

McCullys Gap Battery Energy Storage System Environmental Impact Statement

August 2026



Declaration

Project details	Project name	McCullys Gap Battery Energy Storage System	
	Application no.	SSD-81555720	
	Address of land	578 and 380 Sandy Creek Road in McCullys Gap, NSW	
Applicant details	Applicant name:	Muswellbrook Pro Unit Holdings Pty Ltd	
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	Organisation registered with	GHD Pty Ltd	
Declaration	The undersigned declares that this EIS: – has been prepared in accordance with the Environmental Planning and Assessment Regulation 2021; – contains all available information relevant to the environmental assessment of the development, activity or infrastructure to which the EIS relates; – does not contain information that is false or misleading; – addresses the Planning Secretary's environmental assessment requirements (SEARs) for the project; – identifies and addresses the relevant statutory requirements for the project, including any relevant matters for consideration in environmental planning instruments; – has been prepared having regard to the Department's <i>State Significant Development Guidelines – Preparing an Environmental Impact Statement</i>; – contains a simple and easy to understand summary of the project as a whole, having regard to the economic, environmental and social impacts of the project and the principles of ecologically sustainable development; – contains a consolidated description of the project in a single chapter of the EIS; – contains an accurate summary of the findings of any community engagement; and – contains an accurate summary of the detailed technical assessment of the impacts of the project as a whole.		
	Signature		
	Date	13/08/2026	

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Executive summary

Background

Muswellbrook Pro Unit Holdings Pty Ltd (the applicant) is proposing the McCullys Gap Battery Energy Storage System (BESS) (the project) in McCullys Gap, New South Wales (NSW). The project involves constructing, operating (including maintenance) and decommissioning a BESS and associated infrastructure to connect into the NSW high voltage electricity transmission network. Once operational, the project would store and dispatch energy, contributing to a stable, reliable and diverse energy system in NSW.

The project is State significant development in accordance with Section 2.6(1) of the State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP). As such, the project requires preparation of an Environmental Impact Statement (EIS) and is subject to approval by the Minister for Planning and Public Spaces and is to be assessed in accordance with the provisions of Section 4.36 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The project is also subject to approval from the Australian Minister for the Environment and Water under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This EIS considers the potential impacts of the project and has been prepared to support an application for approval of the project in accordance with the requirements of Section 4.36 of the EP&A Act. The EIS addresses the Planning Secretary's environmental assessment requirements.

The project

Key features

The project is located across two properties at 380 and 578 Sandy Creek Road, McCullys Gap in the Muswellbrook Shire local government area (LGA), about six kilometres northeast of Muswellbrook, NSW.

The key features of the project include:

- 400 megawatts battery energy storage system with a duration period of four hours (1,600 megawatt hours) with associated power controllers, transformers, switchgear and safety systems
- connection infrastructure, including a project substation, 800 metre transmission line and associated infrastructure to connect the project substation to the existing Muswellbrook 330 kilovolt (kV) substation
- works at the existing Muswellbrook 330 kV substation to facilitate connection of the project's connection infrastructure to the high-voltage transmission connection point
- associated ancillary and enabling infrastructure including operation and maintenance facilities, internal access, fencing, drainage, firewater facilities, safety and security infrastructure.

The project involves the construction, operation and decommissioning of above-ground infrastructure associated with the BESS and its connection to the transmission network.

Subject to receiving planning approval, the project is expected to be operational in 2029 and operate for at least 30 years, after which infrastructure would be decommissioned and the site rehabilitated.

The project design reflects an established battery energy storage configuration consistent with current industry practice. Design, assessment and management measures have been informed by technical investigations and stakeholder input and are addressed in the relevant chapters of this EIS.

Strategic context

As NSW transitions from ageing coal-fired generation to a more diverse electricity system, there is a growing need for infrastructure that can respond rapidly to changes in supply and demand and help maintain system reliability. The project would provide large-scale, firm and dispatchable capacity that can store electricity during periods of higher generation and dispatch it when needed, supporting peak demand, managing variability in supply, and responding to unplanned outages or network disturbances. Its strategic location adjacent to the existing Muswellbrook 330 kV substation would enable efficient connection to the high-voltage transmission network and support the timely delivery of storage capacity in a part of the Hunter region already characterised by major electricity infrastructure. In doing so, the project would support the efficient utilisation of existing and proposed

generation in the region and align with national and NSW energy strategies that identify storage as critical to maintaining a secure, reliable and diverse energy system.

At the local level, the project would contribute to regional investment and employment diversification in the Muswellbrook Shire. The project also includes an ongoing community benefit framework, proposed to be delivered through a Voluntary Planning Agreement collaboratively with Muswellbrook Shire Council. While delivering these benefits, the project also recognises the need to manage local impacts and community expectations in a region experiencing multiple energy developments. By providing dispatchable storage capacity the project would play an important role in supporting a secure, reliable and affordable electricity supply for NSW while contributing to the orderly transition of the electricity system.

Site suitability

The project site has been selected on the basis of technical, environmental and land use suitability, with careful consideration of potential conflicts with existing and future surrounding land uses. Its immediate proximity to the existing Muswellbrook 330 kV substation enables a direct and efficient connection to the high-voltage transmission network via a short connection, minimising the need for additional connection infrastructure and limiting associated land disturbance. The site is located within the Hunter-Central Coast Renewable Energy Zone and within an established energy infrastructure setting, allowing the project to integrate with existing electricity assets in an orderly and efficient manner rather than introducing infrastructure into a previously unaffected area.

The project area is within a predominantly rural landscape characterised by agricultural land uses, existing infrastructure and areas of historical disturbance. The site selection and layout refinement process was informed by biodiversity values, Aboriginal heritage sensitivity, bushfire risk, watercourses, topography and proximity to rural dwellings, with permanent infrastructure located in comparatively lower constraint areas where practicable. This approach has reduced the extent of native vegetation clearing, minimised earthworks and supported the management of amenity impacts through setbacks, design controls and landscaping. The location of the project within the site provides sufficient separation from surrounding land uses and public roads to support appropriate management of operational noise and visual impacts.

The site is not constrained by incompatible surrounding land uses that would preclude operation of the project, and its relatively compact footprint within a rural landscape would allow surrounding agricultural activities to continue. Overall, the selected location supports orderly land use planning outcomes by consolidating infrastructure within an area already associated with major electricity assets, and avoiding and minimising impacts on environmental, social and economic matters to the extent reasonably practicable.

Community and stakeholder engagement

Community and stakeholder engagement has been undertaken since the public announcement of the project in December 2024 and has continued through preparation of the EIS. Engagement has involved local residents and landowners, Aboriginal stakeholders, local government, emergency services, State and Commonwealth agencies, and infrastructure providers. A range of engagement methods has been used, including community drop-in sessions, briefings, site visits, direct correspondence, website, toll free number, email address and ongoing enquiry channels, consistent with the *Undertaking Engagement Guidelines for State Significant Projects* (DPHI, 2024).

Feedback received during engagement focused on potential construction and operational impacts, particularly traffic and road safety on Sandy Creek Road and the New England Highway (A15), noise and visual impacts to nearby residents, fire risk and safety, cumulative impacts with other major projects in the region, and the nature and delivery of community benefits. These matters have directly informed project development and assessment, including refinements to project layout and connection infrastructure alignment, adjustments to setbacks and equipment orientation, targeted assessment of noise, visual, traffic and hazard risks, and the identification of mitigation and management measures to address community concerns. Feedback has also informed the project's community benefit approach, which is proposed to be delivered through a Voluntary Planning Agreement with Muswellbrook Shire Council. This provides a transparent mechanism for administering community benefit funding, with consultation highlighting the importance of equitable distribution and alignment with local priorities. Ongoing engagement will continue throughout the public exhibition of the EIS and, if approved, during construction and operation of the project.

Environmental assessment

The EIS assessed a comprehensive range of potential environmental, social and economic impacts during construction, operation and decommissioning. Overall, impacts are expected to be localised and manageable, with established mitigation and management measures to ensure impacts are reduced to as low as reasonably practicable. Consideration of cumulative impacts concluded that, with spatial separation and independent operation of facilities, cumulative impacts to amenity, land-use safety or public health are limited and manageable.

Findings related to the key matters are provided as follows:

Biodiversity

The project is located in a modified rural landscape that has been historically cleared and used for agricultural, residential and electricity infrastructure purposes. Biodiversity values within the project area have been assessed through detailed surveys and targeted investigations. The project area contains about 16.92 hectares of native vegetation, including vegetation associated with an endangered ecological community under the *Biodiversity Conservation Act 2016* (NSW) and the corresponding critically endangered ecological community under the *Environment Protection and Biodiversity Conservation Act 1999*. Targeted surveys also confirmed one threatened flora species and eight threatened fauna species within the project area.

The project would remove or modify up to 16.92 hectares of native vegetation, including up to 9.00 hectares of the NSW-listed threatened ecological community and 3.66 hectares of the corresponding Commonwealth-listed critically endangered ecological community. It would also affect habitat for a number of threatened species. For the purposes of the Commonwealth assessment, all matters of national environmental significance, including the threatened ecological community, are considered to be significantly impacted. The project is therefore a controlled action and requires approval under the *Environment Protection and Biodiversity Conservation Act 1999*.

With impacts avoided and minimised where practicable through iterative design and mitigation measures, and residual impacts to be addressed through the NSW Biodiversity Offsets Scheme and applicable Commonwealth offset requirements, the assessment concludes biodiversity impacts are acceptable in a state and regional context.

Noise

The noise and vibration assessment confirms the project is located in a quiet rural setting, with low background levels adopted in accordance with the *Noise Policy for Industry* (EPA, 2017). Construction noise impacts are expected to be temporary and variable, with the highest impacts occurring during short-duration road and utilities works. These impacts would be proactively managed through standard construction controls and implementation of a Construction Noise and Vibration Management Plan as part of the Construction Environmental Management Plan (CEMP) (including notification, monitoring where required, and feasible source/pathway controls).

Operational noise is predicted to comply at all receivers.

Visual

The landscape and visual assessment found the project would be introduced into an already modified rural landscape and would not result in major changes that would significantly affect views or landscape character.

Construction impacts are expected to be temporary and range from moderate to low, while operational visual impacts are predicted to be low at most locations, with moderate impacts largely limited to two sensitive receivers. Ongoing detailed design will further consider opportunities to reduce visual prominence (particularly of connection infrastructure), supported by targeted landscaping and visual management measures. Overall, visual impacts are considered acceptable given the modified landscape context, limited number of sensitive receivers and proposed management measures.

Heritage

The Aboriginal cultural heritage assessment identified one previously registered AHIMS site within the project area, an artefact scatter that has not been able to be located during multiple survey attempts over several years. Survey of the project area with Aboriginal representatives was undertaken between August 2025 – February 2026 and identified two new sites; a potential archaeological deposit (PAD) and an isolated find. The project design was refined to completely avoid the PAD, and any archaeological value that may be present would not be impacted. The isolated find and the registered artefact scatter would be impacted by the project; however, the combination of low archaeological value, the disturbed nature of the environment and the site type supports salvage of these items prior to the commencement of construction.

Desktop heritage database searches identified no listed heritage items within the project area on the National or Commonwealth Heritage lists, the State Heritage Register, or the Muswellbrook Local Environmental Plan. While several locally listed items are located in the broader vicinity, including the St Heliers Correctional Centre and the Muswellbrook Railway Depot, the assessment confirmed no impacts to any listed heritage item or conservation area. Field survey identified no significant historic heritage within the project area and archaeological deposits relating to historic settlement are considered unlikely.

Transport

The traffic and transport assessment identifies that the project would use the existing road network, with access via the New England Highway (A15) and Sandy Creek Road. During construction, vehicle movements would increase temporarily to support delivery of materials, plant and workforce, and these movements will be managed to minimise disruption through a construction traffic management plan, including scheduling, routing and stakeholder coordination. High risk oversize/overmass movements associated with the delivery of project transformers would be planned and implemented through detailed construction planning and consultation with the relevant road authorities.

During operation, the facility would be remotely operated with only periodic site visits for inspection and maintenance, so ongoing traffic impacts are expected to be negligible.

Water

The water assessment found the project is located within the Hunter River catchment, where drainage is conveyed via an unnamed third-order ephemeral watercourse and a localised shallow depression towards Sandy Creek. Flood modelling confirms that the BESS compound is not inundated in events up to and including the one per cent annual exceedance probability, with off-site flood impacts minimal and no change to the trafficability of the adjacent Sandy Creek Road. Based on criteria consistent with the NSW Government's *Flood Prone Land Package* (DPHI, 2021), the project is considered to manage flood risks to an acceptable level.

During construction, potential impacts to watercourses, flooding and groundwater would be localised and manageable, with erosion, sedimentation and water quality risks controlled through implementation of a soil and water management plan. Reflecting a preference raised by Muswellbrook Shire Council during consultation to minimise construction vehicle movements, non-potable construction water would preferably be sourced from on-site groundwater bores, with tankering from a licensed external source retained as a contingency. Where groundwater is used, predicted drawdown at neighbouring bores would remain within the limits of the *NSW Aquifer Interference Policy* (Department of Primary Industries, 2012).

During operation, low potable water demand and the provision of stormwater treatment infrastructure confirmed through modelling to meet best-practice pollutant reduction targets means that impacts to water resources are not expected to be significant.

Hazards

The hazards and risk assessment, including a preliminary hazard analysis, indicates that the project does not pose an unacceptable risk to public safety or human health, with risks managed to with risks effectively managed through design and operational safeguards. Assessment of thermal runaway indicates that, with appropriate design controls, separation distances and safety systems, potential hazard effects would be contained on site and are not expected to affect surrounding land uses or sensitive receivers. The project would achieve compliance with *Hazardous Industry Planning Advisory Paper No. 4* risk criteria.

The bushfire assessment confirms the project can be safely and appropriately designed and operated within a bushfire-prone landscape. The design incorporates Asset Protection Zones and a Bushfire Attack Level-29 bushfire construction response, consistent with *Planning for Bushfire Protection* (RFS, 2019) requirements.

Social and economic

Construction of the project is expected to take approximately 18 months. A peak workforce of around 150 workers, over a four-to-six-month peak within the construction program, would create short-term employment and procurement opportunities, with some workers likely sourced from outside the local and regional areas. This influx could place temporary pressure on short-term local accommodation, particularly in Muswellbrook, Singleton and Aberdeen. The project has committed to avoidance of the private rental market and has an accommodation strategy that has responded to concerns raised during engagement. A workforce accommodation strategy and workforce management measures would be prepared in consultation with Muswellbrook Shire Council and would have regard to other major projects proposed or underway in the area, to support coordinated planning and minimise cumulative pressure on local accommodation and services.

The project would be operated remotely for a minimum of about 30 years, with activities largely limited to periodic inspection and maintenance. Up to six personnel are expected to undertake maintenance activities on a quarterly basis, potentially sourced locally where practicable. With low and intermittent maintenance visits, no material impacts on housing, social infrastructure and services, community cohesion, or access and connectivity are anticipated during operation.

The project has committed to benefit sharing equating to approximately \$320,000 per annum (adjusted) on an ongoing, indexed basis, proposed to be delivered through a Voluntary Planning Agreement administered collaboratively with Muswellbrook Shire Council, supporting lasting community benefits over the operational life of the project and responding to issues raised during engagement.

Land

The land use and agriculture assessment confirms the project is in a predominantly agricultural area, and its construction footprint (about 20.02 hectares) represents only about 0.01 per cent of available agricultural land in the Muswellbrook Shire LGA. Areas not required for permanent infrastructure would be reinstated after construction. During operation, land use change is largely limited to the BESS operational footprint (about 9.4 hectares), while land within the connection infrastructure corridor (4.3 hectares) can continue to support most normal agricultural activities (including grazing); with LUCRA-informed controls and biosecurity/property management measures in place, residual impacts on agricultural productivity are negligible.

Waste

Waste streams are typical of major construction and would be managed using the waste hierarchy and circular economy principles, with appropriate classification and lawful disposal pathways. The project has committed to avoiding Council operated waste facilities and has identified appropriate private waste facilities that are able to receive all anticipated project waste streams. Operational waste volumes are expected to be low and managed through operational waste procedures. Waste management plans will be developed and implemented during construction and operation to ensure the correct classification, management and disposal of project wastes.

Justification and conclusion

Australia's electricity system is transitioning as coal-fired generation retires. Longer duration firm capacity, in the form of utility scale battery energy storage systems, are required to maintain a secure, reliable, resilient and diverse energy system for the benefit of New South Wales. The project supports NSW energy security by providing large-scale, firm and dispatchable capacity to improve system reliability, resilience and secure transmission network operations. In doing so, the project would deliver short- and long-term benefits to NSW, households, business and industries.

The project would also deliver local benefits, including short-term employment and procurement opportunities during construction and ongoing community benefit funding to support local priorities through a Voluntary Planning Agreement with Muswellbrook Shire Council.

In this strategic location on the NSW energy network, adjacent to existing transmission infrastructure and within an established and modified rural landscape in the Hunter-Central Coast Renewable Energy Zone, these benefits are achieved while avoiding or minimising land use conflict, environmental impact and risks to surrounding land uses.

Mitigation measures for design, construction, operation and decommissioning have been identified to avoid, minimise and manage potential impacts identified in this EIS. Project impacts would be mitigated through best-practice environmental management. Environmental performance will be managed through the CEMP and operational controls to ensure compliance with relevant legislation and approval conditions. With these measures in place, potential impacts will be effectively managed to acceptable levels.

The project's justification has been considered against its objectives, impacts and benefits over its design life. In summary, the project is justified because:

- environmental and socio-economic impacts have been avoided and minimised as far as reasonably practicable, with consideration of biophysical, economic and social impacts
- there is a clear and demonstrated need for the project, consistent with relevant national, state and regional plans and policies
- it promotes social and economic welfare through a stable, secure and reliable energy system
- it promotes resilience to climate change
- it involves orderly and economic use of the land
- it is in accordance with the Objects of the EP&A Act and is consistent with the ecologically sustainable development principles, because it would achieve an appropriate balance between the relevant environmental, economic and social considerations.

On balance, while construction would involve temporary, localised impacts, these are expected to be acceptable with the proposed mitigation and management measures in place. The project's broader benefits and strategic alignment, together with the ability to manage residual impacts to an acceptable level, support a conclusion that the project is justified and in the public interest.

How can I comment on the project and/or the EIS?

Public exhibition

The EP&A Act requires exhibition of an EIS for public comment for a minimum period of 28 days.

The NSW Government will exhibit the EIS on the NSW Major Projects website. A printed copy of the EIS, the appendices and technical reports will be available at Muswellbrook Shire Council – 60-82 Bridge Street, Muswellbrook New South Wales 2333.

The EIS will also be referred to key government agencies for their review.

Further information about the project will be provided on the project website, available at: [McCullys Gap Battery Energy Storage System \(BESS\)](#).

Making a submission

Submissions about the project are invited during the exhibition period from any interested person or organisation. Submission can be made to the NSW Department of Planning, Housing and Infrastructure (DPHI) via the Major Projects website.

Details on to make a submission are provided on the project website and in other communication material. All submissions must be received before the close of the exhibition period (as detailed on the project website and the Major Projects website).

Following exhibition of the EIS, all stakeholder feedback will be reviewed and addressed in a Submissions Report. If further engagement is required to respond to the issues raised (e.g. to clarify issues of concern or to seek feedback on proposed refinements to the project), the details of that engagement will be outlined in the Submissions Report.

Glossary of terms and abbreviations

Terms and abbreviations	Definition
ABS	Australian Bureau of Statistics
AC	Alternating current
ACT	Australian Capital Territory
AEMO	Australian Energy Market Operator
AEP	Annual Exceedance Probability
AHIMS	Aboriginal Heritage Information Management System
APZ	Asset Protection Zone
AQMS	Air quality monitoring station
AS	Australian Standard
AS/NZS	Australian/New Zealand Standard
AWS	Automatic Weather Station
BC Act	<i>Biodiversity Conservation Act 2016</i>
BDAR	Biodiversity Development Assessment Report
BESS	Battery Energy Storage System
BoM	Bureau of meteorology
BSAL	Biophysical strategic agricultural land
BW	BW Group (parent company of the applicant)
°C	Celsius
CCTV	Closed-circuit television
CEEC	Critically endangered ecological community
CEMP	Construction Environmental Management Plan
CS	Construction scenario
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTMP	Construction Traffic Management Plan
dB	Decibels
DC	Direct current
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
Development footprint	The term 'disturbance footprint' is used in the EIS to refer to the area of direct ground disturbance required to construct and operate the project.
DP	Deposited Plan
DPE	Department of Planning and Environment (<i>former NSW department</i>)
DPHI	Department of Planning, Housing and Infrastructure
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment (<i>former NSW department</i>)
EIS	Environmental Impact Statement
EMF	Electromagnetic fields
EPA	Environment Protection Authority

Terms and abbreviations	Definition
EP&A	Environmental Planning and Assessment
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographic Information System
GRS	Gross Regional Product
GW	Gigawatt
HEVAE	High Ecological Value Aquatic Ecosystems
HHIA	Historic Heritage Impact Assessment
HIPAP No. 4	<i>Hazardous Industry Planning Advisory Paper No. 4</i>
HV	High-voltage
HVAC	Heating, ventilation and air conditioning
IAQM	Institute of Air Quality Management
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IBRA	Interim Biographic Regionalisation for Australia bioregion and subregion
ILUA	Indigenous Land Use Agreement
IPC	Independent Planning Commission
IRSAD	Index of Relative Socio-Economic Advantage and Disadvantage
ISP	Integrated System Plan
kV	Kilovolt
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LETS	Low Emissions Technology Statement
LFP	Lithium-iron phosphate
LGA	Local Government Area
LUCRA	Land Use Conflict Risk Assessment
LSPS	Local Strategic Planning Statement
mG	Milligauss
ML	Monitoring location
MNES	Matters of national environmental significance
MP	Minister for Planning and Public Spaces
MW	Megawatt
MWh	Megawatt hours
MW	Megawatt
NEM	National Electricity Market
NML	Noise management level
NorBE	Neutral or beneficial effect
NPfi	Noise Policy for Industry
NSW	New South Wales
NSW BOS	New South Wales Biodiversity Offset Scheme
NSW RFS	New South Wales Rural Fire Service
NSW SHR	New South Wales State Heritage Register

Terms and abbreviations	Definition
OEH	Office of Environment and Heritage
OEMP	Operational environmental management plan
OSOM	Oversize / overmass
PAD	Potential archaeological deposit
PCTs	Plant community types
PBP	Planning for bushfire protection
PHA	Preliminary hazard analysis
PMF	Probable Maximum Flood
Project area	The term 'project area' is used in the EIS to refer to the area required to construct and operate the project. It includes the location of: – the areas for construction of the BESS, substation and connection infrastructure components – construction ancillary facilities – new access tracks and upgrades to existing local roads, access tracks and intersections – the permanent easement for the connection infrastructure – permanent surface operational infrastructure.
RAI	Rental Affordability Index
RAPs	Registered Aboriginal Parties
RBLs	Rating background noise levels
Resilience and Hazards SEPP	State Environmental Planning Policy (Resilience and Hazards) 2021
SAII	Serious and irreversible impacts
SEPP	State Environmental Planning Policy
SEIFA	Socio-Economic Indexes For Areas
SIA	Social Impact Assessment
SALs	Suburbs and localities
SSD	State Significant Development
SWMP	Soil and Water Management Plan
TEC	Threatened ecological community
the applicant	Muswellbrook Pro Unit Holdings Pty Ltd
the BAM	<i>Biodiversity Assessment Method</i>
the BC Regulation	<i>Biodiversity Conservation Regulation 2017</i>
VPA	Voluntary Planning Agreement
VP	Viewpoints
VRZ	Vegetated riparian zone
WNAC	Wanaruah National Aboriginal Corporation

Part A

Introduction and project context

1. Introduction

1.1 Background

The New South Wales (NSW) electricity system is undergoing a significant structural transition, driven by the progressive withdrawal of ageing coal-fired generation and the rapid uptake of variable renewable energy sources.

This transition requires not only new sources of electricity supply but, critically, technologies that can maintain system reliability as reliance on renewable energy sources such as solar and wind increases. In this context, energy storage plays a central role by providing firm and dispatchable capacity, enabling electricity to be supplied during periods of high demand, reduced renewable output or broader system stress.

The *NSW Electricity Strategy* (NSW Government, 2019) sets out the NSW Government's plan to deliver a reliable, affordable and sustainable electricity system (Department of Planning, Industry and Environment (DPIE), 2019). The strategy recognises that renewable generation, supported by firming and storage technologies including battery energy storage systems, is required to replace retiring coal-fired capacity while maintaining grid stability and energy security. More recently, the Energy Security Target framework and associated Energy Security Target Monitor have been established to identify and manage forecast shortfalls in firm capacity as the energy system transitions.

Against this policy and market context, Muswellbrook Pro Unit Holdings Pty Ltd (the applicant) is proposing to develop the McCullys Gap Battery Energy Storage System (referred to as 'the project' for the purposes of this document). The project is intended to support the NSW electricity system by providing large-scale, firm and dispatchable capacity, contributing to system reliability and resilience and supporting the secure operation of the transmission network as the generation mix continues to evolve.

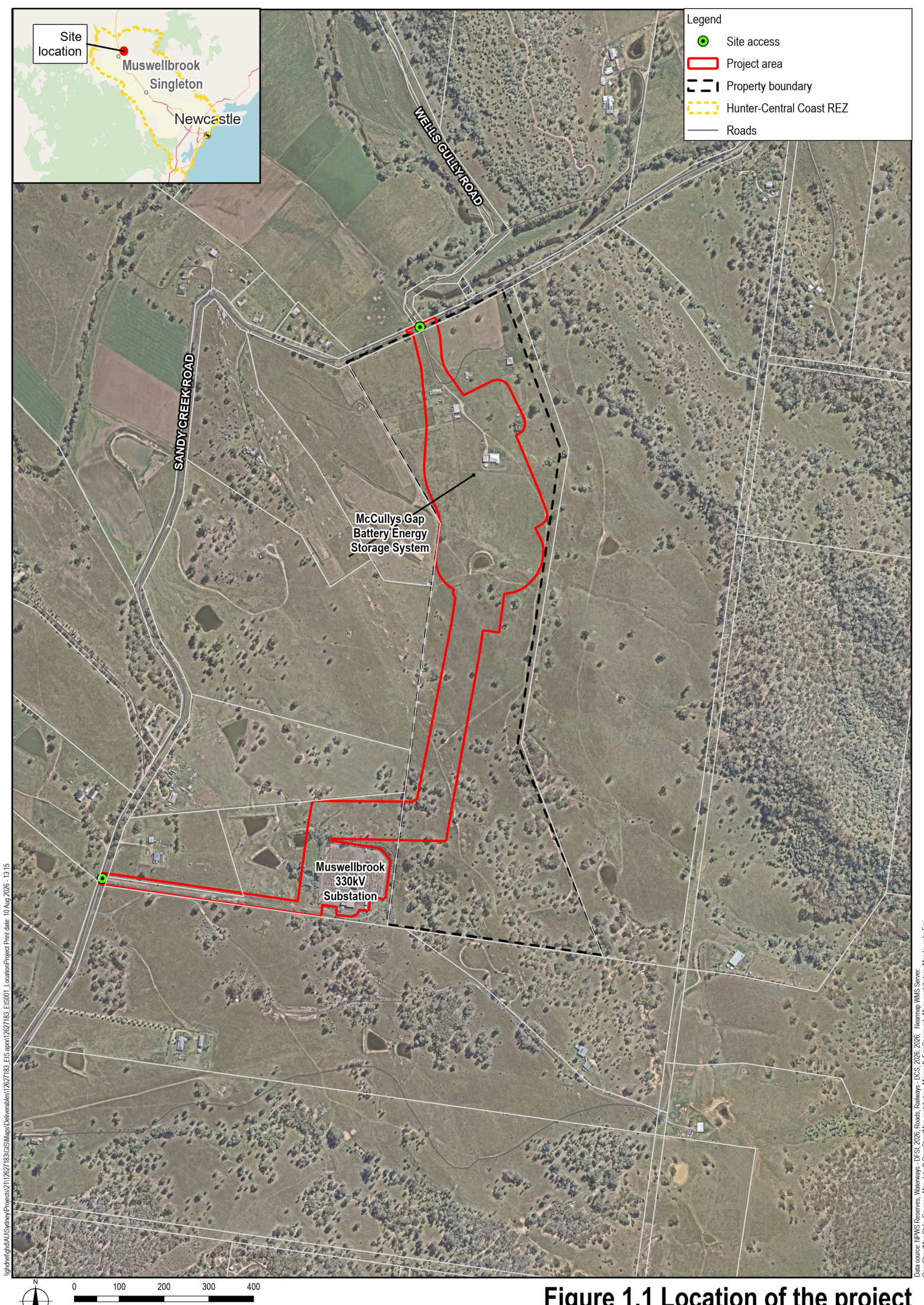
1.2 Project overview

The project involves constructing and operating a grid-scale battery energy storage facility (BESS) near Muswellbrook in NSW. The BESS would have a capacity of up to 400 megawatts (MW) and a storage duration of four hours. The project is proposed to connect to the existing NSW high-voltage transmission network via dedicated connection infrastructure and the existing Muswellbrook 330 kilovolt (kV) substation. This capacity enables the project to provide firm and dispatchable electricity during peak demand periods, consistent with the system reliability needs of the NSW transmission network. Electricity would be imported to and exported from the BESS via a new on-site substation and associated connection infrastructure.

1.2.1 Location

The project is located in the Muswellbrook Shire local government area (LGA) in the Upper Hunter region of NSW on the lands of the Wonnarua (also spelled as Wanaruah) people. The project is located across two properties at 578 and 380 Sandy Creek Road in McCullys Gap, NSW, approximately six kilometres northeast of the township of Muswellbrook. The project area also includes the existing Muswellbrook 330kV substation. This rural setting offers the necessary land availability and environmental conditions suitable for the development.

The location of the project is shown on Figure 1.1.



1.2.2 Key features

The key operational features of the project include:

- 400 MW battery energy storage system, with a duration of up to four hours (1,600 megawatt hours (MWH)) with associated power control, transformers, switchgear and safety systems
- connection infrastructure, including a project substation, 800 metre transmission line and associated infrastructure to connect the project substation to the existing Muswellbrook 330 kV substation
- works at the existing Muswellbrook 330 kV substation to facilitate connection of the project's connection infrastructure to the high-voltage transmission connection point
- associated ancillary and enabling infrastructure including operation and maintenance facilities, internal access, fencing, drainage, firewater facilities, safety and security infrastructure.

Further information about the project is provided in Chapter 3 of this Environmental Impact Statement (EIS).

1.2.3 Anticipated timing

The project is expected to be operational in late 2029 following commissioning and testing of the electrical infrastructure and operate for 30 years.

It is anticipated that construction would commence in 2027, subject to obtaining all necessary approvals.

1.2.4 Objectives

The objectives of the project are to:

- store and dispatch energy to the NSW energy system
- assist with a stable, secure, reliable and diverse energy system
- avoid, minimise, mitigate and offset environmental impacts
- deliver environmental and community benefits by lowering carbon emissions, minimising impacts, and supporting local economic outcomes.

Further details of the Australian, NSW and local Government strategies and policies which align with these objectives and support project development are provided in section 2.

1.2.5 Approval requirements

The project is State Significant Development (SSD) under State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP). As SSD, the project requires development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Minister for Planning and Public Spaces is the consent authority for the project.

In accordance with Division 4.7 of the EP&A Act, the proponent requested and obtained the Planning Secretary's Environmental Assessment Requirements (SEARs) for the project. The SEARs, dated 23 January 2025, define the matters that must be addressed in this EIS to support the assessment of the project and inform the determination of the development application.

The project was determined to be a controlled action on 27 February 2026 following referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Approval is also required from the Australian Minister for the Environment and Water.

Further information about the approval and assessment requirements is provided in Chapter 4 (Statutory context).

1.3 The applicant

The applicant for the project is the Muswellbrook Pro Unit Holdings Pty Ltd.

The details of the applicant are as follows:

Name: Muswellbrook Pro Unit Holdings Pty Ltd
ACN: 682 732 592
Address: 10 – 20 Gwynne Street, Cremorne, VIC 3121

1.4 Purpose and structure of this EIS

This EIS supports an application for development consent in accordance with Division 4.7 of the EP&A Act. This EIS has been prepared to address the Planning Secretary's Environmental Assessment Requirements (SEARs) for the project (SSD-78810458) issued on 24 March 2025. A compliance table demonstrating how the SEARs have been addressed is provided in Appendix A.

The EIS has been prepared in accordance with the form and content requirements specified in Part 8 of the *Environmental Planning and Assessment Regulation* (EP&A Regulation). The EIS has also been prepared in general accordance with the form, content, and structure requirements outlined in the *State Significant Development Guidelines – preparing an environmental impact statement* (DPIE, 2022a), *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE, 2022b) and the *Renewable Energy Planning Framework* (Department of Planning, Housing and Infrastructure (DPHI), 2024).

The structure and content of this EIS are outlined in Table 1.1.

Table 1.1 Report structure and content

Chapter No.	Chapter title	Content
	Executive summary	Provides an overview of the environmental impact statement.
1	Introduction	Provides background to the project, an overview of the applicant and the project. It also outlines the document purpose and structure.
2	Strategic context	Explains the strategic need for the project, benefits, consistency with government plans, policies and guidelines, and outlines the alternatives considered during development of the project.
3	Project description	Provides a detailed description of the project. Includes a description of the project area, the physical layout and design, uses and activities, and timing (stages, phases and sequencing) of the project.
4	Statutory context	Provides the statutory context of the project, including an outline of the relevant legislation and environmental planning instruments applicable to the project.
5	Community and stakeholder engagement	Discusses engagement undertaken with the community, including government agencies. Outlines how the community engagement aims have been addressed, the key issues raised by the community, and the proposed future approach to community engagement.
6 to 19	Assessment of impacts	Provides an assessment of the potential environmental, social and economic impacts during construction, operation, and decommissioning and rehabilitation for the following: – Identification of key issues – Biodiversity – Noise and vibration – Landscape and visual – Aboriginal heritage – Historic heritage – Land and soils – Traffic and transport – Water – Hazard and risk – Bushfire – Social and economic

Chapter No.	Chapter title	Content
		– Air quality – Waste management and resource use. It identifies management measures to avoid or reduce impacts associated with construction, operation, and decommissioning and rehabilitation of the project.
20	Environmental management and mitigation	Recommends measures to mitigate and manage the potential impacts identified.
21	Justification and conclusion	Provides an overview of the conclusions from the environmental impact assessment and discusses the project's justification on balance of environmental, social and economic considerations.
	References	Provides a list of references used throughout the EIS.

The EIS is supported by a series of appendices and technical reports that address the project statutory requirements and underpin the impact assessment findings in Chapters 6 to 19. These include:

- Appendix A – SEARs compliance table
- Appendix B – Statutory compliance
- Appendix C – Consolidated mitigation measures
- Technical Report 1 – Biodiversity Development Assessment Report
- Technical Report 2 – Noise and Vibration Impact Assessment
- Technical Report 3 – Landscape and Visual Impact Assessment
- Technical Report 4 – Aboriginal Cultural Heritage Assessment Report
- Technical Report 5 – Historic Heritage Impact Assessment
- Technical Report 6 – Land Use and Agriculture Assessment
- Technical Report 7 – Traffic and Transport Impact Assessment
- Technical Report 8 – Water Impact Assessment
- Technical Report 9 – Preliminary Hazard Analysis
- Technical Report 10 – Bushfire Hazard Assessment
- Technical Report 11 – Social Impact Assessment.

2. Strategic context

2.1 Project need

The need for the project arises from the ongoing transformation of the NSW and National Electricity Market, characterised by the withdrawal of coal-fired generation and increasing reliance on variable renewable energy sources. This section outlines the strategic and policy context that establishes the need for additional energy storage capacity and demonstrates how the project responds to relevant Australian, State, regional and local planning frameworks.

2.1.1 Electricity system context

Australia's electricity system is undergoing a structural transition driven by the progressive withdrawal of coal-fired generation and increasing penetration of variable renewable energy sources. While fossil fuels continue to play a significant role, their contribution to electricity generation is declining. In 2024, fossil fuels accounted for approximately 64 per cent of total electricity generation in the National Electricity Market (NEM), while renewables contributed around 36 per cent, led primarily by solar and wind generation (DCCEE, 2024).

As this transition accelerates, ensuring that the electricity system remains secure, reliable and capable of meeting peak demand has become a central system challenge. Variable renewable generation is weather-dependent and does not always align with periods of highest demand, particularly during summer heatwave events. Addressing this challenge requires sufficient firm and dispatchable capacity that can respond rapidly to changes in supply and demand and operate independently of weather conditions.

In NSW, this system challenge is formally assessed through the Energy Security Target, which defines the level of reliable electricity capacity required to meet customer demand during a one-in-ten-year summer heatwave, with an additional reliability buffer. The Energy Security Target Monitor assesses whether sufficient firm capacity – including generation, firming and energy storage – is available to meet this requirement over time.

2.1.2 Transition of the NSW electricity system

The *NSW Electricity Strategy* (DPIE, 2019) and supporting planning frameworks recognise that the State's electricity system is entering a period of heightened transition risk as ageing coal-fired power stations progressively withdraw from the market. Four of NSW's five remaining coal-fired power stations are expected to reach the end of their technical lives over the next decade, and experience has shown that ageing generators become increasingly prone to outages and unplanned failures, particularly during periods of extreme demand.

This transition is reflected in national electricity system planning undertaken by the Australian Energy Market Operator (AEMO). Under the Step Change scenario identified in the 2024 Integrated System Plan (ISP) as the most likely future pathway for the NEM, substantial investment in new generation, firming capacity, energy storage and transmission infrastructure is required to maintain system reliability and security. The 2024 ISP forecasts that approximately 90 per cent of existing coal-fired generation capacity would retire by 2034–35, with all coal-fired generation exiting the NEM by around 2040.

In NSW, the implications of this transition are assessed in detail through the Energy Security Target Monitor reports. The most recent Energy Security Target Monitor Report (2025) concludes that, while NSW currently maintains sufficient firm capacity, a forecast shortfall in firm capacity is expected to emerge in the 2027–28 summer period. Following this, firm capacity is forecast to remain sufficient until a further shortfall emerges in 2033–34, associated with the anticipated closure of the Bayswater and Vales Point power stations.

While the Energy Security Target Monitor indicates that projects already under development could address these forecast shortfalls if delivered on time, the assessment highlights ongoing uncertainty associated with renewable energy lulls, changing generator operating patterns and future demand growth. To address these emerging risks, NSW energy policy has placed increased emphasis on the timely delivery of firming infrastructure, including large-scale battery energy storage, to ensure sufficient dispatchable capacity is available during periods of peak demand and system stress.

2.1.3 Role of the battery energy storage system

As the electricity system transitions away from synchronous coal-fired generation towards greater reliance on variable renewable energy sources, there is an increasing need for technologies that can respond rapidly to changes in supply and demand. Large-scale battery energy storage systems help address this need by providing dispatchable capacity that can operate independently of weather conditions, support system security during peak demand periods, and respond to unexpected outages or network disturbances.

Energy storage enables electricity generated during periods of high supply to be stored and dispatched when needed, improving operational flexibility and supporting a stable and reliable electricity system. In this context, battery energy storage is recognised as a cost-competitive and flexible technology capable of responding rapidly to changes in supply and demand, assisting with peak demand management and helping to manage variability associated with solar and wind generation.

The project would contribute to grid stability and reliability by storing electricity during periods of higher generation and dispatching it when required. This capability supports the efficient utilisation of existing and proposed generation in the region by providing storage capacity in proximity to the high-voltage transmission network. In doing so, the project would assist in meeting periods of peak demand, responding to unexpected outages, and helping to smooth fluctuations in renewable output.

2.1.4 Strategic alignment with government strategies, policies and legislation

Australian, State and regional energy strategies consistently identify large-scale energy storage as essential infrastructure to support the reliability and security of the electricity system as ageing coal-fired generation retires and the proportion of variable renewable energy increases.

The Australian Government's *Long-Term Emissions Reduction Plan* (Australian Government, 2021) adopts a technology-led approach to achieving net zero emissions by 2050 while maintaining affordable and reliable electricity supply. The plan identifies energy storage, including battery storage, as a priority technology to support the delivery of clean, reliable and low-cost electricity. The associated *Technology Investment Roadmap* and *Low Emissions Technology Statement 2021* recognise that the widespread deployment of energy storage would facilitate the integration of renewable generation, provide system security services, supply dispatchable electricity during periods of peak demand, and place downward pressure on electricity prices.

The ISP prepared by the AEMO provides a whole-of-system planning framework for the National Electricity Market. The most recent final ISP (2024), together with the Draft 2026 ISP currently under consultation, confirms that a renewables-led electricity system firmed by storage and supported by transmission infrastructure represents the least-cost and most reliable pathway to meet future electricity demand as coal-fired generation retires. While the Draft 2026 ISP is not yet finalised, it reaffirms the strategic direction established in the 2024 ISP, including the critical role of large-scale storage in managing variability in supply and maintaining system reliability.

At the State level, the NSW *Electricity Strategy* and the NSW *Electricity Infrastructure Roadmap* establish the policy framework to ensure a reliable, affordable and secure electricity system during the transition away from coal-fired generation. These strategies recognise that firmed renewables, including battery energy storage systems, represent the most cost-competitive form of new capacity and identify energy storage as essential infrastructure for maintaining reliability, meeting peak demand and responding to unplanned outages. The Roadmap specifically identifies the delivery of energy storage infrastructure as a core pillar supporting system security, regional investment and economic development.

The NSW *Electricity Infrastructure Investment Act 2020* (EII Act) establishes the legislative framework to deliver the NSW Electricity Infrastructure Roadmap and accelerate investment in generation, storage and transmission infrastructure to support a secure, reliable and affordable electricity system. The EII Act provides for the coordinated development of energy infrastructure within Renewable Energy Zones and introduces mechanisms to ensure sufficient firming and storage capacity is delivered alongside renewable generation to maintain system reliability. Large scale battery energy storage systems are recognised as critical infrastructure to firm variable renewable energy, manage supply and demand imbalances, and support the efficient utilisation of transmission network capacity. While the project is not in a Renewable Energy Zone, its location adjacent to existing high voltage transmission infrastructure and its ability to provide dispatchable storage capacity is consistent with the

intent of the EII Act to facilitate timely delivery of firming infrastructure required to support the transition of the electricity system and respond to forecast firm capacity shortfalls identified in NSW energy planning frameworks.

The project aligns with these Commonwealth and NSW policy frameworks by providing large-scale battery energy storage infrastructure capable of supporting system reliability, assisting with peak demand management and enabling the efficient utilisation of existing and proposed generation in the region. In doing so, the project contributes to the orderly transition of the electricity system while supporting secure and reliable electricity supply.

2.1.5 Regional and local land use planning

Hunter Regional Plan 2041

The Hunter Regional Plan 2041 (Department of Planning and Environment (DPE), 2022) sets the strategic land use framework for continued economic growth and diversification in one of Australia's most diverse and liveable regions. This plan aims to unlock sustainable growth opportunities and investments, as well as housing choice and lifestyle opportunities, while also considering changes due to the Hunter–Central Coast REZ that encompasses the Muswellbrook Shire LGA.

Objective 7 of the plan aims to reach net zero and increase resilience and sustainable infrastructure. The project is consistent with the infrastructure required to support the Renewable Energy Zone, providing firming capacity in the same location as renewable generators to enhance system reliability as renewable generation increases.

Muswellbrook Shire 2020 – 2040 Local Strategic Planning Statement

The Muswellbrook Shire 2020-2040 Local Strategic Planning Statement (LSPS) (Muswellbrook Shire Council, 2020) outlines the planning priorities and principles that guide Muswellbrook Shire Council in the development of the region. It highlights the opportunities and challenges facing Muswellbrook Shire Council, and sets actions to undertake.

The LSPS notes under opportunities that Muswellbrook Shire plans to embrace technology and innovation (Planning Priority 1). The LSPS vision includes that the production and distribution of sustainable energy will continue in the Shire, with a shift to alternative renewable energies such as wind, biomass, gas, solar, geothermal and pumped hydro sources.

As a battery energy storage project, the project is consistent with Muswellbrook Shire Council's vision through providing firming capacity for existing and anticipated energy generation, improving system reliability and delivering broader benefits to the NSW energy system.

Muswellbrook Shire Community Strategic Plan 2022–2032

The Muswellbrook Shire Community Strategic Plan 2022–2032 (Muswellbrook Shire Council, 2022) sets out a vision for sustainable growth and resilience in the region. It focuses on community wellbeing, economic diversification, environmental sustainability, and cultural values. Key objectives include creating local jobs, supporting emerging industries, and advancing initiatives that reduce the impacts of climate change.

The project would directly support these objectives by firming renewable energy and supporting a stable, secure and reliable energy system. The project would contribute to economic diversification through investment in advanced energy infrastructure and skilled employment opportunities, and the delivery of community benefit funds that would facilitate broader social and economic benefits for the local community.

2.2 Location and setting

2.2.1 Regional context

The project is located in the Upper Hunter region of NSW, within the Muswellbrook Shire LGA and on the traditional Country of the Wonnarua (Wanaruah) people. The Upper Hunter region has a long-established history of energy production, agriculture and resource-based industries and is undergoing a significant economic and land-use transition associated with a diversification of energy generation, supplementing existing thermal-coal generation with renewable energy and energy storage infrastructure. This is associated with the region's location within the Hunter Central-Coast REZ, which has been identified by the NSW Government as suitable for renewable energy generation and associated infrastructure, including BESS', solar and wind farms, and connection infrastructure.

Muswellbrook Shire covers an area of approximately 3,400 square kilometres and includes the townships of Muswellbrook, Denman, Sandy Hollow, Baerami, Wybong and surrounding rural localities. It includes extensive rural land used primarily for grazing, agriculture and resource extraction, alongside major electricity infrastructure, mining operations and transport corridors. Energy infrastructure, including power stations, substations, transmission lines, renewable energy projects and associated industries, forms a prominent component of the regional landscape.

The town of Muswellbrook is the primary regional service centre and administrative hub for the LGA. Muswellbrook is located approximately six kilometres southwest of the project area and provides key services, employment opportunities and infrastructure supporting the surrounding rural and industrial areas.

Other notable physical features within 20 kilometres of the project area include:

- Lake Liddell and Lake Glenbawn
- open cut coal mines (various) and related infrastructure
- townships of Scone and Aberdeen
- Hunter River and tributaries, Bowman and Muscle Creeks
- St Heliers Correctional Facility
- Kingdom Hall of Jehovah's Witnesses
- existing substations.

Other regional features and infrastructure in the vicinity of the project area include the Muswellbrook electricity transmission hub, and major transport routes including the New England Highway (A15), Denman Road and the Main Northern Railway. These regional features and infrastructure elements are shown on Figure 2.1.

2.2.2 Project area

The project would be located across two parcels accessed from Sandy Creek Road on land zoned RU1 Primary Production under the Muswellbrook Local Environmental Plan 2009 (Muswellbrook LEP) (refer Table 2.1, Figure 2.2 and Figure 2.3).

Table 2.1 Summary of lots within project area

	Lot ID No. 1	Lot ID No. 2
Address	578 Sandy Creek Road, McCullys Gap, 2333 Australia	380 Sandy Creek Road, McCullys Gap
Lot / DP	Lot 5//DP802081	Lot 1621, DP 852356
Ownership	Private	Electricity Transmission Ministerial Holding Corporation
Land use zoning	RU1 Primary Production	RU1 Primary Production

The project area is located within a predominantly agricultural land use and also includes the existing Muswellbrook 330 kV substation which provides the connection point to the NSW high-voltage electricity transmission network. The surrounding region also supports a mix of established energy, resource and infrastructure uses, reflecting its role in the evolving energy landscape.

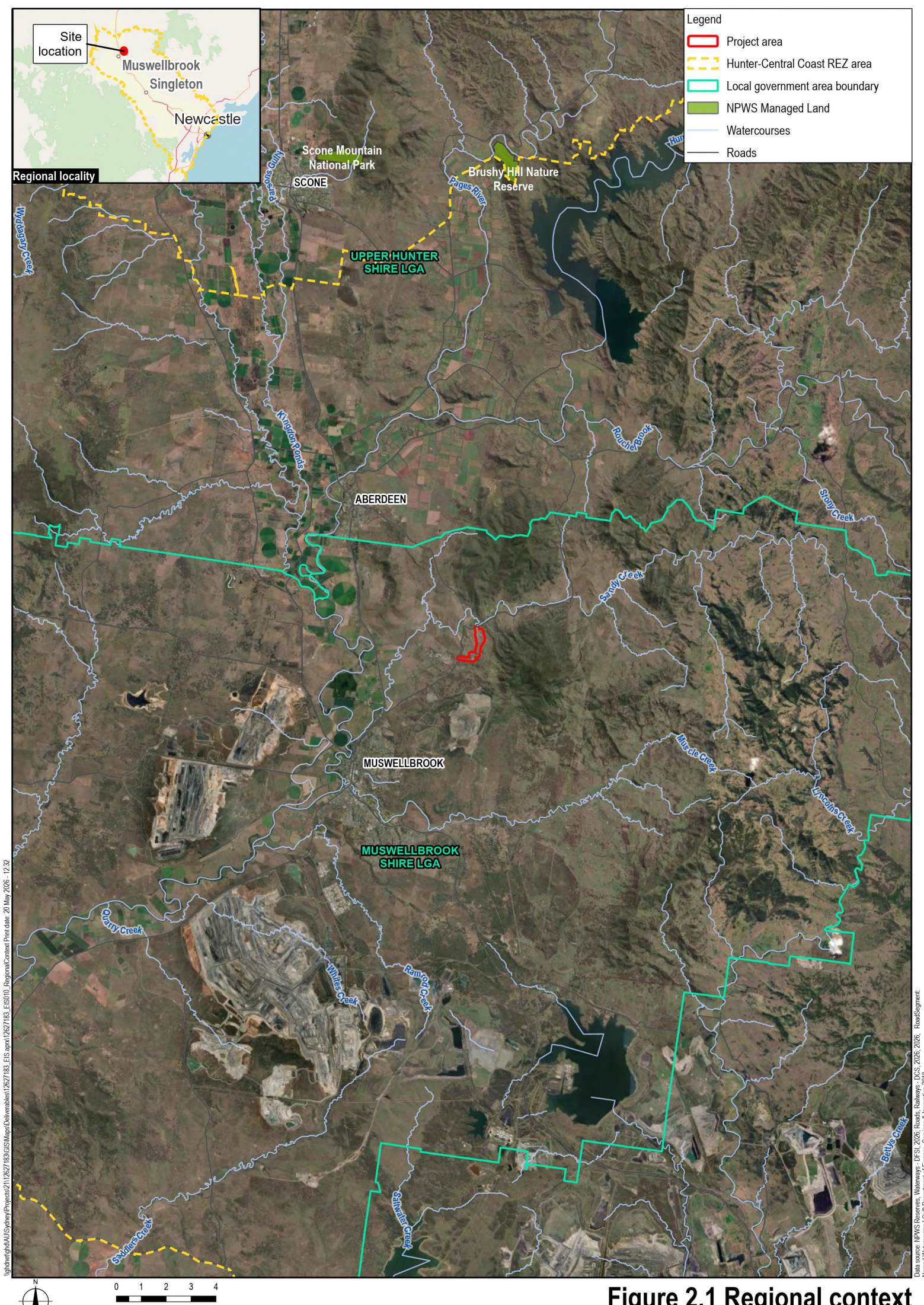


Figure 2.1 Regional context

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Data source: NPWS Reserves, Waterways - DFSI, 2026; Roads, Railways - DCS, 2026; RoadSegment, Named Watercourse LS © Department of Finance, Services & Innovation, 2018

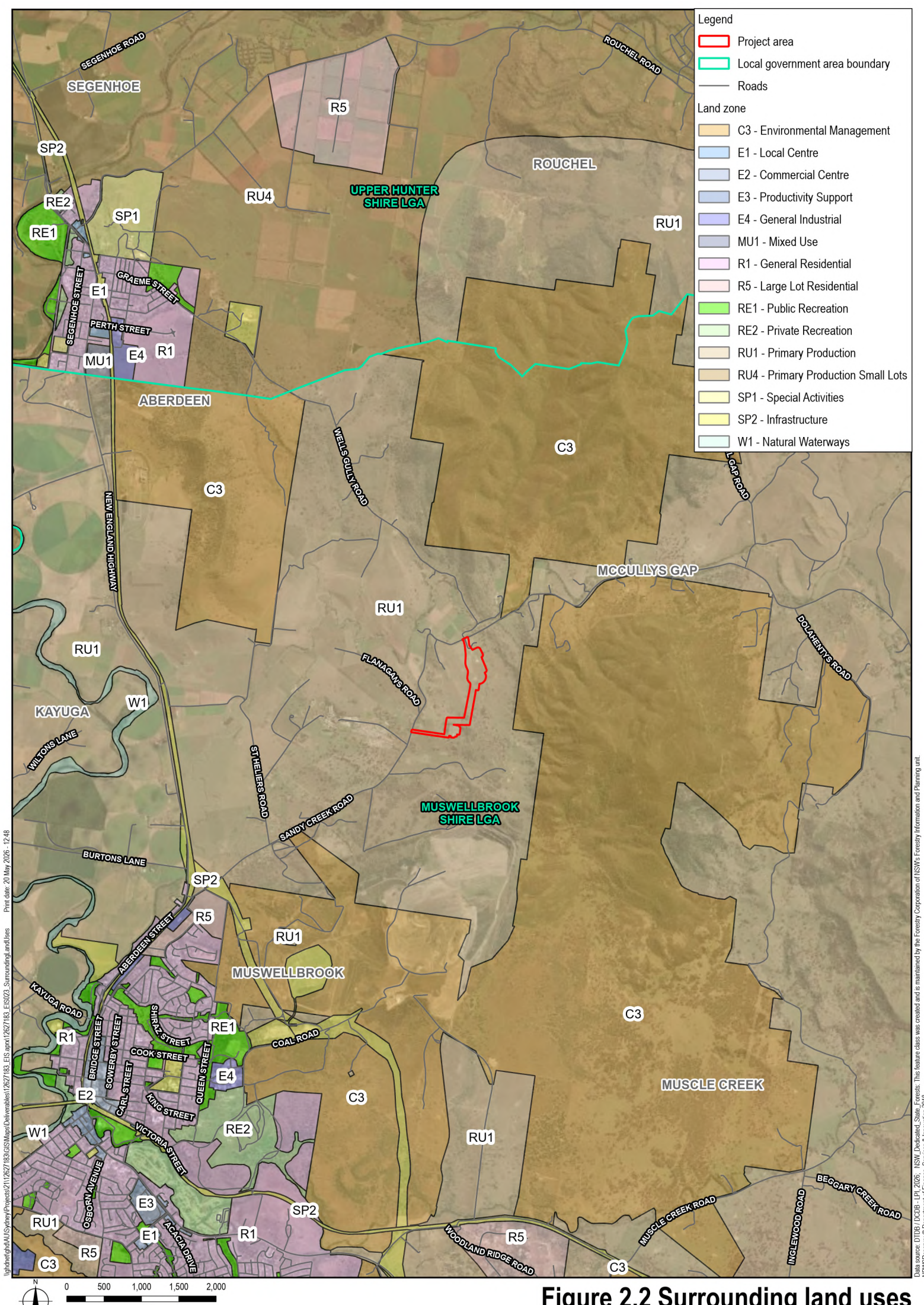
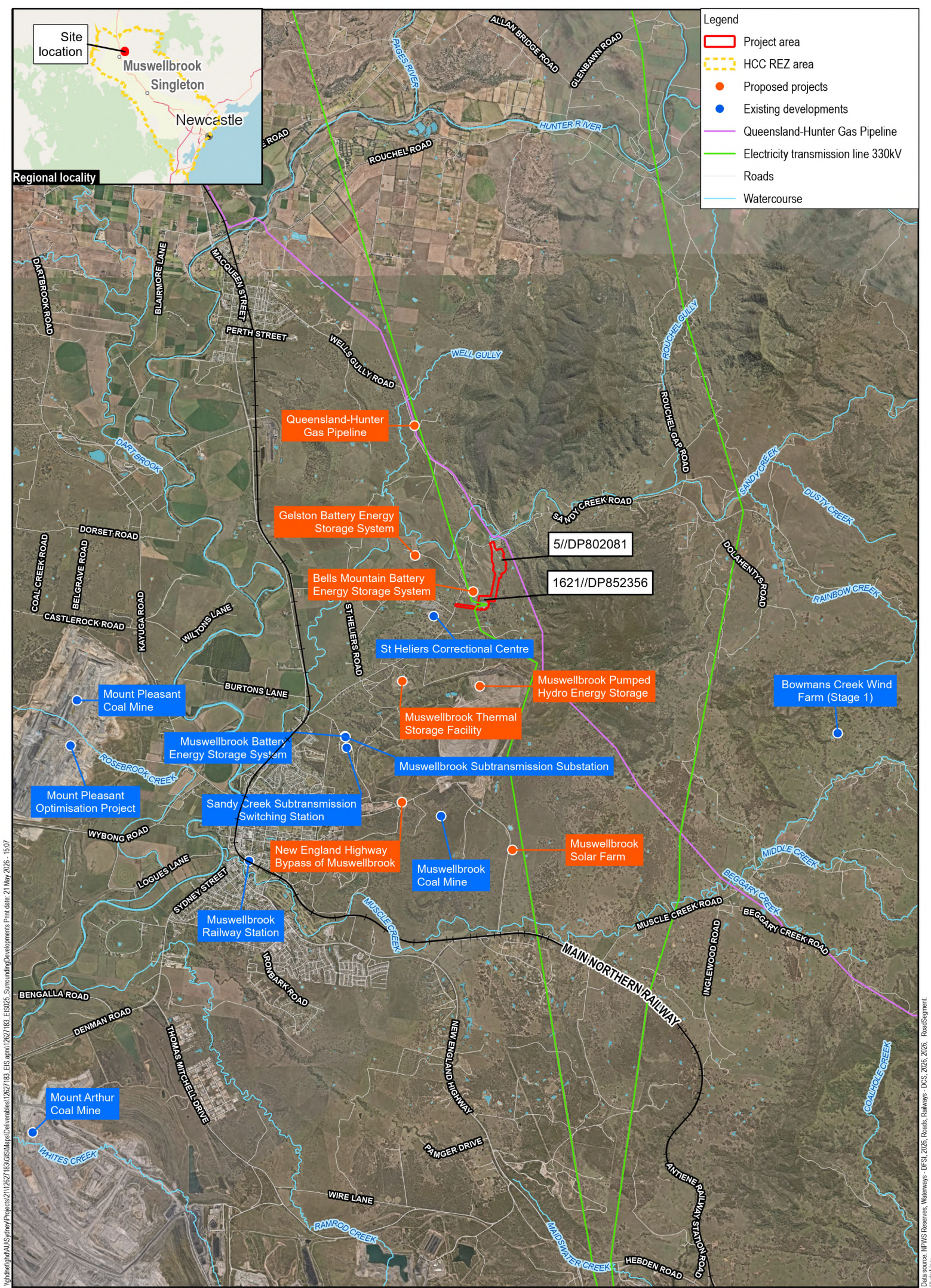


Figure 2.2 Surrounding land uses



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Data source: IPWS Reserves, Waterways - DFSI, 2026; Roads, Railways - DCS, 2026; 2026; RoadSegment, HydroLine.

