fencing; ▪ Construction of new 330 kV gantry columns and beams, three phase busbar supports, single phase busbar supports, three phase disconnectors, three phase circuit breaker, single phase current transformers, single phase voltage transformers, single phase surge arresters; and ▪ Cables as required for the new 330 kV switch bay.
Dimensions	
BESS and Transformer bay finished surface level (FSL)	Finished surface level of BESS compound and transformer bay would be approximately 16 m AHD (average elevation across site).
Battery enclosures height	Up to 3 m height above FSL arranged in strings and spread across the BESS compound area.

Project element	Summary of the Project
Power conversion systems (inverter transformers) height	Up 2.5 m above FSL arranged amongst battery enclosures.
330/33KV transformers height	▪ Tips of bushings approximately 11 m; ▪ Fire wall (if required) of approximately 9 m; ▪ Conservator tank of approximately 8 m; ▪ Radiators of approximately 7 m; and ▪ Main tank of approximately 4.5 m. For the purpose of visual impact assessment, a height of 9 m has been applied for the indicative transformer bay area as items exceeding this height would be limited and difficult to discern from distance.
New on-site connection infrastructure	Five structures likely comprising lattice type towers and / or polls with height of up to 50 m linking the Transformers to the TransGrid switchyard to the north.
Other	The following ancillary items may also be located within the Project area and specifically within the BESS compound and substation area: ▪ Ancillary buildings including control rooms, switch rooms and amenity buildings that would not exceed 5 m above FSL with location subject to final layout; ▪ Lighting and lightning protection poles (height do be determined); and ▪ Fencing of approximately 3 m in height.
Construction	
Peak construction workforce	Up to 128 people per day.
Construction schedule	Construction to commence in 2022 and the Project will be progressively constructed and commissioned in line with battery supply availability and increased demand for the Product in the NEM and in line with REZ progression. It is contemplated that this would likely be undertaken in 2 to 3 stages across 2 to 5 years generally as follows: ▪ Stage 1 expected to begin in 2022 (subject to approval) and have a duration of 18 months, with commercial operations possible in 2023. ▪ Stage 2 construction commencing 2023 and operations commencing 2025; and ▪ Stage 3 construction commencing 2026 and operations commencing 2027. Origin may accelerate the staging if market conditions warrant.
Construction hours	Construction work would generally be limited to standard construction with some exceptions for low impact works.
Vehicle movements	The following maximum vehicle movements are currently anticipated but are subject to change as part of detailed design: ▪ Staff light vehicles – 128 per day (128 in and 128 out) – To facilitate standard construction hours (arriving before 7:00am and departing from 6:00pm); ▪ Heavy vehicles – 60 per day (60 in and 60 out) – even spread between 7:00am and 6:00pm; ▪ OSOM – 20 total outside standard hours; ▪ 50/50 worker split from north and south as per current EPS labour movements; ▪ Heavy vehicles from South (Sydney); and ▪ Oversize from North (Newcastle).

Project element	Summary of the Project
	Average daily heavy vehicle movements would be much lower as key deliveries of battery enclosures are anticipated to arrive in batches of approximately 22 containers with one batch per week being delivered to site from port in one day.
Water demand	Water used directly on site for construction is estimated at 10 mega litres (ML) (in total) used predominantly for dust suppression purposes. Water for construction purposes would be sourced from existing fill points within the EPS and from within existing water license entitlements. Minimal amounts of water would be required for the operation of the Project.
Operations	
Operational life expectancy	The BESS is expected to operate for 20 years and this may be extended subject to replacement of components.
Operational workforce	The BESS can be operated remotely. Inspection and maintenance activities would be undertaken by up to three personnel on a continuous basis. Larger maintenance activities could potentially involving a larger temporary / contractor workforce over short durations.
Daily Operation Traffic Movements	Staff light vehicles up to 10 per day (10 in and 10 out). Ad hoc deliveries of replacement parts may involve heavy vehicles but this would be unlikely to exceed one in-bound and one outbound movement per day.
Noise Emission Level dB(A)	The range of Project component sound power levels used for assessment purposes are ▪ Battery modules: 71 dB(A) – 82.6 dB(A) ▪ Transformers / inverters: 67.5 dB(A) – 90 dB(A); and ▪ 330 kV Transformers: 92.5 dB(A).
Decommissioning	
Decommissioning approach	Areas disturbed as part of construction and not required for operation would be rehabilitated following completion of works to return areas to the existing use. At the end of the life of the Project, built infrastructure associated with the Project would be removed and the Project area would be rehabilitated to a safe, sustainable and non-polluting landform.
Timing	Decommissioning would be subject to a decision that the BESS was past its useful life and not able to be upgraded.
Decommissioning works	Works to undertake decommissioning would not exceed intensity associated with construction.
Duration	Estimated at 12 months per stage for decommissioning followed by a revegetation and monitoring and maintenance until such time as the landform is stable.

3.1.1 Design status

Detailed design for the Project is yet to be completed. The EIS is based on a current design status for each Project component as illustrated in **Figure 3-1** which may be amended through the detailed design process. Construction methods may also vary subject to design refinements and the selection of the construction contractor. The assessment of the Project within the EIS is based on consideration of reasonable worse case environmental impacts to allow flexibility in design and construction methodology. The ongoing design of Project components would deliver the identified performance outcomes for the Project as identified in the EIS.

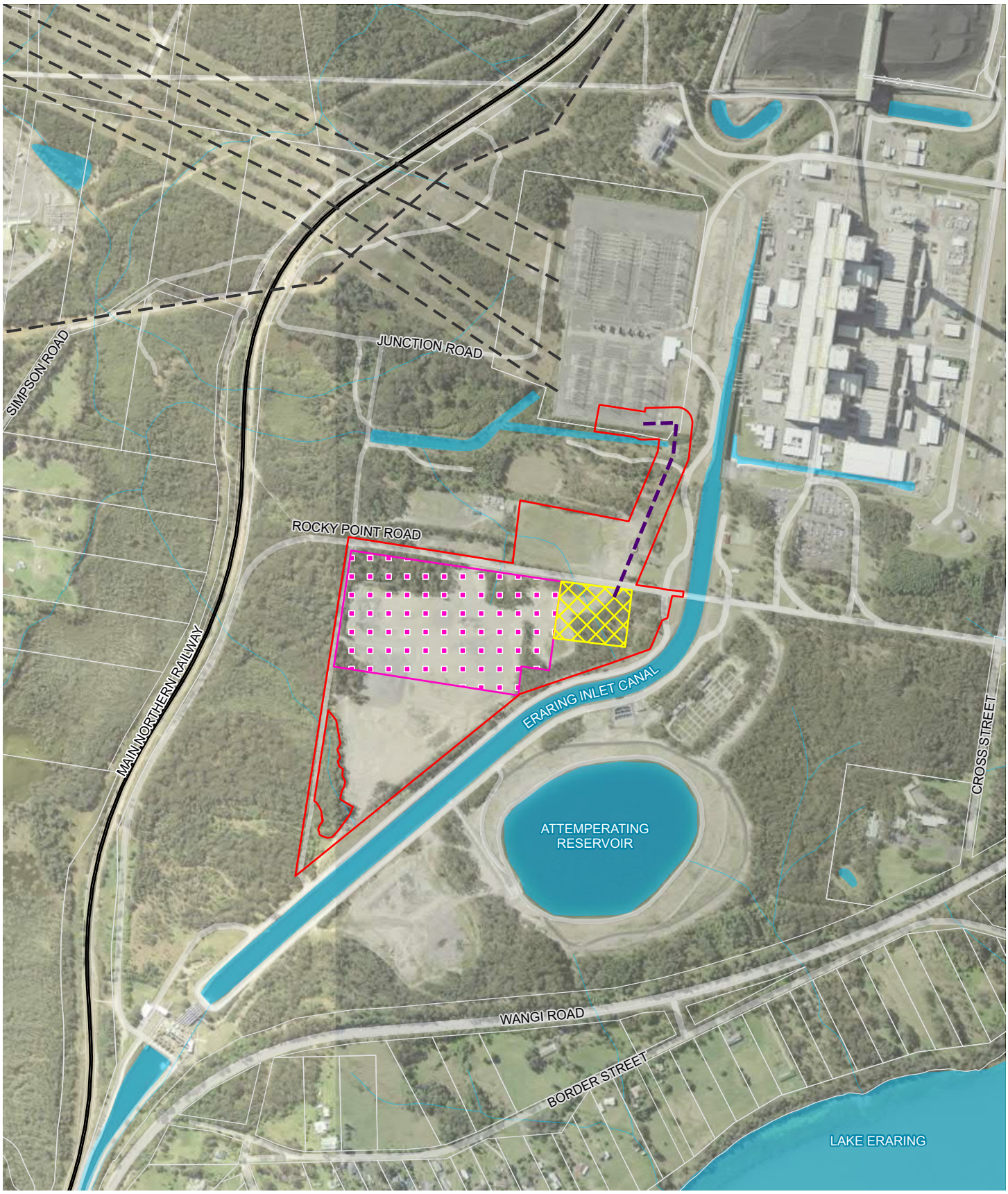


Figure 3-1 Project overview

Following the engagement of a contractor for each Project component, a risk assessment would be completed on the actual methods to be implemented and an environmental management plan prepared that incorporates the Project commitments and conditions of approval. Further consultation with relevant agencies would be undertaken and necessary approvals of final designs and methods sought. Origin would comply with any pre-construction compliance obligations prior to the commencement of all Project components. The risk assessments, final design plans and management plans would be used to confirm that no greater impact than that assessed in this EIS would occur.

3.1.2 Project area

The Project is located on appropriately zoned land predominantly owned by Origin as illustrated in **Figure 3-1**. The Network connection would require works within the TransGrid switchyard. The Project is within an industrial area with the primary land use being energy generation. The Project area is located on a non-operational area in the south western portion of the EPS. The Project area was largely disturbed as part of original construction of the EPS and comprises of the former Fire Training Area (FTA) which was subsequently used in the construction of the EPS attemperation dam construction as a borrow-pit and stockpile area and has since been rehabilitated.

3.1.3 Physical disturbance

The Project may involve complete physical disturbance including vegetation clearing, cut and fill and bulk earthworks to establish level areas for establishment of BESS components, access tracks, drainage and transformer area.

Partial disturbance within the transmission alignment to establish structure footings and maintain clearance to vegetation would also be required.

Limited clearing or ground disturbance is required for the establishment and use of the laydown area, which would be used for temporary parking, administration and laydown purposes, as it would be located on existing cleared and levelled area.

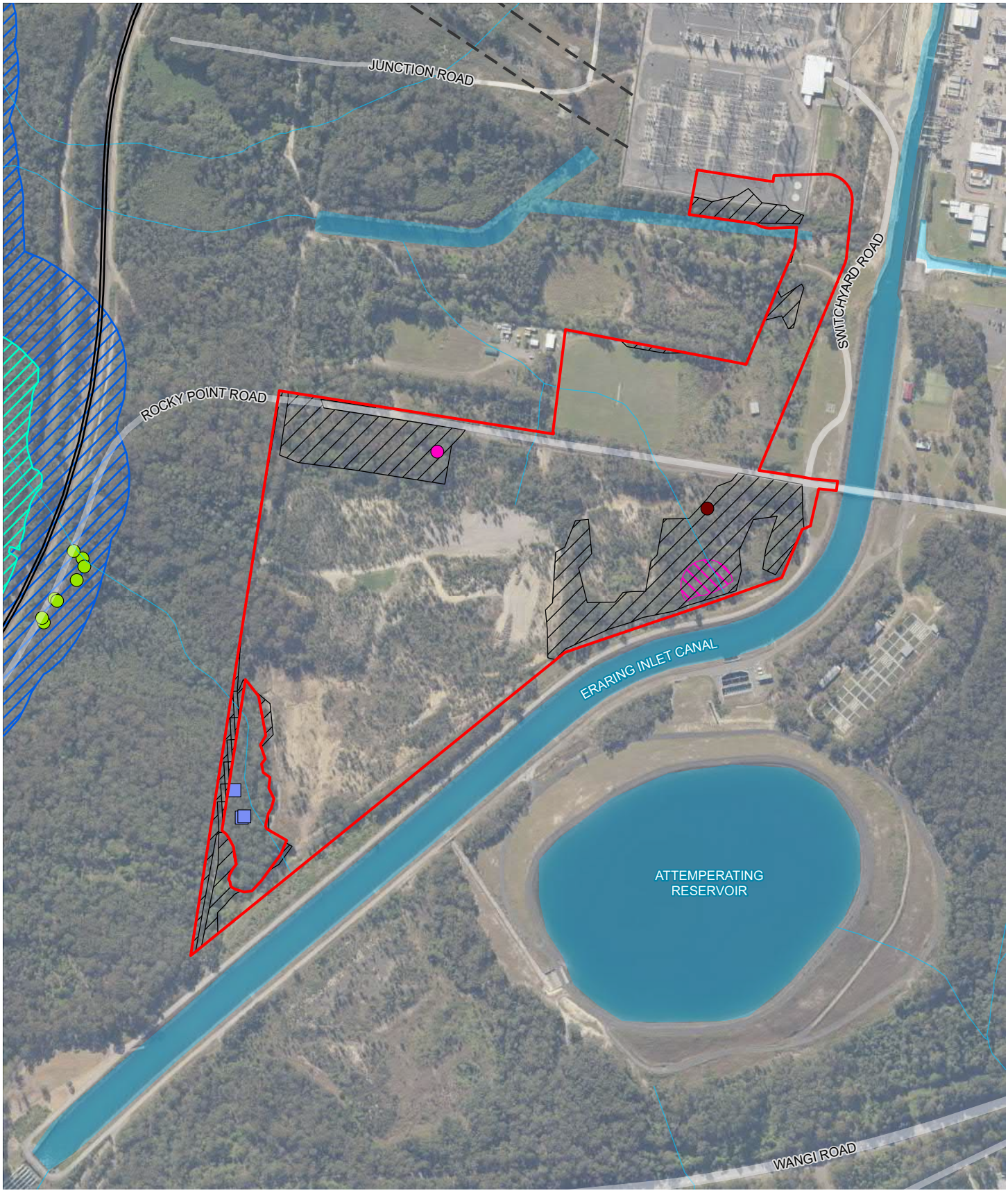
While no works are currently illustrated as occurring in the southern portion of the Project area, this may be subject to change as part of detailed design. This area is retained as part of the Project area to provide flexibility to respond to constraints that may not be managed adequately through design and technology selection alone.

Following construction, areas subject to physical disturbance not required for ongoing operation would be rehabilitated to prevent erosion as a minimum and to return vegetation for landscaping and habitat purposes. Any necessary asset protection zones would be managed on an ongoing basis for bushfire protection purposes.

3.1.4 Environmental constraints

The following environmental constraints are present within the Project area as shown in **Figure 3-2** and detailed design would consider the ability to avoid and reduce impacts in these areas to the extent feasible:

- Swift Parrot important area mapping;
- Small-flower grevillea (*Grevillea parviflora subsp parviflora*); and
- One individual of black- eyed Susan (*Tetratheca juncea*).



Project area

SEPP (Coastal Management) 2018

Coastal Wetlands

Coastal Wetlands Proximity Area

Swift Parrot important area

Tetratheca - Black Eyed Susan

Hollow-bearing trees

Green and Golden Bell Frog

Small-flower Grevillea

Potential *Corybas dowlingii* location

Railway

Electricity transmission line

0 150 m

1:6,000 at A4

GDA94 MGA56

N

Data sources

Origin 2021
Aerometrex 2020,
© Department Finance, Services and Innovation Dec 2020
UMWELT
© Department of Customer Service 2020

Figure 3-2 Environmental constraints

The following environmental constraints are outside the Project area but have been considered in site selection to avoid direct disturbance and for detailed planning to manage indirect impacts:

- Land immediately west of the Project area is zoned E2 environmental protection (Lake Macquarie LEP 2014) and would not be directly impacted as part of the Project;
- The wetlands area associated with Muddy Lake to the west of the Project area is identified as Fauna Key Habitats (NE NSW), with identified possible Squirrel Glider Crossing Zone around 230 m west of the Project area;
- The wetlands area west and north of the Project is identified as coastal wetland under the State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) and is also identified partially as Flood Planning Area under the Lake Macquarie LEP 2014; and
- An area identified as potential green and gold bell frog breeding habitat is located west of the Project area and receives site run-off.

The Great Northern Railway alignment runs along the border of Dora Creek and Eraring suburbs, 200 m west of the Project area. The Railway separates the Project from nearest sensitive receptors on Gradwells Road to the west. Wangi Road is located approximately 400 m south east of the Project area and separates the Project from nearest sensitive receptors on Border street. The Pacific Motorway is located approximately 3 km west of the Project area.

3.2 Physical layout and design

3.2.1 The BESS compound

Origin has completed a RFT process from which the preferred technologies will be selected for the development of the first stage of the Project but ultimate technology selection is not complete and as such no detailed design is currently available. However, based on Origin's selection process a good understanding of available technology on offer is available. The Project description is typical of the concepts being considered by Origin and where necessary ranges are provided to accommodate options currently under consideration. It should be noted that the pace at which technology is developing in the battery storage space means that the option selected for early stages may not be replicated throughout subsequent stages. In general environmental performance, energy density and built-in controls are expected to improve such that reasonable worst case assumptions based on current technology would be unlikely to be exceeded and may be reduced.

The BESS compound is proposed to be installed in up to three stages and targets land within the Project area immediately south of Rocky Point Road. Significant flexibility is available within the BESS compounds for each stage to arrange power islands in different ways. This flexibility would facilitate necessary separation distances, asset protection and otherwise respond to constraints. Origin is considering various stage layouts and the detailed design of each stage would consider technology selection, design mitigation measures, layout and location to best balance environmental impacts, cost and achieve assessed performance outcomes. Visualisations depicting an aerial view of the BESS compound at full development is depicted in **Photo 3-1.**

Photo 3-1: Indicative aerial visualisation of Project at full development

Conceptually, the 700 MW – 2,800 MWh Project may comprise in the order of 2,000 to 8,500 battery enclosures, dependant on the selected supplier, containing battery modules with individual capacity of 0.3 to 1.4 MWh of energy storage. The largest enclosure type under consideration is be in the order of 2.5 m x 2.5 m x 2.8 m (length x width x height). When arranged in rows, all enclosures under consideration resemble a shipping container as depicted in **Photo 3-2**. Each enclosure would house racks of lithium-ion type batteries, internal cooling, fault and fire detection and energy management systems. The battery enclosures, inverters and transformers would be provided with internal bunding and environmental controls for hazardous substances management suitable for the selected technology in accordance with applicable guidelines.

Photo 3-2: Indicative visualisation of within BESS compound

The enclosures would likely be organised in rows and integrated with power conversion systems (inverter / transformers) servicing a number of enclosures to convert direct current from the battery to alternating current required within the electricity network. The rows of BESS enclosures would be physically separated and each enclosure substantially self-contained with local control and protection devices.

Each group of battery enclosures and associated PCS would form a power island which would be sized to deliver maximum dispatch durations under consideration. The PCS will be four-quadrant bidirectional type, with capability for both charge/discharge in leading and lagging reactive power scenarios. The PCS will also have grid forming capability to allow islanded operation and SRAS where required.

The BESS compound would also house and range of ancillary infrastructure including:

- Auxiliary transformer(s);
- Electrical buildings and kiosks;
- Office and amenities buildings and associated parking for operational staff;
- Water supply and/or firefighting tanks and pumps; and
- Surface water drains and retention ponds.

The compound would be surrounded by security fencing and accessed from Rocky Point Road. Internal access for inspection and maintenance purposes would be facilitated by internal access roads surrounding the large groups of battery enclosure rows. The compound would also be surrounded with accessible asset protection zone to form a defendable space.

The existing condition of the BESS compound area is illustrated in **Photo 3-3.**

Photo 3-3: BESS compound area from centre looking north to EPS

3.2.1.1 BESS operations

The BESS would operate on an as needed basis in response to market demands. For the purposes of assessment, the operations are assessed as operating continuously but are expected to undergo one full cycle of charging and discharging per day.

Operations would be supervised remotely. Routine inspections are expected to occur on a day to day basis and maintenance of the BESS is expected to be undertaken on a regular basis in line with manufacturers recommendations. Unscheduled works and repairs will be undertaken on an as needed basis.

3.2.1.2 BESS upgrades

Over the operational life of the Project, various components may require or benefit from upgrade or replacement. This is most likely to involve the replacement of battery cores within enclosures but may also involve the repair or replacement of other infrastructure. If required, upgrade works intensity would not exceed, and is likely to be significantly lower than construction works assessed. Should additional generation capacity also be attainable from improved technology without increasing the disturbance area or exceeding assessed performance outcomes, then this may also occur.

3.2.2 Network connection

The Project would take advantage of the existing under-utilised transmission, substation, switching and other infrastructure assets associated with the existing TransGrid switchyard to which the EPS connects. The Project will be connected directly to the grid within the TransGrid switchyard and would operate independently of the EPS. The following components are required to connect the battery to the NEM:

- Power conversion systems and medium voltage reticulation up to 33kV within the BESS compound;
- 33/330 kV transformers within the BESS substation;
- Network connection cable in above ground configuration as described below;
- Overhead tie-in to TransGrid 330 kV network; and
- Circuit breakers and connecting infrastructure at the switchyard connection point.

3.2.2.1 BESS Substation

The BESS substation would be located to the east of the BESS compound immediately south of Rocky Point Road. The BESS substation would have an indicative footprint of 160 m x 160 m and be surrounded by security fencing and asset protection zone. The BESS substation would require the creation of an earth bench on which up to three 330 kV transformer bays would be established. Each transformer bay would be bunded and subject to separation distance and may also include fire walls subject to design requirements.

The BESS substation would accommodate typical electrical equipment and ancillary infrastructure for the conversion electricity between the high voltage transmission network and low voltage BESS compound. The key infrastructure within the BESS substation would be the installation of 330/33kV transformers within bunded transformer bays. Other ancillary infrastructure would include but not be limited to the following:

- Auxiliary services building and footings to accommodate secondary protection systems, AC/DC distribution equipment and 110 V batteries, fire detection and control, CCTV and intrusion detection;
- Up to four 33/0.436 kV 500 kVA auxiliary transformers;
- High voltage connections between switchgear;
- 33 kV three phase post insulator supports and three phase voltage transformer supports, disconnectors, and cable sealing ends; and

- Other ancillary components including security fencing, lightning protection, lighting poles, security poles and cables.

The BESS substation would be connected to the BESS by below ground 33 kV cables.

3.2.2.2 330 kV transmission connection

The transmission connection would consist of approximately 400 m of 330 kV double circuit overhead transmission line strung on two 330 kV double circuit steel lattice tension structures with 330 kV steel pole terminal structures adjacent to the BESS substation and existing TransGrid switchyard.

The transmission line would require the establishment of a 60 m wide easement that would be maintained to facilitate safe distances between overhead cable and vegetation for bushfire risk management purposes.

3.2.2.3 TransGrid switchyard works

The Project is proposing to connect into the existing TransGrid switchyard via currently vacant gantry structures. This is expected to require the connection of overhead conductors and the population of vacant bay. If vacant bays are not available, the following additional work would be required:

- Switchyard bench extension along the southern edge;
- Removal and relocation of security fencing;
- Construction of new 330 kV gantry columns and beams, three phase busbar supports, single phase busbar supports, three phase disconnectors, three phase circuit breaker, single phase current transformers, single phase voltage transformers, single phase surge arresters; and
- Cables as required for the new 330 kV switch bay.

The current condition and the location of the TransGrid switchyard is shown in **Photo 3-4**.

Photo 3-4: View of vacant gantry at the TransGrid switchyard

3.3 Development stages

3.3.1 Construction

3.3.1.1 Construction works

Construction works associated with Project would be likely to involve, in general order:

- Installation and maintenance of environmental controls including drainage and sediment controls;
- Upgraded construction access track from existing internal access road to battery location;
- Vegetation clearing including for transmission easement and asset protection zones;
- Cut and fill to level areas and establish a hardstand pad;
- Structural works including numerous individual slabs to support battery modules, power conversion systems and transformer structures;
- Establishment of noise control solution if required by the stage under construction;
- Delivery, installation and electrical fit-out of battery modules, power conversion systems and transformers;
- Installation of tower structures including foundation piles;
- Installation of 330 kV overhead cabling from the BESS substation transformers to the TransGrid switchyard;
- Minor works to connect the battery to vacant bay in the TransGrid switchyard or more extensive works for bench extension and installation of new bay if required;
- Testing and commissioning activities; and
- Removal of construction equipment and rehabilitation of construction areas.

3.3.1.2 Construction program

Construction is proposed to commence in 2022 and the Project will be progressively constructed and commissioned in line with battery supply availability and increased demand for the Product in the NEM and in line with REZ progression. It is contemplated that this would likely be undertaken in 2 to 3 stages across 2 to 5 years generally as follows:

- Stage 1 expected to begin in 2022 (subject to approval) and have a duration of 18 months, with commercial operations possible in 2023.
- Stage 2 construction commencing 2023 and operations commencing 2025; and
- Stage 3 construction commencing 2026 and operations commencing 2027.

Origin may accelerate the staging if market conditions warrant.

The construction of each Stage is anticipated to take 12-18 months consisting of the civil works component, mechanical and structural component, electrical works and testing and commissioning. Construction of each Project Stage would be undertaken in four key phases as follows:

- Site establishment;
- Cut and fill to battery compound and transformer yard and establishment of pad;
- Structural works to support battery enclosures, inverters, transformers, building and transformer compounds and transmission structures; and
- Delivery, installation and electrical fit-out of components.

A fifth construction phase is also assessed in the NIA related to the use of an air track drill for establishment of transmission structure footings within the transmission line easement only. This fifth phase would be undertaken only during works associated with the first Project Stage.

3.3.1.3 Construction hours

Construction works would generally be limited to standard construction hours of:

- Monday-Friday 0700-1800;
- Saturday 0800-1300;
- No works on Sunday or public holidays.

Activities outside of the standard construction hours include:

- Work determined to comply with the relevant noise management level;
- The delivery of materials as required by the authorities for safety reasons;
- Commissioning activities where the operation of the Project must align with demands on the grid;
- Emergency situations to prevent the loss of lives and properties and/or to prevent environmental harm; and
- Situations where agreement is reached with affected receivers.

3.3.1.4 Construction workforce

The Project is anticipated to require the recruitment and training of a construction workforce of up to 128 people during peak construction periods. The Project will also provide localised upskilling and training in the region for the deployment of batteries. Major contractors will be asked to demonstrate their commitment to using a regional workforce and creating Indigenous and equal opportunity employment.

3.3.1.5 Construction plant, equipment and materials

A range of plant and equipment would be used during construction. The final equipment and plant requirements would be determined by the construction contractor. Indicative plant and equipment have been broadly categorised into typical construction phases as documented in **Table 3-2**.

Table 3-2: Typical construction plant and equipment

Construction phase	Equipment
Site Establishment	Trucks (medium rigid, heavy rigid, dog trailers and tipper combinations)
	Road truck
	Scissor lift
	Light vehicles
	Franna crane
Cut and fill to battery compound and transformer yard and establishment of pads	Franna cranes
	Excavators (tracked) 35t
	Graders
	Vibratory rollers
	Concrete trucks
	Dump trucks
	Water cart
	Concrete pumps
	Concrete vibrators

Construction phase	Equipment
	Generators
	Light vehicles
	Front loaders
	Backhoes
	Asphalt truck and sprayer
Structural works to support battery enclosures, inverters, transformers, building and transformer compounds and transmission structures	Mobile cranes
	Concrete vibrators
	Concrete pumps
	Welding equipment
	Excavators (tracked) 35t
	Generators
Delivery, installation and electrical fit-out of components	Rigid trucks
	Mobile cranes
	Compressors
	Welding equipment
	Generators
Establishment of transmission structure footings	Air track drill

3.3.1.6 Construction materials

The following indicative volumes of materials are likely to be required for the construction of the Project:

- Approximately 300 tonnes (t) of structural steel;
- Approximately 5000 cubic metres (m^3) of concrete;
- Cables (quantity subject to detailed design);
- Prefabricated buildings;
- Water tanks; and
- Ash, sand, gravel, clay, rock and bitumen (quantities to be confirmed).

Up to 10 ML of water is expected to be required predominantly for compaction and dust suppression activities. Water would be sourced from Origin's current water entitlements or purchased from potable water supplies.

3.3.2 Operation

Operation would be 24 hours per day 365 days per year and will respond to market demand, fluctuating from discharge at full capacity for up to four hours or partial capacity for a longer duration. Maintenance activities will be ongoing (landscaping, asset protection zones, water management infrastructure, access tracks and inspection, testing, service and replacement of components). Operation life is expected to be 20 years. Component replacements and / or upgrades may extend this timeframe.

During operation, water use would be limited to the following:

- Sanitary water used for toilets, handwashing and showering facilities;
- Minor water losses during fire hydrant testing;
- Minor miscellaneous uses; and
- Drinking water, likely to be supplied via bottled systems.

Less than 200,000 L of water per annum is likely to be used during the Project operational stage given onsite operational staffing levels are approximately 10 people and that no water is used in the BESS operational process.

3.3.3 Decommissioning

Following the end of economic life, above ground components would be removed and re-purposed where possible. Land rehabilitation will be undertaken where necessary to achieve acceptable conditions as far as reasonably practicable in accordance with relevant approval requirements.

4. Statutory context

This chapter describes the environmental impact assessment and approval process for the Project as well as the statutory context for the Project, including:

- How the Project meets the provisions and objectives of the EP&A Act and EP&A Regulation;
- Consideration of the Project against relevant Environmental Planning Instruments (EPIs); and
- Approvals that must be obtained before the proposed Project can commence; and
- The likely interactions between the existing development consents and other environmental regulatory instruments.

4.1 Summary of statutory context

The EP&A Act and the EP&A Regulation provide the framework for land use planning and development control in NSW. The EP&A Act and Regulation are supported by a number of EPIs which include State Environmental Planning Policies (SEPPs) and LEPs.

Part 4 of the EP&A Act establishes the framework for assessing development that is permissible with consent. The Project is SSD under Part 4, Division 4.7 Section 4.36 of the EP&A Act, as it meets the requirements of Clause 8 of the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). The Project is specified in Schedule 1 Clause 20 of the SRD SEPP in that it is:

- Development for the purpose of electricity generating works; and
- Has a capital investment value (CIV) of more than $30 million.

The Project is defined as electricity generating works and has a CIV greater than AUD$500 million. Therefore, the Project is proceeding with an application for SSD. Under Section 4.12(8) of the EP&A Act, the application is to be accompanied by an EIS that meets the requirements of Schedule 2 of the EP&A Regulation (Refer to **Appendix B**) and any other relevant legislative requirements (refer to **Table 4-4**) that relate to the EIS.

A scoping report was prepared and SEARs were received on 19 April 2021 (refer to **Appendix A**). This EIS has been prepared to address the requirements of the SEARs and schedule 2 of the EP&A Regulation.

4.2 Permissibility

The Project meets the definition of 'electricity generating works' under the Standard Instrument – Principal Local Environmental Plan (Standard Instrument), being a building or place used for the purpose of 'electricity storage'. The Project is wholly located in land zoned SP2 Infrastructure (Electricity generating works) with the purpose shown on the map permissible with consent under the Lake Macquarie LEP 2014. Further, clause 34 of the State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) states 'development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone'. Land which is zoned SP2 Infrastructure is prescribed special use zone for the purposes of clause 34 of the Infrastructure SEPP. Therefore, the Project is permissible with consent under Part 4 of the EP&A Act.

4.3 Power to grant consent

As SSD, the Project will be assessed under Part 4, Division 4.7 of the EP&A Act. Under Section 4.5(a) of the EP&A Act, the consent authority for the Project is the Independent Planning Commission. The consent authority will evaluate the SSD application in accordance with Section 4.15 of the EP&A Act.

Chapter 8 provides justification for the Project including mandatory considerations under Section 4.15 of the EP&A Act and Schedule 2 of the EP&A Regulations. The relevant provisions of the EP&A Act are identified in **Table 4-1.**

Table 4-1: EP&A Act mandatory considerations

Statutory reference	Consideration
Section 4.36 Development that is SSD	The Project is declared SSD through the application of Clause 8 and Schedule 1 of SRD SEPP being for the purpose of electricity storage and having a CIV exceeding $30 million.
Section 4.37 Staged SSD	The Project application does not seek consent for a staged development.
Section 4.38 Consent for SSD	The Independent Planning Commission is the consent authority for SSD under Division 4.7 of the EP&A Act due to reportable political donations made by Origin. The consent authority may determine the SSD application by either granting conditional consent or refusing consent.
Section 4.39 Regulations – SSD	The relevant regulations establish the form and content requirements for the EIS and the requirements for the consultation process.
Section 4.10 Evaluation	The determination of the application is to be evaluated under Section 4.15 of the EP&A Act.

Environmental approvals that are not required for SSD under Section 4.41 of the EP&A Act, but which have been considered as part of the EIS are listed in **Table 4-2.**

Table 4-2: Relevant approvals not required under Section 4.41

Approval	Consideration	Where addressed
A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994* (FM Act)	The Project would not involve dredging or reclamation works or works in water ways. The Project would not impact on marine vegetation or cause blockage in fish passage. No permits under the relevant FM Act sections are required.	Not applicable
An approval under Part 4, or an excavation permit under section 139 of the *Heritage Act 1977* (Heritage Act)	The Heritage Act provides for the conservation of buildings, works, relics and places that are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the State. Matters protected under the Act include items listed on the State Heritage Register, the heritage schedules of local council LEPs, and/or the conservation registers (or Section 170 Registers) of NSW State government agencies, as well as items subject to an Interim Heritage Order. Section 139 of the Heritage Act prohibits a person from disturbing or excavating any land on which the person has discovered or exposed a relic, except in accordance with an	A Statement of Heritage Impact (SOHI) is provided in **Appendix G** and summarised in **Section 6.3**

Approval	Consideration	Where addressed
	excavation permit or a notification granting exception for the permit. An approval under Part 4, or an excavation permit under Section 139 of the Heritage Act is not required for SSD that is authorised by a development consent (Section 4.41 EP&A Act). Two local heritage items are identified under the Lake Macquarie LEP 2014 at or in the vicinity of the Project area, being the EPS and the Great Northern Railway.	
An Aboriginal heritage impact permit (AHIP) under section 90 of the *National Parks and Wildlife Act 1974* (NPW Act)	The NPW Act seeks to protect natural and cultural heritage by prescribing offences and defences relating to, but not limited to, Aboriginal heritage and the preservation of native title within NSW. Under Part 6 Section 86 of NPW Act, it is an offence to harm or desecrate an Aboriginal object or Aboriginal place. Section 87(1) of the NPW Act provides that it is a defence to these provisions if the harm or desecration act is authorised by an AHIP. Under Section 4.41 of the EP&A Act, an AHIP under Section 90 of the NPW Act is not required for SSD that is authorised by a development consent. Nevertheless, the Project is required to comply with all legislative requirements under Part 6 of the NPW Act.	An Aboriginal cultural heritage impact assessment is provided in **Appendix F** and summarised in **Section 6.2**
A bushfire safety authority under section 100B of the *Rural Fires Act 1997* (Rural Fires Act)	The Rural Fires Act facilitates the prevention, mitigation and suppression of bush and other fires in LGAs and parts of NSW considered to be rural fire districts. The Project would be located partially on Bush Fire Prone Land (BFPL). 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 4.41 of the EP&A Act overrides the requirement for a bush fire safety authority to authorise the Project under Section 100B of the Rural Fires Act.	A bushfire assessment is provided in **Appendix N** and summarised in **Section 6.9**
A water use approval (section 89), a water management work approval (section 90) or an activity approval (other than an aquifer interference approval) under section 91 of the *Water*	The WM Act was introduced to provide a comprehensive singular piece of legislation to effectively manage and regulate access and use of the State's water resources. Section 3, Part 3 of the WM Act requires that approval be granted for works that are classified as 'controlled activities' within waterfront land	A water impact assessment is provided in **Appendix L** and summarised in **Section 6.8**.

Approval	Consideration	Where addressed
Management Act 2000 (WM Act).	defined as 40 m from the bank of any river, lake, estuary or coastal waters of the State (Lake includes a wetland, a lagoon, a saltmarsh and any collection of still water, whether perennial or intermittent and whether natural or artificial). The Project may involve work being carried out on waterfront land. The Project would not require a water use approval under section 89 of the WM Act. The Project would involve water management work (drainage) under section 90 of the WM Act.	

Environmental approvals identified in Section 4.42 of the EP&A Act, that if required cannot be refused if it is necessary for carrying out SSD and must be applied consistently with conditions under the EP&A Act are outlined in **Table 4-3**.

Table 4-3: Approvals that cannot be refused for SSD under Section 4.42 of the EP&A Act

Approval	Consideration	Application
An aquaculture permit under section 144 of the FM Act	The Project would not involve aquaculture development and no aquaculture permit is required.	Not applicable
An approval under section 15 of the Mine *Subsidence Compensation Act 1961* (repealed by *Coal Mine Subsidence Compensation Act 2017*)	The CMS Act requires that certain development within mine subsidence districts must obtain approval from the Subsidence Advisory, to ensure new structures are built to an appropriate standard that reduces the risk of damage should subsidence occur.	The Project is located within a mine subsidence district. An approval under the *Coal Mine Subsidence Compensation Act 2017* would be required. Consultation with the Mine Lease holder is documented in **Chapter 5**.
A mining lease under the *Mining Act 1992*	An exploration licence and mining/production lease cover the Project area. Since the Project would only involve surface infrastructure with a limited footprint, potential impacts on existing or future mining activities are not anticipated. A mining lease is not required.	Not applicable
A production lease under the *Petroleum (Onshore) Act 1991*	The Project would not involve petroleum production and no production lease is required.	Not applicable
An environment protection licence (EPL) under Chapter 3 of the *Protection of the Environment Operations Act 1997* (POEO Act) (for any of the purposes referred to in section 43 of that Act)	The principal legislation regulating pollution and waste management in NSW is the POEO Act which specifies the requirements for licences and regulates activities that have the potential to pollute or harm the environment. All scheduled activities as listed in Schedule 1 of the POEO Act require an EPL.	Origin would seek a variation of the existing EPS EPL number 1429 to cover scheduled development work and any new scheduled activities.

Approval	Consideration	Application
	Schedule 1 lists activities that require a licence and Section 17 applies to 'general electricity works'. EPS operates under EPL 1429.	
A consent under section 138 of the *Roads Act 1993*	The 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 Transport for NSW (TfNSW) and other public authorities as roads authorities for classified and unclassified roads. The Project is located with the Origin landholding next to Rocky Point Road, which is a local road owned and managed by Lake Macquarie City Council. No road upgrades are currently planned in relation to the Project.	Not applicable
A licence under the *Pipelines Act 1967*	The Pipelines Act describes the approvals system for the construction and operation of 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 and, excluding exempt items a licence is required to construct, alter and operate a pipeline. No pipelines or associated licences would be required for the Project.	Not applicable

4.4 Other NSW environmental legislation

Based on the scope of the Project the legislation that may be applicable in addition to those identified in **Table 4-2** and **Table 4-3** above are identified in **Table 4-4**.

Table 4-4: NSW legislation requirements

Legislation	Requirement	Application
Contaminated Land Management Act 1997	This Act outlines the circumstances in which notification of the NSW Environment Protection Authority (EPA) is required in relation to the contamination of land.	A contamination assessment has been undertaken for the Project (refer to **Appendix H**) on the basis that up to 2013, and prior to Origin ownership of the EPS, the Project area was used as a firefighting training area. The contamination assessment concludes that the nature of land and water contamination across the Project area does not represent a risk to human health that requires remediation as part of the proposed Project.
Biodiversity Conservation	The BC Act introduced mandatory requirements for biodiversity assessment and reporting and	A BDAR has been prepared and is provided in **Appendix E** and summarised

Legislation	Requirement	Application
Act 2016 (BC Act)	established the BAM and Biodiversity Offsets Scheme (BOS), with the key principle of 'no net loss' where any impact of development is assessed and offset, while demonstrating impact avoidance, minimisation and management measures prior to implementing offsets. Under section 7.9 of the BC Act, any SSD application is to be accompanied by a BDAR, unless it is determined that the proposed development is not likely to have any significant impact on biodiversity values.	in **Section 6.1**. The BDAR assesses the Project on all potential direct, indirect and prescribed impacts in accordance with the BC Act and BAM.
Native Title (New South Wales) Act 1994	This Act provides for native title in relation to land or waters. The Project does not affect land subject to a native title claim or determination, or land to which an Indigenous Land Use Agreement applies.	Not applicable
Waste Avoidance and Resource Recovery Act 2001 (WARR Act)	The objects of the WARR Act are to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development. The WARR Act outlines the requirement for the NSW Environment Protection Authority (EPA) to develop a waste strategy for the State.	Waste management for the Project is described in **Section 6.11**.

4.5 NSW environmental planning instruments

Relevant SEPPs and LEP to the Project have been considered in **Table 4-5**.

Table 4-5: Environmental planning instruments and considerations

Environmental planning instrument	Application	Mandatory consideration
State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP)	The SRD SEPP identifies development that is significant to the state of NSW. As discussed in **Section 4.1**, the Project is classified as SSD under Clause 8 in conjunction with Clause 20 of Schedule 1 of the SRD SEPP. Under Clause 8A the Independent Planning Commission is declared, under section 4.5(a) of the EP&A Act, to be the consent authority under circumstances which include Council or at least 50 other parties object to the application or where the application is made by a person who has disclosed a reportable political donation. Under Clause 10 a subdivision certificate may be issued by an accredited certifier for	No mandatory considerations

Environmental planning instrument	Application	Mandatory consideration
	a subdivision that is State significant development in accordance with section 6.5(3)(a) of the EP&A Act. Under clause 11, development control plans (whether made before or after the commencement of this Policy) do not apply to SSD.	
State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP)	The aim of the Infrastructure SEPP is to facilitate effectively delivery of infrastructure projects across NSW. The Project area is located in land zoned SP2 Infrastructure under the Lake Macquarie LEP. This land use zone is also defined as a special use zone for the purpose of electricity generating works and under clause 34 of the Infrastructure SEPP the Project is permissible with consent.	Under clause 101(2) of the Infrastructure SEPP the consent authority must not grant consent to development on land that has a frontage to a classified road unless it is satisfied in relation to various issues aimed at maintaining safe, efficient and ongoing operations. The Project does not front a classified road. A traffic impact assessment is provided in **Appendix K** and summarised in **Section 6.7** and identifies that traffic volumes would not affect the operation of the existing road network. Clause 104 of the Infrastructure SEPP requires that prior to determining a development identified as a traffic generating development under Schedule 3, the determining authority is to give notice to TfNSW within seven days of the application being made and consider and submissions received within 21 days in addition to the accessibility of the Project area and any potential traffic safety, road congestion or parking implications. The Project can be considered an expansion of an existing facility that may exceed vehicle generation thresholds to be a traffic generating facility. TfNSW provided input into the preparation of the SEARs for the Project and the Traffic assessment (refer to **Appendix K**) has addressed accessibility and traffic safety.
State Environmental Planning Policy (Koala Habitat Protection 2021) (Koala SEPP)	This Policy aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free-living population over their present range and reverse the current trend of koala population decline. The Koala SEPP applies to many LGAs across NSW as listed in Schedule 1, including the Lake Macquarie LGA.	Under clause 11 before a council may grant consent to a development application for consent to carry out development on the land, the council must assess whether the development is likely to have any impact on koalas or koala habitat. The BDAR (refer to **Appendix E**) assesses the Project in relation to Koalas and found no Koalas to be present.
State Environmental Planning	SEPP 55 aims to streamline approaches for the remediation of contaminated land to	In accordance with clause 7(1) of SEPP 55, a consent authority must not consent to the

Environmental planning instrument	Application	Mandatory consideration
Policy No. 55 – Remediation of Land (SEPP 55)	minimise the risk of harm to the health of humans and the environment.	carrying out of development on any land unless: ▪ it has considered whether the land is contaminated, and ▪ if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and ▪ if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose. The Project represents a continuation of the current electricity generation uses of the Origin landholding, being a form of industrial development. **Section 6.4** and **Appendix H** confirm that potential contamination risks present in the Project area is not an impediment to the implementation of the Project.
State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33)	SEPP 33 aims to ensure that measures are used to reduce the impact of a development that is potentially hazardous or offensive. Clause 12 of SEPP 33 requires a preliminary hazard analysis for development of a potentially hazardous industry.	Clause 13 of SEPP 33 specifies that the consent authority must consider: ▪ current circulars or guidelines published by the Department of Planning relating to hazardous or offensive development, and ▪ whether any public authority should be consulted concerning any environmental and land use safety requirements with which the development should comply, and ▪ in the case of development for the purpose of a potentially hazardous industry—a preliminary hazard analysis prepared by or on behalf of the applicant, and ▪ any feasible alternatives to the carrying out of the development and the reasons for choosing the development the subject of the application (including any feasible alternatives for the location of the development and the reasons for choosing the location the subject of the application), and ▪ any future use of the land surrounding the development.