The project area has been subject to historical agricultural use and contains existing rural access tracks and disturbed areas associated with farming activities. Vegetation within the project area primarily comprises modified pasture, with areas of native vegetation occurring along drainage lines and in less disturbed portions of the site.

Vehicle access to the project area is provided via existing access points from Sandy Creek Road. Rural dwellings in the vicinity of the project area are sparse, typically located on large allotments. The nearest sensitive receivers are located approximately 50 to 70 metres from the project area boundary.

No mapped permanent watercourses occur within the immediate project area, with the closest watercourse located approximately 10 metres directly east of the project area boundary. The site lies within the Hunter River catchment. A single farm dam is located approximately in the middle of the project area. The project is not within any special or controlled areas.

2.3 Site suitability

The following sections explain why this site is suitable for the development of a grid-scale battery energy storage system, having regard to technical, environmental and strategic planning considerations. Selection of the project site from other alternatives is outlined in section 2.4.

The project area demonstrates a high level of suitability for the development of a grid-scale battery energy storage system, having regard to technical, environmental and strategic planning considerations. In particular, the site benefits from its proximity and connection to existing high-voltage transmission infrastructure, its location within an established energy infrastructure corridor, and its capacity to accommodate the project while minimising impacts on surrounding land uses and environmental values.

2.3.1 Technical considerations

The project area includes the existing Muswellbrook 330 kV substation, enabling a direct and efficient connection to the NSW high-voltage transmission network via a short overhead transmission line. The availability of existing connection infrastructure was a primary consideration in the site selection process and is consistent with approaches adopted for other grid scale battery energy storage projects in NSW.

The landform of the project area comprises a combination of gently undulating to moderately sloping rural land that provides sufficient space to accommodate the BESS compound, substation infrastructure and ancillary infrastructure. Site access is achievable via Sandy Creek Road, which connects to the New England Highway and forms part of an established regional and local road network that already services rural and energy-related land uses. This enables construction, operational and maintenance traffic to be managed without reliance on new public road corridors. The site is sufficiently separated from major population centres, minimising the potential for disturbance during construction and operation, while remaining accessible for maintenance and emergency response.

The co-location of the project with major transmission infrastructure also supports operational reliability and system performance. The site allows the BESS to perform its intended role of storing and dispatching energy efficiently in response to network demand, supporting system security and reliability as renewable generation increases across the NSW electricity network.

2.3.2 Environmental considerations

Environmental suitability was a key consideration in the selection and refinement of the McCullys Gap project area. The site is located within a rural landscape that has been shaped by historic agricultural use and existing energy infrastructure, including the existing Muswellbrook 330 kV substation. The project area includes portions of the site that have experienced a high degree of historical disturbance and exhibit more favourable topography, reducing the extent of required earthworks. The availability of sufficient land within the project area has allowed for the development footprint to be configured to avoid or minimise impacts on key environmental values through careful siting and layout design.

The site selection and layout refinement process was undertaken iteratively and informed by consideration of known environmental constraints, including biodiversity values, Aboriginal heritage sensitivity, bushfire risk, watercourses, topography, and areas of previous disturbance. Detailed investigations identified areas of higher ecological and archaeological sensitivity within portions of the site, leading to the relocation of permanent infrastructure into areas exhibiting comparatively lower constraint and more favourable topography. This approach

has reduced the extent of native vegetation clearing, minimised earthworks requirements, and limited the potential for secondary environmental impacts such as erosion and sedimentation. Residual environmental risks are proposed to be managed through established mitigation and management measures, as detailed in the relevant technical assessment chapters. The ability to locate permanent infrastructure outside of the most constrained areas and to manage residual risks through established mitigation measures supports the site's suitability for a BESS.

The rural setting of the project area and its separation from urban centres, together with the low-scale and contained nature of the BESS infrastructure, supports the management of amenity related environmental impacts, including noise and visual changes. The scale of the site enables appropriate separation distances, buffering and landscape treatment to have been included in the project design. This enables the project to be integrated into its surrounding landscape while maintaining the operational and safety requirements of critical electricity infrastructure. A figure showing some of the key environmental constraints identified that were used to drive revisions of the project layout are shown in Figure 2.4.

2.3.3 Strategic planning considerations

From a strategic planning perspective, the site aligns with State and regional energy objectives that prioritise the efficient integration of renewable generation and storage infrastructure within existing energy corridors. The project is located within the Hunter-Central Coast REZ, an area expressly identified to support large-scale renewable energy and storage projects, and the McCullys Gap locality is already characterised by existing electricity infrastructure. The proposed BESS represents a complementary land use that builds on this established role rather than introducing a new or incompatible use.

Locating the BESS adjacent to an existing substation supports orderly land use planning outcomes by consolidating energy infrastructure within a defined area, limiting the need for dispersed infrastructure across the landscape. This approach is consistent with strategic planning principles which emphasise co-location, efficient land use and minimisation of incremental impacts.

The site's zoning for Rural Landscape purposes further supports its strategic suitability. The project is permissible with consent within the RU1 zone and is consistent with zone objectives that seek to avoid fragmentation of agricultural land and minimise land-use conflict. The project does not encroach on land identified as biophysical strategic agricultural land or critical industry clusters and avoids areas of higher agricultural capability, ensuring that the prop represents a compatible and appropriate use within the broader rural landscape.

The site is not constrained by incompatible surrounding land uses that would preclude the operation of a BESS. The predominance of rural land uses in the surrounding area, together with the existing presence of transmission infrastructure, reduces the potential for land use conflict and supports the long-term operation of the project. The site therefore represents a strategically appropriate location for grid-scale battery storage that supports broader State energy and emissions reduction objectives.

2.3.4 Summary

In summary, the project area is considered suitable for development of the project for the following key reasons:

- The site is located within the Hunter-Central Coast REZ and immediately adjacent to the existing Muswellbrook 330 kV substation, enabling a direct and efficient connection to the high-voltage transmission network and minimising the need for additional connection infrastructure.
- The project area has been historically modified by agricultural, and infrastructure uses and contains areas of lower environmental constraint, enabling the project to avoid or minimise impacts on biodiversity, waterways and other environmental features where practicable.
- The site provides sufficient separation from most sensitive receivers as well as public roads, supporting the management of amenity impacts such as noise and visual effects, with potential visual changes generally limited in extent and able to be mitigated through setbacks, design controls and landscaping measures.
- The location supports orderly land use planning outcomes by consolidating new energy infrastructure within an area already characterised by major electricity assets, reducing land use conflict and avoiding the dispersal of infrastructure across the broader landscape.

- The project occupies a small and largely reversible footprint within the Rural Landscape zone, avoids land of higher agricultural capability, and allows for the continuation of agricultural activities during operation and following decommissioning.

Overall, the selected location facilitates the project objectives while avoiding and minimising impacts on the natural and built environment to the extent reasonably practicable.

2.4 Alternatives and options considered

Alternatives to the project have been considered at both a strategic and site-specific level. These considerations have informed the evolution of the project and will continue to be refined through detailed design to ensure the development meets technical requirements while avoiding or minimising environmental, social and economic impacts where practicable. Given the identified need relates to firm capacity and system reliability, the alternatives assessment focused on variations in site location, layout and technology configuration for a battery energy storage system, rather than alternatives that would not provide comparable dispatchable capacity or would introduce additional delivery risk.

Following a constraints and opportunities analysis, the following alternatives were considered:

- the ‘do nothing approach’
- site location alternatives
- alternative layouts within the selected site
- battery technology alternatives.

In assessing alternatives, a primary consideration was whether an option could contribute to the provision of firm and dispatchable capacity within the timeframes identified through the NSW Energy Security Target framework. The Energy Security Target Monitor indicates forecast shortfalls in firm capacity are expected to emerge in 2027–28 and 2033–34 if additional firming infrastructure is not delivered. Accordingly, alternatives were evaluated with regard to:

- ability to contribute to firm capacity and system reliability
- deliverability within relevant timeframes
- locational efficiency, including proximity to existing high-voltage transmission infrastructure to minimise additional connection works and associated impacts.

2.4.1 The ‘do nothing’ approach

The ‘do nothing’ approach would involve not constructing and operating a BESS at the proposed site.

The Energy Security Target Monitor identifies that while NSW currently maintains sufficient firm capacity, a forecast shortfall in firm capacity is expected to emerge in the 2027–28 summer period, with a further shortfall projected in 2033–34 associated with the anticipated retirement of major coal-fired power stations. In the absence of additional firming infrastructure, the ‘do nothing’ alternative would not address these forecast capacity shortfalls or the associated risks to electricity system reliability and security.

While the ‘do nothing’ alternative would avoid the localised environmental impacts associated with construction and operation of the project, it would not deliver the system-wide benefits associated with additional firm and dispatchable capacity. Accordingly, the ‘do nothing’ alternative was not pursued.

2.4.2 Site location alternatives

Site location alternatives were considered during the early stages of project development to identify suitable areas for a grid-scale BESS capable of meeting network needs. This assessment focused on identifying locations that could provide viable grid connection opportunities while avoiding unacceptable environmental, land use or constructability constraints.

Site location alternatives were assessed primarily against (i) proximity to existing high-voltage transmission infrastructure to enable timely and efficient connection, (ii) deliverability within the timeframes relevant to forecast firm-capacity shortfalls identified through the Energy Security Target Monitor, and (iii) avoidance of unacceptable environmental, land use or constructability constraints. Locations requiring materially longer connection

infrastructure or higher delivery risk were not progressed, as these factors reduce the ability of the project to contribute to addressing forecast firm-capacity shortfalls.

The site selection process considered a range of factors, including:

- availability of grid capacity and connection opportunities
- land availability and landowner interest
- strategic planning context and land use compatibility
- proximity to sensitive receivers
- environmental and cultural heritage constraints
- constructability, access and topography.

A number of potential locations in the broader vicinity of the Muswellbrook 330 kV substation were considered but not progressed due to a combination of constraints, including increased distance from connection infrastructure, higher levels of environmental sensitivity, greater potential for land use conflict, or increased construction complexity and cost.

Through this comparative process, the McCullys Gap project area was identified as the most suitable option to progress, as it presented the lowest overall risk and greatest ability to meet the project objectives.

2.4.3 Alternative layouts within the selected site

The project has been iteratively designed in accordance with the avoidance hierarchy, with priority given to avoidance, followed by minimisation and, where required, mitigation of potential environmental impacts.

During early scoping and site selection, a broader project area was assessed to identify opportunities to avoid environmentally sensitive areas, including steep terrain and areas of higher biodiversity value. Within the selected site, successive layout options were developed and refined to avoid identified physical and environmental constraints where practicable. As further site-specific information became available through detailed on-site surveys, geotechnical investigations and environmental assessments, the design was progressively refined to better avoid known constraints, including steep land and sensitive vegetation and potential Aboriginal deposits.

Within the selected site, a range of layout options (see Figure 2.4) were assessed to respond to physical and environmental constraints. Layout refinements were informed by:

- the avoidance principle
- the need to minimise earthworks by avoiding steeper terrain
- over two years of on-ground survey to identify constraints and sensitivities
- the orientation and placement of BESS infrastructure to reduce potential operational noise impacts
- refinement of the connection infrastructure alignment and tower locations to minimise impacts on areas of the project site with high biodiversity value.

The BESS and project substation locations within the property boundary was informed by a comprehensive assessment of environmental, cultural and physical constraints. This included consideration of biodiversity values, Aboriginal heritage sensitivity, bushfire risk, proximity to watercourses, existing land disturbance, topography and constructability.

During the initial development of the project, the central portion of the property was identified as a potentially suitable location for the BESS and associated infrastructure due to its proximity to grid connection infrastructure. This formed the design basis for the Request for SEARs report (GHD, 2024) (see Scoping Report project layout on Figure 2.4). Further ecological and archaeological investigations over two years identified a number of sensitivities within this area, including the presence of threatened flora species, threatened ecological communities and a potential Aboriginal archaeological deposit. These sensitivities were considered in progressing the design.

The northern portion of the property exhibits comparatively lower biodiversity values and has been subject to a higher degree of historical disturbance, resulting in reduced ecological and archaeological sensitivity. This area also presents more favourable topography, with gentler slopes that reduce the need for extensive cut-and-fill earthworks. This design formed the basis for the project EPBC referral in December 2025 (see EPBC Referral project layout on Figure 2.4).

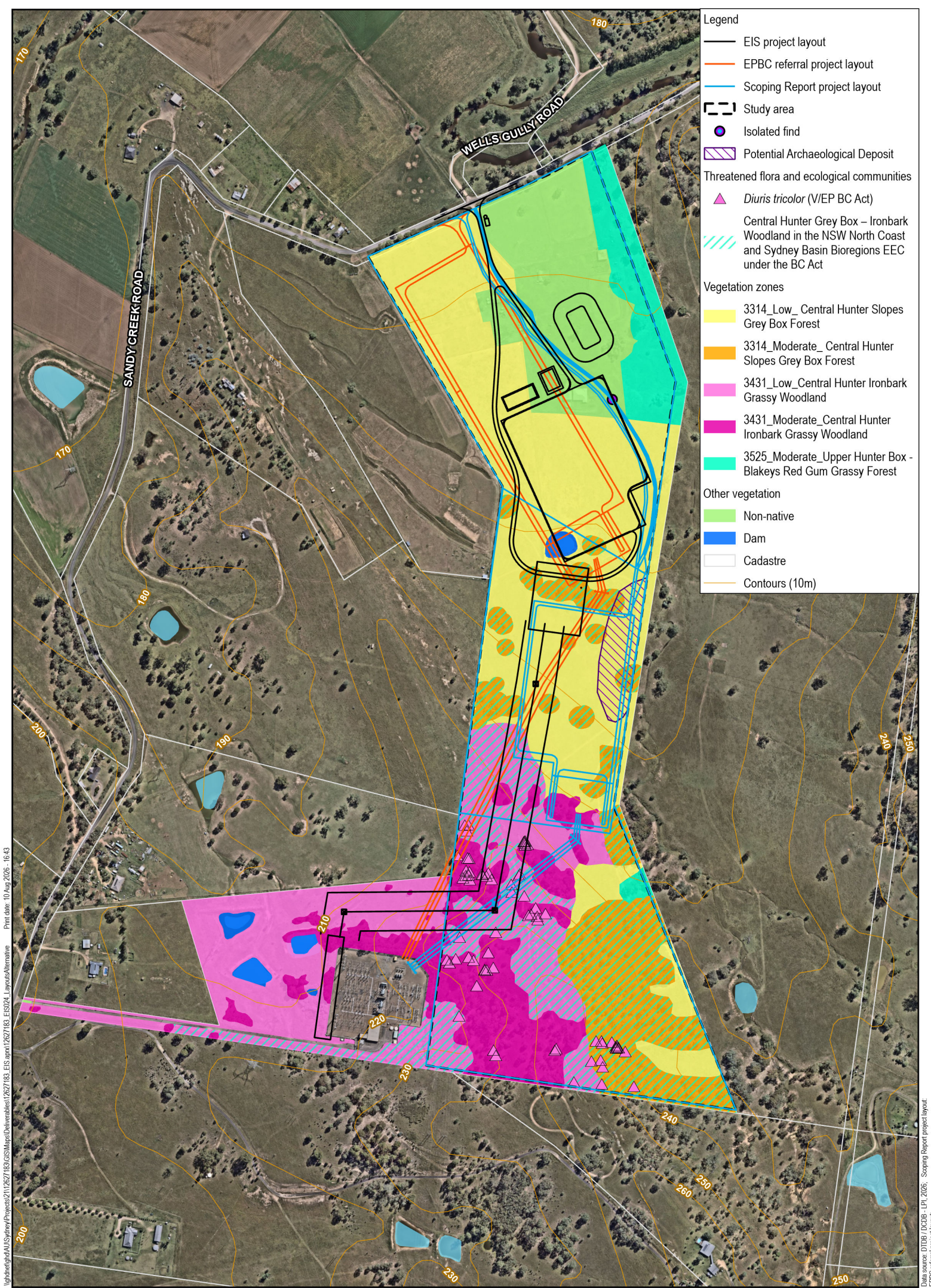


Figure 2.4 Alternative project layouts and key site constraints

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Data source: DT08 / DC016 - LP1, 2026, Scoping Report project layout.
EPBC referral project layout.

This design was then further assessed for noise and visual amenity impacts, with particular regard to the proximity of nearby rural dwellings. Initial noise modelling identified the potential for exceedances at some residential receivers. In response, the project layout and location were refined, including consideration of alternative configurations within the property, to reduce operational noise impacts.

This iterative process resulted in a layout that reduces predicted noise levels at sensitive receivers while also avoiding areas of higher ecological and Aboriginal heritage sensitivity and limiting the extent of earthworks required.

While a range of alternative layouts across the property were considered, the chosen location and layout provides the most balanced outcome. This location minimises ecological disturbance, avoids areas of higher archaeological risk, reduces potential operational noise impacts on nearby sensitive receivers, and limits the need for major earthworks.

2.4.4 Battery technology refinements

Battery technology options were considered to identify a solution capable of providing firm and dispatchable capacity, with an appropriate safety profile and deliverability within the timeframe required to contribute to forecast firm-capacity shortfalls identified through the Energy Security Target framework. On this basis, lithium-iron phosphate (LFP) technology in containerised or enclosed form, is considered the most feasible option currently available for the project, noting technology selection would be confirmed during procurement and detailed design.

No alternative battery technologies offering an equivalent combination of deliverability and safety performance were identified through the procurement process undertaken by the applicant.

2.4.5 Project design development and refinement

Following confirmation of the preferred project site and development area, the project design was progressively developed and refined during the EIS process informed by technical investigations, environmental assessments, stakeholder engagement and constructability considerations.

Early concept layouts were prepared to establish an indicative project footprint and test high-level assumptions regarding the location of the BESS compound, project substation, transmission connection, access arrangements and ancillary infrastructure. These initial layouts were based on preliminary constraints mapping and high-level engineering inputs and were used to identify key design risks and opportunities.

As the project progressed, additional site-specific information became available, including detailed site surveys, geotechnical investigations and environmental constraints analysis. This information informed subsequent design iterations, enabling refinement of infrastructure siting to better respond to topography, natural drainage patterns, environmental sensitivities and constructability considerations.

Design development focused on:

- reducing the extent of earthworks by relocating infrastructure to flatter areas of the site and balancing cut and fill
- refining the BESS compound and on-site substation layout to improve operational efficiency and maintenance access
- adjusting internal access tracks, tower platforms and the transmission alignment to minimise impacts on native vegetation and watercourses
- optimisation of connection infrastructure, reducing the number of towers
- responding to early operational noise modelling outcomes, through adjustments to infrastructure orientation and setbacks from sensitive receivers.

Successive design iterations progressively reduced the disturbance footprint and refined the internal layout to avoid environmental constraints, respond to topography and improve constructability, while retaining the same overall project area.

2.5 Agreements with other parties

The applicant has entered into, or proposes to enter into, agreements with relevant parties to support the development, operation and delivery of the project and associated community benefits.

2.5.1 Planning agreement and benefit-sharing

The applicant acknowledges the importance of delivering tangible and enduring benefits to the local community from the development of the proposed infrastructure. Consistent with contemporary NSW policy settings, the project would enter into a Voluntary Planning Agreement (VPA) with Muswellbrook Shire Council to administer the delivery of community benefits associated with the project through the Muswellbrook Shire Community Benefit Fund.

The proposed approach to benefit sharing has been informed by the *Benefit Sharing Guideline* (DPHI, 2024). The detailed terms of the VPA, including the allocation, eligibility and administration of community benefits, will be finalised through the planning agreement process in consultation with Muswellbrook Shire Council and relevant stakeholders.

3. Project description

3.1 Overview

The project involves the development, construction, operation and decommissioning of a utility-scale battery energy storage system with a capacity of up to 400 MW and up to four hours of storage, in one or more stages. This capacity enables the project to provide firm and dispatchable electricity during peak demand periods, consistent with the system reliability needs identified in section 2.

The project would be located at 578 and 380 Sandy Creek Road, McCullys Gap in NSW which is located approximately six kilometres northeast of the township of Muswellbrook in a rural area. The project also includes the installation of a project (on-site) substation, establishment of a 330 kV overhead line, and related infrastructure to connect the BESS to the existing Muswellbrook 330 kV substation, operated by Transgrid.

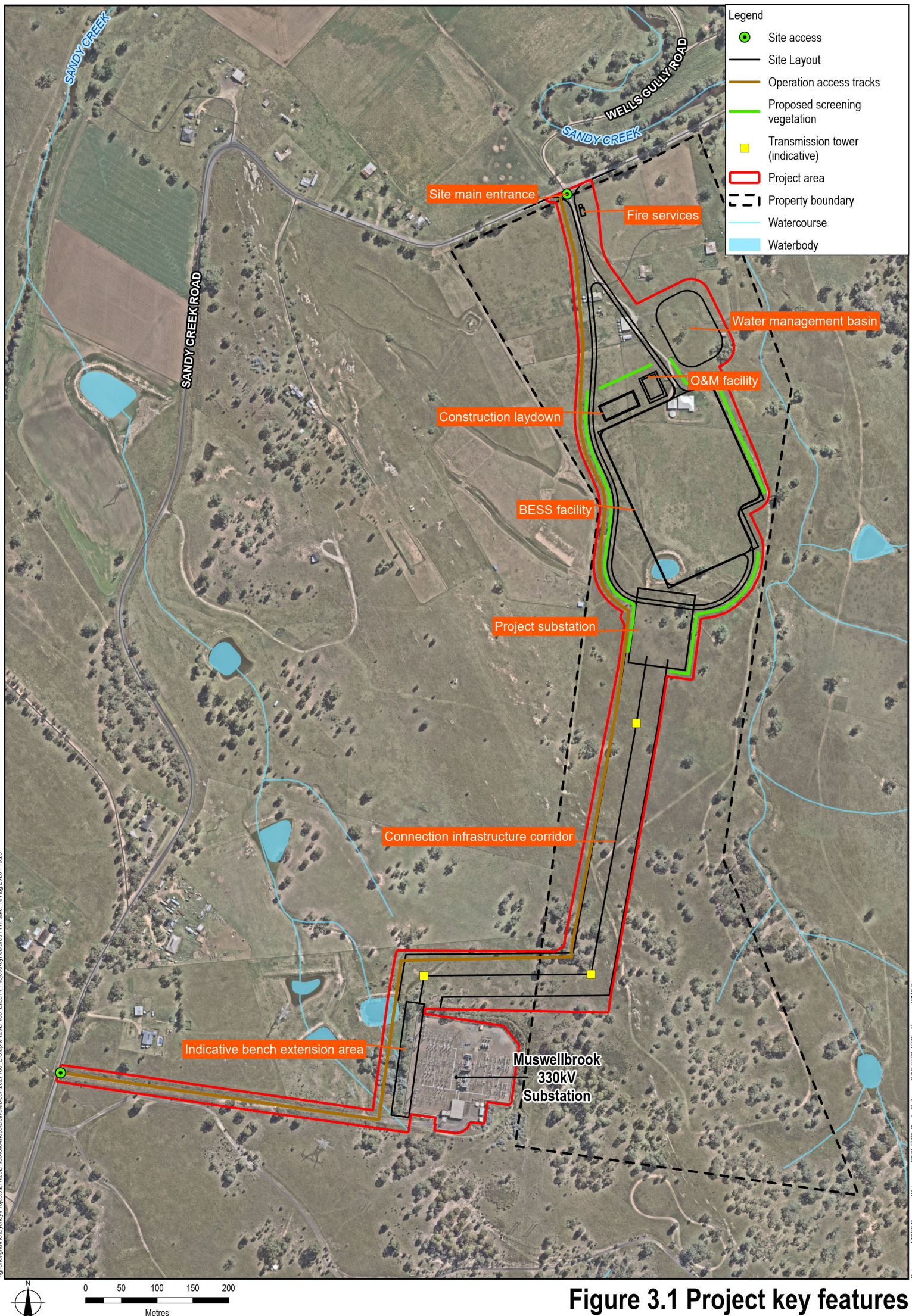
A summary of the key elements of the project is provided in Table 3.1 and shown on Figure 3.1. A detailed description of the proposed infrastructure, land requirements, construction methodology, operation and future decommissioning is provided in sections 3.2 to 3.7.

The project design and construction methodology presented in this EIS is preliminary and would be further refined during the detailed design and construction planning process with the intent to further reduce or avoid identified impacts. The project design has assumed a conservative disturbance footprint in which to assess potential environmental impacts, which will also facilitate flexibility in subsequent project development stages.

Table 3.1 Project overview

Key aspects	Description
Project infrastructure and operation	
Battery energy storage system	Utility-scale battery energy storage system utilising lithium-ion phosphate technology within enclosed battery containers with a total capacity of up to 400 MW and 1,600 MWh.
Power conversion systems	Inverters, transformers and associated electrical equipment to convert DC battery output to AC for export to the electricity network.
Project substation	Project substation to enable the project to connect to the existing high-voltage transmission network.
Transmission connection infrastructure	Approximately 800 m, 330 kV overhead line within a 60 m wide corridor connecting the project substation to the existing Muswellbrook substation.
Ancillary infrastructure	Internal access roads, control and maintenance buildings, stormwater infrastructure, fire safety systems, security fencing and lighting, and utilities required for operation and maintenance.
Operational footprint	The operational footprint of the project would be approximately 9.4 ha, where permanent project infrastructure would be located. This includes the 60 m connection infrastructure operational corridor.
Operation	Remotely operated facility capable of operating 24 hours per day, 7 days per week, with periodic on-site attendance for inspection and maintenance.
Operational life	The project is anticipated to operate for at least 30 years.
Estimated Development Cost	The project is estimated to generate annual expenditure exceeding \$30 million over its operational life.
Construction	
General activities and facilities	Construction would include site preparation, installation of the battery energy storage system, substation and connection infrastructure, followed by testing and commissioning. Construction ancillary facilities would include: – temporary construction compound and amenities – temporary access tracks and carpark – stockpiles, refuelling and laydown areas for equipment and materials.

Key aspects	Description
Construction hours	Construction work would generally be undertaken within standard construction hours as defined by the <i>Interim Construction Noise Guideline</i> (DECC, 2009) which are: – 7am to 6pm Monday to Friday – 8am to 1pm on Saturday – no work Sunday or public holidays.
Construction workforce and program	Up to 150 people are expected to be needed during the peak construction period (3-5 months). Construction is expected to take up to 18 months and scheduled to commence in 2027, subject to obtaining planning approval. The project would be constructed in one or more stages.
Site access, road and intersection upgrades	Access to the project area would be via two existing access points at 380 Sandy Creek Road and 578 Sandy Creek Road, located off the New England Highway. Depending on the oversize overmass (OSOM) vehicle route selected, between two and five road intersections would require upgrades to accommodate OSOM vehicle movements. Minor upgrades to existing roads between Port of Newcastle and the project area would be required to accommodate OSOM vehicle movements. Upgrades to existing internal access tracks, and some new access tracks, would also be required to facilitate the transport of equipment and materials within the project area.
Disturbance footprint	The disturbance footprint required for construction is approximately 20.02 ha, including the 60 m connection infrastructure operational corridor.



3.2 Permanent project infrastructure

3.2.1 Project design and built form

The BESS has been designed to provide largescale energy storage capacity while maintaining a low profile built form that responds to the rural landscape setting while minimising visual and land use impacts. Permanent infrastructure design and layout has been undertaken to optimise operational efficiency, safety and connection to the existing transmission network, while limiting the extent of earthworks and disturbance to surrounding environment and land uses.

The permanent infrastructure associated with the project would comprise of battery enclosures, power conversion equipment, a project substation, internal access tracks, security fencing, lighting and ancillary operational infrastructure. All permanent infrastructure would remain in place for the operational life of the project.

Height of infrastructure

The project has been designed to maintain a relatively low vertical profile across the site. The approximate maximum heights of key permanent infrastructure are summarised below:

- Battery containers:
 - approximately 2.6 metres high.
 - Control building, switch room and site amenities:
 - maximum building height of 4.5 metres.
- Step-up transformers, located within the project substation:
 - approximately 7.1 metres high (to the top of the HV bushings)
 - located within the dedicated project substation compound.
- Firewater storage tanks:
 - approximately six metres high.
- Transmission line structures:
 - steel lattice towers or monopoles up to 60 metres high.
- Lighting poles:
 - pole-mounted security and operational lighting up to 12 metres high.

No permanent buildings would exceed 7.1 metres in height within the BESS facility, with taller elements confined to the connection infrastructure corridor and project substation.

Materials, finishes and appearance

The project utilises industrial materials selected for durability, safety and visual integration:

- Battery containers:
 - anodised steel construction, in a muted colour to reduce heat absorption and visual intrusiveness
- Buildings (including control buildings, switch rooms and site amenities):
 - metal-clad or masonry structures with neutral, non-reflective finishes.
- Transformers and electrical equipment:
 - standard utility-scale steel components with protective coatings
- Fencing and barriers:
 - secure perimeter fencing of industrial design, with finishes selected to minimise visual prominence.

The overall colour palette and finishes are intended to be recessive and complementary to the surrounding rural landscape.

Landscaping

Screening landscaping would be planted within the project area near sensitive receivers to provide additional screening to the project. Mature vegetation within the project area would be retained where possible to maintain habitat values and provide additional screening.

3.2.2 Operational infrastructure

BESS compound

The proposed BESS facility would consist of weatherproof containers, arranged in rows and mounted on either concrete footings or compacted gravel. The design and shape of each BESS container is expected to be similar to the example provided on Figure 3.2. The final number and layout of containers would be determined during detailed design and is subject to change based on the selection of manufacturer.

The proposed BESS facility would include the following components:

- a thermal management system (i.e. HVAC systems) including air or liquid cooling to maintain controlled operational temperatures
- power conversion systems, including inverters to convert electricity from DC to AC (and vice versa) for use on the grid/ storage in the battery
- battery management system to monitor battery health, voltage, temperature and control charging and discharging schedules
- fire detection and suppression systems
- collector segments to gather and distribute the electricity within the BESS.

The layout and spacing of BESS containers would be designed and implemented in accordance with appropriate standards and manufacturers specifications to ensure the integrity of the system and to minimise the potential consequences of unplanned events. These standards would include:

- *NFPA 855 Standard for the Installation of Stationary Energy Storage Systems* (National Fire Protection Association, 2023)
- *International Fire Code* (International Code Council 2021)
- *UL 9450A the Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems* (UL, 2022).



Figure 3.2 Example battery container unit

Buildings and control systems

The BESS facility would comprise battery container units, control and switch rooms, underground cabling, and associated ancillary infrastructure. Supporting facilities would include a control building, site amenities, and ancillary workshop and storage areas required for operation and maintenance.

3.2.3 Connection infrastructure

Substation

The project substation would transform the energy in the BESS facility to the required voltage to connect to the existing high-voltage transmission network located at the existing Muswellbrook 330 kV substation. The connection from the project substation to the existing Muswellbrook 330 kV substation would be achieved via a 330 kV connection infrastructure linking to the existing Muswellbrook 330 kV substation. The BESS facility would connect to the 33 kV switchgear located within a switch room. This room would accommodate auxiliary equipment such as ventilation and arc-duct systems, fire suppression systems and monitoring and control equipment to provide a controlled environment for electrical components that ensures the safe and reliable operation of electrical components. A separate control room would house network infrastructure, control and protection panels, operator workstations, control panels, metering equipment, and other essential systems required for facility operation.

Two high-voltage step-up transformers would be located within the project substation, which would accommodate associated high-voltage equipment, switchgear, and cable support structures. The specific ratings and types of these components would be confirmed during detailed design.

Electrical connections between the BESS, the 33 kV switch room, and the step-up transformers would be facilitated via underground 33 kV cables. The step-up transformers would connect to the NEM via a 330 kV overhead line linking to the existing Muswellbrook 330 kV substation.

Transmission connection

A single circuit 330 kV overhead line would connect the project substation to the existing Muswellbrook 330 kV substation. The overhead line would be approximately 800 metres in length and contained within a 60 metre wide corridor, consistent with industry guidelines.

The overhead line would be supported by double circuit steel lattice towers or monopoles, founded on concrete footings and up to 60 metres in height as shown on Figure 3.3 and Figure 3.4.

The proposed connection infrastructure would run southwest from the site and connect dedicated 330 kV feeder bays at the existing Muswellbrook 330 kV substation. Offset distances from other transmission and electrical infrastructure, particularly near the existing substation, would be maintained in accordance with relevant electrical and safety standards.



Figure 3.3 Typical lattice tower design (EnergyCo, 2025)

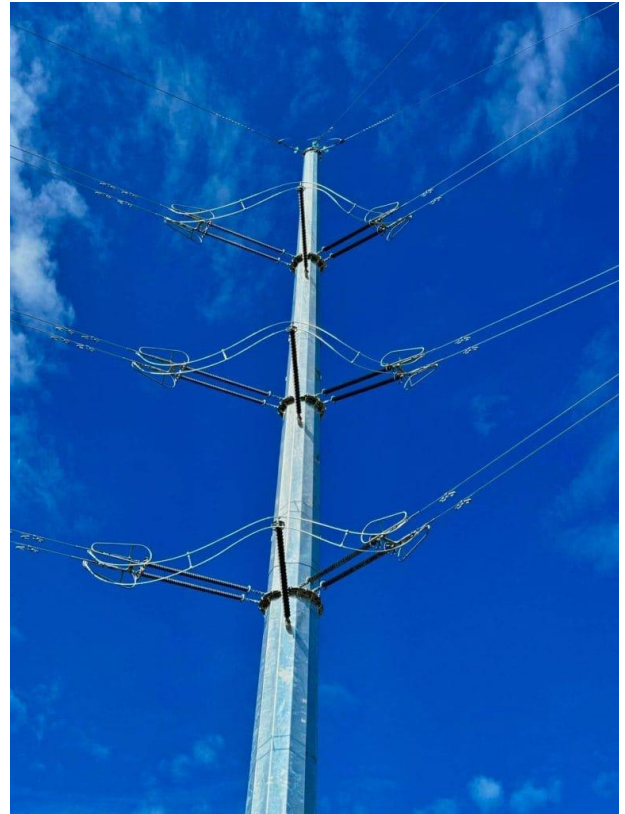


Figure 3.4 Typical monopole design (TOBCO, 2026)

3.2.4 Ancillary infrastructure

The permanent ancillary infrastructure components associated with the project are described in Table 3.2.

Table 3.2 Ancillary infrastructure

Aspect	Details
Site access	The project area would be accessed via the existing site entrance at 578 Sandy Creek Road from the New England Highway. The existing access road at 578 Sandy Creek Road would be upgraded and gravelled with a 6 m wide formation to tie-in to the existing road formation. The road would be retained during operation of the project to allow for movement of maintenance and operational activities. An additional site access would utilise the existing Muswellbrook 330 kV substation entrance, primarily for substation and connection infrastructure works. As shown in Figure 3.1 internal access tracks would be established to allow for inspection and maintenance of the battery enclosures, project substation and other on-site services. A staff carpark would also be provided.
Power supply and telecommunications	Auxiliary power would be sourced from an on-site 33/0.415 kV transformer. The site would also be connected to the existing low voltage electrical network that services the area. On-site diesel generators and diesel storage tank would provide backup power. The generators would be sized to ensure critical systems remain operational during any unplanned outages.
Fire safety	The site layout, access road design and fire safety infrastructure would be designed in consultation with Fire and Rescue NSW requirements. Emergency water tanks with a minimum of 40,000 L would be included on-site. A fire hydrant system would be installed in accordance with Australian Standards unless alternative systems are agreed with Fire and Rescue NSW. All fire safety systems would be detailed in a future Fire Safety Study prepared in consultation with Fire and Rescue NSW.

Aspect	Details
Security fencing, lighting, signage, CCTV	A site gate, secure perimeter fencing up to 2.4 m in height, signage, CCTV and alarm system would be installed. Appropriate warning signs would be positioned on the fence at regular intervals and at the entry gate. A back to base alarm system would be established to monitor the site security. The system would provide alerts if an alarm is triggered. The security fence would include security lighting and would be constructed around the perimeter of the BESS and project substation facilities. Access to the facilities will be controlled by security gates to facilitate authorised access only. Lighting would be provided via pole mounted installations across the BESS compound, switch room and transformer area for security purposes, and for emergency maintenance operations at night if required. Poles would be up to a nominal 12 m in height. All lighting would be designed and operated in accordance with AS/NZS 4282:2019 <i>Control of the obtrusive effects of outdoor lighting</i>.
Stormwater infrastructure	Stormwater infrastructure would be established to manage surface water runoff and water quality within the site. A drainage basin would be established on the eastern side of the BESS compound to treat stormwater runoff before discharge. This basin would provide stormwater quality treatment as well as fire water capture storage during operation. A swale west of the BESS compound and a berm at the southern side of the BESS compound are also proposed, based on the outcomes of the flood modelling undertaken for the project.
Water and wastewater	Potable water would be supplied directly via water tanker and stored in suitable sized tanks to service the site office and amenities. Non-potable water required for construction activities would be sourced via on-site non-potable sources i.e. groundwater bores. If groundwater sourcing is not selected for use to provide the full demand, non-potable water may be tankered into the site from an appropriately licenced external source to partially or fully supplement supply demands. Amenities, waste drains (within the ancillary infrastructure) and sewage would be collected on-site via a septic tank and trucked off-site for disposal.

3.2.5 Land requirements

The operational footprint covers two lots owned by a private landholder and the Electricity Transmission Ministerial Holding Corporation (refer Table 2.1 and Figure 2.3). The total size of the operational footprint is approximately 9.4 hectares, noting that this total includes the 60-metre connection infrastructure operational corridor, most of which would not be needed for day-to-day operations.

Subdivision of the project land may be required to reflect operational requirements; in particular to enable third party access and ownership of the project substation. A subdivision plan indicatively illustrating the area proposed for subdivision has been included as Figure 3.5. The details of the subdivision, including a subdivision plan will be confirmed during detailed design.

An indicative connection infrastructure easement is also shown on the project site and may be required to reflect operational requirements, in particular to facilitate third party access to connection infrastructure. The details of any easements will be confirmed during detailed design.

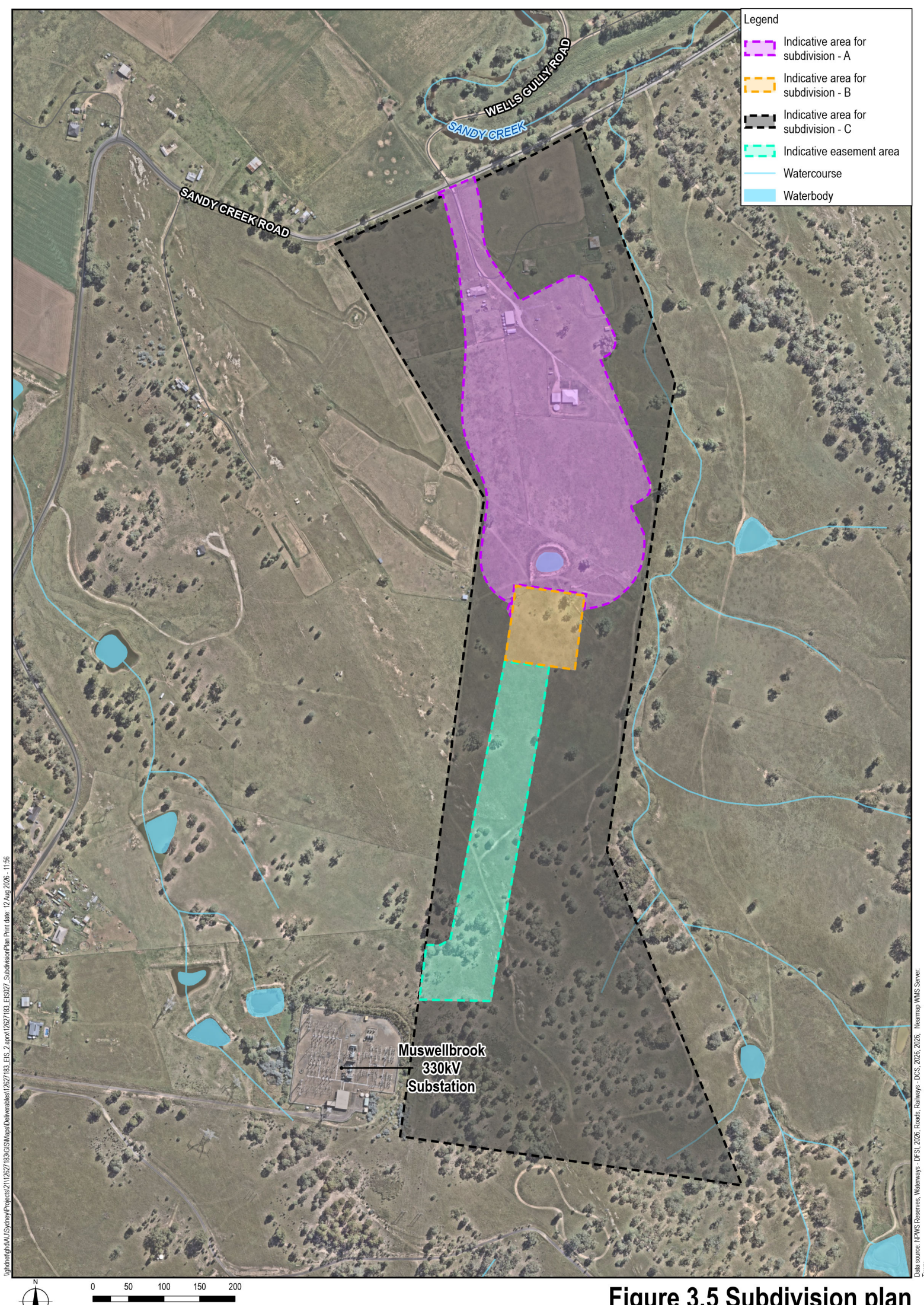


Figure 3.5 Subdivision plan

3.3 Indicative construction methodology

3.3.1 Enabling works

Enabling works would include:

- upgrade of the primary site access from Sandy Creek Road as well as other road works to provide for safe and efficient access to the project area (refer section 3.5.3 for further details)
- geotechnical, survey and other investigative activities to finalise project design.

3.3.2 Site establishment

Site preparation and establishment activities would include:

- demolition of existing dwellings and farm structures, including dewatering of the farm dam, where required
- installation of security fencing, lighting and surveillance systems
- establishment of erosion and sediment and other environmental controls including no-go areas and limits of clearing
- establishment of the site compound using transportable demountable structures, including temporary office, lunchrooms, storage areas and site amenities
- establishment of asset protection zones (APZs)
- upgrade of the main construction access and existing internal access tracks to construction areas, including grading and compaction of site won or imported materials, including grading and compaction of site won or imported materials
- preliminary investigations including cable locating and potholing to confirm the location of buried utilities, geotechnical investigations and site survey
- protection or relocation of any potentially affected utilities, as required and in consultation with the relevant utility provider
- delivery of plant, equipment and construction materials to the proposed site compound.

A power connection would be established during site preparation from the existing low voltage electrical network on-site.

3.3.3 Main construction works

Construction would involve:

- construction and installation of the BESS, including:
 - earthworks and grading to create level platforms for the installation of the battery foundations.
 - installation of concrete slabs or foundations to support the battery containers/modules, power conversion systems, transformers and other elements
 - installation and electrical fit out of the battery modules, power conversion systems, transformers and other elements, as necessary involving OSOM movements
 - installation of earthing system.
- construction and installation of connecting transmission and related infrastructure, including:
 - switchyard and substation adjacent to the BESS
 - the overhead 330 kV connection infrastructure from the switchyard and substation to the existing Muswellbrook 330kV substation.
 - works at the existing Muswellbrook 330kV substation to connect the project to the existing high-voltage transmission network
- construction and installation of ancillary infrastructure, including:
 - site drainage infrastructure including a retention basin
 - fit out of on-site buildings, light vehicle parking and heavy vehicle parking.

All buildings would be constructed in accordance with the relevant industry and regulatory standards including the Building Code of Australia.

Vegetation clearing would be undertaken progressively over the project area in parallel with other activities to minimise the areas of exposed ground and reduce the potential for erosion. Disturbed areas would be progressively stabilised as work is completed. Where vegetation is removed, it would be stockpiled and stored on-site and may be chipped or mulched and used for erosion and sediment controls. Subsurface vegetation would be grubbed to a depth suitable to facilitate construction.

Earthworks and grading would be necessary to provide a flat surface for construction and to ensure adequate drainage. Topsoil and subsoil would be stripped and stockpiled separately. Where suitable and weed free, topsoil would be stockpiled and maintained for rehabilitation or disposed of. Subsoil, if suitable, would be stockpiled for use as road subbase or as backfill at the project area. Cut and fill would be balanced as much as practicable to minimise excess spoil. If required, excess material would be removed from the project area and reused elsewhere or disposed of in accordance with the relevant waste classification.

3.3.4 Commissioning

Commissioning and testing would include final inspection and testing of all proposed facilities to ensure they operate as intended.

3.3.5 Reinstatement and rehabilitation

As soon as practicable after construction is complete, disturbed areas not required for surface infrastructure would be reinstated and rehabilitated. Site rehabilitation and demobilisation would include:

- landscaping and reseedling or revegetating, using appropriate species
- removal of environmental controls
- removing all equipment, materials and waste from the project area
- decommissioning of construction ancillary facilities and any temporary access tracks not proposed to be reused during operation.

3.4 Construction program and timing

3.4.1 Program

Subject to regulatory approvals, construction would commence in 2027 and is expected to take approximately 18 months.

An indicative breakdown of the construction periods is as follows, with some tasks overlapping or being undertaken in parallel:

- enabling works and site establishment – approximately a month
- main construction works – approximately 13 months, with an indicative peak construction period of four to six months
- commissioning – approximately three months
- reinstatement and rehabilitation – approximately a month.

The project is expected to be operational in 2029 following commissioning, testing and demobilisation.

3.4.2 Working hours

Most construction works would be undertaken within the recommended standard working hours defined by the *Interim Construction Noise Guideline* (ICNG) (Department of Environment and Climate Change (DECC), 2009):

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays and public holidays: no work.

The ICNG (DECC, 2009) recognises there are some situations where construction may need to be carried out outside of the recommended standard construction hours. For the project, these activities may include:

- emergency situations to prevent the loss of lives and properties and/or to prevent environmental harm
- situations where agreement is reached with affected receivers
- work determined to comply with the relevant noise management level at the nearest sensitive receiver
- the delivery of oversized materials and heavy equipment – for instance power transformers, as required by the NSW Police or other authorities for road safety reasons.

3.5 Construction resources, access and facilities

3.5.1 Workforce

It is anticipated that a peak construction workforce of up to 150 construction staff may be required. The construction workforce would be sourced from the local area as far as practicable.

3.5.2 Temporary construction facilities

Ancillary facilities such as a construction compound and access tracks would be required during construction as shown on Figure 3.1.

The construction compound would be established within an APZ which would be maintained on an ongoing basis for bushfire protection. The construction compound would include a range of facilities and uses to support construction. The compound would cover an area of approximately 2.5 hectares and include the following:

- laydown and materials storage
- office and staff amenities, including parking
- bunded fuel/hazardous material storage and refuelling area
- vehicle wash bay
- maintenance areas.

All ancillary facilities would be located within the project area. Temporary laydown areas would be on levelled ground with appropriate security and environmental controls in place.

The final location of these areas would be developed with the construction contractor and documented in the Construction Environmental Management Plan (CEMP) prior to commencement.

3.5.3 Site access and vehicle movements

Site access

The proposed construction access point to the project area is via Sandy Creek Road off the New England Highway (A15) and the site entrance at 578 Sandy Creek Road, as shown on Figure 3.1. An additional site access would also be provided at the existing Muswellbrook 330 kV substation, although the activities supported by this access would be more limited, primarily for substation and connection infrastructure works.

The existing access at 578 Sandy Creek Road would be upgraded for use during construction, operation and maintenance, including to enable heavy vehicle access (including OSOM vehicles). Upgrades, undertaken in stages, may include widening and sealing to enable safe and sustainable use of the track and to allow for bi-directional traffic flow. Vehicles would be able to enter and exit the site in a forward direction.

Short sections of temporary access tracks to transmission support structures would be required to facilitate construction activities and enable maintenance access once operational. These shorter access tracks would aim to utilise the closest access points to the existing access tracks at the site (refer to Figure 3.1).

Traffic movements and temporary road works

Estimated vehicle movements during construction include light and heavy vehicles transporting workers to the site each day and construction plant and equipment. Where possible, workers would be encouraged to car pool or be transported from their accommodation to the site using shuttle buses to reduce light vehicle movements.

OSOM loads would be required for transport of transformers, transmission structures and high-voltage cable drum rolls with other construction equipment and site sheds, etc using flat-bed semi-trailers. The proposed OSOM vehicle route would be from the Port of Newcastle

Temporary road works eg removal and reinstatement of roadside furniture, placement of gravel on road shoulders and crossing of kerbs and roads medians would be required and would be undertaken in accordance with relevant legislative and permitting requirements by specialist haulage contractors.

Further details of traffic and transport issues, including these works are provided in Technical Report 7 – Traffic and Transport Impact Assessment.

3.5.4 Equipment and materials

Plant and equipment

An indicative list of the plant and equipment that would be used to construct the project is provided below. The equipment list would be further refined during detailed design.

- | | |
|------------------------------------|---------------------------------|
| – bulldozer | – welding equipment |
| – front end loaders | – slew cranes or crawler cranes |
| – dump trucks and semi-trailers | – franna cranes |
| – water carts | – telehandler |
| – excavators | – concrete saws and grinders |
| – graders | – scrapers |
| – compactors and vibratory rollers | – backhoe |
| – concrete trucks and pumps | – generators |
| – elevated work platforms | – concrete truck |
| – compressors | – light vehicles |
| – impact piling rig | – hand tools. |

Construction materials

Where possible, general construction materials would be sourced from the local region to minimise traffic movements and ensure the project is able to maximum use of locally based services. Specialist equipment, including battery units, power conversion systems, transformers and prefabricated buildings would arrive by sea or road. The main construction materials would include:

- aggregates, road base and concrete
- fencing materials, including steel
- cables, conduits and junction boxes
- timber and fixtures for building fit-out
- non-potable water for dust suppression, vehicle washdown and for drinking.

3.5.5 Waste management

Waste generated during construction would include construction waste, domestic waste, and wastewater. Construction waste and domestic waste would be managed by collecting, separating, and storing waste according to its potential for reuse, recycling, recovery, treatment and/or disposal. Waste would be stored in appropriate containers such as industrial bins or drums in dedicated waste collection areas for collection by appropriately licenced waste contractors. Wastewater would be collected on-site and removed by truck.

3.5.6 Water

It is anticipated that the major water use would be non-potable water required for dust suppression and for the installation of BESS foundations. Final water requirements would be subject to weather conditions and project procurement. The majority of non-potable water would be sourced from existing groundwater bores located on the site, subject to obtaining the necessary approvals, or tankered to site from an appropriately licenced external source to partially or fully provide the necessary water demand. During detailed design, a revised water balance would be undertaken to confirm the water requirements and available sources.

Potable water would be required at the construction compound ablution facilities. Potable water would be trucked to site and stored in tanks.

3.5.7 Power and telecommunications

For construction, power would be supplied by diesel generators. It is proposed to store diesel on-site in tank(s) at the ancillary facilities. Diesel would be stored on-site in tank(s) at the ancillary facilities in accordance with AS 1940-2004 *The storage and handling of flammable and combustible liquids* (Standards Australia, 2004).

Phone reception on the project area is available.

3.6 Operation

3.6.1 Operational life, employment and operating hours

The project is proposed to operate remotely 24 hours a day seven days a week, with up to six staff visiting site to undertake routine and preventative maintenance activities, including equipment testing, vegetation management, pest control and general site maintenance.

Operation and maintenance activities would generally be undertaken during standard hours.

Wastewater generated from site offices during operations would be managed via a septic tank.

3.6.2 Operational traffic

Traffic movements would be minimal with only light vehicles needing to access the project area for routine maintenance activities. Heavy vehicles would only be needed very occasionally for replacement of any larger components.

An alternative emergency access is proposed at the site. This access would be accessible to emergency services only during operations.

3.7 Decommissioning

The operational life of the project is expected to be at least 30 years; however individual project components may be replaced or upgraded as required.

In the event of decommissioning, all above-ground infrastructure would be removed from the project area, unless otherwise agreed with the relevant stakeholders. Infrastructure within the existing Muswellbrook 330 kV substation would not be decommissioned or removed.

Decommissioning activities are likely to occur over a period of approximately 12 to 24 months. Decommissioning would be undertaken in accordance with a Decommissioning Management Plan which would be prepared prior to the cessation of operation.

At the end of its operational life, all infrastructure, utilities, and disturbed areas would be decommissioned in consultation with relevant stakeholders. Where it is possible to do so, adaptive reuse of buildings, infrastructure, or utilities would be considered.

4. Statutory context

4.1 Summary of statutory requirements

A summary of the statutory requirements for the project is provided in Table 4.1, with further detail provided in sections 4.2 through to section 4.6. A detailed assessment of the statutory requirements is addressed in the relevant sections of the environmental impact assessment presented in Chapters 6 to 19. A and a statutory compliance table is provided in Appendix B.

Table 4.1 Summary of statutory requirements

Category	Summary
Power to grant approval	The project is State significant development (SSD) under Section 4.36 of the EP&A Act. In accordance with section 4.5 of the EP&A Act, the consent authority for the project would be the NSW Minister for Planning and Public Spaces, unless the application is required to be determined by the Independent Planning Commission (IPC) (see section 4.2).
Permissibility	The project area is zoned RU1 Primary Production under the Muswellbrook Local Environmental Plan 2009 (Muswellbrook LEP). The project is characterised as “electricity generating works” under clause 2.36 of the State Environmental Planning Policy (Transport and Infrastructure) 2021 (the Transport and Infrastructure SEPP) and is permissible with development consent on a prescribed non-residential zone, including RU1 Primary Production.
Other approvals	The following secondary approvals are anticipated to be required: – A consent under Section 138 of the <i>Roads Act 1993</i> (discussed in section 4.3). No other approvals are required under NSW legislation. For the avoidance of doubt: – An environment protection licence under the Protection of the Environment Operations Act 1997 is not required on the basis that the works do not entail a scheduled activity by reference to Schedule 1 of the Act. – An approval under the Coal Mine Subsidence Compensation Act 2017 is not required on the basis that the project is not within a mine subsidence district.
Pre-condition to exercising the power to grant approval	Pre-conditions to grant of development consent include consideration of matters discussed in further detail in section 4.4.
Mandatory matters for consideration	Pursuant to Section 1.7 of the EP&A Act, the <i>Biodiversity Conservation Act 2016</i> (the BC Act) is a mandatory matter for consideration. Section 7.9 of the BC Act provides that any application under Part 4 of the EP&A Act for SSD must be accompanied by a Biodiversity Development Assessment Report (BDAR) unless the Planning Agency Head and Environment Agency Head determine that the development is not likely to have any significant impact on biodiversity values. Mandatory matters that the consent authority is required to consider in determining the application under the EP&A Act and other relevant legislation are identified in section 4.5.

4.2 Approval pathway and permissibility

The project is SSD under section 4.36(2) of the EP&A Act and clause 2.6(1) of State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP). The project meets the definition of SSD under clause 20 of Schedule 1 to the Planning Systems SEPP, as it has capital investment value exceeding \$30 million.

The project is characterised as ‘electricity generating works’ under clause 2.36 of the Transport and Infrastructure SEPP and is permissible with development consent on land zoned for prescribed non-residential purposes, including RU1 Primary Production. The project is located in land zoned RU1 Primary Production under the Muswellbrook LEP and is therefore permissible with consent under Section 2.36(1)(b) of the Transport and Infrastructure SEPP. Clause 2.36 of the Transport and Infrastructure SEPP prevails over the zoning provisions of the Muswellbrook LEP to the extent of any inconsistency.

The NSW Minister for Planning and Public Spaces is the consent authority for SSD applications, unless required to be determined by the IPC.

Further information about the approval pathway and permissibility is provided in Appendix B.

4.3 Other approvals

4.3.1 Approvals under NSW legislation

Approvals not required

In accordance with Section 4.41 of the EP&A Act, the following approvals, which may otherwise have been required, are not required for SSD:

- a permit under Sections 201, 205 and 219 of the *Fisheries Management Act 1994*
- an approval under Part 4 or an excavation permit under section 139 of the *Heritage Act 1977*
- an Aboriginal heritage impact permit under Section 90 of the *National Parks and Wildlife Act 1974*
- a bush fire safety authority under section 100B of the *Rural Fires Act 1997*
- a water use approval under Section 89, a water management work approval under Section 90, or an activity approval (other than an aquifer interference approval) under Section 91 of the *Water Management Act 2000*.

Approvals that must be applied consistently

In accordance with Section 4.42 of the EP&A Act, approvals under other specified NSW legislation that may apply to the project cannot be refused and must be applied consistently with the approval for SSD. Approvals listed in section 4.42 that are potentially relevant to the project are considered below.

Environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997*

An environment protection licence is only required where a development involves a scheduled activity listed in Schedule 1 of the *Protection of the Environment Operations Act 1997*. The project does not involve a scheduled activity and, accordingly, an environment protection licence is not required.

Consent under Section 138 of the *Roads Act 1993*

The project includes works in, on or over a public road within the meaning of Section 138 of the *Roads Act 1993*, namely road works to support construction traffic (see section 3.5.3). Accordingly, a consent under Section 138 is anticipated to be required and, in accordance with section 4.42 of the EP&A Act, must be applied consistently with any development consent granted for the project.

Other legislative requirements

In addition to the approvals described above, a range of other legislation applies to the design, construction, operation and decommissioning of the project. This legislation addresses matters such as requirements for notifications, utility connections, construction safety, design requirements, traffic management, operational obligations, and water access licenses as relevant.

Further information regarding legislative requirements applicable to the project is provided in Appendix B.

4.3.2 Approvals under Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's primary environmental legislation. It provides a legal framework to protect matters of national environmental significance (MNES), the environment of Commonwealth land, and actions undertaken by Commonwealth agencies.

In accordance with the EPBC Act, actions that have, or are likely to have, a significant impact on a matter protected by the Act must be referred to the Australian Minister for the Environment and Water to determine whether the action is a controlled action requiring approval.

The project is not being carried out by a Commonwealth agency and no impacts on the environment of Commonwealth land have been identified. The project was referred to the Australian Minister for the Environment and Water and by decision dated 27 February 2026, was determined to be a controlled action, requiring assessment and approval under the EPBC Act. The controlling provisions for the project are listed threatened species and endangered communities.

The potential impacts on matters protected under the EPBC Act are assessed in this EIS in accordance with the bilateral assessment agreement between the Australian and NSW governments. Supplementary SEARs addressing these matters were issued on 24 March 2026 (see Appendix A (SEARs compliance table)).

The assessment of potential impacts on matters of national environmental significance (threatened species and ecological communities) is summarised in Chapter 7 (Biodiversity).

Native Title Act 1993

The *Native Title Act 1993* provides for the recognition and protection of native title across Australia. No Native Title claims or determinations cover the project area.

4.4 Pre-conditions to exercising the power to grant approval

Under clause 4.6 of the State Environmental Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP), a consent authority is required to consider:

- whether a proposed development site is contaminated
- whether it is suitable for the intended use.

This is addressed in Chapter 12 (Land use and soils).

4.5 Mandatory matters for consideration

This EIS has been prepared in accordance with Part 8, Division 5 of the EP&A Regulation, which specifies the form and content of an EIS. Appendix B indicates each requirement and where each is addressed in this EIS.

Appendix B also describes each mandatory matter for consideration and identifies where each is addressed in the EIS. It also identifies pre-conditions to exercising the power to grant approval (including mandatory conditions) and identifies in which section of the EIS each is addressed.

4.6 Assessment process and requirements

The key steps in the assessment process, in accordance with the EP&A Act, EP&A Regulation and the *State Significant Development Guidelines* (DPHI, 2024), are outlined below.

4.6.1 Environmental assessment requirements

The SEARs for the project define the matters the Planning Secretary requires the EIS to address. The SEARs were issued on 16 April 2025, and supplementary SEARs received 24 March 2026. The requirements detailed in the SEARs, together with where they are addressed by this EIS, are provided in Appendix A.

4.6.2 Public exhibition and submissions

If the EIS is considered to meet the SEARs, the EIS will be exhibited publicly by the Department of Planning, Housing and Infrastructure (DPHI) for at least 28 calendar days and invite submissions. At the end of the exhibition period, DPHI will provide the applicant with a copy of the submissions and will request the applicant to prepare a submissions report responding to the issues raised. The applicant may also elect to provide an amendment report that outlines any proposed changes to the project to minimise its environmental impact or deal with other issues raised during the assessment of the application.

Further information on consultation undertaken for the project and EIS, and the proposed approach to consultation during the exhibition period, is provided in Chapter 5 (Community and stakeholder engagement).

4.6.3 Assessment and approval

Following the exhibition period, DPHI will review the EIS, the submissions report, and any amendment report. DPHI will prepare an assessment report, which is provided to the consent authority (the Minister for Planning and Public Spaces or their delegate, or in some cases the IPC) for consideration. The consent authority may refuse the project or approve it with conditions and modifications. The determination and the assessment report will be published on the NSW Planning Portal (Major Projects) following the decision.

Following consideration of the NSW assessment process, the Australian Minister for the Environment and Water will make a separate decision on whether to approve the project under the EPBC Act.

5. Community and stakeholder engagement

5.1 Engagement approach

5.1.1 Overview

The applicant recognises effective engagement is fundamental to a transparent and robust project development and environmental impact assessment process. Early neighbour and community engagement commenced in December 2024 with a letter sent to local residents offering an in-person or online briefing. Since the public announcement of the project in March 2025, a structured and ongoing program of community and stakeholder engagement has been undertaken to raise awareness about the project, understand key issues and concerns, and inform development of the project's design and environmental assessment.

During preparation of the EIS, consultation has been undertaken with relevant local, State and Commonwealth government agencies, infrastructure and service providers, community groups, affected landowners, consistent with the requirements of the SEARs (refer to Appendix A). Engagement activities have been carried out consistent with the *Undertaking Engagement Guidelines for State Significant Projects* (DPHI, 2024). This chapter outlines the consultation undertaken, summarises the issues raised, and explains how this feedback has informed the project, including where refinements have been made and, where not, the reasons for this.

Engagement for the EIS has been guided by the applicant's commitment to maintaining constructive relationships with stakeholders and the community, and has been characterised by:

- on-going, two-way engagement throughout the project lifecycle focused on listening and responding to feedback
- use of a range of engagement tools and methods to reach different audiences
- culturally informed engagement undertaken to support the Aboriginal heritage and social impact assessments (refer Chapters 10 and 17, respectively).

5.1.2 Engagement objectives

The engagement objectives for the project are to:

- build and maintain community and stakeholder relationships
- inform the local community and stakeholders about the project and the opportunities to engage
- provide the community and stakeholders with an opportunity to ask questions and identify areas of concern regarding the project, and explain how their feedback will be considered
- provide direct feedback to the project team so it can be considered as part of the project development
- develop solutions that address stakeholder expectations where possible, being clear about the level of influence engagement will have on the project
- effectively and proactively identify and manage issues raised by the community and key stakeholders when making project refinements
- manage stakeholder feedback and complaints in a timely and respectful manner
- monitor and evaluate stakeholder feedback.

5.1.3 Community and stakeholder identification

Understanding the local community and identifying stakeholders and interest groups is critical to the success of the project. A stakeholder or interest group is any individual, group, organisation or entity that has an interest in a project, policy or decision. Stakeholders may be directly or indirectly affected by the outcomes, or may perceive that they could be impacted. As part of the Scoping Report, the applicant undertook an initial stakeholder scoping exercise and identified a number of key interest groups and stakeholders, as outlined in Table 5.1.

Stakeholder identification is an ongoing process, and additional stakeholders will continue to be identified and consulted throughout all phases of the project, including (if approved) the construction, operation, decommissioning and rehabilitation phases of the project.

Table 5.1 Stakeholder groups for the project

Stakeholder group	Proximity	Description
Commonwealth government	National	Includes Mr Dan Repacholi MP (Federal Member for Hunter), DCCEEW and AEMO with an interest in Commonwealth regulatory compliance, national energy and climate policy, and electricity market and network considerations.
NSW government	Statewide >100 km	Includes DPHI, Department of Primary Industries (DPI), NPWS, Regional Development Australia – Hunter, Corrective Services NSW, St Heliers Correctional Centre (Muswellbrook), Mr Dave Layzell, MP (State Member for Upper Hunter), with an interest in statutory approvals, environmental protection, land use planning and regional development outcomes.
Local government:	Local ~5 km	Muswellbrook Shire Council, including the CEO and Director of Environment and Planning, with an interest in local planning controls, environmental management, service provision and community impacts.
Emergency services	Regional 5-100 km	Includes the Muswellbrook State Emergency Service, Fire and Rescue NSW – Muswellbrook, Edinglassie Rural Fire Brigade – Muswellbrook and Muswellbrook Hospital, with an interest in bushfire risk management, emergency response access, fire safety during construction and operation and emergency medical services.
Aboriginal community and stakeholder groups	Regional 5-100 km	Includes Wanaruah National Aboriginal Corporation (WNAC) representatives and Wanaruah Local Aboriginal Land Council, with an interest in Aboriginal cultural heritage protection, land use, and ongoing consultation regarding potential project impacts.
Utility owners	Regional 5-100 km	Transgrid, with an interest in connection infrastructure, grid connection, network capacity and operational safety.
Landowners	Local ~5 km	Includes the landowners of 578 Sandy Creek Road, with an interest in site investigations and access requirements.
Community – residents	Local ~5 km	Residents along Sandy Creek Road, St Heliers Correction Facility, Muswellbrook Coal Co and Kingdom of Jehovah's Witnesses, with an interest in amenity, construction and operational impacts, traffic and safety: – briefings – direct mailouts, letters and emails – maps, project updates – website – community / drop-in sessions.
Community – special interest groups and broader community	Regional 5-100 km	Includes local chambers of commerce, residents and businesses in Muswellbrook and Hunter, Sustainable Futures Muswellbrook, Committee for the Hunter and HunterNet, with an interest in local economic activity, amenity, traffic, and construction and operational impacts: – direct mailouts, letters and emails – project updates – website – community / drop-in sessions.
Other infrastructure proponents	Local	The owner/developer of the proposed Queensland-Hunter Gas Pipeline (SSI-MP06_0286) – Santos Limited due to proximity of the project area to the pipeline.

5.2 Engagement prior to and during preparation of the EIS

The applicant employed a broad suite of engagement methods and communication tools to support project engagement. Method and tools were selected depending on the stakeholder, their availability and the purpose of the engagement activity.

The following key communication tools facilitated information sharing and engagement, and were used to communicate upcoming community information and consultation sessions, project information and contact details:

- communication material, including project updates, website information, newsletters, factsheets, and letters/emails;
- free call phone number and email address for people to direct their enquiries.

The following activities were undertaken to engage stakeholders and gather feedback:

- community information and consultation sessions held in Muswellbrook and McCullys Gap in June 2025 and April 2026
- site visits
- meetings and briefings, including one on one small group meetings with government, stakeholders and community members
- attendance at Muswellbrook Shire Council forums in July 2025 and May 2026
- direct mail and letterbox drops
- updates via a dedicated project website and local social media posts
- landholder engagement.

Since December 2024, ongoing engagement has been undertaken with neighbouring landholders and sensitive receivers in the vicinity of the project. As the project has progressed, engagement has been undertaken in a timely, appropriate and proportionate manner, using a range of methods tailored to stakeholder needs and circumstances. In addition to the engagement activities outlined above, this has included letterbox drops, door knocking, emails, phone calls and site visits. These activities have provided opportunities for stakeholders to obtain project information, ask questions and provide feedback, which has been considered during the development and refinement of the project.

A summary of key tools and activities is provided in Table 5.2. An overview of the neighbouring landholdings engaged during preparation of the EIS is provided in Figure 5.1.

Table 5.2 Engagement tools and activities

Tool / activity	Targeted interest group (community/ stakeholder group)	Description / purpose	Effort (reach or outcome)
Community contact points (phone and email)	All stakeholders	The free information and enquiries line (1800 329 172) and email address (mccullysgap@bw-ess.com) are available for the community and stakeholders to seek information, ask questions, provide feedback and raise concerns. These contact details are provided on all communication materials.	10 phone calls as of May 2026 50 emails in, and 80 emails out as of May 2026
Project website	All stakeholders	The website (see McCullys Gap Battery Energy Storage System (BESS)) provides a central source of information on the project and links to communication and engagement material. Share Your Thoughts online form	Maintenance of the website.
Communication material	Landowners, local community (within 5 km radius around project area) and subscribers to news updates, along with attendees to community information sessions described below.	Communication material, including project updates, fact sheets and letters, have been distributed at engagement activities and sent via mail, letterbox drops and via email distribution lists. This included sending letters to community interest groups inviting them to participate in consultations about the project. Large (A0) coreflute posters were used in conjunction with a rotating PowerPoint presentation at the community sessions. The April 2026 community drop-in session was promoted in the Muswellbrook Chronicle, and via the McCullys Gap Hall Facebook page alongside letterbox drops.	Letters posted to 17 rural addresses in proximity of the site, including the St Heliers Correctional Centre (Muswellbrook) and the Kingdom of Jehovah's Witnesses. Letters hand-delivered to approximately 40 residences in proximity to the site. – first letter box drop in December 2024. – second letter box drop in April 2026.
Briefings	Government agencies, Aboriginal stakeholders, Muswellbrook Shire Council	Written notification to provide overview and updates on the project on a regular basis to advise of project milestones and opportunities for consultation. Meetings have been undertaken to share information and updates and seek feedback during the scoping and preliminary investigations phase, as well as the EIS development phase. In addition to consultation required under the relevant guidelines for Aboriginal cultural heritage and social impact assessment (see chapters 10 and 17), the project has engaged more broadly with key stakeholders regarding the project and EIS.	Number of stakeholder briefings (online and in person): – Transgrid – ongoing – online Muswellbrook Shire Council briefing – 20/11/24 – online meeting with Santos Limited – 15/8/25 – online meeting with Muswellbrook Shire Council – 17/10/25 – online meeting with environmental group – 20/10/25 – online Meeting with DPHI 24/11/25 – online Muswellbrook Shire Council briefing – 2/12/25 – online Commonwealth DCCEE Pre-referral meeting – 5/12/25 – online Meeting with Muswellbrook Shire Council 10/12/25 – in-person meeting with Fire & Rescue NSW and three RFS Units (McCullys Gap, Muswellbrook, Eden Glassie) – 20/2/26

Tool / activity	Targeted interest group (community/ stakeholder group)	Description / purpose	Effort (reach or outcome)
		Online briefings were usually complemented by PowerPoint presentations that outlined the project and also provided specific information customised to the audience. For example, for RFS and Fire & Rescue NSW, details about fire risk management with batteries was included.	– online meeting with Heritage NSW – 17/3/26 – online meeting with Transport for NSW, Transport Planning – 30/4/26 – online pre-lodgement meeting with DPHI – 11/5/26 – email to Transport for NSW, Freight Branch – 12/5/26 – online meeting with Port of Newcastle – 12/6/26 – online meeting with Transport for NSW, Muswellbrook Bypass – New England Highway Project Manager – 22/6/26
Site visits	Aboriginal stakeholders	Site visits have been undertaken with the following stakeholders to enable familiarisation with the project area and undertake survey : – Wanaruah Local Aboriginal Land Council (LALC) – Registered Aboriginal Parties (RAPs).	Site visits in August 2025 – February 2026 with project RAPs and representatives from Wanaruah LALC.
Community information and consultation sessions	Landowners, community, groups, business and industry	Advertised drop-in information and consultation sessions have been held to provide an opportunity for the community, stakeholders and landholders to meet with members of the project team, discuss project details, ask questions, provide feedback, or discuss issues of concern. Large (A0) coreflute posters showing the project site, indicative project layout, proposed OSOM routes and surrounding developments were available for viewing at the sessions. The posters were complemented by PowerPoint presentations that outlined the project and also provided specific information customised to the audience. For each session, the detail in the PowerPoint presentations was built upon, aligning with the development of the project and specialist assessments. A follow-up ‘thank you’ email was distributed to the community members present at the community drop-in session and BBQ held by BW ESS on 29/4/26. Digital copies of the posters were also provided to attendees. Promotion has included via the Muswellbrook Shire Council and McCullys Gap Hall social media pages, advertisements in the Muswellbrook Chronicle, and using the McCullys Gap ‘blackboard’ sign close to the intersection of Sandy Creek Road and the new England Highway.	Seven sessions were held between June 2025 and July 2026, in Muswellbrook and McCullys Gap: – A pop-up engagement activity was held in the foyer of Muswellbrook RSL during the afternoon of 2/6/25. – Community drop-in session held in a meeting room at Muswellbrook RSL – 2/6/25. Approximately 17 community members attended this session. – A community session run by Muswellbrook Shire Council was held on 21/7/25 with more than 100 community members present, and with proponents present for several local proposals. – A community drop-in session and BBQ was held by BW ESS at McCullys Gap Hall on 29/4/26. This event had more than 20 local community members in attendance. – A second community session run by Muswellbrook Shire Council was held on 13/5/26, with eight proponents present for several local proposals. This event had more than 90 community members in attendance. – Two community drop-in sessions were held by BW ESS at Muswellbrook RSL on 21/7/26.

●

Project stakeholders

●

Sensitive receiver

●

Industrial receiver

Project area

Roads

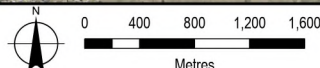
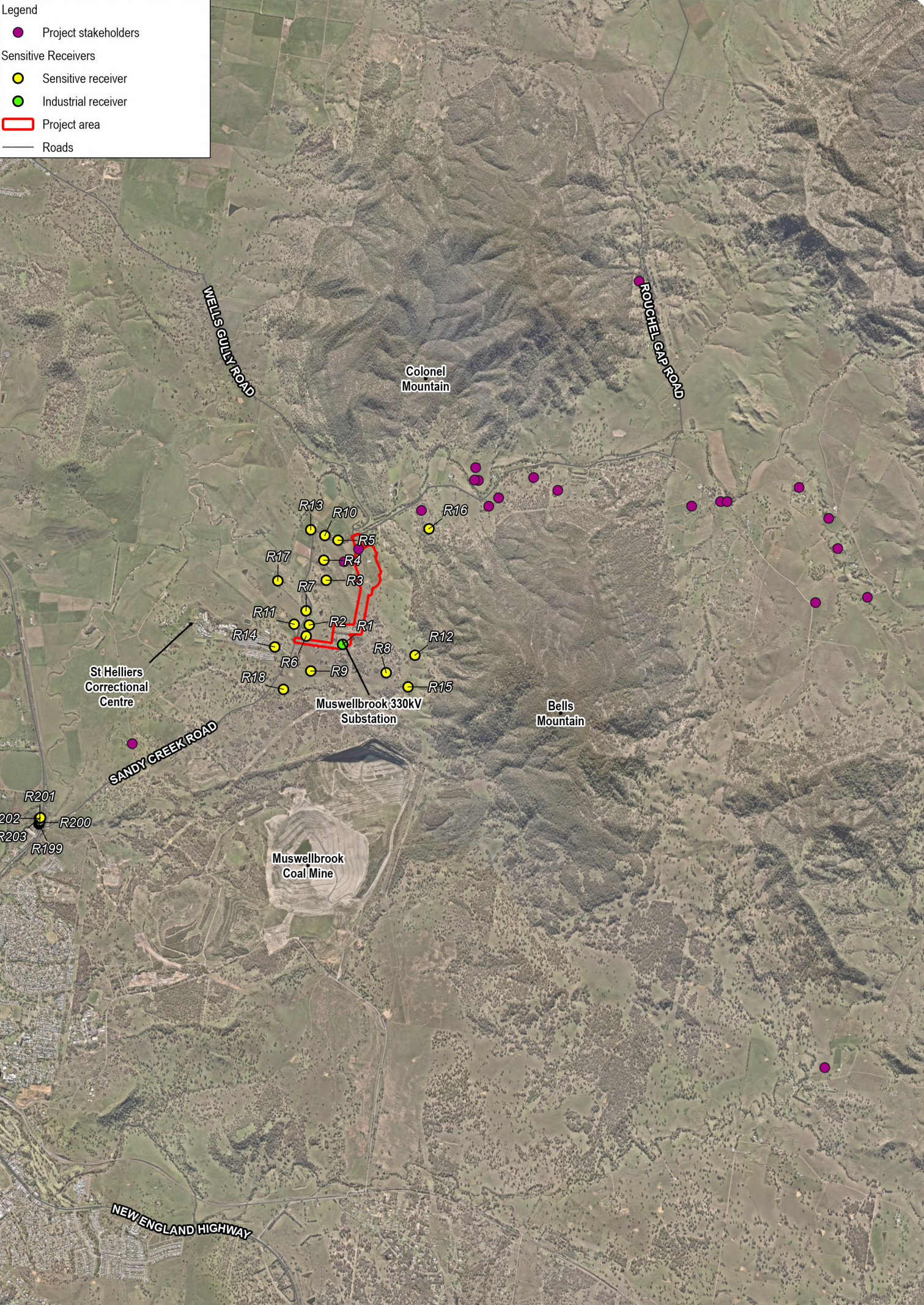


Figure 5.1 Neighbouring landowners engaged during preparation of the EIS

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Data source: JPWS Reserves, Waterways - DFSI, 2026; Roads, Railways - DCS, 2026; Nearmap, WMS Server, OpenStreetMap. Style: Sources: Map data © OpenStreetMap contributors, Microsoft, Esri Community Maps contributors, Map layer by Esri

5.2.1 Summary of key community issues

A number of issues were raised by various stakeholder groups during the preparation of the Scoping Report and the EIS, including environmental and social concerns as to the potential impacts on the local road network, noise and visual impacts to surrounding neighbours, and proposed community benefits.

The key issues raised and the location of where the issues is addressed in the EIS, is provided in Table 5.3.

Table 5.3 Summary of issues raised during community engagement

Issue category	Key issue raised	Location addressed in EIS
Fire and hazard	Battery emissions, safety and operations, availability and location of water supply	Chapter 15 (Hazards and risk) Chapter 16 (Bushfire) Technical Report 9 – Preliminary Hazard Analysis Technical Report 10 – Bushfire Hazard Assessment
Traffic and transport	Increased traffic movement during construction on local roads, particularly Sandy Creek Road	Chapter 13 (Transport and traffic) Technical Report 7 – Traffic and Transport Impact Assessment
Landscape and visual	Visual impacts to residents from construction, operation and decommissioning	Chapter 9 (Landscape and visual) Technical Report 4 – Landscape Character and Visual Impact Assessment
Noise and vibration	Noise and vibration impacts to residents from construction, operation and decommissioning	Chapter 8 (Noise and vibration) Technical Report 5 – Noise and Vibration Impact Assessment
Community benefits	Scale, equity and long-term value of community benefit mechanisms relative to local impacts	Chapter 17 (Social and economic)
Cumulative impacts	Cumulative impacts arising from the number of major infrastructure and energy projects proposed or underway in the Muswellbrook Shire Council area	Chapter 17 (Social and economic)
Water	Preference raised by Muswellbrook Shire Council for the use of on-site water sources during construction to minimise construction vehicle movements	Chapter 14 (Water) Technical Report 8 – Water Impact Assessment

5.3 On-going engagement

5.3.1 Engagement during exhibition of the EIS

Community and stakeholder engagement will continue during the EIS public exhibition period. DPHI will exhibit the EIS and invite public submissions as part of the assessment process. The EIS will also be referred to key government agencies for their review. During the exhibition period, DPHI will:

- publish the EIS online via the Major Projects Planning Portal
- notify the public of the exhibition period in accordance with the requirements of the EP&A Act and EP&A Regulation.

Stakeholders who are interested in are able to access this EIS and make a formal submission via DPHI's Major Projects Planning Portal.

The applicant will:

- provide updates on the project via the project website
- provide a printed copy of the EIS, the appendices and technical reports at Muswellbrook Shire Council – 60-82 Bridge Street, Muswellbrook New South Wales 2333

- hold community information and consultation sessions in the local region develop communications material that conveys relevant project information in plain English, so that potential impacts and implications can be easily understood. USB copies of the EIS, the appendices and technical reports will be made available to community members at these sessions.
- encourage stakeholders who are interested in, or who may be potentially impacted by the project to make a formal submission via the Major Projects Planning Portal.

5.3.2 Engagement following the exhibition of the EIS

Following the exhibition of the EIS, all stakeholder feedback will be reviewed and addressed in a Submissions Report. If further engagement is required to respond to the issues raised (e.g. to clarify issues of concern or to seek feedback on proposed refinements to the project), the details of that engagement will be outlined in the Submissions Report.

If responding to the submissions extends over a long period of time, regular updates (via the tools/techniques listed in Table 5.4) will be provided to the stakeholders regarding the status of the project.

5.3.3 Future engagement

If approved, engagement with key stakeholders would continue through the construction, operation and decommissioning and rehabilitation of the project. Details of the key methods of engagement that may be used during future stakeholder engagement are presented in Table 5.4.

Table 5.4 *Methods that may be used during ongoing stakeholder engagement*

Engagement method	Purpose
Meetings	To facilitate discussion about construction/operation activities and timing; impact on the stakeholder; and to seek feedback and comments for consideration.
Phone calls	To set up meetings with key stakeholders.
Emails	To facilitate ongoing liaison with key project stakeholders and to enable direct enquiries about construction/operation from the general community.
Website updates	To provide an overview of the construction/operation activities; answers to frequently asked questions; and access to key documents.
Project update letters	To update the community on the progress of construction/operation and to provide reference sources for further information.
Enquire lines (phone and email)	To provide community stakeholders with lines of enquiry to the construction/operation team.

Part B

Environmental assessment

6. Identification of key issues

An ongoing and iterative assessment has been undertaken throughout project development and preparation of the EIS to identify and assess potential environmental, social, and economic impacts associated with construction, operation and decommissioning of the project.

The assessment was initially undertaken in 2024 in support of the request for project SEARs, consistent with Appendix A of the *State Significant Development Guidelines – Preparing a Scoping Report* (DPE 2022a). These key issues were identified having regard to the scale and nature of the project, the receiving environment, and stakeholder and agency feedback during scoping. The assessment identified a shortlist of issues considered to be key issues for the EIS and informed the matters to be addressed in the issued project SEARs.

In accordance with the issued SEARs, the following key issues have been assessed in Chapters 7 to 20 of this EIS:

- | | |
|----------------------------|-----------------------|
| – Biodiversity | – Hazards and risk |
| – Aboriginal heritage | – Bushfire |
| – Land use and agriculture | – Socio-economic |
| – Landscape and visual | – Air quality |
| – Noise and vibration | – Waste |
| – Transport and traffic | – Cumulative impacts. |
| – Water | |

The assessment of potential impacts in subsequent chapters has been undertaken based on the project design described in Chapter 3 and includes the application of established, industry-standard construction, environmental and safety management controls that are inherent with similar major projects of this nature. Where the assessment has identified potential impacts that may not be mitigated through these industry standard controls alone, additional project-specific mitigation measures have been identified. The adopted environmental management framework and proposed mitigation measures are provided in Chapter 21 and Appendix C respectively.

7. Biodiversity

This chapter provides a summary of the potential impacts of the project on biodiversity. The chapter describes the existing biodiversity environment; identifies potential impacts during construction, operation and decommissioning; and provides measures to avoid, mitigate, manage and offset the potential impacts identified.

The assessment found that biodiversity impacts would be concentrated in the construction phase and have been reduced, where practicable, through iterative project design and refinement. While some vegetation clearing and habitat loss would occur, the project retains broader habitat linkages in the locality and provides for residual impacts to be addressed through the NSW Biodiversity Offsets Scheme and other applicable offset requirements. Given the limited scale of maintenance activities, no material biodiversity impacts are anticipated during operation.

Further information is provided in the Biodiversity Development Assessment Report (BDAR) (Technical Report 1) which has been undertaken in accordance with the BC Act, the *Biodiversity Assessment Method* (DPIE, 2020) (the BAM) and the SEARs.

7.1 Methodology

7.1.1 Study area

The BAM outlines that the assessment area for a BDAR comprises the subject land and the surrounding area considered as part of the site context assessment (including the required buffer). The BDAR uses the term subject land to describe the area where the project is planned, where biodiversity values are assessed, and where any biodiversity credits required to offset impacts are calculated. For the EIS, this same area is referred to as the project area; accordingly, the subject land is synonymous with the project area.

The broader study area investigated for the BDAR included the subject land and the surrounding land with the potential to be directly or indirectly affected by the project. This comprised all of Lot 5 DP 802081, and part of Lot 1621 DP 852356, as well as the associated areas that may be affected. For BAM purposes, the assessment area extended beyond the study area to include a 1,500-metre buffer around the subject land and other land considered in the site context assessment.

7.1.2 Key tasks

The methodology for the BDAR assessment included the following key tasks:

- defining the subject land and assessment area in accordance with the BAM
- reviewing the legislative and policy context
- undertaking a desktop review of existing ecological data, including vegetation mapping of plant community types (PCTs), threatened species records, and literature sources including previously prepared reports for the project and survey results for projects that intersect the land
- assessing the site context, including landscape connectivity, proximity to protected areas, and presence of important habitat features
- consultation with state and commonwealth government agencies through the preparation of the BDAR
- conducting field surveys in accordance with the BAM and relevant NSW and Australian Government biodiversity survey guidelines across a range of seasons (July 2023, and between late-2024 and mid-2026) to map vegetation, describe habitats, and confirm whether listed threatened flora, fauna or communities are present, including:
 - flora and fauna surveys
 - vegetation integrity assessments
 - habitat condition
 - targeted threatened species credit surveys
 - Hunter Valley Delma tile array surveys
 - targeted Glossy-Black Cockatoo diurnal bird surveys

- assessing the potential direct and indirect impacts on biodiversity values, including native vegetation, habitats, threatened species, ecological communities, key threatening processes and matters of national environmental significance, including assessment of:
 - prescribed impacts (impacts that may affect biodiversity values in addition to, or instead of, impacts from clearing vegetation)
 - serious and irreversible impacts (SAIL) on threatened species, populations, or ecological communities
 - impacts on terrestrial groundwater dependant ecosystems
 - key threatening processes
 - cumulative impacts
- identifying mitigation and management measures to avoid and minimise impacts, consistent with the BAM hierarchy of avoid, minimise, offset
- calculating biodiversity credit obligations using the BAM Calculator, including:
 - ecosystem credits for impacted vegetation
 - species credits for threatened species habitat
- reviewing offset options under the *NSW Biodiversity Offset Scheme* (NSW BOS)
- preparing a BDAR to describe the results of the assessment in accordance with section 6.12 of the BC Act, clause 6.8 of the Biodiversity Conservation Regulation 2017 (the BC Regulation) and the BAM.

7.2 Existing environment

7.2.1 Landscape biodiversity features

Landscape features contribute to the overall biodiversity value of the study area. The key landscape features, as defined by the BAM, and how these relate to the biodiversity study area, are summarised in Table 7.1.

Table 7.1 *Landscape features within study area*

Landscape features	Project area
NSW landscape regions (Mitchell landscapes)	Central Hunter Foothills and Upper Hunter Channels and Floodplain
Areas of outstanding biodiversity value under the BC Act	None present
Interim Biographic Regionalisation for Australia (IBRA) bioregion and subregion	The study area is located within the Hunter and Ellerston IBRA subregion.
Rivers, streams and estuaries	Ellerston: There are no rivers or estuaries within the subject land. One first order drainage line occurs in the west of the subject land. Unnamed tributaries of Sandy Creek occur parallel the subject land in the east. Hunter: One of these drainage lines also overlaps within the subject land within the Ellerston subregion.
Habitat connectivity features	Ellerston: The assessment area contains intact vegetation associated with a third order stream and Bells Mountains and Colonel Mountain in the east. Hunter: The assessment area contains an extensively cleared agricultural landscape containing fragmented patches of remnant and regrowth native vegetation to the west.

7.2.2 Terrestrial flora

The vegetation within the subject land is predominantly cleared for agricultural and residential purposes, and electricity infrastructure. The vegetation present in the subject land is in poor condition with low to moderate native vegetation cover and structural diversity, and moderate to high exotic plant cover. The overall character of the study area is structurally simple forested woodlands and relatively few hollow-bearing trees.

Scattered trees are present in the central and southern portions of the subject land, and along the unnamed tributary off Sandy Creek. There are indications of significant regeneration of canopies in the south of the subject area, however the northern and western portions remain maintained for residential use, cropped paddocks and electricity infrastructure.

Vegetation communities / Plant community types

Vegetation communities (PCTs) within the subject land are summarised in Table 7.2. A total of two PCTs were identified.

Areas of native vegetation were assigned to one of three vegetation zones per PCT based on their condition (low, moderate or high). Vegetation was allocated into these condition classes based on factors such as vegetation health, fire history and land management.

A list of the PCTs identified with further descriptive information is provided in section 4.3 of Technical Report 1 (BDAR).

As shown in Table 7.2, there is a total of about 16.92 hectares of native vegetation in the subject land (about 85 per cent of the subject land).

Table 7.2 Plant community types

PCT name	PCT ID	Condition / other defining feature	Extent in subject land (hectares)
Native vegetation – Hunter			
Central Hunter Slopes Grey Box Forest	PCT 3314	Derived Native Grassland	1.29
		Low	6.41
		Woodland	0.09
Central Hunter Ironbark Grassy Woodland	PCT 3431	Derived Native Grassland	1.15
		Woodland	0.78
Native vegetation – Ellerston			
Central Hunter Slopes Grey Box Forest	PCT 3314	Derived Native Grassland	1.17
		Low	1.51
		Woodland	0.99
Central Hunter Ironbark Grassy Woodland	PCT 3431	Derived Native Grassland	1.73
		Woodland	1.80
Total native vegetation			16.92
Disturbed areas and non-native vegetation – Hunter			
Non-native	N/A	Exotic	0.19
Waterbody	N/A	Dam	0.19
Infrastructure	N/A	N/A	0.87
Disturbed areas and non-native vegetation – Ellerston			
Non-native	N/A	Exotic	0
Waterbody	N/A	Dam	0.02
Infrastructure	N/A	N/A	1.83

Threatened ecological communities

One threatened ecological community (TEC) associated with two PCTs was identified in the subject land after confirming the suite of PCTs present and reviewing primary literature sources on TECs. The TEC is summarised in Table 7.3 and shown in Figure 7.1.

Table 7.3 Threatened ecological communities

PCT ID	BC Act Listing	EPBC Act Listing	Conservation status
3431 and 3314	Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	Central Hunter Valley eucalypt forest and woodland	BC Act – EEC EPBC Act – CEEC

Note: CEEC = Critically endangered ecological community, EEC – Endangered ecological community.

Threatened flora

One species-credit threatened flora species was identified on the subject land, the Pine Donkey Orchid (*Diuris tricolor*). This species is listed as vulnerable under the BC Act.

A full list of flora species recorded is provided in Appendix C of Technical Report 1 (BDAR).

Weeds

Weed species were found within the study area during surveys. These included 13 priority weed species. The General Biosecurity Duty under the *Biosecurity Act 2015* requires any person who deals with weeds to ensure that the biosecurity risk of the weed is prevented, eliminated or minimised, as far as reasonably practicable.

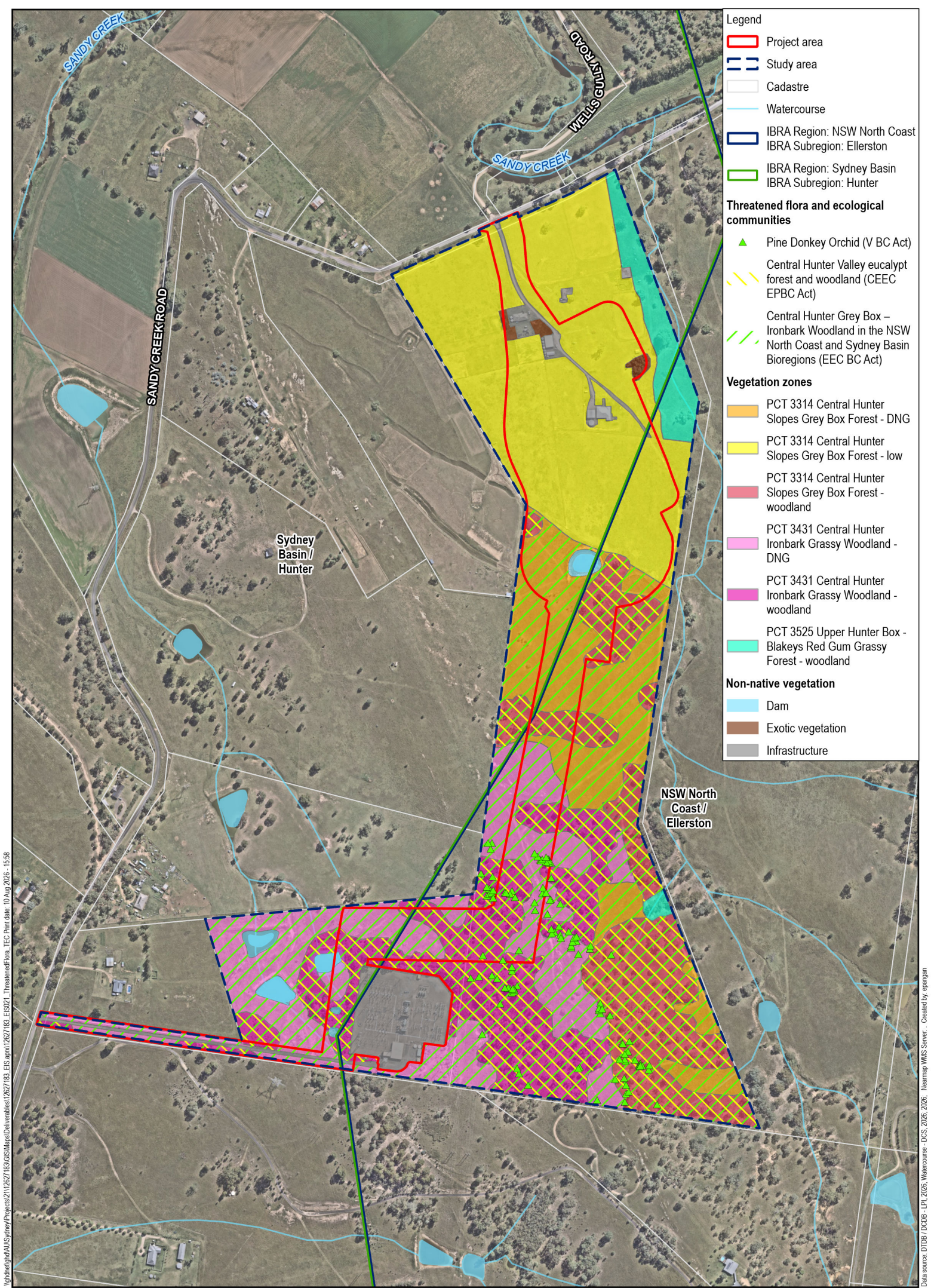


Figure 7.1 Threatened ecological communities

\\ghdnet\ghdnet\AU\Sydney\Projects\2112627183\GIS\Map\Deliverables\2027183_EIS\021_ThreatenedFlora_TEC Print date: 10 Aug 2026 - 15:58

Data source: DT08 / DC08 - LPI, 2026; Watercourse - DCS, 2026; 2026; Nearmap WMS Server. Created by: epangan

7.2.3 Terrestrial fauna

Terrestrial fauna habitats

Broad fauna habitat types found in the study area include:

- remnant and regenerating woodlands including areas of derived scrub
- artificial structures within 100 metres of a floodplain
- derived grasslands with scattered trees
- fallen/standing dead timber including logs
- living or dead mature trees in suitable vegetation within one kilometre of rivers, lakes, large dams or creeks, wetlands and coastlines
- land within 40 metres of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts
- hollow bearing trees
- woodland and forest including ‘nest trees’
- semi-permanent/ephemeral wet areas within five kilometres
- habitat within one kilometre of wet areas/swamps, waterbodies
- waterbodies with permanent pools/stretches three metres or wider, including rivers, large creeks, billabongs, lagoons, estuaries, dams and other waterbodies, on or within 200 metres of the subject land
- Koala use trees (DPE, 2024)
- subject land that intersects with ‘*Aprasia parapulchella*’ distribution for BAM assessments and characteristics of the subject land align with figure 2 of the ‘*Aprasia parapulchella distribution and habitat for BAM assessments – interpretive guide*’
- presence of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices within two kilometres.

Terrestrial fauna species

The results of the desktop review and preliminary calculations using the BAM Calculator indicated the following:

- **Hunter:** 41 potential candidate species-credit threatened fauna species, of which 28 species were retained for further assessment (i.e. targeted surveys as per the BAM)
- **Ellerston:** 28 potential candidate species-credit threatened fauna species, of which 20 species were retained for further assessment.

A total of 34 ecosystem credit species in Hunter and 26 ecosystem credit species in Ellerston were considered likely to occur on or use the subject land, of which a total of eight ecosystem credit fauna species were recorded during the field surveys. Offsets for ecosystem credit species are captured through offsets generated for associated PCTs. Further information is provided in section 5 of Technical Report 1 (BDAR).

A total of eight threatened fauna species were recorded within the subject land during the targeted surveys of which five require species credits. Table 7.4 lists the fauna species recorded or assumed to be present, together with their conservation status under the BC Act and/or EPBC Act, and credit type under the BAM.

Table 7.4 Recorded threatened fauna species

Species recorded during surveys	Listing ¹	BAM credit type
Hunter Valley Delma (<i>Delma vescolineata</i>)	EPBC Act – E BC Act – E	Species
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	BC Act – V	Species
Squirrel Glider (<i>Petaurus norfolcensis</i>)	BC Act – V	Species
Southern Myotis (<i>Myotis macropus</i>)	BC Act – V	Species
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	EPBC Act – E BC Act – E	Species

Species recorded during surveys	Listing ¹	BAM credit type
Species and ecosystem species recorded, species credit not required		
Large Bent-winged Bat (<i>Miniopterus orianae oceanensis</i>)	BC Act – V	N/A
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	EPBC Act – V	N/A
Little Bent-wing Bat (<i>Miniopterus australis</i>)	BC Act – V	N/A

7.2.4 Summary of Matters of National Environmental Significance

Threatened ecological communities

As shown in Table 7.3, one TEC listed under the EPBC Act was identified within the subject land: Central Hunter Valley eucalypt forest and woodland.

Threatened flora and fauna species

The following threatened species listed under the EPBC Act were recorded during surveys:

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Hunter Valley Delma (*Delma vescolineata*).

As well as these species, there is potential habitat for several other threatened species based on the results of the site surveys and habitat assessments. There are no known records of any of these species, or specific habitat features or resources at the subject land that suggest that it would be important to any populations of any of these species. The fauna species listed as a 'possible' likelihood of occurrence in Table 5.14 of Technical Report 1 (BDAR) would not occur at the subject land on a long-term basis or rely on any of the habitat resources at the subject land for their persistence in the local area. They are only likely to pass over or through the subject land on a transient basis (if at all) as part of their use of habitat resources in the local area.

Migratory species

No migratory shorebird species were recorded in the study area or have the potential to occur. A total of three migratory species were identified with a possible likelihood of occurrence at the subject land and are detailed in Table 8.11 of the Technical Report 1 (BDAR). While these species may occur on occasion in the area, the subject land does not provide important breeding habitat for these species.

7.3 Construction impacts

Impacts on biodiversity during construction include:

- direct impacts as a result of vegetation clearing and disturbance in the project area
- indirect impacts on flora and fauna located outside the disturbance as a result of activities within the project area.

A summary of the results of the impact assessment is provided in the following sections.

7.3.1 Terrestrial flora

Direct impacts on native vegetation

The project would result in direct impacts to native vegetation and associated threatened species habitat through the removal or modification of up to 16.92 hectares of native vegetation for construction of the BESS facility, connection infrastructure, access tracks and associated infrastructure.

Threatened ecological communities

A summary of estimated direct impacts on the TECs listed under the BC Act and/or EPBC Act is provided in Table 7.5.

Table 7.5 Summary of potential direct impacts on threatened ecological communities

Threatened ecological community		Condition	Area of impact (ha)		Risk of SAIL
BC Act listed name	EPBC Act listed name		BC Act	EPBC Act	
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	Central Hunter Valley eucalypt forest and woodland	Woodland DNG	9.00	3.66	Yes

Summary of impacts on communities listed under the BC Act

The project would directly impact one TEC listed under the BC Act, identified as Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions.

The amount of vegetation that would have the potential to be directly impacted is listed in Table 7.5.

Summary of impacts on communities listed under the EPBC Act

The project would directly impact one TEC listed under the EPBC Act, identified as Central Hunter Valley eucalypt forest and woodland.

The amount of vegetation that would have the potential to be directly impacted is listed in Table 7.5.

To address the Supplementary SEARs, assessments of significance of potential impacts on threatened flora species listed under the EPBC Act has been undertaken using the results of the targeted field surveys (see Appendix H of Technical Report 1 (BDAR)) in accordance with the Significant Impact Guidelines 1.1.

During further design and construction planning, direct impacts on this TEC would continue to be reviewed to avoid and/or minimise impacts as far as practicable in accordance with mitigation measures in section 7.6. Biodiversity offsets would be provided for unavoidable impacts as described in section 7.6.1.

Impacts on listed threatened flora species

The project has the potential to impact individuals and potential habitat for one threatened candidate flora species listed under the BC Act that was recorded in the subject land; the Pine Donkey Orchid. Approximately 5.69 ha of habitat for this species would be directly impacted.

In accordance with the BC Regulation, species credits are required to offset impacts on the Pine Donkey Orchid.

The Pine Donkey Orchid is not considered a 'serious and irreversible impacts' entity.

Potential impacts would be avoided, minimised, managed and offset as described in section 7.6.

7.3.2 Terrestrial fauna

Direct impacts

Potential direct impacts on threatened fauna and their habitats are summarised below.

Removal of habitat and habitat connectivity

The removal and modification of native vegetation within the subject area would affect fauna through the loss of foraging, breeding and dispersal habitat. This includes up to 3.66 hectares of better condition native vegetation comprising mature trees, understorey vegetation and shelter substrates such as fallen timber, leaf litter and grasses, as well as a further 5.22 hectares of derived native grassland with more limited shelter and foraging value. The remainder of the subject land is predominantly low condition grassland with relatively limited habitat value for most threatened flora and fauna, except for species adapted to more open grassland environments such as the Hunter Valley Delma.

Construction in woodland and grassland habitats would remove breeding, foraging and shelter habitat for a range of species, including small woodland birds, arboreal mammals and microbats. Eucalyptus and other native canopy species provide nectar resources and foraging substrate for these fauna groups. While the project may widen the gap between some small patches of open woodland within the connection infrastructure corridor, broader habitat connectivity would be retained through adjacent open woodland and scattered trees along waterways linking to more intact native vegetation associated with Bells Mountain.

Man-made structures

A number of dwellings and sheds would be removed during construction. Surveys of man-made structures within the subject land did not identify any potential microbat roost habitat. Two dilapidated sheds in the surrounding study area contained features broadly suitable for roosting microbats; however, dusk surveillance and Anabat monitoring did not detect roosting microbats. On this basis, man-made structures within the subject land and nearby study area are not considered to provide critical habitat for microbats in the locality.

Removal of hollow bearing trees

Construction in woodland and grassland habitats would result in the loss of up to five hollow-bearing trees that may provide nesting and denning sites for threatened fauna known or likely to occur within the subject land, including microbats, Squirrel Glider and Brush-tailed Phascogale. A further seven hollow-bearing trees would be retained.

Injury and mortality

Construction may result in the injury or mortality of less mobile fauna species and other small terrestrial fauna sheltering within vegetation, grasses, fallen timber or other habitat features in the project area. This could include nesting birds, reptiles, frogs, small mammals and nocturnal fauna using hollows or ground shelter. More mobile fauna such as adult birds, larger mammals and reptiles are more likely to move away from active construction areas.

Impacts on listed threatened fauna species

A total of eight threatened fauna species listed under the BC Act, including five candidate species (species credit species) in accordance with the NSW Biodiversity Assessment Method, have the potential to be impacted by the project. Of these, three species are also listed under the EPBC Act.

Direct impacts on threatened fauna species are primarily associated with habitat loss as defined in accordance with the BAM. These direct impacts have been quantified based on the subject land and the presence of recorded or assumed habitat for each species.

As the project progresses through further design and construction planning, the assessment of direct impacts on threatened fauna species will be reviewed and refined to avoid and/or minimise impacts where practicable in accordance with mitigation measures.

Summary of impacts on species listed by the BC Act

Table 7.6 lists the candidate fauna species credit species with the potential to be impacted, including the estimated area of habitat that would be affected. Species credits have been calculated in accordance with the BAM and would require retirement of like-for-like species credits in accordance with the BC Act, the BC Regulation and the Bilateral Agreement.