Environmental planning instrument	Application	Mandatory consideration
		A Preliminary Hazard Analysis (PHA) has been prepared for the Project in and is provided in **Appendix M**.
Lake Macquarie Local Environmental Plan 2014	The Project would be located within the City of Lake Macquarie LGA and development within this LGA is regulated by the Lake Macquarie LEP. The Project area is zoned SP2 Infrastructure (Electricity generating works) with the purpose shown on the map permissible with consent, and energy storage included in the definition of Electricity generating works. The Lake Macquarie LEP 2014 contains various applicable development standards that could apply to the Project. Clause 4.6 identifies that development consent may, subject to this clause, be granted for development even though the development would contravene a development standard imposed by this or any other environmental planning instrument.	Under Clause 4.6 (3) development consent must not be granted for development that contravenes a development standard unless the consent authority has considered a written request from the applicant that seeks to justify the contravention of the development standard by demonstrating— (a) that compliance with the development standard is unreasonable or unnecessary in the circumstances of the case, and (b) that there are sufficient environmental planning grounds to justify contravening the development standard. Under Clause 4.6 (4) development consent must not be granted for development that contravenes a development standard unless— (a) the consent authority is satisfied that— (i) the applicant's written request has adequately addressed the matters required to be demonstrated by subclause (3), and (ii) the proposed development will be in the public interest because it is consistent with the objectives of the particular standard and the objectives for development within the zone in which the development is proposed to be carried out, and (b) the concurrence of the Planning Secretary has been obtained.
	Clause 4.3 height of buildings not to exceed the maximum heights shown for the land on the height of buildings map (8.5 m).	Clause 4.3 is considered unreasonable in relation to the Project as the Project area is appropriately zoned for electricity generation which is typically associated with a need for above ground network connection structures and other structures that would typically exceed 8.5 m. The restriction is also considered unnecessary in the circumstances of close proximity to existing EPS assets that already exceed height of building standard and are taller and more obtrusive than the buildings and structures proposed as demonstrated in the visual impact assessment (refer to **Appendix I**).
	Clause 5.10 Heritage conservation	The consent authority must, before granting consent under this clause in respect of a

Environmental planning instrument	Application	Mandatory consideration
	Heritage protection in relation to the listing of the EPS as a locally significant heritage item.	heritage item or heritage conservation area, consider the effect of the proposed development on the heritage significance of the item or area concerned. A cultural heritage impact assessment is provided in **Appendix F** and a statement of heritage impact is including in **Appendix G**.
	Clause 7.1 acid sulfate soils Requiring the preparation of an acid sulfate soils management plan in specified circumstances prior to issue of development consent required by the clause.	Development consent must not be granted under this clause for the carrying out of works unless an acid sulfate soils management plan has been prepared for the proposed works in accordance with the Acid Sulfate Soils Manual and has been provided to the consent authority. While the Project area is partially mapped as class 5 land, the works do not affect land that is below 5 m AHD and is unlikely to lower the groundwater table of any adjacent class 1, 2, 3 or 4 land below 1 m AHD.
	Clause 7.2 earthworks The Project involves ancillary earthworks.	Before granting development consent for earthworks (or for development involving ancillary earthworks), the consent authority must consider the following matters— (a) the likely disruption of, or any detrimental effect on, drainage patterns and soil stability in the locality of the development (addressed in **Appendix L**) (b) the effect of the development on the likely future use or redevelopment of the land (Addressed in **Section 6.4**); (c) the quality of the fill or the soil to be excavated, or both (Addressed in **Appendix H**); (d) the effect of the development on the existing and likely amenity of adjoining properties (Addressed in **Section 6.4**, **Appendix J** and **Appendix I**); (e) the source of any fill material and the destination of any excavated material; (f) the likelihood of disturbing relics (Addressed in **Appendix G**); (g) the proximity to, and potential for adverse impacts on, any waterway, drinking water catchment or environmentally sensitive area (Addressed in **Appendix L**); and (h) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development (refer to **Chapter 7**).

Environmental planning instrument	Application	Mandatory consideration
		Cut and fill will be balanced to the extent possible within the Project area. Any fill required would meet waste exemptions and all excess material would be lawfully disposed of under the POEO Act which may include re-use within the Origin landholding in accordance with EPL1429.
	Other provisions The Project area is not mapped as: ▪ Environmentally Sensitive Land; ▪ Coastal Risk; ▪ Terrestrial biodiversity; ▪ Sensitive Aboriginal landscapes; or ▪ Environmentally Sensitive Land.	Mandatory considerations not applicable.

4.6 Commonwealth environmental legislation

4.6.1 Environmental Protection and Biodiversity Conservation Act 1999

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

The EPBC Act requires referral to the Commonwealth Minister for the Environment and Energy for any actions that are likely to have a significant impact on the following:

- Matters of National Environmental Significance (MNES):
- An action by the Commonwealth or a Commonwealth agency which has, will have or is likely to have a significant impact on the environment: and
- An action which has, will have or is likely to have a significant impact on the environment on Commonwealth land, no matter where it is to be carried out.

Origin is not a Commonwealth agency and a preliminary assessment of the Project indicates no Commonwealth land would be affected.

A search of the EPBC Act Protected Matter Search Tool (PMST) for the Project study area was conducted in February 2021 to identify potential MNES that may trigger the need for referral of the action to the Department of Agriculture, Water and the Environment (DAWE). A summary of the potential MNES within 10 km of the Project area is presented in **Table 4-6**.

Table 4-6: Protected matters search results

MNES	Matters within 10 km of the Project area
World heritage properties	None
National heritage places	None
Wetlands of international importance	None
Great Barrier Reef Marine Park	None

MNES	Matters within 10 km of the Project area
Listed Threatened Ecological Communities	3
Listed Threatened Species	72
Listed Migratory Species	47
Other matters protected by the EPBC Act	
Commonwealth Land	3
Commonwealth Heritage Places	None
Listed Marine Species	52
Whales and Other Cetaceans	1
Critical Habitats	None
Commonwealth Reserves Tribunal	None
Commonwealth Reserves Marine	None

It is generally the responsibility of the proponent of a proposed development to identify whether a project, or action, has the potential to impact upon a MNES and constitute the need for a referral to the Commonwealth for determination.

An EPBC Act referral (2021 / 8956) was made to DAWE on 1 June 2021 to consider whether the Project would be a controlled action.

On 19 July 2021, DAWE determined the Project is not a 'controlled' action, if done in a particular manner under the EPBC Act. The particular manner conditions relate to the prevention of contaminated run-off from leaving the referral area. Accordingly, the Project does not require further assessment or approval under the EPBC Act.

4.6.1.1 Native Title Act 1993

The Native Title Act (Commonwealth) seeks to recognise and protect native title. A successful native title determination results in the recognition of the rights, interests or uses claimed by the registered party, and any actions by Government on that land must be consistent with the claim.

Searches of the register maintained by the National Native Title Tribunal indicate that there are no native title claims registered with respect to the land within the Project area.

4.6.1.2 National Greenhouse and Energy Reporting Act 2007

The Federal Government uses the National Greenhouse Gas and Energy Reporting (NGER) legislation for the measurement, reporting and verification of Australian Greenhouse Gas (GHG) emissions. This legislation is used for a range of purposes, including being used for international GHG reporting purposes. Corporations which meet the thresholds for reporting under NGER must register and report their GHG emissions.

Under the NGER Act, constitutional corporations in Australia (including Origin) which exceed thresholds for GHG emissions or energy production or consumption are required to measure and report data to the Clean Energy Regulator on an annual basis. The *National Greenhouse and Energy Reporting (Measurement) Determination 2008* identifies a number of methodologies to account for GHGs from specific sources relevant to the Project. This includes emissions of GHGs from direct fuel combustion (fuels for transport energy purposes), emissions associated with consumption of power from direct combustion of fuel (e.g. diesel generators used during construction), and from consumption of electricity from the grid.

5. Engagement

This chapter provides a summary of consultation undertaken by Origin with the relevant local, State or Commonwealth Government authorities, LMCC, infrastructure and service providers, community groups, affected landowners and any exploration license and/or mineral title holders.

5.1 Origin's Stakeholder engagement approach

Origin is committed to engaging with all identified stakeholders across the development of new projects, expansions of existing infrastructure, and ongoing operations. During engagement, Origin:

- Conducts consultation with identified stakeholders including local community, local and state government agencies;
- Establish constructive working relationships and communication channels with stakeholders;
- Consider Aboriginal cultural heritage issues in the consultation process;
- Seek community feedback; and
- Provide regular updates to interested communities on the progress of projects.

5.2 SEARs requirements for consultation

SEARs for the Project were issued to Origin on 19 April 2021. The SEARs require that:

During the preparation of the EIS, you should consult with relevant local, State or Commonwealth Government authorities, infrastructure and service providers, community groups, affected landowners and any exploration licence and/or mineral title holders. In particular, you must undertake detailed consultation with affected landowners surrounding the development and Lake Macquarie City Council. The EIS must describe the consultation process and the issues raised and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.

The summary of consultation undertaken, issues raised and where or how they are addressed is provided in **Appendix C**.

5.3 Community consultation

Origin commenced stakeholder consultation following the public announcement of their plans to develop a BESS at the Origin landholding in January 2021. Community consultation to date has included:

- General media release regarding plans to develop the Project resulting in publication in newspapers circulating locally, regionally, and nationally;
- Informing near neighbours of the Project via phone where contact details were known, or via letter box drop;
- Email correspondence with the EPS Community forum advising of plans for the proposed action;
- Email correspondence and presentation with EPS Ash Dam Community Consultation Committee (CCC) advising of plans for the proposed action;
- Eraring Power station website was updated to include information in relation to the Project contact details for enquiries; and
- A community and consultation plan has been developed outlining the activities Origin will undertake to inform and consult the community and other identified stakeholders.

The primary mechanism for community engagement regarding activities at the EPS is the Community Forum. The forum is made up of local community members and meets, in person, quarterly. The forum is advised of current and upcoming activities and opportunities (including community investment) and provides the community the opportunity to raise concerns or ask questions relating to Origin's operations. Due to Covid-19 pandemic and the inability to meet in person, Origin has created a community newsletter. Three additions of the newsletter have been issued since March 2020 with the latest edition issued in June 2021 including Project details and providing contact details. All editions were made available on the Origin website (www.originenergy.com.au/about/who-we-are/what-we-do/generation/eraring-documents-resources.html#news).

The CCC was established in 2020 as a condition of approval relating to the expansion of the EPS Ash Dam. The CCC brings together representatives of the community which include those living close to EPS and the broader community, LMCC, and Origin facilitate open discussion about the expansion of the EPS Ash Dam. The CCC meets quarterly, providing an opportunity for Origin to update the community on activities at Eraring, and for the community members to raise matters with Origin. Both the EPS Community Forum and the CCC have been notified in writing of the Project and invited to provide feedback.

Origin will continue to engage with public, community and agencies during the exhibition of the EIS and subsequent response to submissions process.

No comments have been received in response to Origin's consultation initiatives that require design amendments with the community generally supportive where interested.

5.4 Government Authority Consultation

Origin has corresponded with various stakeholders to introduce the Project. A summary of this, as well as responses to DPIE regarding the Environmental Assessment requirements provided in **Table 5-1.**

A summary of agencies who provided comments on the SEARs is listed below:

- TransGrid;
- Geological Survey of NSW – Mining, Exploration and Geosciences (MEG);
- Heritage NSW;
- Water and the Natural Resources Access Regulator (NRAR);
- TfNSW;
- EPA;
- Biodiversity Conservation Division (BCD);
- Subsidence Advisory NSW;
- NSW Rural Fire Service; and
- LMCC.

These responses document each authority's key concerns and assessment requirements. The agency input into the environmental assessment requirements was provided to DPIE and incorporated at DPIE's discretion.

The following authorities were consulted further on their areas of interest to further support the assessment process where necessary:

- LMCC;
- Centennial Coal;
- Commonwealth Department of Agriculture, Water and the Environment;

- EPA; and
- NSW Treasury.

The outcome of this consultation is provided in **Appendix C**.

5.5 Commonwealth Government consultation

A referral was made under the EPBC Act as described in **Chapter 4** and Origin consulted on numerous occasions via phone and email with representatives of DAWE in relation to identified presence of green and gold bell frog in the down gradient receiving water bodies. The Project has been declared to not be a controlled activity if undertaken in a particular manner. The particular manner conditions are incorporated into the mitigation measures in **Chapter 7** and would be adopted as part of detailed design and execution of the Project.

5.6 Aboriginal stakeholder consultation

Aboriginal stakeholder engagement and involvement is important for the identification of Aboriginal cultural values relevant to the Project. This section summarises the consultation process relating to the organisation and conduct of the Aboriginal Cultural Heritage Assessment Report (ACHAR). Details of consultation including examples of letters sent to the Registered Aboriginal Parties (RAPs) and knowledge holders, conversations undertaken during archaeological survey, native title search results, records of cultural heritage values interviews and a detailed consultation log are included in Appendix A of the ACHAR (refer to **Appendix F**). **Table 5-1** outlines the stages of consultation undertaken for the Project.

Table 5-1: Summary of Project consultation process

Task Name	Start	Finish
Stage 1- Agency Letters	22 February 2021	
Stage 1- Newspaper advertisements	18 February 2021 (Koori Mail) and 22 February 2021 (Newcastle Herald)	
Stage 1- Project Notification and invitation to register supplied to potential Aboriginal stakeholders	2 March 2021	17 March 2021
Stage 1- Supply of the list of RAPs to Heritage NSW and Wanaruah LALC	30 March 2021	
Stage 2 and 3- RAP review of project information and methodology and request for information about cultural significance	19 March 2021	19 April 2021
Stage 4- Carry out archaeological survey and prepare a draft ACHAR	3 May 2021	10 June 2021
Stage 4- Present the draft ACHAR to RAPs for review and comment	11 June 2021	9 July 2021

Stage 1 of the consultation process is to identify, notify and register any Aboriginal people or groups who hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects and/or places in the Project area. Notification was initiated on 22 February 2021 to all relevant organisations listed under Section 4.1.2 in the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRP) (DECCW, 2010)

In accordance with Section 4.1.3 of the ACHCRP a notice in the local newspaper circulating in the general location of the proposed Project was completed, with information explaining the Project and its exact location. Notices were placed in the Koori Mail (18 February 2021) and Newcastle Herald (22 February 2021). These advertisements provided additional opportunity for Aboriginal people who are interested in the Project to register.

Project notifications were sent to all groups and individuals identified in the above consultation process. A total of 12 groups and individuals registered their interest:

- A1 indigenous Services;
- Awabakal and Guringai Pty Ltd;
- Awabakal Traditional Owners Aboriginal Corporation;
- Biraban Local Aboriginal Land Council;
- Corroboree Aboriginal Corporation;
- Didge Ngunawal Clan;
- Gunjeewong;
- Jumbunna Traffic Management Group Pty Ltd;
- Kawul Pty Ltd trading as Wonn1 Sites;
- Lower Hunter Aboriginal Incorporated;
- Murra Bidgee Muilangari Aboriginal Corporation; and
- Widescope Indigenous Group.

Following Section 4.1.6 of Stage 1 of the ACHCRP (DECCW, 2010), a list of RAPs for the Project and copies of the notifications from Section 4.1.3 were submitted to Heritage NSW and Biraban LALC on 30 March 2021.

Stage 2 of the consultation process provides RAPs with information about the scope of the proposed Project and the proposed cultural heritage assessment process. The RAPs were provided with a letter outlining the Project and a copy of the document Eraring BESS Aboriginal Cultural Heritage Assessment Methodology which included all Project information. Comments on this document were invited from RAPs and they were invited to contact Jacobs at any time throughout the assessment process to discuss the Project.

Every RAP organisation was invited to provide a site officer for the archaeological survey and were issued a checklist to ensure safety and preparedness for work.

Stage 3 of the consultation process is to facilitate a process whereby RAPs can contribute to culturally appropriate information gathering and the research methodology, provide information that will enable the cultural significance of Aboriginal objects and/or places on the Project area to be determined, and have input into the development of any cultural heritage management options. RAPs were invited to submit information relevant to the cultural significance of the Project area and any areas and objects within it, at all stages of the consultation process.

Stage 4 of the consultation process involves the RAPs review and feedback on the draft ACHAR. The draft ACHAR was sent to all RAPs on 11 June 2021, so that they could review the document and supply comments and provide feedback. No feedback was received from RAPs and the ACHAR has been finalised. The Final ACHAR has been sent to RAPs to coincide with Public exhibition of the EIS.

5.7 Public exhibition of the EIS

During the public exhibition period, the community and other stakeholders will have the opportunity to review the EIS and make written submissions to DPIE regarding the Project. The EIS will be available for review by the community and stakeholders on the DPIE Major Projects website (www.planningportal.nsw.gov.au/major-projects).

Engagement carried out after exhibition of the EIS will most likely focus on responding to any key and substantive issues raised in submissions. A submissions report would then be prepared by Origin for submission to DPIE which would be available to the public via the DPIE Major Projects website (https://www.planningportal.nsw.gov.au/major-projects).

5.8 Ongoing community Feedback Strategy

Community members will have the opportunity to submit feedback throughout the Planning process. Origin has a dedicated email address and a contact number to ensure community members can provide feedback and raise any issues they may have.

Origin has a dedicated community complaints procedure to manage all complaints and concerns from the community. The most common feedback methods are outlined in **Table 5-2**.

Table 5-2: Origin consultation contact details

Feedback method	Details
Dedicated 1800 number	A 1800 number is available for all stakeholders to lodge enquiries and complaints. 1800 677 315
Email	A dedicated email address for Origin Development Projects enables stakeholders to provide feedback or ask questions. Powerdevelopmentprojects@originenergy.com.au

6. Environmental impact assessment

This chapter provides an assessment of the predicted and potential impacts associated with the Project.

For each environmental aspect the existing environment is described, the potential impacts of the Project during construction and operation are assessed and the proposed management measures are described. The environmental management measures proposed in this chapter are consolidated and summarised in **Section 7.3**.

The key environmental issues for the Project are identified in the SEARs as reproduced in **Appendix A** and are summarised as follows:

- Biodiversity including an assessment of the aquatic and terrestrial biodiversity values and likely impacts in accordance with the BAM and fisheries management act and details of measures proposed to address offset obligations;
- Aboriginal heritage (cultural and archaeological) impacts of the development and consultation with the local Aboriginal community in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents;
- Historic heritage including a Statement of Heritage Impact (SOHI), prepared in accordance with the guidelines in the NSW Heritage Manual;
- Land including consideration of:
    - Location in relation to mine subsidence, flood prone land, crown lands, mining quarries, mineral and petroleum rights;
    - Soil characteristics and potential for erosion to occur;
    - A site contamination assessment;
    - Cumulative impacts; and
    - Land use compatibility including zoning provisions and potential for land use conflicts.
- Visual impact assessment of all components of the Project;
- Construction and operational noise impacts including cumulative impacts;
- Transport including identification and assessment of peak and average traffic generation and cumulative impacts and considering capacity and condition of roads, safety and intersection performance;
- Water including consideration of surface water and groundwater resources and flooding, identifying water supply arrangements and a description of erosions and sediment control measures;
- Hazards including a Preliminary Hazard Analysis (PHA), bushfire assessment and consideration of electromagnetic fields (EMF);
- Social and Economic including consideration of impacts on the local community and demands on Council infrastructure; and
- Waste including identification, quantification, and classification of likely waste streams.

The SEARs identify that the EIS must address and focus on these specific issues and include:

- A description of the existing environment likely to be affected by the Project;
- An assessment of the likely impacts of all stages of the Project, (which is commensurate with the level of impact), including any cumulative impacts of the site and existing, approved or proposed developments in the region and impacts on the site and any road upgrades, taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice;

- A description of the measures that would be implemented to avoid, mitigate and/or offset the impacts of the Project (including draft management plans for specific issues as identified below); and
- A description of the measures that would be implemented to monitor and report on the environmental performance of the Project.

Where assessment of key issues are technical in nature and the level of likely impacts warrant detailed consideration, these assessments requirements are addressed by detailed investigations that are documented in the specialist assessment reports in **Appendix E** to **Appendix N**. The less technical assessment requirements of waste and socio-economic impacts the level of assessment reflects the fact that for this Project these issues are commonly associated with construction and are appropriately addressed through the design process or by implementing best practice management and management measures.

6.1 Biodiversity

This section summarises the findings of the BDAR provided in **Appendix E**. The BDAR addresses the following SEARs:

Biodiversity – including:

- *an assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the Biodiversity Conservation Act 2016 (NSW), the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR), unless BCD and DPIE determine the proposed development is not likely to have any significant impacts on biodiversity values;*
- *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;*
- *an assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the Fisheries Management Act 1994, and a description of the measures to minimise and rehabilitate impacts;*
- *if an offset is required, details of the measures proposed to address the offset obligation.*

In accordance with the wording of the BAM, the BDAR (refer to **Appendix E**) and the following section uses 'development footprint' to refer to the Project area.

6.1.1 Assessment methodology

The method for the biodiversity assessment included:

- Desktop review of available databases and literature including previous documents and reports relevant to the proposed development to inform survey design and to assist in the assessment of potentially occurring threatened and migratory species, endangered populations, threatened ecological communities (TECs), ecosystem-credit species, and species-credit species
- Field surveys to identify the biodiversity values within the study area including:
  - Floristic and vegetation integrity surveys were undertaken. A total of eight BAM plots were conducted within the development footprint during the surveys;
  - Targeted searches for threatened flora species using transects undertaken across suitable habitats within the disturbance footprint during the required survey periods (seasons);
  - Opportunistic sampling of vegetation was undertaken along meandering transects across the area in between the collection of floristic plots, or for the deployment or collection of remote cameras;
  - Review of digital imagery of the development footprint prior to and after vegetation surveys to identify spatial patterns in vegetation, land use and landscape features;
  - A mixture of targeted fauna survey techniques including habitat assessments, nocturnal spotlighting, targeted searches and call-playback for threatened frogs, owl species and bush-stone curlew, searches

for stick-nests and active hollows, remote sensor camera monitoring, and stag-watching. Surveys were conducted over 18 days between November 2020 and June 2021. Twenty cameras were active on-site for 29 nights between 4 May 2021 and 1 June 2021, equating to 580 trap nights.

- Vegetation mapping undertaken to delineate vegetation communities across the development footprint;
- Comparison of vegetation communities identified in the development footprint to TECs;
- Alignment of each vegetation communities described within the development footprint with an equivalent plant community types (PCTs) as detailed in the *Vegetation Information System Classification Database* (DPIE, 2021a);
- Identification and assessment of potential impacts on biodiversity arising from the Project;
- Management measures for avoiding, managing, or reducing impacts on biodiversity values during detailed design, construction and operation; and
- Identification of any residual impacts that cannot be avoided, minimised or mitigated which must be offset.

The BDAR has been undertaken in accordance with Stage 1 and Stage 2 of the BAM (OEH, 2017). The BDAR addresses potential impacts to biodiversity listed under the BC Act, FM Act and MNES identified in the EPBC Act.

Further detail about the assessment methodology, including field surveys undertaken is provided in the BDAR (refer to **Appendix E**).

6.1.2 Existing environment

6.1.2.1 Landscape features

The landscape features of the study area were determined in accordance with the requirements of the BAM. **Table 6-1** summarises the biodiversity landscape features of the development footprint.

Table 6-1: Biodiversity landscape features of the development footprint

Landscape feature	Description
Interim Biogeographic Rationalisation for Australia (IBRA) (Thackway & Cresswell, 1995)	The Project is located in the Sydney Basin IBRA Bioregion, and within the Wyong IBRA sub-region.
NSW Landscape Regions (Mitchell, 2002)	The Project is within the Gosford – Cooranbong Coastal Slopes landscape.
Rivers, streams and estuaries	No rivers, streams or estuaries are located within the development footprint. Lake Eraring, Lake Macquarie occur to the southeast and Dora Creek to the west of the Project.
Wetlands	There are no wetlands within the development footprint, however Muddy Lake wetlands occurs approximately 900 m south-west of the development footprint.
Native vegetation extent	Approximately 525.4 ha of the 1500 m buffer area to the development footprint (50%) consists of native vegetation. This native vegetation is predominantly comprised of forested areas in various conditions from remnant to regrowth.
Areas of geological significance and soil hazard features	No areas of geological significance and soil hazard features were identified within the development footprint.
Areas of outstanding biodiversity value	No areas of outstanding biodiversity value were identified within the development footprint.

Landscape feature	Description
Exotic/disturbed areas	Cleared areas exist within the development footprint, largely for tracks and historic storage areas. There are also areas of exotic vegetation.
Connectivity features	The development footprint is not an important link for any fauna movement and has not been identified in connectivity mapping. The development footprint was also not identified within a Priority Investment Area and was not identified as an important flyway for migratory species.

6.1.2.2 Native vegetation

Plant community types and vegetation zones

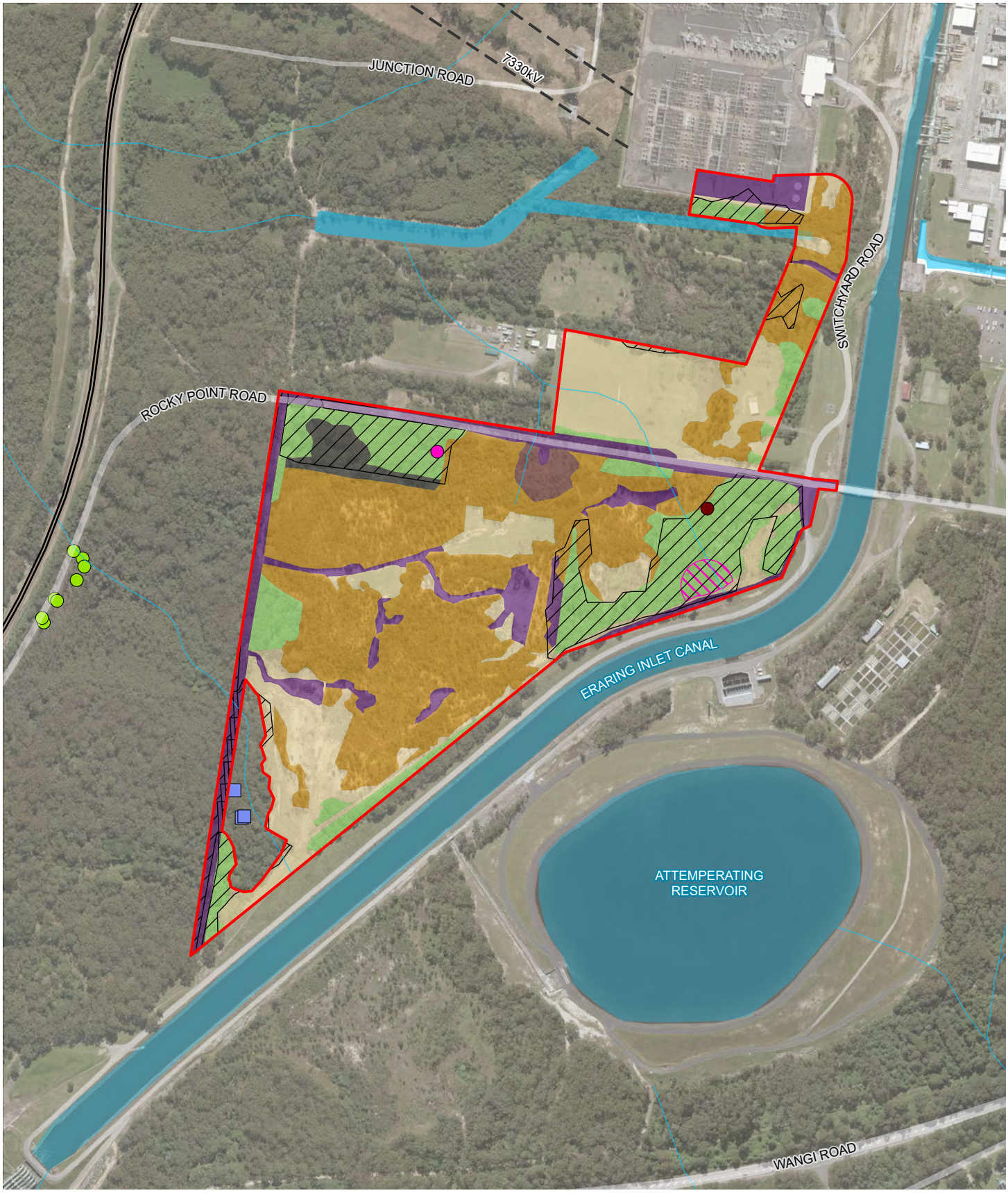
Following desktop review and ground truthing, two PCTs were identified in two condition types, as shown on **Figure 6-1**. These PCTs are:

- PCT 1636: Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast; and
- PCT 1716: Prickly-leaved Paperback forest on coastal lowlands of the Central Coast and Lower North Coast.

PCTs were also split up into vegetation zones based on broad condition classes. A detailed description of each PCT, vegetation zone and corresponding vegetation integrity score is provided in the BDAR (refer to **Appendix E**) and the vegetation zone, broad condition class, amount of each PCT in the development footprint, and vegetation integrity score are provided in **Table 6-2**.

Table 6-2: Plant community types identified within the development footprint

Vegetation zone	PCT ID No.	PCT Name	Broad condition class	Vegetation zone area in development footprint (ha)	Vegetation integrity score
1	1636	Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast	Moderate	4.6	55.1
2	1716	Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Low	0.3	53.5
3	-	Planted native vegetation	Moderate	10.2	-



Project area
Swift Parrot important area
Tetratheca - Black Eyed Susan
Potential *Corybas dowlingii* location
Hollow-bearing trees
Green and Golden Bell Frog
Small-flower Grevillea
Electricity transmission line
Railway

Plant community types

1636 Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast good condition

1716 Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast low condition

Disturbed/cleared
Exotic
Exotic - Pine Trees
Planted Native Vegetation

0 150 m

1:6,000 at A4
GDA94 MGA56

N

Data sources
Origin 2021
Aerometrex 2020,
© Department Finance, Services and Innovation Dec 2020
UMWELT

Figure 6-1 Biodiversity

Planted Vegetation

In accordance with Appendix D of the BAM (OEH, 2017) any native vegetation that was planted and cannot reasonably be assigned to a PCT can be mapped as planted native vegetation under specified circumstances. Via this process, a swamp oak (*Casuarina glauca)*-dominated community has been determined as planted native vegetation, as shown in **Table 6-2** and justified in the BDAR (refer to **Appendix E**).

Threatened ecological communities

PCT 1716 corresponds to Swamp Sclerophyll Forest on Coastal Floodplains Endangered Ecological Community (EEC), listed under the *Biodiversity Conservation Act 2016* (BC Act) and may conform to the Coastal swamp sclerophyll forests of south-eastern Australia community currently nominated for listing under the EPBC Act.

6.1.2.3 Threatened species

Ecosystem-credit species

The following Ecosystem-credit species are considered to have potential to occur in the development footprint:

- Glossy black-cockatoo (*Calyptorhynchus lathami*);
- Little lorikeet (*Glossopsitta pusilla*);
- Eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern coastal free-tailed bat (*Micronomus norfolkensis*);
- Little bent-winged bat (*Miniopterus australis*);
- Large bent-winged bat (*Miniopterus orianae oceanensis*); and
- Grey-headed flying-fox (*Pteropus poliocephalus*).

Breeding habitat for the above species is limited in the development footprint. Some hollows are present within PCT 1636, though these exist in relatively small, fragmented patches.

Species-credit species

Small-flower grevillea (*Grevillea parviflora subsp. parviflora*) was detected within the development footprint, with 42 individuals present at one location. Black- eyed Susan (Tetratheca juncea) was also detected at one location over an area of approximately 20cm across (assumed to be one individual) in the Development Footprint. Squirrel glider (*Petaurus norfolcensis*) was also captured on remote camera and is known at the Origin landholding. It has been aligned with PCT 1636 and 1716.

The green and golden bell frog (*Litoria aurea*) was detected approximately 200 m west of the development footprint, within Origin landholding during surveys in 2021. The frogs were occupying a relatively small (0.3 ha) swamp and both males and females were detected. A species polygon drawn to the specifications outlined in the *NSW Survey Guide for Threatened Frogs* (DPIE, 2020b) did not extend into the development footprint.

Potential individuals of red helmet orchid (*Corybas dowlingii*) were detected within the development footprint but were located outside of the development footprint within PCT 1716 in good condition.

6.1.2.4 Aquatic habitats and threatened fish

Several un-named, ephemeral, first-order tributaries are mapped as occurring within the development footprint. These were not observed as formed creeklines during the surveys, and no riparian vegetation or typically riparian species appeared to be present. These areas were wet during surveys in March and May but appeared as boggy areas rather than aquatic habitats.

One waterway exists which flows east to west into the artificial EPS water management dam immediately south of the TransGrid switchyard. This waterway appears to be relatively permanent and may provide aquatic habitat and resources for local fauna species. Existing waterways and drainage lines surrounding the development footprint eventually flow into Muddy Lake to the west. Surface water from the development footprint would also drain to Muddy Lake.

6.1.3 Avoidance and minimisation of impacts

Opportunities to avoid or minimise impacts on biodiversity values were considered as part of the Project design process, with a constraints analysis undertaken so that the development footprint could be designed with the least ecological impact possible. The development footprint was refined following the constraints analysis to avoid large areas of TECs and numerous threatened species, including:

- 14.1 ha of swamp sclerophyll forest EEC;
- Green and gold bell frog (*Litoria aurea*);
- Netted bottlebrush (*Callistemon linearifolius*);
- Black-eyed Susan (*Tetratheca juncea*); and
- Potential red helmet orchid (*Corybas dowlingii*).

The development footprint has been located in an area of relatively low biodiversity value, resulting in a small area of disturbance to native vegetation or fauna habitats. Further refinements may be made during the detailed design process and any currently unavoidable residual impacts, such as those relating to the small flower-grevillea or swamp sclerophyll TEC, will be prioritised if possible.

Environmental management measures to further avoid and minimise impacts, prior to and during construction, are captured in **Section 6.1.5**.

6.1.4 Assessment of impacts

6.1.4.1 Construction

Direct impacts

The Project will result in direct impacts on biodiversity values. Direct impacts include the loss of vegetation and fauna habitat as a result of clearance works and BESS installation. The following vegetation would be directly impacted by the Project:

- Up to 6.4 ha of exotic vegetation;
- Up to 3.5 ha of disturbed/cleared areas;
- Up to 15.1 ha of native vegetation, consisting of:
  - 10.2 ha of planted native vegetation;
  - 4.6 ha of PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast moderate condition; and
  - 0.3 ha of PCT 1716 Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast low condition.

The habitat of two species-credit threatened species would also be directly impacted, including:

- 3.1 ha of Swift parrot (*Lathamus discolor)* habitat; and
- 4.9 ha of Squirrel glider (*Petaurus norfolcensis*) habitat.

About 0.2 ha of Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) and one Black- eyed Susan (Tetratheca juncea) would also be directly impacted as a result of the Project.

Indirect impacts

Indirect impacts are negative changes to the structure and function of retained vegetation as a result of factors such as increased light intensity and duration, increased exposure to wind, and weed invasion in edge habitats. These 'edge effects' can have a negative impact on flora and fauna species. The proposed BESS is not expected to result in any substantial indirect impact on the biodiversity values of the adjacent land. No indirect impacts are expected to occur in relation to surrounding connectivity, corridors or habitat fragmentation, considering the already disturbed nature of the development footprint.

Changes to the water flow or quality from the development footprint into the ephemeral streams supplying water to the swamp occupied by the green and golden bell frog has the potential to impact this species. Changes to hydrology are considered unlikely and Origin is committed to a design that maintains pre-development flows from the development footprint into the green and golden bell frog habitat identified in the Origin landholding as well as the Muddy Lake system.

Noise and vibration from construction activities would potentially disrupt the roosting and foraging behaviour of fauna species and reduce the occupancy of areas of suitable habitat. Given that the BESS will be adjacent to the existing power station and associated infrastructure with existing noise impacts, there would be no substantial change to noise impacts on biodiversity.

Weed species could inadvertently be brought into the development footprint with imported materials or could invade naturally through the removal of native vegetation. The presence of weed species within the development footprint has the potential to decrease the value of proximate extant vegetation.

Clearing, thinning of vegetation, and the creation of tracks have the ability to assist the establishment and spread of feral fauna species. Given the level of clearing proposed, it is unlikely that fauna species would populate the development footprint due to an absence of vegetation.

Air quality impacts have the potential to adversely impact native species during ground disturbance works. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth.

While the BESS itself is permanent, construction would only be temporary and as a result, any additional impacts resulting from the Project are not expected to be of any level of significance in relation to threatened species, populations, and communities, given that the development footprint will occur in an already disturbed area.

Prescribed biodiversity impacts

No threatened entities are considered likely to be dependent upon or may use habitat features associated with any of the prescribed impacts.

Serious and irreversible impacts

Eight species-credit species predicted by the BAM calculator for the proposed development are also listed as serious and irreversible impact (SAII) entities in the *Guidance to Assist a Decision-Maker to Determine a Serious and Irreversible Impact* (OEH, 2017c), including:

- *Corunastylis* sp. Charmhaven (NSW896673);
- Variable midge orchid (*Genoplesium insigne);*
- Regent honeyeater (*Anthochaera phrygia*);
- Large-eared pied bat (*Chalinolobus dwyeri*);

- Swift parrot (*Lathamus discolor*);
- Little bent-winged bat (*Miniopterus australis*);
- Large bent-winged bat (*Miniopterus orianae oceanensis*); and
- Brush-tailed rock-wallaby (*Petrogale penicillata*).

The development footprint occurs in the area mapped as important habitat for the swift parrot only. As such an assessment of this species against the SAII principles is required. The BDAR considers that none of the principles of the SAII are likely to occur as a result of the Project in relation to the Swift Parrot and concluded that it is unlikely that the removal of 3.1 ha of marginal habitat would be significant to the survival of the swift parrot, or impede its recovery. Detailed consideration is provided in Section 5.3 of the BDAR (refer to **Appendix E**).

For candidate species, other than the swift parrot, the development footprint was either considered not to contain features important to their survival or the species had not been historically recorded within the wider locality or within the development footprint despite extensive targeted surveys. The BDAR concluded that Project is not expected to have an impact that is serious and irreversible and further assessment against the principles is not requires for these remaining seven species.

Impacts to Matters of National Environmental Significance

A referral was submitted to the Department on 28 May 2021 regarding the above matters. A 'Not a Controlled Action' if taken 'In a Particular Manner' (NCA-PM) decision was made by the Minister on 19 July 2021.

MNES are those that are listed under the Commonwealth EPBC Act. Two species listed under the EPBC Act, small-flower grevillea (*Grevillea parviflora* subsp.parviflora) and black- eyed Susan (*Tetratheca juncea*) are present within the development footprint and will be impacted by the Project. Impacts to the 42 individual stems of small- flower grevillea and one individual of black- eyed Susan in the Development Footprint are not anticipated to be significant to the local populations of these species. Residual impacts on these species will be offset in accordance with the BC Act and the Bilateral Agreement in a like for like manner.

An important population of the green and golden bell frog (*Litoria aurea*), listed as vulnerable under the EPBC Act, is located down gradient of the Project at Muddy Lake but significant impacts are considered unlikely. The NCA-PM includes a range of mitigation measures for indirect impacts that would prevent significant impacts from occurring.

The development footprint occurs in the area mapped as important habitat for the swift parrot (*Lathamus discolor*) which is listed as critically endangered under the EPBC Act. The BDAR considers that this species is unlikely to occur within the development footprint and any occurrence would be foraging individuals and impacts are not considered to be significant as discussed above.

Aquatic impacts

Aquatic habitats within the development footprint are limited to boggy areas that are wet following rain, as well as artificial EPS water management dam immediately south of the TransGrid switchyard which is separated from the downstream muddy lake by a weir structure and has been heavily modified up stream associated with the existing EPS. The potential impacts on water quality are anticipated to be limited, given the nature and scale of the construction works, the low quality of aquatic habits within the development footprint and mitigation measures proposed to address indirect water quality impacts.

6.1.4.2 Operation

No adverse impacts on biodiversity (either direct or indirect) are anticipated during operation of the Project.

6.1.5 Mitigation measures

Biodiversity mitigation measures, including the proposed regime for minimising, managing and reporting biodiversity impacts, are presented in **Table 6-3**. The mitigation measures will also be included in the environmental management documentation for the Project.

Table 6-3: Environmental management measures for biodiversity impacts

Reference	Environmental management measures	Timing
B01	Pre-clearance surveys will be undertaken prior to tree felling works by suitably qualified and experienced persons/personnel and will include: ▪ The demarcation of areas approved for clearing to reduce risk of accidental clearing; ▪ Habitat resources and habitat trees will be identified and marked. (Note: habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows, and boulder piles); ▪ The potential presence of threatened flora and fauna species, endangered populations and TECs will be identified; ▪ The identification of threatened species or habitat features that are suitable for translocation or salvage; and ▪ Disturbance activities will be targeted to specific times of the year to minimise impacts to threatened species' usage of habitat features for breeding and roosting, where practicable.	Prior to clearance and during clearance activities
B02	Tree felling will be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built). Tree felling supervision will be undertaken by an appropriately qualified and experienced person after pre-clearance surveys have identified potential habitat features.	Prior to clearance and during clearance activities
B03	Surface water design commitments will include: ▪ Design erosion and sediment controls as per sensitive environments (Managing Urban Stormwater – Soils and Construction (Landcom, 2004)); and ▪ Detailed design of drainage will balance clean water discharges to maintain minimum flows (as estimated based on current topography and hydrology) to identified green and golden bell frog habitats.	Prior to clearance and during clearance activities
B04	Surface water construction commitments will include: ▪ Hygiene protocol will be implemented in accordance with the NSW Threatened Species Management Information Circular No.6 (April 2008)); ▪ Flocculants or other chemicals proposed to be used on-site will be known and verified as being sage in sensitive environments, particularly in relation to amphibians; and ▪ Appropriate hygiene controls will be implemented in accordance with Saving Our Species Guidelines for threatened frog species	Prior to clearance and during clearance activities
B05	Erosion and sediment controls will be designed, installed and managed as follows: ▪ An Erosion and Sediment Control Plan will be developed by the Contractor and implemented prior to the commencement of topsoil stripping and earthworks;	Construction and operation

Reference	Environmental management measures	Timing
	▪ Erosion and sediment control structures will be regularly inspected and maintained, particularly in advance of and following significant rainfall events; ▪ Any water discharges are required to be managed to avoid pollution of waters having regard to the sensitivity of the receiving environment. In particular, any flocculants are to be demonstrated as being both effective and safe for amphibians prior to use; and ▪ All disturbed surfaces will be revegetated as soon as possible.	
B06	The following surface water construction monitoring will be implemented: ▪ Pre-discharge physical water quality condition (temperature; dissolved oxygen; pH; electrical conductivity) and chemical water quality condition in sediment dams will be monitored; ▪ Water quality leaving the Project area will meet the specified criteria for total suspended solids (less than 50 mg/L), pH (between 6.5 and 8.5) and no hydrocarbon or any other chemical contaminants exceeding the trigger levels set out in relevant guidelines; and ▪ Visual post rainfall checks of sediment dam water level and water quality, and to ensure erosion and sediment controls are effectively functioning.	Prior to clearance and during clearance activities
B07	Weed management controls will include: ▪ All machinery and equipment will be cleaned thoroughly prior to entering the development footprint. Cleaning will include the removal of all mud and plant matter, followed by washing with high pressure water; and ▪ Mulch containing weeds will be placed in piles separate from clean mulch, removed from site, and disposed of in accordance with weed management guidelines as soon as practicable.	Construction and operation
B08	During construction, fencing will be used to demarcate vegetation where required to avoid accidental damage to areas outside of the development footprint. Access control measures will include: ▪ Appropriate fencing and signposting of areas to prevent the uncontrolled entry of people, accidental disturbance, and to minimise vehicular and human traffic; ▪ Clear and visible signage will be appropriately located to inform the workforce and others of the restricted access or otherwise of areas outside the development footprint; and ▪ Locking of gates to prevent unwanted vehicle, person access and disturbance.	Construction and operation
B09	A Stormwater Management Plan will be prepared to appropriately limit post development flows and manage downstream water quality as part of the SSDA for site establishment and clearing works. Measures to be implemented include: ▪ Minimising the area of disturbance; ▪ Diverting run-off water around disturbed areas; ▪ Installation and ongoing maintenance of erosion and sediment controls (e.g. sediment fencing) throughout the duration of the Project; and ▪ Stabilisation (e.g. sealing, landscaping) of all disturbed areas to reduce the potential for future erosion.	Construction and operation
B10	The following mitigation actions will be implemented for the Project to develop a greater understanding and awareness of biodiversity issues in non-ecologically trained personnel:	Prior to construction

Reference	Environmental management measures	Timing
	▪ Inductions for the workforce will be undertaken to make them aware of the key ecological issues present in the development footprint and so that they know their role and responsibilities in the protection and/or minimisation of impacts to all native biodiversity; and ▪ Inductions will identify the location of sensitive flora and fauna and the policies being implemented to protect the biodiversity values of such areas.	and during construction

6.1.6 Biodiversity offsets

Offsets would be required for the impacts of the Project to the PCTs and species-credit species present within the development footprint. A full Biodiversity Credit Report is included in Appendix E of the BDAR. **Table 6-4** summarises the impacts of the Project that would require biodiversity offset.

Table 6-4: Impacts requiring offset

Vegetation zone	PCT/Species-credit species	Vegetation Integrity Score			Area (ha)	Credits required
		Current	Future	Change		
1	1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast moderate condition	55.1	0	-55.1	4.6	111
2	1716 Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast low condition	53.5	0	-53.5	0.3	8
-	Swift parrot (*Lathamus discolor)*	-	-	-	3.1	128
-	Squirrel glider (*Petaurus norfolcensis*)	-	-	-	4.9	135
-	Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)	-	-	-	0.2	6
-	Black- eyed Susan (*Tetrathecajuncea*)	-	-	-	0.2	6
Total						394

6.2 Aboriginal heritage

This section summarises the findings of the ACHAR provided in **Appendix F** which assessment of the potential Aboriginal heritage impacts of the Project and measures to mitigate them. The assessment addresses the following SEARs:

Heritage – including an assessment of the development:

- *on Aboriginal heritage (cultural and archaeological) impacts of the development and consultation with the local Aboriginal community in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents;*

Non-Aboriginal heritage is addressed separately in **Section 6.3.**

6.2.1 Assessment methodology

The methodology for the Aboriginal heritage assessment included:

- A desktop review of archaeological literature and data including an Aboriginal Heritage Information Management System (AHIMS) search;
- An archaeological field survey of the Project area carried out on 3 May 2021 with Registered Aboriginal Parties representatives;
- Consultation with the Aboriginal community representatives;
- Assessment to determine the cultural significance of identified items;
- Assessment of the potential impacts on Aboriginal sites, places and objects; and
- Identification of appropriate mitigation and environmental management measures.

The consultation with the Aboriginal stakeholders was carried out in accordance with the ACHCRP (DECCW, 2010) and is summarised in **Section 5.6**.

6.2.2 Existing environment

The Project is located within the Doyalson Soil landscape which consists of gently undulating rises with broad crests and long gently inclined slopes. Due to past grazing and industrial uses, the Project area has been previously cleared. The Project area is located about 1 km north of Lake Eraring, which feeds into Lake Macquarie. The drainage line that crosses the highly modified Project area drains west into Muddy Creek.

6.2.2.1 Ethno-historic background

According to the tribal boundaries as defined by Tindale (1974), the Project area traverses the traditional lands of the Awabakal people. The Aboriginal people of the Hunter region would have used the wide variety of natural resources present within the fertile landscape, and ethno-historical accounts list some of the methods through which Aboriginal people harvested fruits, nuts, marine resources, terrestrial fauna, birds and so forth. While there are gaps in the ethno-historical account, such as the lack of description regarding stone artefact manufacture and use, it does provide a basis that can be used to understand how Aboriginal people used the landscape prior to non-Aboriginal colonisation.