Table 7.6 Summary of potential direct impacts on threatened fauna species listed by the BC Act

Species	Area of potential habitat impact (ha)
Hunter Valley Delma (<i>Delma vescolineata</i>)	16.92
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	9.00
Squirrel Glider (<i>Petaurus norfolcensis</i>)	3.66
Southern Myotis (<i>Myotis macropus</i>)	10.67
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	16.92

Potential impacts would be avoided, minimised, managed and offset as described in section 7.6.

Summary of impacts on species listed by the EPBC Act

To address the Supplementary SEARs, assessments of significance have been undertaken for potential impacts on relevant threatened fauna species listed under the EPBC Act. These assessments cover species that have been recorded or assumed present in the project area (see Table 7.6). The assessments have been informed by the results of the targeted field surveys (see Appendix H of Technical Report 1 (BDAR)).

Taking a precautionary and conservative approach, the project is considered to have the potential to significantly impact the following species in accordance with the assessment criteria defined by the Significant impact guidelines 1.1:

- Hunter Valley Delma (*Delma vescolineata*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*).

Potential impacts would be avoided, minimised, managed and offset as described in section 7.6.

As the significant impact criteria assessment concluded that there is the potential for a significant impact, offsets are required under the EPBC Act Offset Policy. This offset requirement would be addressed through the retirement of biodiversity credits in accordance with the BOS.

Indirect impacts

A summary of potential indirect impacts is provided in Table 7.7. Construction of the project is expected to result in minimal indirect impacts on terrestrial and aquatic ecology within the project area and surrounding environment. Therefore, offsets under the BAM would not be required for these indirect impacts.

Table 7.7 Summary of potential indirect impacts

Impact	Description
Edge effects	'Edge effects' occur where cleared areas meet intact vegetation (e.g., increased noise/light and erosion/sedimentation) and can alter vegetation structure, promote exotic plant growth, and increase predation or habitat avoidance by native fauna. These effects can be initiated by vegetation clearing and other construction activities and extend into vegetation retained outside the subject land. There is a low-moderate risk that construction could spread high-threat and environmental weeds into adjoining vegetation in the central and southern portions of the subject land where a larger patch of TEC are present. No new edge effects are expected along the northern boundary of the subject land given the land is essentially already cleared.
Introduction and spread of weeds, pests and pathogens	Disturbance from vegetation clearing and construction traffic can increase the risk of spreading weeds, pest species and pathogens. Moderate levels of priority weeds and high-threat exotics are already present, and construction could spread these into nearby native vegetation where they are currently absent or sparse. Works near sensitive and/or connected vegetation are considered low risk because activities in this portion of the project area is limited to stringing connection infrastructure transmission lines. Environmental inductions and exclusion measures (e.g., visual barriers/fencing) will keep personnel and vehicles within the construction footprint, and all vehicles, plant and equipment will be wash/blow-down cleaned, certified weed-free prior to entry, and restricted to approved roads, tracks and work areas.
Noise and light impacts on fauna	Noise, vibration and light during construction can affect fauna (e.g., foraging, breeding success and local occurrence) and may temporarily displace animals close to works, particularly any nesting, roosting or denning fauna. Some disturbance to microbats may occur if noisy works overlap with dusk activity, but the effect is expected to be localised and short-term given the temporary nature of construction, the presence of alternative habitat nearby, and the likelihood that more resilient species will habituate. Given the site's history, and the availability of alternate habitat in surrounding areas, it is unlikely that the temporary increase in noise during construction of the project would significantly impact on fauna that occur adjacent to the subject land.
Erosion and sedimentation	Construction and exposed soils could cause erosion and sediment runoff to adjoining vegetation and aquatic habitats if unmanaged, including on water quality downstream. These activities have the ability to degrade water quality in Key Fish Habitat parallel to subject land to the east (approximately 50 metres away from the subject land) and also at Sandy Creek to the north (a third order stream approximately 30 metres from the subject land) on the northern edge of Sandy Creek Road.

Impact	Description
Dust	Unmanaged dust could reduce habitat quality by affecting plant function and fauna health. Suppression of dust will be undertaken during construction and detailed in a CEMP. Dust suppression will be applied on unpaved work areas subject to traffic or wind, spoil and aggregate stockpiles and during the loading and unloading of dust generating materials on unpaved access tracks. There are no expected residual impacts from dust.
Fire	Construction can create ignition sources (e.g., fuels, hot works). The risk of fires spreading to adjacent areas will be minimised through the implementation of a Bushfire Emergency Management and Operations Plan to contain and control the outbreak of fire.

Additional impacts that require consideration

In accordance with the BAM, an assessment of biodiversity values, in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat are required. For many of these impacts, the biodiversity values may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical. Clause 6.1 of the BC Regulation requires the following prescribed impacts to be assessed under the NSW BOS. These include, where they relate to the project:

- Human-made structures – the project includes the removal of human-made structures. As noted above, there is no evidence to suggest these structures are occupied based on the results of targeted thermal camera, Anabat detector and surveillance during the dusk emergence period.
- Non-native vegetation – the project would remove up to 3.10 hectares of planted vegetation. This non-native vegetation provides limited habitat resources for any threatened species with potential to occur in the locality.
- Habitat connectivity – the construction of the project may increase the risk or energy cost of movement of threatened or migratory birds, as well as a number of reptiles and arboreal mammals.
- Water bodies, water quality and hydrological processes – the project may modify the catchment and would result in local changes to waterbodies, water quality and hydrological processes through clearing of vegetation.
- Vehicle strikes – impacts of vehicle strike during construction are unlikely to substantially impact threatened species in the local area and region as a whole.

7.4 Operation impacts

Operation and maintenance of approximately 800 metres of connection infrastructure may increase the risk of powerline strike for fauna that fly or glide at conductor/tower height. The likelihood would be higher in the south of the subject land where a large patch of woodland adjacent to smaller patches is present. Powerlines are already present or will be present in the study area at similar heights, so this represents an incremental change to an existing risk.

Given the limited scale of maintenance activities, no other impacts on biodiversity during operation are anticipated.

7.5 Decommissioning

Potential biodiversity impacts during decommissioning are expected to be limited to short-term land disturbance associated with the removal of infrastructure. Measures to manage these impacts on biodiversity would be detailed in the Decommissioning Management Plan, which would be adapted from the CEMP to ensure continuity of environmental protection measures and regulatory compliance

7.6 Mitigation measures

A summary of measures that will be implemented to address potential biodiversity impacts are listed in Table 7.8. Measures to minimise potential impacts associated with noise, flooding, water quality, soil management, soil contamination, and air quality will also assist in minimising potential indirect impacts on biodiversity.

Table 7.8 Mitigation measures – biodiversity

ID	Impact/issue	Mitigation measure	Timing
BD1	Avoiding impacts on biodiversity	Vegetation clearing will be limited to the minimum necessary to construct the project. The design and location of infrastructure will be further refined to minimise or avoid impacts on native vegetation and fauna habitat as far as practicable.	Design / Pre-construction
BD2	Offsetting impacts on native vegetation and threatened species	Biodiversity offsets will be finalised in accordance with the NSW Biodiversity Offsets Scheme.	Design
BD3	General biodiversity impacts and management	A Biodiversity Management Plan will be prepared and implemented as part of the CEMP. The plan will: – identify biodiversity values within the project site, including native vegetation, fauna habitats and ecologically sensitive features – describe measures to avoid, minimise and manage impacts on biodiversity values, including site-specific controls, procedures and responsibilities – specify induction and training requirements for all personnel prior to commencing site works, ensuring awareness of biodiversity values, protection measures and responsibilities – define fauna management protocols, including pre-clearing surveys and procedures for fauna handling and relocation (see mitigation measures BD4 – BD7) – identify consultation requirements with relevant stakeholders – include a biosecurity management procedure with measures to minimise the potential of biodiversity risks in accordance with the general biosecurity duty under the <i>Biosecurity Act 2015</i> (NSW) (refer also to mitigation measure LS3) and regional weed management plans – include an unexpected finds procedure – outline fauna monitoring and adaptive management protocols.	Pre-construction / Construction
BD4		Pre-clearing surveys will be undertaken prior to construction by a suitably qualified ecologist. The surveys and inspections, and any subsequent relocation of species, will be undertaken in accordance with the Biodiversity Management Plan.	Construction
BD5		During pre-clearing surveys, trees in the project area with hollows or other high habitat values located within two metres of the edge of the project area will be marked and avoided where practicable. Tree hollows in hollow-bearing trees within areas to be cleared will be assessed by an ecologist for suitability for salvage and relocation.	Construction
BD6		A fauna handling and relocation protocol for the management of fauna and habitats will be prepared including: – a procedure for the felling of hollow-bearing trees to prevent or minimise mortality of fauna, and the salvage of hollows and logs where practicable – a procedure for earthworks and understorey vegetation clearing to minimise mortality of the Hunter Valley Delma, and relocation of individuals to areas outside the project area – supervision by a suitably qualified ecologist during initial vegetation clearing, grubbing and stripping of the top 30 cm of the soil profile, and removal of hollow-bearing trees and surface rock for salvage and installation within the avoidance area – management of any trenches or drill sites to prevent fauna from becoming trapped or injured.	Detailed design / Pre-construction
BD7	Impacts on man-made structures	Pre-clearing survey of human-made structures will be conducted to confirm the presence / absence of active breeding roosts. Demolition of man-made structures will be in accordance with the methodology provided in Table 8.12 of Technical Report 1 (Biodiversity Development Assessment Report).	Detailed design / Pre-construction

7.6.1 Offsetting

The offsets required to compensate for the residual terrestrial biodiversity impacts under the BC Act have been determined using the BAM Calculator. In accordance with the offset rules established by the BC Regulation, offset obligations can be achieved by retiring appropriate biodiversity credits from an established Biodiversity Stewardship Site, monetary payment directly into the Biodiversity Conservation Fund, or funding an approved biodiversity action.

Offsets are required for residual impacts on native vegetation and threatened species habitat that cannot be avoided or mitigated. The following ecosystem and species credits would need to be retired to offset residual direct impacts of the project on threatened species habitats:

- 17 ecosystem credits for Central Hunter Slopes Grey Box Forest (PCT 3314)
- 70 ecosystem credits for Central Hunter Ironbark Grassy Woodland (PCT 3431)
- 151 species credits for the Large-eared Pied Bat
- 102 species credits for the Hunter Valley Delma
- 66 species credits for the Pine Donkey Orchid
- 57 species credits for the Southern Myotis
- 51 species credits for the Squirrel Glider
- 88 species credits for the Brush-tailed Phascogale.

In accordance with the EPBC Act Environmental Offsets Policy (Department of Sustainability, Environment, Water, Population and Communities, 2012), biodiversity offsets are required to compensate for significant residual impacts on matters of national environmental significance after all reasonable avoidance, minimisation, and mitigation measures have been applied. Where potential impacts on matters of national environmental significance can be reduced to below the threshold of significance, biodiversity offsets are not necessary.

Under the Bilateral Agreement the retirement of biodiversity credits in accordance with the BOS is considered an acceptable offsetting mechanism for potentially significant impacts on matters of national environmental significance. These offset requirements have been calculated using the BAM Calculator and will be delivered in line with the BOS and the BC Act, in accordance with the Bilateral Agreement.

The project will secure the offset requirements for the project summarised in section 9.6 of Technical Report 1 (BDAR) either by:

- retiring credits from Biodiversity Stewardship Agreements newly established for the project containing the required biodiversity values
- purchasing suitable 'like-for-like' biodiversity credits from the credit market or the Planning, Offsets, Threatened Species and Ecosystems division Credit Supply Fund, and formally retire the credits
- entering a Strategic Offset Delivery Agreement for a portion of the credit liability
- payment to the Biodiversity Conservation Fund for a portion of the credit liability.

The final strategy and proposed offset delivery approach would be confirmed as the design of the project is further refined, and the final disturbance footprint is confirmed.

8. Noise and vibration

This chapter provides a summary of the potential noise and vibration impacts associated with the construction, operation and decommissioning of the project and provides mitigation measures to reduce potential impacts, where necessary. This chapter includes a summary of the results of the Noise and Vibration Impact Assessment (Technical Report 2), which has been prepared in accordance with the SEARs.

During construction, some construction activities would result in exceedances of the noise management levels at nearby residential receivers, which would be minimised and managed through implementation of a construction noise and vibration management plan and standard construction management measures.

During operation, the project is not predicted to result in exceedances of the applicable noise criteria at any sensitive receivers.

8.1 Methodology

8.1.1 Study area

The noise and vibration assessment study area has been defined as a three-kilometre buffer around the project area, as shown in Figure 8.1, and a one kilometre buffer around the temporary road works.

The study area is predominantly rural with a low population density and relatively few sensitive receivers. The adjacent Sandy Creek Road means that some parts of the study area and adjacent receivers would experience road traffic noise.

8.1.2 Key tasks

The noise and vibration assessment included:

- defining a study area to identify nearby noise sensitive receivers for assessment
- characterising the existing noise environment by undertaking long-term unattended background noise monitoring at representative locations to establish rating background noise levels
- reviewing anticipated construction activities and equipment, and assessment of potential construction noise and vibration impacts in accordance with the ICNG (DECC, 2009) and relevant vibration guidelines
- reviewing the proposed project layout and equipment, including battery containers, power conversion systems and transformers, to identify operational noise sources
- undertaking noise modelling to predict construction and operational noise levels at identified noise-sensitive receivers in accordance with the *Noise Policy for Industry* (NPfI) (EPA, 2017)
- assessing potential construction and operational road traffic noise impacts in accordance with the NSW Road Noise Policy (Department of Environment, Climate Change and Water, 2011)
- recommending feasible and reasonable mitigation and management measures to avoid, minimise or manage potential noise and vibration impacts, where required.

The project area, study area, sensitive receivers and noise monitoring locations are shown in Figure 8.1.

Long-term unattended noise monitoring was undertaken between 30 June 2025 and 17 July 2025 at two locations representative of nearby residential receivers situated in the north-western and south-eastern corners of 578 Sandy Creek Road. Details of the monitoring equipment and equipment settings are provided in Table 8.1.

Table 8.1 Noise monitoring equipment details

Location	Equipment details	Equipment settings	Site photos
Monitoring Location 1 (ML1): Southeast corner of 578 Sandy Creek Road, McCullys Gap, NSW on Lot 5 DP802081	Sound Level Meter Svantek 977 Class 1 sound level meter IEC 61672-3:2013- compliant Manufactured prior to 2019 Calibrator Svantek SV30A Class 1 sound level calibrator IEC 61672-3:2013- compliant Manufactured prior to 2017 SN: 39467	Serial Number: 99442 A-weighted Fast time response 15-minute intervals Pre and post calibration variation: 0.1 dBA	
Monitoring Location 2 (ML2): Northwest corner of 578 Sandy Creek Road, McCullys Gap, NSW on Lot 5 DP802081		Serial Number: 36872 A-weighted Fast time response 15-minute intervals Pre and post calibration variation: 0.3 dBA	

Noise monitoring was undertaken in accordance with the *Approved Methods for the Measurement and Analysis of Environmental Noise* (NSW EPA, 2022). Rating background noise levels (RBLs) were calculated in accordance with the NPfI.

Noise data affected by adverse weather conditions, if recorded, was excluded from the assessment, including periods where rainfall occurred or wind speeds exceeded five metres per second at the monitoring height. Meteorological data was obtained from the Bureau of Meteorology Scone Airport automated weather station.

Further details of the noise monitoring methodology and results are provided in Technical Report 2.

8.2 Existing environment

The project is located within a predominantly rural environment characterised by low background noise levels typical of rural residential areas. The surrounding noise environment is influenced by intermittent rural activities and local traffic on Sandy Creek Road, distant traffic on the New England Highway, movement of freight trains and existing operations at the existing Muswellbrook 330 kV substation.

A total of 209 noise-sensitive receivers were identified within the study area (refer Figure 8.1), comprising predominantly residential dwellings as well as a small number of commercial and industrial premises. The closest residential property (R6) to the project area boundary is located approximately 50 metres north, near the existing access road to the Muswellbrook 330 kV substation. The closest residential property to the BESS facility (R5) is located approximately 390 metres to the northwest.

A summary of the noise monitoring results at the residential monitoring locations is provided in Table 8.2. The monitoring results indicate that the established rating background noise levels were below the daytime RBL of 35 dBA. In accordance with the NPfI, the minimum daytime RBLs of 35 dBA was therefore adopted. As the RBLs derived at both monitoring locations were equivalent, these levels have been applied to rural receivers in the vicinity of the project area. Receivers adjacent to and set back from the New England Highway are exposed to higher existing traffic noise therefore more representative background noise levels for these receivers were

adopted from the *Broadlands Muswellbrook Stage 3 & 4 Noise and Vibration Impact Assessment* (E-Lab Consulting, 2026). This results in differentiated noise management levels, as detailed in Technical Report 2.

Table 8.2 Summary of background noise monitoring results

Location	Address	Rating Background Level (dBA) ¹			Ambient noise descriptors ¹ L _{Aeq, period} (dBA)		
		Day	Evening	Night	Day	Evening	Night
ML1	Southeast corner of 578 Sandy Creek Road, McCullys Gap, NSW on Lot 5 DP802081	35 (31) ²	31	30	53	49	50
ML2	Northwest corner of 578 Sandy Creek Road, McCullys Gap, NSW on Lot 5 DP802081	35 (29) ²	31	30	62	57	49

Notes: 1. The time periods are defined as follows:

- Day: 7am to 6pm Monday to Saturday and 8am to 6pm Sunday
- Evening: 6pm to 10pm
- Night: 10pm to 7am Monday to Saturday and 10pm to 8am Sunday.

2. The minimum RBLs of 35, 30 and 30 dBA for the daytime, evening and nighttime respectively have been adopted where the measured RBL is lower than the minimum RBL.

8.3 Potential impacts

8.3.1 Construction

Construction noise levels were predicted at sensitive receivers in accordance with the ICNG (Department of Environment and Climate Change, 2009). The assessment considered a suite of construction scenarios (CS01a, CS01b and CS02 to CS14) representative of the anticipated construction activities, including enabling works (temporary road widening), site establishment, main construction works, commissioning, and reinstatement and rehabilitation.

The construction noise modelling adopted a conservative approach, with scenario sound power levels based on the proposed equipment inventory and assuming the loudest items of plant operate concurrently. Where relevant, an ICNG +5 dB penalty was applied for activities with annoying noise characteristics including rock hammering and impact piling.

Construction noise levels are predicted to exceed the standard hours rural residential noise management level (NML) (45 dBA L_{Aeq,15min}) at residential receivers during several construction scenarios. The highest construction noise impacts are predicted during temporary road widening works in wet conditions (CS01b), where three residential receivers (R5, R199 and R200) are predicted to be highly noise affected (>75 dBA). If these works are undertaken during dry conditions (CS01a), a single residential receiver (R5) is predicted to be highly noise affected. For other scenarios, predicted exceedances are generally limited to the *clearly audible* or *moderately intrusive* perception categories. Detailed receiver-specific predicted noise levels for each construction scenario are provided in Technical Report 2. A summary of construction noise impacts by activity, including the extent and character of impacts at residential receivers, is provided in Table 8.3.

Construction noise impacts will be temporary and variable over the approximately 18-month construction period; however, higher noise levels are expected during short-duration activities, particularly temporary road widening works, and will require targeted mitigation and communication with affected receivers.

Table 8.3 Summary of construction noise impacts by activity

Construction activity	Representative scenario(s)	Extent of impact	Maximum predicted level	Impact character
Temporary road widening works	CS01a (dry) / CS01b (wet)	Wet (CS01b): up to 12 residential receivers (3 highly affected); Dry (CS01a): up to 9 residential receivers (1 highly affected)	Up to 81 dBA $L_{Aeq,15min}$ (CS01b)	Highly intrusive at closest receivers; short-term duration and localised (a few days at each location)
Site establishment	CS02–CS04	Up to 3 residential receivers	Up to 60 dBA $L_{Aeq,15min}$	Clearly audible to moderately intrusive
Main construction – BESS facility	CS05–CS07	Up to 3 residential receivers	Up to 55 dBA $L_{Aeq,15min}$	Clearly audible
Main construction – connection infrastructure	CS08–CS11	Up to 17 residential receivers	Up to 65 dBA $L_{Aeq,15min}$	Clearly audible to moderately intrusive
Commissioning	CS12	Nil	≤ 37 dBA $L_{Aeq,15min}$	Below NML
Reinstatement and rehabilitation	CS13–CS14	Up to 1 residential receiver	Up to 46 dBA $L_{Aeq,15min}$	Clearly audible

Construction road traffic noise

Construction road traffic noise was assessed in accordance with the *NSW Road Noise Policy* (Department of Environment, Climate Change and Water, 2011). The assessment indicates that during peak construction periods, road traffic noise levels along the New England Highway and Sandy Creek Road are not predicted to increase by more than 2 dB at nearby sensitive receivers. Accordingly, construction road traffic noise impacts are anticipated to be negligible.

Construction vibration

Construction vibration impacts were assessed with reference to *Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006) and relevant British Standards for human comfort and cosmetic damage screening.

The screening assessment indicates that the majority of construction activities are not expected to result in vibration impacts at sensitive receivers.

Up to three sensitive receivers (R5, R199 and R200) are within the minimum working distances for human comfort vibration during temporary road widening works in wet conditions (CS01b), where compaction (plate compactor / 1–2 tonne vibratory roller) is required. Vibration-intensive equipment is unlikely to be required if these works are undertaken during dry conditions (CS01a). No structures are located within the minimum working distances for cosmetic damage during any construction scenario. A summary of construction vibration screening outcomes is provided in Table 8.4. Identified impacts would be managed through the management measures to be included in the CEMP, as outlined in Table 8.5.

Table 8.4 Construction vibration screening summary

Impact type	Scenario / equipment	Outcome
Human comfort vibration	CS01b – plate compactor / vibratory roller (1–2 tonnes) (20 m screening distance)	3 receivers (R5, R199, R200) located within the human comfort screening distance
Cosmetic damage to structures	All scenarios (screening distances in accordance with CNVG/BS 7385)	No structures located within cosmetic damage screening distances

8.3.2 Operation

Operational noise modelling was undertaken in accordance with the NPfl (EPA, 2017) to assess potential noise emissions from the proposed plant and equipment. The predicted noise levels were analysed for annoying noise characteristics with the results indicating that no tonal noise characteristics requiring a modifying-factor adjustment are predicted to be present at sensitive receivers.

The assessment indicated that operational noise levels during worst-case conditions are predicted to comply with the applicable night-time project noise trigger levels at all sensitive receivers. Detailed operational noise modelling outputs and contour figures are provided in section 6.1 and Appendix G of Technical Report 2 (Noise and vibration impact assessment).

8.3.3 Decommissioning

Decommissioning is expected to occur at the end of the project's operational life and would involve removal of above-ground infrastructure, utilities and ancillary components, followed by rehabilitation of disturbed areas. Decommissioning is expected to occur over approximately 12 to 24 months.

Noise and vibration impacts during decommissioning are anticipated to be similar, but generally lower in intensity, than construction-related impacts. Decommissioning works would be managed using construction-type controls consistent with the ICNG, and in accordance with the mitigation measures outlined in section 8.4.

Vibration-intensive activities are not expected during decommissioning. No piling or vibratory compaction would be required and only dismantling and removal of plant would be used. Accordingly, vibration impacts during decommissioning are expected to be negligible, with vibration levels well below human comfort and cosmetic damage criteria.

8.4 Mitigation measures

Mitigation measures proposed to avoid or minimise potential noise and vibration impacts during construction, operation and decommissioning of the project are listed in Table 8.5.

Table 8.5 Mitigation measures – noise and vibration

ID	Impact/issue	Mitigation measure	Timing
NV1	Construction noise and vibration management	A Construction Noise and Vibration Management Plan will be prepared and implemented as part of the CEMP, including identification of high noise/vibration activities, source and pathway controls, monitoring (as required), notification and complaints handling.	Pre-construction / Construction
	Construction noise (source controls)	Feasible and reasonable source controls will be implemented including temporary noise screens where practicable, broadband/smart reversing alarms, residential-class mufflers, maximising offset distances to sensitive receivers and avoiding unnecessary high maximum noise events.	Pre-construction / Construction
NV2	Construction noise (administrative controls)	Administrative controls will be implemented including environmental awareness training, selection of low-noise plant, scheduling noise-intensive works to less sensitive times where practicable, and maintaining equipment to minimise noise emissions.	Pre-construction / Construction
NV3	Construction vibration	Where vibration-intensive activities are planned within screening distances, alternative methods or equipment will be investigated and vibration-intensive activities will be scheduled during less sensitive times where practicable.	Pre-construction / Construction
NV4	Cumulative construction noise	Where cumulative construction noise impacts are likely to affect sensitive receivers, the applicant will, where practicable, seek to engage with other proponents to identify opportunities to minimise cumulative noise impacts.	Construction

9. Landscape and visual

This chapter provides a summary of the potential landscape and visual amenity impacts associated with the construction, operation and decommissioning of the project and provides mitigation measures to reduce potential impacts, where necessary. This chapter includes a summary of the results of the Landscape and Visual Impact Assessment (Technical Report 3), which has been prepared in accordance with the SEARs.

The project would involve temporary changes within the project area during construction, which may be viewed from private residences as well as from adjacent roads. Permanent changes during operation would be associated with the introduction of new infrastructure within an already modified and infrastructure-influenced landscape and visual setting.

The assessment found that the project is not predicted to result in major changes that would significantly impact views and landscape character. During construction, potential visual and landscape impacts would be temporary and would range from moderate to negligible. During operation, potential visual impacts would be moderate at two sensitive receiver locations, and low at other locations.

Suitable mitigation and management measures will be implemented during construction to ensure the risk of impacts remains low.

9.1 Methodology

9.1.1 Study area

The study area for the landscape character assessment covered a five-kilometre buffer from all operational project elements.

The study area for the visual impact assessment covered a three-kilometre buffer from the project area based on the scale of the project and surrounding landscape character.

The study area is shown on Figure 3.1 of Technical Report 3 (Landscape and visual assessment).

9.1.2 Key tasks

The landscape and visual assessment involved:

- desktop analysis, including analysing aerial photographs and topographic maps, and reviewing relevant strategies, plans and guidelines
- site visit and analysis to understand the existing landscape and visual context
- identifying landscape character zones and representative viewpoints and their sensitivity to change
- understanding the key visual features of construction, operation and decommissioning of the project
- assessing the potential for landscape character and visual impacts during construction, operation and decommissioning, and determining the potential significance of impacts by assessing sensitivity and magnitude
- considering cumulative visual impacts within the surrounding area
- recommending mitigation and management measures.

Landscape character impact assessment

Landscape refers to all aspects of a tract of land, including landform, vegetation, buildings, villages, and infrastructure.

The potential landscape character impacts of the project were determined based on the scenic quality of the landscape character zones as well as the sensitivity of the landscape character zones (see section 9.2.1) and the magnitude of the change.

Scenic quality is defined as the “holistic and relative scenic, cultural or aesthetic value of the landscape” and is based on the presence or absence of key landmarks or landscape features (DPHI, 2024). These landmarks or features are further defined in legislation and policy. Table 3.1 in Technical Report 3 (Landscape and visual assessment) provides a reference guide for scenic quality.

Sensitivity refers to how sensitive the existing character of the setting is to the proposed change. A high sensitivity means that a landscape is less able to absorb the impacts of a project and, therefore, there is more potential for impacts on landscape character. Magnitude of landscape character impacts refers to the physical size and scale of the change to the landscape. The combination of sensitivity and magnitude determines the landscape character impact, which is rated from negligible to high.

Visual impact assessment

An assessment of visual impacts considers the effects of change and development on the views available to people or groups, and their visual amenity.

Viewshed mapping was used to understand the potential visibility of the project on the surrounding area, including preparing zone of theoretical visibility mapping to identify areas from which it is theoretically possible to view the project. The zone of theoretical visibility plan was prepared using the tallest points of the main project infrastructure to help determine worst-case scenario visibility associated with the operational components of the project.

A total of five representative viewpoints were selected to illustrate the visual influence of the project (see section 9.2.2).

The potential visual impacts were determined based on the sensitivity of the viewpoint and the magnitude of the change. The combination of sensitivity and magnitude determines the potential visual impact, with the level of significance rated from negligible to high.

9.2 Existing environment

The project’s landscape is dominated by rural agricultural land uses. The surrounding area comprises grazing and cropping land, intermittent tree cover, creek corridors and gently undulating landform.

The landscape has been substantially modified by agricultural activities and infrastructure, including existing high voltage transmission lines and the existing Muswellbrook 330 kV substation. These elements form an established part of the visual context of the area.

9.2.1 Landscape character

Four landscape character zones were identified within the study area, as described in Table 9.1 and shown on Figure 9.1. Representative photographs from each landscape character zone are provided in Table 9.1.

Table 9.1 *Assessment of surrounding dwellings*

Landscape character zone	Description of existing character	Scenic quality	Sensitivity	Indicative appearance
1 – Vegetated undulations	This landscape character zone is characterised by undulating land, typically with slopes ranging from 30% to 60% (Department Mineral Resources, 2002). It consists of both gentle and steep undulations which are densely vegetated and classified as ecologically sensitive areas. It distinguishes from surrounding lands due to the changes in topography and vegetation character. Bells Mountain is the major feature within this zone, and it is characterised by a moderately steep terrain with dense native vegetation. The natural character of this zone remains largely intact, and it presents itself as a naturalistic landscape in the existing setting. The existing 132 kV and 330 kV transmission lines traverse through this zone.	High	Moderate	
2 – Creek corridors	This landscape character zone is characterised by dense and intermittent stands of vegetation located along the course of Sandy Creek. It distinguishes itself from surrounding lands typically due to the vegetation stands that segregate it from the surrounding farmlands, and because the creek course carries water during periods of heavy rainfall. Generally, it is characterised by minor undulations along the creek course surrounded by a relatively flat topographic setting. The natural character of this landscape character zone remains largely intact with a few areas that have been modified to suit human settlement. The landscape character zone comprises of natural features that strongly contribute to the local natural character.	Moderate.	Moderate	
3 – Mining and waste	This landscape character zone is characterised by a highly modified landscape with the mine consisting of deep, large open cut pits. The topography is modified around the waste management facility resulting from human activity. Vegetation cover is limited to the perimeter of the respective mining and waste facilities. No specific landscape values have been identified for this landscape character zone, and it does not contribute to the local character or significance of the study area.	Very low	Negligible	

Landscape character zone	Description of existing character	Scenic quality	Sensitivity	Indicative appearance
4 – Rural farmlands	This landscape character zone is characterised by gently undulating to flat land parcels that have been modified to suit agricultural activities such as grazing and cropping. This is the most prominent landscape character zone within the study area. The landscape character zone distinguishes itself from surrounding landscapes due to the cleared land, intermittent stands of vegetation, and gentle undulations in topography. No specific landscape values have been identified for this landscape character zone apart from the low-lying flats along Sandy Creek.	Low	Low	

9.2.2 Representative viewpoints

Sensitive visual receivers within the study area include:

- rural properties located on Sandy Creek Road and Wells Gully Road
- St Heliers Correctional Centre and the Kingdom Hall of Jehovah's Witnesses
- motorists travelling along Sandy Creek Road.

No public viewpoints of State or local scenic significance were identified within the visual study area.

Views within the study area are typically open to partially filtered, with screening provided by vegetation and topography and farm infrastructure.

A total of 46 sensitive receiver locations were identified within the context of the study area (R2 to R47). A total of five viewpoints (VP) were selected as representative locations to assess the potential visual impacts of the project. The locations of the viewpoints are representative of the range of views to the project area. The viewpoints are shown on Figure 9.1 and listed in Table 9.2

Further information on the viewpoints, including a description and representative photos, are provided in section 6 of Technical Report 3 (Landscape and Visual Impact Assessment).

Table 9.2 *Key viewpoints and sensitivity ratings*

Viewpoint	Location	Sensitivity
VP01	Receiver R2 – Sensitive receiver located at 408 Sandy Creek Road, McCullys Gap	Moderate
VP02	Receiver R4 – Sensitive receiver located at 540 Sandy Creek Road, McCullys Gap	Moderate
VP03	Receiver R5 – Representative of sensitive receiver at 551 Sandy Creek Road, McCullys Gap	Moderate
VP04	Near project area access point at 578 Sandy Creek Road, McCullys Gap	Low
VP05	Wells Gully Road, McCullys Gap	Low

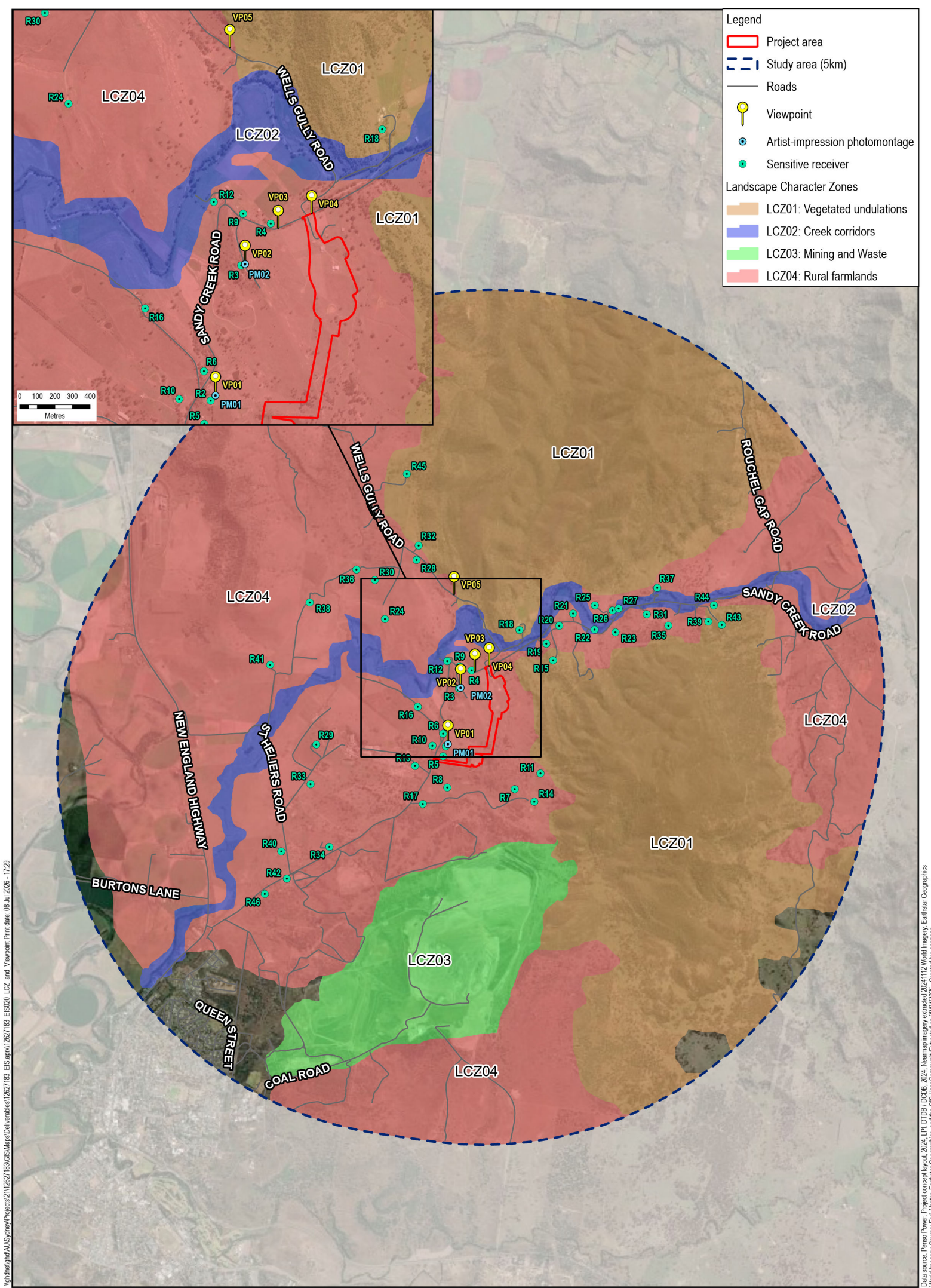


Figure 9.1 Landscape character zones and viewpoint locations

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Data source: Penso Power: Project concept layout, 2024; LP: DDB / DDB, 2024; Nearmap imagery extracted 2024/11/2; World Imagery, Earthstar Geographics World Imagery, Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community/Extracted on 08/07/2026. Created by: eparagon

9.3 Potential impacts

9.3.1 Construction

The project would result in temporary and localised changes to landscape character and visual amenity during construction. These changes would be experienced by visual receivers, such as residents and motorists in the vicinity of the project area.

Visible elements during construction would include plant and equipment, compounds, ancillary facilities, construction vehicle movements, and installation of project infrastructure. Other construction activities that may result in changes to landscape character and visual amenity include earthworks and the removal of vegetation that contributes to the amenity and character of the local area and/or screens views from properties surrounding the project area.

The change in the visual environment would generally be experienced from a relatively short distance, and impacts would be more significant at locations where sensitive receivers have unscreened views towards the project area.

Potential landscape character and visual impacts during construction would be minimised by implementing the measures provided in section 9.4.

Landscape impacts

Construction activities, particularly the presence of construction plant and equipment, vegetation clearing, and earthworks, has the potential to result in landscape impacts. Most impacts would be temporary and short-term, restricted to the construction phase. The removal of vegetation and earthworks to facilitate construction would result in a longer-term change to the landscape character. These activities would be confined to landscape character zone 4, within a landscape that already exhibits a working rural and infrastructure-influenced character. As such, the assessment concluded that the project would have a moderate impact on landscape character zone 4 (see Table 9.3).

Further information on the ratings and assessment for each landscape character zone is provided in section 5 of Technical Report 3 (Landscape and visual impact assessment).

Table 9.3 Summary of landscape character impacts during construction

Landscape character zone	Description	Sensitivity to change	Magnitude of change	Significance of impact
LCZ 1	Vegetated undulations	Moderate	Low	Moderate-low
LCZ 2	Creek corridors	Moderate	Low	Moderate-low
LCZ 3	Mining and waste	Negligible	Negligible	Negligible
LCZ 4	Rural farmlands	Low	High	Moderate

Visual impacts

During construction, the movement of vehicles, establishment of a construction compound, stockpile areas and construction of site access tracks would be visible at the viewpoint locations, especially at sensitive receivers R4, R5 and along Sandy Creek Road. These visual impacts, however, would be temporary.

The assessment identified that the existing visual character at these viewpoint locations is likely to have a moderate visual modification during the operation phase. The project area would be visually prominent at sensitive receiver R4 and along Sandy Creek Road. However, the existing 132 kV and 330 kV transmission lines form part of the current views at these locations. Therefore, the character of the existing setting is not likely to be adversely impacted by the project.

A summary of the changes and the significance of potential impacts at viewpoints during construction are provided in Table 9.4. Further information on the ratings and assessment for each key viewpoint is provided in section 6.3 of Technical Report 3 (Landscape and Visual Impact Assessment). Images showing changes during construction at selected viewpoints are provided in section 6.3 in Technical Report 3.

Table 9.4 Summary of visual impacts during construction

Viewpoint number	Description of changes	Magnitude of change	Significance of impact
VP01	During construction, temporary visual impacts associated with excavators, cranes, and other ancillary structures and machinery may potentially occur in the middle ground and background of the view. Laydown areas, construction compound, stockpile sites and site access track associated with the establishment of connection infrastructure are likely to be visible.	Low	Low
VP02	During construction, potential temporary visual impacts associated with excavators, cranes, access roads and other ancillary structures and machinery would occur in the middle ground of the view. Laydown areas, vehicles and activity associated with construction works are likely to be visible due to the proximity to the project area. Existing topographical variation limits some views in the southeastern direction. However, lack of intervening vegetation and proximity to project area would allow prolonged views of construction activities.	Moderate	Moderate
VP03	Temporary visual impacts associated with excavators, cranes, access roads and other ancillary structures and machinery are likely to occur in the foreground of the view. Laydown areas, site establishment activities, vehicles and activities associated with construction works are likely to be visible due to the proximity of the project area. Lack of intervening vegetation and proximity to the project area would allow prolonged views of construction activities	Moderate	Moderate
VP04	Temporary visual impacts associated with site establishment, stockpile areas, site access tracks and other ancillary structures and machinery are likely to occur in the foreground of the view. Laydown areas, vehicles and activity associated with construction works are likely to be visually prominent due to the proximity of the project area. Views from this location are generally open and expansive due to the lack of intervening vegetation.	Moderate	Low
VP05	During the construction phase, temporary visual impacts associated with establishment of the construction compound, stockpile areas and increased traffic movement are likely to occur in the background of the view. Activities associated with construction works may be visible in the distance.	Low	Low

9.3.2 Operation

Landscape impacts

The project would introduce permanent built elements, including a BESS facility, project substation, and connection infrastructure, in what is currently a predominantly rural agricultural landscape. The permanent infrastructure would result in a localised alteration to the rural landscape character, particularly within the parts of landscape character zone 4 where the BESS facility and connection infrastructure would be visible, namely from residential dwellings nearest to the project area.

While the project would introduce significant built form into an open pastoral setting, the change represents a low modification to a landscape setting that is characterised by existing infrastructure elements within pastoral lands. As such, the assessment concluded that the project would have a moderate-low to negligible significance of impacts on the landscape during operation, as summarised in Table 9.5.

Table 9.5 Summary of landscape character impacts during operation

Landscape character zone	Description	Sensitivity to change	Magnitude of change	Significance of impact
LCZ 1	Vegetated undulations	Moderate	Low	Moderate-low
LCZ 2	Creek corridors	Moderate	Low	Moderate-low
LCZ 3	Mining and waste	Negligible	Negligible	Negligible
LCZ 4	Rural farmlands	Low	High	Moderate

Visual impacts

Views to the project during operation would vary depending on the location and elevation of the viewer relative to the project area. The BESS facility would be fully screened by existing vegetation and topography at receiver R2 (VP01), while the connection infrastructure would be visible from all assessed viewpoints, consistent with the existing visual setting which already includes 132 kV and 330 kV transmission line infrastructure. At sensitive receivers R4 (VP02) and R5 (VP03), which are located at similar or elevated positions relative to the project area and in closer proximity, both the BESS facility and connection infrastructure are likely to be visible due to the lack of intervening vegetation and topographic screening.

A summary of the changes and the significance of potential impacts at viewpoints during operation are provided in Table 9.6. Visual impacts during operation are generally assessed as moderate to low. Sensitive receivers R4 and R5 are predicted to experience moderate visual impacts, reflecting their proximity to the project area and the potential for prolonged views of project infrastructure. These impacts have been discussed with the relevant landowners in the context of the negotiated agreements between the parties, and on-site screen planting has been proposed to partially mitigate views from these locations. All other assessed locations, are predicted to experience low visual impacts, reflecting the screening provided by existing vegetation and topography, greater distance from the project area, and shorter or transient viewing time.

Images showing the approximate location of project features at select viewpoints are provided in Technical Report 3 (Landscape and visual assessment).

Table 9.6 Summary of visual impacts during operation

Viewpoint	Description of change	Magnitude of change	Significance of impact
VP01 (R2)	The BESS facility is likely to be completely screened by existing vegetation and topography. Ancillary infrastructure such as the connection infrastructure is likely to be visible in the middle ground of the view.	Low	Low
VP02 (R4)	During operation, the project area and ancillary infrastructure such as the connection infrastructure would be visible in the middle ground of the view. Views of the BESS facility and ancillary infrastructure are likely to be available in the eastern/southeastern direction once the topography of the project area is altered due to the cut and fill associated with the project groundworks. Views along the driveway of this residence are directed to the east/southeast, which is the direction in which the project area would be visible. A gentle rise in the topography in the southern direction helps screen a part of the project area when viewed from this location.	Moderate	Moderate
VP03 (R5)	During operation, the project area and ancillary infrastructure are likely to be visually dominant in the foreground of the view for the motorists and the landowners of sensitive receiver R4. The topography of the project area would be altered due to the cut and fill associated with the project groundworks and it is likely that the BESS facility would be visually prominent at eye level when viewed from this location.	Moderate	Moderate
VP04	During operation, the project area and ancillary infrastructure are likely to be visually prominent in the foreground and middle ground of the view. The topography of the project area would be altered due to the cut and fill associated with the project groundworks and it is likely that the BESS facility would be visible at eye level when viewed from this location.	Low	Low
VP05	The BESS facility and ancillary infrastructure are likely to be visible in the distance due to the elevated position of this viewpoint. However, it is likely that the project would not dominate the existing view.	Low	Low

Decommissioning

Potential landscape and visual impacts from decommissioning activities would be temporary, localised, and similar in nature to construction impacts, though generally of shorter duration. Impacts would also be diminishing as infrastructure removal is completed.

9.4 Mitigation measures

Mitigation measures proposed to avoid or minimise potential landscape and visual impacts associated with construction, operation and decommissioning of the project are summarised in Table 9.7.

Table 9.7 *Mitigation measures – landscape and visual*

No.	Impact/issue	Mitigation measure	Timing
LV1	Visual impacts from connection infrastructure	Where possible, the number and height of transmission towers or monopoles will be minimised to reduce visual changes.	Design
LV2	Visual impacts during construction	A Landscape and Visual Management Plan will be developed and implemented as part of the CEMP detailing measures to minimise visual contrast and landscape disturbance during construction. The plan will include: – staging construction activities to limit the extent and duration of exposed ground surfaces visible from key sensitive receivers – rehabilitating disturbed areas progressively using endemic species of appropriate form and height to re-establish landscape character and soften views of the project – managing stockpiles, laydown areas and machinery placement to reduce clutter and visual prominence, including maintaining tidy, compact work zones – implementing glare-minimisation measures for construction lighting and ensuring lighting is directed downward and shielded to reduce light spill.	Pre-construction / Construction
LV3	Landscaping and vegetation management	The draft landscape plan provided in Appendix B of Technical Report 3 (Landscape and Visual Impact Assessment) will be further refined with the final location, species selection and extent of planting confirmed during detailed design in consultation with relevant affected landowners. Landscaping and planting will be implemented and maintained in accordance with this plan.	Design / Construction / Operation

10. Aboriginal heritage

This chapter provides a summary of the potential Aboriginal heritage impacts associated with the construction, operation and decommissioning of the project and provides mitigation measures to reduce potential impacts, where necessary. The chapter includes a summary of the results of the Aboriginal Cultural Heritage Assessment Report (Technical Report 4), which has been prepared in accordance with the SEARs.

The assessment confirmed that the project would have impacts to two registered Aboriginal sites within the project area, one of which could not be identified during field survey and both of which were identified as having low archaeological value. These impacts would be managed through salvage methodology procedures. With standard construction management measures in place, any further impacts to Aboriginal cultural heritage during construction, operation and decommissioning will be minimised as far as reasonably possible.

10.1 Methodology

10.1.1 Study area

The study area for the Aboriginal cultural heritage assessment encompassed the project area.

10.1.2 Key tasks

The Aboriginal cultural heritage assessment involved the following key tasks:

- background research on the Aboriginal archaeological and historical context of the project area and surrounding locality, including reviewing previous studies/investigations and searching the NSW Aboriginal Heritage Information Management System (AHIMS) database to identify existing registered Aboriginal sites
- four field surveys involving surface ground inspections within the project area to confirm the presence of existing registered sites and identify any new sites, undertaken with representatives of the Wanaruah Local Aboriginal Land Council (LALC) and Registered Aboriginal Parties (RAPs) in August 2025 – February 2026
- consultation with the Aboriginal community (see below)
- assessing the potential for impacts on Aboriginal heritage
- identifying measures to minimise impacts on Aboriginal heritage.

Aboriginal consultation

Consultation with Aboriginal community stakeholders for the project was undertaken in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* and included:

- providing an opportunity for those Aboriginal people and organisations potentially relevant to the project to register and participate in the management of their cultural heritage, identified as RAPs. Thirteen groups or individuals registered to be consulted as RAPs on this project, and are documented in section 3 of Technical Report 4 (Aboriginal Cultural Heritage Assessment Report)
- providing project information and the proposed assessment methodology to those people and organisations (RAPs) who registered their interest in for review and comment in June 2025
- incorporating any comments received (in this case, no comments about methodology were received)
- inviting those who registered to participate in on-site field survey of the project area
- providing the draft Aboriginal cultural heritage assessment report to the RAPs for comment in April 2026. No comments were received.

10.2 Existing environment

10.2.1 Aboriginal historical and landscape context

The project area is in the upper Hunter Valley on Wonnarua Country. Ethno-historic sources describe Wonnarua Country as centred on the Hunter River and its tributaries (with debated boundaries), within a resource-rich landscape that supported a diverse diet, seasonal movement, trade/exchange and ceremonial gatherings. The project landscape sits between two recognised bioregions – NSW North Coast (Hunter Subregion) to the east and the Sydney Basin (Ellerston Subregion) to the west – and traverses the Central Hunter Foothills and Upper Hunter Channels and Floodplain soil landscapes, characterised by undulating lowlands and rounded to steep hills with rocky outcrops on ridgelines on Permian lithic sandstone, conglomerate, shale and coal (generally 40 metres to 300 metres AHD). The surrounding landscape is predominantly rural and shaped by grazing land use, scattered farm infrastructure and existing electricity infrastructure, with remnant native vegetation largely associated with drainage lines and less disturbed parts of the project area.

The main project area is a gentle to moderately steep north-descending slope (high point ~236 metres) drained by two ephemeral channels to Sandy Creek (about 45 metres north at the closest point), with one drainage line substantially disturbed by the existing Muswellbrook 330 kV substation and nearby dams. The remaining project areas are small, highly modified road corridors influenced by ephemeral drainage to non-perennial Sandy Creek and proximity to Muscle Creek (perennial). Given the distance to permanent water (the Hunter River ~3.5 kilometres west), the main project area is most likely to have supported travel and short-term/seasonal use when Sandy Creek held water, while the disturbed road corridors are unlikely to represent sustained occupation in their current form.

Further information on the Aboriginal historical context is provided in section 5 of Technical Report 4 (Aboriginal Cultural Heritage Assessment Report).

10.2.2 Aboriginal sites and places

Registered sites

The results of the AHIMS search identified one registered site within the project area, TR/1 (AHIMS ID 37-2-5052), which is an artefact scatter. According to the site card, TR/1 (AHIMS ID 37-2-5052) has not been able to be located for several years.

Sites identified during the field survey

A total of two new sites, consisting of a potential archaeological deposit (PAD) and a single artefact, were identified within or adjacent to the project area during the field survey (see Table 10.1).

The design was refined to ensure impacts to the PAD are completely avoided.

Table 10.1 Aboriginal cultural heritage sites within the project area recorded during the field surveys

AHIMS ID	Site name	Site type	Observed characteristics
TBC	McCullys Gap PAD 1	PAD	PAD extent is approximately 178 m long by 54 m wide. Close to ephemeral drainage line, no artefacts identified. Some small stones identified in eroded areas (not artefactual).
37-2-6778	McCullys Gap IF 1	Isolated find	Single artefact on a vehicle track, gently sloping landform. One small artefact identified, a mudstone flake. No other artefacts identified in the vicinity.

Significance of identified sites

The Burra Charter (Australia International Council on Monuments and Sites (ICOMOS), 2013) defines significance in terms of social or cultural, archaeological/scientific, aesthetic and historic values. The assessment of significance provides a guide for determining appropriate mitigation and management strategies.

Sites within the project area were assessed in accordance with the Burra Charter and the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (Office of Environment and Heritage, 2011), as well as in consultation with RAPs, and identified to have the following values:

- Social or cultural values – all identified sites are considered to have social and cultural significance to Aboriginal people, as they provide a tangible connection to ancestors, Country and past cultural practices.
- Archaeological/scientific values – the scientific significance of McCullys Gap PAD 1 cannot be determined without archaeological excavation, however the PAD is subject to a moderate level of disturbance and is located outside the project disturbance area. Therefore, any archaeological value that may be present would not be impacted. McCullys Gap IF 1 and TR/1 were assessed as having low archaeological/scientific value.
- Aesthetic values – the identified sites are considered to have low aesthetic value, as the integrity of the surrounding sensory and visual landscape has been substantially altered by historical and contemporary land uses. The physical artefacts themselves are limited in number and typology, and are not distinctive in terms of material, form or visual characteristics.
- Historic values – the recorded Aboriginal sites are not associated with historically significant persons, places or events. Accordingly, the sites are assessed as having low historic value.

Archaeological potential

The likelihood of Aboriginal archaeological sites occurring within the project area is influenced by landform, access to water and other resources, the durability of surviving material evidence, and the extent of disturbance and post-depositional processes. In general, sites are more frequently recorded along permanent and ephemeral water sources, along access or trade routes, and where resources and shelter are favourable; however, artefacts may not remain in their original depositional context due to erosion/transport and historical land uses such as grazing, cropping and farm/infrastructure disturbance. A review of AHIMS records indicates Aboriginal heritage in the locality is dominated by stone artefact-based sites, with 88 records returned in the broader search area (most being artefacts, artefact scatters and isolated finds), typically occurring along watercourses without a clear distinction between perennial and non-perennial sources.

Within the main project area, archaeological potential is most closely associated with the local drainage setting. Overall, the project area is assessed as having low archaeological potential, noting that the dominant landforms are degrading slopes and disturbed drainage contexts where any Aboriginal objects, if present, are most likely to occur as isolated finds or low-density artefact material in secondary contexts, and the heavily modified road-corridor areas are unlikely to contain Aboriginal objects. This landform context suggests the area may have been suitable for use by Aboriginal people, but more likely for smaller groups and short-duration, task-focused activities rather than sustained occupation. The remaining project areas (road-corridor sections) are heavily modified; while parts occur within 200 metres of Muscle Creek (a perennial water source), extensive road and infrastructure modification means these areas are unlikely to contain Aboriginal objects other than a small possibility of isolated find.

Aboriginal places

No Aboriginal places declared under section 84 of the *National Parks and Wildlife Act 1974*, or Aboriginal places of heritage significance defined by the Muswellbrook LEP are located within or near the project area.

Aboriginal cultural values

No specific Aboriginal cultural values have been identified by RAPs in relation to the project area. Notwithstanding this, the cultural significance of the broader landscape to Aboriginal people is recognised, and further opportunities for RAP input would be provided through ongoing consultation as part of the EIS and during construction.

10.3 Potential impacts

10.3.1 Construction

Direct impacts on Aboriginal sites may occur through the following processes:

- Direct harm or disturbance to surface and/or subsurface features, which would generally result in a total or partial loss of heritage value.
- Potential inadvertent direct harm or disturbance (total or partial), where construction takes place adjacent or close to an item.

Indirect impacts on Aboriginal sites can also occur as a result of vibration from nearby construction activities, and impacts on views to and from a site or place.

It is anticipated that construction would directly impact McCullys Gap IF 1 and TR/1. However, TR/1 is currently also marked for impact by the Bells Mountain BESS due to its location adjacent to the Transgrid Muswellbrook 330kV substation. No impacts would occur to McCullys Gap PAD 1.