Modification of the landscape by Aboriginal people took place through the use of fire farming and reed planting/weir development, but little evidence of such activities is likely to have been preserved in the archaeological record due to the perishable nature of the materials used and the consequent alteration of the landscape through non-Aboriginal occupation. Evidence of campsites, through deposits of stone artefacts and shell, hearths or middens are, in contrast, likely to be found where the landscape has not suffered severe ground disturbance or sedimentation. While ethno-historical accounts refer to camps being located near waterways, campsites would not have been limited to riverbanks. These descriptions do, however, aid in developing a predictive model for the location of Aboriginal sites.

Scarred trees, which were a result of the production of items such as canoes, containers, shelters and bowls also have the potential to be present within the region. Carved trees, which were decorated with designs and could be associated with ceremonial sites, are much rarer. However, the prevalence of logging in the Hunter region would have severely reduced remaining scarred and carved tree numbers.

Other sites, such as grinding grooves, stone quarries, burials and ceremonial grounds (bora rings, stone arrangements), while rarer, are discussed in the ethno-historical records and are known to be focal points with the current cultural landscape.

6.2.2.2 Database search results

Jacobs carried out a search of AHIMS on 2 March 2021. The Origin landholding boundary and a 3 km buffer zone was used as the search area. This buffer zone is not proposed for impact, it is included to provide information on the archaeological context of the area.

There are 109 previously recorded sites identified in the AHIMS search (refer to **Table 6-5** and **Figure 6-2**). One site 45-7-0070 (shell midden) is recorded within the Origin landholding but outside of the Project area. Two restricted sites were identified during the search, however, David Gordon (Senior Heritage Information Officer) of AHIMS confirmed that the two restricted sites will not be impacted by works in the Project area via email 8 March 2021.

Table 6-5: AHIMS Search Results

Site type	Description	Number of sites
Isolated Find	A single stone artefact	4
Artefact Scatter	Multiple stone artefacts	30
PAD	Potential archaeological deposit	4
Artefact Scatter with PAD	Multiple stone artefacts visible on the surface with a potential archaeological deposit	1
Scarred Tree	A tree modified by Aboriginal people	15
PAD with Scarred Tree	A tree modified by Aboriginal people with a potential archaeological deposit.	1
Grinding Groove	An outcrop of stone that has been modified through the grinding of a stone implement.	1
Habitation structure	Habitation structure	1
Water Hole	Water Hole	4
Shell Midden	A deposit of shells created by Aboriginal people	10
Shell midden with Artefacts	A deposit of shells created by Aboriginal people with visible stone artefacts.	32
Grinding Groove and Shelter with Deposit	An outcrop of stone that has been modified through the grinding of a stone implement associated with a rock shelter with a potential subsurface Archaeological deposit.	1
Aboriginal Place (Natural and Mythological)	Natural Mythological or Ritual area	1
Restricted site	Sites that have their details restricted	2
Sites no longer valid	Site record deleted or declared not a site	2
Total		**109**

Figure 6-2 AHIMS search results (indicative locations)

6.2.2.3 Predictive modelling

Predictive modelling is used to determine the archaeological sensitivity of particular landforms within the Project area. The predictive model used to identify areas of archaeological sensitivity for this desktop assessment is based on a 'land system' or 'archaeological landscape' model of site location. This type of modelling enables the prediction of site location based on known patterns of site distribution in similar landscape regions or archaeological landscapes.

The predictive model was developed based on:

- A review of previous models developed for the area;
- An assessment of the results of the previous archaeological assessments;
- The interpretation of the distribution patterns of known sites in the Project area; and
- A study of previous impacts to the Project area and the potential effects of these impacts on the archaeological record.

The following specific predictive points are noted for the Project area:

- Flat and gently inclined landforms associated with freshwater tributaries of Lake Macquarie have high archaeological potential;
- The most common site type will be surface and sub-surface scatters of stone artefacts and middens;
- There is low potential for grinding grooves, ceremonial sites and rock shelters as the Project area is not located on the slopes of the Wattagans (mountain range located over 6 km to the west); and
- There is potential for scarred trees in areas that have not been subject to vegetation removal.

6.2.2.4 Field survey

The archaeological survey was conducted on the 3 May 2021. On-site consultation with nominated Site Officers from the RAPs contributed to the development of management and mitigation recommendations, including recommendations for any further assessment.

The Project area demonstrates extensive disturbance, and all proposed works are limited to this disturbance or located on landforms of low archaeological potential. No previously recorded sites existed within the Project area. No new Aboriginal sites or PADs were identified within the Project area.

6.2.2.5 Cultural heritage values identified during assessment

Discussions regarding the cultural values of the Project area were undertaken on 3 May 2021 during the survey. It was identified that the Lake and foreshore was of high cultural value, while the Project area is away from the water and heavily disturbed. No feedback regarding the cultural heritage value of the Project area was supplied by the RAPs during the completion of comprehensive stakeholder consultation completed in accordance with the ACHCRP.

6.2.3 Assessment of impacts

Previous archaeological assessments within the Project area and vicinity have not identified any sites or PADs. The long post-contact history of development in the area has resulted in destruction of most of the natural landforms.

A search of the AHIMS database of the Project area and included a 3 km buffer zone identified no sites within the Project area.

The Project area demonstrates extensive pre-existing disturbance, and all proposed works are limited to this disturbance or located on landforms of low archaeological potential. No previously recorded sites existed within the Project area. No new Aboriginal sites or PADs were identified within the Project area.

As no Aboriginal sites are identified within the Project area, none are subject to impact.

A significance assessment is made up of several significance criteria that attempt to define why a site is important. Such assessment recognises that sites may be important for different reasons to different people, and even at different times. The assessment of Aboriginal cultural heritage in this assessment is based upon the four values of *The Burra Charter* (Australia ICOMOS, 2013).

- Social values;
- Historical values;
- Scientific values; and
- Aesthetic values.

Each of these values is typically assessed for Aboriginal sites in or adjacent to the Project area, and an overall significance is assigned based on an average across the values. This is inherently a reductive process and oversimplifies what is important for different reasons to a range of different stakeholders, but is a necessary process in being able to create comparative values between sites. The significance of each site ultimately informs the management of sites and places.

As no Aboriginal sites or PADs have been identified within or adjacent to the Project area no Significance Assessment is required.

Assessing cumulative impacts involves the consideration of the proposed impact in the context of existing developments and past destruction of heritage sites, as well as the population of heritage sites that still exist in the region of interest (Godwin, 2011). The concept of assessing cumulative impacts aims to avoid discussing the impact of a development in isolation and aims to assess the impact in terms of the overall past and future degradation of a region's heritage resource.

Prior impact to large areas of land in the immediate surrounding region, have increased the rarity of surviving Aboriginal sites in the region. Site selection had deliberately targeted areas of prior disturbance and as no Aboriginal sites or PADs have been identified in the Project area the cumulative impact of the Project is assessed as being low.

6.2.4 Mitigation measures

Environmental management measures for impact on Aboriginal heritage are presented in **Table 6-6**. No operational management measures are required on the basis that no addition potential for impact exists beyond completion of construction.

Table 6-6: Environmental management measures for Aboriginal heritage impacts

Reference	Environmental management measures	Timing
AH1	The Unanticipated Finds Protocol in the ACHAR will be followed for any unidentified Aboriginal heritage objects found during the works.	Construction
AH2	An Aboriginal cultural heritage awareness training will be developed with the local Aboriginal community and will be provided to workers involved in clearing and ground disturbance activities associated with construction of the Project.	Construction

6.3 Non-Aboriginal heritage

This section summarises the findings of the SOHI provided in **Appendix G** which assessment of the potential non-Aboriginal heritage impacts of the Project and measures to mitigate them. The assessment addresses the following SEARs:

Heritage – including an assessment of the development:

- *on historic heritage and a Statement of Heritage Impact (SOHI), prepared in accordance with the guidelines in the NSW Heritage Manual;*

6.3.1 Assessment methodology

A desktop assessment of known heritage values was undertaken in June 2021 using the following heritage registers:

- NSW State Heritage Register (SHR);
- State Heritage Inventory including s170 State Agency Heritage and Conservation Registers;
- Lake Macquarie LEP 2014;
- Commonwealth Heritage List;
- National Heritage List;
- World Heritage List;
- LMCC and Lake Macquarie Libraries; and
- Register of the National Estate.

A field survey of the Project area was undertaken on the 3rd of May 2021 in order to understand the nature of the LEP-listed EPS and to identify whether any other historical heritage was present within the Project area. The results of this field survey are discussed in Appendix G.

6.3.2 Existing environment

Historical activities as summarised in the contamination assessment (AECOM, 2021) include:

- Rural land use from the 1980s till the early 2000's;
- Playfields for recreational purposes prior to construction of EPS. The playing fields continued to be used for recreational purposes during operation of the EPS;
- FTA used for training purposes associated with the EPS prior to Origin's occupancy of the EPS; and
- Borrow pits associated with the construction of the attemperation reservoir southwest of the EPS inlet canal from 2007 to 2011.

Prior to the construction of the EPS in 1975, the land at Eraring was used for a mixture of small farms and native vegetation. During the construction of the EPS the Project area appears to have been used and disturbed in places. Following the construction of the EPS, the Project area remained vegetated in places with intervening grassed and formalised areas evident in aerial photography. Based on recent Google Earth images from 2005 and 2010, the area was significantly disturbed by 2010 where it is shown cleared and used as a borrow pit and for stockpiling of material for the construction of the attemperation reservoir. The Project area has recently undergone rehabilitation.

The Project area is within the boundary of one locally listed heritage item – EPS (LEP 93). The Great Northern Railway (LEP 189) heritage listing is located within a 250 m from the Project area at its nearest point.

The previous land use of the Project area included agriculture and orcharding. The types of heritage items or archaeology related to these historical activities would include small structures or outbuildings, fencing and other ancillary features related to farming activities. Outside of the current Project area to the south, fence lines and a collapsed residential structure of some kind were observed in 2007 (HLA-Envirosciences, 2007). Since the establishment of the EPS in the 1970s, there has been substantial disturbance and development to the Project area. Given the small-scale nature of the historical activities prior to the power station, and subsequent levels of ground disturbance, there is unlikely to be historical archaeological remains present in the Project area, and the archaeological potential is considered to be negligible.

6.3.3 Assessment of impacts

A summary of the impacts against the proposed works are provided in **Table 6-7**.

Table 6-7: Summary of impacts against proposed works

Proposed work	Type of impact	Degree of impact	Consequence of impact to heritage item	Recommended management
Installation and maintenance of environmental controls	Direct (physical)	Negligible	No loss of significance	Heritage to be included in the site induction for all workers.
Upgraded construction access track	Direct (physical)			
Vegetation clearing	Direct (physical)			
Cutting and filling in areas	Indirect (visual)			
Structural works	Direct (physical)			
Installation of battery modules, power conversion systems and transformers	Indirect (visual)			
Installation of 330 kV overhead cabling	Direct (physical) Indirect (visual)			
Minor works	Direct (physical)			

The *NSW Heritage Manual* guidelines for preparing Statements of Heritage Impact (NSW Heritage Office, 2002) pose a range of questions to be considered when assessing heritage impacts for works to or in proximity to a heritage item. Relevant considerations in relation to impacts to the EPS (LEP 93) are addressed in **Table 6-8**.

Table 6-8: Consideration of impact on heritage item

Consideration	Response
Is the demolition essential for the heritage item to function?	No demolition of the key heritage elements of the power station are proposed. Impact will be limited to land previously undeveloped for the power station.
Are important features of the item affected by the demolition?	No important features of the item are proposed to be demolished.
Is the resolution to partially demolish sympathetic to the heritage significance of the item?	No demolition of the key heritage elements of the power station are proposed.

Consideration	Response
If the partial demolition is a result of the condition of the fabric, is it certain that the fabric cannot be repaired?	Not applicable.
How is the impact of the addition on the heritage significance of the item to be minimised?	The design of the proposed BESS infrastructure has a similar utilitarian / functional approach to that for which the power station is of heritage significance. The addition of BESS infrastructure would not impact on the technological or historical significance of the power station, and it would contribute to the continuing operation of the site for its significant historical use.
Will the additions visually dominate the heritage item?	The design of the proposed BESS infrastructure has a similar utilitarian / functional approach to that for which the power station is of heritage significance. Further, given the smaller scale and footprint of the BESS, it is not likely to visually dominate the power station.
Is the addition sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered?	No significant archaeological deposits (i.e. relics) are expected within the proposed works area given the previous disturbance related to the power station.
Are the additions sympathetic to the heritage item? In what way?	The design of the proposed BESS infrastructure has a similar utilitarian / functional approach to that for which the power station is of heritage significance. The addition of BESS infrastructure would not impact on the technological or historical significance of the power station, and it would contribute to the continuing operation of the site for its significant historical use. In this way it would be sympathetic to the heritage item.
Do the trees being removed contribute to the heritage significance of the item or landscape?	The trees and vegetation proposed for removal do not contribute to the heritage significance of the power station.
Why are the tree/s being removed?	The trees are being removed to allow for construction of the proposed works.
Has the advice of a tree surgeon or horticultural specialist been obtained?	Advice from a tree surgeon or horticultural specialist is not considered necessary in this instance – the trees are small examples of common local species; they are not considered to be significant or their removal in any way challenging.
Is the tree being replaced?	The trees are not being replaced. The surrounding bushland setting of the heritage item contains many examples of similar trees and their replacement is not considered to be necessary either for the proposed works or the heritage significance of the power station.

Overall, the key elements of the power station described in the LEP listing, will not be disturbed, removed or altered by the Project. The proposed works are situated to the south of the key EPS elements. As there are no areas of historical archaeological potential within the Project area, there would be no impact on the archaeological potential.

No demolition of the key heritage elements of the EPS itself are proposed. The design of the proposed BESS infrastructure has a similar utilitarian / functional approach to that for which the EPS is of heritage significance. The addition of BESS infrastructure would not impact on the technological or historical significance of the EPS, and it would contribute to the continuing operation of the site for its significant historical use. As such, the

proposed works have been assessed as having negligible adverse impact on the heritage significance of the EPS (LEP 93).

Potential risk to any unexpected finds would be managed with standard unexpected finds safeguards and management measures which would be implemented as detailed in **Table 6-9.**

6.3.4 Mitigation measures

Environmental management measures for non-Aboriginal impacts are presented in **Table 6-9.** No operational management measures are required.

Table 6-9: Environmental management measures for non-Aboriginal heritage impacts

Reference	Environmental management measures	Timing
NAH1	Should any unexpected historical heritage, including archaeological relics, be uncovered during the course of the proposed works, works should stop, and the area cordoned off. A qualified archaeologist and, if necessary, Heritage NSW (in accordance with s146 of the Heritage Act) should be contacted to assess significance and advise on further requirements before work can recommence.	Construction
NAH2	All contractors and subcontractors should be made aware of their obligations under the Heritage Act. The presence of a heritage item and associated elements in the vicinity of the proposed works should be communicated to all staff during toolbox talks.	Construction

6.4 Land

This section provides an assessment of the potential land use and zoning impacts of the Project as well as an assessment of the potential land and contamination impacts of the Project and measures to mitigate them.

The assessment of the potential contamination impacts associated with the Project is contained in the *Eraring Power Station Contamination Assessment* (AECOM, 2021) (contamination assessment) which is provided in **Appendix H**.

The assessment addresses the following SEARs:

Land – including:

- *an assessment of the potential impacts of the development on existing land uses on the site and adjacent land, including:*
  - *a consideration of the project's location in a mine subsidence district, flood prone land, Crown lands, mining, quarries, mineral or petroleum rights; and*
  - *a soil survey to determine the soil characteristics and consider the potential for erosion to occur; and*
  - *a site contamination assessment in accordance with the Managing Land Contamination Planning Guidelines: SEPP 55 – Remediation of Land (DUAP, 1998);*
  - *a cumulative impact assessment of nearby developments,*
- *an assessment of the compatibility of the development with existing land uses, during construction, operation and after decommissioning, including:*
  - *consideration of the zoning provisions applying to the land, including subdivision (if required);*
- *completion of a Land Use Conflict Risk Assessment in accordance with the Department of Industry's Land Use Conflict Risk Assessment Guide*

6.4.1 Assessment methodology

The methodology for the land assessment included:

- A desktop review using publicly available databases and previous investigations specific to the Project to characterise the existing environment;
- Review of the *Site Investigation for Battery Energy Storage System Geotechnical Factual Report* (GHD, 2021a), *Site Investigation for Battery Energy Storage System Geotechnical Interpretive Report* (GHD, 2021b);
- Preparation of contamination assessment. A contamination assessment was carried out which included a review of available historical investigations for the Project area, intrusive soil investigation and surface water sampling for identified contaminants of potential concern (CoPC) to evaluate the potential risk to human health and/or environment for the future development. The contamination assessment was prepared in accordance with the requirements of SEPP 55;
- An assessment of land use conflicts. This has involved:
  - Review of land use zoning and surrounding land uses;
  - Consideration of findings of heritage, ecology, hazards, visual, traffic, noise and socio-economic assessments; and
  - Identification of potential for Project conflicts to arise in relation to the Project with reference to *Land Use Conflict Risk Assessment Guide* (Department of Primary Industries (DPI), 2011)
- Identifying key land issues and impacts during construction and operation; and
- The identification of mitigation measures required to minimise these impacts and conflicts.

The flood hazards and cumulative impacts are discussed in **Section 6.8** and **Section 6.12** respectively.

6.4.2 Existing environment

6.4.2.1 Topography, soils and geology

Topography

The Project area elevation ranging from 20 m AHD on the south eastern boundary to 12 m AHD on the north western boundary. The Project area is gently undulating with a ridge running down the eastern side of the Project area sloping down to a large drainage line between the Project area and the EPS inlet canal.

Geology

The 1:100,000 scale regional geology map for Gosford–Lake Macquarie (sheet 9131 & part sheet 9231) indicates that regional geology in the vicinity of the Project is underlain by the Late Permian to Early Triassic aged Munmorah Conglomerate of the of the Narrabeen Group. The Munmorah Conglomerate is characterised by conglomerate, pebbly sandstone and grey to green shale. The Gosford- Lake Macquarie Geological sheet identifies a potential unidentified fault running through the centre of the Project area.

The Munmorah Conglomerate is underlain by the Dooralong Formation and Newcastle Coal Measures. Quaternary alluvial and lacustrine deposits exist to the west and southwest of the Project area associated with Dora Creek and Muddy Lake.

Geotechnical site investigations (GHD, 2021b) indicate that the Project area is variably covered by fill and alluvial soils overlying residual soil and transitioning to weathered rock at depth.

Soils

The 1:100,000 soil landscape map and report for Gosford–Lake Macquarie shows that the Project area is mostly underlain by the Doyalson erosional soil landscape group, with a small area of 'disturbed' terrain noted in the north-eastern corner (associated with the EPS water inlet canal). The 'disturbed' terrain is shown to continue north of the Project area (associated with the EPS), while the Doyalson Soil landscape is mapped continuing to the east of the EPS water inlet canal disturbed area.

The Wyong alluvial soil landscape and the Tacoma Swamp soil landscape groups are mapped about 300 m west of the Project area and are associated with creek systems which lead into Muddy Lake, Lake Eraring and eventually Lake Macquarie.

The Doyalson soil landscape is characterised by gently undulating rises on Munmorah Conglomerate. Slope gradients are typically less than 10%, with local relief up to 30 m. The typical soil profile consists of loose loamy sand overlying a hardsetting clayey sand, sandy clay loam and/or clay. Total soil depth ranges between 0.5 m and 1.5 m (but deeper in drainage lines) and is underlain by sandstone and conglomerate, and/or siltstone and claystone.

The topsoil encountered during early-stage site investigations carrying in 2021 comprised gravelly sand, sand and clayey sand (GHD, 2021a). The soil landscape is shown on **Figure 6-3**.

Acid sulphate soil

Acid sulfate soil (ASS) is the common name for naturally occurring sediments and soils containing iron sulphides. The exposure of these soils to oxygen by drainage or excavation, oxidises the iron sulphides and generates sulfuric acid. The sulfuric acid can be readily released into the environment, with potential adverse effects on the natural and built environments. The majority of ASS are formed when available sulfate (which occurs widely in seawater, marine sediment, or saturated decaying organic material) reacts with dissolved iron and iron minerals forming iron sulfide minerals, the most common being pyrite. This generally limits their occurrence to deeper marine sediments and low lying sections of coastal floodplains, rivers and creeks where surface elevations are less than approximately 5 m AHD.

According to NSW ASS risk mapping viewed on eSpade v2.1 (DPIE, 2021b), ASS are predicted less than one metre below ground surface in the coastal swamp area around Muddy Lake. Muddy Lake waterbody is predicted to have high probability of acid sulfate soils in bottom sediments. The ASS probability mapping does not specify if the Project area itself is likely to contain ASS, however there is potential for ASS as the composition of the disturbed terrain is unknown.

While ASS mapping has not shown the Project area to be within an area of ASS risk, the surface water sampling carried out as part of the contamination assessment reported a low pH, indicating acidic conditions and presence of potential ASS within the Project area.

Soil salinity

The online eSpade v2.1 mapping (DPIE, 2021b) indicates that the Project area has modelled soil electrical conductivity (EC) which is a measure of the amount of salts in soil (salinity) as generally 0.05 to 0.10 decisiemens per metre (DS/m), with some localised areas of up to 0.4 DS/m for both 0 – 0.3 m below ground level and 0.3-1 mBGL.

These soils are considered 'non saline' to 'slightly saline' as per soil salinity class ranges (Agriculture Victoria, 2020).

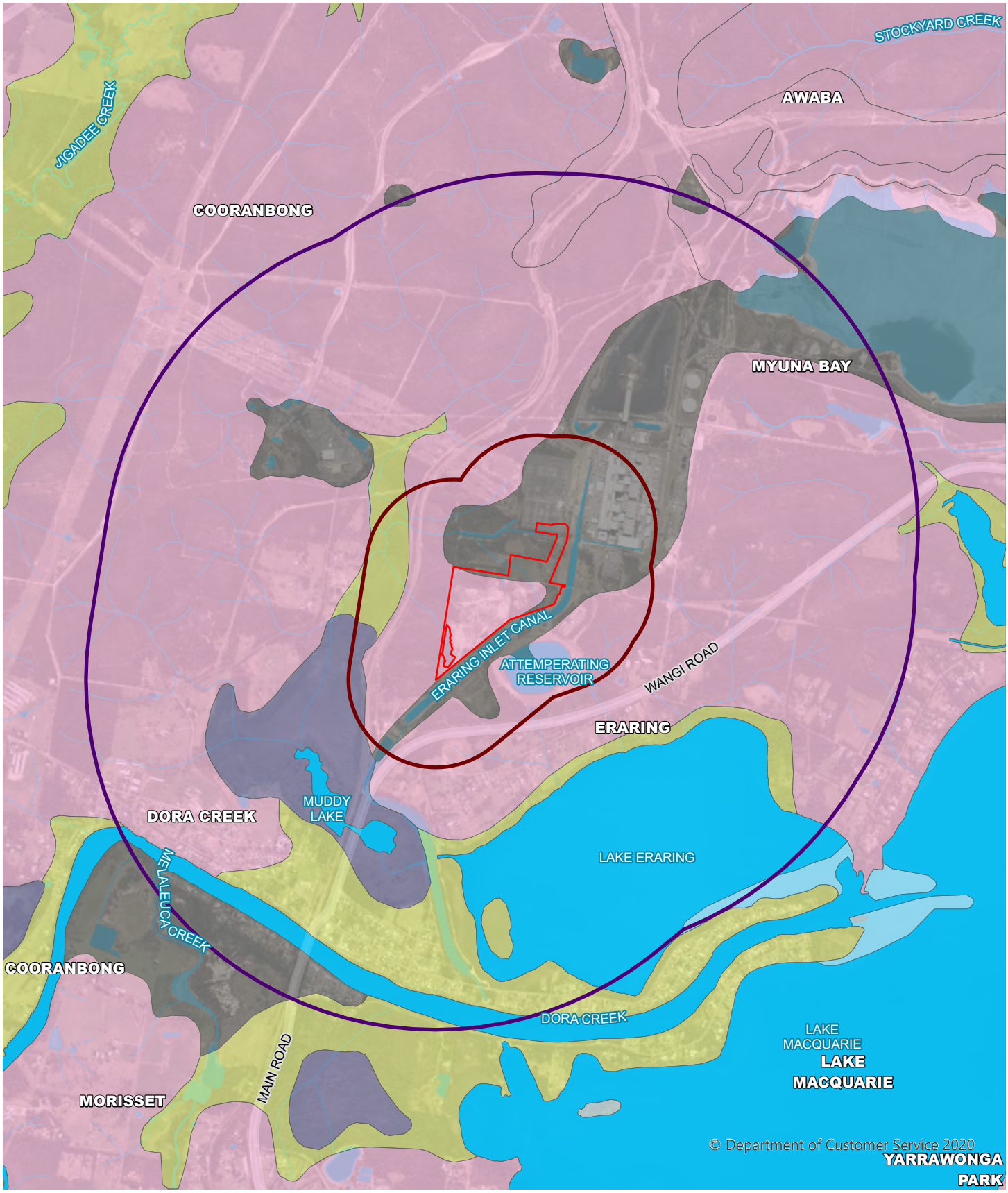


Figure 6-3 Soil landscapes

Sodicity and dispersivity

The typical characteristics of sodic soil are that they are:

- Dispersive and erodible;
- Hard-setting when dry (i.e. could potentially increase excavation difficulty);
- Prone to waterlogging when wet, which could make for poor trafficability conditions during construction; and
- Poor wet strength.

As part geotechnical investigations carried out for the Project, soils in the Project area were tested and classed as ranging from non-sodic to highly sodic (GHG, 2021b).

Dispersion is the potential for clay soil to break down in contact with water and disperse to form a cloudy colloidal suspension. Where water infiltrates into dispersive soils around (including beneath) structures, the flow of water may lead to loss of soil through erosion and eventual formation of voids around the structures' edges.

The soils in the Project area were found to range from low to high dispersion potential. These results align with surface erosion observed on site, refer to **Photo 6-1**.

Photo 6-1: Erosion noted on site (GHD, 2021)

Geotechnical stability

General observations in relation to geotechnical stability of the Project area are as follows:

- Soils with high erosion hazard, reactive soils (i.e. soils that swell on wetting and shrink on drying) and strongly acid soils may present a localised foundation hazard;

- Low permeability cohesive soils in low-lying areas or watercourses are likely to become waterlogged for a period of time following significant rainfall events. Waterlogged soils are generally softer, may not provide adequate foundation/subgrade strength and may be untrafficable;
- The Project area is not located near any coastal hazards and there are no landslide or land movement risks;
- The Project area is within a mine subsidence district (refer to **Section 6.9.2**), however the Project area has not been directly undermined;
- Active and historical coal mines are present in the vicinity of the Project, with the most relevant operation being the Awaba Colliery that ceased operation in 2012. The closest Awaba Colliery workings are approximately 600 m north of the Project; and
- There is a current mining lease under the Project area which is not currently being mined.

6.4.2.2 Contamination

Historical activities occurring within the Project area as summarised in the contamination assessment (AECOM, 2021) include:

- Rural land use (small farms and native vegetation) prior to the construction of the EPS;
- Recreational purposes (playing fields and pony club) prior to and following construction of EPS;
- Construction areas including earthworks associated with the EPS and inlet canal from 1977 to 1984;
- FTA historically used for training purposes prior to Origin's acquisition of the EPS in 2013; and
- Borrow pits associated with the construction of the attemperation reservoir from 2007 to 2011.

The contamination assessment found that:

- Asbestos containing material (ACM) has historically been identified in the borrowed pits associated with the construction of the attemperation reservoir, these localised impacts are not widespread;
- There are low level perfluorooctane sulfonate (PFOS) impacts (exceed the adopted ecological criteria (Interim Marine 99% protection level)) in pooled surface water from an intermittent drainage line in the northern part of the Project area. Recent surface water sampling indicated that reported concentrations of PFOS were below the laboratory limit of reporting (LOR) at the most downgradient surface water location adjacent to Muddy Lake, which is also down-gradient of the Project area; and
- Historically, metals (Copper (Cu), Lead (Pb), Nickel (Ni) and Zinc (Zn)) and Per- and Poly-fluoroalkyl Substances (PFAS) have been detected in monitoring wells in the vicinity of the Project area at concentrations greater than the adopted ecological screening criteria, however, concentrations of PFAS in groundwater further downgradient of the Project area have reported concentrations below the LOR. Concentrations of metals at the downgradient boundary of the Project area are consistent with metal concentrations detected in groundwater across the broader EPS Station, and with concentrations detected at these locations during previous monitoring events.

The contamination assessment concluded that the nature of land and water contamination across the Project area does not identify a risk to human health that requires remediation as part of the proposed Project.

6.4.2.3 Compatibility of the development with existing land uses

The existing environment is described in **Section 3.2.1**. In relation to land use the following is identified as relevant to identification of potential conflicts:

- The Project area is located within Origin landholding which is zoned SP2 Infrastructure (Electricity generating works). This landholding is surround by land zoned as E2 Environmental Conservation, refer to **Section 4.5**;

- The Project area is within a non-operational area of the Origin landholding and is not currently used for economic purposes and has recently been rehabilitated;
- The Muddy Lake and associated wetlands are located approximately 250 m south and southwest of the Project area. The wetlands are classified as coastal wetland under the Coastal Management SEPP. There is a water body east of the Great North Rail line identified as potential green and gold bell frog breeding habitat that receives site run-off;
- The surrounding land outside EPS consists of broad acre rural development and low-density residential properties. The closest residential suburb is Dora Creek and the closest residential receiver is 600 m west of the Project on Gradwells Road and south of the Project on Border Street;
- Other nearby industrial land uses include the CES (coal mine) and The Great Northern Railway;
- The Project is located within a mine subsidence district, however the Project area has not been directly undermined; and
- The Project area does not contain Crown lands, quarries, mineral or petroleum rights. Land north of the Origin landholding is Crown land and generally aligns with E2 environmental protection land use zonings.

6.4.3 Assessment of impacts

6.4.3.1 Construction

Topography, soils and geology

During earthworks and vegetation clearance, and while soils remain exposed it is possible that soil erosion may occur. Soil stabilisation and revegetation would minimise potential soil dispersion impacts. As noted in **Section 6.4.2.1** the soils in the Project area have high erosion hazard and are reactive. As such soil stabilisation would be required to minimise potential soil dispersion impacts. This may include consideration of:

- Lime stabilisation around footings;
- Graded non-dispersive backfill materials around structures such as culverts to limit the loss of fines from soils;
- Use of geotextile filter materials or other engineered solutions to protect exposed soils from scour and erosion potential; and
- Dispersive nature of soils in the design of drainage and erosion control measures to prevent the pollution of waters.

While the potential for erosion exists, mitigation measures in accordance with industry guidelines are available and would be implemented.

The Project is unlikely to cause large-scale soil disturbance at depth and is not proposed to interface with groundwater.

Mitigation measures to manage potential impacts of erosion and sedimentation on surrounding watercourses is provided in **Section 6.4.4.**

Geotechnical stability

New Project components would include establishment of foundations to support new infrastructure.

While the slope, soils and geology of the Project area as described in **Section 6.4.3** have implications for geotechnical stability the specific ground engineering requirements to facilitate the Project are not expected to present significant design or construction challenges given the Origin landholding already supports a range of similar infrastructure associated with EPS.

In general, the nature of the Project components is not at elevated risk from geotechnical stability risks. The detailed design of the Project would need to consider potential to increase geotechnical stability risks to existing infrastructure including the EPS inlet canal. The detailed design of each Project component would consider geotechnical stability in accordance with applicable design standards to manage risks.

Contamination

During construction there would be potential for construction activities to result in contamination of soil and/or water due to leaks and spills of potentially contaminating materials which would pollute the local environment including waterways if not appropriately managed.

As described in **Section 6.4.2.2**, there is potential to encounter localised areas of contamination associated with historical land uses at the Project area. Exposure to these contaminants may present a risk to human health during construction through inhalation and/or direct contact, or impacts to the environment due to contamination, if not managed appropriately.

The findings of the Contamination Assessment indicated that the nature of identified land and water contamination at the Project area does not represent a risk to human health that requires remediation as part of the proposed Project. Whilst localised ACM was historically identified in the borrowed pits associated with the construction of the attemperation reservoir, these localised impacts are not widespread and can be managed by implementation of mitigation measures as part of development of a construction environment management documentation specific to the Project.

Elevated but low concentrations of PFOS were detected in a relatively small volume of stagnant surface water pooled within an intermittent drainage line (dry at the time of sampling) on the Project area. Recent surface water sampling from the December 2020 monitoring event indicated that reported concentrations of PFOS were below the laboratory LOR at the most downgradient surface water location adjacent to Muddy Lake (AECOM, 2021), which is also downgradient of the Project area. The data generated indicates that migration of PFOS via surface water discharging from the Project area is potentially limited and intermittent. The surface water sampled from the pooled stagnant water also reported a low pH, indicating acidic conditions and presence of potential acid sulphate soils (PASS) at the Project area.

The Heads of Environment Protection Authority (HEPA) *PFAS National Environmental Management Plan Version 2.0* (NEMP) (HEPA, 2020) includes a decision tree for assessment of re-use of soils on site, which outlines that leachate concentrations need to be protective of receiving water bodies. Given that PFOS concentrations in soil leachate exceed the adopted ecological assessment criteria for protection of nearby ecological receptors, further assessment of risk and implementation of appropriate management measures is required prior to soil reuse at the Project area.

Historically, metals (Cu, Pb, Ni and Zn) and PFAS have been detected in monitoring wells in the vicinity of the Project area at concentrations greater than the adopted ecological screening criteria, however, concentrations of PFAS in groundwater further downgradient of the Project area have reported concentrations below the laboratory LOR. Concentrations of metals at the downgradient boundary of the Project area are consistent with metal concentrations detected in groundwater across the broader EPS, and with concentrations detected at these locations during previous monitoring events.

Based on the nature of land and water contamination identified in the contamination assessment, mitigation measures as part of a CEMP will be implemented to minimise any potential contamination risks from the Project, refer to **Section 6.4.4**.

6.4.3.2 Land Use Conflict Risk Assessment

Land use conflicts occur when one land user is perceived to infringe upon the rights, values or amenity of another (DPI, 2011). The process of identifying potential land use conflict is generally to identify potential risks

by considering land use changes that may affect existing land uses in the area. **Table 6-10** identifies and quantifies potential land use conflicts based on the findings of assessment as part of the EIS process.

Table 6-10: Potential land use conflicts

Environmental matter	Impact mechanism	Summary of conflict
Biodiversity	Vegetation clearing and has potential to impact habitat and connectivity through the Project are. During construction some clearing is required but aims to avoid native vegetation and habitat features to the extent feasible. Two threatened species (the Swift parrot and the Squirrel glider), would be impacted through the clearing of habitat and about 0.2 ha of Small-flower grevillea would also be directly impacted as a result of the Project.	A conflict with the use of the Project area for the three threatened species has been identified. Impacts have been assessed in accordance with the BAM and would be mitigated as described in **Section 6.1**
Visual	Visual impacts have potential to lead to land use conflict where they obstruct or disrupt scenic views or alter the scenic character. Visual impacts have been found to be negligible the visible changes would likely be minimal from any publicly accessible location given the visual screening provided by the existing vegetation surrounding the Project area and the intervening off-site vegetation and topography. The composition and character of the existing views towards the Project would remain substantially unaltered following the proposed change as BESS infrastructure is low lying and not visible while the addition of two transmission structures would be within the context of the existing, dominant, EPS structures.	Visual impacts within the Origin landholding would occur during both construction and operation but not to an extent they would unreasonably infringe on amenity of surrounding land uses (refer to **Section 6.5** and **Appendix I**).
Noise	Noise impacts have the potential to lead to land use conflict with sensitive receivers and also affect amenity for recreational uses.	The noise impact assessment concludes that both construction and operational noise can be managed to achieve applicable noise criteria through the application of available mitigation measures. Reasonable and feasible mitigation measures are available and would be implemented to minimise noise impacts (refer to **Section 6.6**).
Transport	Traffic impacts have potential to lead to land use conflict where they unreasonably restrict access. During construction, some additional light and heavy vehicles would use the existing road network in the vicinity of the Project but not to the extent that they are assessed as causing delays to other road users. No road upgrades are proposed.	Minor increase in traffic on local roads is predicted but not to the extent that it would restrict or interfere with access for the general public (refer to **Section 6.7**).

Environmental matter	Impact mechanism	Summary of conflict
	Post construction, routine maintenance involving one vehicle attending site over a one week period each year is required. This would not lead to land use conflicts either on or off site.	
Water	Water impacts have potential to lead to land use conflicts where they affect the volume or quality of water for other users. During construction, the potential exists for increased erosion leading to sediment laden run-off. This will be managed in accordance with standard mitigation measures such that off-site water quality impacts do not eventuate. Post-construction, disturbed areas would be rehabilitated and the site maintained to prevent erosion and sediment laden run-off with construction water quality controls converted to permanent controls to prevent concentrated flows and erosion.	The minor increase in impervious surface within the overall catchment would lead to a minor increase in run-off but with proposed mitigation measures this would not cause land-use conflicts (refer to **Section 6.8**).
Hazards	The Project would introduce new hazards to the Project area. However most hazards can be prevented by employing a combination of common measures, including following all applicable Standards, separation distances and setbacks, physical protection and control systems measures.	The Project is not considered likely to restrict the types of development compatible with current zoning or likely future uses of Origin landholdings from a hazard and risk point of view. The risk of off-site impacts is considered able to be mitigated to a level where off-site land uses are not restricted or affected.
Air quality and odour	Air quality impacts are able to be readily managed during construction using standard methods and were not considered a key issue requiring further assessment for the Project. Dust would be managed during construction to avoid off-site impacts. No operational air quality emissions would result from the Project under normal operations. BESS technology includes extensive monitoring and safety mechanisms such that risks of emergency situations where air emissions could eventuate are extremely low. Should an emergency lead to air emissions these would be similar to those emitted from a plastic fire.	Air quality impacts would be unlikely to extend off-site and would be managed so as not to infringe on amenity of surrounding land uses. The Project would not have odorous qualities, characteristics or attributes with potential to interfere with local amenity.

As demonstrated in **Table 6-10**, no significant land use conflicts are identified for the Project.

6.4.3.3 Operation

The final layout of the BESS compound is likely to comprise large areas of hardstand that will minimise the potential for any direct contact with subsurface soil during operations. No ongoing contamination risks to human health are likely to result from the Project.

Operation of the Project is not expected to impact on the land, land zoning or land use of the Project area.

6.4.4 Mitigation measures

The environmental management measures to be implemented for impacts to land, geology, soils and contamination are presented in **Table 6-11.** Management measures for potential impacts to water quality as a result of erosion and sedimentation are presented in **Section 6.8.4**. No operational management measures are required.

Potential conflicts arising in relation to habitat and connectivity, access, visual, water and noise would be managed through the implementation of mitigation measures developed specifically for these issues as summarised in **Section 7.3**. On the basis that no significant land use conflicts have been identified, no additional mitigation measures are proposed.

Table 6-11: Environmental management measures for land and contamination impacts

Reference	Environmental management measures	Timing
L1	Detailed design of each Project component would consider and address geotechnical stability risks in accordance with applicable design standards.	Detailed design
L2	Potential contamination-related impacts associated with the Project will be managed by the implementation of a CEMP that includes (but not limited to): ▪ An ASS management plan in accordance with *Acid Sulfate Soil Manual* (NSW ASSMAC, 1998) will be in the event that PASS is encountered; ▪ An unexpected finds protocol, including encountering ACM during the extent of the construction works; ▪ Management of surface water when present to minimise the mobilisation of any potential residual soil impacts that could migrate to sensitive off-site ecological receptors; and ▪ Management of materials during construction works by implementation of the decision tree for reuse of soil in the *PFAS National Environmental Management Plan* (DAWE, 2020), so that excavated soils can be reused in less sensitive areas or managed within the Project area to prevent unacceptable risks to any receptor and minimise off-site disposal of excavated materials to a licensed landfill.	Construction
L3	To manage soils hazards: ▪ High dispersion potential soils would be removed from structural foundations; ▪ Adequate topsoil and vegetation cover over the embankment face is used for permanent embankment batter slopes that are to remain through high dispersion potential soils to assist with limiting erosion. Consideration could also be given to the use of stabilisation or geosynthetic solutions on cut or embankment batter faces; ▪ The clay foundation soils be treated to reduce the potential for dispersion/erosion. This could include graded non-dispersive backfill materials around structures such as culverts to limit the loss of fines from soils surrounding such structures and the use geotextile filter materials; and ▪ Design of drainage and erosion control measures will need to take due consideration of the dispersive nature of soils at the site.	Construction

6.5 Visual

This section summarises the findings of the *Eraring Battery Energy Storage System – Visual Impact Assessment* (Jacobs, 2021a) (VIA) provided in **Appendix I**. The VIA addresses the following SEARs:

Visual – including *a detailed assessment of the likely visual impacts (including any glare, reflectivity and night lighting) of all components of the project (including transmission lines, substations and any other ancillary infrastructure) on surrounding residences and key locations, scenic or significant vistas, air traffic and road corridors in the public domain and provide details of measures to mitigate and/or manage potential impacts (including a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners);*

6.5.1 Assessment methodology

The methodology for the visual impact assessment included:

- A description of the subject site and surrounding area;
- A description of the planning instruments that are relevant to visual impact and apply to the subject site and the surrounding area;
- Identification of potential viewpoints using digital elevation model and aerial photography;
- An assessment of the visual impact of the Project from publicly accessible locations; and
- Identification of appropriate mitigation and environmental management measures.

When considering the predicted effect of changes upon views/ visual receptors, the sensitivity is combined with the magnitude of the change to give an overall judgement of significance of impact supported by analysis of evidence and professional judgement. The *Guideline for Landscape Character and Visual Impact Assessment* (TfNSW, 2020a) is regarded as best practice for visual impact assessments within NSW and provides the following definitions:

- **Sensitivity** refers to the qualities of an area, the number and type of receivers and how sensitive the existing character of the setting is to the proposed nature of change
- **Magnitude** refers to the physical scale of the Project, how distant it is and the contrast it presents to the existing condition.

Table 6-12 is used to rank the criteria above and provide an overall impact assessment as a conclusion to this assessment.

Table 6-12: Impact assessment rating matrix

		MAGNITUDE			
		High	Moderate	Low	Negligible
SENSITIVITY	High	High	Moderate/High	Moderate	Negligible
	Moderate	Moderate/High	Moderate	Moderate/Low	Negligible
	Low	Moderate	Moderate/Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

6.5.1.1 Viewshed

The viewshed comprises the area from within which the Project area would likely be visible. The extent of the viewshed is influenced by a combination of factors including elevation, landform and vegetation.

This viewshed has been generated using the following method:

- Establishment of elevation models for both ground, buildings and vegetation from Lidar data;
- Establishment of building envelope for major components of the Project;
- Applying points to top of building envelope along all sides and tops of transmission structures; and
- Using GIS to identify locations from which these points have unobstructed views.

The viewshed identification of transmission structures have been calculated separately from the viewshed of the BESS compound and substation on the basis that while they are taller and more likely to be visible, they would also be less obtrusive than the building envelope of the BESS compound. The viewshed for both transmission structures and BESS compound and substation with and without vegetation external to the Origin landholding is presented in the visual impact assessment provided in **Appendix I**.

The viewshed assessment is presented in in **Section 6.5.3.2.**

6.5.1.1 Viewpoints

Two representative viewpoints from publicly accessible locations have been selected from within the viewshed to illustrate both the existing view and the potential visual impacts of the Project. These viewpoints include:

- VP01 – Looking north from New England Highway; and
- VP02 – Indicative subdivision viewpoint – Looking northeast from Gradwells Road subdivision

The viewpoints are described further in **Section 6.5.3.2,** and a photo from each viewpoint is also provided in this section.

6.5.2 Existing environment

As described in **Section 3.1**, Project is located within the existing Origin landholding which includes vegetated and topographical buffers to sensitive receivers. The Project would be close proximity to existing EPS operational areas and targets the use of land previously disturbed by the EPS.

As shown in **Section 1.2** infrastructure associated with the EPS is evident and typical within the landscape which is otherwise defined as being largely vegetated with interspersed rural residential development and road, water management and electrical infrastructure.

There are no publicly accessible viewpoints within 250 m of the Project. The Great North Railway line passes within 250 m at its nearest point but is screened by vegetation.

The BESS compound and substation would be located approximately 400 m southwest of the EPS turbine hall and 300 m south of the existing TransGrid switchyard. The network connection would be installed between the proposed BESS substation in the East of the Project area to the south east corner of the TransGrid switchyard where it would connect into existing or extended gantries and existing 330 kV Transmission network.

Both the EPS turbine hall and TransGrid switchyard have FSLs of approximately 16 m AHD. The tops of the existing EPS turbine hall and stacks are approximately 100 and 200 m above ground level respectively and are partially visible from some publicly accessible locations. While infrastructure within the TransGrid switchyard is in the order of 20 m in height above ground level. **Table 6-13** summarises the potential receivers present surrounding the Project.

Table 6-13: Potential visual receptors

Distance	Potential for views
Within 250 m	There are no publicly accessible viewpoints within 250 m of the Project. The Great North Railway line passes within 250 m at its nearest point but is screened by vegetation within the E2 zoned land which would not be impacted by the Project and is otherwise unlikely to be removed.
250 m - 500 m	The Publicly accessible Wangi Road is located within 500 m of the Project along with approximately five properties on Border Street, Lake Eraring. No views to the Project are likely from these publicly accessible locations due to intervening topography and infrastructure associated with EPS attemperation dam and inlet canal. Portions of private property within 500 m but zoned E2 to the west are not screened by topography but dense vegetative screening is present and protected by E2 zoning and Origin ownership.
500 m – 1 km	No views to the Project are likely from publicly accessible locations to the south due to intervening topography and infrastructure associated with EPS attemperation dam and inlet canal or west due to intervening dense vegetation protected by E2 zoning and Origin ownership.
1km – 2km	No views to the Project are likely from publicly accessible locations to the south or west due to intervening topography and infrastructure associated with EPS attemperation dam and inlet canal or west due to intervening dense vegetation protected by E2 zoning and Origin ownership.

A number of images from publicly accessible areas have been included to illustrate the visual context of the Project area as shown in **Photo 6-2** to **Photo 6-5** . The area north of the Project is not publicly accessible

Photo 6-2: View east towards the Project area from Gradwells Road frontage of nearest public receptor (VP01)

Photo 6-3: View from southwest looking across Project area to EPS (VP02)

Photo 6-4: View from southeast from Border Street to EPS

Photo 6-5: View from south on Dora Street towards the Project area and EPS

6.5.3 Assessment of impacts

6.5.3.1 Construction

As outlined in **Chapter 3**, the Project consists of a number of elements of work. The majority of the Project components are largely screened by existing vegetation and topography and are typical of existing infrastructure from publicly accessible locations. Visual impacts during construction would be limited to Origin personnel and contractors, and construction personnel.

These visual impacts would include clearing of vegetation and stockpiling of debris from construction activities. These visual impacts would be temporary in nature.

6.5.3.2 Operation

Visual impact mechanisms

The Project has the potential to impact the visual amenity of receptors within the surrounding landscape through the installation of extensive areas of containerised batteries, electrical infrastructure and overhead powerlines within an area dominated by existing, larger energy generation and transmission infrastructure.

Viewshed

The visual impact assessment determined that the BESS compound and substation are not likely to be readily visible within the landscape from any publicly accessible locations. The views from ground level are limited to within densely wooded areas within crown land or otherwise access restricted land where dense woodland is considered highly likely to completely screen views towards the BESS.

There are larger areas potentially having views of the notably higher transmission structures. Unlike for the BESS compound and substation, off-site vegetative screening is of greater importance in obscuring views and a number of locations in public ownership may be able to see the tops of transmission structures. The visual impact assessment (refer to **Appendix I**) selected two locations for further analysis on the basis that they are most likely to be impacted. These are:

- Viewpoint 1 - High points in private property west of Gradwells Road to the west; and
- Viewpoint 2 - High points in private property west of Gradwells Road to the southwest.

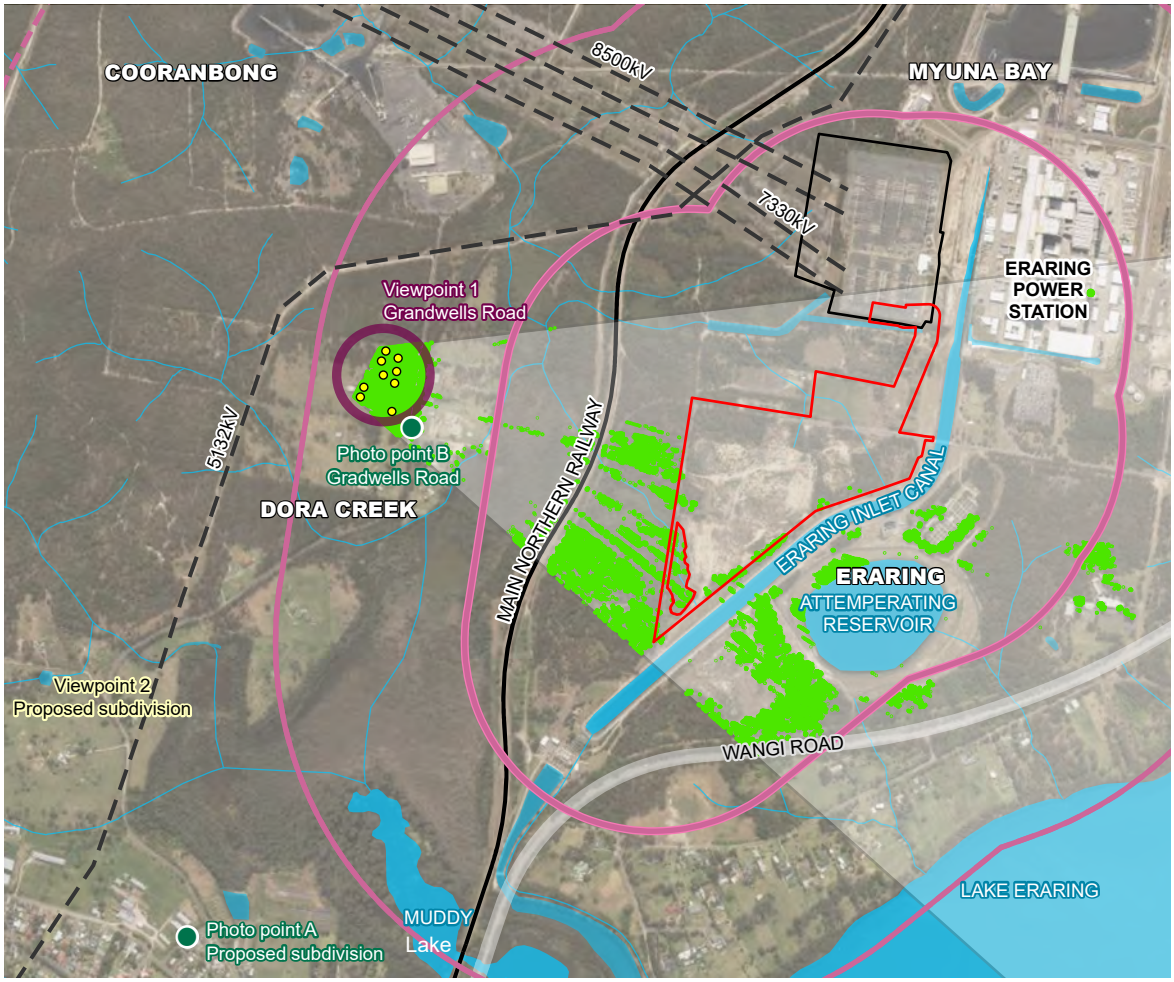
The Further analysis from these locations included:

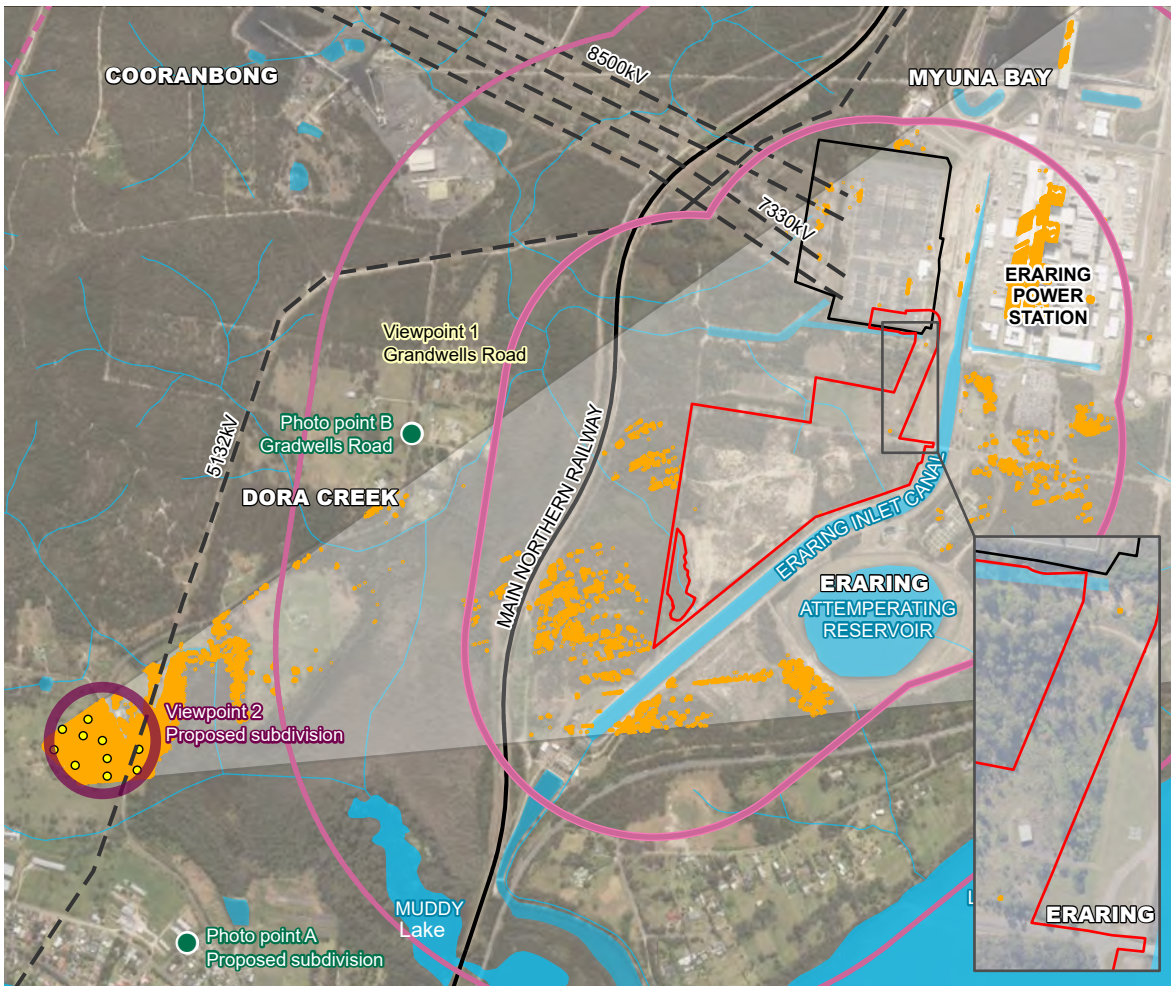
- Selecting observer locations within the digital terrain model;
- Applying a 2 m view height to represent eye level; and
- Analysis of what can be seen with intervening vegetation included.

Based on the analysis the following conclusions are drawn in relation to potential visibility of transmission structures (and can be inferred as also being applicable to the BESS compound that sits lower in the landscape):

- Tops of transmission structures may be visible from west and southwest of the Project area;
- Intervening vegetation provides significant screening such that limited vantage points are available; and
- Views affected by the addition of the transmission structures already feature existing transmission structures, the EPS stacks and turbine hall.

The results of this analysis are shown in **Figure 6-4**.





Project area
Observer location
Photo location
Viewpoint
TransGrid switchyard

Distance from Project area
500m
1000m
2000m

Area visible from observer locations
Area of viewshed analysis
Electricity transmission line
Railway

Data sources

Origin 2021
Jacobs 2021,
© Department Finance, Services and Innovation Dec 2020

0 500 m

1:20,000
GDA94 MGA56

Figure 6-4 Views of BESS compound, switchyard and transmission towers

Viewpoint analysis

The potential visual impacts of the Project were assessed according to the impact of the Project at the two separate viewpoints as described below.

Viewpoint 1: Indicative near neighbour viewpoint

Description

This viewpoint looks east from the Gradwells Road reserve across a residential property landholding towards the Project area. The road reserve features mature trees that filter views east towards EPS. This viewpoint illustrates both the view from Gradwells Road and the adjacent residential property which is set at a slightly lower elevation than the road. East of the property, dense vegetation heavily filters views beyond with further visual containment provided by a low, heavily vegetated ridgeline. The EPS Turbine hall and stacks are local landmarks and are visible against the skyline approximately 1 km to the east with views filtered by intervening trees.

Sensitivity

The sensitivity of the view is High due to the viewpoint being representative of the adjacent residential receptor where occupants are likely to contemplate, spend long periods of time and focus on views. Viewers in this location include residents and road users afforded existing, rural views that feature EPS as a local landmark on the skyline. The local landscape is not recognised for particular characteristics or quality and road users would have short-term exposure to/appreciation of long/ panoramic views which would likely be screened /heavily filtered by landform and vegetation.

Magnitude

The magnitude of change would be negligible within this view. The visible changes would likely be minimal from this location given the approximate 1km distance over which they would be seen, the visual screening provided by the existing landform and vegetation surrounding the Project area and the dense vegetation and low ridgeline immediately east of the property. The composition and character of the existing view would remain substantially unaltered following the proposed changes as the addition of two transmission structures within the view would be seen within the context of the existing, visually dominant, EPS structures. The BESS compound and TransGrid switchyard would not be visible from the viewpoint due to the dense woodland within the EPS landholding west of the Project area. The tower structures would be partially visible above the treeline as relatively lightweight structures when viewed as adjacent to the EPS turbine hall and tower structures which currently form focal points within the view. Due to the nature of the proposed changes, their partial screening by intervening vegetation and the distance over which they would be viewed the changes would not be remarkable within the view.

Summary

The impact of the Project on view point 1 has been assessed as negligible.

Viewpoint 2: Indicative proposed subdivision viewpoint

Description

This viewpoint looks northeast from private land in the direction of Muddy Lake, towards the Project area and EPS which are visible on the skyline. The viewpoint location is illustrative of potential future views from the Grandwells Road subdivision where the landform generally slopes downwards towards Muddy Lake across gently rolling terrain. Views towards EPS are heavily filtered by intervening vegetation within the EPS landholding, dense stands of woodland southwest of Muddy Lake and a vegetative strip alongside Gradwells Road. Views from the western extents of the subdivision are generally from a higher elevation and feature more intervening nearfield vegetation. Views from the eastern extents of the subdivision are from lower in the landscape and feature more open views.

Sensitivity

The sensitivity of the view is High due to the viewpoint being representative of views experienced by residential properties, where occupants are likely to contemplate, spend long periods of time and focus on views. Viewers in this location include residents and road users afforded existing, rural views that feature EPS as a local landmark on the skyline, at a distance of approximately 2 km. Whilst Muddy Lake is a local feature in the landscape, the wider locality is not recognised for particular characteristics or quality and road users would have short-term exposure to/appreciation of long/ panoramic views which would likely be screened /heavily filtered by landform and vegetation.

Magnitude

The magnitude of change is negligible within this view. The visible changes would likely be minimal from this location given the visual screening provided by the existing, dense vegetation surrounding the Project.

The composition and character of the existing view would remain substantially unaltered following the proposed changes as the addition of two transmission structures within the view would be seen within the context of the existing, visually dominant, EPS structures. The BESS compound and TransGrid switchyard would not be visible from the viewpoint due to the dense woodland within the EPS landholding west of the Project area. The tower structures would be partially visible above the treeline as relatively lightweight structures when viewed as adjacent to the EPS turbine hall and tower structures which currently form focal points within the view. Due to the nature of the proposed changes, their partial screening by intervening vegetation and the distance over which they would be viewed the changes would not be remarkable within the view.

Summary

The impact of the Project on view point 2 has been assessed as negligible.

Changing land use context

It is noted that the Project would be operational beyond the end of life of the EPS and occur within a changing land use context. At this stage a future land use for the EPS has not been confirmed however the current land use zoning and applicable strategic plans as described in **Section 4** envisage the ongoing use of the Origin landholding for energy generation or storage purposes.

The BESS infrastructure is generally low-lying, containerised infrastructure established in a formalised layout. Such a layout is unlikely to be detrimental from a visual perspective for likely future land uses of the Origin landholding. In the event that more visually sensitive land uses are proposed the low-lying nature of the infrastructure can be readily screened with mitigation planting.

6.5.4 Mitigation measures

Environmental management measures for landscape character and visual impacts are presented in **Table 6-14**. No operation management measures are required.

Table 6-14: Environmental management measures for landscape character and visual impacts

Reference	Environmental management measures	Timing
V1	Origin will seek to minimise disturbance associated with the Project, for example by retaining existing mature vegetation and limiting areas of disturbance where possible in order to limit the visual impact of the Project.	Detailed design
V2	A landscape management plan will be prepared as part of construction and operational environmental management documentation and implemented and will include the following recommendations:	Detailed design

Reference	Environmental management measures	Timing
	▪ Retention and enhancement of existing landscape features (areas of scrub, individual trees) will be considered where feasible and not conflicting with bushfire management requirements; ▪ Limit the area of disturbance during construction where possible; ▪ Colour of proposed structures and built form will be considered in a suitable muted palette to visually integrate the Project within the landscape where possible noting that battery enclosures may need to be white for thermal regulation and longevity requirements; ▪ BESS compound and TransGrid switchyard night lighting will be oriented inwards and downwards to minimise light spill; ▪ Transmission structure lighting will be limited to the extent necessary for safety and aeronautical purposes (if required); and ▪ The use of reflective surfaces will be minimised to avoid drawing attention to the site within views due to reflective glare.	
V3	▪ All construction plant, equipment, waste and excess materials will be contained within the designated boundaries of the work site and will be removed from the site following the completion of construction; ▪ Stockpiles will be stabilised to prevent erosion by wind and water and avoid the development of dust plumes adversely impacting air and visual quality; and ▪ On completion of the work disturbed areas will be stabilised and rehabilitated.	Construction

6.6 Noise

This section summarises the findings of the Noise Impact Assessment report (NIA) provided in **Appendix J**. The NIA addresses the following SEARs:

Noise – including *an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG), operational noise impacts in accordance with the NSW Noise Policy for Industry (2017), cumulative noise impacts (considering other developments in the area), and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria;*

6.6.1 Assessment methodology

The NSW EPA sets guidance and criteria for major development proposals in terms of the different types of noise and vibration likely to be generated during construction and operation of a proposal. These guidelines and criteria form the basis of impact assessments, based on an understanding of existing (i.e. undeveloped or predevelopment) background noise levels which are measured and recorded. For this Project the NIA assessment included:

- Identification of noise sensitive receivers and background noise levels;
- A construction and operational noise assessment predictions based on detailed noise modelling of construction phases and operational stages to predict noise levels that may be generated by the Project in accordance with current guidelines;
- Assessment of noise and vibration impacts, summarising the modelled predictions at sensitive receivers; and
- The identification of management measures required to minimise impacts.

6.6.2 Existing noise context

Establishing the existing noise context has involved establishing Noise Catchment Areas (NCA), representative sensitive receivers and the capture of background noise data at representative locations within each NCA. These NCAs, representative receivers and monitoring locations are illustrated in **Figure 6-5**.

Based on a desktop study of sensitive receivers, land use and noise influencing factors surrounding the Project site, five NCAs have been established to assess potential noise impacts. In addition to the land use, other factors such as the predominate noise sources were also used to determine the NCAs. **Table 6-15** below details each NCA.

Table 6-15: Noise Catchment Area Summary

Noise Catchment Area	Location	Approximate Distance of Nearest Sensitive Receiver from Project Site	Predominate Land Use zones	Predominate Background Noise Feature
NCA 1	Gradwells Road, Dora Creek	600 m	▪ RU2 – Rural Landscape ▪ E2 – Environmental Conservation	Environmental noise, rail noise, industrial noise, residential noise
NCA 2	Dora Street and surrounds, Dora Creek	1,500 m	▪ R2 – Low Density Residential ▪ RE1 – Public Recreation	Traffic noise, residential noise, rail noise
NCA 3	Western Border Street, Eraring	850 m	▪ RU4 – Primary Production Small Lots	Traffic noise; Environmental noise, residential noise
NCA 4	Eastern Border Street, Eraring	600 m	▪ RU4 – Primary Production Small Lots ▪ E4 – Environmental Living	Heavy traffic noise, environmental noise, residential noise
NCA 5	Point Piper Road and surrounds, Eraring	1,500 m	▪ E4 – Environmental Living ▪ E2 – Environmental Conservation	Environmental noise, residential noise

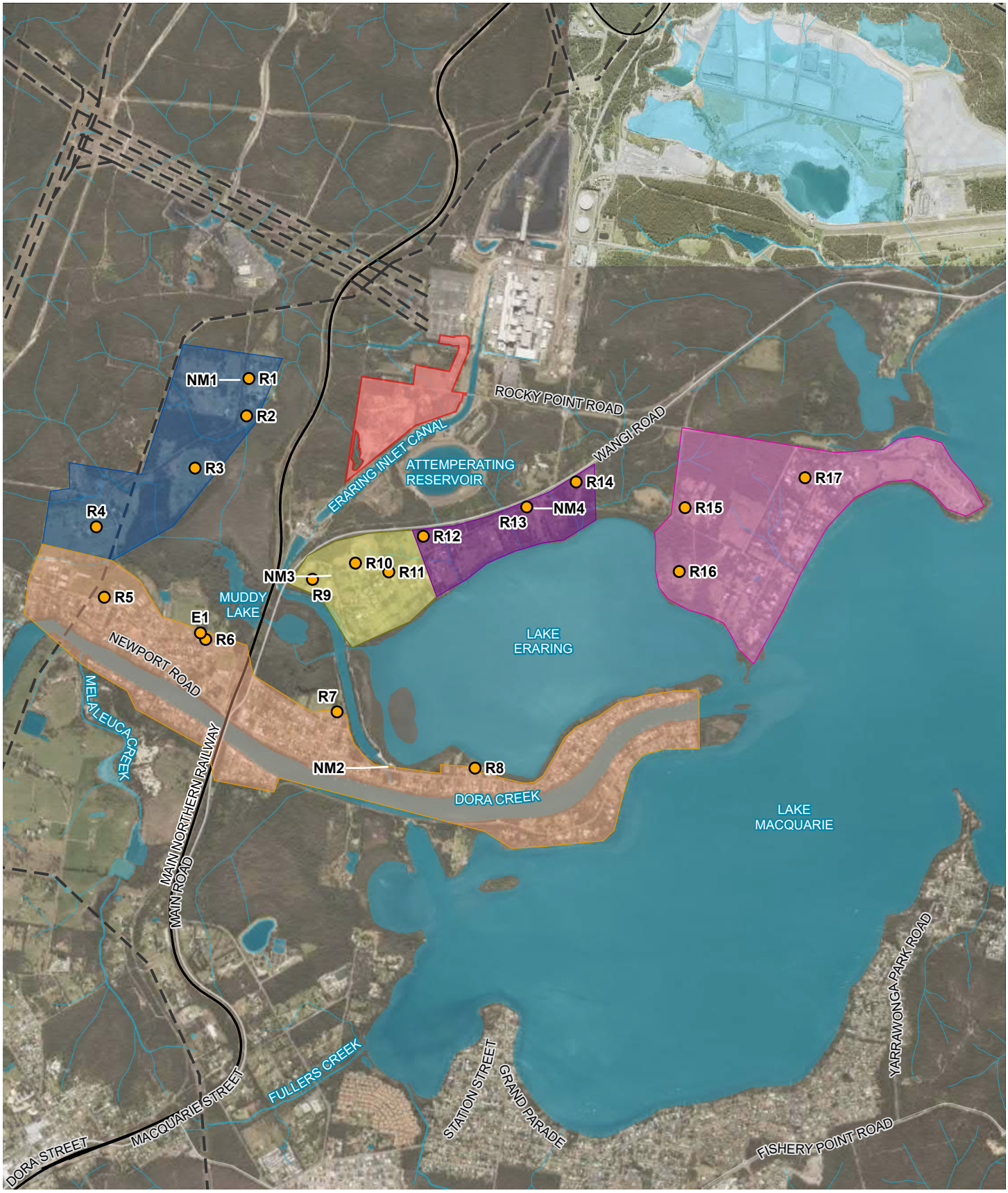


Figure 6-5 Project noise catchment areas, representative receivers and background noise monitoring locations

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In order to understand the potential noise impacts at receivers around the Project, a number of the nearest receivers to the Project within each NCA were selected as locations where modelled noise predictions have been measured. These are detailed in **Table 6-16**.

Table 6-16: Receivers used to Predict Noise Impacts

Receiver	Address	Type of Receiver	Noise Catchment Area
R1	232 Gradwells Road, Dora Creek	Residential	NCA 1
R2	213 Gradwells Road, Dora Creek	Residential	
R3	170 Gradwells Road, Dora Creek	Residential	
R4	95 Gradwells Road, Dora Creek	Residential	
R5	93 Coorumbong Road, Dora Creek	Residential	NCA 2
R6	23 Coorumbung Road, Dora Creek	Residential	
R7	23 Awaba Road, Dora Creek	Residential	
R8	79 Dora Street, Dora Creek	Residential	
R9	8 Awaba Road, Eraring	Residential	NCA 3
R10	21 Border Street, Eraring	Residential	
R11	32 Border Street, Eraring	Residential	
R12	63 Border Street, Eraring	Residential	NCA 4
R13	124 Border Street, Eraring	Residential	
R14	140 Point Piper Road, Eraring	Residential	
R15	70 Point Piper Road, Eraring	Residential	NCA 5
R16	41 MacLeay Street, Eraring	Residential	
R17	4 Payten Street, Earaing	Residential	
E1	Dora Creek Public School	Educational	NCA 2

Background noise monitoring was performed over a two-week period from 7 June to 21 June 2021. A monitoring location was selected to represent each of the NCAs with the exception of NCA 5, where the land use and noise environment surrounding NM3 was considered representative. A summary of the monitored background noise levels is provided in **Table 6-17**. Graphs of the monitored noise levels are detailed in Appendix A of the NIA.

Table 6-17: Background Noise Levels

Monitor ID	NCA	Monitoring Location	Measurement	Measured Noise Level – dB(A)		
				Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
NM1	NCA 1	232 Gradwells Road, Dora Creek	L_{Aeq} (equivalent noise level)	50	48	45
			Rating Background Level (Background L_{A90})	43	39	37

Monitor ID	NCA	Monitoring Location	Measurement	Measured Noise Level – dB(A)		
				Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
NM2	NCA 2	Adjacent to 102M Dora Street, Dora Creek	L_{Aeq} (equivalent noise level)	59	55	53
			Rating Background Level (Background L_{A90})	48	41	37
NM3	NCA 3 & NCA 5	8 Border Street, Eraring	L_{Aeq} (equivalent noise level)	46	45	45
			Rating Background Level (Background L_{A90})	41	39	38
NM4	NCA 4	124 Border Street, Eraring	L_{Aeq} (equivalent noise level)	49	47	44
			Rating Background Level (Background L_{A90})	40	40	38

In order to gain an understanding of the sources of background noise, handheld attended noise monitoring was undertaken at each noise monitoring location midway through the monitoring period in the morning of 14 June 2021. These noise sources are detailed in **Table 6-18**.

Table 6-18: Noise sources detected during attended monitoring

Monitoring Location	NM1	NM2	NM3	NM4
Recorded $L_{Aeq,15min}$ Noise Level	52 dB(A)	55 dB(A)	53 dB(A)	60 dB(A)
Recorded $L_{A90,15min}$ Noise Level	48 dB(A)	49 dB(A)	48 dB(A)	51 dB(A)
Day Noise Sources, SEL	▪ Bird Calls – 50 to 55 dB(A) ▪ Distant Traffic – 50 dB(A) ▪ Industrial Hum (source unidentified) – 48 dB(A) ▪ Passing Train – 48 to 50 dB(A) ▪ Overhead Light Plane – 66 dB(A) ▪ Passing Car – 60 dB(A)	▪ Traffic on Wangi Road – 50 dB(A) ▪ Local Traffic – 60 dB(A) ▪ Bird Calls – 55 to 60 dB(A) ▪ 4WD on Local Road – 68 dB(A) ▪ Pedestrian Chatter – 55 dB(A)	▪ Traffic on Wangi Road – 56 dB(A) ▪ Local Traffic – 62 dB(A) ▪ Passing 4WD – 71 dB(A) ▪ Quiet Period – 47 dB(A)	▪ Traffic on Wangi Road – 60 dB(A) ▪ Distant Traffic (No Traffic Passing on Wangi Road) – 54 dB(A) ▪ Passing Motorbike – 80 dB(A) ▪ Passing 4WD – 80 dB(A)

6.6.3 Vibration sensitive receivers

Whilst most receivers and surrounding structures are sensitive to vibration impacts, some receivers such as medical centres, precision industry and heritage structures are more typically susceptible and are subject to more stringent criteria. The nearest medical centre to the Project Site, Southlakes Medical Group, is located approximately 2km south of the Project site. No precision industry has been identified in the vicinity of the Project.

A single medical centre has been identified in the vicinity of the Project, the South Maitland Railway System, located approximately 1.3km from the site. No precision industry was identified within a 4 km radius of the Project. Two local heritage items have been identified in the vicinity of the Project:

- The Great Northern Railway, approximately 200m west of the Project, and
- Eraring Power Station, in which the Project is located. The power station itself is approximately 320m northeast of the Project.

At these distances, no vibration impacts from the Project site are predicted.

6.6.4 Assessment Criteria

6.6.4.1 Construction noise management levels

The "Interim Construction Noise Guideline" (ICNG) (Department of Environment and Climate Change [DECC], 2009) provides guidance for assessing noise from construction activities in NSW. It establishes noise management levels (NMLs) for recommended standard construction hours and for outside of the recommended standard hours. Construction is considered to have the potential to cause a noise impact if the predicted noise exceeds the applicable noise management level. Table 6-19 lists ICNG guidance for establishing construction NMLs at residential receivers.

Table 6-19: ICNG guidance for establishing construction NMLs at residential receivers

Time of day	Management level $L_{Aeq(15min)}$	How to apply
Recommended standard hours (**SH**): Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected: Rating Background Level (**RBL**) + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected: 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of

Time of day	Management level $L_{Aeq(15min)}$	How to apply
		construction in exchange for restrictions on construction times.
Outside recommended standard hours (**OOH**) - All other times including public holidays	Noise affected: RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Considering the adopted RBLs presented in **Table 6-17**, the NMLs for the identified surrounding residential receivers are presented in **Table 6-20**.

Table 6-20: Construction noise management levels (residential receivers)

NCA	NML $L_{eq\ 15\ min}$ dB(A)			
	Day (during standard hours) 7am – 6pm Weekdays, 8am – 1pm Saturdays	**Day (outside standard hours)** 7am – 6pm Outside of Standard Hours	**Evening** 6:00pm-10:00pm	**Night** 10:00pm-7:00am
NCA 1	51	46	44	43
NCA 2	50	45	45	43
NCA 3	53	48	44	42
NCA 4	58	53	46	42
NCA 5	53	48	44	42

The ICNG also provides construction NMLs for non-residential land uses. These are presented in **Table 6-21**.

Table 6-21: ICNG NMLs for non-residential receivers

Non-residential receiver type	Noise management level, $L_{Aeq(15min)}$ (applies when properties are being used)
Commercial	External Noise Level – 70 dB(A)
Industrial	External Noise Level – 75 dB(A)
Educational facilities	Internal Noise Level – 45 dB(A)
Hospital / Medical	Internal Noise Level – 45 dB(A)
Place of Worship	Internal Noise Level – 45 dB(A)
Passive Recreation	External Noise Level – 60 dB(A)
Active Recreation	External Noise Level – 65 dB(A)

It should be noted that the NSW EPA is developing a new construction noise guideline, the *Construction Noise Guideline*, which is currently in-draft. When released, the *Construction Noise Guideline* will replace the ICNG.

6.6.4.2 Project Operation Noise Criteria

Operational noise criteria for the Project were determined in accordance with the NSW EPA's NPI which seeks to regulate noise impact from 'industrial activity' pertaining to noise from fixed industry and mechanical plant rather than from road, rail or construction sources. To achieve this, the NPI applies two separate noise criteria:

- Limiting the intrusiveness of the Project's noise against the prevailing background noise, and
- Achieving suitable acoustic amenity for the surrounding land uses from industry.

The more stringent of these is used to define the operational noise criteria for a Project.

Intrusiveness and amenity noise levels are not used directly as regulatory criterion. They are used in combination to assess the potential impact of noise, assess reasonable and feasible mitigation options and subsequently determine achievable noise requirements.

Considering the intrusive and amenity criteria established in the NIA, **Table 6-22** presents the Project Noise Trigger Levels (PNTLs) adopted for the various NCAs related to the Project.

Table 6-22: Project noise trigger levels

Receiver type	Time of day	Recommended L_{Aeq} Noise Level dB(A)
NCA 1	Day (7 am to 6 pm)	46
	Evening (6 pm to 10 pm)	44
	Night (10 pm to 7 am)	43
NCA 2	Day (7 am to 6 pm)	45
	Evening (6 pm to 10 pm)	43
	Night (10 pm to 7 am)	38
NCA 3	Day (7 am to 6 pm)	48
	Evening (6 pm to 10 pm)	44
	Night (10 pm to 7 am)	42
NCA 4	Day (7 am to 6 pm)	53
	Evening (6 pm to 10 pm)	46
	Night (10 pm to 7 am)	42
NCA 5	Day (7 am to 6 pm)	48
	Evening (6 pm to 10 pm)	43
	Night (10 pm to 7 am)	38
Educational facilities	When operating	43 dB(A)

6.6.4.3 Sleep Disturbance

For premises where night construction and operations occur, the potential for noise levels to lead to sleep disturbance should be considered. Section 4.3 of the ICNG discusses the method for assessing and managing sleep

disturbance. This guidance references further information in the *NSW Road Noise Policy* (RNP) (NSW EPA, 2013) that discusses criteria for the assessment of sleep disturbance.

Where noise levels from a construction or industrial source at a residential receptor at night exceeds the following, a maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$ 40 dB(A) or the RBL + 5 dB(A), whichever is greater, and/or
- L_{AFMax} 52 dB(A) or the RBL +15 dB(A), whichever is greater.

Based on this guidance, **Table 6-23** presents sleep disturbance screening criterion for the noise catchment areas surrounding the Project.

Table 6-23: Sleep disturbance criterion

Noise Catchment Area	$L_{eq\ 15\ min}$ dB(A)	L_{AFMax} dB(A)
NCA 1	43	53
NCA 2	43	53
NCA 3	42	52
NCA 4	42	52
NCA 5	42	52

6.6.4.4 Vibration assessment criteria

Section 7 of the CNVG provides guidance for safe working distances to achieve human comfort (*Assessing Vibration: a technical guideline* (DECC, 2006)) and cosmetic building damage (BS7385-2:1993) criteria for a range of different plant and equipment. These safe working distances are relevant for some plant and equipment that may be used during construction of the Project, and so this guidance was considered.

6.6.5 Assessment of impacts

6.6.5.1 Construction noise emissions

Construction of each Project Stage would be undertaken in four key 'phases' as follows:

- Site establishment;
- Cut and fill to battery compound and transformer yard and establishment of pad;
- Structural works to support battery enclosures, inverters, transformers, building and transformer compounds and transmission structures; and
- Delivery, installation and electrical fit-out of components.

A fifth Project phase is also assessed in the NIA related to the use of an air track drill for establishment of transmission structure footings within the transmission line easement only. This fifth phase would be undertaken only during works associated with the first Project stage to be constructed and over short duration.

Sound power levels were estimated for each phase of construction for the Project. Sound power levels for each construction phase were determined by developing an inventory of noise producing equipment and the estimated numbers of equipment based on the works taking place and estimating the sound power levels of each piece of equipment using sound power levels presented in national and international standards and guidelines, as well as from a Jacobs measurement database.

The indicative construction phases for the Project works are presented in **Table 6-24**.

Table 6-24: Construction Phase Sound Power Levels

Phase	Works	Equipment	Number of Equipment	Individual Equipment SWL	Phase SWL
1	Site Establishment	Truck (medium rigid)	2	106	113
		Road truck	2	111	
		Scissor lift	1	98	
		Light vehicles	4	94	
		Franna crane	1	98	
2	Cut and fill to battery compound and transformer yard and establishment of pad	Franna crane	1	98	123
		Excavator (tracked) 35t	2	110	
		Grader	1	113	
		Vibratory roller	1	109	
		Concrete truck	2	109	
		Dump truck	2	113	
		Water cart	1	107	
		Concrete pump	1	109	
		Concrete vibrator	1	113	
		Generator	1	103	
		Light vehicles	8	97	
		Front loader	2	115	
		Backhoe	2	114	
		Asphalt truck and sprayer	1	103	
3	Structural works to support battery enclosures, inverters, transformers, building and transformer compounds and transmission structures	Mobile crane	1	113	118
		Concrete vibrator	1	113	
		Concrete pump	1	109	
		Welding equipment	1	105	
		Excavator (tracked) 35t	1	110	
		Generator	1	103	
4	Delivery, installation and electrical fit-out of components	Rigid trucks	2	106	118
		Mobile crane	2	116	
		Compressor	1	109	
		Welding equipment	1	105	

Phase	Works	Equipment	Number of Equipment	Individual Equipment SWL	Phase SWL
		Generator	1	103	
5	Transmission structure footings (between Substation and Switchyard only)	Air track drill*	1	126	126

** - Noise source is considered to feature annoying characteristics and has been applied with a 5 dB(A) penalty. The noise source has also had a time correction applied, noting that it would operate on a sporadic basis over the construction phase.*

6.6.5.2 Construction noise assessment

Estimated noise levels at the nearest receivers were predicted from the anticipated noise levels generated during each construction phase of the Project. **Table 6-25** presents the predicted noise impact at the nearest residential receiver of each NCA during each construction phase.

The assessment approach adopted considered a "worst-case" scenario which assumed all plant and equipment for each activity was operated concurrently while positioned within their work location (as defined in **Table 6-24**) at a location closest to each respective prediction location. This was considered to be a conservative approach and while this may provide for the determination of conservative noise levels, actual construction noise levels should be lower than predicted in this assessment.

As **Table 6-25** shows noise levels were predicted to exceed the standard hours NMLs of residential receivers in NCA 1, NCA 2 and NCA 3 during Phase 2, as well as the standard hours NMLs of residential receivers in NCA 1, NCA 2 and NCA 3 during Phase 5.

The construction phase predicted to result in the highest noise levels at the nearest sensitive receivers is Phase 5 (i.e., Transmission Structures footings establishment). These works would result in noise levels in exceedance of the standard hours NMLs by up to 3 dB(A) at R1 and R6, 2 dB(A) at R2 and R11, and 1 dB(A) at R10. It is however noted that these works are transient in nature and would only occur during the construction of Stage 1 of the Project, not being repeated during the construction of the additional Stages.

Noise contour maps for each of the assessed construction phases are displayed in Appendix C of the NIA.

Table 6-25: Noise Impact from Construction Phases

Receiver	NCA	Standard Hours Construction Noise Criteria (dB(A))	Predicted Noise Performance									
			Construction Phase 1		Construction Phase 2		Construction Phase 3		Construction Phase 4		Construction Phase 5	
			Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)	Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)	Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)	Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)	Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)
R1	NCA 1	51	41	-	52	1 dB(A)	47	-	46	-	54	3 dB(A)
R2			41	-	52	1 dB(A)	47	-	46	-	53	2 dB(A)
R3			39	-	49	-	44	-	44	-	50	-
R4			32	-	42	-	37	-	37	-	43	-
R5		50	31	-	41	-	36	-	36	-	43	-

Receiver	NCA	Standard Hours Construction Noise Criteria (dB(A))	Predicted Noise Performance									
			Construction Phase 1		Construction Phase 2		Construction Phase 3		Construction Phase 4		Construction Phase 5	
			Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)	Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)	Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)	Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)	Predicted Noise Level – dB(A)	Exceedance of Noise Criteria – dB(A)
R6	NCA 2		41	-	51	1 dB(A)	46	-	46	-	53	3 dB(A)
R7			33	-	44	-	39	-	38	-	46	-
R8			35	-	45	-	40	-	40	-	48	-
R9	NCA 3	53	45	-	55	2 dB(A)	50	-	50	-	52	-
R10			45	-	55	2 dB(A)	50	-	50	-	54	1 dB(A)
R11			43	-	53	-	48	-	48	-	55	2 dB(A)
R12	NCA 4	58	34	-	45	-	40	-	39	-	48	-
R13			40	-	51	-	46	-	45	-	55	-
R14			29	-	39	-	34	-	34	-	40	-
R15	NCA 5	53	34	-	45	-	40	-	39	-	48	-
R16			35	-	45	-	40	-	40	-	48	-
R17			29	-	39	-	34	-	34	-	43	-
E1	NCA 2	55	39	-	49	-	44	-	44	-	50	-

6.6.5.3 Operation noise emissions

Representative noise sources were identified for the operation of the Project. These sources, the number of each and the layouts of the sources across the Project site have been modelled based on a number of data sources and inputs provided to Origin by prospective suppliers. The range of sound power levels and unit numbers have been detailed in **Table 6-26.** The noise levels of the units assume the units will be operating at their peak load (i.e., at their highest noise producing capability). While the operation of the Project at full load under these conditions is assessed, the market and thermal characteristics of the BESS equipment make this circumstance extremely unlikely to occur, assuring a level of conservatism in the analysis.

Table 6-26: BESS Sound Power Levels

Noise Source	Number of Units	Sound Power Level (dB(A))
Battery Enclosures	1044 - 2130	71 dB(A) – 82.6 dB(A)
Transformers / Inverters (where not included in Battery Enclosure emissions estimate)	170 - 355	67.5 dB(A) – 90 dB(A)
Grid Transformer	3	92 dB(A)

6.6.5.4 Operational noise assessment

The predicted noise impacts resulting from the operation of the Project at residential receivers are detailed in **Table 6-27**. The 'standard' and 'noise-enhancing' meteorological conditions were adopted for the assessment and the Project has been assumed to operate continuously over a 24-hour period.

The BESS units would most likely reach their operational peak during the mid-morning period (6am – 8am) and evening period (5pm – 7pm), with a reduced operation during the midday and night periods. Due to this, the potential crossover of noise enhancing conditions (i.e., night time temperature inversion events with wind up to 2 m/s) and the BESS operating at peak load will be limited, that is the frequency of occurrence when these two conditions may coincide would be rare and the durations of such events would be short.

Noise contours displaying the spatial distribution of noise from the operation of the Project are displayed in Appendix D of the NIA.

As shown in Table 6-27, no exceedances of the PNTL have been predicted during any of the three Stages of the Project's operation. It should be noted however that at R10 during the operation of Stages 1, 2 and 3 simultaneously, noise levels reach but do not exceed the PNTL noise at the receiver. The noise levels and forms of noise associated with the project remains consistent with those historically produced by the EPS itself.

Examination of available supplier data does not indicate a need to apply tonal or low frequency for annoying noise characteristics. A commitment has been made that selected technology would avoid or otherwise manage annoying noise characteristics to acceptable levels.

Table 6-27: Operational Noise Impact

Receiver	Noise Catchment Areas	Highest Predicted Noise Level at Residential Receiver (L_{Aeq} dB(A))						Noise Criteria (PNTL)	Compliant with Noise Criteria?					
		Stage 1		Stages 1 and 2		Stages 1 and 2 and 3			Stage 1		Stage1 and 2		Stages 1 and 2 and 3	
		Standard Conditions	Noise Enhancing Conditions	Standard Conditions	Noise Enhancing Conditions	Standard Conditions	Noise Enhancing Conditions		Standard Conditions	Noise Enhancing Conditions	Standard Conditions	Noise Enhancing Conditions	Standard Conditions	Noise Enhancing Conditions
R1	NCA 1	31	35	34	39	35	40	Day – 46 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 44 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R2		30	35	34	39	36	40	Day – 46 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 44 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R3		26	31	29	35	31	37	Day – 46 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 44 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R4		18	24	21	27	23	29	Day – 46 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 44 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R5	NCA 2	17	23	20	26	22	28	Day – 45 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 38 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes

								Sleep Disturbance – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R6		22	29	25	32	28	34	Day – 45 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 38 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R7		16	22	21	27	23	29	Day – 45 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 38 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R8		17	23	22	28	24	34	Day – 45 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 38 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R9	NCA 3	30	35	34	39	36	41	Day – 48 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 44 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 42 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R10		30	36	34	39	37	42	Day – 48 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 44 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 42 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R11		29	34	33	38	35	40	Day – 48 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 44 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 42 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes

								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R12	NCA 4	20	26	24	29	26	31	Day – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 46 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 42 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R13		20	26	24	29	25	31	Day – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 46 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 42 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R14		13	18	18	23	20	26	Day – 53 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 46 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 42 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R15	NCA 5	21	26	24	30	26	31	Day – 48 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 38 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R16		22	28	25	31	25	31	Day – 48 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 38 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
R17		15	21	17	24	19	25	Day – 48 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Evening – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
								Night – 38 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes

								Sleep Disturbance – 52 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes
E1	NCA 2	21	27	25	30	27	33	When Operating – 43 dB(A)	Yes	Yes	Yes	Yes	Yes	Yes

6.6.5.5 Vibration

Vibratory rollers and air track drills are considered to be a vibration-generating plant and may be used during construction. The equipment, setback distances and nearest impacted receivers are displayed in **Table 6-28**.

Table 6-28: Predicted Vibration Impact

Equipment	Setback Distance (m)			Nearest Affected Receiver (m)			Vibration Impact?
	Human Comfort	Cosmetic Building Damage	Heritage Structure Impact	Residency	Occupancy	Heritage Item	
Vibratory Roller	100m	25m	45m	700m	300m	200m	No
Air Track Drill	50m	15m	27m				No

As displayed in the table, no vibration impacts at nearest receivers have been predicted as a result of the construction of the Project. Additionally, as the nearest medical facility is 2 km away from the Project site, no impacts to medical facilities due to construction vibration have been predicted.

No equipment used during the operation of the Project has been predicted to produce vibration impacts.

6.6.6 Mitigation measures

Environmental management measures for noise and vibration are presented in **Table 6-29**.

Table 6-29: Environmental management measures for noise and vibration impacts

Measure	Details	Timing
NV1	Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner.	Prior to and during construction
NV2	Where possible, use quieter and less vibration emitting construction methods.	During construction
NV3	Only have necessary equipment on-site and turn off when not in use.	During construction
NV4	Where possible, concentrate noisy activities at one location and move to another as quickly as possible.	During construction
NV5	Vehicle movements, including deliveries outside standard hours should be minimised and avoided where possible.	During construction
NV6	Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices.	Prior to and during construction
NV7	Use only the necessary size and powered equipment for tasks.	During construction
NV8	Implement training to induct staff on noise sensitivities	Prior to and during construction

Measure	Details	Timing
NV9	Where possible, consider the application of less intrusive alternatives to reverse beepers such as 'squawker' or 'broadband' alarms.	During construction
NV10	Consider the installation of temporary construction noise barriers or earth mounds for concentrated, noise-intensive activities.	During construction
NV11	Where practicable, install enclosures around noisy mobile and stationary equipment as necessary.	During construction
NV12	Where possible, avoid simultaneous operation of two or more noisy plant close to receivers. The offset distance between noisy plant and sensitive receivers should be maximised.	During construction
NV13	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements.	Prior to and during construction
NV14	Complete routine monitoring to evaluate construction noise levels and evaluate whether the mitigation measures in place are adequate or require revision.	During construction
NV15	▪ Choosing alternative, lower-impact equipment or methods wherever possible ▪ Scheduling the use of vibration-causing equipment at the least sensitive times of the day (wherever possible) ▪ Locating high vibration sources as far away from sensitive receiver areas as possible ▪ Sequencing operations so that vibration-causing activities do not occur simultaneously. ▪ Keeping equipment well maintained Do not conduct vibration intensive works within the recommended safe setback distances.	During construction
NV16	Informing nearby receivers about the nature of construction phases and the vibration-generating activities.	During construction
NV17	The detailed design of the Project would include further consideration and modelling of the selected BESS component supplier's equipment SPLs and layout to confirm the predictions of the noise impact assessment remain valid prior to construction commencing. Selected technology would avoid or otherwise manage annoying noise characteristics to acceptable levels.	Detailed design for each Project Stage
NV18	Operational noise monitoring would be undertaken immediately following commissioning of each Project Stage to confirm predictions and to identify any need to retro-fit mitigation measures to achieve compliance with applicable criteria. Results would be used to determine need for additional mitigation for subsequent Stages.	Immediately following commissioning of each Stage.
NV19	All reasonable and feasible mitigation measures would be explored and implemented to achieve compliance with all criteria at all times.	Operations

6.7 Transport

This section summarises the findings of the *Eraring Battery Energy Storage System – Traffic and Transport Assessment* (Jacobs, 2021b) (traffic assessment) provided in **Appendix K.** The traffic assessment addresses the following SEARs:

Transport – including:

- *an assessment of the peak and average traffic generation, including over-dimensional vehicles and construction worker transportation;*
- *an assessment of the likely transport impacts to the site access route (including, but not limited to the M1 Pacific Motorway, A43 New England Highway, Wangi Road and Rocky Point Road), site access point(s), any Crown land, particularly in relation to the capacity and condition of the roads, road safety and intersection performance;*
- *a cumulative impact assessment of traffic from nearby developments; and*
- *provide details of measures to mitigate and / or manage potential impacts including a schedule of all required road upgrades (including resulting from heavy vehicle and over mass / over dimensional traffic haulage routes), road maintenance contributions, and any other traffic control measures, developed in consultation with the relevant road authority;*

6.7.1 Assessment methodology

The methodology for the traffic assessment included:

- A review of the existing transport network including access, traffic volumes and generation and crash history;
- Traffic modelling was carried out to assess the potential impacts of the Project on key intersections at the Wangi Road and Rocky Point Road interchange. The approach to traffic modelling assessment aligns with the *Traffic Modelling Guidelines* (Roads and Maritime, 2013);
- Assessment of the potential transport and traffic impacts during construction and operation of the Project. This also include an assessment on:
  - Cumulative impacts – assessed through a qualitative analysis of the performance of the road network with vehicle movements associated with other major projects expected to be occurring at the same time as the Project based on current publicly available information;
  - Impacts of OSOM vehicles – assessed through an analysis of OSOM requirements and potential routes; and
- Identification of appropriate mitigation and environmental management measures.