The proposed infrastructure has been sited by considering spatial requirements, landform, existing vegetation and known heritage, and utilising existing access tracks where possible. Sites McCullys Gap IF 1 and TR/1 are unable to be avoided due to project constraints, including siting requirements and existing disturbance, with avoidance having been considered during design development. Impacts from vegetation removal and earthworks would result in a total loss of value at these sites, which would be managed by salvage as described in section 10.4. Salvage is considered appropriate because of the combination of low archaeological value, the disturbed nature of the environment and the site type (small scatter/isolated find).

No sites with the potential to be indirectly impacted (as a result of vibration, subsidence or visual impacts) have been identified.

10.3.2 Operation

No impacts on Aboriginal heritage during operation are expected. Operational and maintenance works would be restricted to areas previously disturbed during construction.

10.3.3 Decommissioning

At the end of its operational life, all infrastructure, utilities, and disturbed areas would be decommissioned and returned to the pre-existing land use in consultation with relevant stakeholders.

Decommissioning of the project is not expected to result in further impacts on Aboriginal heritage as decommissioning activities would be restricted to areas previously disturbed during construction.

10.4 Mitigation measures

Mitigation measures proposed to avoid or minimise impacts to Aboriginal cultural heritage during construction, operation, and decommissioning of the project are summarised in Table 10.2.

Table 10.2 Mitigation measures – Aboriginal heritage

ID	Impact	Mitigation measure	Timing
AH1	Avoiding and minimising impacts on Aboriginal heritage	Design and construction planning will continue to be refined to avoid impacts on identified sites of Aboriginal heritage significance, as far as practicable.	Design / Pre-construction
AH2	Managing Aboriginal heritage and minimising impacts during construction	An Aboriginal Cultural Heritage Management Plan will be prepared and implemented. The plan will include measures to minimise the potential for impacts on Aboriginal heritage and measures to manage impacted sites, including: – a salvage methodology for sites that would be impacted (mitigation measure AH3) – an unexpected finds procedure (mitigation measure AH4) – protocols for long-term management of salvaged Aboriginal sites – cultural awareness training for site workers. The plan will be prepared in consultation with the relevant Registered Aboriginal Parties, DPHI, and Heritage NSW.	Pre-construction / Construction
AH3		A salvage methodology will be developed in accordance with the recommendations of section 9.2 of Technical Report 4 (Aboriginal Cultural Heritage Assessment Report) for the following sites: – AHIMS site 37-2-5052 (TR/1) – AHIMS site 37-2-6778 (McCullys Gap IF 1).	Pre-construction
AH4	Unexpected heritage finds and human remains	An unexpected finds and human skeletal remains procedure will be developed and included into the Aboriginal Cultural Heritage Management Plan to provide a consistent method for managing any unexpected Aboriginal heritage items or human skeletal remains.	Pre-construction

11. Historic heritage

This chapter provides a summary of the potential historic heritage impacts associated with the construction, operation and decommissioning of the project and provides mitigation measures to reduce potential impacts, where necessary. The chapter includes a summary of the results of the Historic Heritage Impact Assessment (Technical Report 5), which has been prepared in accordance with the SEARs.

The historic heritage assessment found that no historic heritage items were identified within the project area and there would be no impacts to listed heritage items. Therefore, no mitigation is required beyond preparation and implementation of an unanticipated finds protocol.

11.1 Methodology

11.1.1 Study area

The study area for the historic heritage assessment encompassed the project area, including areas where road works are proposed.

11.1.2 Key tasks

The assessment involved:

- a desktop review of relevant heritage databases and statutory listings, including the Australian Heritage Database, the State Heritage Inventory and the Muswellbrook LEP, to identify whether historical heritage items or areas are, or are likely to be, present within the project area
- four field surveys in August 2025 – February 2026 to identify potential historic heritage items within the project area
- applying the guidelines established in *Investigating Heritage Significance. A guide to identifying and examining heritage items in NSW* (Heritage Council of NSW, 2021) to evaluate the heritage significance of any recorded historical heritage items or areas and any potential impacts from the project
- recommending mitigation measures to minimise impacts on historic heritage.

11.2 Existing environment

11.2.1 Historical context

The project area is located within the broader Muswellbrook region of the Hunter Valley, one of the earliest areas settled by Europeans in NSW. Following exploration of the Hunter River in the late eighteenth century, the region was opened to free settlement in the early 1820s and rapidly developed for pastoral and agricultural uses.

Land within and surrounding the study area was historically associated with large pastoral estates, including the St Heliers estate established by Henry Dumaresq from the late 1820s. Throughout the nineteenth and early twentieth centuries, the area supported sheep grazing, cattle husbandry and mixed farming, with Muswellbrook developing as a regional service and administrative centre.

Historical mapping and aerial imagery indicate that the study area itself has been predominantly used for agricultural purposes, with associated dwellings and major infrastructure located outside the project boundaries for at least the past 80 years.

11.2.2 Historic heritage items

Listed historic heritage items

There are no listed sites within the project area. Listed sites within the vicinity of the project area are summarised in Table 11.1 and shown on Figure 11.1.

Table 11.1 *Listed heritage items within and adjacent to project site*

Item	Listing (instrument and item number)	Significance	Location with respect to the project area
St Heliers Correctional Centre	State Heritage Inventory, Muswellbrook LEP 2009 (I113)	State and local	Curtilage partially intersects. Closest item 1.5 km west
Lime Kiln (E.I.E.I.O)	Muswellbrook LEP 2009 (I115)	Local	Curtilage 150 m west Item 350 m west
Gelston homestead	Muswellbrook LEP 2009 (I114)	Local	Curtilage 1.1 km west Item 1.6 km west
Muswellbrook Railway Depot	Muswellbrook LEP 2009 (I53)	Local	Directly adjacent (south)
Fitzgerald / Olympic Park Gates	Muswellbrook LEP 2009 (I124)	Local	Curtilage 8 m west Item 350 m west
Residential Heritage Conservation Area (C2)	Muswellbrook LEP 2009	Planning control area	13 m west

Field survey

Field surveys identified no significant historic heritage within the project area and archaeological deposits relating to the historic settlement of the land are considered unlikely.

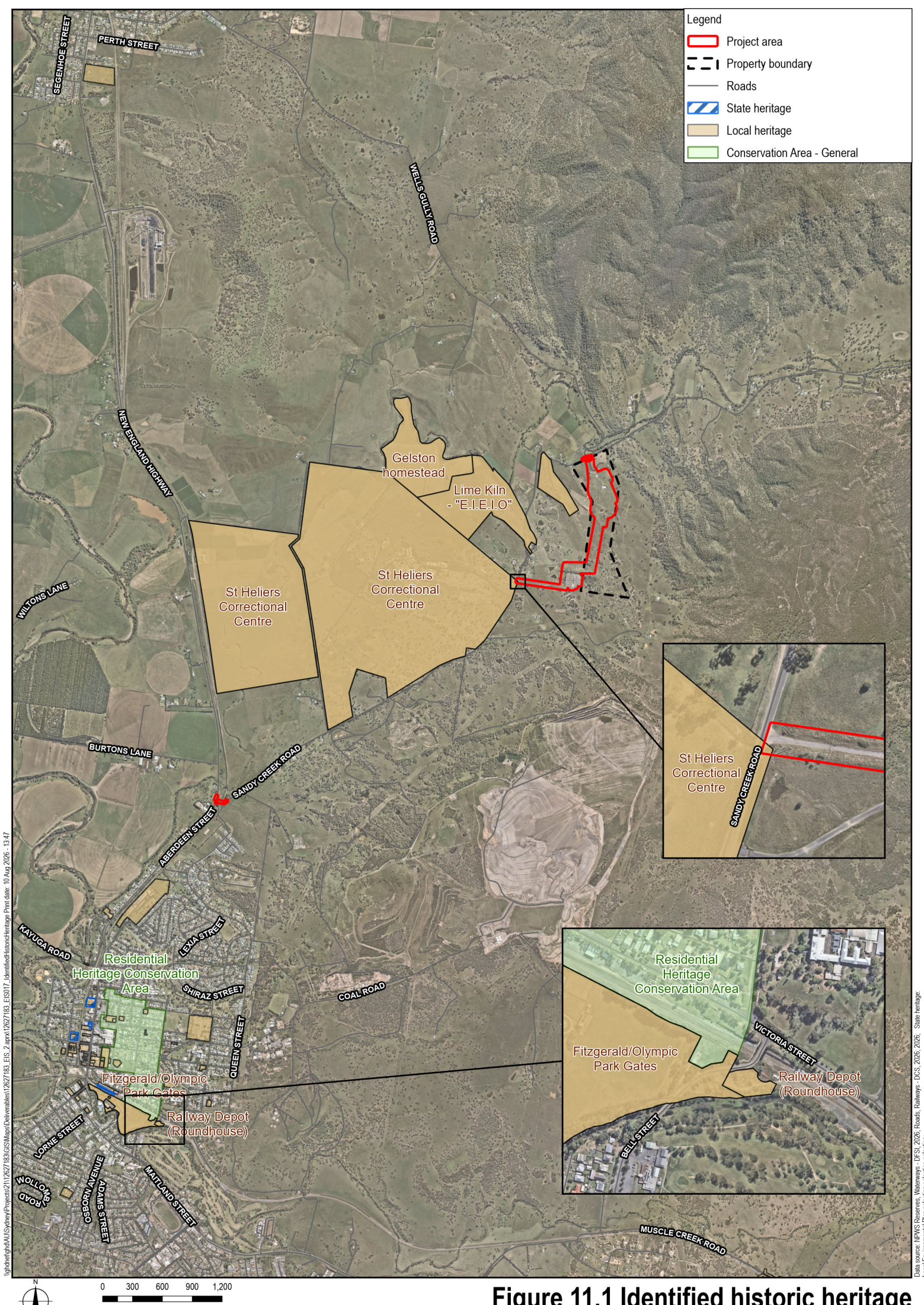


Figure 11.1 Identified historic heritage

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Data source: NPWS Reserves, Waterways - DF SI, 2026; Roads, Railways - DCS, 2026; State heritage: Local Environmental Plan selection selection.

11.3 Potential impacts

11.3.1 Construction

Potential impacts on non-Aboriginal heritage during construction were assessed based on impacts on the significance of a heritage item as a result of:

- direct (physical) impacts – caused by removing or altering the item or fabric of heritage significance or excavating in areas of archaeological potential
- potential direct impacts – incidental physical impacts from construction activities, such as damage from the movement of construction machinery or vibration impacts.

Potential impacts to the heritage items described in section 11.2.2 are summarised in Table 11.2. As noted in Table 11.2, there would be no impacts to listed heritage items or conservation area in proximity to the project area.

Table 11.2 Summary of potential impacts on listed heritage items

Item	Impact	Significance of assessed impact
Railway Depot (Roundhouse) (I53)	Curtilage is just south of the project area. Works for the project would be confined to an existing disturbed road corridor and would not interact with the heritage item or its fabric.	The overall impact to this item has been assessed as none .
St Heliers (I113)	Although mapped curtilage extends into the study area, the actual heritage items and buildings are approximately 1.5 km away from the project area and would not be affected. Additionally, the overlap of curtilage with the study area is likely to be a mapping error.	The overall impact to this item has been assessed as none .
Gelston (I114)	The heritage item and its curtilage are sufficiently distant from the project to preclude any direct or indirect impact.	The overall impact to this item has been assessed as none .
Lime Kiln "E.I.E.I.O" (I115)	The kilns are situated a property that is separated from the project area by a fenceline, property boundaries and intervening landform. No direct works are proposed to the item or its curtilage.	The overall impact to this item has been assessed as none .
Fitzgerald / Olympic Park Gates (I124)	Although the curtilage is close the actual heritage item is 350 m away and works for the project would be confined to an existing disturbed road corridor and would not interact with the heritage item or its fabric.	The overall impact to this item has been assessed as none .
Residential Heritage Conservation Area (C2)	While close to the project area works for the project would be confined to an existing disturbed road corridor and will not affect the aesthetics or values of the conservation area.	The overall impact to this item has been assessed as none .

11.3.2 Operation

There would be no impacts to the listed heritage items during operation. Project infrastructure would not intrude upon the setting, curtilage or significant views associated with nearby heritage items, and the existing separation distances would be maintained.

11.3.3 Decommissioning

Decommissioning of the project is not expected to result in impacts on historic heritage, as activities would be restricted to areas previously disturbed during construction and would not affect heritage fabric or values within mapped curtilage areas.

11.4 Mitigation measures

Mitigation measures proposed to avoid or minimise impacts to historic heritage during construction, operation, and decommissioning of the project are summarised in Table 11.3

Table 11.3 Mitigation measures – historic heritage

ID	Impact/issue	Mitigation measure	Timing
HH1	Unexpected heritage items	An unexpected heritage finds procedure will be developed and included in the CEMP to provide a consistent method for managing any unexpected heritage items discovered during construction, including potential historic heritage items or relic and human skeletal remains.	Pre-construction / Construction

12. Land and soils

This chapter provides a summary of the potential land and soils impacts associated with the construction, operation and decommissioning of the project and provides mitigation measures to reduce potential impacts, where necessary. The chapter includes a summary of the results of the Land Use and Agriculture Assessment (Technical Report 6), which has been prepared in accordance with the SEARs.

The assessment found that construction would result in a temporary disturbance to land predominantly used for extensive livestock grazing. The extent of disturbance is small in a regional context, and areas not required for permanent infrastructure would be progressively reinstated and returned to pre-construction agricultural use following construction.

During operation, permanent land use change would be limited to the BESS facility and project substation (approximately 5.1 hectares), with land within the connection infrastructure corridor remaining available for most normal agricultural activities, including ongoing grazing. The project does not intersect any biophysical strategic agricultural land, and the estimated effect on agricultural productivity is negligible in the context of the Muswellbrook Shire LGA.

12.1 Methodology

12.1.1 Study area

The study area for the land and soils assessment comprises the two properties on which the project area is located, and additional areas required to facilitate temporary road works at four intersections on the public road network, as described in section 2.2.2.

12.1.2 Key tasks

The land use and agriculture assessment involved:

- reviewing relevant legislation, guidelines, policies and land use plans
- describing existing land uses (including agricultural uses) based on a review of aerial imagery and spatial mapping, including that produced by the former NSW DPE, and a site inspection
- scoping potential land use conflicts through the completion of a land use conflict risk assessment in accordance with the *Land Use Conflict Risk Assessment (LUCRA) Guide* (Department of Primary Industries(DPI), 2011)
- a soil investigation, including review of historical soil sampling information, collection of five surface samples across the project site and submission of those samples to an accredited laboratory for analysis of standard soil condition and fertility indicators (further information is provided in section 4.2 of Technical Report 6 (Land Use and Agriculture Assessment))
- considering the potential impacts of constructing, operating and decommissioning the project on land use and agriculture, including temporary and permanent land use changes, property impacts, agricultural resources and agricultural productivity, and cumulative impacts
- consultation with affected landowners
- recommending measures to mitigate the potential impacts identified.

12.2 Easement arrangements

Where required, easement acquisition and compensation would be negotiated in accordance with the *Electricity Supply Act 1995* and the *Land Acquisition (Just Terms Compensation) Act 1991*.

The terms of the easement provide an electricity network operator or authorised licensee under the *Electricity Supply Act 1995* with a legal right to enter land for the purposes of construction, operation and maintenance of electricity infrastructure, including transmission lines. Easements are registered on the underlying land title and remain in place following any future change in land ownership.

Formal easements are not anticipated to be required within the Transgrid-owned land (Lot 1621, DP 852356), as Transgrid maintains operational control of transmission corridors on its land. A formal easement would be established for the connection infrastructure on Lot 5//DP80208 (see Figure 3.5). The corridor would generally be 60 metres wide along the length of the connection infrastructure. The applicant would retain responsibility for maintaining and repairing the infrastructure within the corridor. Access for maintenance, repair and inspection activities would be undertaken in a manner that minimises disruption to affected landholders.

Subdivision of land to create a separate lot for the project substation is also being considered (see Figure 3.5). The details of the subdivision, including a subdivision plan, would be confirmed during detailed design.

12.3 Existing environment

12.3.1 Regional context and land use

Land use and property

Land use within the Muswellbrook Shire LGA is dominated by agricultural activities, with livestock grazing representing the most common land use, alongside areas of conservation, mining and existing electricity infrastructure.

Table 12.1 presents relevant land use areas for the project area and the Muswellbrook Shire LGA based on NSW land use mapping (DCCEEW, 2023) and shows the proportion of the project area and the Muswellbrook Shire LGA occupied by these land uses. A further breakdown of the mapped agricultural uses is also provided in Table 12.2.

Table 12.1 Land uses based on land use mapping (DCCEEW, 2023)

Land use	Project area		Muswellbrook Shire LGA	
	Land area (ha)	Proportion of project area (%)	Land area (ha)	Proportion of Muswellbrook Shire LGA (%)
Agriculture	18.11	90.5	137,103	40.25
Utilities	1.70	8.5	1,480	0.43
Transport and communication	0.15	0.8	2,446	0.72
Total	20	100.0	340,634	100.0

Land within the project area is zoned RU1 Primary Production under the Muswellbrook LEP.

Figure 12.1 shows land uses within and around the study area.

A description of the indicative land requirements for construction and operation of the project is provided in section 3.2.5. Land tenure within the project area consists of private landholders only, including Transgrid.

Regional agricultural productivity

Livestock production and broadacre cropping are key agricultural activities in the study area. Major crops reported include wheat, oats, barley, sorghum and maize, with hay and silage production representing the largest cropped area (over 2,000 hectares) and the greatest number of associated businesses (55) in 2020-21. Smaller areas of horticulture are also present, including grapes for wine production.

Cattle enterprises dominate livestock production in the Muswellbrook Shire LGA, primarily beef cattle, with a smaller dairy sector also present. Sheep and lamb, poultry and pigs are also recorded. In addition, the region supports a significant thoroughbred bloodstock equine industry (training, spelling and breeding), which forms an important part of the broader agricultural profile. The gross value of agricultural commodities produced in 2020-21 was just over \$40 million, with the largest contribution from livestock meat (about \$21 million), followed by livestock products (about \$12 million, largely milk) and broadacre crops (about \$7 million, including hay) (ABS, 2022).

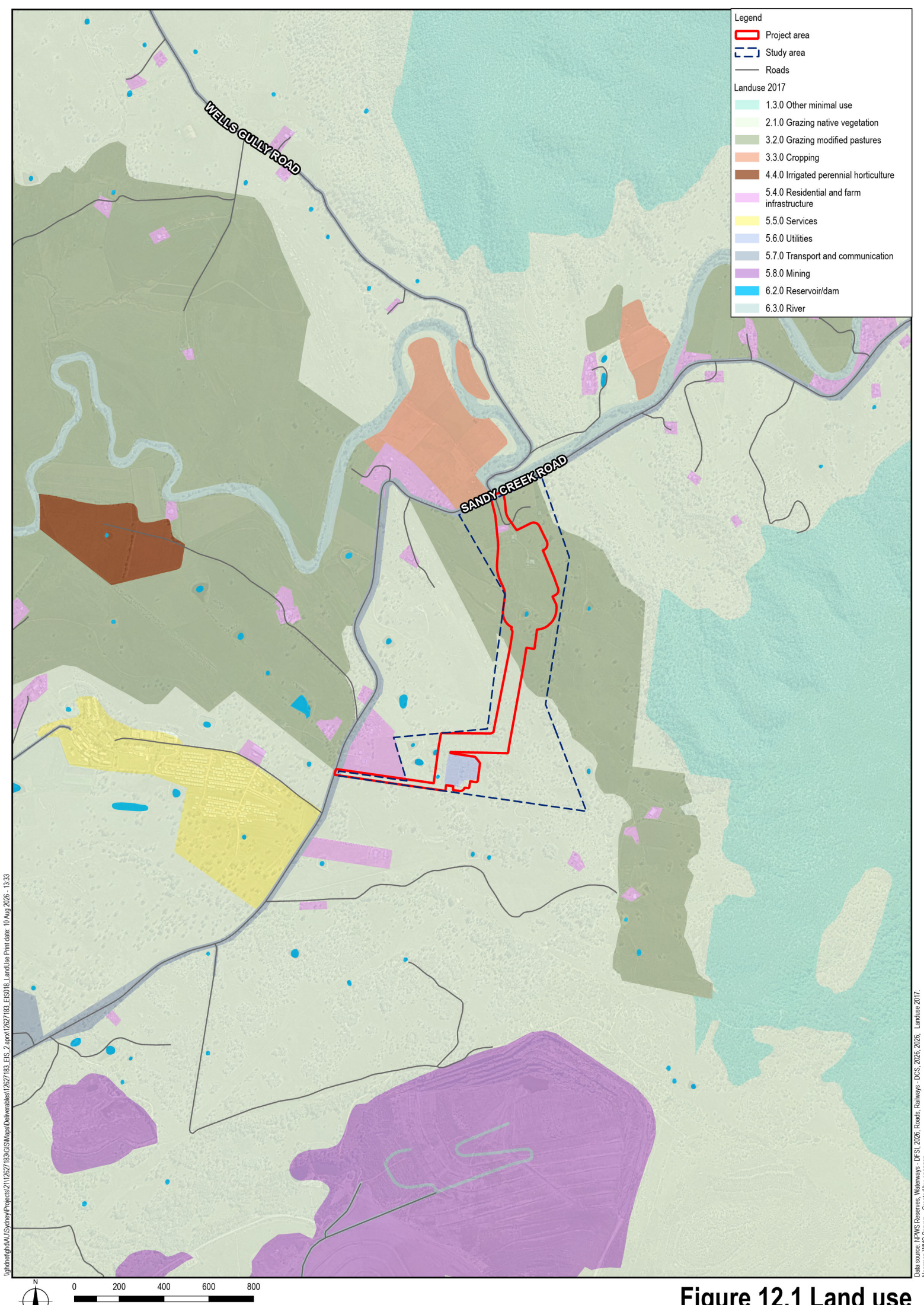


Figure 12.1 Land use

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Data source: IPWS Reserves, Waterways - DFSI, 2006; Roads, Railways - DCS, 2026; Landuse 2017; Neatmap WMS Server - Created by epaigan

Other prominent existing land uses

In addition to agricultural land uses, the project area and surrounding locality support established electricity connection infrastructure, including the existing Muswellbrook 330 kV substation and associated high-voltage transmission lines. This infrastructure reflects the long-standing role of the McCullys Gap locality in supporting major electricity transmission and energy infrastructure.

The broader Muswellbrook Shire LGA also contains extensive existing mining operations, which form a prominent component of the regional land use context. While no mining titles or activities occur within the project or study area, mining remains a dominant land use within the surrounding region and contributes to the established multi-use rural and industrial landscape in which the project is proposed.

These existing land uses demonstrate that the locality already accommodates major infrastructure and resource-related activities alongside agricultural land uses.

Historical land use

The project would be located across two properties at 578 and 380 Sandy Creek Road, McCullys Gap. The main subject property at 578 Sandy Creek Road is approximately 43 hectares, with generally flat terrain across the northern and central areas and a ridge in the south, sloping toward an unnamed tributary of Sandy Creek (approximately 175 metres to 190 metres AHD). The property was historically part of a larger dairy enterprise that was later subdivided and includes established agricultural infrastructure (including livestock yards, old dairy sheds and farm sheds), paddocks with livestock-proof fencing, and water infrastructure (a farm dam and troughs). At the time of inspection, it was used for livestock grazing and includes two residential dwellings.

Historical contamination

Searches of NSW EPA regulatory databases, including the contaminated land record, did not identify any sites within the study area that are listed as contaminated or subject to contamination notices. The likelihood of encountering widespread or significant contamination of soils or groundwater within the study area is therefore considered to be low.

Historical land uses within the study area have predominantly comprised agricultural activities, including grazing and former dairy operations. These land uses could have introduced diffuse (such as broadacre application of pesticides or herbicides on agricultural land) or localised (such as accidental fuel spills or leaks of hazardous or dangerous goods) contamination into the soil.

Soil types and characteristics

Soil types

The soil assessment indicates that the project area is entirely underlain by Sodosols under the Australian Soil Classification system. These soils are characterised by a strong texture contrast between a sandy A horizon and a sodic B horizon.

Site surveys indicate that surface soils across the project area are predominantly grey to brown sandy loams with low organic carbon content, indicating marginal organic matter levels. Soil pH is acidic to near neutral, and electrical conductivity values indicate non-saline conditions.

The soils exhibit a low nutrient-holding capacity, with calcium dominating the exchange complex and low sodium levels in the surface horizon, indicating no sodicity issues in the A horizon. Nutrient indicators show generally marginal levels of key nutrients, including nitrogen, phosphorus, potassium and sulphur, consistent with soils used for extensive grazing.

Due to the sandy nature of the surface soils and the presence of a sodic subsoil, Sodosols within the project area may be susceptible to erosion, lateral water movement and nutrient loss under disturbed conditions.

The project area and surrounding study area are located on elevated, well-drained terrain that has not historically been subject to coastal inundation, tidal influence, or prolonged waterlogging. Given the topography, soil characteristics, and dryland grazing history of the project area, there is no indication that conditions exist for the formation of acid sulfate or saline soils.

Soil erodibility

Soil erodibility reflects the susceptibility of soils to erosion resulting from rainfall and surface runoff and is influenced by factors including slope, surface soil texture, soil organic carbon content, groundcover type and density, and dispersion potential.

The project area is currently used for grazing and supports near-complete pasture groundcover, which reduces erosion risk under existing conditions. The site is located within the Roxburgh soil landscape, which is characterised by undulating low hills with slopes generally ranging from 0 to 10 per cent.

Soils within this landscape comprise a mix of brown and yellow podzolic soils, red solodic soils, lithosols and yellow soloths, which occur across different slope positions. Minor to moderate sheet erosion is common within the landscape, and localised gully erosion has been observed in some areas, particularly where dispersible solodic soils and soloths are present along drainage lines.

Modelled soil erosion estimates derived from the eSPADE platform indicate erosion rates of approximately 0.2 to 0.5 tonnes per hectare per year across the project area. Under existing grazing conditions and maintained groundcover, erosion risk is generally low.

Soil investigation findings

The surface soil investigation indicates generally marginal soil fertility across the project area, with soils exhibiting acidic conditions at all sampling locations. These conditions may influence nutrient availability; however, the soils remain suitable for pasture-based land uses under existing grazing practices. Nutrient results indicate low to marginal nitrogen availability across the site, while phosphorus was generally low and potassium was present at adequate to high levels. Sulphur concentrations were consistently below optimal levels, which may constrain pasture productivity if not managed through standard agricultural practices. Overall, the soil fertility characteristics are consistent with extensive grazing systems typical of the region and highlight the importance of appropriate soil handling to minimise nutrient loss during construction.

Detailed soil investigation results are provided in Appendix C of Technical Report 6 (Land Use and Agriculture Assessment).

Agricultural land

Agricultural land uses

The land within the project area has historically, and is currently used for agricultural purposes, predominantly extensive livestock grazing. Existing agricultural infrastructure within the project area includes livestock handling facilities, fencing, paddocks, farm sheds, water troughs and farm dams, along with residential dwellings. Site inspections and discussions with landowners confirm that beef cattle grazing is the primary current land use, although stocking rates are relatively low.

Based on NSW land use mapping (DCCEE, 2023), approximately 91 per cent of the project area is mapped for agricultural land use, with grazing identified as the dominant land use. The type of agricultural land uses within the project area and Muswellbrook Shire LGA, based on the land use mapping (DPE, 2023), are listed in Table 12.2.

Table 12.2 Mapped agricultural land uses (NSW DPE, 2023)

Agricultural land use	Project area		Muswellbrook Shire LGA	
	Area (ha)	Proportion of project area (%)	Area (ha)	Proportion of Muswellbrook Shire LGA (%)
Cropping	-	-	1,935	0.57
Grazing native vegetation	6.3	31.7	86,742	25.46
Grazing modified pastures	11.5	57.5	33,510	9.84
Grazing irrigated modified pastures	-	-	7,345	2.16
Horticulture	-	-	1,279	0.38
Residential and farm infrastructure	0.3	1.3	3,752	1.10
Reservoir / dam	0.1	0.3	458.5	0.13
Other agricultural land uses	-	-	2,502	0.73
Total	18.1	90.5	137,066	40.23

Agricultural land capability and productivity

Land in NSW is commonly classified according to the capability to remain stable under particular land uses. Capability systems classify land in terms of its inherent physical characteristics or constraints and consider the optimum use of land rather than the maximum use. In general, the classification will not change over time. Land and Soil Capability (LSC) class 1 to class 3 land has low to moderate limitations to intensive agricultural uses and is considered capable of being regularly cultivated. LSC class 4 to class 6 increase in their level of limitations and are suitable for grazing and less frequent cultivation.

There is no LSC class 1 land within the regional study area. High to moderate-low LSC classes 5-7 are the dominant land types across the regional study area. The project area is predominantly characterised by moderate to low land capability (LSC class 5).

Strategic agricultural land is highly productive land that has unique natural resource characteristics, such as soil and water resources, and socio-economic value, such as high productivity, infrastructure availability and access to markets (DPI, 2013). One of the categories of strategic agricultural land is biophysical strategic agricultural land (BSAL), which is land with high quality soil and water resources capable of sustaining high levels of productivity. The project area does not intersect any mapped BSAL, with the nearest mapped BSAL located approximately 80 metres north of the project area.

Critical Industry Clusters are areas that support highly productive agricultural industries of state significance, including the equine and viticulture industries in the Upper Hunter region. There are no Critical Industry Clusters located within the project area, with one property located 22 metres east and directly adjacent to the north of the project area mapped as an equine critical industry cluster.

The value of agricultural production within the study area to the economy can be calculated by considering the likely enterprise gross margins of the potential livestock enterprises on the broader landholdings where the project is located. A value of \$252 per hectare of livestock enterprises has been adopted for the assessment. Further detail on the methodology and assumptions is provided in Technical Report 6 (Land use and agriculture assessment).

12.3.2 Biosecurity

Biosecurity measures protect agricultural land from pests, weeds, and diseases that can affect productivity and the environment. During the site visit, the following biosecurity issues were observed:

- Pest animals – no evidence of major pest animals was noted on the project area, although feral deer, feral cat, wild dog, European red fox, feral goat, feral horse, wild rabbit and feral pig are known to occur in the region and could pose a risk to livestock.
- Weeds – several priority weed species were recorded, including Galenia (*Galenia pubescens*), Patterson's curse (*Echium plantagineum*), Saffron Thistle (*Carthamus lanatus*), Prickly pear (*Opuntia spp.*) and St. John's wort (*Hypericum perforatum*). These species are common across the Hunter Local Land Services region and require management to minimise spread.
- Animal and plant diseases – no notifiable animal or plant diseases were detected during the site visit. Landholders are required to report any suspect diseases in accordance with the *Biosecurity Act 2015*.

12.3.3 Crown land

Crown land holdings include land managed for purposes such as forestry, conservation, Crown roads and Crown reserves, in accordance with the *Crown Land Management Act 2016 (NSW)*.

The project area does not intersect any travelling stock reserves and is not subject to a Native Title Claim. Additionally, no Crown or "paper" roads occur within the project area.

12.4 Potential impacts

12.4.1 Construction

General land use and property impacts

During construction, land use within the project area would temporarily change from the existing uses to a construction site. Construction activities would include the establishment of work areas, access tracks, stockpiling areas and construction facilities. Landholders would experience temporary disruption where construction activities occur within their property.

Construction would result in a temporary disturbance of up to 20 hectares of land of which 14.9 ha is currently used for livestock grazing. This would result in a minor reduction to the amount of land available at private properties for the duration of construction. For the connection infrastructure corridor this is considered a worst-case estimate as construction works would likely happen progressively and be limited to the immediate locations around the proposed transmission towers.

Following construction, the project area (excluding areas required for permanent infrastructure) would be reinstated consistent with pre-construction use and condition (or as agreed in consultation with the landholder). This would include reinstating affected infrastructure (such as fencing and access tracks) as agreed with each landholder.

Temporary use of land during construction would occur under formal agreements with the relevant parties.

Agricultural land

Agricultural land uses

The project would be undertaken on an area of about 20 hectares of land zoned for agricultural use, representing about 0.01 per cent of this land use in the Muswellbrook Shire LGA. During construction, agricultural use of the project area would be temporarily affected.

Most normal agricultural land use can be re-established over the permanent easement following completion of construction. Land used for permanent facilities, totalling about 9.4 hectares of agricultural land, would not be suitable for agricultural use. This is considered negligible in the context of land used for agriculture in the Muswellbrook Shire LGA as listed in Table 12.2.

Current agricultural land use immediately adjacent to the study area and in the broader Muswellbrook Shire LGA would not change as a result of the project, and the project would not result in any fragmentation or displacement of existing agricultural industries.

Agricultural land capability and economic productivity

During construction, the project would permanently impact approximately 5.1 hectares of LSC Class 5 land associated with the BESS facility and temporarily impact approximately 14.9 hectares of LSC Class 3, 5 and 6 land for the connection infrastructure corridor. The permanent impact on LSC Class 5 land for the BESS facility represents less than 0.008 per cent of LSC Class 5 land within the Muswellbrook Shire LGA. Land within the BESS facility would not be available for agricultural production for the life of the project.

The connection infrastructure would connect the project substation to the existing Muswellbrook 330 kV substation and would be predominantly located on LSC Class 6 land (approximately 3.3 hectares), with smaller areas of LSC Class 5 (approximately one hectare). Direct land disturbance during construction would largely be limited to transmission line structures and temporary access tracks, meaning that not all land within the corridor would be removed from agricultural production during construction.

As soon as practicable after construction, disturbed areas not required for surface infrastructure (approximately 14.9 hectares) would be reinstated and rehabilitated and returned to an equivalent land and soil capability class. Accordingly, construction-related impacts on land and soil capability are anticipated to be negligible following rehabilitation.

The project's estimated construction-phase effect on agricultural productivity has been calculated using a gross margin of \$252 per hectare, resulting in an overall estimated economic impact of \$5,045. This represents 0.012 per cent of the gross value of agricultural production within the Muswellbrook Shire LGA and is considered negligible.

Impacts on farm infrastructure and operations

Agricultural infrastructure

As outlined in section 12.3.1, the study area supports an ongoing livestock grazing and includes agricultural infrastructure typical of rural properties. As part of the construction site establishment works, existing agricultural infrastructure within the project area would be demolished, including dewatering of farm dams where required. To facilitate the continuation of agricultural operations in areas outside the operational footprint following construction, new agricultural infrastructure may be required, including livestock handling yards, fencing, sheds, water troughs or dams.

Water resources and availability

Construction is expected to require approximately 15 megalitres of non-potable water, with demand primarily associated with construction activities such as dust suppression (e.g. access tracks and disturbed areas).

The non-potable water supply would be sourced from either a groundwater bore installed as part of the project or trucked to site from an appropriately licensed external source, potentially supplementing supply demands. On this basis, water required during construction is unlikely to impact water availability for agricultural purposes on adjacent properties.

Biosecurity risk

If a new pest or disease becomes established, it can affect agricultural properties through increased costs (monitoring and control), reduced productivity, and potential loss of markets. During construction, the project would involve increased movement of vehicles and personnel to, around and within the project area. The main biosecurity risk relates to the spread of weeds that may result from the increased movement of vehicles and the disturbance of ground cover and soil. Weed seeds could be transported through and within the project area, on clothing, and via vehicle wheels and undercarriages. Pesticides used in weed control would be applied in accordance with prescribed label instructions to avoid harm to the environment.

The CEMP would include measures to minimise the potential for biosecurity risk during construction in accordance with the general biosecurity duty and *Biosecurity Act 2015* and regional weed management plans (refer to section 12.5).

Soil erosion

Earthworks during construction would disturb the soil profile and temporarily expose both surface and subsurface soils to rain and wind, which can lead to soil erosion, particularly in areas of steeper slopes.

As noted in section 12.3.1, soils within the project area have moderate erodibility and occur within a soil landscape with minor to moderate sheet erosion and some gully formations associated with dispersible soils. If rainfall contacts these dispersive subsoils, or if any exposed soil types on steep slopes are left unprotected, the risk of erosion can increase. Additionally, the operation of heavy construction machinery may lead to soil compaction, which can reduce infiltration, increase surface runoff, and further contribute to soil erosion. The potential for erosion within the project area would be present until the land is rehabilitated.

Temporary workspaces would be cleared of all construction equipment, materials and waste, and land outside the operational footprint would be rehabilitated. Appropriate management measures would be implemented during construction to protect soil health and maintain land productivity.

Other land use impacts

Road reserves

During construction, minor works may be required at selected road intersections and site access points to safely accommodate construction traffic, including oversize over-mass (OSOM) vehicles. These works would be limited to the placement of temporary and localised measures such as placement of gravel within existing road reserves, providing a durable surface to support construction vehicle movements (including turning and loading activities).

Road reserves would continue to function as transport infrastructure throughout construction, with no permanent change to their land use designation or purpose.

Following completion of construction works, any temporarily disturbed road reserve areas would be reinstated in consultation with the relevant road authority, ensuring the road corridor continues to operate as road infrastructure.

Contamination

Unexpected existing soil contamination may be encountered during construction and decommissioning of the existing farm operation, evidence of which could include:

- staining or odours
- buried materials, potentially containing asbestos
- buried drums or machinery.

The potential for impacts due to disturbance of any unexpected contamination would be minimised by implementing the mitigation measures in section 12.5. This includes developing and implementing an unexpected contaminated finds procedure as part of the CEMP.

Construction would involve storage and handling of materials and wastes that require management to prevent contamination of soils and water. Implementation of standard measures to manage the potential for accidental spills and leaks of fuel, oils and other hazardous materials would ensure there is minimal potential for contamination of soil and groundwater. The potential for impacts associated with handling hazardous materials during construction is considered in section 15.3.1. Waste management during construction is considered in section 19.3.1.

12.4.2 Operation

General land use and property impacts

During operation, property impacts would be associated with the land required for permanent infrastructure located within the operational footprint.

The BESS facility would be positioned wholly within a single privately owned property which would be leased to the applicant for the life of the project, registered on the lots as a long-term lease under Division 2 of the *Real Property Act 1900*. The project would result in a change in land available for agricultural land use on this property, which has been agreed between the relevant parties.

Of the operational footprint, approximately 5.1 hectares of mapped agricultural land would be permanently removed from production as a result of the BESS facility and project substation. This loss represents less than 0.007 per cent of agricultural land within the Muswellbrook Shire LGA and is considered negligible. The remaining approximately 4.3 hectares, associated with the connection infrastructure corridor, would largely remain available for ongoing agricultural use, including grazing, subject to standard safety and access requirements.

The land within the project area is zoned RU1 Primary Production. The area unavailable for agricultural use during operation represents less than 0.004 per cent of RU1 zoned land within the regional study area and would not materially affect the availability or function of RU1 land at a regional scale. Agricultural activities would be able to continue within areas not occupied by permanent infrastructure.

Land zoned RU1 within the project area has a minimum lot size of 80 hectares, while the subject property is approximately 43 hectares. As the land is already below the minimum lot size threshold, the project would not alter the subdivision or development potential of the land.

Agricultural land

Land use conflicts

The LUCRA considered a range of operational land use risk items relevant to the project. With the implementation of mitigation measures and management controls identified in the LUCRA and the wider EIS, land use conflict risks are reduced to an acceptable level in accordance with the LUCRA Guide, with no residual operational land use conflicts anticipated following implementation of controls.

The operational footprint affects land currently used for extensive livestock grazing and associated farm infrastructure, with land and soil capability classes within the footprint predominantly comprising LSC Classes 5 and 6 (moderate-low to low capability land). In the context of the broader LGA, the extent of agricultural land permanently removed from production by the project is considered negligible.

Only the BESS facility and project substation would permanently exclude agricultural use. Land within the connection infrastructure corridor and areas outside the operational footprint would remain available for ongoing agricultural activities, including grazing, which represents the current land use.

During operation, periodic access would be required for inspection and maintenance activities, along with vegetation management within and adjacent to the transmission line, to maintain safe electrical clearances. These activities would not prevent the continuation of existing agricultural practices and are not expected to result in a material change in land use.

Productivity

The estimated agricultural productivity of the project area is described in section 12.3. During operation, the BESS facility would occupy an operational footprint of approximately 5.1 hectares. Applying the adopted gross margin of \$252 per hectare results in an estimated annual economic impact of approximately \$1,260 to the Muswellbrook Shire LGA economy. This represents approximately 0.003 per cent of the gross value of agricultural production within the LGA and is therefore considered negligible.

Soils

Disturbed areas not required for permanent infrastructure would be rehabilitated following construction in consultation with the relevant landholders, minimising the potential for erosion or soil stability issues during operation. Operation of the project is not expected to result in adverse impacts on soils. Routine operational activities would include inspections for erosion or settlement, which would be remediated if identified.

Contamination

During operation, the BESS facility and connection infrastructure are not expected to introduce sources of soil contamination. Routine operation would involve limited handling of hazardous materials, managed in accordance with established operational procedures. With the implementation of standard operational management controls, the potential for contamination impacts during operation is expected to remain negligible.

12.4.3 Decommissioning

Potential land use impacts during decommissioning are expected to be limited to short-term land disturbance associated with the removal of infrastructure. Measures to manage these impacts on land and soils would be detailed in the Decommissioning Management Plan, which would be adapted from the CEMP to ensure continuity of environmental protection measures and regulatory compliance. The plan would include erosion and sediment controls, rehabilitation measures, and landholder consultation protocols, tailored to the location and nature of decommissioning activities.

12.5 Mitigation measures

Mitigation measures proposed to avoid or minimise potential land and soils impacts during construction, operation and decommissioning of the project are listed in Table 12.3.

Table 12.3 Mitigation measures – land use and agriculture

ID	Impact/issue	Mitigation measure	Timing
LS1	Unexpected contamination	An unexpected finds protocol will be prepared as part of the CEMP and implemented to manage the identification of unexpected contamination during construction. The unexpected finds protocol would include details for stopping work, engaging a suitably qualified professional to carry out a relevant assessment, and providing recommendations to control risks and proceed with work safely.	Construction
LS2	Biosecurity risks	A Biosecurity Management Procedure will be prepared and implemented as part of the CEMP, to minimise biosecurity risks in accordance with the general biosecurity duty under the <i>Biosecurity Act 2015</i> (NSW) and relevant regional weed management plans. The Biosecurity Management Procedure will be developed with reference to relevant guidance, including <i>Landholder Biosecurity and Utility Service Providers</i> (Department of Regional NSW, 2022) and <i>Managing Biosecurity Risks in Land Use Planning and Development Guide</i> (Department of Primary Industries, 2020).	Pre-construction / Construction
LS3		Biosecurity management measures will be implemented during operation to minimise biosecurity risks associated with maintenance activities in accordance with the <i>Biosecurity Act 2015</i> (NSW) and relevant regional weed management plans.	Operation

13. Transport and traffic

This chapter provides a summary of the potential traffic and transport impacts associated with the construction, operation and decommissioning of the project, and provides mitigation measures to reduce potential impacts, where necessary. The chapter includes a summary of the results of the Traffic Impact Assessment (Technical Report 7), which has been prepared in accordance with the SEARs.

During construction, the project would generate additional light and heavy vehicle movements, however the assessment confirmed that the New England Highway and Sandy Creek Road would continue to operate well within their maximum capacity. Some construction plant and equipment would be oversize and overmass (OSOM), requiring temporary road modifications to facilitate OSOM vehicle movements. All construction traffic movement will be managed through standard construction management measures and OSOM route planning.

Traffic impacts associated with operation, including routine maintenance, are expected to be negligible.

13.1 Methodology

13.1.1 Study area

Assessment of potential traffic and transport impacts was undertaken with reference to the *Guide to Transport Impact Assessment* (Transport for NSW, 2024). The study area for the traffic assessment encompassed the following:

- the project area
- Sandy Creek Road between the project area and its intersection with New England Highway (A15).

The proposed OSOM vehicle route between the Port of Newcastle and the project area was also considered for the assessment.

13.1.2 Key tasks

The assessment involved the following tasks:

- reviewing existing conditions of the surrounding transport network, including road network characteristics and performance, the public and active transport network, crash data, restricted heavy vehicle routes and traffic volumes on the New England Highway (A15) and Sandy Creek Road
- reviewing proposed construction activities, including workforce resources, construction facilities, traffic volumes, heavy vehicle haulage routes and site access
- undertaking mid-block assessments of the New England Highway (A15) and Sandy Creek Road for road network operation
- undertaking SIDRA intersection modelling of the intersection of New England Highway (A15) and Sandy Creek Road including operation of the railway level crossing
- identifying and assessing the potential impacts of the project during construction, including impacts on the performance of the road network, public and active transport network, and potential disruption due to OSOM vehicle movements
- reviewing conditions expected during operation and decommissioning of the project
- assessing the potential for cumulative impacts with other projects
- identifying measures to manage the potential impacts identified.

13.2 Existing environment

13.2.1 Road network description

The road network within the study area includes the following key roads:

- New England Highway (A15)
- Sandy Creek Road.

Details of these key roads are summarised below.

New England Highway (A15)

The New England Highway (A15) is an arterial road that runs north/south connecting regional centres in NSW and Queensland which is owned and controlled by Transport for NSW. In the vicinity of Sandy Creek Road, it comprises a single travel lane in each direction, with auxiliary turning lanes at the intersection (see Figure 13.1).

New England Highway (A15) has a speed limit of 60 kilometres per hour in Muswellbrook, and 100 kilometres per hour outside population centres. There are several school bus services that operate in Muswellbrook and use the highway. The highway is used by major through-traffic, connecting Yarraman in QLD to Hexham in NSW, and is approved for 26-metre B-double and OSOM vehicles. There are no active transport facilities provided along the highway.



Source: Google Street View (image taken January 2025)

Figure 13.1 New England Highway (A15) looking north to Sandy Creek Road

Sandy Creek Road

Sandy Creek Road is a local (unclassified) road that runs east/west connecting the project area to the New England Highway (A15) (see Figure 13.2). It is owned and controlled by Muswellbrook Shire Council. It comprises a sealed two-way carriageway with no dedicated active transport facilities. It has a speed limit of typically 100 kilometres per hour and 60 kilometres per hour in proximity to the New England Highway (A15).

Sandy Creek Road is approved for 19-metre B-double and OSOM vehicles, subject to school hour restrictions.

A level crossing of the Main Northern Line is located approximately 45 metres east of the New England Highway (A15)/ Sandy Creek Road intersection.



Source: Google Street View (image taken January 2025)

Figure 13.2 *Sandy Creek Road looking east from the New England Highway (A15) to the level crossing*

Heavy vehicles

Approved OSOM freight routes in the vicinity of the project area include the New England Highway (A15)/ Maitland Street and Sydney Street Muswellbrook. Sandy Creek Road is not currently approved for 25 metre and 26 metre B-doubles.

A section of the New England Highway (A15) within Muswellbrook, between Maitland Road and Market Street, is subject to restrictions associated with a rail underpass.

Crash data

Road crash information in the vicinity of the project area was collected from crash statistics published by Transport for NSW Centre for Road Safety over a five-year period, between 2020 and 2024. The data shows that there have been six crashes within about 500 metres of the New England Highway (A15) / Sandy Creek Road intersection. These included:

- four rear-end collisions, three resulting in moderate injuries
- two run-off-road crashes, one moderate injury and one non-casualty.

Additional crashes included:

- a crash north of Sandy Creek Road (vehicle left road, moderate injury)
- a crash on Sandy Creek Road (loss of control, minor injury).

Overall, the small number of crashes recorded over a five-year period does not indicate a systemic road safety issue in the vicinity of the project area.

13.2.2 Traffic volumes and performance

Traffic volumes

Traffic counts were undertaken to identify morning and afternoon peak traffic volumes for the key roads within the study area. The observed traffic network peak hours were identified as between 8am to 9am in the morning, and 4pm to 5pm in the afternoon. The volumes indicated that:

- the New England Highway carries about 452 to 487 vehicles and around 435 to 663 vehicles in both directions during the morning and afternoon peak periods, respectively
- Sandy Creek Road carries much lower traffic volumes, with around 38 vehicles in the morning and afternoon peaks.

Road network performance

An assessment was undertaken of the performance of the key roads for the project based on the existing traffic volumes. The performance of the road network is measured by the level of congestion on a road, given the relative traffic volume and the road capacity. The assessment concluded the key roads for the project operate with traffic volumes well within their maximum capacity.

13.2.3 Other transport facilities

Public transport

There are no public transport facilities on the New England Highway (A15) in proximity to Sandy Creek Road.

There is one school bus service that operates on Sandy Creek Road, as well as six other school bus services that operate within Muswellbrook and traverse sections of the New England Highway (A15). There are five local bus services in Muswellbrook, and two regional bus services.

Sandy Creek Road crosses the Main Northern Line at a level crossing about 45 metres east of the New England Highway (A15). There are three commuter rail services that operate on weekdays at Muswellbrook Station, and three that operate on weekends and public holidays.

Pedestrian and cyclists

Footpaths and pedestrian crossings are provided on the New England Highway (A15) within Muswellbrook, however there are no cycle paths, dedicated footpaths or pedestrian crossings in the vicinity of the project area.

13.2.4 Freight services

In addition to passenger trains, the Main Northern Line carries frequent freight services, including general freight, grain, and coal. On average, about 56 freight trains traverse the rail line at Sandy Creek Road over a 24-hour period (EMM, 2023). During train pass-bys, queues of up to five light vehicles are observed on Sandy Creek Road between the New England Highway (A15) and the level crossing.

13.3 Potential impacts

13.3.1 Construction

Construction vehicle movements

Construction of the project would generate additional vehicle movements, including light and heavy vehicles. Light vehicles would generally be used by construction workers moving to and from the project area, and heavy vehicle movements would generally be associated with trucks delivering construction materials and equipment to the project area. OSOM vehicles would be required for delivery of the transformer.

For the purposes of undertaking a conservative assessment of potential construction impacts, the following peak hour volumes of construction traffic have been adopted, aligned with the potential peak construction activity:

- AM peak hour:
 - 50 inbound light vehicles
 - 4 inbound and 4 outbound shuttle buses
 - 10 inbound and 10 outbound heavy vehicle movements
- PM peak hour
 - 50 outbound light vehicles
 - 4 inbound and 4 outbound shuttle buses
 - 10 inbound and 10 outbound heavy vehicle movements.

Accordingly, the project is expected to generate up to approximately 78 vehicle trips during the morning and evening peak hours.

Table 13.1 summarises the peak vehicle trips generated during the peak construction period of the project.

Table 13.1 Traffic generation during peak construction periods

Vehicle type	AM Peak		PM Peak	
	Inbound	Outbound	Inbound	Outbound
Light vehicle (car / 4WD)	50	-	-	50
Shuttle bus	4	4	4	4
Heavy vehicles	10	10	10	10
Total	64	14	14	64

Road network impacts

Relative to a theoretical capacity of 1,200 vehicles per hour along New England Highway (A15) (north and south), and 900 vehicles along Sandy Creek Road:

- there is 32 to 56 per cent spare capacity along New England Highway (A15) (north and south)
- there is 61 to 88 per cent spare capacity along Sandy Creek Road.

The mid-block assessment considered background traffic growth, construction traffic from other nearby developments and construction traffic associated with the project. The assessment determined that the key roads in proximity to the project area are expected to remain operating well below their maximum capacity in the peak hour and throughout the rest of the day. As such, the operational capacity would not be affected by construction traffic, and they are expected to continue functioning at a good level of service.

When considering relevant future projects with available information online, significant cumulative traffic impacts to the local road network during construction are not anticipated.

OSOM vehicle movements

Up to two OSOM vehicle movements would be required during construction to transport the transformer to the project substation and other large electrical components. The majority of construction materials, plant and equipment would be delivered to site using standard heavy vehicles and flat-bed trucks.

A concept-level route assessment for the movement of OSOM vehicles has been undertaken between the Port of Newcastle and the project area (see Appendix C Technical Report 7). The selected OSOM route has maximised the use of major State roads, approved Restricted Access Vehicle routes and also aligned with upgrades being carried out by EnergyCo as part of the Port to Renewable Energy Zones (Port to REZ) transport corridor. These upgrades are being performed in advance of the movement of OSOM vehicles associated with the project for the purposes of future development in the REZs.

Consultation with EnergyCo confirms that the project's OSOM vehicle is both smaller in length and width than the EnergyCo design vehicle. A swept-path analysis for the project OSOM vehicle was undertaken and confirms that OSOM turning movements can be safely accommodated with local constraints identified in and around Muswellbrook and along Sandy Creek Road. In these locations, minor temporary and localised measures are required. No permanent road upgrades or additional turning lanes are required to facilitate OSOM vehicle movements.

OSOM vehicle movements would be managed in accordance with a Construction Traffic Management Plan prepared as part of detailed construction planning. This would include appropriate traffic control measures (such as traffic controllers and escort vehicles) at specific locations and times, to ensure the safety of other road users and construction personnel. Sandy Creek Road is expected to remain trafficable for the duration of construction.

Other impacts

Construction is not expected to impact bus operations within the study area.

Sufficient parking would be provided on-site to support the demands of workers during the construction, operation, and decommissioning of the project.

13.3.2 Operation

The project is proposed to operate remotely 24 hours a day, seven days a week, with up to six operational staff required monthly or quarterly to carry out regular maintenance activities on site, including equipment testing and maintenance, vegetation management, pest control and general site maintenance. Traffic impacts associated with operation, including routine maintenance, are expected to be negligible.

13.3.3 Decommissioning

Decommissioning works would be less intensive than construction activities, involving fewer personnel, reduced equipment requirements and a shorter overall duration compared to construction. As such, vehicle volumes and traffic movements would be lower than during construction, and no impacts on the local and regional road network are expected.

13.4 Mitigation measures

Mitigation measures proposed to avoid or minimise traffic and transport impacts during construction, operation, and decommissioning of the project are listed in Table 13.2.