The study area for the traffic assessment consists of the transport network surrounding the Project area, including the roads which form part of the proposed access routes for construction and operational vehicles.

The cumulative traffic impact is discussed in **Section 6.13.4.2**.

6.7.2 Existing environment

6.7.2.1 Road network and access

The Project is connected to the surrounding road network by Rocky Point Road and Wangi Road (B53), as shown in **Figure 6-6.**

Wangi Road is a 13 km road that extends between the township of Toronto to the north-east and the township of Dora Creek to the south-west. Wangi Road is classified as a State road and forms part of route B53, connecting settlements along the western shore of Lake Macquarie to the M1 Pacific Motorway and Newcastle's western suburbs. Wangi Road generally comprises a single carriageway with one lane in each direction, however

overtaking lanes are provided at three locations. Wangi Road generally has a posted speed limit of 90 km per hour, which reduces to 60 km per hour near the townships of Toronto and Dora Creek.

Rocky Point Road connects to Wangi Road via a grade-separated interchange. The western end of Rocky Point Road provides access to the EPS and the Project area. The eastern end of Rocky Point Road provides public access to the suburb of Eraring. Wangi Road is a single carriageway road with one lane in each direction and has a posted speed limit of 60 km per hour that reduces to 40 km per hour near the EPS. Beyond the EPS, Rocky Point Road transitions to become a private road at its western extent.

No formal off-road pedestrian or cycling facilities are provided on Wangi Road or Rocky Point Road.

6.7.2.2 Heavy vehicle access

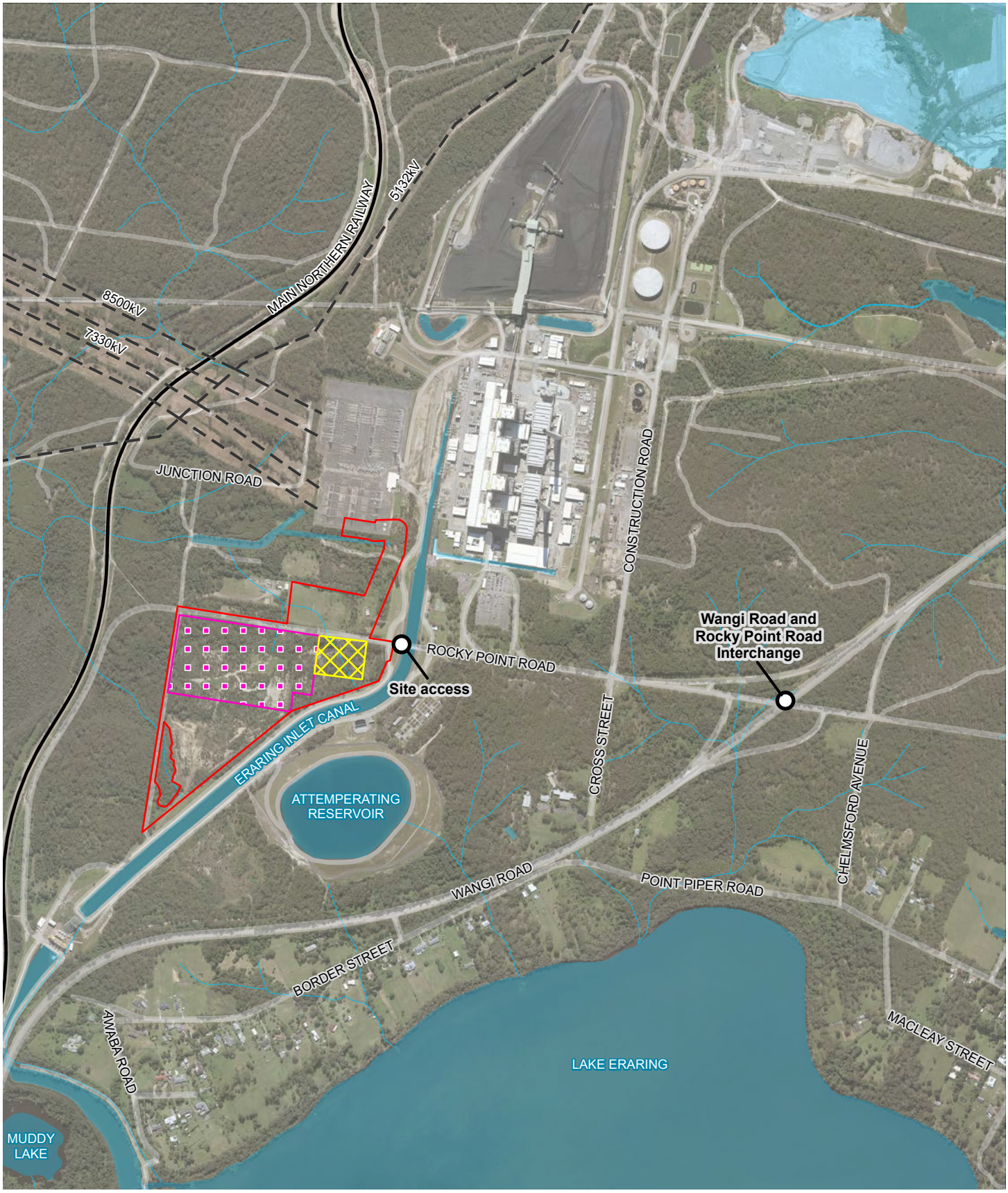
The main materials and components required to construct the Project are expected to originate from Port Botany with oversize over mass loads coming from the Port of Newcastle.

Heavy vehicle access to the Project from the north is expected to be via the M1 Pacific Motorway to Ryhope, then through Awaba via Cessnock Road and Wilton Road, and to the Project area via Wilton Road, Wangi Road and Rocky Point Road. While heavy vehicle access to the Project from the south is expected to be via the M1 Pacific Motorway to Morisset, then through the Dora Creek via Mandalong Road and Main Road, and to the Project area via Wangi Road and Rocky Point Road.

6.7.2.3 Traffic volumes

Traffic volumes at:

- Wangi Road indicate that the morning peak hour is from 7:00am to 8:00am and the evening peak hour is from 3:00pm to 4:00pm. Wangi Road exhibits a northbound peak direction of travel during the morning peak hour and a southbound peak direction of travel during the evening peak hour. Near Wangi Point Road, peak hour volumes on Wangi Road typically range between 520 and 640 vehicles. Heavy vehicles comprise 12% of traffic travelling on Wangi Road; and
- The Wangi Road and Rocky Point Road grade-separated interchange indicate that the morning peak hour is 7:30am to 8:30am and the evening peak hour is 4:30pm to 5:30pm. The peak direction of travel on Rocky Point Road is westbound during the morning peak period and eastbound during the evening peak period. Peak hour volumes on Rocky Point Road typically range between 90 and 400 vehicles. The majority of vehicles access Rocky Point Road from Wangi Road, with a small proportion of traffic travelling to and from residential areas located near Rocky Point.



Project area
Battery Energy Storage System
Substation
Electricity transmission line
Railway

0 300 m

1:15,000 at A4
GDA94 MGA56

Data sources

Origin 2021
Aerometrex 2020,
© Department Finance, Services
and Innovation Dec 2020

Figure 6-6 Road network surrounding the Project area

6.7.2.4 Public transport network

Passenger rail network

The Great Northern Railway alignment lies approximately 200 m west of the Project. Also known as the Main North Line, the Great Northern Railway is a major railway in NSW that runs through the Central Coast, Hunter and New England regions. The line comprises two tracks that serve both passenger and freight traffic. The nearest train station to the Project area is Dora Creek, approximately 1.6 km to the south.

Bus network

Two public bus services operate on Wangi Road including route 275 (Toronto to Wangi via Fishing Point & Rathmines) and route 281 (Lake Haven to Wangi Wangi). Route 275 and 281 are operated by Hunter Valley Buses. The nearest bus stop to the Project is an unmarked stop located on Wangi Road opposite Horn Street (Stop ID 2264163).

6.7.2.5 Crash history

A review of crash data was undertaken to provide an assessment of safety issues and trends on the nearby haul route for the Project. Crash data for was sourced from Transport for NSW's *Centre for Road Safety database* (TfNSW, 2020b). The crash data comprised self-reported crashes in the five-year period from January 2015 to December 2019.

In the five-year period from 2015 to 2019, a total of 44 crashes were recorded on Wangi Road and Rocky Point Road. The majority of crashes (43 crashes) occurred on Wangi Road while a total of two crashes occurred at the Wangi Road and Rocky Point Road interchange, one in 2015 and one in 2019. Further analysis of crash history data is provided in **Appendix K**.

6.7.3 Assessment of impacts

6.7.3.1 Construction

Traffic generation and distribution

Traffic generated by the Project includes transportation of personnel, plant, equipment and materials.

The construction of the Project is expected to generate an additional:

- 128 workers travelling to the Project area, generating an expected 128 two-way light vehicle movements per day (i.e. 128 inbound movements and 128 outbound movements). These light vehicle movements are expected to occur during the hours prior to shift commencement (6:00am to 7:00am) and after shift end (6:00pm to 7:00pm);
- 60 two-way heavy vehicle movements per day. The majority of heavy traffic movements would occur between 6:00am to 7:00pm and are assumed to be distributed evenly within the time period. The main materials and components required to construct the Project are expected to originate from Port Botany in Sydney. As such, heavy vehicles would access the Project area from the south.

During construction, all light vehicles would access the Project area via Rocky Point Road and Wangi Road. It is anticipated that the distribution of light vehicles would continue in accordance with existing traffic distribution patterns in the area, with approximately 50% of light vehicles accessing the Project area from the north and 50% of light vehicles accessing the Project area from the south.

Oversized components are expected to be transported to the Project area from the Port of Newcastle. Oversized vehicle movements would be conducted outside standard hours.

Impacts on intersection performance

The criteria for evaluating the operational performance of intersections is defined in **Table 6-30** and comes from the *Guide to Traffic Generating Developments* (Roads and Traffic Authority, 2002). For priority (sign-controlled) intersections, the criteria for evaluating the performance of intersections is based on the worst delay across all legs of the intersection during the peak hour. This average vehicle delay is equated to a corresponding level of service (LoS) from A (best) to F (worst). For rural roads, the desired LoS is LoS C. This LoS was adopted for the modelled intersections.

Table 6-30: Level of service definitions

LoS	Average delay (seconds/vehicle)	Give way and stop signs
A	Less than 15	Good operation
B	15 to 28	Acceptable delays and spare capacity
C	29 to 42	Satisfactory, but accident study required
D	43 to 56	Near capacity and accident study required
E	57 to 70	At capacity, requires other control mode
F	Over 70	Extreme delay, traffic signal or other major treatment required

SIDRA Intersection 9 software was used to model the existing and future Project scenarios at key intersections at the Wangi Road and Rocky Point Road interchange. The modelled existing and future peak year traffic modelling results are shown in **Table 6-31**.

Table 6-31: Modelled SIDRA intersection performance with the Project and nearby developments (2026)

Intersection	Peak period	Degree of Saturation	Intersection delay (seconds)	LoS	95th percentile queue length (m)
Rocky Point Road / Construction Road / Cross Street	Morning peak	0.26	14.5	A	0.9
	Evening peak	0.25	11.9	A	1.2
Rocky Point Road / Wangi Road northbound on-ramp	Morning peak	0.13	6.0	A	0.0
	Evening peak	0.27	5.7	A	0.0
Rocky Point Road / Wangi Road Slip Lane	Morning peak	0.14	4.7	A	0.2
	Evening peak	0.13	5.4	A	0.3
Rocky Point Road / Wangi Road northbound off-ramp	Morning peak	0.15	5.7	A	0.1
	Evening peak	0.13	6.8	A	0.4
Rocky Point Road / Wangi Road southbound on-ramp	Morning peak	0.14	8.7	A	1.2
	Evening peak	0.15	5.9	A	5.3
Rocky Point Road / Wangi Road southbound off-ramp	Morning peak	0.21	5.8	A	5.7
	Evening peak	0.03	5.9	A	0.7

The modelling indicates all existing intersections in the study area are operating satisfactorily at a LoS A and are currently operating well within their capacity. The maximum increase in average delay as a result of the Project when combined with other nearby developments is anticipated to be eight seconds and would occur at the Rocky Point Road / Construction Road / Cross Street intersection.

The traffic modelling also found that the queue lengths of the exit ramps from Wangi Road to Rocky Point Road due to the Project are expected to be very low and are not expected to extend into nor impact Wangi Road.

Road capacity

The Level of Service associated with existing traffic volumes and the expected cumulative traffic volumes on Wangi Road and Rocky Point Road indicate all roads would operate at or above a LoS B under the 'with Project' scenario. These results therefore suggest that there is spare capacity to accommodate the cumulative additional traffic generation on Wangi Road and Rocky Point Road without adversely impacting the operation of the roads.

Impacts on Road Safety

During the construction and operation of the Project, additional traffic has the potential to impact road safety on roads forming part of the proposed access route. This includes heavy vehicles transporting materials and equipment as well as personnel commuting to and from the Project.

The Wangi Road and Rocky Point Road interchange has historically experienced a low rate of crashes, with two crashes reported during the five-year period between 2015 and 2019. Additional vehicle movements to and from the Project are unlikely to have an impact on the future crash frequency at the interchange as modelled performance suggests that all intersections at the interchange would continue to operate at a LoS A with additional cumulative traffic volumes. Moreover, queue lengths at the interchange with additional cumulative traffic volumes are not expected to exceed 5.3 m in length and therefore would not extend into nor cause safety issues on Wangi Road.

Beyond the Wangi Road and Rocky Point Road interchange, Wangi Road and Rocky Point Road are expected to have sufficient spare mid-block capacity to accommodate additional traffic volumes generated by the Project without adversely impacting the operation or safety of the roads.

Impacts on public transport, pedestrians and cyclists

The Project would not result in any change or impact to public transport operations.

As there are no formal pedestrian or cycling facilities near the Project, the Project would not have an impact on pedestrians or cyclists other than through additional vehicles using current roads and intersections.

Impacts of OSOM vehicles

The following OSOM vehicles are expected to be generated from the Port of Newcastle throughout the Project:

- Five one-way oversized vehicle movements to transport battery components to the Project area;
  - Up to four one-way movements to transport four 285 MVA transformers to the Project area; and
  - One one-way movement to transport one control building to the Project area.

The proposed OSOM vehicle routes from the Port of Newcastle and the relevant restrictions from the *NSW OSOM Load Carrying Vehicles Network Map* (TfNSW, 2021) are described in **Table 6-32** and shown in **Figure 6-7.** It is noted that physical constraints may exist on each route and would be determined via a detailed route survey.

Project area
Proposed route 1
Proposed route 2
National Park
Nature Reserve
Regional Park
State Conservation Area
State Forest

0 5000 m

1:165,000 at A4
GDA94 MGA56

N

Data sources

Origin 2021
Jacobs 2021,
© Department Finance, Services and Innovation Dec 2020

Figure 6-7 Proposed OSOM routes

To manage OSOM vehicles, an access permit will be sought from the National Heavy Vehicle Regulator. This permit will undergo a separate approval process and a suitable contractor will be engaged for transportation. As part of the permit, the subcontractor would develop a TMP and determine the suitable route based on the required OSOM vehicle dimensions and mass in consultation with Origin and the National Heavy Vehicle Regulator. These traffic movements would be undertaken at night under police escort and in accordance with any OSOM permit conditions.

Due to the low number of OSOM vehicle movements, combined with the fact that these OSOM vehicles would travel outside of peak periods, it is expected that the traffic impact of OSOM vehicles on the road network would be minimal.

Table 6-32: Proposed OSOM vehicle routes and restrictions

No.	Proposed routes	Distance (km)	Restrictions
1	From Port of Newcastle via Morisset: ▪ Selwyn Street ▪ A43 from Port of Newcastle to Sandgate ▪ A37 from Sandgate to Jesmond ▪ A15 from Jesmond to the M1 ▪ M1 to Morisset ▪ B53 at Morisset to the Project area	70	▪ Narrow bridge over Dora Creek and Muddy Lake
2	From Port of Newcastle via Toronto: ▪ Selwyn Street ▪ A43 from Port of Newcastle to Sandgate ▪ A37 from Sandgate to Jesmond ▪ A15 from Jesmond to the M1 ▪ M1 to Ryhope ▪ Cessnock Road / Awaba Road from Ryhope to B53 at Toronto ▪ B53 at Toronto to the Project area	60	▪ Nil

6.7.3.2 Operation

The operation of the Project would require negligible vehicle movements. As such, the overall operation of the Project would not result in impacts to the performance of the road network.

6.7.4 Mitigation measures

Environmental management measures for traffic and transport impacts are presented in **Table 6-33**.

Table 6-33: Environmental management measures for traffic and transport impacts

Reference	Environmental management measures	Timing
T1	A Construction Traffic Management Plan will be prepared and implemented by the construction contractor. The CTMP will include: ▪ Confirmation of haulage routes; ▪ Access to construction site including entry and exit locations; ▪ Times of transporting to minimise impacts on the road network; ▪ Measures to minimise the number of workers using private vehicles; ▪ Management of oversized vehicles;	Prior to commencement of construction.

Reference	Environmental management measures	Timing
	▪ Site specific traffic control measures (including signage) to manage and regulate traffic movement; ▪ Relevant traffic safety measures including driver induction, training, safety measures and protocols; ▪ Identify requirements for, and placement of, traffic barriers; ▪ Requirements and methods to consult and inform the local community of impacts on the local road network due to the development-related activities; ▪ Consultation with Transport for NSW and Council; ▪ Consultation with the emergency services to ensure that procedures are in place to maintain safe, priority access for emergency vehicles; ▪ A response plan for any construction related traffic incident; ▪ Monitoring, review and amendment mechanism; and ▪ Individual traffic management requirements at each phase of construction.	
T2	An oversized vehicle permit will be sought for all OSOM vehicle movements where required. The OSOM movements would be in accordance with the permit requirements and be outside of peak traffic periods where possible. In addition, a separate OSOM Transport Management Plan will be prepared and will include: ▪ Identification of route; ▪ Measures to provide an escort for the loads; ▪ Times of transporting to minimise impacts on the road network; ▪ Communication strategy and liaising with emergency services and police; and ▪ Any minor temporary civil infrastructure works may be required to accommodate OSOM movements.	Prior to delivery of OSOM loads.
T3	The CEMP and general site induction would inform construction and operational personnel of the risk of collisions, and the risks of speeding and fatigue on safety. In addition, a Driver Code of Conduct will be prepared and used to outline the rules and behaviours which drivers associated with the Project would be required to adhere to. The Driver Code of Conduct will outline arrangements for light and heavy vehicle drivers including: ▪ General requirements including site induction requirements ▪ Travelling speeds and safe driving practices, particularly through residential areas and school zones ▪ Fatigue management ▪ Adherence to designated transport routes and heavy vehicle noise ▪ Public complaint resolution and penalties and disciplinary action.	Construction
T4	Road maintenance is not proposed as part of the Project on the basis that total heavy vehicle movements associated with full Project construction would be equivalent of 6 days of heavy vehicle movements on Wangi Road while movements on Rocky Point Road would be equivalent to 20 days of existing operations of the EPS.	Construction
T5	Affected parties including emergency services will be notified in advance of any disruptions to traffic and restriction of access impacted by Project activities.	Construction

6.8 Water

This section provides an assessment of the potential impacts of the Project on surface water, hydrology, groundwater and flooding, and provides the measures to mitigate them. This assessment was informed the findings of the *Eraring Battery Energy Storage System – Surface Water and Groundwater Impact Assessment* (Jacobs, 2021c). This assessment is summarised below and is provided in **Appendix L**. The assessment addresses the following SEARs:

Water – including:

- *an assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources (including watercourses traversing and surrounding the site, drainage channels, wetlands, riparian land, farm dams, groundwater dependent ecosystems and acid sulfate soils), related infrastructure, adjacent licensed water users and basic landholder rights, and measures proposed to monitor, reduce and mitigate these impacts;*
- *details of water requirements and supply arrangements for construction and operation; and*
- *a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with Managing Urban Stormwater: Soils & Construction (Landcom, 2004).*

6.8.1 Assessment methodology

The methodology for the hydrology assessment included:

- A review of existing background information relevant to the Project area including publicly available databases and previous investigations specific to the Project to characterise the existing environment;
- Qualitative assessment of potential impacts to flooding as a result of construction and operation of the Project. Given the very low flood risk of the Project area, quantitative modelling assessment of flooding impacts is not warranted;
- Assessment of the impact of construction and operational activities on water quality, hydrology, groundwater and flooding; and
- Identification of appropriate mitigation and environmental management measures.

6.8.2 Existing environment

6.8.2.1 Climate

The Project area is considered to have a Mediterranean type climate with hot summers and cool to mild winters. Analysis of the available climate data indicates:

- A seasonal cyclic variation in total monthly rainfall amounts. The data shows evidence of a prevalent 'wet' (February to April) and 'dry' (July to September) season with an average total annual rainfall of 1120.7 mm; and
- The Project area is positioned within a temperate climatic region characterised by mild to warm summer and cool winters. Average minimum and maximum temperatures range from approximately 16 – 29 Degrees Celsius (December to February) to 5 – 19 Degrees Celsius (June to August) seasonally, with predominantly mild temperatures in the autumn and spring months.

6.8.2.2 Catchment overview

The Project area is located in the Lake Macquarie and Tuggerah Lakes catchment areas in the Hunter Region of NSW. The Lake Macquarie and Tuggerah Lakes catchment areas are bound to the west and north by the Hunter River catchment and bound to the south by the Hawkesbury-Nepean catchment. The Lake Macquarie portion of the catchment covers approximately 648 square km. More locally, the Project area falls within the Dora Creek sub-catchment which is located on the western side of Lake Macquarie. Dora Creek catchment has an area of approximately 238 square km and is the largest sub-catchment flowing into Lake Macquarie. Specifically, the catchment area for Muddy Lake makes up 893 ha of this sub-catchment.

The main waterways within the Dora Creek catchment include Dora Creek, Stockton Creek, Jigadee Creek and Muddy Lake, refer to **Figure 6-8**.

6.8.2.3 Waterways and drainage

The Muddy Lake and associated wetlands are located approximately 200 m west of the Project area and Dora Creek is located approximately 1.7 km to the south. The EPS inlet canal and attemperation reservoir are located directly east of the Project area.

The northern two-thirds of the BESS compound area drains via a number of individual flow paths to a main low point at Rocky Point Road, which then drains via culverts under the road and then off site via existing drainage channels towards the north-west, joining Muddy Lake Creek downstream of an existing EPS settling pond. Water then flows through culverts through the Main Northern rail line and then south-west towards Muddy Lake.

Surface water from the southern portion of the Project area flows in a westerly direction off site and then through culverts through Rocky Point Road and the Main Northern rail line to Muddy Lake.

The key surface water features including waterways, drainage channels and the EPS inlet canal, waterbodies and wetlands within the study area are shown on **Figure 6-8**.

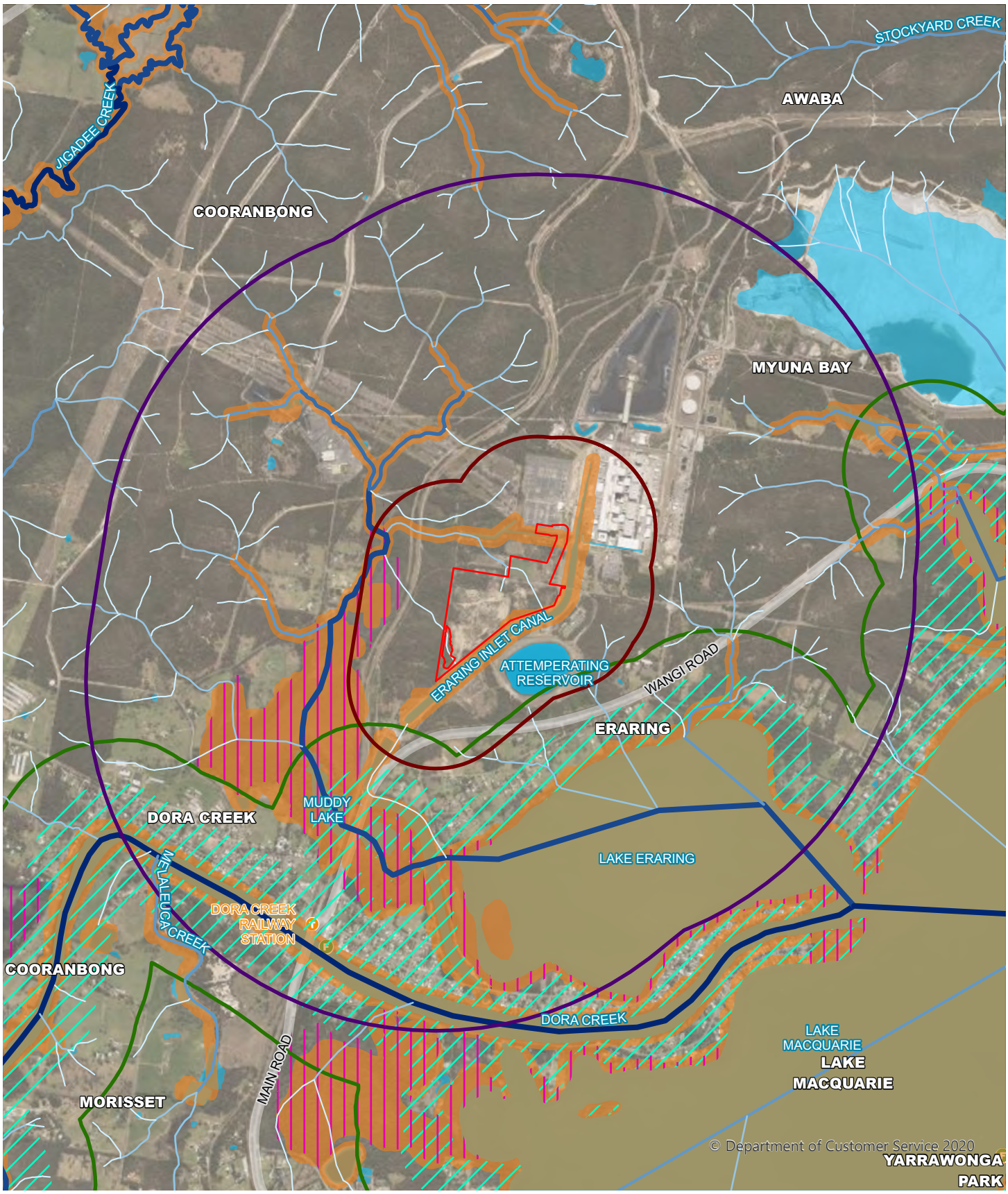


Figure 6-8 Water assessment study area

6.8.2.4 Groundwater

Level and flows

Previous studies have identified two main aquifer types within the Origin landholding:

- A shallow unconfined groundwater system within alluvium, fill and residual soils; and
- A deeper groundwater system with weathered and fractured rock.

The shallow unconfined groundwater system is generally present within fill/reworked material, residual soils and in alluvial sediments near drainage. It is noted that the unconfined groundwater system is not consistent across the Origin landholding. The permeability of the shallow unconfined groundwater system is expected to be low to very low.

The deeper bedrock groundwater system comprises fractured rock aquifers hosted within the Munmorah Conglomerate and deeper Newcastle Coal Measures.

Given the locality of the Project area, being situated between Lake Eraring and Muddy Lake, natural groundwater levels are likely to be relatively low lying range from approximately 19 m AHD beneath the northeast corner of the Project area to approximately five to six m AHD beneath the western boundary.

It was noted that is a substantial hydraulic gradient to the west beneath the Project area and some elevated water levels observed are considered to be the result of leakage or seepage emanating from the EPS inlet canal. The groundwater flow direction is generally to the west toward the upper reaches of Muddy Lake.

Given the low lying nature of the area, and being situated between saline Lake Eraring and Muddy Lake, shallow groundwater quality beneath the Project area, is likely to be more brackish in nature.

Seepage from the EPS inlet canal in the east of the Project area is also likely to result in the presence of more saline water beneath the Project area. Stantec (2018) indicate the salinity of the water in the canal, drawn from Lake Macquarie, is of the order of 34,000 micro siemens per centimetre (expressed as µS/cm). It is noted that additional areas of potential seepage from the canal are apparent from aerial imagery approximately 200 to 300 m north of the Project area.

Groundwater quality

Given the low-lying nature of the area, and being situated between saline Lake Eraring and Muddy Lake, shallow groundwater quality beneath the Project area is likely to be more brackish in nature.

Groundwater use

The *Australian Groundwater Explorer* (Bureau of Meteorology, 2019a) indicates that other than groundwater bores associated with the EPS, there are no other groundwater users within 2 km of the Project. The closest bores to the Project are:

- GW052111 at approximately 2050 m to the southwest (49 m deep for stock and domestic purposes); and
- GW053438 at approximately 2080 m to the west-southwest (53 m deep for irrigation purposes.

6.8.2.5 Groundwater dependant ecosystems

The *Groundwater Dependent Ecosystem Atlas* (Bureau of Meteorology, 2019b) identifies areas of the Muddy Lake wetland as high potential aquatic groundwater dependent ecosystems (GDEs), with the majority of the wetland area, located west of the railway line and Rocky Point Road, mapped as a high potential terrestrial GDE (Paperbarks/Woollybutt swamp forest on coastal lowlands of the Central Coast). The area immediately west of the Project area is also mapped as moderate to high potential terrestrial GDE.

It is also noted that the Muddy Lake wetland is classified as a Coastal Wetland under the State Environmental Planning Policy (Coastal Management) 2018.

6.8.2.6 Flooding

The Project area is impacted by flooding in the peak 1 in 100 (or 1%), 1 in 20 (or 5%) and 1 in 500 (0.2%) Annual Exceedance Probability (AEP) rainfall events. Flooding around the Project area is caused by two main mechanisms:

- Mainstream flooding in Muddy Lake, resulting primarily from floodwaters in Dora Creek overflowing into Muddy Lake and associated wetland areas, to the west of the Project area. Runoff from local watercourses feeding this area also contribute to the flooding; and
- Local overland flooding in main flow paths to the north of the Project area, including Muddy Lake Creek and Muddy Lake Settling Pond, and main open drains and flow paths which are located to the north of Rocky Point Road and on forested areas to the west. The local overland flooding is influenced by the elevated floodwaters in Muddy Lake and associated wetlands, in addition to the hydraulic constraints posed by the Main Northern railway line and its transverse drainage culverts.

The peak flood levels at key locations for selected flood events are summarised in **Table 6-34** and shown on **Figure 6-9.** This figure also shows mainstream flooding in Muddy Lake in the west of the figure and overland flooding flows around the Project area in the 1% AEP event. Minor overland flows of up to 0.25 m are also shown and can be considered and managed as drainage and runoff, rather than considered as flooding.

Figure 6-9: Flood level reporting locations (extracted from Figure 3-4 in GHD (2021a). (1% AEP flood shown)

During the existing case, the Main Northern rail line is overtopped by floodwaters from the local catchment which flow westward toward Muddy Lake. The rail line has an elevation of 5.5 m AHD at Muddy Lake Creek crossing and 3.4 m AHD at the overland flow crossing to the west of the Project area. It is overtopped in the 0.2% AEP event and larger.

The Project area is situated at elevations of 10 to 23 m AHD, and hence is above the mainstream and overland flooding in up to the Probable Maximum Flood (PMF) event.

Table 6-34: Peak flood levels (m AHD) in vicinity of Project area

Flood AEP	Location			
	1	2	3	4
5%	1.99	3.49	9.84	7.42
1%	2.45	4.20	9.88	7.47
0.2%	2.74	4.22	9.92	7.51
PMF	3.53	5.37	10.01	7.57

6.8.3 Assessment of impacts

6.8.3.1 Construction

Water quality and hydrology

Based on review of Project design and typical construction methodology, it was determined that there would be no direct impacts to downstream waterways as there would be no instream works required. Potential impacts during construction are therefore limited to mobilisation of sediment and contaminants to downstream receivers by wind or stormwater runoff and subsequent indirect impacts on the aquatic ecosystem of Muddy Lake. During construction, the following potential impacts were identified if no mitigation measures were implemented:

- Erosion of soils and sedimentation of waterways;
- Reduced water quality from elevated turbidity, increased nutrients and other contaminants;
- Smothering of aquatic organisms from increased sediments and associated low dissolved oxygen levels;
- Potential increased occurrence of algal blooms associated with reduced water quality;
- Migration of litter off-site; and
- Contamination from accidental leaks or spills of chemicals and fuels.

These potential impacts are considered unlikely to occur and would be managed through implementation of proposed erosions and sediment controls and other identified management measures. Construction discharges would be carried out in accordance with the *Managing Urban Stormwater: Soils & Construction (Landcom, 2004)*, any EPL that may be held during construction and as per the water quality performance criteria outlined in the EPBC referral decision – Particular Manner 3 (2021).

Water for construction purposes would be sourced from Origin's current water entitlements or purchased from potable water supplies. Construction runoff would be treated for discharge or reuse. Water may be re-used (as a supplementary source to the primary water supply) for activities such as dust suppression, where there is appropriate supply and quality available within the sediment basins. However, it is noted that that the amount of surface water to be utilised for re-use from sediment retention basins is anticipated to be negligible over the life of the Project.

Water quality controls and management measures (detailed in **Section 6.8.4**) would be implemented to ensure no runoff is mobilised downstream prior to being captured and treated in on-site construction sediment basins.

Groundwater

Extraction of groundwater for construction use is not proposed. The Project is therefore not expected to impact on any adjacent licensed water users or existing groundwater infrastructure.

While groundwater is present at relatively shallow depths in some areas, the BESS compound pad would be formed predominantly by filling the low-lying ground to elevations of approximately 16 m AHD and may include benching towards the lower lying ground in the west. Final landforms will be confirmed as part of detailed design for each stage. It is noted that some areas of excavation would also be required to achieve the final pad elevation; however, these would predominantly occur on areas of elevated ground that are situated well above the water table.

Foundations for the batteries, transformers and associated infrastructure would comprise slabs to be formed on top of the pad and no excavations intersecting groundwater are anticipated. Excavation for the establishment of drainage may be required in low lying areas but is not expected to be significant. The final design and construction of the Project would adopt design aspects with the aim to minimise or avoid groundwater interaction. The construction of the Project is therefore not currently expected to result in any aquifer interference activities, including intersection of the water table, obstruction of groundwater flows, or changes in groundwater quality.

Indirect impacts to the groundwater environment during construction may occur as a result of potential spills or leaks of materials occurring during construction and migrating to the water table. Potential spills or leaks may include oils, lubricants and fuels used by construction plant.

6.8.3.2 Flooding

The available flood studies indicate that the Project area is above the PMF level in Muddy Lake and at the PMF in overland flow paths in the vicinity of the Project area.

Heavy rainfall during the construction period could result in local overland flows entering excavations or stockpiles of construction materials and spoil being washed away into nearby drainage lines and waterways.

The sequencing of construction activities should be considered such that drainage and flood mitigation measures are implemented prior to other key activities which would cause flooding impacts, such as placement of impervious surfaces.

6.8.3.3 Operation

Water quality and hydrology

During operation, water will be supplied from the existing potable water supplies to the EPS. Negligible water would be required for operation and would be limited to potable supply for site facilities and top-up of any fire water management systems if required.

Risks to surface water during operation of the Project are primarily associated with the establishment of new permanent impervious surfaces. Without appropriate on-site management of stormwater and drainage design, the new impervious surfaces would result in an increased flow rate, volume and velocity of surface water runoff which could lead to on-going potential risk of soil erosion and subsequent sedimentation to downstream receivers, potential impacts from flooding, and potential heavy metal contamination downstream.

Increased flow rates, volume and velocities of surface water runoff from new impervious surfaces would be considered in the detailed design of the stormwater drainage system to ensure downstream erosion and scour is minimised as far as practicable. It is expected that the operational stormwater infrastructure would provide adequate containment and treatment of surface water runoff prior to reaching downstream sensitive receiving environments. Detailed design would also consider need for emergency isolation and water retention, treatment

or disposal in the event of a spill or thermal runaway event requiring fire suppression based on outcomes of final hazard analysis of selected technology and specific fire management philosophy.

Groundwater

No operational impacts are expected on groundwater.

Flooding

The available flood studies indicate that the Project area is above the PMF level in Muddy Lake and at the PMF in overland flow paths in the vicinity of the Project area. Any filling and earthworks in the Project area would not result in loss of floodplain storage or flood flow obstruction. Hence, flooding impacts due to these effects are not expected.

The increased imperviousness of the Project area could potentially alter and increase overland flood flow rates, without any mitigation, resulting in potential increased flooding potential of the Main Northern rail line. Existing roads within the Origin landholding may be affected but are private roads associated with the Project. No public roads would be affected by increased stormwater and flood flow rates and resulting increased flooding in the overland flow paths.

The increased stormwater volumes discharged from the Project area are not expected to impact on flooding of existing rural residential properties to the west of Muddy Creek during flood events. This is due to flooding in Muddy Lake being dominated by backwater flooding from Dora Creek, with the flood volumes from the creek being many orders of magnitude larger than the likely increased runoff volume from the Project area due to the large size of the Dora Creek catchment (238 square km).

6.8.4 Mitigation measures

Environmental management measures relating to water (including groundwater and surface water) are outlined in **Table 6-35.**

Table 6-35: Environmental management measures for water impacts

Reference	Environmental Management Measure	Timing
SW1	A Construction surface water management plan (CSWMP) will be prepared as a sub-plan of the CEMP for each stage of the Project. The plan will outline measures to manage soil and water impacts associated with the construction works. The CSWMP will include but not be limited to: ▪ Measures to minimise/manage erosion and sediment transport both within the construction footprint and off-site including requirements for the preparation of an Erosion and Sediment Control Plan for construction; ▪ Processes for dewatering of construction sediment basins, including relevant discharge criteria; ▪ Measures to manage accidental spills including the requirement to maintain materials such as spill kits; ▪ Measures to manage any potential ASS found in excavated fill material, in accordance with the Acid Sulfate Soil Guidelines; ▪ Measures to manage potential tannin leachate; and ▪ Details of surface water quality monitoring to be undertaken prior to, throughout, and following construction (refer to SW2 for further information).	Pre-construction, Construction

Reference	Environmental Management Measure	Timing
SW2	A surface water monitoring program will be implemented prior to, during and following construction and decommissioning. The monitoring program will include (but not be limited too): ▪ Visual assessment and routine monitoring (at least fortnightly) of physio-chemical parameters and contaminants of concern at downstream sensitive receiving environments to ensure compliance with applicable default guideline values (ANZG, 2018) and HEPA (2020) guidelines during construction and decommissioning stages and until permanent drainage are demonstrated to be functioning and non-polluting. ▪ Visual assessment of surface water runoff structures at least once every week and also following any heavy rain during construction and decommissioning, until such time as permanent drainage is established and functioning to prevent sediment laden run-off, to ensure all water structures are operating effectively for their designed purpose, and to promptly address any deficiency in their operation. Should any deficiency in water structure operation or downstream water quality be identified, prompt remedial actions will be employed to address issues, including clearing sediment traps of sediment, storing and disposing of sediment (if required) in accordance with the *Managing Urban Stormwater: Soils & Construction (Landcom, 2004)*, and repairing any damaged structure immediately after the damage is identified.	Pre-construction, Construction, Operation
SW3	Site specific controls and procedures would be developed and implemented as part of the CSWMP to reduce the risk of litter and spills and leaks entering downstream waterways. The CSWMP would include (but not be limited to) the following measures: ▪ All fuels, chemicals and liquids would be stored on level ground away from waterways (including existing stormwater drainage systems) and would be stored in a sealed bunded area within the construction site; ▪ Refuelling and minor maintenance activities would be limited to designated areas with established spill capture and management controls; ▪ An emergency spill response procedure would be prepared as part of the CSWMP; ▪ Regular visual water quality checks (for hydrocarbon spills/slicks, turbid plumes and other water quality issues) will be carried out at waterways in proximity to works; and ▪ Installing and maintaining control measures such as silt fencing and gross pollutant traps, etc.	Pre-construction, Construction
SW4	To avoid ingress of concrete waste material into downstream waterways, the CEMP would outline procedures to capture, contain and appropriately dispose of any concrete waste from concrete works including designated lined, bunded and controlled concrete wash-out areas.	Pre-construction, Construction
SW5	Dewatering any construction sediment basins will be in accordance with the *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004), any EPL licence conditions which may be held for construction, and as per the EPBC Referral decision (August 2021) water quality runoff performance criteria outlined in Particular Manner 3. Dewatering procedures would be outlined in the Erosion and Sediment Control Plan and will include (but not be limited to):	Construction

Reference	Environmental Management Measure	Timing
	▪ Routine and pre-discharge sampling and analysis to confirm absence of contaminants exceeding applicable criteria; ▪ Pre-discharge confirmation of compliance with water quality performance criteria able to be analysed in real time; ▪ The methodology for dewatering including use of amphibian friendly flocculants and pH balancing agents; ▪ Supervision requirements; ▪ Staff responsibilities and training; and ▪ Approvals required before any dewatering activity commences.	
SW6	The design of permanent drainage and water management would demonstrate ability to meet Project performance outcomes of no pollution of waters. Any necessary maintenance or emergency isolation requirements would be documented in the Project operations manual. As a minimum, the operations manual would include: ▪ Details for bi-annual surveillance inspections of drainage and water management infrastructure and rectification requirements; ▪ Bi-annual discharge water sampling and analysis to confirm pollution of waters is not resulting from the operations of the Project; ▪ Operational procedures for emergency isolation in response to spills, leaks or fire events as necessary in response to recommendations of PHA; ▪ Stormwater / flooding detention facilities to mitigate against increases in peak runoff rates from the Project; and ▪ Monitoring of receiving drainage channels and waterways downstream of the discharge location(s) to identify any evidence of channel erosion and scour	Operation
SW7	▪ All equipment or storage containing dangerous goods or hazardous substances would be bunded or otherwise contained in accordance with AS 2067 and AS1940. ▪ A PHA for the Project would be progressed to a final hazard study as part of detailed design when specific technology is confirmed. The design of operational water management system would accommodate the emergency response philosophy for the selected technology and include emergency isolation and water management measures as warranted.	Operation
F1	▪ Provision of stormwater detention facilities to mitigate against increases in peak runoff rates from the Project with sizing to be confirmed during detailed design.	Operation
F2	▪ Permanent stormwater detention facilities should be installed prior to construction of hardstand/paved areas to mitigate against potential flood impacts during construction phase.	Construction
F3	▪ The BESS compound site should be filled to a minimum of the 1% AEP flood level + 0.5 m freeboard or the PMF level, whichever is higher. The recommended minimum finished level is 10.4 m AHD.	Construction, Operation

6.9 Hazards

This section provides an assessment of the potential hazard and safety impacts of the Project and measures to mitigate them. The potential hazards and risks have been informed by the *Eraring Battery Energy Storage System – Preliminary Hazard Analysis* (Jacobs, 2021d) (PHA) and *Eraring Battery Energy Storage System – Bushfire Assessment Report* (Jacobs, 2021e) (bushfire assessment). These are provided in **Appendix M** and **Appendix N** respectively.

The PHA and this section addresses the following SEARs:

Hazards – including:

- *an assessment of potential hazards and risks including but not limited to assessment of bushfire risk against the RFS Planning for Bushfire Protection 2019, electromagnetic fields or the proposed grid connection infrastructure against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields; and*
- *a Preliminary Hazard Analysis prepared in accordance with Hazardous Industry Planning Advisory Paper No. 6 – Guideline for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011);*

This hazards assessment does not take into account potential health and safety risks to on-site workers associated with normal construction operations, as these are regulated by workplace health and safety legislation (including the *Work Health and Safety Act 2011* (WHS Act)) and are not relevant to approval of the Project under Part 4, Division 4.7 of the EP&A Act.

The contamination and flood hazards and risk are discussed in **Section 6.7** and **Section 6.12** respectively. The remaining risks to public safety such as EMF and fire are discussed in this section.

6.9.1 Assessment methodology

6.9.1.1 PHA

The assessment of hazards and risks associated with the Project has involved review of information provided by Origin's battery technology providers and consideration of the Project area and surrounding land-uses. The purpose of the PHA was to identify and assessing hazards that have the potential to impact community safety and documenting the mitigation measures to be implemented to reduce the risk. The hazards and risks were considered throughout the full Project lifecycle (construction, operations and decommissioning).

The PHA was prepared in accordance with DPIE's *Hazardous Industry Planning Advisory Paper No. 6* (DPIE, 2011a) (HIPAP) and the *Multi-level Risk Assessment guideline* (DPIE, 2011b).

6.9.1.2 Bushfire

The bushfire assessment included:

- Identifying bushfire risk factors;
- Reviewing bushfire prone land maps;
- Identifying bushfire protection measures; and
- Outlining bushfire emergency management during construction.

6.9.1.3 EMF

The EMF assessment was limited to:

- High level consideration of potential EMF exposure risk to the public and occupational exposure (during inspection and maintenance) for the operation of the substation with consideration to its remote location, site security and restriction of public access.

- High level consideration of potential EMF risks to the public from the operation of the transmission lines with reference to typical EMF levels at ground level along standard transmission compared to the adopted health guideline reference levels for the public outlined in **Table 6-36**.

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is a Commonwealth Government body whose responsibilities include protecting the health and safety of people, and the environment from EMF. ARPANSA has adopted the *International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines for limiting exposure to time varying Electric and Magnetic Fields (1Hz – 100kHz)* (ICNIRP, 2010). The ICNIRP Guidelines express limits in terms of 'Reference Levels' and 'Basic Restrictions' under general public and occupational exposure conditions. The general public reference levels for EMF are listed in **Table 6-36**. These limits apply independent of duration of exposure.

Table 6-36: Health guideline reference levels for the public and occupational exposure (ICNIRP, 2010)

Parameter	ICNIRP 2010 Reference Levels
Electric fields – general public	5,000 volts per metre (V/m)
Magnetic fields – general public	2,000 milligauss (mG)
Electric fields – occupational	10,000 V/m
Magnetic fields – occupational	10,0000 (mG)

Consultation with stakeholders, including with DPIE's Hazard Branch, NSW Rural Fire Service (NSW RFS) and Fire Rescue NSW (FRNSW) would be conducted during detailed design.

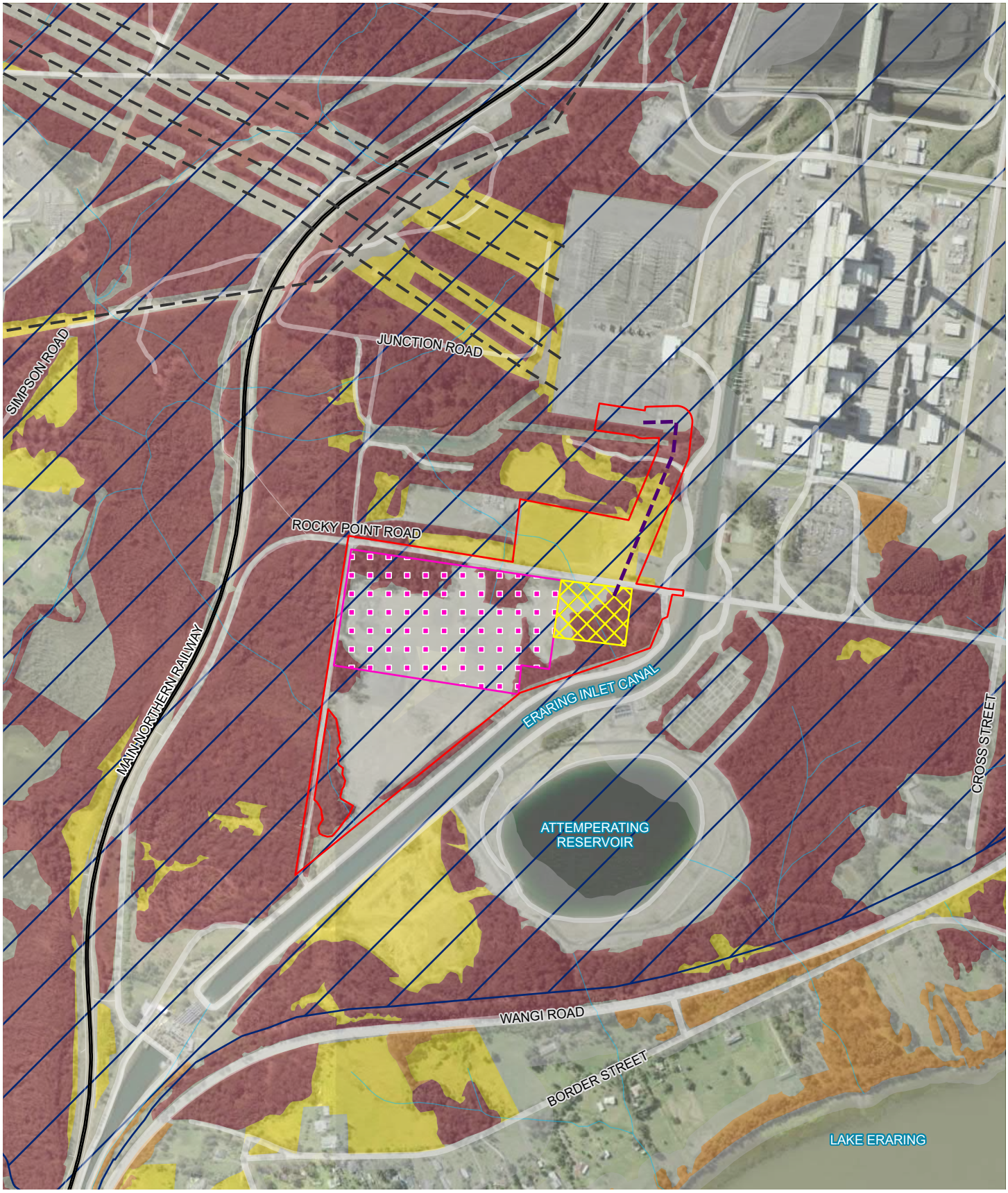
6.9.2 Existing environment

6.9.2.1 PHA

In relation to hazards and risks, the Project components would be located:

- Within areas mapped as bushfire prone land. The proximity of the Project area to nearby native vegetation (along west and northern perimeters) means that some sections of the Project area would be exposed to levels of radiant heat exceeding Bushfire Attack Level 19 (BAL19) or above in the event of a bushfire. The existing bushfire risks are discussed further in **Section 6.9.2.2** and shown on **Figure 6-10**;
- In close proximity to energy generation and distribution infrastructure associated with EPS and network connections to NSW which generate EMF. EMF is part of the natural environment and electric fields are present in the atmosphere and static magnetic fields are created by the earth's core. EMF is also produced wherever electricity or electrical equipment is in use. EMF are strongest closest to the wires and electrical equipment and their level reduces with distance. The higher the voltage, the stronger the field;
- About 600 m from the nearest sensitive receiver and about 1.2 km form the closest residential suburb;
- At an elevation above where flooding could impact the Project, refer to **Section 6.8.3.2**;
- Within areas that have the potential to be impacted from contamination from historic EPS operations, refer to **Section 6.4.3**. The contamination risk would be managed in accordance with the management measures provided in **Section 7.3**;
- Within land mapped as mine subsidence district (Westlake district), refer Figure 6-10 The works associated with the Project within the mine subsidence district are not above existing or currently proposed workings. As such the risk from mine subsidence are considered to be low and have not been considered any further; and
- There is a current mining lease under Project area which is not currently being mined; and
- The Project area is not located near any coastal hazards and there are no landslide or land movement risks.

The Project is in close proximity to existing EPS and operational areas and the PHA considers whether the new activities or components would alter the current level of hazards or risk.



Project area
Proposed 330kV transmission connection
Battery Energy Storage System
Substation

Mines subsidence district
Bushfire Prone Land
Category 0
Category 1
Category 2
Category 3

Railway
Electricity transmission line

0 300 m

1:10,000 at A4
GDA94 MGA56

Data sources

Origin 2021,
Aerometrex 2020,
© Department Finance, Services and Innovation Dec 2020
© Department of Customer Service 2020

Figure 6-11 Hazards

6.9.2.2 Bushfire

Bushfire management arrangements for the region in which the Project is located are described in the *Central Coast Bush Fire Risk Management Plan 2020-2025* (BFRMP) (Central Coast Bush Fire Management Committee, 2020)

The Central Coast BFRMP identified the EPS and associated infrastructure as a priority 2B (very high risk) area, and specified several risk mitigation strategies, including:

- Hazard reduction through fuel reduction burning within Land Management Zones (LMZ) and inspection and maintenance of Asset Protection Zones (APZ); and
- Building preparedness by inspecting and maintaining fire management trails.

The existing infrastructure at the EPS is set within an APZ and areas of bushfire prone native vegetation lie to the north and west of the Project area.

In the *EPS Bushfire management Plan* (AECOM, 2020) the vegetated areas surrounding the BESS compound are managed either as a Strategic Fire Advantage Zones (SFAZ) or APZ, which means there are specific fuel management measures in place to protect the new infrastructure from bushfire and increase the likelihood of successful containment in the forests surrounding the BESS.

The area is relatively well-served by fire response services. The nearest Fire and Rescue NSW station is located at 68 Newcastle St, Morisset, approximately 9 km to the south of the EPS. NSW RFS have a control centre at Lake Munmorah, approximately 25 km from the Project area.

The bushfire season in the Central Coast region generally runs from October to March, although commencement has been declared as early as August. Days of elevated fire danger are relatively infrequent, but mostly occur between December and March. Dry electrical storms and north-westerly winds are common during the fire season.

The Central Coast BFRMP reports that, on average, there are approximately 843 bush and grass fires per year. About six to eight of these develop into major fires each year, on average and the main ignition sources in the landscape surrounding the Project are:

- Illegal burning activities - ignitions are mainly concentrated in rural areas, with a greater proportion of the ignition points on large private landholdings that are adjacent to populated areas and are mainly from deliberate or negligent ignitions. This particular activity largely occurs from autumn to spring;
- Escapes from legal burning - mainly in rural areas, occurring in similar areas to illegal burning activity. This particular activity also occurs largely in mid to late spring;
- Arson and incendiarism - most common in the bushland reserve areas adjacent to townships, with increased incidence during school holidays
- Ignition of abandoned/stolen motor vehicles - this activity occurs throughout the year, and particularly during the summer months represents serious potential for major bushfires, primarily in State Forest and National Parks areas
- Lightning - mainly associated with late spring and summer thunderstorm activity, which is normally (but not always) accompanied by rainfall; and
- Arcing distribution power lines - which during high winds, particularly those on top and west of the escarpment, can result in the ignition of bushfires.

The bushfire history of the area surrounding the Project area show that large fires (up to several thousand ha in size) can occur in this region. Wildfire activities appear to be higher in the last two decades (2000s and 2010s) compared to previous ones.

6.9.2.3 EMF

EMF is part of the natural environment and electric fields are present in the atmosphere and static magnetic fields are created by the earth's core. EMF is also produced wherever electricity or electrical equipment is in use.

Electric fields are strongest closest to the wires and electrical equipment and their level reduces quickly with distance. The higher the voltage, the stronger the electric field. Most materials act as a shield or barrier to electric fields.

Magnetic fields are produced by the flow of an electric current through a wire. The higher the current, the greater the magnetic field. Like electric fields, magnetic fields are highest closest to the wire and their level reduces quickly with distance. Most materials would not act as a shield or barrier to magnetic fields.

The primary existing sources of EMF near the Project area includes existing TransGrid switchyard and 330 kV and 500 kV transmission network to the north and particular areas of the EPS.

6.9.3 Assessment of impacts

6.9.3.1 Preliminary hazard assessment

The PHA (refer to **Appendix M**) found that the highest identified Project risks relate to the consequences of a lithium-ion battery failure mode known as thermal runaway which can cause a single battery module fire that has the potential to initiate further thermal runaway in adjacent battery modules. The failure mode has previously been experienced by lithium-ion technology, occurs infrequently and is well understood by experienced battery manufacturers. Despite some thermal runaway events occurring globally since the early adoption of the technology, the industry's understanding of design controls has improved and it is evident that experienced battery manufacturers incorporate inherent design features and layers of protection into battery energy storage systems control this risk.

Origin is engaging with experienced technology suppliers, however there is insufficient evidence to demonstrate any fail-safe lithium-ion BESS technology that is proven not to be potentially susceptible to thermal runaway and therefore the PHA has conservatively considered a fire as a credible event for risk and hazard management purposes. Origins concept design and specifications for the Project along with the recommendations of the PHA adopt sensible and specific controls to mitigate the risk associated with such an event to as low as reasonably practical.

The following is a summary of the highest assessed risks and a summary of the key controls:

- A thermal runaway event in a single battery enclosure causing pollution is assessed as a credible hazard. In conventional designs there may be many layers of protection, that have not previously been available in battery designs, that would need to fail for an event to escalate. The PHA concludes that the risk can be reasonably mitigated through monitoring of early signs of the failure and design of direct and automatic control and shutdown action in the battery management system. Further, the adoption of a large number of smaller battery enclosures reduces the amount of pollution caused if an event escalates and is considered unlikely to cause any harmful concentrations if pollution in the form of smoke cross the Project area boundary. Manufacturers inherent design controls vary, and consideration of these would be undertaken during detailed safety in design processes during detailed design including fire risk assessment. Examples of known methods of additional control that are available in some technologies are individual enclosure fire suppression and fire-resistant layers within the enclosures to limit propagation. Cooling systems are also key to controlling the environment and dissipating heat.
- A thermal runaway event in one battery enclosure which triggers thermal runaway in adjacent battery enclosures whereby increasing the volume of pollution is assessed as a credible hazard. The risk is reasonably mitigated by the adoption of separation distances between battery enclosures included in Origin's concept requirements
- A thermal runaway event in an enclosure causing uncontrolled build-up of off-gas to explosive limits and igniting with deflagration / explosion of battery enclosure(s) is assessed as a credible hazard and can be

reasonably mitigated through design controls noted earlier to contain the propagation of thermal runaway and the design of deflagration and normal venting of enclosures to avoid build-up of gases above unsafe limits

- Escalation of thermal runaway event due to poor information or knowledge of appropriate methods of response is assessed as a credible risk and can be reasonably mitigated through robust communications and information transfer, training and education and involvement of operations staff and emergency response services to understand the technology and safely manage responses, and
- Surface water containing contaminants leaving the Project area and having a negative impact on biota in waterways downstream of the development is assessed as a credible hazard and the associated risk can be reasonably mitigated by standard industry design and controls of site drainage and containment.

The PHA concluded that at the current stage of development there are no unacceptably high Project development and operation related hazards that could result in significant off-site effects that are not manageable through application of inherent safety in design principles and the adoption of appropriate standards and quality systems.

Inherent design features built into supplier's battery units are a primary control for detecting and managing thermal runaway and confidence in these systems by suppliers is demonstrated by extended warranties that are available and placed on installations.

The adoption of design principles for containment within enclosures and maintaining separation distances of battery enclosures to prevent thermal runaway being triggered by an adjacent BESS fire and limiting the size and capacity of individual BESS enclosures significantly reduces the severity of a fire or deflagration incident. The low population density and reasonable separation from the closest sensitive receptor leads Jacobs to opine that our conclusion will unlikely change once more information comes to hand during the detailed design phase to quantify volumes of potentially hazardous by-products (e.g. smoke) and their effects.

Origin's screening level refinement of BESS concepts obtained through formal tendered market enquiries has not identified any material concerns with siting the battery enclosures in the Project area while retaining the expected buffer from asset protection zones and maintaining reasonable separation distances between enclosures to avoid the potential spread of a fire. Recommendations are made to ensure that this is confirmed during the detailed design.

6.9.3.2 Bushfire

Two main bushfire risk scenarios face the Project are:

- A fire igniting in the surrounding vegetation northwest of the Project area on a day of elevated fire danger burns under the influence of north-westerly winds towards/through the Project area. Embers and radiant heat are carried towards the site infrastructure. Three such bushfire incidents have occurred within the region around the Project in the last 20 years; and
- Electrical equipment failure, battery fire, or hot works cause ignition at the Project during construction or operation. Fire spreads from the Project area into surrounding vegetation to the north or west under the influence of moderate fire weather conditions with wind from the south or east.

Should native vegetation in the vicinity of the Project be ignited in a bushfire, it would potentially expose the BESS and associated infrastructure to radiant heat and embers. The level of exposure to bushfire attack (the BAL) is calculated using AS3959:2018 *Construction of building in bushfire prone* areas (Standards Australia, 2018). The BAL represent the potential radiant heat explore in units of kW/sqm. The interpretation of the BAL is described in **Table 6-37**.

Table 6-37: Interpretation of the bushfire attack level (BAL)

BAL	BAL description (AS3959-2018 Building standards)
Outside BAL12.5	There is insufficient risk to warrant any specific requirements but there is still some risk
BAL-12.5	There is a risk of ember attack - The construction elements are expected to be exposed to a heat flux not greater than 12.5 kW/sqm
BAL-19	There is a risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to radiant heat. The construction elements are expected to be exposed to a heat flux not greater than 19 kW/sqm.
BAL-29	There is an increased risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to a high level of radiant heat. The construction elements are expected to be exposed to a heat flux not greater than 29 kW/sqm.
BAL-40	There is a much increased risk of ember attack and burning debris ignited by windborne embers. A likelihood of exposure to a high level of radiant heat and some likelihood of direct exposure to flames from the fire front. The construction elements are expected to be exposed to a heat flux not greater than 40 kW/sqm.
BAL-FZ	The highest level of bushfire attack as a consequence of direct exposure to flames form the fire front in addition to heat flux and ember attack.

The BAL was calculated from vegetated areas located to the west and north of the BESS compound based on the following assumptions:

- As per AS3959 guidelines, the strip of vegetation along the northern boundary is excluded because the forest in this section is <20 m wide (measured on the ground and not over the canopy);
- The vegetation to the west is SFAZ (as per EPS BMP) and managed to fuel loads ~15t/ha using planned burning. This are of vegetation is classified as forest;
- The vegetation to the north is APZ (as per EPS BMP) and managed to fuel load of 8t/ha using planned burns and mechanical removal of understory vegetation. The low fuel load means this vegetation in this area is classified as woodland; and
- Slopes leading up the boundary of the BESS footprint are <5 degrees. This is the case when measuring slope from over lengths of 100-150 m.

The result for the analysis is depicted in **Figure 6-11**.

Radiant heat exposure (and ember attack) above BAL-19 is likely to threaten the integrity of conventional buildings (NSW RFS, 2019a). The northern and western boundaries of the BESS footprint are exposed to radiant heat at this level. Under the influence of north-westerly to westerly winds on a day with elevated fire weather conditions, much of the Project area could also be exposed to ember attack generated by fire in the nearby native vegetation.

The available land within the Project area is sufficiently large to enable redistribution of equipment within the Project area or shielding as part of the civil solution, and thereby provide sufficient separation between the Project components and radiant heat at the northern and western boundaries of the Project area. The details on internal separation requirements and need for active firefighting requirements at the BESS compound footprint would be determined in detailed design, in consultation with NSW RFS and DPIE. Detailed firefighting response and any need for fire water containment would be confirmed based on selection of technology provider post development approval, and provided for review by DPIE, Fire and Rescue NSW and the NSW RFS as part of management documentation.

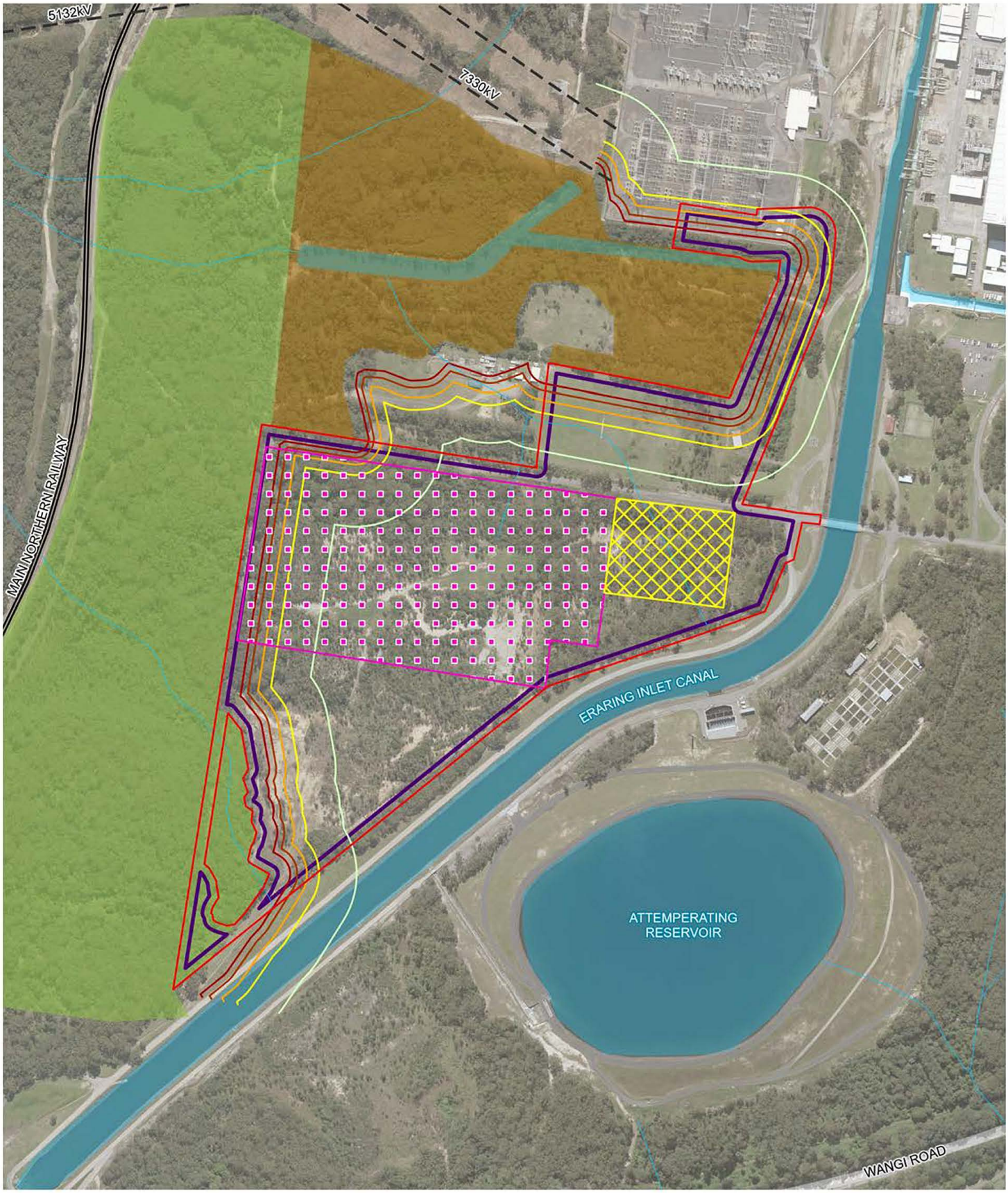


Figure 6-11 Bushfire Attack Level

6.9.3.3 Electromagnetic fields

The Project would introduce a new substation and new high voltage transmission lines into the Project area. Consequently, there would be additional localised increases to EMF. Operation of the Project is not expected to pose a risk to the public as the Project area is not publicly accessible and no residential dwellings are within a proximity that could be affected by EMF.

Given the nearest public receptor locations are in excess of 200 m from the Project area with no permanent nearby sensitive receivers the risk of chronic low level EMF exposure is considered negligible.

Substation

Potential EMF exposure risks to the public and workers from the operation of the BESS compound and substation are expected to be negligible due to:

- Electrical equipment being surrounded by a security fence to prevent unintentional access therefore restricting exposure to high voltage electrical equipment at close distances;
- Being located in an access-controlled area which:
  - Is only accessed periodically by the Origin inducted staff and contractors; and
  - The nearest residential properties are located approximately over 500 m away.

Further to the above and to manage EMF exposure risks to on-site workers carrying out routine inspection and maintenance, the BESS compound and substation would be designed to ensure predicted EMF exposure limits would be within the EMF reference levels outlined in **Section 6.9.1.3**.

Transmission lines

EMF exposure to the workers from operation of the Transmission line conductors would potentially occur beneath the transmission lines and within the easement. The predicted EMF levels based on typical 330 kV arrangements for the Project are as follows:

- The maximum magnetic field strength on the transmission corridor would be in the order of 10% of the general public reference level of 2000 mG and well below occupational reference levels;
- The maximum electric field strength on the transmission corridor in the order of 50% of the general public reference level of 5000 V/m well below occupational reference levels.

Given only occupational exposure is likely, EMF exposure risks to both public and on-site workers from the operation of the transmission connection is expected to be well below the ICNIRP and ARPANSA health reference levels.

6.9.4 Mitigation measures

Environmental management measures to manage hazards and risks are presented in **Table 6-38**.

Table 6-38: Environmental management measures for hazard and risks

Reference	Environmental management measures	Timing
H1	The PHA would be progressed to a final hazard study to further develop document and implement the recommendations of the PHA to: ▪ Specify requirements for suppliers and designers to demonstrate robust designs to prevent, monitor and (where unable to eliminate the possibility) control thermal runaway and undertake specialist safety in design assessments such as fire risk assessment to inform the design and selection of the battery; ▪ Implement a design principle that assumes a thermal runaway event within an enclosure will occur in the lifetime of the asset and	Detail design

Reference	Environmental management measures	Timing
	therefore limits deflagration energy release, and prevents the spread of fire to adjacent enclosure by adopting appropriate design controls such as suitably designed enclosures and separation distances; ▪ Undertake detailed HAZOP studies and design review of the selected designs with specific attention on the inherent design features that detect, control and prevent thermal runaway; ▪ Review findings from thermal runaway event incident investigations, to identify applicable lessons and improvements, and establish the Project design basis accordingly; ▪ Determine credible scenario's from a thermal runaway event once the technology and its size is determined to quantify the amount of potential hazardous by products that must be managed and establish the Project design basis accordingly (e.g. amount of combustion and pollution, fire water use for containment (if applicable), volumes of retention dams etc); ▪ Bushfire risk assessment is covered in detail other Chapters of the EIS, the PHA recommends that heat maps from the detailed bushfire study be used to inform the design and determine adequate asset protection zones required to prevent conditions that could trigger thermal runaway in the specific technology selected; ▪ Implement a robust quality plan and inspections throughout the supply chain and during construction focused on aspects that provide layers of protection to prevent battery modules being installed that have manufacturing defects or mechanical damage; ▪ Develop and implement suitable asset management plans to ensure proper maintenance of the facility in line with manufacturers recommendations and good industry practice throughout the operations phase; and ▪ Engage reputable and experienced design consultants knowledgeable in good industry standards to design the proposed grid connection infrastructure and undertake an EMF study and assessment to confirm that EMF levels beneath the proposed transmission line are within public exposure guidelines.	
H2	During detail design: ▪ An EMF study and assessment will be carried out to confirm that EMF levels beneath the proposed transmission line are within public exposure guidelines detailed in the *Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields (ICNIRP, 2020);* ▪ It will be confirmed that step and touch potential of infrastructure from induced voltages will be limited within appropriate standard thresholds as part of the design process; and ▪ EMF impacts to workers at the site will be considered and appropriate health and safety management practices will be implemented.	Detailed design
H3	Storage and management of dangerous goods and hazardous materials (if required) will occur in a safe, secure location consistent with the requirements of applicable Australian Standards.	Construction/ operation

Reference	Environmental management measures	Timing
H4	Refuelling will take place in a designated area within the works area, away from ignition sources and trees or vegetation and with appropriate controls to prevent any spills coming into contact with the ground.	Construction/ operation
H5	Appropriately stocked emergency spill kits will be available at all work areas at all times. All staff will be made aware of the location of the spill kit and trained in its use.	Construction/ operation
H6	Temporary construction compounds will be maintained in a tidy and orderly manner to minimise potential fuel loads in the event that any construction compounds are affected by fire.	Construction
H7	An emergency response plan for the BESS would be prepared for the Project and provided to the relevant stakeholders.	Construction/ operation
H8	The following bushfire risk mitigation measures would be applied during construction: ▪ *SFAZ and APZ:* management of bushfire fuel hazard in the surrounding landscape should continue in accordance with the EPS Bushfire Management Plan (AECOM, 2020; Figure 15); ▪ *Site clearance:* vegetation within the development footprint for each stage will be cleared as a first step in construction; ▪ *Access:* site access from Rocky Point Road would be maintained throughout construction. In the event of a fire, emergency services would access the site via Rocky Point Road and have access to construction access tracks and existing perimeter roads for firefighting purposes; ▪ *Fire water supply:* access to water for fire suppression and/or protection of structures or equipment located on-site will be provided so that water supply arrangements for firefighting meet the NSW RFS requirement (NSW RFS, 2019a). Fire water for firefighting proposes would be identified in the detailed design stage in consultation with NSW RFS and Fire and Rescue NSW. The intent is to provide adequate services of water for the protection of infrastructure during and after the passage of a bushfire; ▪ *Hazardous materials:* storage of diesel fuel and other potentially flammable materials on-site would follow environmental protection guidance and be located at parts of the site with low radiant heat exposure in the event of a bushfire (i.e. outside the BAL-12.5 zone). ▪ *Hot works controls:* works that have potential to generate sparks and ignite fires will be subject to the contractor's hot works safety management procedures. Hot works will not be undertaken on TOBAN days without a permit from the RFS; and ▪ *Emergency management:* on-site bushfire emergency management arrangements will be addressed through the construction contractor's site emergency management plan. Given the level of fire risk and proximity of the site to fire services, bushfire-specific fire-fighting equipment (e.g. 4WD with slip on tank and pump) will not be held on-site during construction. If a fire is ignited and cannot be safely contained using fire extinguishers or other materials at hand, construction crews will dial 000 and seek emergency service assistance.	Construction
H9	The following bushfire risk mitigation measures would be applied during operation:	Operation

Reference	Environmental management measures	Timing
	▪ The EPS bushfire Management Plan would continue to be implemented to maintain target fuel loads in land to the west and north of the BESS compound; ▪ A 10 m Project APZ would be established inside the Project area between bushfire prone land and the BESS compound and may be implemented on a staged basis with final details to be confirmed as part of detailed design; ▪ The Project APZ would be maintained clear of native vegetation; ▪ Where existing access tracks are not available, new access tracks would be constructed within part of the APZ to provide access for fire-fighting vehicles to bushfire-prone parts of the Project area. Measures would be in place to ensure fire response vehicles and personnel are separated from electrical infrastructure within the BESS footprint where necessary; ▪ The BESS compound and substation would be kept free of vegetation; ▪ Existing and new access tracks required for inspection and firefighting purposes would be available for emergency services and tracks would be a minimum of 4 m wide and have a minimum vertical clearance of 4 m; ▪ Where fire access tracks are to be constructed within the proposed APZ, these would be constructed to a standard that allows use by fire response vehicles (as specified in NSW RFS fire trail standards (NSW RFS, 2019b) for *Category 1 fire appliances*); and ▪ Fire water for bushfire responses would be identified in the detailed design stage in consultation with RFS and Fire and Rescue NSW. Suitable water supply arrangements shall be provided for firefighting that meet RFS requirements (NSW RFS, 2019a). Water would be available from the potable water system or other EPS water bodies as per the current EPS Bushfire Management Plan (AECOM, 2020). Where necessary, additional on-site water storage would be provided and equipped with standard fittings to enable use by RFS to refill fire response vehicles in the event of failure of the potable supply.	

6.10 Socio-economic impacts

This section provides an assessment of the potential social and economic (socio-economic) impacts of the Project and measures to mitigate them. The assessment addresses the following SEARs:

Socio-Economic – including *an assessment of the likely impacts on the local community, any demands on Council infrastructure and a consideration of the construction workforce accommodation;*

6.10.1 Assessment methodology

Socio-economic impact assessment involves identifying, assessing and evaluating changes to or impacts on, communities, business and industry that are likely to occur as a result of a proposed development, in order to mitigate or manage impacts and maximise benefits. Social impacts may be tangible or intangible, direct or indirect, and different people or groups may experience a social impact in different ways.

This assessment has been developed in accordance with the *Social Impact Assessment Guideline for State Significant Projects July 2021* (DPIE, 2021c) and to address the socio-economic, infrastructure and workforce matters outlined in the SEARs.

The methodology for assessing the potential social impacts of the Project involved:

- Scoping the likely range of potential social, land use and property issues relevant to the Project and identifying the communities likely to be affected by the Project's construction and operation. This was informed by the SEARs and the outcomes of consultation carried out for the Project;
- Identifying the study area;
- Reviewing background information relevant to the Project and describing the existing social environment of the study area;
- Preparing a social baseline describing existing social characteristics, values and conditions within the study area;
- Assessing the potential for positive and negative social impacts of the Project including consideration of potential impacts on local amenity, access and connectivity, social infrastructure, business and community values;
- Evaluation of social impacts; and
- Identifying measures to manage or mitigate potential impacts on the social environment and maximise potential benefits.

Previous and ongoing community and stakeholder engagement carried out by Origin has been detailed in **Chapter 5**, and the consultation has informed the Project planning and design process.

The key issues relevant to the socio-economic impact assessment expressed by community and stakeholders is the need for greater employment opportunities.

Evaluation of social impacts

An evaluation matrix was used to evaluate the likely significance of potential positive and negative social impacts associated with the construction and operation of the Project (refer to **Table 6-39**). The matrix refers to levels of likelihood and magnitude set out in **Table 6-40**.

Ratings of both likelihood and magnitude take into consideration both subjective and objective components, depending on people's individual experiences and/or perceptions as well as technical evaluations.

The magnitude of the Project refers to the scale, duration, intensity and scope of the Project, including how it would be constructed and operated. This can be influenced by such things as the geographical area affected, the type, frequency and duration of works, level of interest or concern from the community, and how adaptable or resilient the affected people would be when exposed to the changes brought on by the Project.

Table 6-39: Social impact significance matrix

		Magnitude level				
		1 Minimal	2 Minor	3 Moderate	4 Major	5 Transformational
Likelihood level	A Almost certain	Medium	Medium	High	Very High	Very High
	B Likely	Low	Medium	High	High	Very High
	C Possible	Low	Medium	Medium	High	High
	D Unlikely	Low	Low	Medium	Medium	High
	E Very unlikely	Low	Low	Low	Medium	Medium

Table 6-40: Likelihood and magnitude levels for determining social impact significance

Category		Description
Likelihood level		
A	Almost certain	Definite or almost definitely expected (e.g. has happened on similar projects)
B	Likely	High probability
C	Possible	Medium probability
D	Unlikely	Low probability
E	Very unlikely	Improbable or remote probability
Magnitude level		
1	Minimal	No noticeable change experienced by people in the locality
2	Minor	Mild deterioration/improvement, for a reasonably short time, for a small number of people who are generally adaptable and not vulnerable
3	Moderate	Noticeable deterioration/improvement to something that people value highly, either lasting for an extensive time, or affecting a group of people
4	Major	Substantial deterioration/improvement to something that people value highly, either lasting for an indefinite time, or affecting many people in a widespread area
5	Transformational	Substantial change experienced in community wellbeing, livelihood, amenity, infrastructure, services, health, and/or heritage values; permanent displacement or addition of at least 20% of a community

Study area

The Project is located within the City of Lake Macquarie, which forms the Lake Macquarie LGA in the Hunter region of NSW. The Lake Macquarie LGA makes up the study area for the social-economic impact assessment, as it forms administrative area for which Australian Bureau of Statistics (ABS) Census statistics are applied to inform the social baseline. It is also considered likely that potential impacts of the Project construction and operation phases would be experienced by communities predominantly in Lake Macquarie LGA and also within the wider region. As such, this assessment also considers potential positive and negative impacts for the broader communities in the Hunter region and across NSW, where relevant.

6.10.2 Existing environment

Regional context

The Hunter Region has traditionally been known for coal mining, viticulture and thoroughbred horse breeding, featuring costal and valley landscapes and extensive natural resources. The region is also becoming one of the most popular destinations for tourism and rural lifestyles (NSW Government, 2021b). Newcastle City, Lake Macquarie and Maitland are the major cities and population centres in the Hunter Region, and the regional centres include Cessnock, Muswellbrook and Singleton. These cities contribute significantly to the regional economy and is supported by a skilled workforce in research, health, tourism, manufacturing and resource sectors.

The Hunter-Central Coast region is also planned to establish a REZ which builds on the *NSW Transmission Infrastructure Strategy* (DPE, 2018b) and *Electricity infrastructure Roadmap* (DPIE, 2020a) to deliver renewable energy generation, storage and transmission systems to the surrounding homes and industries. The NSW Government is in the early stages of planning for REZs in the Hunter-Central Coast as set out under the *Electricity Infrastructure Investment Act 2020.*

Community profile

Key population and demographic characteristics of communities in the study area are shown in **Table 6-41**. Lake Macquarie LGA saw an increase from 195,263 to 207,775 persons (6.4%) in the ten years between 2010 and 2020. Over the same period NSW population increased by 14.3% to 8,167,532 persons in 2020. The population of Lake Macquarie LGA grew at an average annual rate of growth below the NSW average.

The population in Lake Macquarie LGA is projected to continue to grow by 10.8% to 232,689 people in the 20-year period from 2021 to 2041, and **Table 6-41** indicates the projected growth rate in Lake Macquarie LGA (10.80%) is slower than the projected growth rate in NSW (25.64%).

Given the population projections were conducted in 2019, the COVID-19 pandemic is expected to impact projections for the years after 2020. Most recently, the NSW population as at 30 September 2020 had a growth rate of 0.6% over the previous year, a reduced growth rate due to decreased net overseas and interstate migration (ABS, 2020b). As comparison in the year ending September 2019 NSW experienced a 1.3% increase in population (ABS, 2019). In this case, the population projections would be subject to further updates by the ABS and may not reflect accurate estimates for the years from 2021 onwards.

Compared to NSW, the Lake Macquarie LGA generally had:

- An older population with higher median age and larger proportion of people (20.6%) aged over 65 years;
- Higher proportion of Australian born persons (85.3%) and Aboriginal and/or Torres Strait Islander population (4.1%), but generally lower levels of cultural diversity with lower proportion of persons (6.5%) who speak a language other than English at home;
- Higher proportion of couple families with no children and marginally lower proportion of families with children (including single parent and couple parents); and

  Higher proportion of separated houses and significantly lower proportion of other types of dwellings such as townhouses or apartments.

Table 6-41: Population characteristics for Lake Macquarie LGA and NSW

Characteristics	Lake Macquarie LGA	NSW
Population and growth		
Total population as of 2016 Census	197,371	7,480,228
Estimated resident population (2020)	207,775	8,167,532
Population change (2010-2020)	+6.40%	+14.30%
Average annual change in ERP (2010-2020)	0.62%	1.35%
Projected population (2021)	210,005	8,414,978
Projected population (2031)	220,912	9,560,567
Projected population (2041)	232,689	10,572,696
Projected population change (2021-2041)	10.80%	25.64%
Age composition in 2016		
Median age (years)	42	38
0-14 years	18.2%	18.5%
15-64 years	61.2%	65.1%
65+ years	20.6%	16.2%
Cultural diversity (percentage of total population in 2016)		

Characteristics	Lake Macquarie LGA	NSW
Aboriginal and/or Torres Strait Islander	4.1%	2.9%
Australian born	85.3%	65.5%
English only spoken at home	91.3%	68.5%
Households where non-English language is spoken	6.5%	26.5%
Families and household composition in 2016		
Total families	55,032	1,940,226
Couple family with no children	39.5%	36.6%
Families with children (one parent and couple families)	59.4%	61.7%
Total dwellings	80,106	2,889,061
Dwelling occupancy rate	91.2%	90.1%
Unoccupied private dwellings	8.8%	9.9%
Separated houses	85.4%	66.4%
Semi-detached, row or terrace house, townhouse, flat or apartment	13.5%	32.1%

Source: ABS (2017a; 2017b)

Estimated population projection based on ABS ERP by LGA ASGS 2020 (ABS, 2020a)

Population projection based on NSW DPIE projections by LGA (ABS, 2019b)

Economic profile

Table 6-42 provides an overview of income and employment data for communities in the study area. The 2016 Census is the latest Census which provides detailed information on economic indicators for regions in the study area. At the 2016 Census, compared to NSW:

- Lake Macquarie LGA generally had lower weekly personal and household incomes, with a higher proportion of households having less than $650 of income per week;
- Lake Macquarie LGA had lower levels of full-time employment and similar proportion of unemployed persons to the NSW average. The workforce participation rate for Lake Macquarie LGA was also lower, with about 46.4% of population being in the labour force (persons aged 15 years or over, employed or looking for work), compared to 48.2% in NSW. In 2016, the 'not in labour force' cohort is the most common labour force status, with this group making up 31.4% of the Lake Macquarie LGA population; and
- Lake Macquarie LGA reported slightly lower median weekly rent than NSW and had a significant proportion of households where rent payments are less than 30% of household income, indicating Lake Macquarie LGA had lower levels of rental stress. Lake Macquarie LGA also had a lower proportion of rented private dwellings and a higher proportion of owned dwellings compared to the NSW average.

Table 6-42: Income and employment characteristics of Lake Macquarie LGA and NSW

Characteristic	Lake Macquarie LGA	NSW
Income and spending		
Median weekly personal income	$609	$664
Median weekly household income	$1,313	$1,486
Households with income <$650/ week	21.4%	19.7%
Households with income >$3,000/ week	13.1%	18.7%

Characteristic	Lake Macquarie LGA	NSW
Median weekly rent	$320	$380
Households where rent payments are less than 30% of household income	90.4%	87.1%
Dwellings rented	23.0%	31.8%
Dwellings owned outright or with a mortgage	73.5%	64.5%
Employment		
Total labour force	91,558	3,605,881
Employed full time	54.9% (of the total labour force)	59.2% (of the total labour force)
Unemployed	6.9% (of the total labour force)	6.3% (of the total labour force)
Not in the labour force	62,065	2,088,240

Source: ABS (2017a; 2017b)

The top sectors by output (gross revenue generated) for Lake Macquarie LGA in 2020-21 is construction ($3.54 billion), manufacturing ($2.93 billion), ownership of dwelling ($1.84 billion) and mining ($1.81 billion). With total economic output of around $21 billion in 2020-21, Lake Macquarie LGA represents 18.9% of the $111.5 billion output generated in the Hunter Region and 1.7% of the output in NSW (Remplan, 2020b).

The top industry sectors of employment for Lake Macquarie LGA and the comparative NSW data is shown in Figure 6-12. Within Lake Macquarie LGA, health care and social assistance is the largest industry of employment with around 18% of total workers, followed by retail trade and construction industries employing around 13% and 12% of total workers respectively. This indicates that Lake Macquarie LGA has a skilled workforce in health, social work or medical services, aged and childcare, however this industry is not a proactive economic driver as the retail and construction sectors contribute more to economic output (Dantia, 2020; LMCC, 2020b). The relatively large construction and manufacturing sectors in the study area could also provide a talent pool for the type of workers that may be needed for the Project.

Comparatively tourism, professional services and public administration industry sectors in Lake Macquarie LGA have lower employment compared to NSW indicating these jobs are concentrated outside the study area. Compared to Hunter Region and NSW, the tourism industry (not including accommodation and food services sector) in Lake Macquarie LGA is a relatively small sector of employment (around 5% of jobs) and economic output ($550 million), indicating visitors to the Hunter Region generally head to destinations outside the study area (Remplan, 2020b).

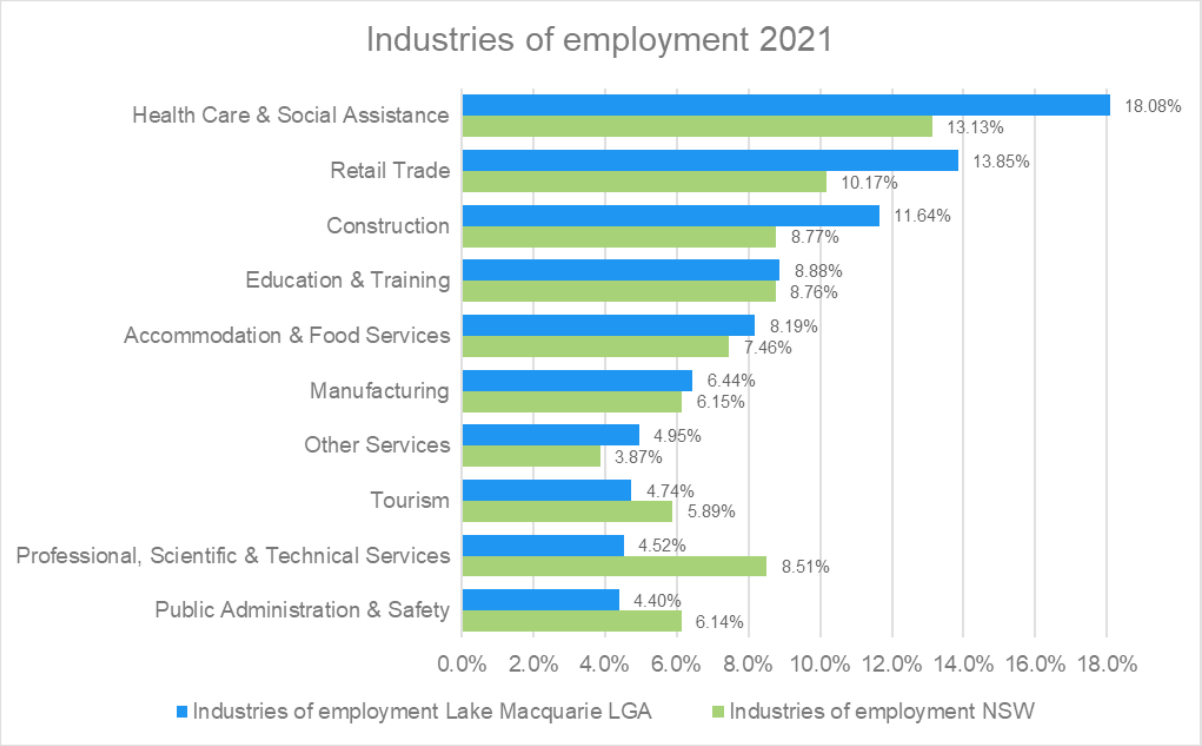


Figure 6-12: Industries of employment (Remplan, 2020a)

Using the Labour Market Information Portal Small Area Labour Markets estimates, the labour force and unemployment rate for Lake Macquarie LGA can be analysed between 2016 and 2020 (Labour Market Information Portal, 2021) and compared to the NSW unemployment rate (ABS, 2021). While the Lake Macquarie LGA data are smoothed statistics (four-quarter average) and thus not directly comparable to ABS Census data, they demonstrate the fluctuations in employment in more recent years. As shown in **Figure 6-13**, Lake Macquarie LGA and NSW both experienced a downward trend in unemployment between December 2016 and December 2019, with Lake Macquarie LGA having a larger decrease in unemployment than the NSW average over this period. However, unemployment rate increased from 4.3% to 7.5% in the year to December 2020 for Lake Macquarie LGA compared to an increase from 4.4% to 6.2% for NSW, and this sharper increase may indicate the study area is more vulnerable to economic slowdowns such as those caused by the COVID-19 pandemic. At the end of 2020, the unemployment rate in Lake Macquarie LGA was higher than the unemployment rate in NSW, suggesting the pandemic could have impacted various job sectors in the study area including retail trade, construction, education and training, and accommodation and food services. These industry sectors have a higher proportion of employment in the Lake Macquarie LGA than in NSW (see **Figure 6-12**).