Table 13.2 Mitigation measures - traffic and transport

No.	Impact	Mitigation measure	Timing
T1	Managing the potential for traffic, transport, access and parking impacts during construction	Design and construction planning will aim to avoid or minimise traffic, transport and access impacts on the surrounding road network as far as practicable.	Detailed design/ Pre-construction
T2		A Construction Traffic Management Plan (CTMP) will be prepared and implemented as part of the CEMP to manage traffic, transport and access impacts during construction. The CTMP will be prepared in consultation with Muswellbrook Shire Council, Transport for NSW and Australian Rail Track Corporation, as relevant, and will include measures to: – maintain the safe and efficient operation of affected public roads – manage construction vehicle access and movements – implement appropriate traffic control arrangements where required – define a driver code of conduct for construction and haulage vehicles.	Pre-construction / Construction
T3	OSOM route planning and permitting	Oversize overmass (OSOM) vehicle movements will be managed in accordance with applicable approvals and permits. Vehicle dimensions and routes will be confirmed prior to OSOM movements and in accordance with necessary permits. OSOM movements will be undertaken in accordance with the approved CTMP and in consultation with relevant road authorities.	Pre-construction / Construction
T4	Temporary road modifications to facilitate OSOM vehicle movements	Temporary road modifications required to facilitate OSOM vehicle movements (such as gravel placement or temporary signage relocation) will be designed and implemented in consultation with the relevant road owner and reinstated following completion of construction activities, unless otherwise agreed.	Detailed design / Construction
T5	Impacts on local roads	Road condition surveys of Sandy Creek Road will be undertaken prior to and following construction, to the satisfaction of the relevant road authority. Where construction activities on this road result in damage, the road will be reinstated to pre-survey condition, or as otherwise agreed with the road authority.	Construction
T6	Cumulative impacts	Coordination with other relevant projects and proponents will be undertaken during detailed design and construction to manage potential cumulative traffic effects, including consideration of construction timing, shared access routes and traffic management requirements, where reasonably practicable.	Detailed design / Construction
T7	Decommissioning impacts	The Decommissioning Management Plan will include measures to manage traffic and access during decommissioning of the project. The plan will include appropriate traffic control measures in consultation with the relevant road authority including Muswellbrook Shire Council.	Decommissioning

14. Water

This chapter provides a summary of potential impacts to surface and groundwater resources associated with the construction, operation and decommissioning of the project and provides mitigation measures to reduce potential impacts, where necessary. The chapter includes a summary of the results of the Water Impact Assessment (Technical Report 8), which has been prepared in accordance with the SEARs.

During construction, potential impacts to watercourses, flooding and groundwater would be localised and manageable, with erosion, sedimentation and water quality risks controlled through implementation of a Soil and Water Management Plan (SWMP). Non-potable construction water would preferably be sourced from on-site groundwater bores, with tankering from an appropriately licensed external source available as a contingency, resulting in no material change to downstream water values or flooding behaviour.

During operation, low water demand, the provision of stormwater treatment infrastructure confirmed through modelling to meet best-practice pollutant reduction targets, and firewater containment measures incorporated into the project design would ensure that impacts to water resources are not expected to be significant.

14.1 Methodology

14.1.1 Study area

The study area encompassed the project area and the broader hydrological domain within which potential impacts could occur. This includes the relevant surface water catchments, downstream receiving environments and associated floodplains, consistent with the catchment-based approach used for flood risk assessment. The study area therefore captures upstream and downstream hydrological processes, local drainage patterns and flooding behaviour that could influence, or be influenced by the project.

14.1.2 Key tasks

The water assessment was undertaken using a combination of desktop review and modelling-based assessment, and included the following:

- defining the study area, including the project area, relevant catchments, regional and local watercourses and drainage patterns
- characterising baseline climate, hydrology, surface water, groundwater, and flood conditions
- assessing potential impacts to water resources during construction, operation and decommissioning phases of the project
- assessing potential water quality impacts and flooding impacts associated with the proposed infrastructure using relevant modelling software
- evaluating the risk of erosion, sedimentation, and pollutant discharge from the project
- identifying mitigation and management measures to manage identified risks and impacts.

Flood behaviour was quantified using hydrologic and hydraulic software modelling. Catchments were delineated using CatchmentSIM software model, and a Watershed Bounded Network Model was developed for hydrological analysis. Outputs informed a TUFLOW hydraulic model which simulated the 1 per cent (%) annual exceedance probability (AEP), 0.5% AEP, 0.2% AEP and probable maximum flood (PMF) events.

Stormwater quality performance was assessed using Model for Urban Stormwater Improvement Conceptualisation (MUSICX) software modelling to test the project stormwater treatment infrastructure (including gross pollutant trap and stormwater management basin) against typical best practice pollutant load reduction targets for developed catchments.

14.2 Existing environment

The project area is located in the Hunter River catchment, the largest coastal catchment in NSW covering approximately 21,500 square kilometres. Runoff from the project area drains towards Sandy Creek, a non-perennial sixth order tributary of the Hunter River. The project area is zoned for primary production and includes modified pastures, farm infrastructure and the existing Muswellbrook 330 kV substation.

14.2.1 Climate

Review of the Australian Government Bureau of Meteorology (BoM) climate Köppen classification mapping indicates the site is located in a temperate climate zone and is characterised by warm summers, with no dry season (Australian Government BoM, 2025). Temperature maximums typically exceed 31 degrees Celsius (°C) in summer months and 15 °C in winter months. Median minimum temperatures range from approximately 17 °C in summer to 3 to 5 °C in winter.

The annual average rainfall is approximately 665 millimetres, with notable inter-annual variability (e.g. a maximum annual total of 981 millimetres recorded in 2021, and a minimum of 338 millimetres recorded in 1980, in the Scientific Information for Landowners record used).

Monthly rainfall is relatively consistent throughout the year, with slightly increased median rainfall typically occurring in November through to March. Evapotranspiration exceeds rainfall in most months, resulting in a persistent moisture deficit.

14.2.2 Surface water and drainage

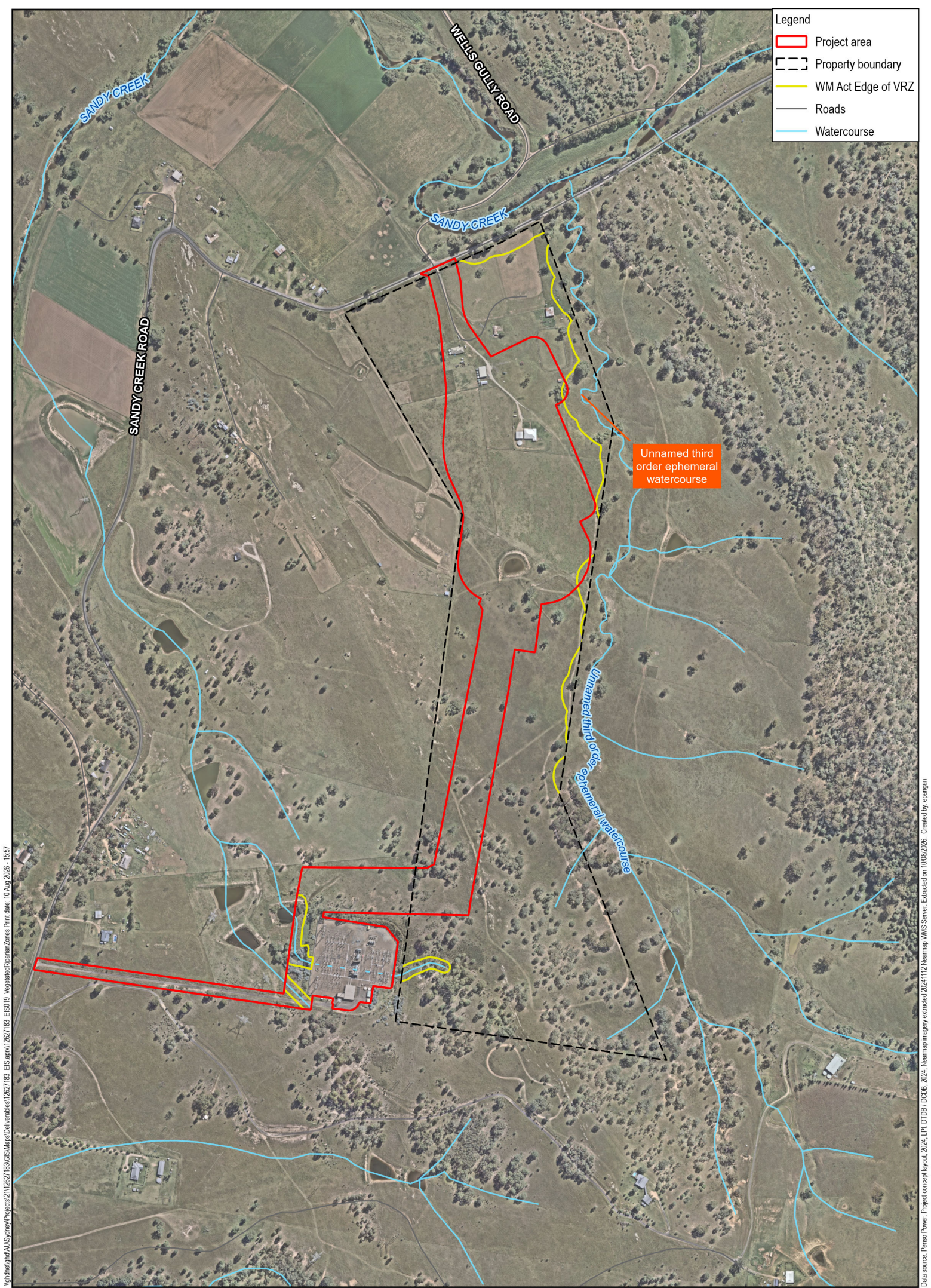
Watercourses and associated riparian corridors were identified and mapped in accordance with the *Controlled Activities – Guidelines for Riparian Corridors on Waterfront Land* (DCCEE, 2025a) (refer to Figure 14.1). Vegetated riparian zone (VRZ) widths were defined based on Strahler stream order and mapped using NSW Spatial Services data verified against high-resolution elevation models.

Runoff from the project area reaches Sandy Creek via the following main pathways:

- drainage towards an unnamed third-order ephemeral watercourse that runs along the eastern boundary of the property and partially crosses into the property, flowing south to north and connecting to Sandy Creek through a culvert under Sandy Creek Road
- a flat, shallow depression (not a mapped watercourse) northwest of the proposed access road, where local flows drain in a northerly direction towards Sandy Creek Road
- drainage from the project substation area north towards a small farm dam, with flows continuing into the shallow depression.

Near the existing Muswellbrook 330 kV substation, a series of farm dams connect with first-order and second-order ephemeral watercourses that flow towards and discharge into Sandy Creek approximately 1.1 kilometres northwest of the substation.

The local watercourses have been identified as having a poor geomorphic condition and low recovery potential.



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Data source: Penso Power Project concept layout, 2024; LPI: DTD6 / DOD6, 2024; Nearmap imagery extracted 20241112; Nearmap WMS Server; Extracted on 10/08/2026. Created by: epangan

Figure 14.1 Vegetated riparian zones of watercourse that intersect the project area

14.2.3 Groundwater

Groundwater occurs within fractured rock aquifers of the New England Fold Belt Coast Groundwater Source and locally within alluvial settings near Sandy Creek. Two registered bores (GW204519 and GW204185) used for stock and domestic purposes are located within the property at 578 Sandy Creek Road although east of the project area. Yields from bores in the vicinity are generally low.

A review of the High Ecological Value Aquatic Ecosystems (HEVAE) dataset identified no high-priority groundwater dependent ecosystems within or in the immediate vicinity of the project area. Areas of vegetation with a medium to low HEVAE category were identified along Sandy Creek, approximately one kilometre north of the project area. No high-priority groundwater dependent ecosystems were identified within 3.5 kilometres of the project area.

14.2.4 Flooding and hydrology

Existing flood behaviour was assessed using flood modelling software for a range of design storm events and extending up to and including the PMF.

The project area is not located within a defined floodplain, with local drainage characterised by a combination of overland flow and an adjacent ephemeral third-order watercourse. Surface water drains from the surrounding catchment via broad, shallow overland flow paths to the west and more defined channelised flows to the east.

Flood modelling indicates that, under the 1 per cent AEP event, flooding across the project area is generally shallow and dispersed. Overland flow depths are typically up to approximately 0.2 metres with low to moderate velocities, while more concentrated flows are contained within the eastern watercourse channel. A minor breakout flow path is present along the eastern boundary, characterised by very shallow depths (primarily less than 100 millimetres) and low velocities.

Flood behaviour is influenced by localised features, including a small farm dam and drainage depressions, which convey flows as broad, shallow sheet flow rather than well-defined floodways. Overall flood hazard across the project area is generally low, with higher hazard conditions localised to watercourse crossings and sections of Sandy Creek Road, where flooding may restrict access during significant events. Refer to Appendix A of Technical Report 8 (Water impact assessment) for the full series of flooding mapping undertaken across design storm events.

14.3 Potential impacts

14.3.1 Construction

Construction would involve vegetation clearing, earthworks, foundations/slabs, and installation of electrical infrastructure. The primary water-related construction risks are associated with erosion/sediment mobilisation, accidental spills, and temporary changes to overland flow paths during works.

Surface water quality

Construction poses a risk of increased turbidity and sedimentation from soil disturbance and stockpiles, particularly during rainfall events. A soil loss hazard assessment was completed for the BESS compound and project substation disturbance footprint as this represents the primary area of erosion and sediment risk given it involves the greater extent of earthworks. The assessment indicates a “very low” hazard when standard controls are applied, and risks would be readily controllable through formal measures which would be outlined in the construction SWMP.

There is also a potential for contaminants (fuels, oils, concrete wash) to become part of runoff if spills occur or if hazardous materials are not appropriately stored and handled. However, with construction activities and hazardous goods managed in accordance with the CEMP, potential risks to water resources are expected to be localised and temporary, if they occur at all.

Portable toilets are proposed during construction and emptied offsite, avoiding impacts from direct wastewater discharge.

Watercourses

The majority of the project area is located outside the VRZs associated with the adjacent third-order watercourse and Sandy Creek as shown on Figure 14.1. Localised encroachments into mapped VRZs would occur for a small number of project elements, including a portion of the access road between the BESS and the project substation and minor disturbance associated with the stormwater management basin footprint (noting the basin itself is located outside the VRZ). Disturbance associated with overhead line towers would be located outside all VRZs, while works at the Muswellbrook 330 kV substation would involve the realignment of minor first-order ephemeral streams.

All works involving the disturbance, removal and/or realignment of watercourses would be undertaken in accordance with the *Controlled Activities – Guidelines for Riparian Corridors on Waterfront Land* (DCCEEW, 2025). Given the limited extent of disturbance, the generally ephemeral or modified nature of the affected watercourses and the location of most impacts within the outer portions of mapped VRZs, riparian objectives relating to flow conveyance, connectivity and geomorphic stability would not be compromised. Accordingly, no measurable impact on riparian or waterfront land values is anticipated.

No direct, ground-level works within higher-order watercourses are proposed. Any indirect impacts to downstream watercourses would be limited to minor localised changes in runoff patterns and would be managed through standard erosion and sediment control measures and drainage design, ensuring no adverse effect on riparian function or watercourse stability.

Flooding

Construction would occur within an area subject to broad and shallow overland flow and localised flooding associated with limited breakout from the eastern watercourse channel.

The proposed extent of earthworks and construction activities would not materially alter catchment characteristics, existing drainage patterns or contributing catchment areas, and therefore would not influence downstream flood behaviour. Construction-phase management would focus on temporary measures to manage local run-on, maintain site drainage and avoid localised ponding, erosion and sediment transport, particularly in areas of shallow overland flow and known breakout pathways.

A SWMP would be prepared and implemented as part of the CEMP, including temporary drainage and flood controls designed in accordance with *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction – Volume 2A* (DECC, 2008).

The construction works area is not exposed to substantial risk of flooding, with flooding of the BESS facility footprint not predicted for events up to and including the 0.2% AEP event. However, flooding of Sandy Creek Road along the evacuation route towards Muswellbrook has been identified in modelled events (refer to Appendix A of Technical Report 8). A construction flood response plan would therefore be integrated into the CEMP to confirm suitable flood evacuation and shelter-in-place procedures for construction personnel. The feasibility of appropriate flood response procedures has been reviewed and confirmed on the following basis:

- Regional flood warning systems in place for Muswellbrook, while not site-specific, would provide sufficient warning to enable construction personnel to evacuate to Muswellbrook before local road flooding occurs, and then follow the flood arrangements applicable to the general public.
- In the unlikely event that evacuation before flooding of Sandy Creek Road does not occur, the 1% AEP event would not inundate the BESS construction footprint or access road. Local road inundation near the site exit is predicted to last up to six hours, meaning shelter-in-place at the project area is feasible until floodwaters recede.
- In the PMF event, vehicles could be relocated to elevated areas of the project area or the Sandy Creek Road reserve immediately west of the site (which is outside the modelled flood extent), with access back towards Muswellbrook expected to be available once local flooding of Sandy Creek Road subsides.

With the implementation of these measures, construction-phase flooding impacts are expected to be temporary, localised and manageable. Overall, construction activities are not expected to result in a material flood risk or cause noticeable changes to existing flood conditions at the project area or surrounding land.

Groundwater

Generally, the project includes earthworks above existing ground level for the BESS facility and associated infrastructure. Below ground components would be limited to underground services (less than one metre deep) and piling for tower foundations. As such, interception of groundwater and impacts to groundwater quality associated with project construction is not anticipated.

Groundwater impacts may arise however if groundwater is extracted as a construction water supply. Predicted drawdown at the closest registered bore (GW200814, approximately 500 metres away) is expected to be less than two metres which is within the Level 1 Minimal Impact Criteria of the *NSW Aquifer Interference Policy* (DPE, 2023) indicating minimal groundwater impact.

Groundwater-dependent ecosystems within the vicinity are not expected to be impacted, as they are associated with surface water systems and no high-priority groundwater dependent ecosystems occur near the project area. Impacts to groundwater are therefore expected to be negligible with the implementation of standard environmental management measures, including appropriate storage and handling controls for hazardous materials and the implementation of the construction SWMP and CEMP.

Water sourcing and security

A number of construction activities are expected to require non-potable water, including for earthworks, dust suppression on access tracks and vehicle washdown. Non-potable water demand has been estimated at approximately 15 megalitres over the 18-month construction period. Reflecting a preference raised by Muswellbrook Shire Council during consultation to minimise construction vehicle movements, non-potable water would preferably be sourced from on-site groundwater bores (GW204519 and/or GW204185), subject to confirmation of viability during detailed design. Use of these bores would require a new Water Access Licence (WAL) and an amended water supply work approval. Assessment of the New England Fold Belt Coast Groundwater Source indicates sufficient entitlement is available to meet this demand, given the substantial volume of unassigned water in the source and an established market for entitlement trading; the appropriate entitlement would be secured prior to any groundwater take. Where groundwater is found not to provide the full demand, water would be tankered to site from an appropriately licensed external source to supplement supply. Potable water demand for construction personnel has been conservatively estimated at about three megalitres per year and approximately 800 kilolitres for concrete production and would be supplied by tanker (or by treatment of non-potable water for concrete).

Given the magnitude of the project's water demands, water sourcing for construction needs is expected to be feasible.

14.3.2 Operation

Operational impacts relate to permanent changes in site imperviousness, ongoing stormwater discharge quality, ongoing water demands, and management of localised flood risk and emergency response.

Surface water quality

Operation of the project would introduce additional impervious areas of approximately 5.1 hectares, which would increase runoff volumes and typical stormwater pollutant loads. These risks would be managed through the provision of a stormwater treatment system, including a gross pollutant trap and stormwater management basin, designed and confirmed through MUSICX modelling to meet typical best-practice pollutant reduction targets. As such, water quality risks associated with increased runoff would be effectively mitigated.

There is a low potential for accidental release of contaminants from plant, equipment or project hardstand areas. These risks would be managed through provision of sealed and bunded infrastructure, spill prevention and response procedures, and treatment of operational runoff. Battery and transformer units are fully enclosed and would not generate leachate or process wastewater under normal conditions.

Operational runoff would be directed to a stormwater management basin (refer Figure 14.1) designed to capture and treat stormwater as well as contain firewater during potential contingency events. Captured firewater would be managed through controlled pump-out and disposal to an appropriately licensed facility, in accordance with regulatory requirements. With these controls in place, contaminants are unlikely to enter downstream watercourses and measurable impacts on surface water quality are not expected.

Wastewater generated from site amenities, e.g. offices and ablutions would be managed via a septic tank system with an infiltration area, designed in accordance with the *Onsite Wastewater Management Guidelines* (DPHI, 2025) and constructed to appropriately manage site wastewater. As a result, no unacceptable residual impacts to water from wastewater are anticipated.

Watercourses

Given the scope of operational activities, most of the impact on watercourses would occur during the construction phase. Operational activities would be generally limited to infrequent vehicle access for inspection and maintenance. No ongoing earthworks or disturbance within drainage lines or adjacent riparian areas would be required during operation with the exception of vegetation management for the connection infrastructure. Therefore, operational impacts on watercourses are anticipated to be minimal.

Flooding

The proposed BESS facility and associated infrastructure have been designed to avoid inundation, with flood modelling demonstrating that for all events up to and including the 1% AEP, the BESS facility and project substation are not inundated. Local drainage is conveyed around the facility via a swale along the western boundary, maintaining the existing drainage regime and directing flows around the development.

During the 1% AEP event, only minor and localised changes to flood levels are predicted in surrounding areas. These include small increases along Sandy Creek Road; however, these do not extend to the residential dwelling to the north of the road and do not result in any increase in flood hazard or reduction in trafficability of the road.

Flood modelling indicates that the project does not materially alter flood behaviour or result in increased flood affectation to surrounding land.

In the PMF event, overbank flows from the unnamed third-order ephemeral watercourse and local catchment runoff would inundate the BESS facility, with depths of up to 1.5 metres and velocities of up to three metres per second. However, the project does not increase the maximum hazard classification along Sandy Creek Road, meaning the trafficability of the road is not affected by the project during the PMF.

Based on criteria consistent with the NSW Government's Flood Prone Land Package, the project is considered to manage flood risk to an acceptable level. Given the limited and localised nature of predicted changes and the absence of adverse impacts to surrounding properties and infrastructure, the project would not result in unacceptable flooding impacts during operation.

Flood response and evacuation during operation has also been considered. The project area does not need to be occupied at all times during operation, meaning regional flood warning systems for Muswellbrook would provide an opportunity for operational staff to leave the site before local flooding of Sandy Creek Road occurs. The BESS facility and project substation are flood-free up to and including the 1% AEP event. In the unlikely event that an extreme flood occurred without prior evacuation, staff could shelter in areas of the site further removed from Sandy Creek, with access back to Muswellbrook expected to become available once local flooding on Sandy Creek Road subsides. A flood response plan would be incorporated into the Operational Environmental Management Plan.

Detailed drainage design would be confirmed during final design to ensure adequate capacity, maintain existing flow paths, and avoid localised flooding, consistent with best-practice flood risk management principles.

Groundwater

Groundwater extraction may be undertaken during operation to meet the project's water supply needs. The estimated non-potable operational water demand is approximately 0.52 megalitres per year, which is substantially lower than construction demand. On this basis, any operational drawdown impacts are predicted to remain within the Minimal Impact Criteria of the NSW *Aquifer Interference Policy* and are not expected to exceed the *Groundwater Impact Assessment Criteria* (DPE, 2023c).

Potential groundwater quality risks during operation are expected to be managed through the project's stormwater treatment train, which has been designed and tested using MUSICX modelling to reduce typical urban stormwater pollutants consistent with best-practice pollutant reduction guidance. The primary operational groundwater quality risk relates to effluent managed via the onsite wastewater system; this would be addressed by designing and operating the system in accordance with the *Onsite Wastewater Management Guidelines* (DPHI, 2025). With these measures and processes in place, no unacceptable residual groundwater impacts are anticipated.

Water sourcing and security

Operational water demands would be low and readily met through a combination of groundwater supply and/or imported water. Non-potable water demand is estimated to be approximately 80 kilolitres per year on average, and would be sourced from on-site groundwater bores if utilised, and/or supplemented by tankered supply from an appropriately licensed external source where necessary.

Potable water demand during operation is minimal (approximately 20 kilolitres per year) and would be supplied via tankering, consistent with construction arrangements.

Given the modest volumes required during operation, water supply arrangements are considered reliable and would not place pressure on local or regional water resources.

14.3.3 Decommissioning

Potential water quality impacts may occur during decommissioning as a result of the movement of vehicles and earthworks to remove project infrastructure. These impacts are expected to be similar to, or less than, those experienced during construction and operation, with no additional risks introduced to the project area. Detailed management measures will be implemented in accordance with a Decommissioning Management Plan to appropriately control potential erosion and sedimentation, and risks associated with hydrocarbons and fuel handling.

14.4 Mitigation measures

Mitigation measures proposed to avoid or minimise impacts to water during construction, operation, and decommissioning of the project are summarised in Table 14.1.

Table 14.1 Mitigation measures – water

No.	Impact	Mitigation measure	Timing
WQ1	Impacts to surface water quality and flooding risks during construction	A construction Soil and Water Management Plan (SWMP) will be developed and implemented in accordance with <i>Managing Urban Stormwater: Soils and Construction</i> (Landcom, 2004) including erosion and sediment controls, inspection and maintenance requirements, unexpected finds procedures and trigger action response plans.	Pre-construction / Construction
WQ2	Flooding risks during construction	A construction flood response plan will be developed and implemented detailing options for safe access to and from the site in the event of flooding, including emergency management and evacuation procedures.	Pre-construction / Construction / Operation
WQ3	Impacts to stormwater quality during operation	A stormwater treatment system will be designed, constructed and maintained to manage runoff from impervious areas and achieve best-practice pollutant reduction targets for downstream receiving environments.	Design / Operation
WQ4	Water quality during operation	An Operational Environmental Management Plan (OEMP) will be prepared and implemented to manage water quality risks during operation, including hazardous material storage and handling, spill prevention and response, firewater containment and controlled removal where required, maintenance of stormwater treatment measures, water supply arrangements, and wastewater management.	Operation

No.	Impact	Mitigation measure	Timing
WQ5	Flooding risks during operation	An operational flood response plan will be developed and implemented detailing options for safe access to and from the site in the event of flooding, including emergency management and evacuation procedures.	Operation
WQ6	Water supply	Water supply for the project will be confirmed prior to construction. If groundwater is to be used, the required Water Access Licence and water supply work approvals will be obtained, and groundwater extraction rates will be monitored and managed to avoid adverse impacts on neighbouring bores, with trigger and response measures defined in the SWMP and OEMP.	Pre-construction / Construction / Operation
WQ7	Wastewater management	Onsite wastewater systems will be designed, installed and managed in accordance with relevant NSW guidelines such as <i>Designing and Installing On-site Wastewater Management Systems</i> (WaterNSW, 2026), including inspection, maintenance and contingency arrangements.	Design / Operation
WQ8	Watercourse crossings and riparian corridors	The design of works within or adjacent to watercourses will continue to be refined in accordance with <i>Controlled Activities – Guidelines for Riparian Corridors on Waterfront Land</i> (DCCEEW, 2025), and best-practice erosion and sediment control principles, to avoid or minimise impacts within and adjacent to watercourses as far as practicable.	Design
WQ9	Decommissioning impacts	The Decommissioning Management Plan will identify reasonably foreseeable risks relating to watercourses, water resources and water quality and describe how these risks will be addressed during decommissioning.	Decommissioning

15. Hazards and risk

This chapter provides a summary of the potential hazards and risks associated with the construction, operation and decommissioning of the project and provides mitigation measures to reduce potential hazards and risks, where necessary. The chapter includes a summary of the results of the Preliminary Hazard Analysis (Technical Report 9), which has been prepared in accordance with the SEARs.

A Preliminary Hazard Analysis is a systematic risk assessment process used to identify credible hazard scenarios and evaluate their potential consequences and was undertaken with a focus on risks to public safety and surrounding land uses. The assessment confirms that, with the proposed facility separation distances and standard operational safeguards, the project does not pose an unacceptable risk to human health or safety and complies with the applicable risk acceptability criteria under HIPAP No. 4.

15.1 Methodology

15.1.1 Study area

The study area for the PHA consists of a one-kilometre radius around the project area. The study area is shown on Figure 4.1 of Technical Report 9 (Preliminary Hazard Analysis).

15.1.2 Key tasks

The PHA involved:

- reviewing the existing environment, including land uses and sensitive receivers with the potential to be affected by or contribute to hazards and risks
- hazard identification, including:
 - identification of the classes, quantities and storage locations of dangerous goods proposed to be used, on-site assessed against threshold quantities under the Resilience and Hazards SEPP
 - consideration of possible hazardous scenarios associated with the project during construction, operation (including maintenance) and decommissioning
- assessment of the project design and adopted management measures and controls
- risk assessment and evaluation, incorporating:
 - qualitative assessment of credible incident scenarios with potential off-site consequences, including causes and existing operational and organisational safeguards across all project life-cycle stages
 - detailed assessment of hazards with potential off-site impacts to people (human health), property and the environment, applying established risk acceptability criteria to determine whether the project constitutes a hazardous industry
- qualitative consideration of the potential bushfire risks, electromagnetic fields (EMF), electrical safety and other risks
- consultation with the owners of the proposed Queensland-Hunter Gas Pipeline, Santos Limited
- risk mitigation and management by identifying management measures and controls to reduce risks to as low as reasonably practicable.

15.2 Existing environment

The landscape surrounding the project comprises predominantly agricultural land, with some rural residences, native vegetation, and existing energy infrastructure. Key existing hazards and risks within the study area and outlined below include electricity infrastructure.

A total of 21 sensitive receivers have been identified within the study area for the Preliminary Hazards Analysis (PHA) as shown on Figure 4.1 of Technical Report 9 (Preliminary Hazard Analysis). The nearest receiver is located approximately 50 metres north of the project area.

The project area is located adjacent to the existing Muswellbrook 330 kV substation, which forms part of the NSW high-voltage electricity transmission network.

The corridor for the proposed Queensland–Hunter Gas Pipeline is 200 metres wide and is located approximately 135 metres east of the operational footprint (shown on Figure 4.1 of Technical Report 9 (Preliminary Hazard Analysis)). This distance represents the closest location of the pipeline to the project.

15.3 Potential impacts

15.3.1 Construction

During construction, potential risks from the project were identified as:

- on-site storage, handling and transport of hazardous materials and dangerous goods, such as diesel fuel
- natural hazards (bushfire)
- electrical safety.

Dangerous goods

Construction activities may introduce ignition sources, including plant, fuel or chemical storage, hot works, and vehicle movements. Construction of the project would require the use of chemicals and dangerous goods (e.g., paint, solvents, diesel, general oils and lubricants, cleaning products). However, there would be minimal storage of these chemicals, and no stockpiling would occur. No dangerous goods thresholds under the Resilience and Hazards SEPP would be exceeded during construction.

Given the rural location of the project area, the low frequency of vehicle movements, and that dangerous goods transport volumes are well below the Resilience and Hazards SEPP thresholds, the risks associated with transport of dangerous goods during construction would be minimal. A ‘use on demand’ approach would be implemented.

Fire

There is a potential risk of a fire originating from construction activities that could ignite vegetation and spread offsite under adverse weather conditions.

The assessment in Technical Report 10 (Bushfire Hazard Assessment) identifies a range of standard controls to manage construction fire risks, including the provision of asset protection zones, emergency access and fire suppression measures. With these controls in place, construction-related fire risks are able to be appropriately managed and not result in unacceptable impacts to public safety.

Should an external bushfire potentially impact the site during construction, many of the same controls and measures would reduce exposure to radiant heat, ember attack and site access, enabling effective bushfire response.

15.3.2 Operation

Risk screening

Operation of the project would require minimal use of dangerous goods apart from the lithium-ion batteries. Lithium-ion, refrigerant, coolant, and transformer oil (contained within the transformers only) would be required for the operation of the project. Lithium-ion batteries are a Class 9 dangerous good (miscellaneous dangerous goods and articles).

Transformer oil is a Class C2 dangerous good (combustible liquid). Neither Class 9 or C2 dangerous goods have a Resilience and Hazards SEPP threshold and therefore, no dangerous good thresholds would be exceeded during operation of the project. Regardless, a Level 2 PHA was undertaken to address the issued SEARs and is summarised in the following sections.

Hazard identification

The operational hazard identification included the following scenarios:

- natural hazards (bushfire)
- fire started within the project area
- loss of containment of chemicals, including dangerous goods
- contact with chemicals, including dangerous goods
- exposure to EMF
- thermal runaway of lithium-ion batteries.

The majority of these hazards would be controlled through implementation of a safety management system and would not result in any significant off-site impacts. The assessment in Technical Report 10 (Bushfire Hazard Assessment) identifies controls to manage the potential for bushfires to impact the project during operation. The only scenarios that could lead to significant off-site impacts and required further assessment in the hazard analysis were:

- thermal runaway (fire) of lithium-ion batteries
- electrical safety and exposure to EMF.

Hazard analysis

Consequence assessment

Consequence determination was undertaken for a thermal runaway event, which represents the primary credible hazardous outcome associated with the operation of the BESS facility. A summary of the worst-case heat radiation consequences from a thermal runaway event is listed in Table 15.1. Considering the design of the project, these distances indicate that potential heat radiation impacts would be contained within the site. The modelled separation distances also indicate a low likelihood of fire propagation to adjacent containers.

Table 15.1 Summary of heat radiation consequences

Release Scenario	Maximum Distance Downwind of Release to Heat Radiation		
	4.7 kilowatts per square metre (kW/m ²) (heat radiation level that can cause injury)	12.6 kW/m ² (heat radiation level that can cause fatality)	23 kW/m ² (heat radiation level that can cause property damage)
Single container battery thermal runaway	6.1 m	2.8 m	1.3 m

Likelihood estimation

The likelihood of the thermal runaway scenarios investigated during operation of the project could be different, so all three scenarios have been assessed. The results of the frequency analysis for the three scenarios are listed in Table 15.2, and were determined using the calculations provided in Appendix B of Technical Report 9 (Preliminary Hazard Analysis). The analysis indicates that a thermal runaway event at the BESS facility could occur at a frequency of approximately once every 38 years.

Table 15.2 Likelihood results for thermal runaway and release scenarios

Scenario	Frequency per year	Interval years
Manufacturing fault or hot joint leading to thermal runaway and fire (per annum)	1.5×10^{-2}	68
Excessive charging leading to fire (per annum) – cumulative value of all unit charges on-site	1.1×10^{-2}	93
HVAC failure leading to cabinet overheating and fire (per annum) – cumulative value of all unit HVAC on-site	7.4×10^{-4}	1,351
Combined site frequency for thermal runaway events (per annum)	2.6×10^{-2}	38

Risk assessment

Risk was determined by combining the consequence assessment with likelihood estimates for potential thermal runaway events. The assessment adopts the risk framework set out in *Hazardous Industry Planning Advisory Paper No. 4* (HIPAP No. 4) (NSW DPE, 2011), with risks evaluated for fatality, serious injury and property damage for both on-site and off-site receivers. A summary of the applicable HIPAP No. 4 risk criteria and the calculated risks for thermal runaway events are listed in Table 15.3 and Table 15.4 respectively. Full details of the consequence modelling, frequency assumptions and risk calculations are provided in Appendix A of Technical Report 9 (Preliminary Hazard Analysis).

Table 15.3 HIPAP 4 Risk Criteria

Impact	On-site criteria	Off-site criteria
Fatality (12.6 kW/m ² or 21 kPa)	5.00 x 10 ⁻⁰⁵	1.00 x 10 ⁻⁰⁶
Serious injury (4.7 kW/m ² or 7 kPa)	–	5.00 x 10 ⁻⁰⁵
Property damage (23 kW/m ² or 14 kPa)	–	5.00 x 10 ⁻⁰⁵

Table 15.4 Risk criteria compliance for thermal runaway events

Event	Frequency per year	Interval years	Compliance
Off-site property damage	0	0	Complies
Off-site serious injury	0	0	Complies
Off-site fatality	0	0	Complies
On-site fatality	4.4 x 10 ⁻⁰⁶	228,000	Complies

When the assessed consequences and likelihood are considered together, the resulting risk of off-site injury, fatality or property damage is negligible and complies with the HIPAP No. 4 risk criteria. The risk assessment indicates that no off-site impacts are expected, reflecting the separation distances to the nearest sensitive receivers and the very low likelihood of a thermal runaway event occurring.

Accordingly, the project does not pose an unacceptable risk to public safety or human health, with both on-site and off-site risks assessed as low and acceptable following application of appropriate design and operational safeguards.

Electrical safety and exposure to EMF

The key hazard associated with high-voltage electrical installations is the risk of electrocution and exposure to EMF. The following are potential sources of these risks:

- BESS containers and electrical cabling
- on-site switchyard
- 330 kV transmission lines connecting the switchyard to the existing Muswellbrook 330 kV substation.

The project substation layout and equipment selection would be finalised during detailed design, with consideration given to relevant design, safety and building codes and standards. Equipment selection and positioning are expected to result in EMF exposure levels at the substation boundary that are comparable to existing background levels. Underground electrical cabling would be appropriately designed, installed and protected to prevent accidental mechanical impact from vehicles, maintenance equipment or ground disturbance activities.

The risk of exposure to EMF would be managed through a combination of access controls, physical protection measures and procedural safeguards. Access to high-voltage equipment areas, including the switchyard, substations and cable corridors, would be restricted to authorised and suitably trained personnel only, supported by security fencing, locked access points and appropriate warning signage. Maintenance and operational works in proximity to underground or above-ground electrical infrastructure would be undertaken in accordance with documented procedures and permit-based access arrangements, as required by the network operator. Routine inspection and asset management practices would further reduce the risk of inadvertent damage to electrical infrastructure. With these measures in place, mechanical damage risks during operation are expected to be low.

While other electrical equipment on-site would generate magnetic fields, their voltage levels and separation distances from the nearest sensitive receivers mean that exposure is expected to comply with both public and occupational exposure limits. Security fencing around the switchyard and BESS facility would prevent public access, ensuring negligible risk of exposure to members of the public at and beyond the site boundary.

Transgrid (2022) has indicated that the magnetic flux measured in milligauss from typical high voltage transmission lines, such as those as part of the connection infrastructure for the project, are:

- 10 to 200 milligauss directly under a high voltage transmission line for people performing ground-based activities.
- 2 to 50 milligauss at the edge of a high voltage transmission line corridor (typically 22.5 metres to 35 metres from the centre line) for people performing ground-based activities.

The magnetic field levels associated with the project are expected to be well below the applicable exposure limits of 2,000 milligauss for both the general public and occupational exposure, as set out in the *ICNIRP Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields (1 Hz to 100 kHz)* (ICNIRP, 2010). Accordingly, magnetic field emissions are not expected to pose a risk to human health and, as a result, were not assessed further in the PHA.

15.3.3 Queensland–Hunter Gas Pipeline (MP06_0286)

The applicant has held ongoing conversations with the Queensland-Hunter Gas Pipeline operator, Santos Limited, commencing in August 2025. Initial discussions related to the project scope and location, and no specific concerns were raised. Santos was subsequently re-engaged following refinements to the project layout in March 2026, and further correspondence is ongoing to confirm how the updated siting has been considered relative to the pipeline. Whilst initial indications suggest that a project-specific pipeline safety management system workshop will not be required at this stage, the applicant will maintain engagement with Santos through the detailed design phase of the project.

15.3.4 Decommissioning

Decommissioning of the project would occur at the end of its operational life and would involve the orderly shutdown, isolation, dismantling and removal of above-ground infrastructure. Activities would be temporary, localised and undertaken in accordance with relevant Australian Standards, Work Health and Safety requirements and environmental management procedures.

A preliminary risk screening indicates that decommissioning activities would not introduce new or materially different risks compared to those assessed for construction and operation. Potential risks would be short-term in nature and would primarily relate to worker safety and site management rather than impacts to off-site receptors. No hazardous land uses or sensitive receivers would be introduced during decommissioning, and separation distances to surrounding rural land uses would be maintained. Therefore, decommissioning is not expected to pose an unacceptable risk to human health or the environment.

15.4 Mitigation measures

15.4.1 Mitigation measures

Mitigation measures proposed to avoid or minimise potential hazards and risks during construction, operation and decommissioning of the project are listed in Table 15.5.

Table 15.5 *Mitigation measures – hazard and risks*

ID	Issue	Measure	Timing
HR1	Fire safety	The location of the BESS facility will maintain a separation of at least 3 metres from the project area boundary and confirmed by the BESS designer/supplier through appropriate thermal testing/modelling.	Detailed design
HR2		The battery energy storage system will be designed, installed and operated in accordance with manufacturers requirements, relevant design codes and electrical standards.	Detailed design / Construction / Operation
HR3	Queensland–Hunter Gas Pipeline	The applicant will continue to engage with the operator of the Queensland–Hunter Gas Pipeline through detailed design in relation to the project.	Detailed design
HR4	Risk of accidents	A CEMP and, where required, a Decommissioning Management Plan, will be prepared and implemented to manage construction and decommissioning risks, including traffic management, designated pedestrian areas and bushfire management in accordance with the relevant legislation and regulations.	Construction / Decommissioning

16. Bushfire

This chapter provides a summary of the potential bushfire hazards associated with the construction, operation and decommissioning of the project, and provides mitigation measures to reduce potential impacts, where necessary. The chapter includes a summary of the results of the Bushfire Hazard Assessment (Technical Report 10) prepared in accordance with the SEARs.

The assessment confirms that the project can be safely and appropriately designed and operated within a bushfire prone landscape. With the implementation of standard design, operational and emergency management measures, bushfire risk during construction, operation and decommissioning would be managed to a level that is as low as reasonably practicable.

16.1 Methodology

16.1.1 Study area

The study area for the bushfire hazard assessment consists of a 140-metre radius around the project area, consistent with the site assessment methodology outlined in Planning for Bushfire Protection (PBP) (NSW Rural Fire Service, 2019). Considerations such as the presence of bushfire prone land, bushfire history and surrounding land use extend over a wider area. The study area is shown on Figure 16.1.

16.1.2 Key tasks

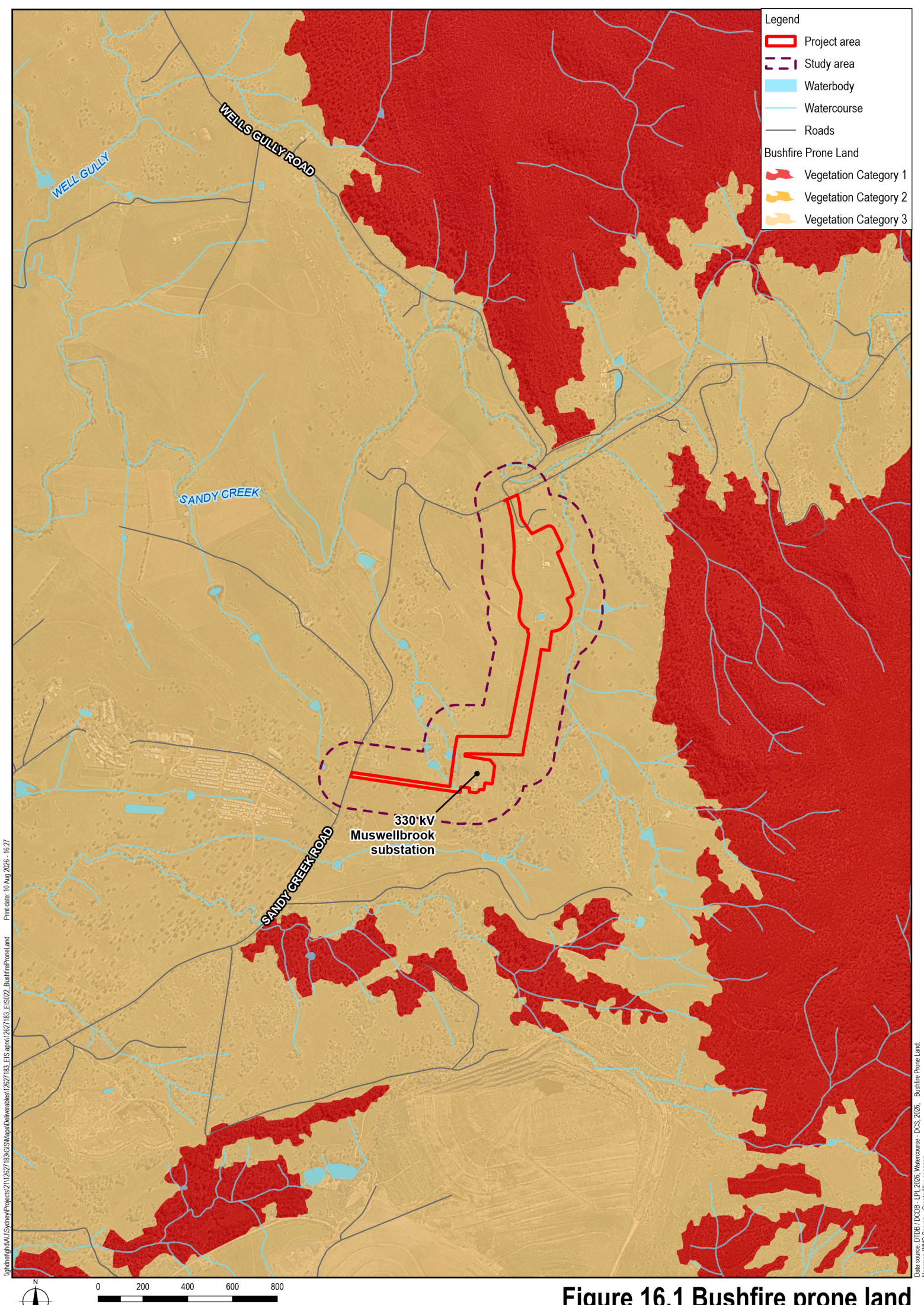
The bushfire hazard assessment involved:

- identification and desktop analysis of site bushfire risk factors and the project design
- a site inspection to verify identified bushfire risk factors
- undertaking a bushfire hazard assessment in accordance with the aims and objectives of PBP
- assessment of project design, including controls and measures relevant to bushfire
- assessment of potential hazards and impacts related to bushfire
- recommending measures to mitigate the potential impacts identified, as required.

16.1.3 Bushfire hazard assessment

A screening of bushfire-prone vegetation within the study area was undertaken to identify vegetation that could result in radiant heat flux affecting the project area. The outcomes of this screening formed the basis for the assessment of bushfire hazard and the development of mitigation measures.

While the project also includes connection infrastructure, this infrastructure is linear and elevated in contrast with the BESS and project substation and designed to operate within bushfire-prone landscapes. Bushfire risk associated with connection infrastructure is managed primarily through established design standards, statutory clearances, protective systems, and ongoing inspection, maintenance and vegetation management regimes, rather than asset-specific radiant heat modelling.



- Legend
- Project area
 - Study area
 - Waterbody
 - Watercourse
 - Roads
 - Bushfire Prone Land
 - Vegetation Category 1
 - Vegetation Category 2
 - Vegetation Category 3

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Data source: DTG / DC016 - LPI, 2025; Watercourse - DCS, 2026; Bushfire Prone Land: Neatmap WMS Server - Created by epangan

Figure 16.1 Bushfire prone land

16.2 Existing environment

16.2.1 Fire danger index

The Fire Danger Index describes potential fire behaviour in areas of native vegetation, taking into account vegetation dryness, temperature, wind speed and humidity (NSW Rural Fire Service, 2019). The project area is located within the Muswellbrook Shire LGA, which forms part of the Greater Hunter region. All land within the Muswellbrook Shire LGA is designated a Fire Danger Index of 100, therefore this level was adopted for the assessment.

A Fire Danger Index of 100 represents severe to extreme fire weather conditions and is applied as a conservative, worst-case assumption to ensure bushfire behaviour is assessed under credible severe conditions rather than average or historical fire weather. This approach is consistent with the requirements of Australian Standard 3959:2018 – *Construction of buildings in bushfire-prone areas* (Australian Standard, 2018) and PBP (NSW Rural Fire Service, 2019) and provides a suitably precautionary basis for assessing bushfire risk to the project.

16.2.2 Bushfire-prone land

The project area and much of the surrounding land is identified as Vegetation Category 3 bushfire-prone land (NSW Rural Fire Service, 2025) as shown on Figure 16.1. Vegetation Category 3 is generally associated with more modified landscapes and lower fuel continuity than Vegetation Category 1. Site-specific bushfire risk is assessed using the vegetation category, together with consideration of vegetation structure, fuel load, topography, climate and separation distances.

16.2.3 Vegetation

Vegetation influences bushfire behaviour by contributing to radiant heat, fuel availability and fire spread characteristics. Variations in vegetation type, structure and moisture content affect ignition potential and fire intensity, with forests and woodlands (Vegetation Category 1) generally supporting higher intensity fires, and grasslands (Vegetation Category 3) supporting fast-moving grassfires. Under severe conditions, all vegetation types can result in a bushfire that has the potential to result in loss of life and damage to assets.

Vegetation within and surrounding the project area is dominated by grasslands, with areas of Grassy Woodlands occurring within the broader locality. Regional-scale vegetation mapping also identifies more isolated patches of Dry Sclerophyll Forest (shrub/grass sub-formation) and Forested Wetlands further from the project area. These vegetation classifications are derived from state and regional mapping datasets and represent broad vegetation formations rather than site-verified plant community types.

Mapped vegetation occurs as small and discontinuous patches across the wider landscape, reflecting a history of agricultural land use and vegetation modification. Large areas within the locality remain unmapped due to historical clearing and ongoing grazing practices. Review of current aerial imagery, verified through site inspection, confirms that the project area itself is extensively cleared and is surrounded predominantly by grassland vegetation on all sides.

Desktop review of recent aerial imagery, corroborated by site inspection, confirms that vegetation in the immediate vicinity of the project area is dominated by managed grassland on all sides. For the purposes of bushfire behaviour assessment, unmapped and modified landscapes have been conservatively assessed as grassland, consistent with AS 3959:2018 and PBP (NSW Rural Fire Service, 2019).

16.2.4 Topography and slope

Topography and slope influence bushfire behaviour by affecting fire spread rates and fire intensity and are a key factor in determining APZ requirements and bushfire attack level (BAL) outcomes in accordance with PBP (NSW RFS, 2019).

The land surrounding the project area is characterised by generally flat to gently undulating terrain. Assessment of effective slope indicates that land to the north of the project area comprises gentle downslope terrain in the order of 0 to 5 degrees, while land to the east, south and west is predominantly upslope to flat.

Effective slopes have been assessed in accordance with the slope categories defined in PBP (NSW RFS, 2019) and are considered representative of the broader local landscape.

16.2.5 Bushfire history

Bushfire history for the project area was reviewed using fire history records maintained by NSW National Parks and Wildlife Service, which document the occurrence of wildfires and prescribed burns across NSW over approximately the past 100 years.

The nearest recorded bushfire to the project area is The Needles wildfire (2008–2009), which occurred approximately 7.4 kilometres north-east of the project area. Other historical fire events within the broader locality include an unnamed wildfire during the 1994–1995 fire season, located approximately 9.8 kilometres to the southwest, and the Edderton Road wildfire (2005–2006), located approximately 12.3 kilometres to the southwest of the project area. The scale of these events is unknown.

16.2.6 Land use, zoning and infrastructure

The project area covers approximately 20 hectares and is zoned RU1 (Primary Production) under the Muswellbrook LEP. The RU1 zoning protects agricultural land while allowing for infrastructure development that is compatible with rural activities. The project area and surrounding land are predominantly used for grazing and are characterised by modified grassland, together with farm dams, internal access tracks and agricultural facilities.

Existing electricity infrastructure is present in the locality, including overhead distribution and connection infrastructure and the existing Muswellbrook 330 kV substation which is part of the project area.

16.3 Bushfire hazard assessment

16.3.1 Asset protection zones

APZs are cleared or partially cleared buffer areas between bushfire hazards and buildings, where vegetation is managed to reduce building exposure to radiant heat, flame contact, and ember attack. APZ dimensions are dependent on the construction standard (based on assessed BAL) for a building.

The project design has incorporated these and other bushfire protection and prevention measures, including APZ requirements, separation distances between BESS components, and firewater and fire management infrastructure.

The project design incorporates APZ distances appropriate to the BAL assessed in section 16.3.2 with the required setbacks generally ranging from 10 to 12 metres, depending on adjacent vegetation type and effective slope (refer to Table 16.1).

16.3.2 Bushfire attack level

The BAL for the project has been determined in accordance with PBP (NSW Rural Fire Service, 2019) through consideration of surrounding vegetation type, effective slope and separation distances to unmanaged vegetation, with the resulting BAL ratings summarised in Table 16.1. The directional references in Table 16.1 describe the location of bushfire prone vegetation relative to the BESS facility and associated infrastructure. Each direction represents a separate interface where vegetation type, slope and separation distance have been assessed to determine the worst-case BAL affecting the project.

The bushfire assessment determined a BAL-29 for the BESS facility and project substation. Project infrastructure has been designed to achieve the required BAL-29 separation distances, such that under bushfire conditions it would be able to withstand ember attack. The assessment confirms that radiant heat flux from surrounding vegetation would not impact the operational project footprint or exceed BAL-29 thresholds.

Table 16.1 *Determination of APZ and BALs for the BESS compound during operation*

ID/Direction	Nearest BF prone vegetation	Effective slope class	Required APZ	Worst-case BAL for all proposed structures with APZ implementation
North	Grassland	0 to 5 degrees downslope	12 m	BAL-29
East	Grassland	Upslope	10 m	BAL-29
South	Grassland	Upslope	10 m	BAL-29
West	Grassland	Upslope	10 m	BAL-29

16.4 Potential impacts

16.4.1 Construction

Bushfire risk from construction activities

Construction activities such as vegetation clearing, earthworks and infrastructure installation have the potential to act as ignition sources for bushfires if not appropriately managed. Potential ignition sources associated with these, and other construction activities include:

- hot works, such as metal cutting, grinding or welding, which may generate sparks capable of igniting dry grasses or fine vegetative fuels
- vehicle use, including vehicles driven or parked in vegetated areas where contact with hot engine or exhaust components may occur
- unapproved human activities, such as the improper disposal of cigarette butts or unauthorised fire use
- storage of combustible materials, where construction materials or substances may ignite due to accidental introduction of sparks or inappropriate storage practices
- machinery use, including slashers, mulchers and earthmoving equipment, which may generate sparks through friction with rocks or hard surfaces during vegetation clearing or excavation.

These activities represent common and well-understood bushfire ignition risks. Effective, reliable and proven risk controls would be applied to each of these risks to prevent accidental ignition and fire spread and are provided as mitigation in section 16.5.

With the systematic application of appropriate risk controls, the likelihood of bushfire ignition and spread resulting from construction activities is expected to be very low. Diligent implementation of these controls can reasonably be expected to prevent accidental bushfire ignitions during the construction period.

Bushfire risk to the construction workforce

The project is located within a bushfire-prone landscape and, as such, construction workers may be exposed to bushfire risk while working within and travelling to and from the project area. Off-site bushfires may occur as a result of natural causes, such as lightning strikes, or through human activity, including accidental ignitions from machinery or deliberate acts such as arson.

A 50 metre APZ would be maintained around all temporary habitable structures, including the construction compound and laydown areas. This separation would significantly reduce bushfire exposure to construction personnel, should it occur, to as low as reasonably practicable and negate the need for additional bushfire protection measures.

Periods of elevated bushfire risk may also occur during construction, and systems to protect workforce health and safety would be established and implemented. Construction activities proposed during a declared bush fire danger period would only be undertaken where permitted and approved in accordance with relevant regulatory requirements.