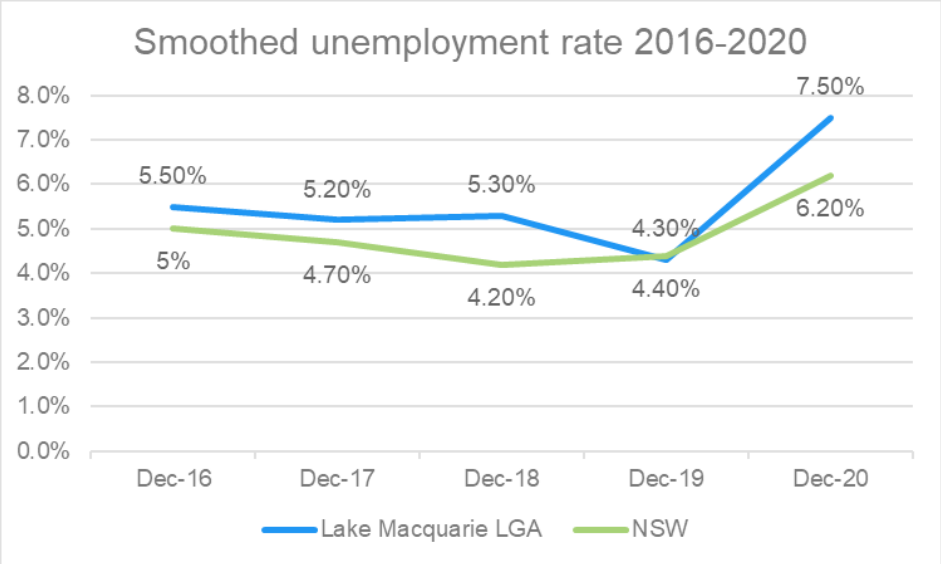


Figure 6-13: Unemployment rate 2016-2020 (ABS, 2021; Labour Market Information Portal, 2021)

Tourism

Based on a four-year average from 2016 to 2019, Lake Macquarie LGA received 11,000 international visitors and 1,354,000 domestic visitors. Of the domestic visitors a vast majority (943,000) took day trips only and spent an average of $88 per trip. Of the domestic visitors who stayed more than one night, a majority (376,000) came from within NSW and spent on average $187 per night on accommodation. However, out of the total 1,030,000 nights that domestic visitors stayed in Lake Macquarie LGA, around 55% stayed at the home of a friend or relative and only around 9% stayed at hotels, with the rest staying at caravan parks or other accommodation (Tourism Research Australia, 2019). The main reasons for visiting the study area included holidays and visiting friends and relatives, and domestic overnight visitors are predominantly either travelling alone (32%) or in a couple (33%) (Tourism Research Australia, 2019). This trend is similarly reflected in the broader Hunter Region where 29% of visitors were unaccompanied and 27% were adult couples in the year ending September 2020 (Tourism Research Australia, 2021). It was estimated that for international visitors, domestic day and overnight visitors the majority are in the 55 and above age group, accounting for around 40% of total visitors during the 2016-19 period and this age group mostly consists of domestic day trippers (TRA, 2019).

In January 2021, the Hunter Region recorded 264,000 visitors, a slight increase from the previous quarter in 2020 (Destination NSW, 2021). Recent data for visitors to the Hunter Region shows that the largest group of overnight visitors is in the 15-29 age range in the year ending September 2020, which may indicate that younger visitors tend to explore the Hunter Region outside Lake Macquarie LGA where Hunter Valley and other destinations may be more popular. However, the largest group of daytrip visitors to the Hunter Region is the 60-69 age range in the year ending September 2020 which corresponds with the data for Lake Macquarie LGA over the previous years. Compared to the previous year, visitor numbers have decreased about 28% for domestic and over 58% for international in 2020 due to ongoing travel restrictions from the COVID-19 pandemic (Tourism Research Australia, 2021).

Visitor accommodation

There are a range of short-term accommodation options in the study area and in the surrounding LGAs, including Central Coast LGA and Newcastle LGA which border the study are to the south and north respectively. As provided above, the majority of visitors to the Lake Macquarie LGA and the Hunter Region choose to stay with friends or relatives.

In 2018-19, there were 167 accommodation establishments with 10 rooms or more in The Hunter region, which offered a total of 7,063 rooms (Destination NSW, 2019). This increased to 169 establishments in the year ending June 2020, offering 7,010 rooms. Room occupancy in 2018-2019 was 67.2%, with this decreasing to 56.1% in

June 2020 (Destination NSW, 2020). The reduction in room occupancy also reflects changed travel behaviours during 2020 as a result of COVID-19 pandemic. Previous data on tourist accommodation in the Hunter region suggests that occupancy rates vary across the year, with high occupancy in December and March quarters, and lower occupancy levels in June and September quarters (Australian Bureau of Statistics, 2016). In addition to accommodation establishments with 10 or more rooms, there are a large number of self-contained apartments, holiday houses, bed and breakfast accommodation, and caravan, camping and holiday parks within the Hunter Region.

There are three accommodation providers located within a 10-minute drive from the Project area. Further from the Project in Lake Macquarie there are 117 accommodation properties based on a search on Booking.com in June 2021 indicating at least 33 facilities categorised as apartment, hotels or motels and all are generally within five to 35 km drive from the Project area.

Social infrastructure

Lake Macquarie LGA accommodates a range of social infrastructure and community facilities that cater for residents, workers and visitors of local and regional communities. These include education facilities, health, medical and emergency services, sport, recreation and leisure and cultural facilities. The majority of social infrastructure in close proximity to the Project area are located in the suburbs of Dora Creek and Morriset, between 2 to 5 km south of the Project area. Within 40 km of Eraring where the Project is located, the suburbs of Wangi Wangi, Morisset, Rathmines and Toronto are considered visitor destinations (Lake Macquarie Visitor Information Centre, 2021) and social infrastructure located in these areas as well as in proximity to the Project is provided in **Table 6-43**.

Table 6-43: List of social infrastructure located near the Project area

Social infrastructure type	Name	
Schools	▪ Dora Creek Public School ▪ Wangi Wangi Public School ▪ Avondale School ▪ Cooranbong Public School ▪ Heritage College Lake Macquarie ▪ Morisset Public School ▪ Morisset High School ▪ Bonnells Bay Public School	▪ St John Vianney Primary School ▪ Arcadia Vale Public School ▪ Rathmines Public School ▪ Coal Point Public School ▪ Toronto Adventist School ▪ Community Kids Morisset Early Education Centre ▪ Brightwaters Christian College
Parks	▪ Cooranbong Playground ▪ Bonnells Bay Park ▪ Shingle Splitter's Point ▪ Lions Park ▪ Brightwaters Park ▪ Lake Macquarie State Conservation Area	▪ Hall Reserve ▪ Sunshine Park ▪ Wangi Point Holiday Park ▪ Gurranba Reserve ▪ Edward Gain Park ▪ Watagans National Park
Recreation	▪ Lake Eraring ▪ Dora Creek Community Hall ▪ Myuna Bay Sport and Recreation Centre ▪ Lakeside Holiday Park ▪ Out and About Adventures	▪ Douglass Street Oval ▪ Dora Creek Squash Courts ▪ Southlakes Athletics Centre ▪ Auston Oval ▪ Toronto Swim Centre
Cultural or religious	▪ Sunnyside Historic Home and South Sea Island Museum	▪ Lakeside Seventh-day Adventist Church ▪ Southlakes Anglican Church Morisset

Social infrastructure type	Name	
	▪ Dora Creek Seventh-Day Adventist Church ▪ Wangi Wangi Uniting Church ▪ Saint Patrick and Brigid Cooranbong Church ▪ Morriset Baptist Church	▪ Grace Church Lake Macquarie ▪ Catholic Parish of St John Vianney Morisset NSW ▪ Morisset Uniting Church in Australia ▪ Hillview Seventh-day Adventist Church ▪ Salvation Army Church Bonnells Bay
Medical and emergency and care services	▪ Southlakes Medical Group ▪ Dora Creek Rural Fire Service ▪ Ochre Medical Centre Bonnells Bay ▪ Waratah Medical Services ▪ Lakeside Retirement Village	▪ Cooranbong Medical Complex ▪ Wangi Medical Centre ▪ Westlakes Medical Centre ▪ Bayside Aged Care ▪ Kindy Patch Bonnells Bay

Community values

The character and identity of the Lake Macquarie LGA is influenced by the area's strong construction and manufacturing industries and lakeside and seaside amenities, as well as outdoor exploration opportunities contributing to a relaxed and lively community. The Lake Macquarie City Vision and Community Values identified key values as lifestyle and wellbeing, mobility, connectedness and a diverse economy among others (LMCC, 2016).

The *Lake Macquarie City Community Strategic Plan 2017-2027* (LMCC, 2017) also identified community goals for the future to protect the natural environment, support a diverse economy, drive creative thinking and adapt to changing climate.

The *Imagine Lake Mac 2050 and beyond* (LMCC, 2019) outlines directions which build on the regional policy framework of the Hunter Regional Plan 2036 and the Greater Newcastle Metropolitan Plan. *Imagine Lake Mac 2050 and beyond* includes aims for Lake Macquarie region to increase local jobs and investment and maximise the potential of existing infrastructure to promote more diverse industries. *Imagine Lake Mac 2050 and beyond* also identifies the need to boost creativity and innovation as manufacturing and coal fired power generation sectors undergo technological transitions (LMCC, 2019). In particular, the shift towards renewable energy generation and sustainable technology industries would require flexibility and openness to help diversify the existing economy, and all the town centres in Lake Macquarie LGA have the potential to support more jobs.

LMCC has had successful implementation of greenhouse gas emissions reduction policies and uptake of renewable energy such as solar power for its residents and broader community, indicating a growing commitment towards environmental sustainability. A Community Battery Trial is being carried out in Lake Macquarie LGA in 2021 which would connect Ausgrid customers who have a solar panel system and who are connected to the same local grid, promoting solar uptake for the community (Ausgrid, 2020). The council's commitment to renewable energy is reflected its participation in the Cities Power Partnership, joining other councils across Australia in taking climate change action (Climate Council, 2020). These values are also acknowledged in the *Environmental Sustainability Strategy and Action Plan 2020-2027* (LMCC, 2020a) with strategic targets to maximise energy resilience and facilitate inclusion of emerging technology such as battery storage.

6.10.3 Assessment of impacts

6.10.3.1 Construction

During construction, potential socio-economic benefits and impacts of the Project would mainly be associated with direct and indirect employment opportunities, benefits for businesses that support construction activities,

increased construction traffic, demand for workforce accommodation, and potential impacts on community values.

Social infrastructure such as schools, recreational places, cultural or religious places listed in **Table 6-43** above are not located within two km of the Project and community activities are mostly based in the suburbs of Dora Creek, Myuna Bay and beyond instead of Eraring, where the Origin landholding is located. Access to social infrastructure would not be disrupted during the construction of the Project.

Due to the distance of the Project to sensitive social infrastructure, construction activities are not expected to result in construction noise or lighting impacts that would affect local communities. Amenity impacts to residential receivers are considered separately within the EIS.

Employment

The Project would impact positively on employment through the creation of direct employment opportunities for up to 128 people per day during the peak construction phase of each stage, including construction workers employed by the Project and specialty contractors. Additional indirect employment would also be sustained or increased particularly in relation to transport workers, consumable suppliers and hospitality workers. Where possible, the construction workforce would be sourced from within the study area and surrounding communities within the Hunter region, although specialised workers may also need to be sourced from elsewhere in NSW.

As indicated in **Section 6.10.2**, levels of unemployment in the Lake Macquarie LGA were above the NSW average at the 2016 Census and throughout 2020. The Project would generate local employment over a minimum three-year period over the stages of construction, helping to support reduced levels of unemployment in the study area and surrounding region. As Lake Macquarie LGA has higher unemployment rate than the NSW average, there is expected to be sufficient labour market capacity to supply the needs of the Project to source the construction workforce locally and regionally.

The Project is also likely to generate a number of indirect jobs in local, regional and national businesses and industries from increased economic activity and spending at businesses providing goods and services to support construction activities.

Local businesses

During construction, potential benefits for businesses would mainly be associated with provision of goods and services to support construction activities (e.g., equipment hire, specialty trades, fuel supplies, transportation, administrated services etc). Spending with local suppliers for construction related activities would help to support local business growth and development within the study area and surrounding region. Increased spending by workers on such things as accommodation, food and services is also likely to impact positively on businesses in the study area and wider Hunter Region.

The use of some short-term accommodation such as hotels, motels, self-contained apartments by the construction workforce is likely to have positive impacts on owners of these businesses, by providing a base load demand. This demand has potential to temporarily reduce the availability of some accommodation types in nearby towns for travellers and visitors during the construction period. However, given some of the construction workforce would also be sourced locally they may not require the use of tourism accommodation services. As such the impacts on accommodation demand is not expected to be significant as there are sufficient available rooms in the accommodation establishments and not all the construction workforce would require the use of visitor accommodation.

Cafes, restaurants and eateries are also likely to benefit from an influx of Project workers during the construction over the 12-18 months construction phase for each of the stages of construction. The positive impacts for accommodation industry in the region would also have flow on effects including an increase in demand for food services and retail trade from suppliers, contractors and employees of the Project.

For the rental, hiring and real estate services and whole sale trade industry sectors, the Project may benefit local businesses through rental or purchase of consumables, safety equipment, construction supplies, machinery and equipment and vehicle hiring during construction. The transport and logistics industry may also benefit from the need for delivery of parts during construction.

Transport and access

Construction of the Project would generate construction traffic associated with the haulage and delivery of construction materials and equipment, transport of construction workforce, and general site activities. These impacts are discussed in **Section 6.7**.

Housing and accommodation

During construction, the Project would generate direct employment for up to 128 people during the peak construction period, including construction workers employed by the Project and specialty contractors. Where possible, workers and contractors would include existing residents of communities in the study area and surrounding region (up to about one to 1.5 hours commuting distance). Maximising the use of local workers would help to reduce demand for temporary worker accommodation although, it is likely that short-term visitor accommodation or rental housing would be needed for construction workers from outside local and regional communities.

It is likely that temporary accommodation would be sourced from towns within commuting distance of the Project, for example Morisset and Toronto within a short drive from the Project area, or accommodation located north of Lake Macquarie and within Newcastle. It is expected that there is capacity within the existing accommodation establishments to respond to the needs of the Project, since a majority of visitors to the region do not stay in accommodation such as hotels and motels and the average length of stays are around three nights, meaning that competition with potential construction workforce requirements would not be significant during non-peak periods throughout the year (refer to **Section 6.10.2**).

Some construction workers may decide to rent within the study area for the duration of the works resulting in very slight increased demand for rental housing in towns near the Project. The duration of Project construction phases would be less than 12 months making this unlikely. Nevertheless, the potential exists that this may increase pressure on rental prices possibly impacting on access to affordable rental housing and rental affordability for some groups on low or fixed incomes (e.g. unemployed, elderly, students). As indicated in **Section 6.10.2**, households in the Lake Macquarie LGA have less rental housing stress compared to NSW. The increase in rental prices may increase the incidence of rental housing stress for some households but this is considered unlikely due to high proportion of home ownership in Lake Macquarie LGA and less rented housing compared to NSW.

Maximising the use of local workers who currently live within the study area and surrounding Hunter Region and maximising the use of short-term visitor accommodation for the non-local workforce would assist in managing potential impacts on rental housing.

Community values

While the Project area is located within the existing Origin landholding which includes buffers to housing and community and social infrastructure and is surrounded by bushland and vegetation screening, construction activities would result in amenity impacts on nearby communities limited to noise impacts as discussed in **Section 6.6**. Noise impacts during construction would be managed to the extent reasonable and feasible.

The Project would deliver direct and indirect employment during construction which would provide positive impacts to the local and regional economy. As the Project would seek to provide training and upskilling to the construction workforce in renewable energy and battery storage technologies the Project would support a diversifying economy in Lake Macquarie LGA and align with existing strategic policies including the *Community Strategic Plan 2017-2027* and the *Imagine Lake Mac 2050* strategy (LMCC, 2017; 2019).

The Project also aligns with the strategic directions set out in the *Environmental Sustainability Strategy and Action Plan 2020-2027* (LMCC, 2020) which focuses on achieving environmental sustainability through certain key themes such as energy resilience.

6.10.3.2 Operation

During operation the Project would deliver safe and reliable energy storage and facilitate potentially increased uptake of renewable energy in the NEM as well as across the region. The Project would support the continuation of electricity generation and existing land uses on the EPS land and benefit communities, businesses and industries by increasing the reliability of electricity. Energy storage technology is expected to result in an overall downward pressure on electricity prices, reduce energy costs for consumers over the medium to long term and reduction in average emissions intensity of the NEM. The Project would support and align with local, regional and national policies to transition towards low emission energy systems.

Amenity impacts are limited to operational noise as described in **Section 6.6** and would be managed in accordance with industry guidelines.

6.10.4 Evaluation of significance

Table 6-44 presents a summary of the social and economic impacts of the Project's construction and operation, along with the outcomes of the evaluation of significance. The rating of likelihood and magnitude are combined to determine overall significance of both positive and negative social impacts. The evaluation of magnitude of social impacts is based on the social risk matrix presented in **Table 6-44**.

Table 6-44: Summary of social and economic impacts and evaluation of significance

Impact	Phase	Likelihood	Magnitude	Significance
Negative social and economic impacts				
Potential impacts on local tourism businesses due to reduced availability of tourist accommodation	Construction	Unlikely	Minor	Low
Potential impact on rental prices due to increased demand for rental housing from construction workers	Construction	Unlikely	Minor	Low
Changes to perceptions of safety for some road users due to increased traffic, including heavy vehicles on local roads	Construction	Possible	Minimal	Low
Amenity impacts (particularly noise)	Construction and Operation.	Possible	Minor	Medium
Positive social and economic impacts				
Impact on community values relating to the environment	Construction	Possible	Minimal	Low
Creation of direct employment opportunities for local and regional communities	Construction	Likely	Moderate	High
Indirect benefits for employment due to increased demand for goods and services by construction workers and construction activities	Construction	Possible	Moderate	Medium
Benefits for businesses that support construction activities (e.g. accommodation, food and services, rental, transport etc.)	Construction	Possible	Moderate	Medium

Impact	Phase	Likelihood	Magnitude	Significance
Impact on community values relating to the environment and local jobs	Operation	Possible	Minor	Medium

6.10.5 Environmental management measures

Environmental management measures to manage social and economic impacts of the Project's construction and operation are summarised in **Table 6-45**. Management measures for noise, traffic, biodiversity, visual amenity are provided in **Section 6.6.6**, **Section 6.7.4**, **Section 6.1.5** and **Section 6.5.4** respectively.

Table 6-45: Environmental management measures for social and economic impacts

Reference	Environmental management measures	Timing
SE1	Origin will keep the community and stakeholders updated on the Project via notifications letters and posts on the Origin website.	Pre-construction
SE2	Identify opportunities to maximise the use of local suppliers, labour and businesses in the provision of goods and services for construction.	Construction

6.11 Waste

This section provides an assessment of the potential waste impacts of the Project and measures to mitigate them. The assessment addresses the following SEARs:

Waste *– 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.*

6.11.1 Legislative and policy context

6.11.2 Assessment methodology

The identification of likely waste streams has involved consultation with Project development team including the battery supplier to understand the construction methodology. Limited information is available regarding likely quantities, but no problematic waste streams or volumes are anticipated. Waste was then attributed to a likely classification based on the *EPA Waste Classification Guidelines* (NSW EPA, 2014) which separate waste into the following:

- Special waste;
- Liquid waste;
- Hazardous waste;
- Restricted solid waste;
- General solid waste (putrescible); and
- General solid waste (non-putrescible).

6.11.3 Existing waste generation and management

Waste management associated with the operation of EPS undertaken in accordance with Origins current waste management practices and regulated under EPL 1429. The Project area does not currently generate waste other than green waste associated with land management practices.

6.11.4 Assessment of impacts

6.11.4.1 Identification of new waste streams

Key additional waste generation activities from the Project are identified as follows:

- Management of battery components including enclosures, battery cores, inverters and transformers at end of life; and
- Standard construction waste.

These waste streams are described in more detail below in **Table 6-46** and **Table 6-47**.

Battery components

Battery technology is in its early stage of deployment and maturity and the rapid increase in deployment makes end of life planning for batteries an important consideration. At this stage, Origin have not appointed a technology supplier and therefore do not have an agreement that the batteries will be returned to the supplier at the end of their useful life.

The expected life span of a BESS plant is expected to be around 20 years, due to the significant dependence of battery aging on their usage profile. It is conventionally considered that a battery has reached its End of Life (EoL) when its energy content has reached 70% of that at Beginning of Life (i.e. year 0), though current technologies allow an extension of this value up to 60%, depending on the type of use. For this reason, the concept of second life of batteries is introduced. Batteries used in a system with specific performance requirements (such as the BESS) may, with aging, achieve performance that is no longer adequate for that system but suitable for other, less demanding uses. For this reason, these batteries are replaced with new modules, while they can be reused in another system for providing different services (second life).

It is noted the EoL of the batteries does not necessarily coincide with the EoL of the other components such as transformers and switchgear, which normally have a longer life expectancy than the batteries. Where possible, all components of the asset would be recycled or reused as to align with the preferences of the waste hierarchy. **Table 6-46** below describes the recycling opportunities and relevant schemes or legislation for major components of the BESS. The scrap metal market in Australia has been weakened by the COVID-19 pandemic but is projected to grow over the next five years, aligning with the projected growth of domestic and global construction activities.

Table 6-46: Recycling opportunities and relevant schemes for major asset components

BESS component	Recycling opportunity
Lithium-ion batteries	Federal Government listed batteries as a priority product, first appearing on the product priority list in 2014-15, moving to a top priority in the product priority list 2020-21. For this reason, the Battery Stewardship Council has progressed with the Battery Stewardship Scheme which was authorised in 2020 and will be launching in January 2022. The Australian Battery Recycling Initiative (ABRI) lists 19 battery recyclers servicing NSW. It is anticipated that with the expansion of both Electric Vehicles and Energy Storage Systems at both residential and utility scale, opportunities to recycle batteries will be available and viable at end of life. In Australia and globally, the recycling industry capable of handling lithium-ion modules is still in a start-up phase and currently ramping up to be able to handle larger quantities of battery modules with different chemistries. CSIRO has published a report into the Australian landscape for lithium-ion battery recycling and reuse in 2020 which identified that as large format batteries such as electric vehicle and utility scale battery storage reach end-of-life the profitability and sustainability of Australian

BESS component	Recycling opportunity
	lithium-ion recycling initiatives will increase and make waste stream flows viable into the long term (Zhao et al., 2021). Several specialty providers (Doosan, Duesenfield, BRUNP for example) have reported successful recycling of waste lithium-ion batteries with a high (approaching 100%) degree of recovery of composite metals. Full enclosures recycling has been estimated at approaching 70% of all constituent parts in recent unpublished trials.
Battery container	There are no explicit schemes/legislation on battery container recycling, however, industrial-scale battery containers can be treated as waste steel at their end-of-life phase. Storage/housing of industrial batteries is typically made from galvanised steel. Waste steel can be recycled at various industrial steel recyclers across Australia and the industry is well established.
Inverter container	Industrial-scale inverter containers are typically made from galvanised steel and are similar to industrial battery containers. Same recycling methods as industrial battery containers (see above). Federal Government listed inverters (domestic, commercial and industrial) with solar PV as a priority product on product priority list 2020-21 which promotes recycling pathways. This does not explicitly mention inverter containers but refers to inverters as a whole. Listed products are considered a high priority for consideration of possible product stewardship approaches.
Air conditioning units (HVAC)	Federal Government listed air conditioners fourth on product priority list 2014-15 where listed products are considered a high priority for consideration of possible product stewardship approaches. Federal Government comments on refrigeration and air-conditioning disposal due to the ozone depleting substances or synthetic greenhouse gases (SGGs) they contain. This requires a Refrigerant Trading Authorisation to be held by those wanting to dispose of these substances within air conditioners. It is noted that hazardous materials are not included in assets within this Project, however, HVAC systems typically contain refrigerants.
Step-up transformers	There are no explicit schemes/legislation on Step-up transformer. Metal components would be readily recyclable following decontamination. Federal government Product Stewardship for Oil Program (PSO) encourages increased collection and recycling of used oil in Australia by providing oil recyclers with product stewardship benefits. It is noted that PCBs are not included in new assets within this Project..
Switch room, prefabricated steel structure and pier footings	There are many components that make up prefabricated switch room. These components are likely to be separated for individual end-of-life management e.g. external steel sheeting steel, air conditioning system, alarm system, vinyl flooring, switchboards etc.

Standard construction wastes

Other standard construction wastes are expected to include:

- Spoil from cut and fill activities for the BESS compound and substation;
- Green waste from clearing activities;
- General construction waste; and
- Sewage.

Table 6-47 identifies likely waste streams, their classification and estimated quantity where possible and proposed management.

Table 6-47: Likely waste streams

Waste identification	Waste description	Likely Classification	Estimated quantity	Proposed management
Sewage	Portable ablutions facilities pump-out	Liquid	Up to 66,000 litres per week at peak construction (100 litres per person per day).	The works may require pump-out for off-site disposal and/ or disposal through existing EPS treatment systems.
Fuels, lubricants, and chemicals	Containers that previously contained Class 1, 3, 4, 5 or 8 substances used for construction plant. Used oil from construction plant.	Hazardous	Unknown volume, waste associated with minor maintenance of generators and earthmoving equipment.	Fuels and oils drained from plant for maintenance would be decanted for re-use. Where unsuitable they would be taken off-site for recycling.
Hydrocarbon contaminated soils	Spills from construction plant and refuelling	Hazardous	Minimal	Refuelling only in controlled areas. Spill clean-up material would be placed in dedicated covered skip bin for collection for off-site disposal.
Excavated natural materials	Earthworks spoil	General	Subject to detailed design but able to be balanced on site.	Maintaining soils on site. Any chance finds of unsuitable or contaminated material would be tested to confirm waste classification prior to off-site disposal at appropriately licensed facility.
Green waste	Clearing of vegetation	General	Subject to detailed design	Reuse in rehabilitation on site unless identified as weed infested in which case disposal at green waste facility.
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.	General	Unknown. Limited packaging waste is required as BESS components would be	Segregated for recycling to the extent practical in accordance with current site practices. Material unable to be recycled or reused on site would be classified for lawful disposal

Waste identification	Waste description	Likely Classification	Estimated quantity	Proposed management
			delivered pre-assembled.	
Grit, sediment in erosion controls	Collected in, and removed from, stormwater treatment devices and/or stormwater management systems.	General	As generated	Clean sediment would be incorporated into rehabilitation.
Site office waste	Paper/cardboard	General	As generated	Recycled as per existing site practices.
Food waste	Generated from worker's lunches.	Putrescible	Approximately 100 kg per day	Off-site disposal as per existing practices.

6.11.4.2 Operational waste

Over the life of the Project, various components of the BESS may require or benefit from upgrade or replacement. This would most likely involve the replacement of battery cores within the containers but may also involve the repair or replacement of other infrastructure. End of life or defective lithium-ion batteries are expected to be recycled with a preference for use of local recycling services if established orreturned to the supplier for re-purposing or appropriate disposal, while steel components would be recycled.

6.11.5 Environmental management measures

Environmental management measures for waste and resource use are presented in **Table 6-48**.

Table 6-48: Environmental management measures for waste impacts

Reference	Environmental management measures	Timing
WR1	A Waste Management Plan will be developed for the Project with the following criteria: ▪ A hierarchical waste management approach will be used, from the most preferable (reduce, reuse or recycle wastes) to the least preferable (disposal) to prioritise waste management strategies to avoid waste generation ▪ The plans will promote the use of materials with minimal packaging requirements, removal of packaging off-site by suppliers and fabrication of parts off-site ▪ Where waste cannot be avoided, waste materials will be segregated by type for collection and removal (for processing or disposal) by licensed contractors ▪ All waste types will be separated at source for recycling ▪ A licensed service provider will be appointed to collect waste during construction and operation ▪ Each waste type will be classified for transport to ensure correct handling ▪ Any waste that cannot be recovered or recycled will be disposed of to a suitably authorised or licensed treatment or disposal facility where it will be treated and disposed of according to its classification.	Detailed design
WR2	End of life batteries will be recycled to the extent reasonable and feasible either through return to suppler for repurposing or other mechanisms.	Operation and decommissioning
WR3	Cleared vegetation will be either mulched for on-site reuse or used to created habitat piles, noting that any weeds and pathogens will be managed according to requirements under the *NSW Biosecurity Act 2015.*	Construction

6.12 Air quality

This section provides an assessment of the potential air quality impacts of the Project and measures to mitigate them. It is noted that consideration of air quality was not included in the SEARs for the Project but was raised by the EPA in their submission. The EPA requested that the EIS identify pollutants of concern, estimate emissions and potential ground level concentrations, and describe mitigation measures.

It should be noted that under normal operation the Project would not emit discernible emissions of any pollutants and as such pollutants of concern are limited to construction dust emissions only. As identified in the PHA (refer to **Section 6.9** and **Appendix M**) and evident in recorded battery thermal runaway events, a facility fire has the potential to emit pollutants as is any electrical installation or other industry type. While identified as a credible risk, technology selection and detailed design will significantly influence the potential for, and scale of, a thermal runaway event and the quantity and type of pollutants is not able to be established to allow modelling or estimation of emissions or ground level concentrations.

6.12.1 Existing environment

The topography and surrounding land use as relevant to air quality impacts are described in **Section 2.3** and **Section 3.1**.

Air quality impacts from the Origin landholding are currently regulated under EPL 1429. Continuous ambient air quality monitoring is currently undertaken at two locations, including south of the Origin landholding at Dora Creek and east of the Origin landholding in Marks Point. Continuous monitoring is undertaken for sulfur dioxide (SO_2), nitrogen oxides (NO, NOx and NO_2) as well as various meteorological parameters. Depositional dust is also

monitored at four locations in the vicinity of EPS. Stack emission monitoring is conducted at discharge points on the four boiler units at EPS and on the Emergency Turbine Generator. The results of the air quality monitoring are reported to the EPA as part of the Annual Return submitted in accordance with the conditions of the EPL 1429.

The background air quality information in the vicinity of the Project is documented in the Northern Coal Logistics – modification 2 Air Quality Impact assessment (EMM 2020) as follows:

- 24-hour PM10 concentration – daily varying;
- Annual average PM10 concentration – 17.5 µg/m^3;
- 24-hour PM2.5 concentration – daily varying;
- Annual average PM2.5 concentration – 6.5 µg/m^3;
- Annual average TSP concentration – 43.7 µg/m^3; and
- Annual average dust deposition – 1.5 g/m^2/month.

EMM (2020) also documents prevailing wind as follows:

- The mean wind speed ranges from 1.3 m/s in winter to 1.7 m/s in spring and summer;
- The annual percentage of calm conditions ranged from 10.7% in summer and 17.5% in autumn;
- The wind patterns in spring and summer were very similar displaying dominant easterly winds;
- In autumn and winter the dominant winds were from the east;
- Variation in wind patterns was more pronounced on a diurnal basis with easterlies and westerlies prominent during daytime hours and westerlies and northeasterlies prominent during night-time hours;
- The average wind speed during the day was 1.9 m/s compared to 1.2 m/s at night-time; and
- The percentage of calms during the day was 7.4% compared to 21.7% at night.

6.12.2 Impact assessment

A detailed dust emissions inventory or model has not been generated for the Project.

During construction, the primary air quality risk would be dust generated from site clearing, cut and fill activities and from wind erosion of stored materials and exposed surfaces resulting in impacts at surrounding sensitive receivers. The intensity of dust-generating activities during construction is expected to be greatest during bulk earthworks until such time as the BESS compound hardstand is established. There would also be exhaust emissions from plant and equipment used during the construction and fugitive emissions from stored fuels and chemicals.

Dust emissions are expected to be typical of standard construction projects and readily managed with the standard mitigation measures proposed in a Project CEMP to avoid off-site impacts.

The levels of air borne dust would be expected to be low level and unlikely to cause concern to sensitive receivers provided the mitigation measures provided in **Section 7.3** are implemented.

The Project would not result in any change to the existing air emissions arising from the combustion of coal or handling of ash at EPS. Consideration of cumulative air quality impacts is provided in **Section 6.13.4.4**.

6.12.3 Environmental management measures

Environmental management measures for air quality are provided in **Table 6-49.**

Table 6-49: Environmental management measures for air quality

Reference	Environmental management measures	Timing
AQ1	The following will be undertaken to manage exhaust emissions from plant and equipment: ▪ Inspecting all plant and equipment before it is used on-site ▪ Ensuring that all vehicles, plant, and equipment are operated in a proper and efficient manner ▪ Switching off all vehicles, plant and equipment when not in use for extended periods ▪	Construction
AQ2	The following will be undertaken to manage wind erosion from stockpiles and exposed surfaces: ▪ Watering stockpiles and exposed surfaces until such time as ; and ▪ Progressive rehabilitation of exposed surfaces (as feasible) that are no longer required for construction; and ▪ Reviewing and where necessary modifying or suspending activities during dry and windy weather and elevated background air quality conditions.	Construction
AQ3	Potential for air quality impacts resulting from a thermal runaway event would be identified as part of a HAZOP / final hazard analysis and air quality risk and management response would be included in operational safety and environmental management procedures and the site pollution incident response management plan as required under EPL1429.	Operation

6.13 Cumulative impacts

This section provides an assessment of the potential cumulative impacts of the Project when considered with other projects in the locality to address the following SEARs:

- *an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including:*

  - *an assessment of the likely impacts of all stages of the development, (which is commensurate with the level of impact), including any cumulative impacts of the site and existing, approved or proposed developments in the region and impacts on the site and any road upgrades, taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice;*

6.13.1 Overview

Cumulative impacts are compounding environmental and community impacts caused by past, present or reasonably foreseeable future activities. Cumulative impacts may arise from the interaction of construction and operation activities of the Project and other approved or proposed projects in the area. When considered in isolation, specific Project impacts may be considered minor. However, these minor impacts may be more substantial when the impact of multiple projects on the same receivers is considered.

6.13.2 Assessment methodology

The assessment of cumulative impacts focused on the Project's interaction with other projects in area where construction and/or operational timeframes are likely to be concurrent and impacts could reasonably expectto accumulate.

Other projects in the locality were identified based on a search of the following data sources in June 2021:

- DPIE's online major projects database;
- Local council websites/ DA tracking databases;
- Proponent websites; and
- Discussion with Origin.

Nearby projects identified were screened in relation to their potential for cumulative impacts with the Project, based on their nature, size, and proximity to the Project area and identified timeframes for development.

The assessment of cumulative impacts has been limited to desktop review of the predicted impacts of external projects and consideration of where these impacts would overlap with the Project. These potential cumulative impacts have been described in general terms to identify the implications over and above those that would result if the Project were to be constructed in isolation. The assessment draws on the findings of **Section 6.1** to **Section 6.12** and environmental impact assessments of other projects.

6.13.3 Other projects in the locality

The projects in the locality that were considered to have the potential for cumulative impacts with the Project are listed in **Table 6-50**.

It is also noted that during maintenance outages at EPS, an additional 280 personnel would travel to and from EPS using personal light vehicles, generating approximately 280 two-way light vehicle movements per day (i.e. 280 additional inbound movements and 280 outbound movements per day). These additional vehicles were considered in the cumulative traffic section.

Table 6-50: Existing and proposed projects

Project	Proponent	Description	Type	Status	Location in relation to the Project	Construction timing
Eraring Power Station – Ash Dam Expansion – Modification 2 Ash Recycling Facilities	Origin Energy	Expansion of the ash dam and changes to the ash disposal method and ancillary infrastructure.	Energy	Response to Submissions	Within the EPS	N/A
Northern Coal Logistics – Modification 2 (Reported to have been withdrawn)	Centennial Northern Coal Services Pty Limited	Modification to SSD-5145 to allow coal to be transferred between Myuna Colliery's pit top and the Cooranbong Entry Site (CES), blending of this coal at CES, and associated activities. Coal would be transported between Myuna's pit top and CES by truck. Approval of the modification would result in the transportation of coal by truck between Myuna's pit top and CES. The proposed transportation route includes the section of Wangi Road between Wangi Point Road and Wilton Road, located approximately four km to the north of the Wangi Road and Rocky Point Road grade-separated interchange. There would be a maximum of 10 loaded trucks (20 truck movements) per hour travelling between CES and Myuna via Wangi Road.	Coal mining	Response to Submissions (Reported to have been withdrawn)	EPS is approximately 1.4 km east of CES.	No construction activities are required to facilitate the Project.
Mandalong Mine Extension – Modification 9 and Modification 10	Centennial Mandalong Pty Limited	Modification 9, which sought approval to reorient longwall mining panels to account for recently discovered poor geological conditions, was approved in April 2021. Modification 10, which is for the addition of Longwall 34 and updates to Appendix 8 of SSD05144, is currently being prepared.	Coal mining	Approved and scoping	Adjacent to the EPS	No construction activities are required to facilitate the Project. Operation of the mine is

Project	Proponent	Description	Type	Status	Location in relation to the Project	Construction timing
						approved to 31 December 2040
Chain Valley Colliery – Modification 4	Great Southern Energy Pty Ltd (trading as Delta Coal)	Modification 4 seeks to extend the Chain Valley Colliery (CVC) consent boundary to incorporate the Northern Mining Area and permit the transfer of coal mined from the Northern Mining Area to the surface via CVC's operations. The proposed modification also seeks to increase the number of employees reporting to the CVC pit top by 128 full time equivalent employees.	Coal mining	Report under assessment	EPS is approximately 5.5 km north-west of the CVC	No additional surface infrastructure would be required to facilitate the Modification.

6.13.4 Cumulative impacts with other projects

Construction specific cumulative effects would most likely occur where construction works overlap in terms of timing and / or location with other local projects. Cumulative effects from construction activities usually relate to biodiversity, water, amenity (visual, air quality, noise and vibration), traffic and access. The scale of the impacts largely depends on the type of work, its duration, and the sensitivity of surrounding land uses.

The majority of the proposed and existing projects listed in **Table 6-50** would not interact with the Project in a manner likely to lead to any cumulative impacts due to the distance away from the Project. However, the most immediate accumulation of impacts would be from the impacts of the Project and the impacts EPS outages and EPS – Ash Dam Expansion as there is an overlap of project access arrangements and possible overlapping of project construction periods.

There are several industrial developments in the locality that are currently in operation or proposing to expand operation during the construction or operation of the Project. The cumulative impacts that may occur off-site are discussed below.

6.13.4.1 Noise

Cumulative operational noise is predicted to remain below recommended amenity levels for all NCAs under standard meteorological conditions at all times. Under rare noise enhancing weather conditions, cumulative impacts remain at or below the recommended amenity level for all NCAs with the exception of MCA1 where recommended amenity levels are already exceeded. Further details of cumulative impacts are described as follows:

Myuna Bay Colliery -The *Myuna Colliery Modification report for modification to project approval MP 10_0080* (EMM, 2020) details the predicted noise impacts associated with regular operation of the facility along with the proposed modifications on site activities (additional truck movements, and coal mixing activities). The assessment predicted noise levels of 35 dB(A) at Eucalypt Close, west of the facility. Noting that Eucalypt Close is approximately 2km northeast of NCA 4, the nearest NCA to the facility, it has been deemed unlikely for cumulative noise impacts between the Myuna Bay Colliery and the Project.

Mandalong Mine Cooranbong Site Entrance - A Cooranbong Site Entrance noise levels of 36 dB(A) under standard meteorological conditions and 46 dB(A) under noise enhancing meteorological conditions has been adopted at each receiver in NCA 1 when determining the cumulative noise impact based on Appendix 5 of the *Centennial Mandalong 2020 Annual Review* (Centennial Mandalong, 2021) and the *Northern Coal Logistics Project: Modification report for modification to development consent SSD-5145* (EMM, 2020). This indicates that the residencies in NCA 1 are already experiencing noise impacts from a nearby industrial operation under adverse meteorological conditions. No exceedance of the recommended amenity noise levels is predicted to result from the cumulative operations under standard meteorological conditions. Under noise enhancing meteorological conditions, the cumulative impacts of Project operating concurrently with Cooranbong Site Entrance is predicted to result in a 1 dB increase to impact at most and a 2dB exceedance of recommended amenity levels. Under noise enhancing conditions, cumulative noise levels would be dominated by the noise of the Cooranbong Site Entrance, and under these circumstances the Project would not be the most audible noise source in NCA 1. Due to the measured noise levels, it has been deemed unlikely that noise from the site entrance could pose a cumulative risk outside of NCA 1.

Eraring Power Station - During discussion with Origin Energy, it was confirmed that both the EPS and EPS inlet canal pumps were at full operation for the duration of background noise monitoring. Following the performance of monitoring, noise generated from the entire EPS operation was isolated from the background noise. This isolated noise has been detailed in the NCA and adopted as the EPS noise contribution when considering cumulative noise impacts with the Project. Cumulative noise levels may be up to 3 dB(A) greater than those of the Project alone. The cumulative noise level under noise enhancing conditions would remain at or below the recommended amenity level for all NCAs. The EPS has been scheduled to cease operation in 2032, and hence would no longer pose a cumulative noise risk after that time.

6.13.4.2 Traffic and transport

Cumulative traffic impacts are expected due to additional traffic volumes that would be generated by the other projects in the locality and during maintenance outages at EPS, which share the external road network, in particular the Wangi Road and Rocky Point Road.

The traffic assessment (refer to **Appendix K**) considered the cumulative impact of EPS outages, Eraring Power Station – Ash Dam Expansion – Modification 2 and the Northern Coal Logistics Project(NCL). These projects are expected to generate an additional 410 vehicles on Rocky Point Road during the morning and evening peak hour. It is noted that the cumulative peak hour traffic volumes are conservative as they assume that the Project and nearby developments would all occur concurrently.

The construction phase of the ash recycling expansion project at EPS is anticipated to generate the greatest cumulative impacts with the Project in comparison to the operational phase of the ash recycling expansion project.

Intersection performance results under the ''With Project' (with vehicles associated with construction of the Project and nearby concurrent projects) scenarios was presented in **Section 6.7.3.1**. As shown in **Table 6-31** all intersections in the study area are expected to continue perform at a LoS A. As such, the cumulative impact of the Project and nearby developments is not expected to have a large impact the operation of the interchange.

No impacts to management and emergency vehicle access are expected, as roads would remain open for these vehicles.

No cumulative transport operation impacts are expected.

6.13.4.3 Socio-economic impacts

Potential cumulative socio-economic impacts include:

- Increased demand for local workers, directly on projects and in businesses that provide goods and services to various projects, increasing competition for local workers and potentially impacting the availability of local workers to support other industries such as tourism and mining; and
- Increased demand for accommodation by construction workers, resulting in potential shortage of rental accommodation, tourist accommodation for tourists and visitors.

Given the population Newcastle and the Central Coast from which a competent construction labour force can be drawn it is considered unlikely that the cumulative impacts of up to 128 additional workers would be negligible.

No cumulative operation socio-economic impacts are expected as a result of the Project.

6.13.4.4 Air quality

Potential cumulative air quality impacts associated with construction dust could result from the overlap with the NCL Project and Modification 2 - EPS Ash Dam Expansion Project as summarised in **Table 6-51**.

Table 6-51: cumulative dust impact potential

Project	Assessment finding
EPS ash dam expansion – and Modification 1 and 2.	A Dust Emission Dispersion Study (AECOM, 2016) was undertaken to better understand the distribution and potential impact of dust emissions from the Eraring Ash Dam. The dispersion study involved detailed sampling of the Ash Dam, determination of the airborne emission rates and detailed meteorological and air dispersion modelling. Based on the quantified findings of the study, potential management and mitigation measures were provided. In general, dust production was found to be a transient occurrence with a few hours of each day resulting in steady dust production. Many of the extreme dust production episodes occur during the early morning hours during winter whilst during summer dust generation events tend to occur during the day. The peak dispersion impacts were predicted to the east of the Origin landholding over the suburbs of Rathmines, Balmoral, Buttaba, Arcadia Vale and Wangi Wangi. However, the potential influence of the Ash Dam emissions dispersion on local receptors was well below the EPA criteria. No exceedances were found to occur at any of the residential areas as a result of the Ash Dam emissions, with a maximum criterion contribution of 27% (24 hour PM10 concentration of 13.6 µg/m3 compared to the EPA PM10 24 hour criterion of 50 µg/m3). A screening analysis for heavy metal impacts using ash composition and total suspended particulates (TSP) dispersion modelling predicted all heavy metals met relevant EPA assessment criteria by a large margin. Potential impacts to air quality during construction of the ash dam expansion were found to primarily relate to the generation of dust associated with vegetation clearing, earthworks for construction of the southwest perimeter wall and stormwater diversions and stockpiling of construction and waste materials. Emissions may also be generated as a result of diesel-powered plant and equipment and the transport of construction/waste materials to and from the Project area. The potential emissions from construction works were identified as minor and temporary and would be managed in accordance with standard construction management measures. Air quality impacts to residential receivers were not expected to be significant given the distance from the Project area to the closest residential receiver (approximately 1 km) and the screening provided by the dense vegetation of the buffer lands. The operation of the augmented ash dam and proposed expanded ash recycling facilities are expected to generate a significant increase in air emissions compared to the existing operations given the sealed nature of the fly ash recycling handling and storage system.
NCL Modification 2	Cumulative impacts were assessed by combining modelled impacts with recorded ambient background levels. The cumulative results showed that compliance with applicable NSW EPA impact assessment criteria is predicted at all assessment locations for all pollutants and averaging periods. The results of the modelling showed that the predicted concentrations and deposition rates for incremental particulate matter (TSP, PM10, PM2.5 and dust deposition) would be below the applicable impact assessment criteria at all assessment locations for both the existing and proposed scenarios.

On the basis that a range of standard construction dust management measures would be deployed to control dust during construction and that post construction landforms would include rehabilitation and treatments to prevent ongoing dust emissions, cumulative dust impacts are considered able to be avoided.

6.13.4.5 Other

Other environmental aspects with limited potential for cumulative impacts are summarised as follows:

- Biodiversity - Site selection had deliberately targeted areas of prior disturbance and the implementation of the BAM including avoidance and offsetting requirements is aimed at achieving a maintained or improved outcome for biodiversity;
- Aboriginal heritage - Prior impact to large areas of land in the immediate surrounding region, have increased the rarity of surviving Aboriginal sites in the region. Site selection had deliberately targeted areas of prior disturbance and as no Aboriginal sites or PADs have been identified in the Project area the cumulative impact of the Project is assessed as being low.

6.13.5 Environmental management measures

Environmental management measures for potential cumulative impacts are provided in **Table 6-52**. Other management measures that would address cumulative impacts are presented in **Section 6.1** to **Section 6.13**.

Table 6-52: Environmental management measures for air quality

Reference	Environmental management measures	Timing
CL1	The CEMP will include a process to review and update management measures if any other development with potential to contribute to cumulative impacts commence in proximity to the Project.	Ongoing

7. Management and monitoring measures

This chapter provides a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS, and how these measures would be integrated with the existing environmental management, monitoring and reporting regime for the EPS.

7.1 Existing arrangements

EPS operates under an Environmental Management System (EMS), which includes a series of management plans and procedures to assess and mitigate environmental risks. Other important documents include the Pollution Incident Response Management Plan (PIRMP) required under the EPL, the Emergency Management Plan and Emergency Response Plan. As a minimum, existing EPS management plans would be updated to recognise the Project where relevant or controls overlap.

7.2 Project environmental commitments

7.2.1 Ongoing design strategy

Detailed design for the Project is yet to be completed. The EIS is based on a current design status for each Project component which may be amended through the detailed design process. Construction methods may also vary subject to design refinements and the selection of the construction contractor.

The assessment of the Project within the EIS is based on consideration of reasonable worse case environmental impacts to allow flexibility in design and construction methodology. The ongoing design of Project components would deliver the identified performance outcomes for the Project as identified in the EIS.

Following the engagement of a contractor for each Project component, a risk assessment would be completed on the actual methods to be implemented and an environmental management plan prepared that incorporates the Project commitments and conditions of approval. Further consultation with relevant agencies would be undertaken and necessary approvals of final designs and methods sought. Origin would comply with any pre-construction compliance obligations prior to the commencement of all Project components. The risk assessments, final design plans and management plans would be used to confirm that no greater impact than that assessed in this EIS would occur.

7.2.2 Construction environmental management strategy

Individual construction packages for each stage of the BESS compound and the transmission connection could be tendered and delivered by separate contractors, each implementing construction works in accordance with their own management systems and processes. In the event of multiple contractors, Origin proposes to develop an overarching Construction Environmental Management Strategy (CEMS) for the Project that would be adopted and implemented through the development of contractor's CEMPs. The CEMS would document the required environmental performance outcomes, management commitments and conditions of approval for the Project and each CEMP would document reasonable and feasible measures for the Project component to implement and document compliance these requirements.

7.2.3 Operational environmental management plan

An Operational Environmental Management Plan (OEMP) would be prepared for the Project and would document the required environmental performance outcomes, management commitments and conditions of approval for the operation of the Project and how compliance would be monitored, document and reported. The OEMP would be supported by an Emergency Response Plan (ERP)as recommended by the PHA.

7.3 Consolidated summary of environmental management measures

A summary of environmental management measures for the Project are shown in **Table 7-1**. Given the design status of the Project, mitigation measures are largely management based or prescriptive.

Table 7-1: Summary of environmental management measures

Reference	Environmental management measures	Timing
Biodiversity		
B01	Pre-clearance surveys will be undertaken prior to tree felling works by suitably qualified and experienced persons/personnel and will include: ▪ The demarcation of areas approved for clearing to reduce risk of accidental clearing; ▪ Habitat resources and habitat trees will be identified and marked. (Note: habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows, and boulder piles); ▪ The potential presence of threatened flora and fauna species, endangered populations and TECs will be identified; ▪ The identification of threatened species or habitat features that are suitable for translocation or salvage; and Disturbance activities will be targeted to specific times of the year to minimise impacts to threatened species' usage of habitat features for breeding and roosting, where practicable.	Prior to clearance and during clearance activities
B02	Tree felling will be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built). Tree felling supervision will be undertaken by an appropriately qualified and experienced person after pre-clearance surveys have identified potential habitat features.	Prior to clearance and during clearance activities
B03	Surface water design commitments will include: ▪ Design erosion and sediment controls as per sensitive environments (Managing Urban Stormwater – Soils and Construction (Landcom, 2004)); and Detailed design of drainage will balance clean water discharges to maintain minimum flows (as estimated based on current topography and hydrology) to identified green and golden bell frog habitats.	Prior to clearance and during clearance activities
B04	Surface water construction commitments will include: ▪ Hygiene protocol will be implemented in accordance with the NSW Threatened Species Management Information Circular No.6 (April 2008)); ▪ Flocculants or other chemicals proposed to be used on site will be known and verified as being sage in sensitive environments, particularly in relation to amphibians; and Appropriate hygiene controls will be implemented in accordance with Saving Our Species Guidelines for threatened frog species	Prior to clearance and during clearance activities
B05	Erosion and sediment controls will be designed, installed and managed as follows:	Construction and operation

Reference	Environmental management measures	Timing
	▪ Progressive ESCPs will be developed by the Contractor and implemented prior to the commencement of topsoil stripping and earthworks; ▪ Erosion and sediment control structures will be regularly inspected and maintained, particularly in advance of and following significant rainfall events; ▪ Any water discharges are required to be managed to avoid pollution of waters having regard to the sensitivity of the receiving environment. In particular, any flocculants are to be demonstrated as being both effective and safe for amphibians prior to use; and All disturbed surfaces will be revegetated as soon as possible.	
B06	The following surface water construction monitoring will be implemented: ▪ Pre-discharge physical water quality condition (temperature; dissolved oxygen; pH; electrical conductivity) and chemical water quality condition in sediment dams will be monitored; ▪ Water quality leaving the Project area will meet the specified criteria for total suspended solids (less than 50 mg/L), pH (between 6.5 and 8.5) and no hydrocarbon or any other chemical contaminants exceeding the trigger levels set out in relevant guidelines; and Visual post rainfall checks of sediment dam water level and water quality, and to ensure erosion and sediment controls are effectively functioning.	Prior to clearance and during clearance activities
B07	Weed management controls will include: ▪ All machinery and equipment will be cleaned thoroughly prior to entering the development footprint. Cleaning will include the removal of all mud and plant matter, followed by washing with high pressure water; and Mulch containing weeds will be placed in piles separate from clean mulch, removed from site, and disposed of in accordance with weed management guidelines as soon as practicable.	Construction and operation
B08	During construction, fencing will be used to demarcate vegetation where required to avoid accidental damage to areas outside of the development footprint. Access control measures will include: ▪ Appropriate fencing and signposting of areas to prevent the uncontrolled entry of people, accidental disturbance, and to minimise vehicular and human traffic; ▪ Clear and visible signage will be appropriately located to inform the workforce and others of the restricted access or otherwise of areas outside the development footprint; and Locking of gates to prevent unwanted vehicle, person access and disturbance.	Construction and operation
B09	A Stormwater Management Plan will be prepared to appropriately limit post development flows and manage downstream water quality as part of the SSDA for site establishment and clearing works. Measures to be implemented include: ▪ Minimising the area of disturbance; ▪ Diverting run-off water around disturbed areas;	Construction and operation

Reference	Environmental management measures	Timing
	▪ Installation and ongoing maintenance of erosion and sediment controls (e.g. sediment fencing) throughout the duration of the Project; and Stabilisation (e.g. sealing, landscaping) of all disturbed areas to reduce the potential for future erosion.	
B10	The following mitigation actions will be implemented for the Project to develop a greater understanding and awareness of biodiversity issues in non-ecologically trained personnel: ▪ Inductions for the workforce will be undertaken to make them aware of the key ecological issues present in the development footprint and so that they know their role and responsibilities in the protection and/or minimisation of impacts to all native biodiversity; and Inductions will identify the location of sensitive flora and fauna and the policies being implemented to protect the biodiversity values of such areas.	Prior to construction and during construction
Aboriginal heritage		
AH1	The Unanticipated Finds Protocol in the ACHAR will be followed for any unidentified Aboriginal heritage objects found during the works.	Construction
AH2	An Aboriginal cultural heritage awareness training will be developed with the local Aboriginal community and will be provided to workers involved in clearing and ground disturbance activities associated with construction of the Project.	Construction
Non-Aboriginal heritage		
NAH1	Should any unexpected historical heritage, including archaeological relics, be uncovered during the course of the proposed works, works should stop, and the area cordoned off. A qualified archaeologist and, if necessary, Heritage NSW (in accordance with s146 of the Heritage Act) should be contacted to assess significance and advise on further requirements before work can recommence.	Construction
NAH2	All contractors and subcontractors should be made aware of their obligations under the Heritage Act. The presence of a heritage item and associated elements in the vicinity of the proposed works should be communicated to all staff during toolbox talks.	Construction
Land		
L1	Detailed design of each Project component would consider and address geotechnical stability risks in accordance with applicable design standards.	Detailed design
L2	Potential contamination-related impacts associated with the Project will be managed by the implementation of a CEMP that includes (but not limited to): ▪ An ASS management plan in accordance with *Acid Sulfate Soil Manual* (NSW ASSMAC, 1998) will be in the event that PASS is encountered;	Construction

Reference	Environmental management measures	Timing
	▪ An unexpected finds protocol, including encountering ACM during the extent of the construction works; ▪ Management of surface water when present to minimise the mobilisation of any potential residual soil impacts that could migrate to sensitive off-site ecological receptors; and ▪ Management of materials during construction works by implementation of the decision tree for reuse of soil in the *PFAS National Environmental Management Plan* (DAWE, 2020), so that excavated soils can be reused in less sensitive areas or managed within the Project area to prevent unacceptable risks to any receptor and minimise off-site disposal of excavated materials to a licensed landfill.	
L3	To manage soils hazards: ▪ High dispersion potential soils would be removed from structural foundations; ▪ Adequate topsoil and vegetation cover over the embankment face is used for permanent embankment batter slopes that are to remain through high dispersion potential soils to assist with limiting erosion. Consideration could also be given to the use of stabilisation or geosynthetic solutions on cut or embankment batter faces; ▪ The clay foundation soils be treated to reduce the potential for dispersion/erosion. This could include graded non-dispersive backfill materials around structures such as culverts to limit the loss of fines from soils surrounding such structures and the use geotextile filter materials; and ▪ Design of drainage and erosion control measures will need to take due consideration of the dispersive nature of soils at the site.	Construction
Noise		
NV1	Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner.	Prior to and during construction
NV2	Where possible, use quieter and less vibration emitting construction methods.	During construction
NV3	Only have necessary equipment on-site and turn off when not in use.	During construction
NV4	Where possible, concentrate noisy activities at one location and move to another as quickly as possible.	During construction
NV5	Vehicle movements, including deliveries outside standard hours should be minimised and avoided where possible.	During construction
NV6	Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices.	Prior to and during construction
NV7	Use only the necessary size and powered equipment for tasks.	During construction
NV8	Implement training to induct staff on noise sensitivities	Prior to and during construction
NV9	Where possible, consider the application of less intrusive alternatives to reverse beepers such as 'squawker' or 'broadband' alarms.	During construction

Reference	Environmental management measures	Timing
NV10	Consider the installation of temporary construction noise barriers or earth mounds for concentrated, noise-intensive activities.	During construction
NV11	Where practicable, install enclosures around noisy mobile and stationary equipment as necessary.	During construction
NV12	Where possible, avoid simultaneous operation of two or more noisy plant close to receivers. The offset distance between noisy plant and sensitive receivers should be maximised.	During construction
NV13	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements.	Prior to and during construction
NV14	Complete routine monitoring to evaluate construction noise levels and evaluate whether the mitigation measures in place are adequate or require revision.	During construction
NV15	▪ Choosing alternative, lower-impact equipment or methods wherever possible; ▪ Scheduling the use of vibration-causing equipment at the least sensitive times of the day (wherever possible); ▪ Locating high vibration sources as far away from sensitive receiver areas as possible; ▪ Sequencing operations so that vibration-causing activities do not occur simultaneously; ▪ Keeping equipment well maintained; and Do not conduct vibration intensive works within the recommended safe setback distances.	During construction
NV16	Informing nearby receivers about the nature of construction phases and the vibration-generating activities.	During construction
NV17	The detailed design of the Project would include further consideration and modelling of the selected BESS component supplier's equipment SPLs and layout to confirm the predictions of the noise impact assessment remain valid prior to construction commencing. Selected technology would avoid or otherwise manage annoying noise characteristics to acceptable levels.	Detailed design for each Project Stage
NV18	Operational noise monitoring would be undertaken immediately following commissioning of each Project Stage to confirm predictions and to identify any need to retro-fit mitigation measures to achieve compliance with applicable criteria. Results would be used to determine need for additional mitigation for subsequent Stages.	Immediately following commissioning of each Stage.
NV19	All reasonable and feasible mitigation measures would be explored and implemented to achieve compliance with all criteria at all times.	Operations
Traffic		
T1	A Construction Traffic Management Plan will be prepared and implemented by the construction contractor. The CTMP will include: ▪ Confirmation of haulage routes; ▪ Access to construction site including entry and exit locations; ▪ Times of transporting to minimise impacts on the road network;	Prior to commencement of construction.

Reference	Environmental management measures	Timing
	▪ Measures to minimise the number of workers using private vehicles; ▪ Management of oversized vehicles; ▪ Site specific traffic control measures (including signage) to manage and regulate traffic movement; ▪ Relevant traffic safety measures including driver induction, training, safety measures and protocols; ▪ Identify requirements for, and placement of, traffic barriers; ▪ Requirements and methods to consult and inform the local community of impacts on the local road network due to the development-related activities; ▪ Consultation with Transport for NSW and Council; ▪ Consultation with the emergency services to ensure that procedures are in place to maintain safe, priority access for emergency vehicles; ▪ A response plan for any construction related traffic incident; ▪ Monitoring, review and amendment mechanism; and ▪ Individual traffic management requirements at each phase of construction.	
T2	An oversized vehicle permit will be sought for all OSOM vehicle movements where required. The OSOM movements would be in accordance with the permit requirements and be outside of peak traffic periods where possible. In addition, a separate OSOM Transport Management Plan will be prepared and will include: ▪ Identification of route; ▪ Measures to provide an escort for the loads; ▪ Times of transporting to minimise impacts on the road network; ▪ Communication strategy and liaising with emergency services and police; and ▪ Any minor temporary civil infrastructure works may be required to accommodate OSOM movements.	Prior to delivery of over size overmass loads.
T3	The CEMP and general site induction would inform construction and operational personnel of the risk of collisions, and the risks of speeding and fatigue on safety. In addition, a Driver Code of Conduct will be prepared and used to outline the rules and behaviours which drivers associated with the Project would be required to adhere to. The Driver Code of Conduct will outline arrangements for light and heavy vehicle drivers including: ▪ General requirements including site induction requirements ▪ Travelling speeds and safe driving practices, particularly through residential areas and school zones ▪ Fatigue management ▪ Adherence to designated transport routes and heavy vehicle noise ▪ Public complaint resolution and penalties and disciplinary action.	Construction
T4	Road maintenance is not proposed as part of the Project on the basis that total heavy vehicle movements associated with full Project construction would be equivalent of 6 days of heavy vehicle	Construction

Reference	Environmental management measures	Timing
	movements on Wangi Rd while movements on Rocky Point Rd would be equivalent to 20 days of existing operations of the EPS.	
T5	Affected parties including emergency services will be notified in advance of any disruptions to traffic and restriction of access impacted by Project activities.	Construction
Water (Surface water, groundwater and flooding)		
SW1	A Construction Surface Water Management Plan (CSWMP) will be prepared as a sub-plan of the CEMP for each stage of the Project. The plan will outline measures to manage soil and water impacts associated with the construction works. The CSWMP will include but not be limited to: ▪ Measures to minimise/manage erosion and sediment transport both within the construction footprint and off-site including requirements for the preparation of ESCP for construction; ▪ Processes for dewatering of construction sediment basins, including relevant discharge criteria; ▪ Measures to manage accidental spills including the requirement to maintain materials such as spill kits; ▪ Measures to manage any potential ASS found in excavated fill material, in accordance with the Acid Sulfate Soil Guidelines; ▪ Measures to manage potential tannin leachate; and ▪ Details of surface water quality monitoring to be undertaken prior to, throughout, and following construction (refer to SW2 for further information).	Pre-construction, Construction
SW2	A surface water monitoring program will be implemented prior to, during and following construction and decommissioning. The monitoring program will include (but not be limited too): ▪ Visual assessment and routine monitoring (at least fortnightly) of physio-chemical parameters and contaminants of concern at downstream SREs to ensure compliance with applicable ANZG (2018) DGVs and HEPA (2018) guidelines during construction and decommissioning stages and until permanent drainage are demonstrated to be functioning and non-polluting. ▪ Visual assessment of surface water runoff structures at least once every week and also following any heavy rain during construction and decommissioning, until such time as permanent drainage is established and functioning to prevent sediment laden run-off, to ensure all water structures are operating effectively for their designed purpose, and to promptly address any deficiency in their operation. Should any deficiency in water structure operation or downstream water quality be identified, prompt remedial actions will be employed to address issues, including clearing sediment traps of sediment, storing and disposing of sediment (if required) in accordance with the *Managing Urban Stormwater: Soils & Construction (Landcom, 2004)*, and repairing any damaged structure immediately after the damage is identified.	Pre-construction, Construction, Operation

Reference	Environmental management measures	Timing
SW3	Site specific controls and procedures would be developed and implemented as part of the CSWMP to reduce the risk of litter and spills and leaks entering downstream waterways. The CSWMP would include (but not be limited to) the following measures: ▪ All fuels, chemicals and liquids would be stored on level ground away from waterways (including existing stormwater drainage systems) and would be stored in a sealed bunded area within the construction site; ▪ Refuelling and minor maintenance activities would be limited to designated areas with established spill capture and management controls; ▪ An emergency spill response procedure would be prepared as part of the CSWMP; ▪ Regular visual water quality checks (for hydrocarbon spills/slicks, turbid plumes and other water quality issues) will be carried out at waterways in proximity to works; and ▪ Installing and maintaining control measures such as silt fencing and gross pollutant traps, etc.	Pre-construction, Construction
SW4	To avoid ingress of concrete waste material into downstream waterways, the CEMP would outline procedures to capture, contain and appropriately dispose of any concrete waste from concrete works including designated lined, bunded and controlled concrete wash-out areas.	Pre-construction, Construction
SW5	Dewatering any construction sediment basins will be in accordance with the *Managing Urban Stormwater: Soils & Construction (*Landcom, 2004*)*, any EPL licence conditions which may be held for construction, and as per the EPBC Referral decision (August 2021) water quality runoff performance criteria outlined in Particular Manner 3. Dewatering procedures would be outlined in the ESCP and will include (but not be limited to): ▪ Routine and pre-discharge sampling and analysis to confirm absence of contaminants exceeding applicable criteria; ▪ Pre-discharge confirmation of compliance with water quality performance criteria able to be analysed in real time; ▪ The methodology for dewatering including use of amphibian friendly flocculants and pH balancing agents; ▪ Supervision requirements; ▪ Staff responsibilities and training; and ▪ Approvals required before any dewatering activity commences.	Construction
SW6	The design of permanent drainage and water management would demonstrate ability to meet Project performance outcomes of no pollution of waters. Any necessary maintenance or emergency isolation requirements would be documented in the Project operations manual. As a minimum, the operations manual would include: ▪ Details for bi-annual surveillance inspections of drainage and water management infrastructure and rectification requirements;	Operation

Reference	Environmental management measures	Timing
	▪ Bi-annual discharge water sampling and analysis to confirm pollution of waters is not resulting from the operations of the Project; ▪ Operational procedures for emergency isolation in response to spills, leaks or fire events as necessary in response to recommendations of PHA; ▪ Stormwater / flooding detention facilities to mitigate against increases in peak runoff rates from the Project; and ▪ Monitoring of receiving drainage channels and waterways downstream of the discharge location(s) to identify any evidence of channel erosion and scour	
SW7	▪ All equipment or storage containing dangerous goods or hazardous substances would be bunded or otherwise contained in accordance with AS 2067 and AS1940. ▪ A PHA for the Project would be progressed to a final hazard study as part of detailed design when specific technology is confirmed. The design of operational water management system would accommodate the emergency response philosophy for the selected technology and include emergency isolation and water management measures as warranted.	Operation
F1	▪ Provision of stormwater detention facilities to mitigate against increases in peak runoff rates from the Project with sizing to be confirmed during detailed design.	Operation
F2	▪ Permanent stormwater detention facilities should be installed prior to construction of hardstand/paved areas to mitigate against potential flood impacts during construction phase.	Construction
F3	▪ The BESS site should be filled to a minimum of the 1% AEP flood level + 0.5 m freeboard or the PMF level, whichever is higher. The recommended minimum finished level is 10.4 m AHD.	Construction, Operation
Hazards (Including PHA, Bushfire and EMF)		
H1	The PHA would be progressed to a final hazard study to further develop document and implement the recommendations of the PHA to: ▪ Specify requirements for suppliers and designers to demonstrate robust designs to prevent, monitor and (where unable to eliminate the possibility) control thermal runaway and undertake specialist safety in design assessments such as fire risk assessment to inform the design and selection of the battery; ▪ Implement a design principle that assumes a thermal runaway event within an enclosure will occur in the lifetime of the asset and therefore limits deflagration energy release, and prevents the spread of fire to adjacent enclosure by adopting appropriate design controls such as suitably designed enclosures and separation distances; ▪ Undertake detailed HAZOP studies and design review of the selected designs with specific attention on the inherent design features that detect, control and prevent thermal runaway;	Detail design

Reference	Environmental management measures	Timing
	▪ Review findings from thermal runaway event incident investigations, to identify applicable lessons and improvements, and establish the Project design basis accordingly; ▪ Determine credible scenario's from a thermal runaway event once the technology and its size is determined to quantify the amount of potential hazardous by products that must be managed and establish the Project design basis accordingly (e.g. amount of combustion and pollution, fire water use for containment (if applicable), volumes of retention dams etc); ▪ Bushfire risk assessment is covered in detail other Chapters of the EIS, the PHA recommends that heat maps from the detailed bushfire study be used to inform the design and determine adequate asset protection zones required to prevent conditions that could trigger thermal runaway in the specific technology selected; ▪ Implement a robust quality plan and inspections throughout the supply chain and during construction focused on aspects that provide layers of protection to prevent battery modules being installed that have manufacturing defects or mechanical damage; ▪ Develop and implement suitable asset management plans to ensure proper maintenance of the facility in line with manufacturers recommendations and good industry practice throughout the operations phase; and ▪ Engage reputable and experienced design consultants knowledgeable in good industry standards to design the proposed grid connection infrastructure and undertake an EMF study and assessment to confirm that EMF levels beneath the proposed transmission line are within public exposure guidelines.	
H2	During detail design: ▪ An EMF study and assessment will be carried out to confirm that EMF levels beneath the proposed transmission line are within public exposure guidelines detailed in the *Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields (*ICNIRP, 2020*);* ▪ It will be confirmed that step and touch potential of infrastructure from induced voltages will be limited within appropriate standard thresholds as part of the design process; and ▪ EMF impacts to workers at the site will be considered and appropriate health and safety management practices will be implemented.	Detailed design
H3	Storage and management of dangerous goods and hazardous materials (if required) will occur in a safe, secure location consistent with the requirements of applicable Australian Standards.	Construction/ operation
H4	Refuelling will take place in a designated area within the works area, away from ignition sources and trees or vegetation and with appropriate controls to prevent any spills coming into contact with the ground.	Construction/ operation

Reference	Environmental management measures	Timing
H5	Appropriately stocked emergency spill kits will be available at all work areas at all times. All staff will be made aware of the location of the spill kit and trained in its use.	Construction/ operation
H6	Temporary construction compounds will be maintained in a tidy and orderly manner to minimise potential fuel loads in the event that any construction compounds are affected by fire.	Construction
H7	An emergency response plan for the Battery would be prepared for the Project and provided to the relevant stakeholders.	Construction/ operation
H8	The following bushfire risk mitigation measures would be applied during construction: ▪ *SFAZ and APZ:* management of bushfire fuel hazard in the surrounding landscape should continue in accordance with the EPS Bushfire Management Plan (AECOM, 2020; Figure 15); ▪ *Site clearance:* Vegetation within the development footprint for each stage will be cleared as a first step in construction; ▪ *Access:* site access from Rocky Point Road would be maintained throughout construction. In the event of a fire, emergency services would access the site via Rocky Point Road and have access to construction access tracks and existing perimeter roads for firefighting purposes; ▪ *Fire water supply:* access to water for fire suppression and/or protection of structures or equipment located on site will be provided so that water supply arrangements for firefighting meet the NSW RFS requirement (NSW RFS 2019a). Fire water for firefighting proposes would be identified in the detailed design stage in consultation with RFS and Fire and Rescue NSW. The intent is to provide adequate services of water for the protection of infrastructure during and after the passage of a bushfire; ▪ *Hazardous materials:* Storage of diesel fuel and other potentially flammable materials on site would follow environmental protection guidance and be located at parts of the site with low radiant heat exposure in the event of a bushfire (i.e. outside the BAL-12.5 zone). ▪ *Hot works controls:* works that have potential to generate sparks and ignite fires will be subject to the contractor's hot works safety management procedures. Hot works will not be undertaken on TOBAN days without a permit from the RFS; and ▪ *Emergency management:* on site bushfire emergency management arrangements will be addressed through the construction contractor's site emergency management plan. Given the level of fire risk and proximity of the site to fire services, bushfire-specific fire-fighting equipment (e.g. 4WD with slip on tank and pump) will not be held on site during construction. If a fire is ignited and cannot be safely contained using fire extinguishers or other materials at hand, construction crews will dial 000 and seek emergency service assistance.	Construction
H9	The following bushfire risk mitigation measures would be applied during operation:	Operation

Reference	Environmental management measures	Timing
	▪ The EPS bushfire Management Plan would continue to be implemented to maintain target fuel loads in land to the west and north of the BESS compound; ▪ A 10 m Project APZ would be established inside the Project area between bushfire prone land and the BESS compound and may be implemented on a staged basis with final details to be confirmed as part of detailed design; ▪ The Project APZ would be maintained clear of native vegetation; ▪ Where existing access tracks are not available, new access tracks would be constructed within part of the APZ to provide access for fire-fighting vehicles to bushfire-prone parts of the Project area. Measures would be in place to ensure fire response vehicles and personnel are separated from electrical infrastructure within the BESS footprint where necessary; ▪ The BESS compound and substation would be kept free of vegetation; ▪ Existing and new access tracks required for inspection and firefighting purposes would be available for emergency services and tracks would be a minimum of 4 m wide and have a minimum vertical clearance of 4 m; ▪ Where fire access tracks are to be constructed within the proposed APZ, these would be constructed to a standard that allows use by fire response vehicles (as specified in NSW RFS fire trail standards (RFS, 2019b) for *Category 1 fire appliances*); and ▪ Fire water for bushfire responses would be identified in the detailed design stage in consultation with RFS and Fire and Rescue NSW. Suitable water supply arrangements shall be provided for firefighting that meet RFS requirements (NSW RFS, 2019a). Water would be available from the potable water system or other EPS water bodies as per the current EPS Bushfire Management Plan (AECOM, 2020). Where necessary, additional on-site water storage would be provided and equipped with standard fittings to enable use by RFS to refill fire response vehicles in the event of failure of the potable supply.	
Socio-economic		
SE1	Origin will keep the community and stakeholders updated on the Project via notifications letters and posts on the Origin website.	Pre-construction
SE2	Identify opportunities to maximise the use of local suppliers, labour and businesses in the provision of goods and services for construction.	Construction
Waste		
WR1	A Waste Management Plan will be developed for the Project with the following criteria: ▪ A hierarchical waste management approach will be used, from the most preferable (reduce, reuse or recycle wastes) to the least preferable (disposal) to prioritise waste management strategies to avoid waste generation	Detailed design

Reference	Environmental management measures	Timing
	▪ The plans will 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 will be segregated by type for collection and removal (for processing or disposal) by licensed contractors ▪ All waste types will be separated at source for recycling ▪ A licensed service provider will be appointed to collect waste during construction and operation ▪ Each waste type will be classified for transport to ensure correct handling ▪ Any waste that cannot be recovered or recycled will be disposed of to a suitably authorised or licensed treatment or disposal facility where it will be treated and disposed of according to its classification.	
WR2	End of life batteries will be recycled to the extent reasonable and feasible either through return to suppler for repurposing or other mechanisms.	Operation and decommissioning
WR3	Cleared vegetation will be either mulched for onsite reuse or used to created habitat piles, noting that any weeds and pathogens will be managed according to requirements under the *NSW Biosecurity Act 2015.*	Construction
Air		
AQ1	The following will be undertaken to manage exhaust emissions from plant and equipment: ▪ Inspecting all plant and equipment before it is used on-site ▪ Ensuring that all vehicles, plant, and equipment are operated in a proper and efficient manner ▪ Switching off all vehicles, plant and equipment when not in use for extended periods ▪	Construction
AQ2	The following will be undertaken to manage wind erosion from stockpiles and exposed surfaces: ▪ Watering stockpiles and exposed surfaces until such time as ; and ▪ Progressive rehabilitation of exposed surfaces (as feasible) that are no longer required for construction; and ▪ Reviewing and where necessary modifying or suspending activities during dry and windy weather and elevated background air quality conditions.	Construction
AQ3	Potential for air quality impacts resulting from a thermal runaway event would be identified as part of a HAZOP / final hazard analysis and air quality risk and management response would be included in operational safety and environmental management procedures and the site pollution incident response management plan as required under EPL1429.	Operation

Reference	Environmental management measures	Timing
Cmulative		
CL1	The CEMP will include a process to review and update management measures if any other development with potential to contribute to cumulative impacts commence in proximity to the Project.	Ongoing

8. Evaluation of merits

This chapter presents an evaluation of the Project as a whole, drawing conclusions on the overall merits of the Project.

8.1 Justification

The Project is necessary to provide flexible dispatchable electricity supply is needed to firm up the variable output from renewable sources such as wind, solar and hydro and provide storage of surplus generation to meet times of peak demand. The essential nature of the Project is considered to outweigh the identified adverse impacts. While some environmental impacts cannot be avoided, in all cases they would be minimised to the extent reasonable and feasible through the design process and implementation of environmental management measures. The Project as described in **Chapter 3** is considered to best meet the Project objectives when compared to all other alternatives and options (refer to **Section 2.2**).

The Project area is largely developed as a power station and the Project represents a continuation of the electricity generation uses, being a form of industrial development which is currently carried out on the site and does not conflict with the ongoing operations or any other currently proposed land uses.

Clause 7(1)(f) of Schedule 2 of the EP&A Regulation require an EIS to provide '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)'. The principles of Ecologically Sustainable Development (ESD) are discussed in **Section 8.1.1** and the biophysical, economic and social considerations are as following:

- Biophysical costs and benefits: The Project would result in the direct removal of up to 21.1 ha of previously disturbed vegetation, of which about 15.1 ha is native vegetation. The removal of this vegetation may impact on the two threatened species (the Swift parrot and the Squirrel glider). About 0.2 ha of threatened Small-flower grevillea and one individual of black-eyed Susan would also be directly impacted as a result of the Project. Where impacts on biodiversity cannot be avoided or minimised, appropriate offsets would be provided;
- Economic and social considerations: Most social impacts are localised and would be temporary during construction. Economic benefits are anticipated for local businesses during construction due to increased demand for goods and services and direct employment opportunities for up to 128 people. During operation, the Project would deliver safe and reliable energy storage and facilitate potentially increased uptake of renewable energy in the NEM as well as across the region including the legislated NSW REZ. The Project would support the continuation of electricity generation and existing land uses on the EPS land and benefit communities, businesses and industries by increasing the reliability of electricity and supporting the *NSW Electricity Infrastructure Investment Act 2020* objectives;
- The Project is considered to be in the public interest. The Project represents a significant and cost-efficient private investment in electricity infrastructure. Overall it would results in strong net public benefits by delivering essential energy storage and firming capacity as part of the energy transition; and
- In addition, the Project is consistent with the ISP 2020 (AEMO, 2020), COP21 agreements and the *NSW Climate Change Policy Framework targets* (OEH, 2016).

8.1.1 Ecologically sustainable development

ESD is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD were an integral consideration throughout the development of the Project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD and how the Project responds to these principles are discussed below.

8.1.1.1 The Precautionary principle

The principle states that:

"if there are threats of serious or irreversible environmental 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—

(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and

(ii) an assessment of the risk-weighted consequences of various options".

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making.

This principle was considered during development of the Project. The precautionary principle has guided the assessment of environmental impacts for this EIS and the development of management measures.

This EIS assesses the environmental impacts associated with the Project. The EIS was prepared adopting a conservative approach, which included assessing reasonable worst case impact scenarios. Management measures are proposed to address identified impacts. These management measures would be implemented during the Project. No management measures have been postponed as a result of lack of scientific certainty regarding impacts. No threat of serious or irreversible damage is considered likely as a result of the Project.

Origin's approach to site selection and tender evaluation has considered various options including consideration of environmental consequences. Commitments to detailed design as specified in **Chapter 7** specify ongoing efforts to minimise environmental and social impacts.

8.1.1.2 Intergenerational equity

The principle states:

"that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations".

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

The Project may have very minor impacts on inter-generational equity through the consumption of resources during construction and operation, including fuel and raw materials. Nevertheless, the Project would provide an advanced delivery schedule for energy storage and dispatchable firming to support the REZs being built across NSW. This would help facilitate the transition to a low carbon energy generation future necessary to achieve NSW and Australia's GHG reduction targets recognised at a global level as essential for avoiding or reducing climate change implications for future generations.

8.1.1.3 Conservation of biological diversity and ecological integrity

The Principle states:

"That conservation of biological diversity and ecological integrity should be a fundamental consideration"

Biodiversity values were considered in the development of the concept design of the Project. Site selection has targeted areas of prior disturbance and avoided areas of higher biodiversity value contained within E2 zoned land surrounding the EPS. The assessment and ongoing design of the Project has been carried out with the aim of identifying, avoiding, minimising and mitigating impacts.

The direct biodiversity impact of the Project would be the clearing of up to 21.1 ha of vegetation, of which about 15.1 ha is native vegetation. 10.2 ha of this native vegetation was planted for ground stabilisation purposes only following past disturbance and does not reflect naturally occurring ecological communities. The removal of this vegetation may impact on the two threatened species (the Swift parrot and the Squirrel glider) identified as potentially in the Project area. In addition, about 0.2 ha of threatened Small-flower grevillea and one individual of black-eyed Susan would also be directly impacted as a result of the Project.

Environmental management measures were identified to reduce the severity of direct and indirect impacts of the Project on biodiversity. Where there are likely to be residual impacts associated with vegetation clearance, such impacts would be offset. Offsets would be delivered in accordance with the Biodiversity Offset Scheme under the BC Act such that long-term improvements and conservation outcomes would be achieved.

8.1.1.4 Improved valuation, pricing and incentive mechanisms

The Principle states:

"That environmental factors should be included in the valuation of assets and services, such as—

(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,

(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,

(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems".

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

Environmental factors were considered throughout the development of the design and in planning for construction and operation of the Project. As a consequence, environmental impacts were avoided or minimised where practical during the concept design development for the Project.

Environmental management measures outlined in this EIS will be implemented during construction and operation of the Project. The cost of these management measures is incorporated into the Project cost, as well as the extent of environmental investigations carried out to inform this EIS.

8.2 Consideration of the objects of the EP&A Act

The objects of the EP&A Act provide a framework within which the justification of the Project can be considered. summary of this assessment is provided in **Table 8-1**.

Table 8-1: Consideration of objects of the EP&A Act

Object	Comment
a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The Project may result in amenity (noise) impacts near the Project and the generation of additional traffic. During construction, economic benefits are anticipated for local businesses and accommodation owners due to increased demand for accommodation, goods and services. Benefits would also be associated with direct and indirect employment opportunities. During operation, the Project would benefit communities, businesses and industry by increasing the reliability in the NEM. The Project may provide

Object	Comment
	an overall downward pressure on energy prices by facilitating the shifting use of lower cost renewable generation from times of peak generation to times of peak demand. This in turn may support reduced electricity costs for households, businesses and industry over the medium to long term while supporting the transition to a low carbon energy future. The socio-economic and community impacts are assessed in **Section 6.10** Some permanent impacts to biodiversity, noise and visual amenity would occur and have been minimised to the extent reasonable and feasible. Environmental management measures have been proposed to manage Project impacts where they cannot be avoided.
b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	As described in **Section 8.1.1**, the Project is consistent with the principles of ESD.
c) To promote the orderly and economic use and development of land.	The Project area is located within the Origin landholding and would not require the acquisition of privately owned land. Project is located on land that is appropriately zoned SP2 Infrastructure (Electricity generating works) under the Lake Macquarie LEP 2014. The Project is considered compatible with the objectives of this land zoning. The Project would promote the orderly and economic use and development of land within the Project area by targeting areas of prior disturbance to continuing to provide dispatchable energy and other network services to the NEM and facilitating the increased penetration of renewable energy into the network.
d) To promote the delivery and maintenance of affordable housing.	The Project would not affect the delivery and maintenance of affordable housing.
e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	Biodiversity was considered in the development and selection of the preferred option, as discussed in **Section 2.2**. Biodiversity impacts are assessed in **Section 6.1**. The Project would result in the direct removal of up to 21.1 ha of vegetation, of which about 15.1 ha is native vegetation and most of which has been previously disturbed. Two species-credit threatened species, the Swift parrot and the Squirrel glider, are assumed to be directly impacted through the potential loss of up to 3.1 ha and 4.9 ha of habitat respectively. About 0.2 ha of Small-flower grevillea and one individual black-eyed Susan plant would also be directly impacted as a result of the Project. No significant impacts to biodiversity are expected. Environmental Management measures include exploring opportunities to limit the extent of vegetation clearance required as part of detailed design and construction planning. Appropriate offsets will be provided for impacts to native vegetation and threatened species habitats.
f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	There are no Aboriginal heritage items identified within the Project area that would be impacted by the Project (refer to **Section 6.2).** The Project area overlaps the local heritage listing of the EPS. No demolition of the key heritage elements of the EPS itself are proposed.

Object	Comment
	The design of the proposed BESS infrastructure has a similar utilitarian / functional approach to that of the EPS which is of heritage significance. The addition of BESS infrastructure would not impact on the technological or historical significance of the EPS, and it would contribute to the continuing operation of the site for its significant historical use. As such, the proposed works have been assessed as having negligible adverse impact on the heritage significance of the EPS (refer to **Section 6.3**).
g) To promote good design and amenity of the built environment.	Good design and amenity of the built environment were considered during Project development. Consideration was given to the placement of Project components in the surrounding landscape to minimise operational visual amenity impacts (refer to **Section 6.5**).
h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	The design, construction and maintenance of the Project would be undertaken in accordance with applicable standards and Origin's existing management systems. A PHA has been completed for the Project that identifies credible health and safety risks and recommended mitigation measures (refer to **Section 6.9**).
i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Origin is seeking approval for the Project under Part 4, Division 4.7, of the EP&A Act. Consultation was carried out with the relevant local Councils and government agencies throughout development of the Project and preparation of this EIS. Consultation carried out to date is described in **Chapter 5**.
j) To provide increased opportunity for community participation in environmental planning and assessment.	The Project development process involved consultation with relevant stakeholders. Consultation undertaken and proposed is outlined in **Chapter 5**. The EIS would be placed on public exhibition by DPIE, in which stakeholders and the community will be able to review the EIS and provide submissions on the Project. Any submissions received would be responded to by Origin. This process provides further opportunity for community participation in the environmental planning and assessment process.

8.3 Consideration of Section 4.15 of the EP&A Act

In determining an application for development consent, the consent authority must take into consideration such of the matters referred to in Section 4.15(1) of the EP&A Act as are of relevance. The factors listed in Section 4.15(1) have been considered in **Table 8-2** below in order to summarise the likely impacts of proposed works on the natural and built environment.

Table 8-2: EP&A Act Section 4.15 Consideration

Matter for consideration	Consideration
The provisions of any environmental planning instrument.	EPIs applicable to the Project and Project area include: ▪ Infrastructure SEPP; ▪ SRD SEPP; ▪ SEPP 33; ▪ SEPP 55; ▪ Koala SEPP; and

Matter for consideration	Consideration
	▪ Lake Macquarie LEP 2014. The relevant provisions and resulting mandatory consideration of applicable EPLs are considered in **Section 4.5**. The proposed works are considered permissible under these instruments. Mandatory considerations and how they have or would be addressed is identified in **Appendix B.**
The provisions of any proposed instrument.	No proposed EPIs have been identified as applying to the Project.
The provisions of any Development Control Plan.	Under clause 11 of the SRD SEPP, Development Control Plans do not apply to SSD.
The provisions of any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4.	No planning agreements affecting the Project location have been entered into or are proposed.
The provisions of the regulations (to the extent that they prescribe matters for the purposes of this paragraph).	Clause 92 of EP&A Regulation identifies matters prescribed for the purposes of section 4.15 (1) (a) (iv) of the EP&A Act, to be taken into consideration by a consent authority in determining a DA. None of the prescribed matters are considered applicable to the Project.
The provisions of any coastal zone management plan	The *Lake Macquarie Coastal Zone Management Plan 2015-2023* (LMCC, 2015) is an extensive document that includes prioritisation of actions across seven themes and divided into three areas. Of most relevance to the consideration of private developments is Theme 2 which includes actions for a healthy coastal zone – protecting biodiversity and ecological resilience as follows: ▪ Maintain or enhance the condition of coastal and estuarine ecological communities in the context of sea level rise; ▪ Maintain or enhance the connectivity of coastal habitats; ▪ Reduce threats from invasive species, pollution and rubbish dumping; ▪ Control catchment inputs to sensitive receiving waters, including stormwater runoff and licensed discharges; ▪ Manage creek bank (riparian) and foreshore vegetation; ▪ Protect sea grass beds; and ▪ Protect wetlands. The Coastal Zone Management Plan notes that these actions are primarily the responsibility of Council. **Chapter 6** assesses the potential environmental impacts including those issues listed above. The Project is considered able to be undertaken in a manner that avoids impacts to the natural environment and processes of the coastal zone.
The likely impacts of the development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality.	Environmental and socio-economic impacts are assessed in **Chapter 6**.

Matter for consideration	Consideration
The suitability of the site for the development.	The site is appropriately zoned and the Project, with the exception of the final grid connection point in the TransGrid switchyard, is within Origin landholdings and buffer lands of EPS. The Project design has focused on previously disturbed land to the extent this is sufficient and appropriate for the required purpose of each component.
Any submissions made in accordance with this Act or the regulations.	To be considered by DPIE following exhibition.
The public interest.	Community and stakeholder engagement has been undertaken as described in **Chapter 5** and would inform the final design of each Project element. The Project would help to deliver safe and reliable energy storage and facilitate potentially increased uptake of renewable energy in the NEM as well as across the region. The Project would support the continuation of electricity generation and existing land uses on the EPS land and benefit communities, businesses and industries by increasing the reliability of electricity. The Project would maximise the long-term social and economic benefits, while minimising the long-term negative impacts on communities and the environment. Some additional traffic and noise generation would result from the Project but would be managed so as not to result in significant off-site impacts. While biodiversity and amenity impacts are anticipated, these would be minimised and mitigated to the extent reasonable and feasible. Biodiversity offsets would also be provided in accordance with the BC Act aimed at resulting in a neutral or beneficial biodiversity outcome. As a result, the Project is considered to be in the public interest. A response to submissions report would be prepared to address any issues raised in submissions and this report, along with submissions, is required to be considered by the relevant consent authority (being the Independent Planning Commission) in determining whether to approve the Project and, if so, on what conditions.

8.4 Conclusion

Origin is seeking regulatory and environmental planning approval for the construction and operation of a grid-scale BESS with a discharge capacity of 700 MW and storage capacity of 2,800 MWh within disused portions of the existing Origin landholding at Eraring. The Eraring BESS would be among the largest battery projects in NSW and Australia in terms of peak power output and discharge duration. The Project would provide energy storage and key network services that would facilitate long term emissions reduction in the NEM while supporting the delivery of secure and reliable electricity for consumers and businesses.

The Project would include the construction, operation and decommissioning of a grid-scale BESS including:

- BESS compounds comprising of rows of enclosures housing lithium-ion type batteries connected to associated PCS and HV electrical reticulation equipment;
- A BESS substation housing high voltage transformers and associated infrastructure;
- Approximately 400 m of overhead 330 kV transmission line connecting the BESS substation to the existing 330 kV TransGrid switchyard; and
- Ancillary infrastructure and facilities including safety protection systems and site ancillary facilities such as laydown areas and site offices.

The Project will also be capable of providing energy, FCAS and SRAS, as well as typical BESS based security services under consideration in the NEM such as fast frequency response and synthetic inertia. The PCS will be four-quadrant bidirectional type, with capability for both charge/discharge in leading and lagging reactive power scenarios. The PCS will also have grid forming capability to allow islanded operation and SRAS where required.

It is considered highly likely that based on these opportunities, the Project could be constructed and operated in an economically feasible manner with limited short-term construction impacts and long term environmental and social benefits. The benefits of the Project are considered to outweigh the identified adverse impacts of this Project. While some environmental impacts cannot be avoided, they would be minimised where possible through the implementation of environmental management measures and offsetting.

A consultation program with community and government stakeholders has been carried out throughout Project development, and would continue through EIS display, response to submissions, detailed design and construction, to ensure that all stakeholder interest is understood, documented and addressed.

The environmental performance of the Project would be managed by the implementation of the CEMS. The CEMS would also ensure compliance with relevant legislation and any conditions of approval. With the implementation of the proposed mitigation and management measures, the potential environmental impacts of the Project can be adequately managed.

This EIS provides a description of the Project, existing information on environmental context and potential for environmental impacts. The EIS considers all available information that is relevant to the environmental assessment of the Project. The EIS has been prepared to support Origin's application for approval of the Project in accordance with the requirements of Part 4, Division 4.7 of the EP&A Act. The EIS addresses the environmental assessment requirements of the SEARs, dated 19 April 2021.

The Project was referred and determined not to be a controlled activity under the EPBC Act if undertaken in a particular manner. The particular manner conditions have been incorporated into the mitigation measures in the EIS.

On the basis of the findings detailed in the assessments within this EIS and with the implementation of the proposed environmental management measures, the Project could be carried out without any significant long-term impacts on the local environment and as such is considered justified.

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