Where approval to undertake works during elevated fire danger conditions is granted, the following risk controls would be implemented:

- restricting access and managing construction activities during days of extreme or catastrophic fire danger, including during total fire bans and ensuring that timely evacuation can be safely achieved
- establishing safe work systems, clear protocols and reliable communication procedures for all personnel
- implementing early warning systems and ensuring workforce awareness of bushfire danger, conditions and safety precautions
- undertaking location and task-specific safety assessments, providing emergency response training, and maintaining appropriate fire suppression equipment on-site.

Section 16.5 outlines the mitigation measures which would be implemented during construction to reduce the risks of bushfire impacting the site and workers and the risks of accidental bushfire ignition.

16.4.2 Operation

Bushfire risk resulting from the project

The potential for a bushfire to result during the operation of the project has been identified as a hazard with the primary risk associated with a failure of a battery within the BESS facility, although the connection infrastructure was also considered.

Lithium-ion batteries can fail due to internal electrical faults, which may result in thermal runaway fire within a battery container, subsequently leading to ignition of vegetation. The likelihood of such events occurring in modern, well-designed BESS facilities is considered low due to the ongoing advances in system design, testing, certification pathways and improvement in safety standards. Australian operational experience indicates that fire events within BESS facilities are rare, with most reported incidents occurring in earlier-generation systems or in facilities lacking contemporary design controls (Electric Power Research Institute, 2024).

The battery containers proposed for the project would incorporate multiple engineered safety features aimed at eliminating, managing and minimising fire risk. These include appropriate separation between battery containers, real-time thermal monitoring, integrated cooling systems within each unit, and automatic shutdown and electrical isolation features to respond to abnormal operating conditions. Continuous monitoring allows rapid detection of faults and early intervention, ensuring that the residual bushfire risk associated with the BESS remains as low as reasonably practicable.

Bushfire ignition risk associated with the proposed connection infrastructure was also assessed as low as reasonably practicable. Contemporary transmission assets are designed with inherent bushfire resilience through conductor clearances, protective systems, and inspection and maintenance regimes (EnergyCo NSW, 2024). Routine vegetation management within connection infrastructure further reduces the likelihood of electrical infrastructure interacting with surrounding fuels. These measures are consistent with industry practice and regulatory requirements and are effective in limiting bushfire risk during operation to as low as reasonably practicable.

Bushfire risk to the project

BESS facility and infrastructure

Given the project's location within a bushfire-prone landscape, a large-scale, high-intensity bushfire impacting the site is considered a credible, albeit infrequent, scenario. In such circumstances, the primary bushfire risk to the project relates to potential damage to site buildings and ancillary structures that may contain combustible materials, rather than structural collapse or loss of core BESS assets.

The project incorporates multiple layers of mitigation, including:

- compliant APZ setbacks as described in Table 16.1 predominantly steel battery containers
- transformers and electrical equipment typically constructed using non-combustible steel components.

While the BESS components are not formally classified as non-combustible under residential building provisions, they typically exhibit strong resistance to radiant heat and ember exposure when compared with conventional habitable buildings. Appropriate mitigation is provided in section 16.5 with regard to the construction standards for this infrastructure.

The project includes the provision of firewater tanks with a combined capacity of 40,000 litres, designed to meet NSW RFS requirements. These tanks will provide a dedicated and reliable water supply for firefighting purposes. The internal access road network will be designed to accommodate NSW RFS Category 1 firefighting vehicles, ensuring safe and effective emergency access to the site in the event of a bushfire. An additional emergency access road is also proposed for emergency services. These and other relevant design and operational provisions of the project would be reviewed and approved by RFS and other regulatory authorities prior to construction commencing.

Workforce safety

Operational and maintenance personnel may be present at the BESS facility during periods of elevated bushfire risk, and it is not practical to prohibit site attendance on all high fire danger days. In accordance with sections 8.3.1 and 8.3.5 of PBP, a Bushfire Emergency Management and Operations Plan would be prepared for the project, as described in section 16.5. This plan would identify bushfire risks relevant to operation and maintenance activities and outline mitigation measures including safe work systems, task-specific risk assessments, hot-work permitting, monitoring of fire danger ratings, and emergency response and evacuation procedures as well as minimum design and operational infrastructure and standards for the facility.

With the implementation of these measures, the bushfire risk to personnel from an external bushfire event would be effectively managed and reduced to a level that is considered as low as reasonably practicable.

16.4.3 Decommissioning

During decommissioning, bushfire ignition risk may arise from the operation of machinery and the undertaking of hot works to remove project infrastructure. To manage this risk, maintenance of the APZ would be continued to inner protection area standards until all decommissioning activities with ignition potential are completed. With these controls and the ongoing application of the Bushfire Emergency Management and Operations Plan provisions in place, the residual bushfire risk associated with decommissioning is expected to remain low.

16.5 Mitigation measures

Mitigation measures proposed to avoid or minimise potential bushfire hazards and risks during construction, operation and decommissioning of the project are listed in Table 16.2.

Table 16.2 Mitigation measures – Bushfire

ID	Impact/issue	Mitigation measure	Timing
BF1	Asset protection zones	A temporary 50 m asset protection zone (APZ) will be established and maintained around all temporary habitable structures (e.g. site office) during the construction stage, unless subsequent studies are conducted to demonstrate a smaller APZ would meet the aims and objectives of <i>Planning for Bushfire Protection</i> (NSW RFS, 2019).	Construction
BF2		A BAL-29 compliant APZ will be maintained around the BESS facility, unless subsequent studies are conducted to demonstrate a smaller APZ would meet the aims and objectives of <i>Planning for Bushfire Protection</i> (NSW RFS, 2019).	Design
BF3	Construction requirements	All buildings will be designed and constructed in accordance with AS 3959:2018 (sections 3 and 7 – BAL-29) or, where applicable, the NASH Standard (2014, Amendment 1.7.14) <i>National Standard for Steel-Framed Construction in Bushfire Areas</i> , and section 7.5 of <i>Planning for Bushfire Protection</i> (NSW RFS, 2019).	Design

ID	Impact/issue	Mitigation measure	Timing
BF4	Project fire provisions	The design of the BESS facility will be finalised in consultation with NSW Rural Fire Service (RFS) to confirm applicable bushfire protection and emergency response requirements in accordance with <i>Planning for Bushfire Protection</i> (NSW RFS, 2019). The consultation will include: – emergency vehicle access and internal circulation arrangements – perimeter and internal road design and trafficability – firewater storage capacity and supply arrangements – hydrant locations and fire-fighting infrastructure – asset protection measures and other fire safety provisions. The design will be finalised in accordance with the outcomes of consultation with NSW RFS and any conditions or recommendations provided.	Design
BF5	Vegetation management	Vegetation management will be applied in accordance with inner protection area standards (<i>Planning for Bushfire Protection</i> section A4.1.1), including maintaining low fuel loads and keeping grass at or below 100 mm in height to ensure radiant heat flux remains below relevant thresholds.	Operation
BF6	Bushfire emergency plan and management	A Bushfire Emergency Management and Operations Plan will be prepared and implemented in accordance with section 8.3.5 of <i>Planning for Bushfire Protection</i> (NSW RFS, 2019). The plan will identify and apply all relevant bushfire risks and mitigation measures for both construction and operation of the site, including: – measures to prevent or mitigate fire ignition – restrictions on works that will not be carried out during total fire bans – provision and availability of fire-suppression equipment, emergency access, and water supply – requirements for safe storage and maintenance of fuels and other flammable materials – notification to the NSW RFS Fire Control Centre for any works with potential to ignite vegetation during a bushfire danger period, ensuring weather conditions are appropriate – appropriate bush-fire emergency management planning to support preparedness and response. The plan will be provided to NSW RFS for review and comment prior to finalisation.	Construction / Operation / Decommissioning

17. Social and economic

This chapter summarises the potential social and economic impacts of the project and the measures proposed to avoid or minimise adverse impacts and enhance the benefits. It presents a summary of the findings of the social and economic assessments, provided in the Social Impact Assessment (Technical Report 11), which has been prepared in accordance with the SEARs.

The assessment identifies that the project's social impacts are expected to be localised, temporary and primarily associated with construction. Key social and economic benefits include local and regional employment opportunities during construction, including indirect economic benefits to nearby towns through demand for goods and services, and support for the ongoing operation and integration of energy storage within the Hunter-Central Coast REZ during operation.

Construction would have the potential for temporary changes to local amenity, access and connectivity for a small number of nearby landholders and road users. The use of a partially non-resident workforce may also contribute to increased demand for short-term accommodation during peak construction periods. These potential impacts would be managed through the implementation of the project's mitigation and management measures, including the workforce accommodation strategy, community and stakeholder engagement arrangements and workforce management measures during construction.

With implementation of these measures, potential adverse social impacts are expected to be low and manageable. The project would support positive outcomes for the local community through local procurement and employment, ongoing engagement, and ongoing benefit-sharing framework delivered through a voluntary planning agreement over the operational life of the project.

17.1 Methodology

A social impact assessment has been undertaken in accordance with the SEARs (see Appendix A (SEARs compliance table)) and relevant guidelines, including:

- *Social Impact Assessment Guideline for State Significant Projects* (DPE, 2023d) (the Social Impact Assessment Guideline)
- *Technical Supplement – Social Impact Assessment Guideline for State Significant Projects* (DPHI, 2023) (the Technical Supplement).

A quantitative assessment of the potential economic impacts and benefits of the project has also been undertaken, informed by the project description presented in Chapter 3 (Project description).

An overview of the approach to the social and economic assessments is provided below. Further information on the methodology is provided in section 3 of Technical Report 11 (Social Impact Assessment).

17.1.1 Study area

The assessment adopts local and regional study areas to define the spatial extent of potential social and economic impacts. The study areas comprise:

- **Local study area:** McCullys Gap and Muswellbrook suburbs and localities (SALs), representing communities most likely to experience direct impacts during construction and operation.
- **Regional study area:** Muswellbrook Shire LGA, representing the broader catchment for labour, goods, services and accommodation, and where indirect economic effects may occur.

These study areas reflect the limited scale of the project, the small construction workforce and the expectation that social effects would be localised.

17.1.2 Key tasks

The assessment involved:

- characterising the existing social and economic baseline for the local and regional study areas
- reviewing demographic indicators, economic and employment profiles, housing and accommodation availability, and social infrastructure and services
- reviewing the project description and relevant technical studies to inform the assessment
- undertaking targeted stakeholder and community consultation
- identifying and assessing potential social impacts and benefits by project phase
- recommending mitigation and enhancement measures to manage adverse impacts and enhance positive outcome.

Consultation

Engagement with the community and stakeholders has been undertaken during the planning, scoping and design phases of the project. Targeted consultation to inform the SIA was completed in October 2025 and included interviews with local stakeholders.

Key issues identified through consultation informed the social baseline, impact identification and the development of mitigation measures. A summary of consultation activities and outcomes is provided in Chapter 5 (Community and stakeholder engagement).

17.2 Existing environment

This section summarises the key social and economic characteristics of the study area relevant to the assessment of potential impacts. Detailed baseline data is provided in section 5 of Technical Report 11 (Social Impact Assessment).

17.2.1 Local context and community characteristics

The project is located in a rural setting at McCullys Gap, a small locality loosely aligned along Sandy Creek Road and focused on the McCullys Gap Community Hall and adjacent McCullys Gap Rural Fire Service Brigade. Residents broadly rely on Muswellbrook for access to employment, services and community facilities, located an approximate 15 minute drive from McCullys Gap.

Muswellbrook functions as the primary regional centre, providing established health, education, emergency and community services. It is well connected by the New England Highway, regional rail services and local road networks, and supports surrounding rural communities.

The locality is characterised by a small and dispersed population, a predominantly agricultural land use context and the presence of existing infrastructure and mining activities. The community is familiar with large-scale development, although the rural character of McCullys Gap remains an important local value.

These characteristics indicate that potential social impacts are likely to be localised, primarily affecting nearby landholders and road users, with broader community interactions occurring through Muswellbrook.

17.2.2 Demographic and socioeconomic profile

The study area exhibits a mixed socioeconomic profile. McCullys Gap represents a small and relatively advantaged rural community, with high levels of home ownership and workforce participation. In contrast, Muswellbrook and the broader LGA exhibit higher levels of socioeconomic disadvantage.

Across the study area, the population is relatively young compared to NSW, with a higher proportion of working-age residents and a higher proportion of Aboriginal and Torres Strait Islander people. Median household incomes are lower than the NSW average.

Employment is strongly influenced by the mining sector, supported by health care, retail and service industries, particularly within Muswellbrook. These characteristics indicate a workforce experienced in resource and construction activities, with the capacity to participate in infrastructure delivery, but also a degree of sensitivity to economic transition.

17.2.3 Economy and employment

The regional economy is large and highly concentrated in mining, which is the dominant contributor to economic output and employment. The Gross Regional Product of the Muswellbrook Shire LGA was estimated at \$14.7 billion in 2024, of which mining contributed approximately 71 per cent of total output (REMPPLAN, 2025). The region also supports established service, construction and infrastructure sectors.

Across the regional study area, employment is concentrated in mining (21.5 per cent), health care and social assistance (9.0 per cent), retail trade (7.9 per cent) and agriculture, forestry and fishing (7.1 per cent). Employment in the construction sector (5.7 per cent) is lower than the NSW average (8.6 per cent).

Workforce characteristics reflect a high level of workforce mobility, with an estimated 44 per cent of people who work in the LGA residing outside it. Strategic planning directions emphasise economic diversification and transition to new energy industries over time.

Labour force participation is slightly higher than the NSW average, although unemployment has historically tracked slightly higher. Aboriginal and Torres Strait Islander residents experience higher unemployment and lower incomes than the broader population.

Overall, these conditions indicate a regional economy with an established mix of mining, health care, agricultural, service and construction sectors, a workforce capable of supporting local and regional employment opportunities, and a degree of reliance on regional centres and external employment markets.

17.2.4 Housing and accommodation

Housing and accommodation conditions are relevant to workforce-related impacts.

The area is characterised by low-density housing, relatively high rates of home ownership and a constrained rental market. Vacancy rates are low and there is evidence of rental stress, reflecting broader affordability pressures.

Short-term accommodation is available within a 45-minute drive of the project area in the suburbs of Muswellbrook, Aberdeen, Denman and Singleton, and represents the primary option for non-resident workers. Muswellbrook Shire LGA has no dedicated workforce accommodation camps available for temporary project workforces. However, project workers can access corporate accommodation providers offering individual dwellings for project workforces, as well as local hotels and campgrounds which advertise to project workforces. A review undertaken in May and June 2026 identified approximately 652 short-term accommodation rooms across 22 providers, with around 55 per cent located in Muswellbrook, 30 per cent in Singleton, 11 per cent in Denman and six percent in Aberdeen.

17.2.5 Social infrastructure and services

Muswellbrook provides an established network of social infrastructure, including health services, schools, emergency services and a range of community and recreational facilities. These services support both the local population and surrounding rural communities.

Consultation identified that some services, particularly emergency services and childcare, operate under existing capacity constraints. Access to services is largely centralised in Muswellbrook, with limited provision in surrounding rural areas.

Given the scale of the regional centre and its established infrastructure base, there is capacity to accommodate minor increases in demand associated with small-scale projects.

17.2.6 Community values and cohesion

The study area has a strong regional identity linked to mining and resource industries, alongside a valued rural character in localities such as McCullys Gap. The community is familiar with infrastructure and energy development, but remains attentive to cumulative change.

Consultation identified sensitivity to changes in rural character and visual amenity, as well as awareness of increasing development in the region. Differing views were also expressed regarding energy transition and its implications for mining employment.

These factors indicate a degree of localised sensitivity to change, particularly in rural areas, within a broader community that is experienced in, and generally accustomed to, major infrastructure development.

17.3 Potential impacts

17.3.1 Construction

Property, landholders and land use

The project area is located on land currently used for livestock grazing. During construction, land use within the project area would temporarily change from the existing uses to a construction site. Landholders would experience temporary disruption where construction activities occur within their property.

Construction would result in a temporary disturbance of up to 20 hectares of land of which 14.9 hectares is currently used for livestock grazing. This would result in a minor reduction to the amount of land available at private properties for the duration of construction.

Construction would not affect surrounding land uses or access to neighbouring properties. Impacts on land use are therefore limited to the project area.

Further detail is provided in Chapter 12 (Land and soils).

Changes to local amenity

Construction would result in temporary and localised changes in amenity for a small number of nearby landholders and road users. These changes would be associated with construction activity, including noise, visual presence of plant and equipment, and intermittent dust.

While the rural setting and limited number of receivers mean impacts would be confined to nearby properties, they may be noticeable during peak construction periods and would be managed through standard mitigation measures provided in Chapter 8 (Noise and vibration), Chapter 9 (Landscape and visual), and Chapter 18 (Air quality).

Economy and employment

Construction would require a workforce across construction, electrical and logistics skill sets, creating short-term employment and procurement opportunities. Local and regional procurement opportunities may arise (particularly for construction, transport and logistics suppliers), with indirect benefits also likely through workforce expenditure in nearby centres such as Muswellbrook and Aberdeen.

A quantitative economic assessment was undertaken for the project. The assessment indicates that construction would generate substantial economic benefits across NSW over the 18-month construction period. Total economic output is estimated at approximately \$157.77 million, including both direct construction expenditure and flow-on effects through supply-chain activity and household consumption.

Peak activity would occur during the main construction year (FY27), with strong economic contributions across multiple sectors. Financial benefits include an estimated \$28.67 million in wages and salaries and \$56.36 million in value-added to the State economy, reflecting the scale of construction activity.

Construction is also expected to support approximately 187 full-time equivalent jobs across NSW at peak, with employment distributed across direct construction roles and indirect supply-chain and induced employment.

Overall, the assessment demonstrates that construction expenditure would drive broader economic activity, supporting employment, business activity and income generation across the State.

Housing and accommodation

The construction workforce is expected to peak at approximately 150 workers, with local employment prioritised where reasonably practicable. Non-resident workers would be accommodated in short-term accommodation in nearby townships such as Muswellbrook, Aberdeen, Denman and Singleton. Private rental housing would not be used, and no temporary workforce accommodation facility is proposed. Accordingly, no impacts on private rental housing availability or affordability are expected.

A review identified approximately 652 short-term accommodation rooms within a 45-minute drive of the project area, with peak workforce demand estimated to represent 23 per cent of supply. Given generally high occupancy and other major projects in the region, this may place temporary pressure on short-term accommodation availability.

A workforce accommodation strategy would be prepared prior to construction, in consultation with Muswellbrook Shire Council and local accommodation providers, to confirm availability, guide booking and transport arrangements, and minimise impacts on local and regional accommodation markets.

Social infrastructure and services

Construction may result in a minor and temporary increase in demand for local services, including health and emergency services.

Given the relatively small workforce and short duration of construction, any increase in demand is expected to be low and unlikely to be noticeable at a regional scale. Social impacts and community feedback would be monitored through the construction environmental management process, including complaints management and reporting mechanisms, with adaptive responses implemented where required.

Community cohesion and wellbeing

Construction would involve a partially non-resident workforce, resulting in a temporary increase in population in the area. The Muswellbrook Shire LGA already has an established non-resident workforce associated with mining and construction, and the community is generally familiar with this type of activity.

Consultation identified differing views regarding energy projects, including concerns about the implications for mining employment. However, the scale and duration of the construction workforce are limited and are not expected to materially influence community cohesion.

Access and connectivity

Construction would result in temporary increases in traffic on Sandy Creek Road and the New England Highway associated with workforce travel and delivery of materials and equipment.

Traffic volumes are expected to remain within the capacity of the existing road network. Nearby residents and road users may experience increased activity and minor delays during peak construction periods. Advance notification of traffic changes and potential disruptions would be provided through the community and stakeholder engagement plan.

17.3.2 Operation

Property, landholders and land use

During operation, impacts to surrounding landholders or changes to neighbouring land uses are expected. Further information on land use and property impacts is provided in Chapter 12.

Changes to local amenity

Operational amenity effects are primarily associated with noise and visual change at a limited number of nearby receivers. The noise assessment indicates operational noise is predicted to comply at all relevant receivers. The landscape and visual assessment concludes that operational visual impacts are generally moderate at two sensitive receivers (R4 and R5). In other locations, the nature of visual change was assessed as low to very low.

Economy and employment

The project would be operated remotely, with on-site staffing limited to periodic inspection and maintenance activities. Up to six personnel are expected to be required on a quarterly basis, with workers likely to be deployed across multiple sites rather than based permanently at the facility.

Operational employment opportunities would be limited in scale, reflecting the highly automated nature of the facility. Where practicable, maintenance and operational tasks would be undertaken by local or regional contractors.

Ongoing operations and maintenance activities would generate expenditure over the life of the project, supporting a small number of local and regional service providers, including electrical, civil and facilities management services. However, the scale and frequency of procurement would be modest and would not materially influence the regional economy.

Overall, operational economic impacts are expected to be minor, with limited direct employment benefits but some ongoing, localised economic contributions.

Community values and cohesion

The project includes an ongoing benefit-sharing framework (through a VPA administered collaboratively with Council), intended to support enduring community outcomes across the operational life of the project.

In line with the Benefit-Sharing Guideline, the project proposes community benefits at a rate of \$200/MWh per annum (FY2024–25, adjusted for CPI and duration) for the operational life of the project. Based on the project's capacity, this equates to approximately \$320,000 per annum (adjusted) once fully operational.

This approach is intended to support community-identified priorities and deliver sustained social and economic benefits over the life of the project.

Other impacts

The operational phase would involve minimal on-site workforce presence, limited to periodic inspection and maintenance activities. No additional social impacts are expected during operation, including impacts on housing and accommodation, social infrastructure and services, community cohesion, access and connectivity and Aboriginal heritage.

17.3.3 Decommissioning

Social impacts during decommissioning are expected to be temporary and generally similar in type to construction impacts, including:

- minor changes to local amenity (such as noise, air quality, visual, traffic and access)
- potential need for a temporary workforce, which may place short-term pressure on accommodation.

Decommissioning activities will be managed in accordance with the Decommissioning Management Plan, which will ensure that any disturbance is minimised and activities are carried out in accordance with relevant environmental and social safeguards. The Decommissioning Management Plan will include measures to ensure there is minimal potential for impacts on noise, air quality, and traffic and access. The plan will also include stakeholder engagement protocols to ensure that directly affected landholders are informed and consulted prior to and during decommissioning activities.

17.4 Mitigation measures

Mitigation measures proposed to minimise and manage impacts potential social and economic impacts, and enhance potential benefits, are listed in Table 17.1. The measures provided in Table 17.1 are proposed in addition to mitigation measures for other issues provided in other chapters in Part B (consolidated in Appendix C).

Table 17.1 Mitigation measures – Social and economic impact assessment

ID	Impact/benefit	Mitigation measure	Timing
SE1	Socio-economic impacts, communication and engagement	A Community and Stakeholder Engagement Plan will be developed and implemented to guide the delivery of communication and engagement, including an approach and mechanisms for engaging with landholders, nearby residents and other relevant stakeholders. The plan will include: – notifications to residents and relevant stakeholders about construction timing, potentially disruptive works, traffic impacts, road closures and project updates – a complaints and enquiries management procedure, including a 24-hour, seven-day-a-week phone line, postal address and email address, published and maintained for the duration of the project lifecycle – protocols for responding to and resolving complaints within defined timeframes – the approach to providing information to the community about the project's design, safety systems and operational management. .	Pre-construction / Construction / Operation / Decommissioning
SE2	Local business participation and employment opportunities	Measures will be developed and implemented to maximise participation of local and Indigenous residents and businesses in the project, including: – provide information to locals seeking employment or procurement opportunities – appoint a point of contact for procurement, and advertise the contact details on the project website.	Pre-construction / Construction / Operation

ID	Impact/benefit	Mitigation measure	Timing
SE3	Workforce accommodation	A workforce accommodation strategy will be developed and implemented prior to the commencement of construction to manage the accommodation requirements and potential impacts of non-resident construction workers for the project. The strategy will include: – an updated review of short-term accommodation availability, occupancy rates, seasonal and peak demand periods, and foreseeable cumulative demand within one hour's driving distance of the project area – the anticipated number of non-resident workers requiring accommodation, including the expected timing and duration of peak accommodation demand – identification of preferred accommodation providers, and documented consultation with relevant accommodation providers during preparation of the strategy to confirm that sufficient accommodation capacity is reasonably expected to be available during the relevant construction periods – booking protocols, including how workforce accommodation will be coordinated and lead times for accommodation providers – monitoring of accommodation occupancy rates during construction to identify and respond to any material changes attributable to the project The strategy will be developed in consultation with Muswellbrook Shire Council and relevant local accommodation providers. A record of consultation undertaken, provider responses and the basis on which sufficient accommodation capacity has been demonstrated will be maintained and made available to the Planning Secretary on request. Non-local workforce accommodation will not be sourced from the private rental market.	Pre-construction / Construction
SE4	Impacts of non-resident workforce on local communities	Workforce management measures will be developed and implemented as part of the CEMP to manage the potential impacts of the non-resident construction workforce on local communities.	Pre-construction / Construction
SE5	Monitoring and adaptive management	The CEMP will include provisions for monitoring and adaptive management of social impacts during construction, including monitoring of complaints and community feedback, and reporting on workforce accommodation, local employment and procurement outcomes. Where monitoring identifies the need to adjust mitigation measures, the relevant measures would be updated accordingly.	Pre-construction / Construction

18. Air quality

This chapter provides a summary of the potential air quality impacts associated with the construction, operation, and decommissioning of the project and provides mitigation measures to reduce potential air quality impacts associated with the project, where necessary.

The assessment indicates that the project has a low potential to result in adverse air quality impacts during construction, operation or decommissioning. Construction dust has been assessed using a risk-based approach, taking into account the scale of works, local meteorological conditions, and the limited number of nearby sensitive receivers. While potential risks to human health and amenity are low, there is a higher potential risk to ecological receptors located in close proximity to the works. With the implementation of standard construction dust management measures, residual impacts are expected to be low, localised and manageable. Operational and decommissioning activities are not anticipated to result in any measurable air quality impacts.

18.1 Methodology

18.1.1 Study area

The study area for the air quality assessment has been defined as a three-kilometre buffer around the project area. The study area is predominantly rural with a low population density and relatively few sensitive receivers (refer section 18.2.3).

18.1.2 Key tasks

The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2022b) establish a tiered, risk-based framework for assessing air quality impacts, allowing screening-level assessment where projects are characterised by low emission potential, short-term activities, and separation distances sufficient to avoid impacts at sensitive receivers.

In accordance with *Guidance on the Assessment of Dust from Demolition and Construction* (IAQM Guidance) (Institute of Air Quality Management, 2024), a construction dust assessment is required where there are human receivers within 250 metres of the site boundary. For receivers located more than 250 metres from the site boundary, the potential for dust impacts is considered negligible and no significant impacts are expected.

The construction air quality assessment has been undertaken using a desktop, risk-based approach, informed by IAQM Guidance, considering there are three sensitive receivers within 250 metres of the project. The IAQM guidance provides a framework for combining the likely scale of dust emissions and the sensitivity of the surrounding area.

Sensitivity is determined by the number of high, medium and low risk sensitive receivers within a defined proximity of the project area for three areas of concern:

- people, to the effects of dust soiling and the build-up of deposited dust on surfaces
- people, to the health effects of PM₁₀
- ecological, to impacts from dust emissions.

In accordance with the IAQM Guidance, the dust emission magnitude is considered in combination with the sensitivity and proximity of surrounding receivers to determine the overall risk of impact.

18.2 Existing environment

18.2.1 Ambient air quality

DCCEEW operates air quality monitoring stations (AQMS) in many locations across NSW. The nearest operating station to the project area is the Muswellbrook AQMS which is located approximately eight kilometres southwest of the project area.

A summary of the ambient air quality data recorded between 2021 and 2025 at the AQMS is provided in Table 18.1. Overall, annual average concentrations of both PM₁₀ and PM_{2.5} remain well below the relevant criteria across all years, indicating generally good baseline air quality. A few PM₁₀ and PM_{2.5} concentrations exceeded the criteria in 2023 and notably in 2025, with the latter showing a particularly elevated peak likely attributable to regional events such as bushfires or dust storms. Annual average concentrations have remained relatively stable since 2023, with a slight increase compared to the earlier monitoring years of 2021 and 2022.

Table 18.1 Summary of background air quality data recorded at Muswellbrook AQMS

Pollutant	Averaging period	Concentration (µg/m³)				
		2021	2022	2023	2024	2025
Muswellbrook						
PM ₁₀	Maximum 24-hour average	43.5	37.1	59.4	42.2	90.9
	Annual average	18.4	16.6	22.1	18.7	20.2
PM _{2.5}	Maximum 24-hour average	21.7	17.1	25.2	20.8	22.3
	Annual average	7.8	6.9	8.4	7.9	7.8

18.2.2 Climate and meteorology

The local climate and meteorology (weather) within the project area and surrounding locality is of critical importance when assessing the potential for air quality impacts at sensitive receivers.

Temperature

Monthly mean temperature statistics for data measured at the BoM Scone Airport Automatic Weather Station (AWS) for the period 2021–2025 were reviewed. The 50th percentile monthly maximum and minimum temperatures range from 31/16 °C (December) to 16/4.3 °C (July).

Rainfall

Monthly rainfall statistics for data measured at BoM Scone Airport AWS for the period 2021–2025 were reviewed. The data indicates that the greatest number of rain days occurred, on average over the five-year data period, in November, January and March. The maximum average rainfall occurred in March, November and January and was 107, 101 and 74 millimetres respectively. The data also shows that the number of rain days and the total rainfall amounts are generally greater during the warmer months.

Wind

The average wind rose over the period of 2021–2025 was generated from information obtained from BoM. The following features are observed:

- The average wind speed measured was 3.0 metres per second (m/s).
- Calm conditions (wind speed less than 0.5 m/s) occurred 15.3 per cent of the time.
- High wind speeds (wind speed greater than 5 m/s which are often attributed to dust lift-off) occur from the west-northwest and south-southwest.
- Winds predominantly occur from the south to southwest and west-northwest directions, with relatively low occurrence from the east and northeast.

18.2.3 Sensitive receivers

There are 44 sensitive receivers located within the study area, with three sensitive receivers (residential) located within 250 metres of the project. Sensitive receivers within 250 metres of the project are:

- R02 which is located about 190 metres to the connection infrastructure / Transgrid substation
- R04 which is located about 190 metres to the project access track / BESS compound
- R05 which is located about 50 metres north of project area, near the access track to the Transgrid substation.

Sensitive habitats in the vicinity of the project include the Central Hunter Grey Box – Ironbark Woodland, a critically endangered ecological community occurring within the subject land across approximately 21 hectares. Sandy Creek, mapped as Key Fish Habitat, is located approximately 30 metres north of the subject land, while an unnamed tributary of Sandy Creek runs parallel to the eastern boundary at approximately 50 metres distant. These riparian corridors also function as fauna movement corridors connecting to larger patches of native vegetation at Bells Mountain and Colonel Mountain.

18.3 Potential impacts

18.3.1 Construction

Activities which may generally result in substantial dust emissions include trucks travelling on unpaved access roads, earthworks, importing and spreading fill, and stockpiling activities.

A summary of the construction activities that would emit dust and the anticipated dust emission magnitude is provided in Table 18.2. The risk of dust arising in sufficient quantities to cause impacts was assessed for these activity types using the IAQM Guidance.

Table 18.2 Construction dust emissions

Construction activity ¹	Description	Comparison with IAQM	Potential dust emission magnitude ¹
Earthworks	– upgrading of access roads – clearing of any remaining vegetation – stripping of topsoil and subsoil – installation and relocation of temporary services.	Total disturbed land area of approximately 20.02 ha (>110,000 m ²) ² .	Large
Construction	– establishment of concrete slabs or foundations – installation of electrical fit out, switchyard, and overhead transmission line – upgrade of access roads – installation of site services – construction of administration and maintenance buildings and required parking areas.	Total building volume (i.e. materials required) conservatively estimated >75,000 m ³ .	Large
Trackout	Establishment of construction access tracks would be completed at the start of the construction process. The number of vehicle movements during peak construction will consist of up to 160 light vehicles and 160 heavy vehicles per day.	>50 Heavy Duty Vehicles (3.5 t) outward movements in any one day	Large

Notes: 1. As per the definitions in section 7 of the IAQM guidance.

2. The disturbance footprint has been conservatively assumed to include the full extent of the project area, however portions of the proposed connection infrastructure corridor will remain undisturbed.

The potential dust emission magnitude associated with uncontrolled earthworks, construction and trackout has been classified as large, reflecting the scale of works rather than the likelihood of off-site impacts.

Based on the definitions in the IAQM Guidance, the assessment identified the surrounding area would generally have a low sensitivity to dust soiling and human health effects, mainly due to the limited number of human receivers within 250 metres of project-related dust sources. However, the sensitivity of the area to ecological

impacts is high due to the presence of a critically endangered ecological community within the project site and Key Fish Habitat within 50 metres of the project boundary.

The dust emission magnitude was combined with the identified sensitivity of the area within 250 metres of the project site to determine the risk of impacts without mitigation applied. The assessment identified there would be a:

- low risk of dust soiling on receivers from all construction activities
- low risk of impacts on human health from all construction activities
- high risk of impacts on ecological receivers when they are located within 50 metres of all construction activities.

Proposed mitigation measures which are standard for similar projects in NSW, would reduce the risk of potential dust impacts and residual impacts occurring (refer to section 18.4).

18.3.2 Operation

The following activities would be carried out during the operation of the project:

- maintenance and management of equipment
- maintenance of connection infrastructure corridor (trimming of vegetation)
- general office activities
- receipt of goods
- waste removal.

Operational activities, such as maintenance vehicle movements, would be undertaken on a limited basis and relative to construction, are not expected to produce any significant emissions to air and have not been further assessed.

18.3.3 Decommissioning

At the end of its operational life, all infrastructure, utilities, and disturbed areas would be decommissioned and returned to the pre-existing land use in consultation with relevant stakeholders.

Decommissioning of the project is expected to produce less emissions and potential impacts than construction, as the volume of earthworks would be substantially reduced compared to construction and therefore have not been assessed further.

18.4 Mitigation measures

Mitigation measures proposed to avoid or minimise potential air quality impacts during construction, operation and decommissioning of the project are listed in Table 18.3.

Table 18.3 Mitigation measures – air quality

ID	Impact/issue	Mitigation measure	Timing
AQ1	Generation of dust emissions	A construction dust control protocol will be developed as part of the CEMP and implemented that details management measures, a method for recording dust complaints, and monitoring requirements.	Construction
AQ2		Dust suppression will be applied as required using water sprays, water extension agents, soil stabilising polymers or other media on: – unpaved work areas subject to traffic or wind – spoil and aggregate stockpiles – during the loading and unloading of dust generating materials – unpaved access tracks.	Construction
AQ3	Generation of emissions from plant and machinery	All plant and vehicles will be maintained in good condition to minimise ignition risk of fuel or chemicals, spills, and air emissions that may cause nuisance.	Construction

19. Waste management and resource use

This chapter provides the waste management assessment for the project in accordance with the SEARs. It includes the types of wastes that could be generated during construction, operation and decommissioning, and measures to reuse, recycle and safely dispose of wastes.

The assessment found the potential impacts from inappropriate waste management include health and safety risks, contaminated soil and water, visual impacts and fire hazards. All waste generated during construction will be managed using circular economy principles and the waste hierarchy before consideration is given to disposal. All wastes will be managed in accordance with the waste provisions contained within the POEO Act and other relevant legislative and policy requirements. Given the relatively small amounts of waste generated, and effectiveness of management measures, potential impacts associated with waste are considered minimal.

19.1 Methodology

19.1.1 Key tasks

The waste assessment involved:

- reviewing the regulatory framework for waste management
- identifying key waste streams for each project phase, their likely classifications and proposed waste handling and management measures consistent with the waste hierarchy and circular economy principles
- estimating waste quantities for each project phase based on available information and comparable projects
- identifying potential environmental impacts associated with waste generation and management
- undertaking a desktop review of local waste management facilities to assess their capacity and capability to accept the anticipated waste types and quantities during each project phase
- consulting with waste facility operators on waste acceptance
- identifying mitigation measures to reduce the impacts of waste generation and improve overall waste management.

The estimated waste quantities are indicative and have been identified for the purpose of determining potential waste management strategies. Although the actual quantities of waste generated by the project may differ from the estimates made, the identified waste management strategies would remain appropriate based on the waste stream identified and are scalable.

19.1.2 Consultation with waste facility operators

Consultation with Muswellbrook Shire Council was undertaken in December 2025 and the applicant has agreed the project would not seek to utilise any Council waste facilities. The applicant has applied this approach to all Council operated facilities within 100 kilometres of the project area. Therefore, the project would mainly utilise commercial/private waste management facilities within a reasonable distance. The applicant has consulted with private waste operators and confirmed there are suitable facilities and capacities available for the anticipated waste streams and volumes.

19.2 Existing environment

19.2.1 Existing regional waste infrastructure

A desktop search was conducted to identify privately owned waste management facilities within approximately 200 kilometres of the project area. These facilities provide capacity for the acceptance, segregation, recycling and lawful disposal of typical construction waste streams, including inert spoil, general solid waste, recyclable materials and regulated waste (where appropriately licensed).

The availability of multiple facilities across the region provides flexibility in waste management arrangements and supports compliance with the NSW waste management hierarchy by enabling waste segregation, recovery and disposal at appropriately licensed facilities.

Final facility selection will be confirmed during construction planning, having regard to licensing, waste acceptance criteria, capacity and haulage efficiency.

19.3 Potential impacts

19.3.1 Construction

The key waste streams expected to be generated during construction are:

- vegetation from site clearance activities
- demolition waste generated from the removal of existing structures, including residential houses and shed, as well as various farm structures
- surplus spoil from site preparation and earthworks (e.g. virgin excavated natural material, excavated natural material, contaminated soils (if any))
- surplus construction materials (such as aggregates, sand and concrete, timber, metals, mechanical equipment, cables and electrical wiring) from the construction of the BESS facility and associated infrastructure
- general construction waste including packaging waste including foam, timber, cardboard and plastics
- food waste, general waste and wastewater (grey water and sewage) from construction compound.

The estimated quantities of these waste streams, their likely classifications and potential end destinations are listed in Table 19.1.

Table 19.1. Potential key waste streams and offsite management facilities – construction

Waste types	Likely waste classifications	Indicative waste generation	Management hierarchy	Potential offsite management facilities	Distance from project area
Demolition waste	General solid waste (non-putrescible)	300-400 tonnes	Reuse on-site Reuse off-site Disposal	Concrush Pty Ltd	127 km
				Cleanaway Bathurst Solid Waste Services	170 km
				Veolia Environmental Services	200 km
				SUEZ Waste and Resource Recovery	220 km
Vegetation	General solid waste (non-putrescible)	1,000-1,200 tonnes	Reduce Reuse onsite Recycle offsite	Cleanaway Bathurst Solid Waste Services	170 km
				Veolia Environmental Services	200 km
				SUEZ Waste and Resource Recovery	220 km

Waste types	Likely waste classifications	Indicative waste generation	Management hierarchy	Potential offsite management facilities	Distance from project area
Surplus spoil	General solid waste (non-putrescible)	Minimal	Reduce Reuse onsite	Cleanaway Bathurst Solid Waste Services Veolia Environmental Services SUEZ Waste and Resource Recovery	170 km 200 km 220 km
Surplus construction material	General solid waste (non-putrescible)	Estimated quantities of surplus construction would be confirmed during detailed design based on the quantities of construction material	Reduce Reuse onsite Recycle offsite Disposal offsite	Manufacturers/ suppliers Concrush Pty Ltd Cleanaway Bathurst Solid Waste Services Veolia Environmental Services SUEZ Waste and Resource Recovery	N/A 127 km 170 km 200 km 220 km
General construction waste	General solid waste (non-putrescible)		Reduce Recycle offsite Disposal offsite	Concrush Pty Ltd Manufacturers / suppliers Cleanaway Bathurst Solid Waste Services Veolia Environmental Services SUEZ Waste and Resource Recovery	127 km N/A 170 km 200 km 220 km
General waste from construction site offices	General solid waste (putrescible) General solid waste (non-putrescible)	Recyclables: 600 L/day at peak General waste: 600 L/day at peak	Reduce Disposal offsite	Cleanaway Dubbo Solid Waste Services Concrush Pty Ltd Cleanaway Bathurst Solid Waste Services Veolia Environmental Services SUEZ Waste and Resource Recovery	110 km 127 km 170 km 200 km 220 km
Wastewater from amenities i	Liquid waste	7.5 kL/day at peak	Reduce Disposal offsite	The facility will be confirmed by the collection provider	N/A

Waste volumes and types generated during construction would be managed using circular economy principles and the waste hierarchy approach of avoidance and reuse before consideration is given to disposal. Wastes would be managed in accordance with the waste provisions contained within the POEO Act and other relevant plans, policies, and guidelines.

Should waste be found to be unsuitable for reuse or recycling, disposal methods would be selected based on the classification of the waste material in accordance with the *Waste Classification Guidelines* (NWS EPA, 2014). The Waste Classification Guidelines provide direction on the classification of waste, specifying requirements for management, transportation and disposal of each waste category.

The proposed approach to managing construction waste, including measures to facilitate segregation and prevent cross contamination, is provided in Table 19.2. Additional mitigation measures, proposed as an outcome of the assessment, are provided in Table 19.5. Waste management and handling would be further detailed based on the information provided by the construction contractor prior to the commencement of construction and outlined in the Construction Waste Management Plan.

Table 19.2 *Management of construction waste*

Waste type	Proposed management
Demolition waste	Demolition waste would be managed in accordance with the waste management hierarchy. Where practicable, materials would be salvaged and reused onsite prior to being transported offsite for reuse or recycling. Waste streams would be separated at source (e.g. scrap metal, concrete, timber and general waste) to minimise cross-contamination and maximise resource recovery. Concrete and masonry materials would be transported to a suitably licensed facility for reuse as fill or road-base, where suitable. Scrap metals would be recovered and sent to licensed metal recyclers. Any residual or non-recoverable materials would be transported to appropriately licensed waste facilities for lawful disposal.
Vegetation	Clearing would be minimised by placing temporary infrastructure in areas that have been previously cleared, degraded or have naturally lower above ground biomass. Areas to be cleared would be marked to reduce incidental clearing. As far as practicable, cleared material would be chipped, mulched, and stockpiled for reuse on-site as part of rehabilitation or landscaping works. Materials with special habitat value, such as hollow-bearing logs or trees, would be selectively removed for reuse, or placed in nearby bushland. If unable to be reused on-site, the material would be removed for off-site reuse in accordance with <i>The Mulch Order 2016</i> (NSW EPA, 2016) or sent for recycling at a suitably licensed facility. Priority weeds would be disposed of in accordance with relevant guidelines/requirements.
Surplus spoil	Surplus spoil is expected to be minimal. Where practicable, excavated materials would be reused on site for construction fill or landscaping purposes. Surplus spoil material that cannot be reused on-site would be transferred to an off-site facility to avoid any runoff from long term stockpiles.
Contaminated soil	The likelihood of contaminated soil is considered low given the historical agricultural land use; however, minor contamination may be present where agricultural chemicals have been stored or handled, particularly if containment, handling, or spill management practices were inadequate. The material would be classified in accordance with the <i>Waste Classification Guidelines</i> (NSW EPA, 2014) and taken to an appropriately licensed facility by an authorised contractor. Options to recycle spoil would be investigated where practicable.
Surplus construction material	Surplus construction material would be reused on-site before transported offsite for reuse or recycle. Materials would be segregated onsite for collection to avoid cross contamination. Opportunities for take back agreements in material procurement would be identified for surplus construction materials.
General construction waste	General construction waste would be classified in accordance with the <i>Waste Classification Guidelines</i> (NSW EPA, 2014) and directed to a waste management facility that is lawfully permitted to accept that type of waste. Where space constraints permit, waste would be segregated and stockpiled, with materials such concrete, metals and asphalt separated and sent to a construction and demolition waste recycling facility. Other recyclable materials would be sent for recycling as a mixed waste stream. Opportunities for take back agreements in procurement would be identified with suppliers, e.g. packaging and pallets, etc.
General waste from construction compounds	Labelled and colour coded receptacles would be provided at the construction compounds for general waste from construction personnel to ensure source separation of recyclable materials and residual landfill waste. These wastes would be collected on a regular basis by authorised and appropriately licensed waste collection contractors for off-site recycling or disposal.
Wastewater from amenities, including sewage	Wastewater generated by the construction staff from amenities would be collected by a package wastewater treatment system and tankered off-site for disposal at a suitably licensed facility.

The potential impacts associated with aspects of waste generation and management during construction (if waste is not managed appropriately) include:

- contaminated runoff and leachate generation, which could impact water quality and aquatic ecosystems (if wastes were inappropriately managed and stored)
- visual impacts of improper waste storage on construction sites and litter generation
- cross contamination of waste due to improper segregation and storage
- waste build ups from irregular or disrupted collections, including attracting pests and disease vectors

- unnecessary loss of capacity at available waste disposal facilities due to insufficient reuse and recycling
- failure to correctly classify, track or manage waste, which could result in waste being transported or disposed of inappropriately.

Other potential indirect impacts in relation to noise and vibration, visual, traffic and transport, land and soils and water have been considered in the respective chapters for these environmental matters (refer to chapters 8, 9, 12, 13 and 14).

With the implementation of the identified measures, construction wastes would be effectively managed and would not result in significant residual impacts.

19.3.2 Operation

The key potential operational waste streams would be as follows:

- food waste, general waste and wastewater (grey water and sewage) from maintenance staff, specialist subcontractors and/or equipment manufacturers
- general waste, lubricants, cleaning agents and packaging materials from maintenance activities
- batteries and electrical parts generated by replacement and maintenance activities.

It is anticipated that only minimal amounts of waste would be generated during operation based on the limited activities needed (relative to construction) and the small number of staff required. Waste materials would be segregated and stored appropriately on-site in wheelie bins or designated storage areas prior to transport to an off-site waste management facility. The estimated quantities of waste streams, their likely classifications and potential end destinations are listed in Table 19.3.

Table 19.3 *Estimated key waste streams quantities – operation*

Waste types	Likely waste classifications	Indicative waste generation	Management hierarchy	Potential offsite management facilities
Maintenance waste including batteries, electrical and electronic waste, lubricants, oils, chemicals	General solid waste (non-putrescible) Hazardous waste	Minimal	Reduce Disposal off-site	Manufactures / suppliers Concrush Pty Ltd Cleanaway Bathurst Solid Waste Services Veolia Environmental Services SUEZ Waste and Resource Recovery
Waste batteries (damaged, exhausted or non-functioning battery components)	Hazardous waste	Minimal	Reused off-site Refurbish offsite	Original equipment manufacturer or accredited battery recycling facilities
General waste from maintenance personnel (such as food waste, paper and cardboard, containers, and other packaging waste, etc.)	General solid waste (putrescible) General solid waste (non-putrescible)	Minimal	Reduce Disposal off-site	Cleanaway Dubbo Solid Waste Services Concrush Pty Ltd Cleanaway Bathurst Solid Waste Services Veolia Environmental Services SUEZ Waste and Resource Recovery
Wastewater from amenities, including sewage	Liquid waste	Minimal	Reduce Treated onsite	Managed onsite

The proposed approach to managing operational waste, including measures to facilitate segregation and prevent cross contamination, is provided in Table 19.4. Additional mitigation measures, proposed as an outcome of the assessment, are provided in Table 19.5.

Table 19.4 *Management of operational waste*

Waste type	Proposed management
Maintenance waste including batteries, electrical and electronic waste, lubricants, oils, chemicals	Waste from any maintenance activities would be collected and stored in designated waste storage areas for collection by an authorised waste collection provider for disposal off-site. Any potentially hazardous waste or chemicals would be stored separately in clearly labelled receptacles and disposed of in accordance with its waste classification. Waste oil and oil filters would be stored in separate recycling bins and collected by an authorised waste collection provider, and recycled off-site, where feasible. Electrical and electronic waste would be segregated and sent for recycling to a suitably licensed facility. Opportunities for take-back agreements in procurement with manufacturers/suppliers would be identified, e.g. packaging and pallets, etc.
Waste batteries (damaged, exhausted or non-functioning battery components)	Batteries would be collected and segregated onsite and transferred to the original equipment manufacturer or a specialised battery recycling facility for reuse, refurbishment or recycling.
General waste from maintenance personnel (such as food waste, paper and cardboard, containers, and other packaging waste etc)	General waste would be managed in accordance with the waste hierarchy. Labelled and colour coded receptacles would be provided at the operation compounds for general waste from construction personnel to ensure source separation of recyclable materials and residual landfill waste. These wastes would be collected on a regular basis by authorised and appropriately licensed waste collection providers for offsite recycling or disposal.
Wastewater (e.g. from ablution and sewage)	Wastewater generated by the maintenance personnel from operation compounds would be collected by a septic tank system and tankered off site for disposal at a suitably licensed facility. The septic tank system must be managed in accordance with the relevant guidelines in Technical Report 8 (Water).

The potential impacts associated with waste generation and management during operation are similar to those identified for construction, with the exception that no excavation of material would occur during operation.

Operational waste management activities are expected to be successfully managed provided that waste handling and management is undertaken as outlined in Table 19.3 and the mitigation measures outlined in section 19.4.

19.3.3 Decommissioning

Currently it is anticipated that batteries and associated equipment would be segregated onsite and returned to the relevant suppliers for reuse, refurbishment or recycling, where possible. Decommissioning waste management would be undertaken in accordance with the Decommissioning Management Plan, with approaches to treatment and disposal aligned to the technologies available at the time.

19.4 Mitigation measures

Mitigation measures proposed to avoid or minimise potential impacts with regards to waste during construction, operation, and decommissioning of the project are listed in Table 19.5. These measures will be included in the issue-specific environmental management sub-plans for the project.

Table 19.5 Mitigation measures – waste

ID	Impact	Mitigation measure	Timing
WM1	Generation of excessive spoil	Earthworks design will be optimised to minimise excess spoil volumes and maximise on-site reuse of excavated material where practicable.	Detailed design
WM2	Improper classification and handling of waste	All waste streams will be classified in accordance with the <i>Waste Classification Guidelines</i> (NSW EPA, 2014) and managed in accordance with the POEO Act and associated regulations. A waste management register will be established and maintained to record waste types, quantities, transport dockets and receiving facilities.	Construction / Operation
WM3	Inefficient waste management	A Construction Waste Management Plan will be prepared and implemented for the project. Circular economy principles and the waste hierarchy will be applied under the <i>Waste Avoidance and Resource Recovery Act 2001</i> . The processes, responsibilities, and measures to manage waste and resource use will be detailed to minimise the potential for impacts during construction.	Construction
WM4	Poorly managed operational waste	An Operational Waste Management Plan will be prepared and implemented prior to operation of the project. Circular economy principles and the waste hierarchy will be applied to manage waste and resource use and minimise the potential for impacts during operation. A waste management register will be maintained to document waste tracking, quantities and lawful disposal or recovery destinations.	Operation
WM5	Public waste facilities	Project waste will not be disposed at public (Council) waste facilities. The Construction Waste Management Plan and Operational Waste Management Plan will identify the receiving waste facility(s) for project waste.	Construction / Operation
WM6	Decommissioning waste	The Decommissioning Management Plan will include measures to manage waste generated during decommissioning of the project. Reuse and recycling opportunities will be investigated for materials such as metals and concrete through local and regional waste facilities.	Decommissioning

20. Cumulative impacts

This chapter assesses the potential cumulative impacts of the project. Cumulative impacts typically arise when impacts from the project interact or overlap with other future projects, potentially resulting in a larger overall effect (beneficial or adverse) on the environment, communities or the economy. Cumulative impacts may occur during construction stages when projects are constructed concurrently or consecutively, or during operation. Projects constructed consecutively (or sequentially) can result in localised construction activities occurring over an extended period of time, or at an intensity greater than a single project. This is similarly the case for operational projects, where the impacts of multiple operational projects is greater or more pronounced than a single project.

The assessment identifies the potential for both beneficial and adverse cumulative impacts at local and regional scales. Beneficial cumulative impacts may include increased investment in energy infrastructure, a material cumulative contribution to dispatchable firm renewable generation capacity supporting the orderly retirement of coal-fired generation, improved network reliability and stabilisation of the broader electricity network, local and regional employment opportunities and expenditure injection into regional businesses during construction, and progress against National and NSW renewable energy transition and emissions reduction objectives. Potential adverse cumulative impacts relate primarily to construction traffic, biodiversity, noise and vibration, landscape and visual, water and short-term pressures on regional workforce accommodation where multiple projects are undertaken concurrently in the McCullys Gap – Muswellbrook locality.

On balance, this cumulative impact assessment has found that with the project-specific mitigation and management measures outlined in this EIS, together with coordination with proponents of other relevant projects, the adverse cumulative effects of the project in combination with other relevant projects are expected to be manageable and substantially outweighed by the beneficial cumulative effects on energy system reliability, the renewable energy transition and regional economic activity.

Cumulative benefits and impacts, as they relate to specific key issues, are addressed further in the relevant technical reports of the EIS.

20.1 Methodology

The cumulative impact assessment has been undertaken in accordance with the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPE, 2022) as required by the SEARs, which establish the following key principles:

- Proportionality – the assessment should be proportionate to the scale and potential significance of cumulative impacts of the project combined with the impacts of other relevant projects. It should focus on key matters that could be materially affected, rather than attempting to address every possible impact.
- Collaboration – managing cumulative impacts is a shared responsibility and requires collaboration between government, industry and the community.

Consistent with these guidelines, the assessment adopts both issue-specific and combined approaches:

- an issue-specific cumulative impact assessment, which considers how the project may contribute to cumulative impacts for key environmental and social issues when assessed alongside other relevant projects. Examples could include increased traffic, biodiversity impacts or noise levels.
- a combined cumulative impact assessment, which considers how multiple types of impacts, such as dust, noise and traffic, may interact at specific locations or affect sensitive receivers when a project is considered together with other developments. It may also involve a regional focus.

For this project, the issue-specific cumulative impact assessment evaluates the potential impacts of the McCullys Gap BESS in conjunction with other relevant projects for the key matters assessed in the EIS. Full issue-specific assessments are provided in Technical Reports 1 to 11.

The combined cumulative impact assessment integrates the findings of the issue-specific assessments and consideration of other projects to determine whether there would be combined effect of different cumulative impacts of the project and other relevant projects.

The cumulative impact assessment process involved:

- identifying other relevant existing, approved and proposed projects
- screening those projects to determine their relevance for issue-specific assessment
- assessing the potential for cumulative impacts during construction and operation
- identifying mitigation and management measures.

In accordance with the guidelines, this chapter recognises that existing and completed developments form part of the existing environment or baseline for the purposes of this environmental impact assessment. The effects of these developments are therefore incorporated into the baseline conditions assessed by this EIS in Chapters 7 to 19. As such, the cumulative impact assessment focuses on the potential for additional or incremental impacts arising from the project in combination with other future or concurrent projects, rather than reassessing impacts from existing developments.

20.2 Assessment scoping

20.2.1 Project identification

In accordance with the Cumulative Impact Assessment Guidelines, the assessment must consider the potential for cumulative impacts arising from other 'relevant future projects'. The Guidelines define 'relevant future projects' as those that are reasonably likely to proceed and have the potential to interact with the project in a way that could result in cumulative impacts.

To identify potentially relevant projects for the cumulative impact assessment, a review of publicly available planning registers was undertaken in June 2026 which included the NSW Government Major Projects Planning Portal and publicly available information on major development proposals within the Muswellbrook Shire LGA.

To be considered relevant, projects were required to be of a similar scale, be located within reasonable proximity to the project area (25 kilometres) and have a construction or operational timeframe that may overlap with the project. Projects identified through this review that meet these criteria are summarised in Table 20.1 and shown on Figure 20.1.

Table 20.1 Relevant existing/future projects for cumulative impact assessment

Project	Assessment stage	Relevance
Muswellbrook Pumped Hydro Energy Storage (SSI-76014961)	Prepare EIS	The Muswellbrook Pumped Hydro project is located about 1 km south of the southern extent of the project area and includes the construction of a hydraulic power station between two reservoirs. The project would include a 1.5 km high voltage transmission line connecting to the existing Muswellbrook 330 kV substation. The transmission line connection works at Muswellbrook substation, use of Sandy Creek Road and substation access will potentially overlap with the works for the project. The Muswellbrook Pumped Hydro project will utilise Sandy Creek Road for access which is also proposed by the project.
Muswellbrook Solar Farm (SSD-46543209)	Approved 27/5/2025	The Muswellbrook Solar Farm project is located 800 m south of the southern end of the project area and includes the construction of a 135-megawatt solar and BESS facility. It is anticipated that construction of the Muswellbrook Solar Farm will commence in 2026 and take up to 31 months. Therefore, it has the potential to overlap, short-term with the construction of the project. The solar farm project will utilise Sandy Creek Road for access which is also proposed by the project.
Muswellbrook Thermal Storage Facility (SSD-88560713)	Prepare EIS	The Muswellbrook Thermal Storage project is located 2.2 km southwest of the southern extent of the project area and includes the construction and operational of a small scale concentrated solar thermal facility with the capacity of up to 30 MW. Construction of the thermal storage facility has the potential to overlap, short-term with the construction of the project.

Project	Assessment stage	Relevance
		The thermal storage facility will utilise Sandy Creek Road for access which is also proposed by the project. It also proposes a connection to the existing Muswellbrook 330 kV substation.
Muswellbrook Battery Energy Storage System (SSD-29704663)	Approved 7/7/2023 Modification 1 under assessment	The Muswellbrook BESS project is located 3.9 km southwest of the southern extent of the project area and includes the construction of a 150-megawatt BESS facility. The project would include 132 kV transmission lines connecting to the existing Muswellbrook 330 kV substation. Construction of the Muswellbrook BESS was anticipated to commence in late 2023 and take up to 12 months. As per the Modification Report, construction is now estimated to begin in quarter four of 2026 and take up to 12 months.
Bells Mountain BESS (formerly known as Sandy Creek BESS) (SSD-83968208)	Prepare EIS	The Bells Mountain BESS project is located immediately west and northwest of the southern extent of the project area and includes the construction of a 750-megawatt BESS facility. The project would include transmission lines connecting to the existing Muswellbrook 330 kV substation. The BESS will utilise Sandy Creek Road for access which is also proposed by the project.
Gelston Battery Energy Storage System (SSD-104190458)	Prepare EIS	The Gelston BESS project is located about 1.6 km west of the project area and includes the construction of a 400-megawatt BESS facility. The project would include transmission lines connecting to the existing Muswellbrook 330 kV substation. The BESS will utilise Sandy Creek Road for access which is also proposed by the project.
New England REZ Transmission Project (SSI-74175972)	Prepare EIS	The New England REZ Transmission project has not been finalised however dual 500 kV transmission lines in a 140 m easement will run generally from Walcha to Bayswater Substation to the south of Muswellbrook. The transmission corridor may be approximately three kilometres east of the project area and require new and upgraded access tracks and public roads. Accommodation camps are also proposed as part of the New England REZ Transmission project; however, the location and number of accommodation camps are yet to be determined. Subject to confirmation in the EIS, construction could commence in 2028.
Muswellbrook Bypass – New England Highway	Approved under Division 5.1 of the EP&A Act	The Muswellbrook Bypass project is located four kilometres southwest of the project area and includes the construction of a nine kilometre bypass to connect the New England highway to the north and south of Muswellbrook, including bridges over Muscle Creek Road and Main North railway line, Muscle Creek, Coal Road, Sandy Creek Road, Sandy Creek, Main North railway line and a southbound exit ramp and connection. Construction of the Muswellbrook Bypass is anticipated to begin in late 2026.
Queensland-Hunter Gas Pipeline (MP06_0286)	Approved 11/2/2009	The Queensland Hunter Gas Pipeline project is located immediately northeast of the project area and includes the construction of a 603 km, 200 m wide corridor for the underground gas pipeline. Accommodation camps are also proposed as part of the Queensland-Hunter Gas Pipeline project on either side of the Liverpool Ranges. An indicative construction start date has not been published therefore it has been assumed with potential to overlap with the construction of the project.
Hunter-Central Coast Renewable Energy Zone network infrastructure upgrades	Approved under Division 5.1 of the EP&A Act	The Hunter-Central Coast REZ is located immediately southwest of the project area. The project includes the upgrading and construction of two new substations at Sandy Creek and Antiene, upgrades to 85 km of sub-transmission lines and minor augmentation to other existing infrastructure, including the existing Muswellbrook 330 kV substation. The Hunter-Central Coast REZ is located across nine LGAs, including the Muswellbrook Shire LGA. Construction works commenced in early 2026 and are expected to be complete by 2028, therefore potentially overlapping with the construction of the project.

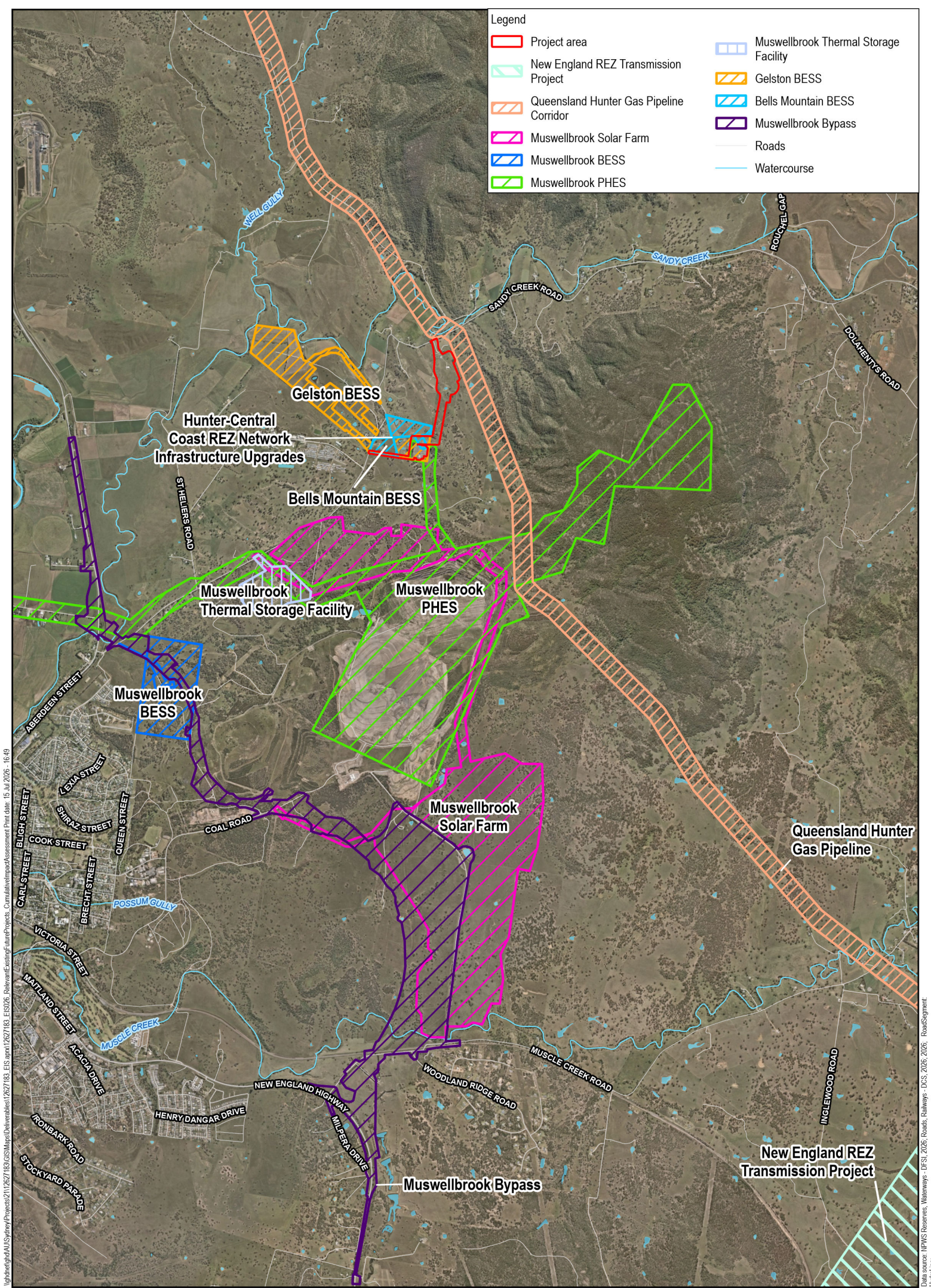


Figure 20.1 Relevant existing/future projects for cumulative impact assessment

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 Data source: NPWS Reserves, Waterways - DFSI, 2026; Roads, Railways - DCS, 2026; HydroLine.

20.2.2 Project screening

In accordance with the Cumulative Impact Assessment Guidelines, the identified projects were screened using the following criteria:

- project size – large-scale, major development or infrastructure projects
- project status – approved (including not yet commenced), under construction, or proposed with sufficient publicly available information to support cumulative impact analysis
- project timeframe – likely to be constructed and/or operated sequentially with the project subject to assessment
- project location – disturbance areas that overlap, or have potential impacts that would spatially overlap, with the project on a local or regional scale.

Table 20.2 Screening of identified projects for issue specific cumulative assessment

Project name	Meets project size criteria?	Meets project status criteria?	Meets project timing criteria?	Meets project location/overlap criteria?	Relevant project for issue-specific cumulative assessment
Muswellbrook Pumped Hydro Energy Storage (SSI-76014961)	Yes	Yes – at prepare EIS stage 2026.	No – construction timing not available yet.	Yes – the Muswellbrook Pumped Hydro is approximately 1 km south of the project area and connects to the Muswellbrook 330 kV substation.	Yes
Muswellbrook Solar Farm (SSD-46543209)	Yes	Yes – NSW planning approval received 2025.	Stage 1 commenced in 2024. Stage 2 commenced in 2026 and may overlap with the project.	No – is approximately 800 m south of the project area with no physical overlap.	Yes
Muswellbrook Thermal Storage Facility (SSD-88560713)	Yes	Yes – at prepare EIS stage 2026.	No - Construction timing not available yet.	Yes – the Muswellbrook Thermal Storage is approximately 2.2 km southwest from the project area and connects to the existing Muswellbrook 330 kV substation.	Yes
Muswellbrook Battery Energy Storage System (SSD-29704663)	Yes	Yes – NSW planning approval received 2023. Modification 1 under assessment 2026.	Construction phase is expected to begin in 2026 and last 12 months, which may overlap with the project.	Yes – the Muswellbrook BESS is approximately 3.9 km southwest of the project area and connects to the existing Muswellbrook 330 kV substation.	Yes
Bells Mountain BESS (formerly known as Sandy Creek BESS) (SSD-83968208)	Yes	Yes – at prepare EIS stage 2026.	No – construction timing not available yet.	Yes – the Bells Mountain BESS is immediately southwest of the project area and connects to the existing Muswellbrook 330 kV substation.	Yes

Project name	Meets project size criteria?	Meets project status criteria?	Meets project timing criteria?	Meets project location/overlap criteria?	Relevant project for issue-specific cumulative assessment
Gelston Battery Energy Storage System (SSD-104190458)	Yes	Yes – at prepare EIS stage 2026.	No – construction timing not available yet.	Yes – the Gelston BESS is immediately southwest of the project area and connects to the existing Muswellbrook 330 kV substation.	Yes
New England REZ Transmission Project (SSI-74175972)	No	Yes - at prepare EIS stage 2026.	No – construction timing not available yet.	No physical overlap with the project area.	Yes
Muswellbrook Bypass – New England Highway	Yes	Yes – approved under Division 5.1 of the EP&A Act.	Construction is expected to begin in 2027 and may overlap with the project.	No – is approximately 4 km southwest of the project area with no physical overlap.	Yes
Queensland-Hunter Gas Pipeline (MP06_0286)	Yes	Yes – NSW planning approval received 2009.	No - Construction timing not available yet.	Yes – the Gas Pipeline is located immediately east of the project area with spatial overlap.	Yes
Hunter-Central Coast Renewable Energy Zone network infrastructure upgrades (multiple projects)	Yes	Yes – approved under Division 5.1 of the EP&A Act.	Stage 1 completed in 2026. Stage 2 commenced, which involves construction of two new substations and upgrades of two existing substations. This includes minor upgrades to the existing Muswellbrook 330 kV substation.	No – the Muswellbrook Bulk Supply Point upgrades will occur within the existing Muswellbrook 330 kV substation compound, which involves the transportation of a fibre marshalling kiosk.	No

The screening process identified that the projects most likely to interact cumulatively with the McCullys Gap BESS are projects that share interaction pathways with the project, namely:

- shared grid connection works in the vicinity of the existing Muswellbrook 330 kV substation,
- shared use of Sandy Creek Road and the New England Highway/Sandy Creek Road intersection during construction,
- spatial proximity that could result in overlapping amenity and landscape change for nearby receivers.

The projects identified for issue-specific consideration therefore include:

- Muswellbrook Pumped Hydro Energy Storage, Bells Mountain BESS and Gelston BESS - primarily as a result of overlapping works associated with their respective connections to existing Muswellbrook 330 kV substation.
- Muswellbrook Solar Farm and the Muswellbrook Thermal Storage Facility - as a result of using Sandy Creek Road for access similar to the project. The potential cumulative interaction is therefore most plausibly realised through construction traffic, access management, and short-term amenity effects along the shared road corridor.

- Muswellbrook Bypass includes a construction interface with Sandy Creek Road and construction activity near the Sandy Creek Road corridor. This is a different project type to energy infrastructure; accordingly, the principal cumulative interaction is traffic/access and construction interface rather than operational energy infrastructure effects.
- New England REZ Transmission Project and the Queensland-Hunter Gas Pipeline are linear developments with potential cumulative interactions that are likely to be distributed along their respective corridors rather than concentrated within their footprint. For these projects, the key screening question is whether any corridor sections or access requirements create a realistic overlap with the project's locality and construction period.

Several of the above projects are in 'EIS preparation' stage, and their construction methodology, timing and impact outcomes may change as assessments progress. For these projects, this cumulative assessment is necessarily qualitative and focuses on the credible interaction pathways identified from publicly available scope information (e.g., shared roads, shared connection points, proximity).

The Hunter-Central Coast REZ network infrastructure upgrades are identified as broader, regional works (multiple substations/line upgrades across multiple LGAs). This project is therefore considered primarily in the combined cumulative assessment given the regional scale and distributed nature of the upgrades.

Screening of environmental and social issues

Building on the project screening outcomes presented in Table 20.2, an issues-based screening was undertaken to identify environmental and social matters with a reasonable likelihood of material cumulative interaction with the project. Table 20.3 summarises the outcome of the issues screening across the identified projects and potential impact categories and provides the basis for the issue-specific cumulative impact assessment that follows.

Table 20.3 Projects with the potential for cumulative impacts – issues screening

Project	Type of potential cumulative impact with the project								
	Biodiversity	Noise and vibration	Landscape and visual	Aboriginal and European heritage	Land use and agriculture	Traffic and transport	Flooding and water resources	Hazards and risk including bushfire	Social and economic
Muswellbrook Pumped Hydro Energy Storage	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Muswellbrook Solar Farm	Yes	Yes	No	No	Yes	Yes	No	No	Yes
Muswellbrook Thermal Storage Facility	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes
Muswellbrook BESS	Yes	Yes	No	No	Yes	Yes	No	No	Yes
Bells Mountain BESS (also known as Sandy Creek BESS)	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Gelston BESS	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes
New England REZ Transmission Project	Yes	No	Yes	No	Yes	No	No	No	Yes
Muswellbrook Bypass – New England Highway	Yes	No	No	No	Yes	Yes	No	No	Yes
Queensland-Hunter Gas Pipeline	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes

Key: Green shading indicates potential for cumulative impact, including positive and negative impacts. Red shading indicates negligible cumulative impact expected, or limited public information available at the time of writing.

Based on this screening process, the following matters were identified as having potential for material cumulative interaction with the project:

- biodiversity
- noise and amenity
- landscape and visual character
- traffic and transport
- social and economic impacts.

The following matters were screened out of further issue-specific consideration for the following reasons (noting that some of these issues will be revisited as part of the combined cumulative impact assessment):

- Air quality: each project will be conditioned to include a dust management strategy and given the nature of the identified projects and their separation, no material cumulative impacts are expected.
- Aboriginal and European heritage: impacts are generally localised and managed through project-specific assessment and approvals. While site-specific cumulative interactions are not anticipated, potential broader cumulative effects are considered in the combined cumulative impact assessment provided in section 20.3.2.
- Hazards and risks: each project is required to achieve regulatory criteria which effectively results in risk being contained to within the site boundaries so that no off-site impacts occur. On this basis, no cumulative impacts with other projects are likely. Each project would also require subsequent regulatory approvals in relation to bushfire preparedness and contingency designed and maintained.

20.3 Impact assessment

20.3.1 Issue-specific assessment

Potential cumulative impacts that may arise as a result of interactions with other identified projects are summarised in Table 20.4. As there is limited public information available regarding the Bells Mountain and Gelston BESS projects at the time of writing, they have been considered together in the table.

Table 20.4 Issue-specific cumulative impact assessment

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
Muswellbrook Pumped Hydro Energy Storage	Potential cumulative biodiversity impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality, including any works associated with the connection to the existing Muswellbrook 330 kV substation. Project-specific avoidance and minimisation measures, together with rehabilitation and offset requirements (where applicable), would manage residual biodiversity impacts, and regional-scale cumulative impacts are not anticipated.	Temporary cumulative construction noise impacts may occur where construction activities overlap in time in the locality (including on shared access routes and/or at the existing Muswellbrook substation connection area). With standard construction noise mitigation and compliance with relevant NSW noise criteria, impacts would be localised, temporary and manageable.	Motorists travelling along Sandy Creek Road and nearby receivers may experience cumulative views of construction and operational components of both projects where they occur in the same viewshed. Cumulative visual impacts would be primarily associated with the increasing presence of energy infrastructure in the locality and are expected to be localised.	Potential cumulative land use and agriculture impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality, including any works associated with the connection to the existing Muswellbrook 330 kV substation. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative traffic impacts may occur where construction traffic for both projects overlaps on Sandy Creek Road and at the New England Highway/Sandy Creek Road intersection. With construction traffic management measures, impacts would be temporary, localised and manageable.	Potential cumulative flooding and water resources impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality. Concurrent construction activities may increase sediment mobilisation and runoff risks due to activities involving topsoil stripping, loosening of earth and earthworks. With standard construction water mitigation and compliance with relevant NSW water quality criteria, impacts would be localised and manageable.	Cumulative social and economic impacts may include increased presence of construction workers and vehicles in the McCullys Gap–Muswellbrook locality and perceived changes to rural character during overlapping construction periods. Conversely, both projects would contribute to regional employment and investment and support electricity system reliability and the energy transition.

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
Muswellbrook Solar Farm	Potential cumulative biodiversity impacts may occur if vegetation clearing and ground disturbance for both projects overlap in time within the locality. Residual biodiversity impacts would be managed through project-specific avoidance, minimisation, rehabilitation and offset requirements (where applicable), and regional-scale cumulative biodiversity impacts are not anticipated.	Temporary cumulative construction noise impacts may occur where construction activities overlap, resulting in short-term increased noise and extended disturbance for nearby receivers along the Sandy Creek Road corridor. With standard mitigation and compliance with relevant NSW noise criteria, impacts would be localised, temporary and manageable	Cumulative impacts not anticipated.	Temporary cumulative land use and agriculture impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative construction traffic impacts may occur due to both projects using Sandy Creek Road and the New England Highway/Sandy Creek Road intersection during overlapping construction periods. The traffic assessment for the project indicates that, with available network capacity and traffic management measures, no significant cumulative impacts on intersection performance or mid-block operations are anticipated.	Cumulative impacts not anticipated.	Cumulative social and economic impacts may include increased construction activity and traffic in the locality during overlapping construction periods, with associated amenity effects. Positive cumulative impacts include direct and indirect employment opportunities and increased regional investment associated with concurrent energy infrastructure development.

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
Muswellbrook Thermal Storage Facility	Potential cumulative biodiversity impacts would be limited to any overlapping construction disturbance in proximity to the project, noting the pipeline corridor passes around the northern end of the project area. Residual biodiversity impacts would be managed through project-specific avoidance, minimisation, rehabilitation and offset requirements (where applicable), and regional-scale cumulative biodiversity impacts are not anticipated.	Temporary cumulative construction noise impacts may occur where construction activities overlap, resulting in short-term increased noise and extended disturbance for nearby receivers along the Sandy Creek Road corridor. With standard mitigation and compliance with relevant NSW noise criteria, impacts would be localised, temporary and manageable	Motorists travelling along Sandy Creek Road and nearby receivers may experience cumulative views of construction and operational components of both projects where they occur in the same viewshed. Cumulative visual impacts would be primarily associated with the increasing presence of energy infrastructure in the locality and are expected to be localised.	Potential cumulative land use and agriculture impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality, including any works associated with the connection to the existing Muswellbrook 330 kV substation. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative traffic impacts may occur where construction traffic overlaps on Sandy Creek Road, as both projects would utilise Sandy Creek Road for access. With construction traffic management measures, impacts would be temporary, localised and manageable.	Cumulative impacts not anticipated.	Cumulative social impacts may include increased presence of construction workers and vehicles in the locality and perceived changes to rural character during overlapping construction periods. Positive cumulative impacts include short-term construction employment and expenditure associated with concurrent energy infrastructure development.

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
Muswellbrook BESS	Potential cumulative biodiversity impacts would be limited to any overlapping construction disturbance within the locality if construction timeframes coincide. Residual biodiversity impacts would be managed through project-specific avoidance, minimisation, rehabilitation and offset requirements (where applicable), and regional-scale cumulative biodiversity impacts are not anticipated.	Temporary cumulative construction noise impacts may occur where construction activities overlap, resulting in short-term increased noise and extended disturbance for nearby receivers. With standard mitigation and compliance with relevant NSW noise criteria, impacts would be localised, temporary and manageable.	Cumulative impacts not anticipated.	Cumulative land use and agriculture impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality, including any works associated with the connection to the existing Muswellbrook 330 kV substation. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative traffic impacts may occur due to construction traffic from both projects using Sandy Creek Road and the New England Highway/Sandy Creek Road intersection if construction periods overlap. The traffic assessment for the project indicates that, with available network capacity and traffic management measures, no significant cumulative impacts on traffic and transport are anticipated.	Cumulative impacts not anticipated.	Cumulative social impacts may include increased presence of construction workers and vehicles in the locality and perceived changes to rural character during overlapping construction periods. Positive cumulative impacts include short-term construction employment and expenditure associated with concurrent energy infrastructure development.

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
Bells Mountain BESS	Potential cumulative biodiversity impacts may occur if construction disturbance overlaps with the project in the locality. At the time of writing, the Bells Mountain BESS is in EIS preparation and detailed impact information may change; however, any residual biodiversity impacts would be managed through project-specific avoidance, minimisation, rehabilitation and offset requirements (where applicable). Regional-scale cumulative biodiversity impacts are not anticipated.	Temporary cumulative construction noise impacts may occur where construction activities overlap in time, resulting in short-term increased noise and extended disturbance for nearby receivers. With standard mitigation and compliance with relevant NSW noise criteria, impacts would be localised, temporary and manageable.	Motorists and nearby receivers along the Sandy Creek Road corridor may experience cumulative views of multiple energy infrastructure projects, including the Bells Mountain BESS and the project, where components occur in the same viewshed. Cumulative visual impacts are expected to be localised.	Cumulative land use and agriculture impacts would extend across the full project area during construction activities for both projects, including any works associated with the connection to the existing Muswellbrook 330 kV substation. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative traffic impacts may occur if construction traffic overlaps on Sandy Creek Road and at the New England Highway/Sandy Creek Road intersection during concurrent construction periods. With construction traffic management measures, impacts would be temporary, localised and manageable.	Potential cumulative flooding and water resources impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality. With standard construction water mitigation and compliance with relevant NSW water quality criteria, impacts would be localised and manageable.	Cumulative social impacts may include increased presence of construction workers and vehicles in the locality and perceived changes to rural character during overlapping construction periods. Positive cumulative impacts include short-term construction employment and expenditure associated with concurrent energy infrastructure development.

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
Gelston BESS	Potential cumulative biodiversity impacts may occur if construction disturbance overlaps with the project in the locality. At the time of writing, the Gelston BESS is in EIS preparation and detailed impact information may change; however, any residual biodiversity impacts would be managed through project-specific avoidance, minimisation, rehabilitation and offset requirements (where applicable). Regional-scale cumulative biodiversity impacts are not anticipated.	Cumulative impacts not anticipated.	Receivers in the locality may experience cumulative views of multiple energy infrastructure projects, including the Gelston BESS and the project, where components occur in the same viewshed. Cumulative visual impacts are expected to be localised.	Cumulative land use and agriculture impacts would extend across the full project area during construction activities for both projects, including any works associated with the connection to the existing Muswellbrook 330 kV substation. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative traffic impacts may occur where construction traffic overlaps on Sandy Creek Road and at the New England Highway/Sandy Creek Road intersection during concurrent construction periods. With construction traffic management measures, impacts would be temporary, localised and manageable.	Potential cumulative flooding and water resources impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality. With standard construction water mitigation and compliance with relevant NSW water quality criteria, impacts would be localised and manageable.	Cumulative social impacts may include increased construction activity and traffic in the locality and perceived changes to rural character during overlapping construction periods. Positive cumulative impacts include short-term construction employment and expenditure associated with concurrent energy infrastructure development.

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
New England REZ Transmission Project	Potential cumulative biodiversity impacts may occur if vegetation clearing and ground disturbance associated with transmission corridor works (including access tracks and road upgrades) overlaps in time with the project in the locality. Residual biodiversity impacts would be managed through project-specific avoidance, minimisation, rehabilitation and offset requirements (where applicable), and regional-scale cumulative biodiversity impacts are not anticipated.	Cumulative impacts not anticipated.	Cumulative visual impacts may occur due to the combined presence of transmission infrastructure and the project's energy infrastructure within the broader locality. Cumulative visual effects would be most relevant where both projects' components occur in the same viewshed and are expected to be localised.	Potential cumulative land use and agriculture impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative impacts not anticipated.	Cumulative impacts not anticipated.	Cumulative social impacts may include increased construction activity and perceived intensification of infrastructure in the locality during overlapping construction periods. Positive cumulative impacts include construction employment opportunities and increased regional investment associated with concurrent infrastructure delivery.

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
Muswellbrook Bypass	Potential cumulative biodiversity impacts may occur if vegetation clearing and ground disturbance associated with the Muswellbrook Bypass overlaps in time with the project in the locality. Residual biodiversity impacts would be managed through project-specific avoidance, minimisation, rehabilitation and offset requirements (where applicable), and regional-scale cumulative biodiversity impacts are not anticipated.	Cumulative impacts not anticipated.	Cumulative impacts not anticipated.	Potential cumulative land use and agriculture impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative traffic impacts may occur due to bypass construction works and construction traffic interacting with the Sandy Creek Road corridor and the New England Highway/Sandy Creek Road intersection during overlapping construction periods. The traffic assessment for the project indicates that, with available network capacity and traffic management measures, no significant cumulative impacts on traffic and transport are anticipated.	Cumulative impacts not anticipated.	Cumulative social impacts may include increased construction activity, traffic and amenity effects in the locality during overlapping construction periods. Positive cumulative impacts include construction employment and expenditure associated with concurrent major infrastructure delivery in the region.

Project	Potential cumulative impact with the project						
	Biodiversity	Noise and vibration	Landscape and visual	Land use and agriculture	Traffic and transport	Flooding and water resources	Social and economic
Queensland-Hunter Gas Pipeline	Potential cumulative biodiversity impacts would be limited to any overlapping construction disturbance in proximity to the project, noting the pipeline corridor passes around the northern end of the project area. Residual biodiversity impacts would be managed through project-specific avoidance, minimisation, rehabilitation and offset requirements (where applicable), and regional-scale cumulative biodiversity impacts are not anticipated.	Temporary cumulative construction noise impacts may occur where construction activities overlap in time within the locality, including where corridor works occur in proximity to sensitive receivers. With standard mitigation and compliance with relevant NSW noise criteria, impacts would be localised, temporary and manageable.	Cumulative visual impacts may occur due to the combined presence of transmission infrastructure and the project's infrastructure within the broader locality. Cumulative visual effects are expected to be localised.	Potential cumulative land use and agriculture impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality. With construction land use and agriculture management measures, impacts would be temporary, localised and manageable.	Cumulative traffic impacts may occur if pipeline construction traffic overlaps with construction traffic for the project on shared routes, including the New England Highway/Sandy Creek Road intersection where access/egress is identified for pipeline construction activities. With construction traffic management measures, impacts would be temporary, localised and manageable.	Potential cumulative flooding and water resources impacts would be limited to areas where construction activities for both projects occur concurrently in the McCullys Gap–Muswellbrook locality. With standard construction water mitigation and compliance with relevant NSW water quality criteria, impacts would be localised and manageable.	Cumulative impacts not anticipated.

20.3.2 Combined impact assessment

The combined cumulative impact assessment integrates the findings of the issue-specific cumulative assessment and considers broader interactions across the locality and region.

Beneficial cumulative impacts from the relevant projects would include direct and indirect employment opportunities, increased regional investment and expenditure and employment opportunities. These are in addition to the project's contribution to improved energy reliability and security and achievement of National and NSW energy transition objectives and the project's role in the Hunter-Central Coast REZ (refer Chapter 20 for further information).

Potential adverse combined cumulative impacts may relate to:

- biodiversity
- construction noise and amenity
- visual and landscape impacts associated with electrical installations and connection infrastructure
- flooding and water resources
- social impacts such as temporary increased demand on accommodation facilities and services for workers and changes to community character and values.

Biodiversity

There is potential for cumulative biodiversity impacts where vegetation clearing, and ground disturbance associated with the project and other relevant projects occur concurrently within the locality. While these impacts are localised to each project, the combined effect across the locality would result in an incremental increase in habitat disturbance and fragmentation. Each project is required to implement avoidance and minimisation measures and provide biodiversity offsets in accordance with relevant legislation. With the implementation of these measures, cumulative impacts would be managed within the existing regulatory framework, and no significant regional cumulative biodiversity impacts are anticipated.

Aboriginal heritage

There is potential for cumulative impacts on Aboriginal heritage where multiple projects result in disturbance to cultural heritage landscapes and values across the locality. While impacts at individual sites would be localised, the combined effect of multiple developments would contribute to a broader pattern of incremental change to cultural heritage values. Each project is required to prepare and implement Aboriginal Cultural Heritage Management Plans, including consultation with Aboriginal stakeholders and measures for avoidance, salvage and management of cultural heritage. With the implementation of these measures and the requirements of relevant approvals, cumulative impacts would be managed within the existing regulatory framework and no significant cumulative impacts on Aboriginal heritage are anticipated.

Noise and amenity

Potential cumulative noise impacts are primarily associated with temporary construction activities occurring concurrently within the locality. With implementation of standard mitigation measures and compliance with relevant NSW noise criteria, impacts would be localised and temporary. Operational noise is subject to project-specific approval requirements and is not expected to result in significant cumulative impacts.

Traffic and transport

There is potential for cumulative traffic and transport impacts associated with the presence of multiple energy infrastructure projects within the locality. The traffic assessment for the project indicates that the local road network would operate with sufficient capacity when accounting for cumulative traffic from the identified projects, and with the implementation of construction traffic management measures. Operational traffic associated with these projects is limited and typically restricted to periodic maintenance activities. Given the rural nature of the surrounding road network and the low baseline traffic volumes, cumulative impacts on road capacity, safety and network performance are expected to remain minimal and are not considered significant.

Visual and landscape

There is potential for cumulative visual and landscape impacts associated with the co-location of multiple energy infrastructure projects within the locality, which may result in an increased presence of built infrastructure in the landscape. However, the study area already contains existing large-scale energy infrastructure and is characterised by a modified and evolving visual setting. Given this context, cumulative visual impacts would be limited to localised increases in the presence of infrastructure within shared viewsheds and are not considered significant.

Land use and agriculture

There is potential for cumulative impacts on land use and agriculture associated with the conversion of agricultural land to energy and infrastructure uses across the locality. While impacts at individual sites would vary in scale and duration, some projects, including pumped hydro energy storage facilities, would result in permanent changes to land use (e.g. conversion to reservoir storage), while others (e.g. solar and battery storage) would involve long-term occupation of land. The combined effect of these projects would result in an incremental, and in some cases, permanent reduction in agricultural land availability and changes to land use patterns in the locality. Notwithstanding this, the scale of impact remains proportionate within the regional context and consistent with the strategic identification of the Hunter-Central Coast REZ for energy infrastructure. No significant cumulative land use or agricultural impacts are anticipated at the regional scale.

Flooding and water resources

There is potential for cumulative impacts on downstream surface water quality and flow and groundwater levels and quality associated with concurrent construction and operation of energy and infrastructure projects across the locality. While impacts at individual sites would vary in scale and duration, construction activities such as topsoil stripping and earthworks may increase sediment mobilisation and runoff where works overlap in time. All identified projects would be subject to a construction environmental management plan and water quality management plan (or equivalent), requiring erosion and sediment controls consistent with the Blue Book (Landcom, 2004) as a standard condition of approval for SSD projects in NSW. Major project components are predominantly located within confined upland valleys rather than downstream floodplains, and do not intersect geomorphic controls influencing regional flow conveyance or floodplain storage. Groundwater extraction and dewatering requirements are limited, and operational stormwater systems have been designed to achieve accepted pollutant-reduction outcomes. The combined effect on downstream water quality, flood behaviour and groundwater levels would therefore be minor. No significant cumulative impacts on surface water, groundwater or flooding are anticipated at the regional scale.

Social impacts

Cumulative social impacts associated with the project are expected to be localised and generally manageable, primarily due to the temporary nature of construction activities and the relatively small workforce. While concurrent projects may contribute to short-term increases in construction-related amenity impacts, traffic and accommodation demand, these impacts would be temporary and managed through project-specific measures developed in consultation with Muswellbrook Shire Council and local providers. Following construction, cumulative impacts would reduce, with residual effects limited to incremental changes in local character associated with the Hunter-Central Coast REZ. No significant cumulative social impacts are anticipated.

Overall, cumulative impacts associated with the project and other relevant projects would be limited, localised and temporary in nature. No significant cumulative impacts are anticipated.

20.4 Management and mitigation

The approach to managing cumulative impacts recognises that each project is responsible for mitigating its own impacts to acceptable levels through compliance with approval conditions and environmental management plans.

For the project, mitigation measures in this EIS, particularly those relating to traffic, noise and stakeholder consultation will minimise its contribution to cumulative impacts.

Where relevant, consultation and coordination with proponents of nearby projects would be undertaken during construction planning and construction delivery to:

- confirm construction timing
- identify shared constraints such as road access as well as any potential opportunities, e.g. worker transport, and implement coordinated mitigation strategies where practicable through mechanisms such as construction environmental management plans and traffic management plans.

Part C

Evaluation and conclusion

21. Environmental management and mitigation

Environmental management for the project will be governed by a comprehensive and enforceable framework comprising the conditions of consent issued under the NSW EP&A Act, applicable NSW and Commonwealth legislation, relevant policies, standards and guidelines, and the commitments and mitigation measures documented in this EIS. Together, these instruments establish clear obligations for environmental performance throughout design, construction, operation and decommissioning, and provide the basis for regulatory oversight, compliance monitoring, auditing and enforcement.

21.1 Environmental management strategy

The purpose of the environmental management strategy is to translate the environmental obligations, commitments and mitigation measures identified in this EIS, together with the conditions of consent and statutory requirements applying to the project, into an integrated and auditable framework for implementation.

The strategy establishes the overarching approach to environmental management across all stages of the project lifecycle and provides assurance that environmental risks will be managed in accordance with legal requirements, approved standards and best-practice environmental management principles. An outline of the environmental management strategy structure is shown in Figure 21.1.

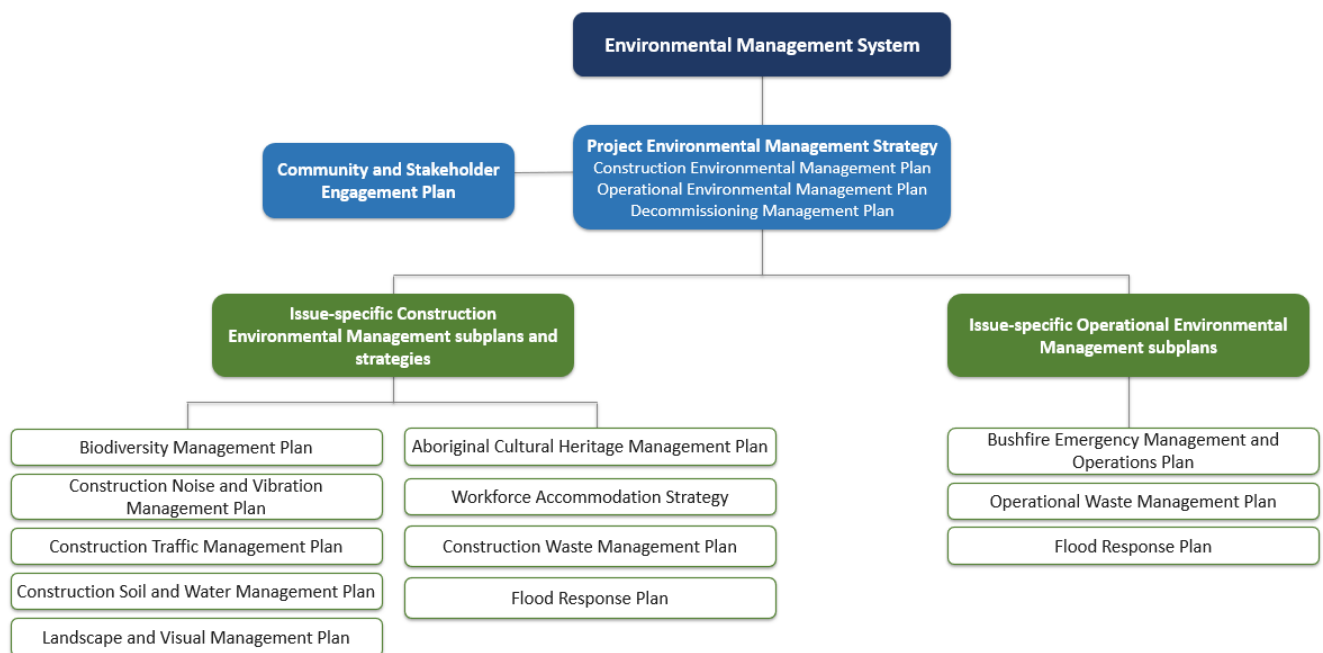


Figure 21.1 Structure of environmental management strategy for the McCullys Gap BESS

The environmental management strategy will be prepared in accordance with the mitigation measures and commitments detailed in this EIS and any conditions of consent issued for the project. It would also be prepared in accordance with any other statutory or licensing requirements that apply to the project at the time.

The environmental management strategy and associated plans will be prepared, implemented and maintained to ensure compliance with all applicable conditions of consent, statutory requirements and approval instruments, as well as relevant Australian Standards and industry best-practice guidelines in force at the time of project delivery. This will include, where applicable, alignment with AS/NZS ISO 14001 Environmental Management Systems and associated risk management principles.

The environmental management strategy will include requirements to:

- ensure that controls are properly implemented, regularly monitored, and audited to assess their effectiveness
- ensure processes for resourcing and implementing the environmental management strategy are developed to provide certainty of delivery
- demonstrate compliance with statutory, legislative and consent conditions
- minimise impacts on the community and the environment
- ensure timely and efficient response to environmental incidents and complaints
- monitor, review, and report on environmental impacts of construction, operation, and decommissioning and rehabilitation activities.

Environmental performance will be monitored, reported and reviewed in accordance with the approved environmental management plans and conditions of consent. Monitoring results, compliance records and audit outcomes will be provided to regulators as required and, where mandated by approval conditions, made publicly available. This approach ensures transparency of environmental performance and provides confidence to the community that commitments made in this EIS will be implemented and enforced.

Consistency with relevant policies, standards and guidelines, including AS/NZS ISO 14001 Environmental Management Systems, will be maintained throughout development and implementation of the environmental management strategy.

Issue-specific environmental management sub-plans (refer below) will be prepared prior to the commencement of relevant stages of the project and will include detailed control, management, avoidance, mitigation, monitoring and reporting measures for each environmental aspect, consistent with the commitments and mitigation measures identified in the EIS and any conditions of consent.

21.2 Issue-specific environmental management sub-plans

21.2.1 Requirements

The issue-specific environmental management subplans to be developed and implemented as part of the environmental management strategy will include construction environmental management subplans, operational environmental management subplans, and a decommissioning management plan. The issue-specific environmental management subplans would be live documents and would be reviewed and amended, as necessary, over the life of the project.

The issue-specific environmental management subplans will be prepared in accordance with the mitigation measures and commitments detailed in this EIS, any conditions of consent issued for the project and any other statutory or licensing requirements that apply at the time.

In addition to the above requirements, the issue-specific environmental management subplans would be developed to be consistent with any other overarching plans, policies or standards in place at the time, such as:

- ISO 14001:2015 Environmental Management Systems.
- *NSW Environmental Management Plan Guideline* (DPIE, 2020).

The issue-specific environmental management subplans would also make reference to the relevant industry standard guidelines for specific issues and activities. For example, erosion and sedimentation would be managed in accordance with *Soils and Construction: Managing Urban Stormwater Volume 1* (the 'Blue Book').

21.2.2 Content and structure

The content of the issue-specific environmental management subplans would follow the same basic structure, similar to that outlined in Table 21.1 and accordance with the requirements listed in section 21.2.1.

Table 21.1 Example content of issue-specific environmental management subplans

Chapter	Content
Introduction	– Purpose, scope, and objectives of the plan. – Identification of the conditions of consent to which the plan relates and where in the document these are addressed.
Project description	– Project overview – Site location – Scope of works – Timing of activities
Community and stakeholder engagement	– How the community and other stakeholders will be informed about the project status and environmental performance – How complaints and enquiries will be managed
Environmental management framework	– Relationship to environmental management system – Environmental management structure and responsibilities – Legal and compliance requirements – Training and awareness – Environmental risk assessment – Hold points – Environmental management measures – Environmental monitoring program – Environmental inspections – Environmental control maps or plans – Environmental management documents – Compliance monitoring and reporting – Environmental auditing – Environmental incident and emergency planning, preparedness, and response – Corrective and preventative actions – Review and revision

21.3 Work method statements and protocols

Work method statements and protocols will be developed as part of the implementation of the approved environmental management plans to provide clear, activity-specific instructions for carrying out works in a manner consistent with the environmental management strategy, statutory requirements and conditions of consent. These documents will support consistent on-ground implementation of environmental management measures during construction, operation and decommissioning, and will align with the overarching environmental management framework.

21.4 Mitigation measures

A compilation of mitigation measures (excluding mitigation measures that are built into the physical layout and design of the project and captured in the project description) is provided in Appendix C. These mitigation measures would be incorporated into the environmental management strategy and environmental management plans developed for the construction, operation and decommissioning of the project.

22. Justification and conclusion

22.1 Summary of strategic need and policy context

As a utility-scale battery energy storage system proposing to connect to the existing high-voltage transmission system, the project will assist to provide a stable, secure and reliable energy network for NSW. The project is consistent with NSW legislation, policy and key strategic planning documents which recognises the transition underway and the need for firm, dispatchable energy capacity as set out in Chapter 2 (Strategic context).

The assessments undertaken in this EIS have been undertaken in accordance with applicable guidelines and requirements, including the NSW Government's Benefit Sharing Guidelines. The result is a project that has been designed and iteratively refined to avoid environmental and social impacts, and minimise those impacts it is unable to avoid. The assessments demonstrate that the impacts are temporary, localised and capable of being managed through established mitigation and management measures as the project is consistent with the principles of ecologically sustainable development.

22.2 Site suitability, land use conflict and alternatives

The suitability of the site, potential land-use conflicts and feasible alternatives have been assessed in detail in Chapter 2 (Strategic context), including the alternatives and options assessment in section 2.3. That assessment confirms the project area is suitable because it is located adjacent to existing high-voltage transmission infrastructure, enabling efficient connection while consolidating new energy infrastructure within an established energy corridor and the Hunter-Central Coast REZ. The surrounding land uses are predominantly rural and compatible with the project, and the project footprint is largely reversible, supporting ongoing agricultural activities during operation and rehabilitation following decommissioning.

Feasible alternatives considered included variations to site location, project layout and transmission connection to avoid higher-value environmental features, reduce land disturbance and manage amenity impacts. Options requiring materially longer connection infrastructure, greater disturbance footprints or higher delivery risk were not progressed, as they would increase environmental and land-use impacts and reduce the project's ability to contribute to system needs within relevant timeframes. Opportunities to leverage existing and planned regional energy infrastructure have been considered through the selection of a location adjacent to existing transmission assets, which avoids the need for extensive new linear infrastructure.

If the development did not proceed, the objectives of the Hunter-Central Coast REZ and the identified need for additional firming and dispatchable capacity to support system reliability would not be met by this project, reducing the availability of timely, large-scale storage in proximity to the transmission network. In that scenario, equivalent capacity would likely need to be met through alternative projects in other locations and/or additional network augmentation, with the potential for increased disturbance and land-use impacts compared with the selected site and layout.

22.3 Evaluation of impact and project justification

22.3.1 Environmental considerations

The environmental assessments documented in this EIS identify that the project would result in a range of potential biophysical impacts during construction, operation and decommissioning, primarily associated with biodiversity, water, noise, visual amenity and hazards. These impacts have been avoided and minimised through site selection, project layout and design refinement where practicable and further managed through established mitigation and management measures.

Residual environmental impacts are generally localised, temporary (during construction) or within accepted policy frameworks. Residual biodiversity impacts would be offset in accordance with the NSW Biodiversity Offsets Scheme and, for matters of national environmental significance determined to be significantly impacted, in accordance with the applicable Commonwealth offset requirements under the EPBC Act and the bilateral assessment framework. The assessments conclude that with mitigation measures implemented and offset obligations fulfilled, environmental impacts would not be significant or unacceptable and can be effectively

managed through the environmental management framework outlined in Chapter 21 and the mitigation measures in Appendix C (Consolidated mitigation measures).

22.3.2 Social considerations

The project would result in some temporary, adverse, social impacts during construction, including changes to amenity, traffic conditions and short-term workforce pressures on short-term accommodation. These impacts are confined to the construction period and are expected to be localised and manageable through construction management planning, ongoing engagement and targeted mitigation measures.

During operation, the project would be remotely managed with limited on-site staffing and minimal traffic movements. Operational impacts on community wellbeing, social cohesion, access and services are expected to be low. The project also incorporates a Benefit-Sharing Plan and community funding mechanisms to provide enduring benefits to the local community, responding to issues raised during stakeholder engagement.

22.3.3 Economic considerations

The project would deliver positive economic outcomes at both the local and state levels through capital investment, construction employment and regional procurement opportunities. Construction is expected to generate a temporary workforce peak, with flow-on benefits to local and regional businesses.

Over the operational life of the project, the project would continue to generate economic benefits. At the local level, this includes an ongoing benefit-sharing framework implemented through a Voluntary Planning Agreement collaboratively with Muswellbrook Shire Council. More broadly, the project would contribute to improved electricity system reliability and may place downward pressure on wholesale electricity prices.

22.3.4 Public interest

Community and stakeholder engagement undertaken since early project development has informed both the assessment and design of the project. Issues raised by the community and stakeholders have been considered and addressed through targeted assessment, mitigation measures and project refinements where reasonable and feasible.

When considered in the context of the identified strategic need, the location of the project within an established energy infrastructure corridor, and the ability to manage residual impacts to acceptable levels, the project is considered to be in the public interest.

22.4 Ecologically sustainable development

The project has been assessed having regard to the principles of ecologically sustainable development, as defined by the Environmental Planning and Assessment Regulation. These principles have been embedded throughout project planning, design, construction and operational frameworks and are reflected in the assessments and mitigation measures presented in this EIS.

A precautionary approach has been applied through conservative assessment methodologies, early identification of potential risks, and the adoption of avoidance and mitigation measures to manage environmental and social impacts. Environmental impacts have been assessed using established scientific methods and statutory frameworks, with residual impacts managed through enforceable mitigation measures and, where relevant, offsetting mechanisms.

Consideration of inter-generational equity is reflected in the project's role in supporting the transition to a low-emissions electricity system while ensuring that environmental values can be maintained or restored through decommissioning and rehabilitation at the end of the project life. The conservation of biodiversity and ecological integrity has been addressed through site selection, impact avoidance and minimisation measures, and offsetting of unavoidable impacts in accordance with statutory requirements.

Environmental values have been appropriately considered in project decision-making through the identification, mitigation and management of environmental impacts, recognising environmental, social and economic costs as part of the overall project development. On this basis, the project is considered to be consistent with the principles of ecologically sustainable development.

22.5 Objects of the EP&A Act

The project has been developed with consideration of the objects of the EP&A Act, as outlined in Table 22.1.

Table 22.1 Consideration of the project against the objects of the EP&A Act

Object	Response
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 would increase storage and firming infrastructure in NSW, consistent with the objectives of the Hunter-Central Coast REZ, and would support the increased uptake of renewable energy generation across the NEM. The project would contribute towards downward pressure on energy prices for consumers, while increasing reliability and security of supply across the State. Improved environmental outcomes would result from the transformation to an energy system supported by firm and dispatchable storage capacity.
To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development has been considered throughout project development and assessment as described in section 22.4. The precautionary principle, conservation of biological diversity, inter-generational equity and the valuation of environmental resources have been embedded through site selection, impact avoidance and mitigation measures and enforceable management frameworks. With consideration for the principle of intergenerational equity, the project is proposed in direct response to the need to decarbonise the NEM, whilst avoiding and minimising negative environmental and social impacts, and maximising positive environmental and social outcomes. The mitigation measures proposed in Appendix C (Consolidated mitigation measures) of this EIS are identified to minimise the direct and indirect negative impacts of the project, including impacts to the natural and socio-economic environments.
To promote the orderly and economic use and development of land.	The project represents an orderly and economic use of land by consolidating new energy infrastructure adjacent to existing transmission assets within the Hunter-Central Coast REZ and a predominantly rural landscape. The site selection and layout minimise land use conflict, avoid higher capability agricultural land where practicable, and enable ongoing agricultural use during operation and following decommissioning.
To promote the delivery and maintenance of affordable housing.	Not relevant to the project.
To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The project would result in the removal and modification of up to 16.92 hectares of native vegetation, including vegetation associated with a threatened ecological community listed under both the BC Act and the EPBC Act The project is a controlled action, and all relevant matters of national environmental significance, including the threatened ecological community, are determined to be significantly impacted. Impacts have been avoided and minimised through iterative project design and mitigation measures, with residual impacts to be offset in accordance with the NSW Biodiversity Offsets Scheme and applicable Commonwealth offset requirements under the EPBC Act. Minor indirect impacts to biodiversity through noise, dust and light spill would be managed through construction and operational environmental management measures
To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	One previously registered Aboriginal heritage site exists within the project area. Survey of the project area with Aboriginal representatives identified two new heritage sites: a PAD and an isolated find. The project design was refined to completely avoid the PAD, and any archaeological value that may be present would not be impacted. The isolated find would be impacted; however, the combination of low archaeological value, the disturbed nature of the environment and the site type supports salvage prior to the commencement of construction. Desktop heritage database searches identified no listed heritage items within the project area and field survey identified no significant historic heritage. An unexpected finds procedure would be implemented to ensure appropriate management of any additional heritage items if encountered.

Object	Response
To promote good design and amenity of the built environment.	The project would be constructed and operated in close proximity to existing energy infrastructure, including the existing Muswellbrook 330 kV substation. The project would generally have low visual impacts, with moderate to low impacts at nearby receivers, and would have a minor influence on the overall amenity of the local built environment. Amenity impacts have been assessed conservatively and are considered acceptable in the context of the surrounding land uses and the project's strategic location within an established energy infrastructure corridor
To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	All construction and operation staff would be required to follow relevant health and safety protocols, including project-specific safety protocols.
To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	The project has involved consultation with Muswellbrook Shire Council regarding environmental considerations, planned engagement and the benefit sharing approach for the project. Consultation has also been carried out between the applicant and various State government agencies, including NSW DPHI, Fire and Rescue NSW, NSW RFS, TfNSW and NSW DCCEEW. As the project is a controlled action under the EPBC Act, the EIS has been prepared in accordance with the bilateral assessment agreement between the Commonwealth and NSW governments, ensuring coordinated assessment across both levels of government.
To provide increased opportunity for community participation in environmental planning and assessment.	Consultation has been carried out with the local community, sensitive receivers, Aboriginal stakeholders, nearby landholders and government agencies to understand their views of the project and to gather feedback to inform the planning approval process. Feedback has been considered and incorporated into the project design and EIS as documented by Chapter 5 (Community and stakeholder engagement) of the EIS.

22.6 Conclusion

Having regard to the strategic need for the project (section 22.1), the suitability of the site and the consideration of alternatives (section 22.2), and the evaluation of environmental, social and economic impacts (section 22.3), the project is considered to be justified. While construction would involve some temporary and localised impacts, these have been avoided and minimised where practicable and are capable of being managed to acceptable levels through the mitigation measures identified in this EIS and the environmental management framework described in Chapter 21 and Appendix C (Consolidated mitigation measures).

Environmental performance would be managed through the preparation and implementation of the required construction and operational management plans, supported by monitoring, reporting and compliance obligations and any conditions of consent. On balance, the project's strategic benefits and contribution to electricity system security and reliability outweigh the residual impacts, and the project is therefore considered to be in the public interest.

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